BINH DUONG PEOPLE'S COMMITTEE
THE SOCIALIST REPUBLIC OF VIETNAM

THE PREPARATORY SURVEY ON WATER SUPPLY PROJECT IN NEW CITY AND INDUSTRIAL PARKS IN NORTHERN PART OF BINH DUONG PROVINCE IN THE SOCIALIST REPUBLIC OF VIETNAM

FINAL REPORT

SEPTEMBER 2015

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
HITACHI, LTD.
NIHON SUIDO CONSULTANTS CO., LTD.

Exchange Rate (As of March 2013)
VND1.0 = JPY0.0044
US$1.0 = JPY91.84

Exchange Rate (As of March 2015)
VND1.0 = JPY0.0056
US$1.0 = JPY119.03

EXECUTIVE SUMMARY

Background

Binh Duong Province, which is the north of Ho Chi Minh City, has an important hub-function in the south of Vietnam. Having a geographical advantage, over 2,000 foreign companies and 150 Japanese companies have already started their business in 28 industrial parks. On the other hand, recent rapid urbanization has been creating a danger of fresh water shortage and impact to the water environment of the Province. The capacity of the treated water production will be outstripped by the rapidly increasing demand from the population and industry.

In Announcement 7038/TB-BNN-XD (Conclusion of Mr. Nguyen Ngoc Thuat, Deputy Minister of MARD at the meeting of Phuoc Hoa Hydraulic Project Steering Board (third time), 2007/12/24), it was decided that Binh Duong Water Supply Sewerage Environment Co., Ltd. (BIWASE) has water rights to intake raw water from the existing canal located in the north of the Binh Duong Province. In Decision No.1797/TTg-KTN (The construction investment of the raw water pipeline from Phuoc Hoa reservoir to Binh Duong urban central area, 2009/9/28), the Prime Minister permitted to start water treatment project in this area, so it is needed to start Feasibility Study as soon as possible.

Objective of the Preparatory Survey

The objective of this preparatory survey which is financed by JICA for private sector participated project is to clarify the necessity, viability and sustainability of the project in view of technical, financial, and environmental aspects, and to propose optimum implementation of water supply infrastructure on a PPP/BOT etc. basis or as a private project and operation and maintenance (O&M) schemes utilizing private funds, international funds, and public fund.

Present Status of Water Supply Business in Binh Duong Province

BIWASE is the service provider in the province having six water supply enterprises in the field of drinking water. The company deals consultancy, construction, and management services in the fields of environment, irrigation, water supply, solid waste, sewerage, civil and industrial construction, and other infrastructures.

There are three major and several small-scale Water Treatment Plants (WTPs) in Binh Duong Province. The outline, production capacities, and production records of the WTPs in 2012 are summarized in **Table S.1.** The locations of the WTPs and raw water resources are shown in **Figure S.1.**

表 S.1 Outline, Production Capacities, and Production Records of the WTPs in 2012

No.	WTP	Built year	Raw Water Resources	Capacity (m^3/d)	Production (m^3/d)	
				Daily Average	Daily Max.	Daily Average
1	Thu Dau Mot	1994-1997	Saigon River	21,600	21,906	18,868
2	Di An	2003-2008	Dong Nai River	90,000	117,000	105,000
3	Tan Hiep	2008-2010	Dong Nai River	60,000	18,124	14,155
4	My Phuoc I	2003	Groundwater	9,000	35,230	31,600
5	My Phuoc II	2003	Groundwater	8,800		
6	My Phuoc III-1	2006	Groundwater	3,000		
7	My Phuoc III-2	2006	Groundwater	7,700		
8	Bau Bang	2007	Groundwater	1,200	671	581
9	Uyen Hung	2002	Dong Nai River	5,000	2,100	1,550

10	South Tan Uyen	2007,2011	Groundwater Dong Nai River	13,000	3,900	3,500
11	Phuoc Vinh	2003	Gial Streem	1,200	1,900	1,000
12	Dau Tieng	2004	Groundwater	1,000	2,600	1,800
Total		-	-	**221,500**	**203,431**	**178,054**

Source: BIWASE

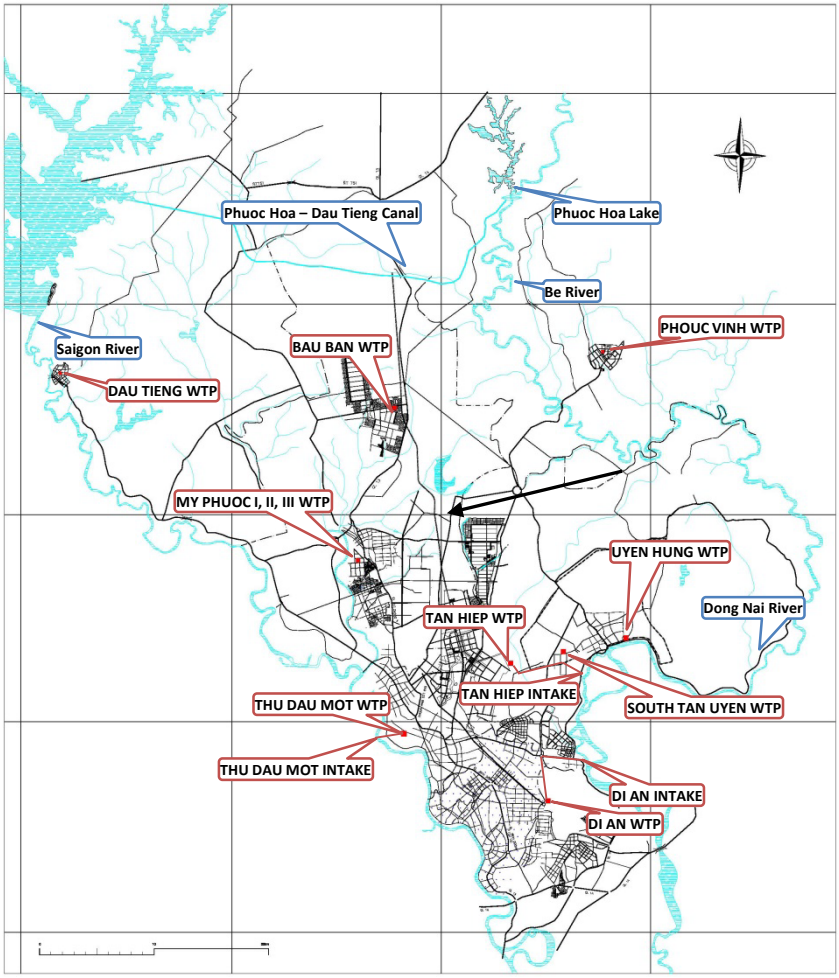

Figure S.1 Existing WTPs, and Raw Water Resources

Present Situation of Water Supply Project in New City and Industrial Parks of Northern Part of Binh Duong Province

Final report on "Options Study for Rehabilitation and Expansion of Water Services in Urban Areas HCMC and Binh Duong Province" (Options Study) dated 14th April, 2011 funded by World Bank provides Pre-Feasibility Study for the Water Supply System for Northern Binh Duong Province.

This is newly formulating system to take raw water from main canal of Phuoc Hoa lake to regulating reservoir at My Phuoc area and to construct pumping station to transmit raw water from regulating reservoir to new North Binh Duong WTP to supply water for mew city, industrial parks and existing urban areas of North of Binh Duong Province, creating conditions for enhancing economic and social development of the Province.

According to the Options Study, North Binh Duong WTP is planned to have capacity of 1,200,000 m^3/day in final stage and phasing construction is planned. Assuming the first stage capacity of North

Binh Duong WTP as 300,000 m³/day, required facilities are extracted and summarized in **Table S.2** and **Figure S.2**from the Options Study.

Table S.2 Facilities Proposed in Options Study for Water Supply Project of Northern Binh Duong Province

Facility	Required Capacity of the Facilities	
	Final Stage with 1,200,000 m^3/d WTP	Stage with 300,000 m^3/d WTP
Raw Water Pipeline	1,200,000 m^3/d (DN 2,600 mm and DN 2,400 mm : 2 lines)	600,000 m^3/d (DN 2,600 mm and DN 2,400 mm : 1 line)
Regulating Reservoir	About 3,100,000 m^3	About 1,000,000 m^3
Intake Pump	1,200,000 m^3/d	300,000 m^3/d
WTP	1,200,000 m^3/d	300,000 m^3/d
Distribution Main	Distribution for 1,200,000 m^3/d	Distribution for 300,000 m^3/d

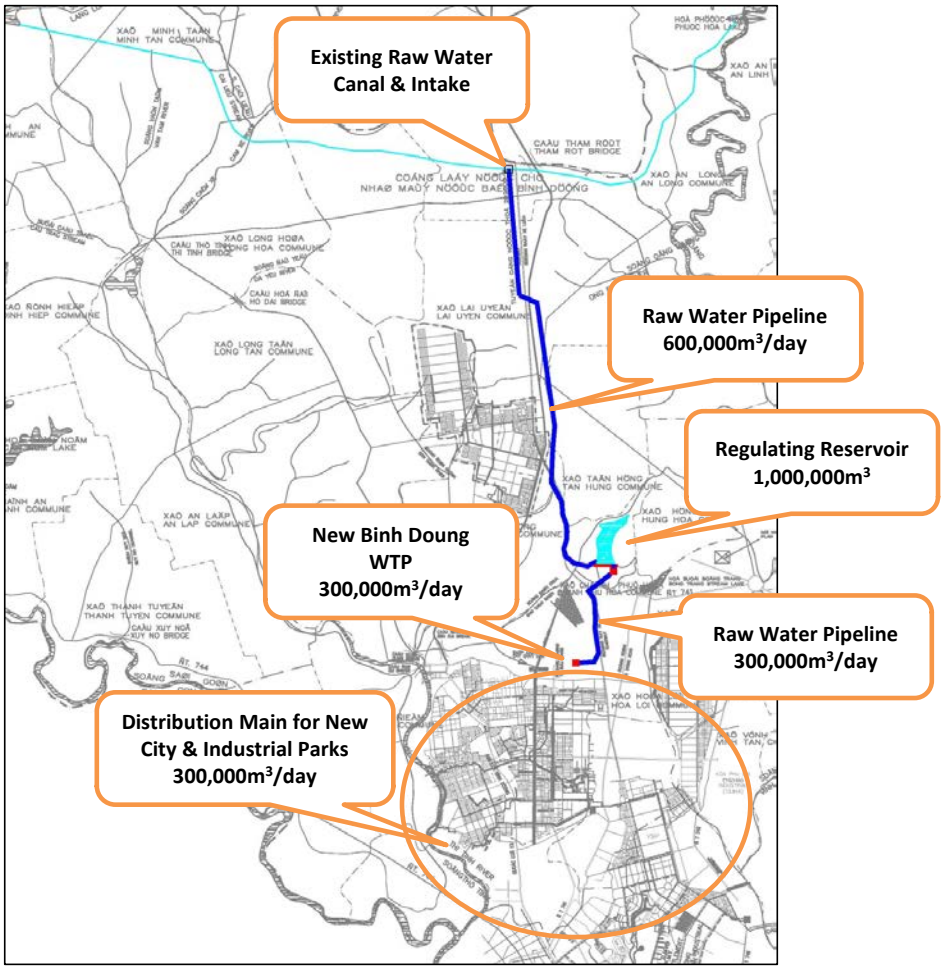

Figure S.2 Facilities Proposed in Options Study for Water Supply Project of Northern Binh Duong Province

Binh Duong Province People's Committee has approved the policy allowing BIWASE to be investor of the project of Raw Water Pipeline from the main canal of Phuoc Hoa lake to the area in My Phuoc, Ben Cat and the districts and towns in the North of Binh Duong Province, and directed BIWASE to prepare report to looking for the investment capital in 20th February, 2008 by No. 399/UBND-SX (Approval of the investment policy in the project of raw water pipeline from the main canal of Phuoc Hoa lake to districts and towns in the South). Development of Raw Water Pipeline from Phuoc Hoa

reservoir to Binh Duong urban area was further approved in principle by the Prime Minister by No. 1797/TTg-KTN dated 28th September, 2009.

Technical Review of the Previous Study

Review of development plan and transmission system proposed in Option Study was conducted to find more cost effective system according to the recent land development progress. New North Binh Duong WTP will supply water to the area of southern part of the WTP and the following areas are the target areas corresponding to the future water demand. The locations of the areas are indicated in **Figure S.3**.

- Existing Supply areas of Thu Dau Mot, Ben Cat, Tan Uyen, Thuan An and Di An
- New Housing areas and Industrial Parks in following areas
  An Tay, My Phuoc, Expanded VSIP, and New City

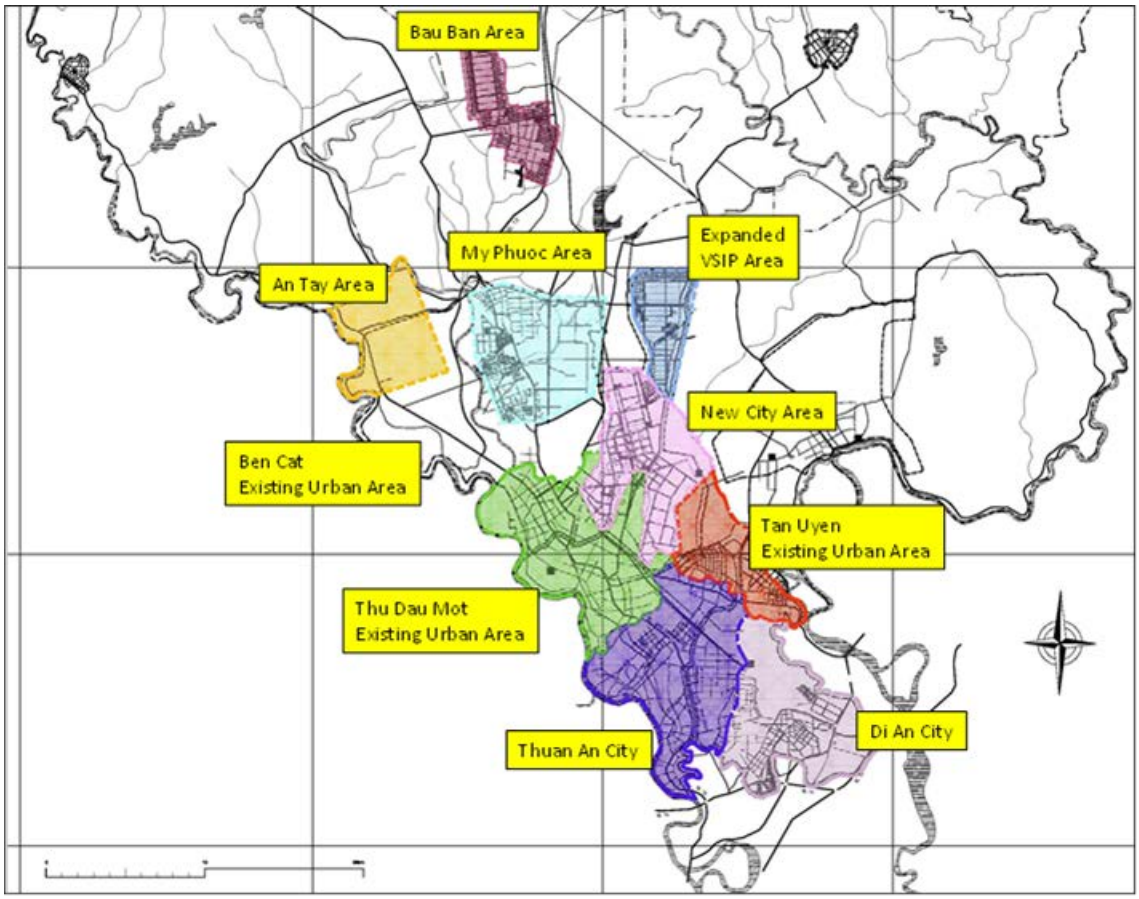

Figure S.3 Study Area for Water Supply Plan

Water demand projection is reviewed based on the present situation of development of industrial parks and new residential areas as well as population growth of the present water supply area. The review results are shown in **Table S.3** and **Figure S.4.**

Table S.3 Water Use Projection in the Study Area (m^3/d)

Study	2020	2025	2030
JICA Survey	412,566	540,135	708,526
Option Study	557,648	-	1,032,267

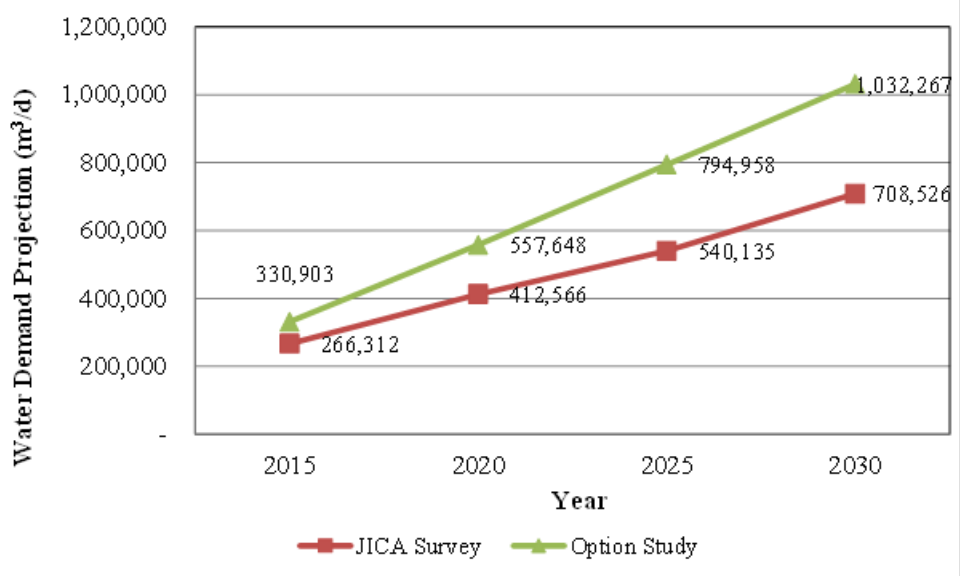

Figure S.4 Water Use Projection

Total production capacity of the existing WTPs for the study area is 218,100m^3/d and will be 248,100m^3/d in 2015 after completion of expansion works of Tan Hiep WTP as shown in **Table S.4**. Total production capacity will be 468,100 m^3/d in 2020, as BIWASE has plan to expand further 220,000m^3/d at Di An and Tan Hiep WTPs by 2020, which exceed the water use projection in this JICA Study.

Increase of the production capacity needs to be arranged according to the requirement, which depends on the progress of land development and occupancy of the property, and the commencement of construction of NBDWTP is planned in 2020 at the moment according to the demand projection of JICA study and production capacity expansion plan of BIWASE.

Table S.4 Present and Expected Water production Capacity (m^3/d)

WTP	2012 (現状)	2015 (見込み)	2020 (計画)
Thu Dau Mot	21,600	21,600	21,600
Di An	90,000	90,000	200,000
Tan Hiep	60,000	90,000	200,000
My Phuoc I	9,000	9,000	9,000
My Phuoc II	8,800	8,800	8,800
My Phuoc III-1	3,000	3,000	3,000
My Phuoc III-2	7,700	7,700	7,700
Uyen Hung	5,000	5,000	5,000
South Tan Uyen	13,000	13,000	13,000
Total	218,100	248,100	468,100

For the transmission system, alternative study was conducted including locations of regulating reservoir and pump station, and gravity and pressurized transmission ways. And then final solution is that regulating reservoir and pumping station are located near the intake point to transmit raw water to NBDWTP.

According to the above amendment in which regulating reservoir originally planned at Ont Te River in My Phouc area was shifted to the site close to the intake point, basic investigation on EIA and resettlement has to be conducted for the new locations by the project owner.

Scope of Work for Water Supply Project in New City and Industrial Parks of Northern Part of Binh Duong Province Phase I (NBDWTP)

Scope of work and main facilities of NBDWTP Phase I is discussed based on the conditions changed from the previous "Option Study" as follow.

- Supply of raw water to Bau Bang area is not included in the Project.
- Area of NBWTP is limited to 31.1 ha, and final production capacity is decided as 1,000,000m^3/d.
- Phase I is divided into Phase IA and IB with each capacity of 150,000 m^3/d based on the slow growth of water demand than expected previously and expansion schedule of the existing WTPs decided.

Alternative study is conducted for raw water transmission system including regulating reservoir and recommendation on the scope of work for Phase I is prepared as shown in **Table S.5** and **Figure S.5.**

Preliminary engineering design is prepared for proposed facilities of Phase I, such as Regulating Reservoir, Intake Pumping Station, Raw Water Transmission Pipe Line, NBDWTP, and distribution Main. For the Distribution Main, measure against non-revenue water by pressure management is examined

Table S.5 Proposed Scope of Work for NBDWTP

Facility	Capacity of the Facilities	
	Phase I with 300,000 m^3/d of NBDWTP	Final Stage with 1,000,000 m^3/d of NBDWTP
Regulating Reservoir	1,000,000 m^3 near intake facility	3,000,000 m^3 near intake facility
Intake Pumping Station	Pump: 3 pumps including 1 standby Flow : 3.97m^3/sec = 343,200m^3/day Head: 16.3 m	Pump: 5 pumps including 1 standby Flow : 13.24m^3/sec = 1,144,200m^3/day Head: 19.8m
Raw Water Pipeline	Dia.: DN2600 mm, Length: 23,858m Flow :343,200 m^3/day Pressurized main from Regulating Reservoir to NBDWTP	Dia.: DN2600 mm, length: 23,858m, Dia.: DN2300 mm, length: 23,858m Flow:1,144,200m^3/d Pressurized main from Regulating Reservoir to NBDWTP
NBDWTP	Capacity Phase IA: 156,000 m^3/day Phase IB: 156,000 m^3/day Total of Phase I: 312,000 m^3/d	Capacity : 1,040,000 m^3/d
Distribution Main	DN 400 - 2500, Length: 48.58 km	DN 300 - 2500, Length: 299.33 km

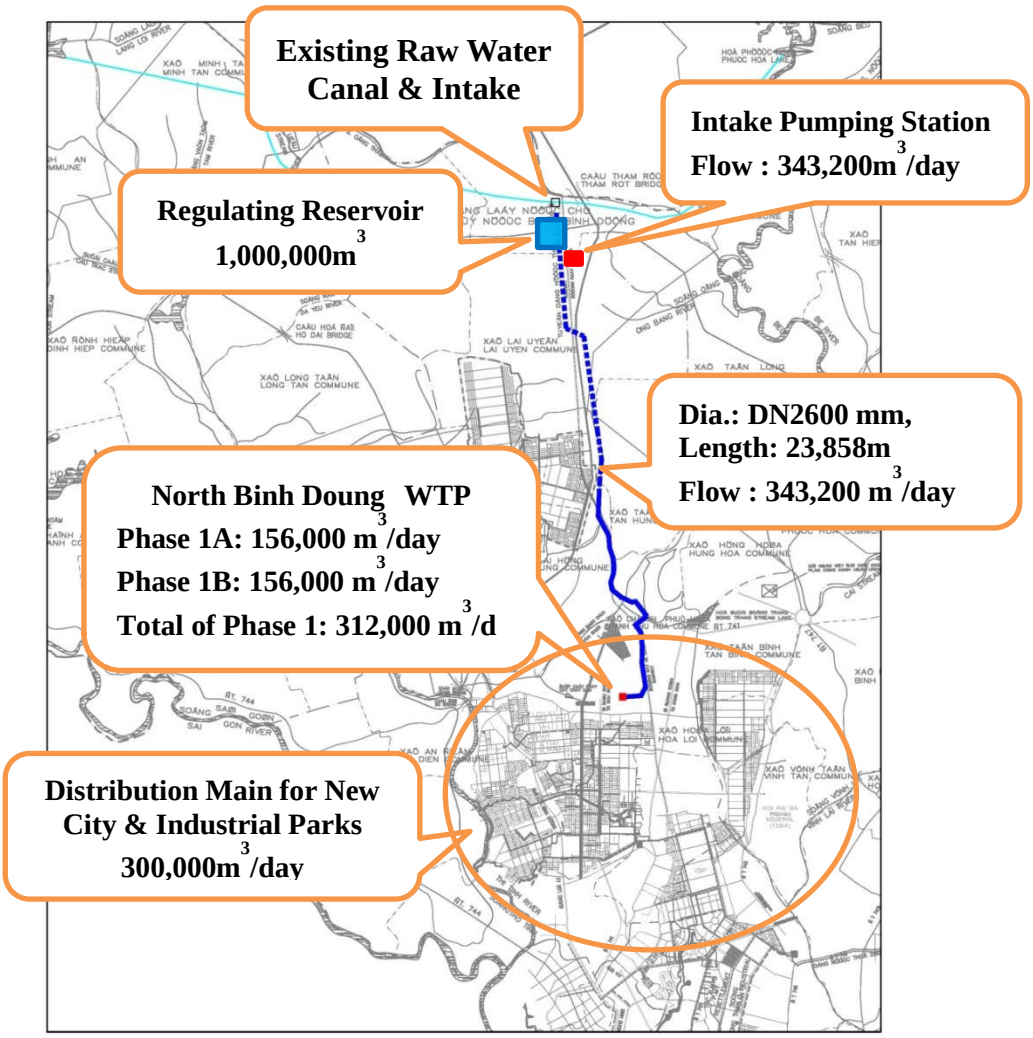

Figure S.5 Proposed Scope of Work for NBDWTP

Environmental and Social Consideration

The majority of planned sites are agricultural land (gum trees) and no wildlife habitat is expected and the related authorities agreed that no significant considerations for the ecosystem are necessary. This issue will be studied by EIA.

The JICA Survey Team prepared a draft EIA report so that the project proponent should only fill in with results of EIA study.

An Initial Environmental Evaluation (IEE) as a basis of the future EIA was conducted by the JICA Survey Team.

As a result, the water quality of the planned raw water, the pipeline route avoiding crowded area and WTP planned site to be constructed in an agricultural land have no significant impacts to surrounding environment.

The only aspect to be considered is the reservoir planned site which is not yet acquired. So, adequate land acquisition and safe design of the structure should be carried out.

Land Acquisition and Resettlement

Scope of Land Acquisition and Resettlement Impacts Total of acquired area is 1,304,830m^2. There is no any school, health and religion facilities as well as the architects are affected by the Project.

Legal and Policy Framework The legal and policy framework for compensation, resettlement and rehabilitation under the Project is defined by the relevant laws and regulations of the Government of Viet Nam and the JICA's policy on Involuntary Resettlement in 2010. Where there are gaps between the Vietnam legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.

Objectives of Compensation and Entitlements The overall objective of the compensation and entitlement policy for the Project is to ensure that all people affected by the Project will be able to restore their pre-project conditions while the poor and vulnerable households will be able to improve their pre-project living standards and income-earning capacity through compensation for the loss of physical and non-physical assets and, as required, other assistance and rehabilitation measures. Compensation will be based on the principle of replacement cost while additional assistance in cash and in-kind will also be provided depending on the severity of impacts. Income restoration measures or programs for severely affected and vulnerable households will be designed and implemented in consultation with PAPs during ARP updating.

Project Policies The basic principle applied in this ARP is that all PAPs must be "supported in their efforts to improve their living standards, income-generating capacity and production to at least the same as or better than their standards of living before the project implementation. The lack of a legal basis for land use does not bar affected households from the entitlements of economic recovery compensation and/or support. Affected assets must be compensated on the basis of their replacement cost.
The cut-off-date for eligibility for entitlement is the day after completing the detailed measure survey (DMS). Affected Persons and local communities have been informed of the cut-off date. Accordingly, after this date new invest lands/assets in the Project's affected areas will not eligible to receive any compensation and/or support from the Project.

Mitigation Measures In the process of preparing the Project, there was close cooperation between the technical consultant and the social consultant to achieve the Project's two objectives of promoting the efficiency of the investment in the Project and minimizing land acquisition. Accordingly, there are 08 mitigation measures proposed, include (i) Recommended the different alternatives, (ii) Disseminating Information about the Project's policy and entitlements to gain people's participation and support, (iii) Compensation for PAPs based on the replacement cost, (iv) conduct closely monitoring and evaluating activities, including internal monitoring if necessary, (v) all trees and crops will be harvested before land acquisition, (vi) Particularly pay intention to the vulnerable groups which include none-land household, poor, loneliness elderlies, disabled persons, policy households (vii) Beside the compensation according the replacement cost, the project will provide assistances such as livelihood stability assistance, support for vocational training and career change, income restoration of these households, (viii) Encourage the contractors to use the local labors and attract the members in working-age of PAPs to work long-term for the Project. In addition, further comprehensive studies and recommendations for resolving negative social and cultural impacts.

Entitlements of PAPs The project entitlements developed correspond to the impacts identified during the census and detailed measure survey. Entitlements adopted are based on the JICA's policies, the

Government Decisions, and the results of consultation with PAPs (to ensure that losses are restored, if not improved). Entitlements for each type of PAPs are based on the types and levels of losses. Unit rates presented in the ARP and Entitlement Matrix is basing on the replacement cost units evaluated by Binh Duong PPC.

All households to be displaced in the affected areas attended the public consultations to receive information, consider the levels of the Project impact, and present their recommendations for the plan for their new lives. Information obtained during the consultations was used to establish project resettlement policies and assist in making the compensation plans for the Project's implementation.
06 public consultation meetings were held by the LFDC, covered 100% of PAPs (53.5% participants was men and 46.5% was women). Content of the meetings were major focused on consultation of Project's related policies (compensation procedures, income & livelihood restoration programs, resettlement selections, etc.), expectation of PAPs. On the other hand, the meetings also introduced to PAPs the project's information (such as project components & investment targets, time for land clearance, compensation and resettlement, entitlement and benefits of relocation PAPs and etc). Public consultation result showed that, 100% PAPs agreed with the project's policy.

Relocation and Resettlement of PAPs The displaced household expected to resettle by themselves and that is why it is no necessary to prepare a resettlement site.

Income Rehabilitation Measures Some income rehabilitation measures are applied in this Project such as (i) Assistance for Living and Production Rehabilitation for the affected households with agricultural land, without agricultural land, or business and production; (ii) Assistance for the poor households and the other vulnerable groups; (iii) Assistance for Vocational Training and Job Creation;

Grievance Redress Mechanism A well-defined grievance redress and resolution mechanism was established to address the grievances and complaints of PAPs regarding land acquisition, compensation and resettlement in a timely and satisfactory manner. PAPs are entitled to lodge complaints regarding any aspect of the land acquisition and resettlement requirements; compensation policy, entitlements, rates and payment; and, strategies and procedures for resettlement including assistance from livelihood & income restoration programs. A four-stage procedure for redress of grievances is provided in the main report. The grievance mechanism was also disclosed to PAPs during consultations with them.
In the implementation of the ARP, complaints will be resolved in accordance with the approved procedure in the ARP. All complaints from PAPs will be resolved fairly and quickly by authorities at levels and project staff. There will be no administrative charge for the settlement of complaints or for redressing grievances.

Monitoring and Evaluation Regular monitoring will be undertaken by the PMU will submit quarterly progress reports to JICA.

Resettlement Budget The total budget for implementing this ARP is VND444,581,108,000. This amount covers compensation and allowances, design and implementation of income restoration measures, administration cost and contingency.

Implementation Schedule, Construction and Maintenance Costs

The target date of a commercial operation to be started is July 2022 and after. **Figure S.6** shows a schedule of project implementation.

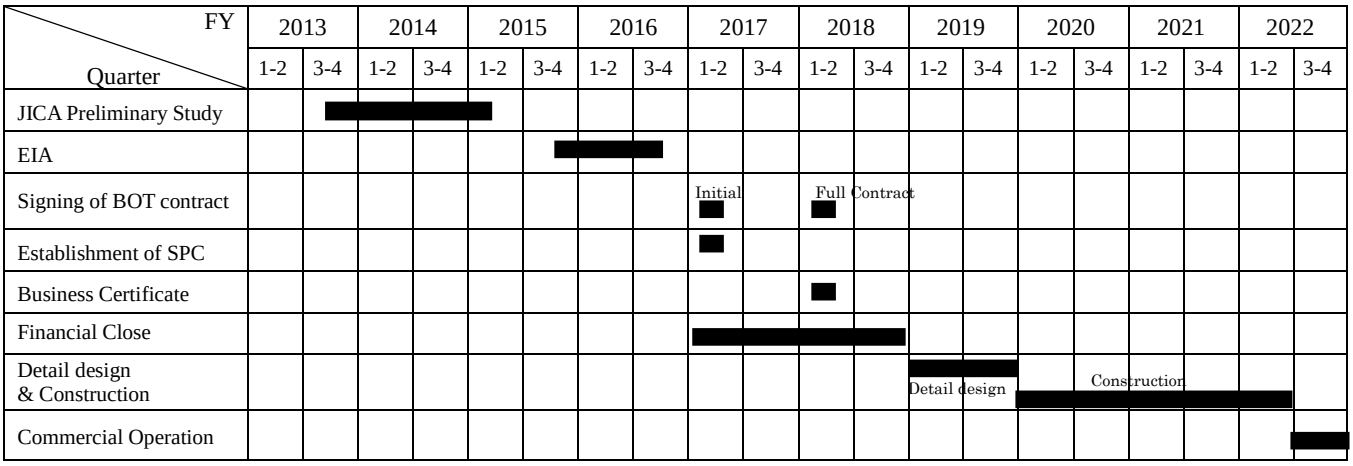

Figure S.6 Schedule of Project Implementation

The construction cost of Phase I with production capacity of 300,000m^3/d will be JPY27.5 billion. The construction and maintenance costs of Phase IA with production capacity of 150,000m^3/d are shown in **Table S.6** and **Tables S.7**.

The costs are estimated under the following conditions and to be adjusted by actual yearly inflation Indexes. The assumptions of the inflation rates of this survey are 3.5% per year in Vietnam, 2.2% per year in U.S.A, and 2.0% per year in Japan from 2013. (Draft Final Report in Sept. 2014) Final adjustment shall be made in the BOT contract.

The report has been adjusted with the actual inflation rates (Consumer Price Indexes) of 4.39% in 2013, and 0.93% in 2014, with the revised assumptions of the future inflation rates from 2015 on. The results are shown as an additional analysis in the "Financial and Economic Analysis".

1) Exchange Rates:
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As of March 2015
VND1.0 = JPY 0.0056
US$1.0 = JPY 119.03

2) Date of Estimate of Construction Cost:
As of March 2013
Date of Adjusted Construction Cost:
As of March 2015

3) FC: Foreign Currency Portion
LC: Local Currency Portion

Table S.6 Construction Cost in Phase 1A

	Item	FC	LC	Combined Equivalent Total
		JPY	VND	JPY
1.	Procurement and Construction			
(1)	Regulating Reservoir	0	114,482,460,006	503,722,824
(2)	Raw Water Intake Pumping Station 1A	445,515,840	35,875,221,899	603,366,816
(3)	Raw Water Pipeline	0	1,652,713,235,058	7,271,938,234
(4)	Water Treatment Plant Phase 1A	3,077,785,600	403,408,968,819	4,852,785,063
(5)	Distribution Mains	0	891,000,800,833	3,920,403,524
	Subtotal 1	3,523,301,440	3,097,480,686,615	17,152,216,461
(6)	Overhead & Profit (15%)	0	464,622,102,992	2,044,337,253
	Subtotal 2	3,523,301,440	3,562,102,789,607	19,196,553,714
(7)	Physical Contingency (5%)	176,165,072	178,105,139,480	959,827,686
	Subtotal 3	3,699,466,512	3,740,207,929,087	20,156,381,400
(8)	VAT (10%)	369,946,651	374,020,792,909	2,015,638,140
	Total Cost of Procurement and Construction	4,069,413,163	4,114,228,721,996	22,172,019,540

Table S.7 Operation and Maintenance Cost of Phase 1A (150,000m^3/d)

No	Type of Expense	Cost (VND/m^3)
1	Personal expense (Fixed wages + Variable wages)	133
2	Insurance (Labor + Healthcare + others)	28
3	Electricity	214
4	Chemical	385
5	Sludge Treatment	3
6	Repair and Maintenance	272
7	Others (Overall management cost, etc)	141
	Total	1,176

（In 2013, Excluding Raw Water Resource and Heavy Repair Fund）

Financial and Economic Analysis

To provide an economically feasible water supply infrastructure for the water supply area introducing BOT structure, optimum demarcation is proposed as Transportation & Distribution main Pipelines, and the Raw Water Intake Pipeline including the Regulating Reservoir for the public sector, Water Treatment Plant and the Pumping Station for the private sector.

Based on the plant capacity of 300,000m^3/d, offered Bulk Water Supply Tariff is VND 5,300 per cubic meters (USD0.2539/m^3) covering water production cost, VND 1,900 per cubic meters (USD0.091/m^3) covering pipelines' cost (Raw water intake & Distribution main), and VND 7,200 per cubic meters (USD0.3449/m^3) in total

The offered Bulk Water Supply Tariff of VND 7,200 per cubic meters (USD 0.3449/m^3) covering water production cost and pipelines' cost available from the plant capacity of 300,000m^3/d is 10% lower than the overall average of End User Water Tariff of VND 8,000 per cubic meters (USD 0.3833/m^3) in Binh Duong Province in 2013.
The offered Bulk Water Supply Tariff will contribute to minimize the raise of future End User Water Tariff in Binh Duong Province.

In case of splitting the plant capacity into 2(two) phases, according to the water use forecast, Bulk Water Supply Tariff by Phase1A 150,000m^3/d is VND 5,920 per cubic meters (USD0.2836/m^3) covering water production cost, VND 3,810 per cubic meters (USD0.1825/m^3) covering pipelines' cost (Raw water intake & Distribution main), and VND 9,730 per cubic meters (USD0.4662/m^3) in total.

Water tariff shall be subject to foreign exchange rate fluctuation adjustment (FOREX adjustment) for capital cost recovery portion and subject to Vietnamese inflation rate for the other portion.

The report (Draft Final Report in Sept. 2014) has been adjusted with the actual inflation rates (Consumer Price Indexes) of 4.39% in 2013, and 0.93% in 2014, with the revised assumptions of the future inflation rates from 2015 on, and the results are the followings.

Based on the plant capacity of 300,000m3/d, Po (Current Bulk Water Supply Tariff in 2015) is VND 5,050 per cubic meters (USD 0.2370/m3) covering water production cost, VND 2,330 per cubic meters (USD 0.1110/m3) covering pipelines' cost (Raw water intake & Distribution main), and VND 7,380 per cubic meters (USD 0.3470/m3) in total.

Phase1A 150,000m3/d Case; Po (Current Bulk Water Supply Tariff in 2015)
VND 5,690 per cubic meters (USD 0.2680/m3) covering water production cost, VND 4,660 per cubic meters (USD 0.2190/m3) covering pipelines' cost (Raw water intake & Distribution main), and VND 10,350 per cubic meters (USD 0.4870/m3) in total.

Development of Business Plan

The Project Company should be established after signing an initial BOT contract between Hitachi and BDPC as a limited liability company in Vietnam. The Project Company borrows 70% of the project cost directly from an available finance source, including JICA- Private Sector Investment Finance as an option, and the remaining 30% will be provided by the sponsors' investment to the project company.
The Project Company should get the right of Business certification and Construction Permit from BDPC, the in-principal approval for Project from MOC and the Permit for water resource exploitation and/or the Permit for discharge of waste water from MONRE.

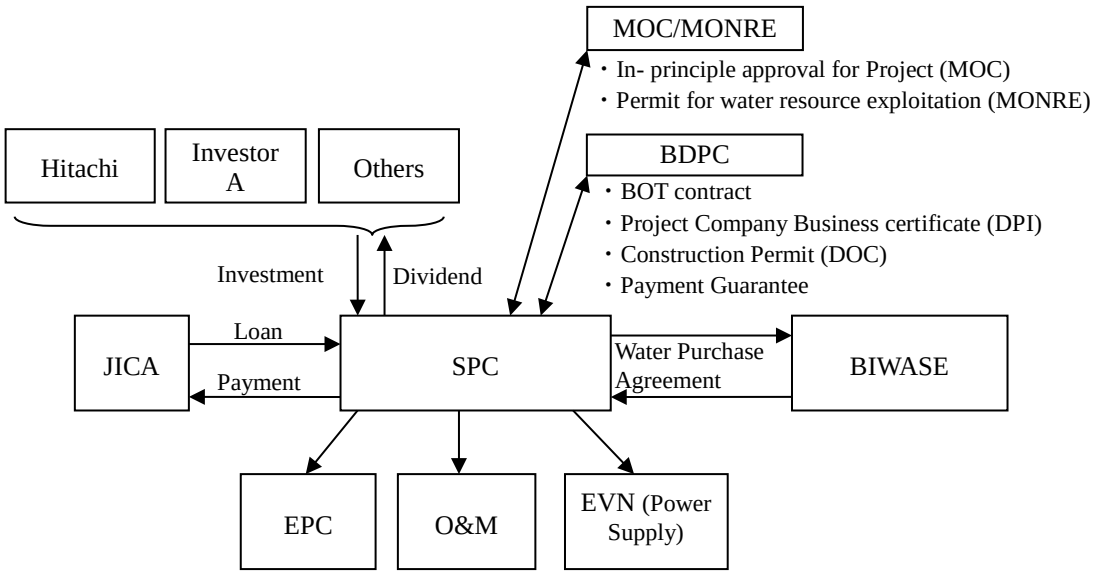

Figure S.7 Project Scheme

In addition, the Project Company is planning to enter into a power purchase agreement with EVN (Vietnam Electricity Holding Company) and an operation and maintenance agreement with BIWASE to keep a stable operation.

Recommendations

In the proposed business scheme, the above components are divided into two sub-projects. One consists of regulating reservoir, raw water transmission pipeline, and distribution mains and would be constructed, operated, and managed by Binh Duong Province. The other contains NBDWTP and intake pumping station, and would be constructed, operated, and managed by a private investor. A steering committee would be required for the comprehensive coordination at each stage of the implementation, such as financing, design, tender/contract, construction and operation.

The public sector partner should be responsible for securing funding for the construction of regulating reservoir, raw water transmission pipeline, and distribution mains in the proposed water supply system development. Binh Duong PPC's own source of financing may not be sufficient. It would be necessary to seek support from the central government and/or funding from donor agencies through the central government. In competing with other candidate projects for donor funding, Binh Duong PPC would have to show strong leadership, such as establishing a sector program for the joint development and management of the water supply project.

To implement the project, Japan International Cooperation Agency (JICA) is expected to continue to support the project. A potential Japanese ODA Loan Program and a JICA- Private Sector Investment Finance are the favorable finance source.

Binh Duong PPC may also wish to make special efforts to discuss with relevant agencies to seek their support and assistance in this process.

THE PREPARATORY SURVEY ON WATER SUPPLY PROJECT IN NEW CITY AND INDUSTRIAL PARKS IN NORTHERN PART OF BINH DUONG PROVINCE IN THE SOCIALIST REPUBLIC OF VIETNAM

FINAL REPORT

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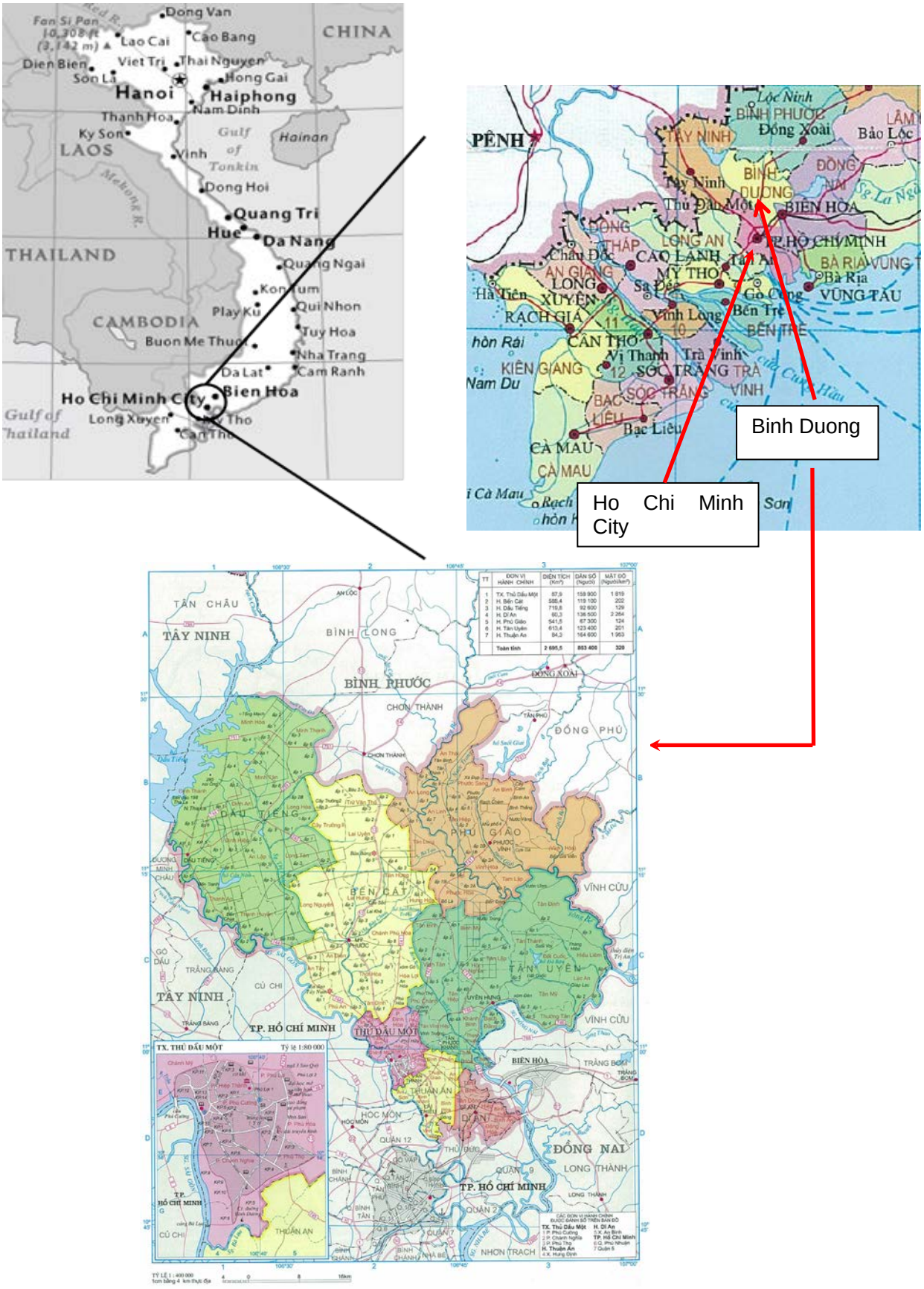

Location Map of Survey Area

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ABBREVIATIONS

ARP	Abbreviated Resettlement Plan
BDPC, BDPPC	People's Committee of Binh Duong Province
BECAMEX	BECAMEX IDC Corp.
BIWASE	Binh Duong Water Supply - Sewerage - Environment Co., Ltd.
BOT	Build Operate Transfer
CIT	Corporate Income Tax
CPI	Consumer Price Index
CSRP	Compensation, Support and Resettlement Plan
DIP	Ductile Iron Pipe
DMS	Detailed Measurement Survey
DN	Nominal Diameter
DONRE	Department of Natural Resources and Environment
DP	Displaced Person
DPI	Department of Planning and Investment
DOC	Department of Construction
DPC	District People's Committee
DSCR	Debt Service Coverage Ratio
EA	Executing Agency
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EPC	Engineering Procurement Construction
EVN	VietNam Electricity
FIRR	Financial Rate of Return
FRP	Fiberglass Reinforced Plastic Mortar Pipe
F/S	Feasibility Study
GDP	Gross Domestic Product
GL	Ground Level
HCMC	Ho Chi Minh City
HDPE	High Density Polyethylene Pipe
IEE	Initial Environmental Examination
IMF	International Monetary Fund
IRR	Internal Rate of Return
JICA	Japan International Cooperation Agency
JPY	Japanese Yen
LFDC	Land Fund Development Center
LURC	Land User Rights Certificate
MOC	Ministry of Construction
MOF	Ministry of Finance
MOIP	Ministry of Investment and Planning
MONRE	Ministry of Natural Resources and Environment
NBDWTP	North Binh Duong Water Treatment Plant
NRW	Non-Revenue Water
O&M	Operation and Maintenance
ODA	Official Development Assistance
OP	Operating policy
PAC	Polyaluminum Chloride
PAP	Project Affected Person
PC	People's Committee
PDO	Project Development Objective
PM	Prime Minister
PMU	Project Management Unit
PPC	Provincial People's Committee
PPP	Public-Private Partnership
Pre-FS	Pre-feasibility Study
PSIF	Private Sector Investment Finance

PSC	Project Steering Committee
PVC	Polyvinyl Chloride Pipe
RAP	Resettlement Action Plan
SP	Steel Pipe
SPC	Special Purpose Company
TOR	Terms of Reference
USD	United State Dollar
VAT	Value Added Tax
VND	Vietnamese Dong
WB	World Bank
WTP	Water Treatment Plant

CHAPTER 1 INTRODUCTION

1.1 Background

Binh Duong Province, which is the north of Ho Chi Minh City, has an important hub-function in the south of Vietnam. Having a geographical advantage, over 2,000 foreign companies and 150 Japanese companies have already started their business in 28 industrial parks. On the other hand, recent rapid urbanization has been creating a danger of fresh water shortage and impact to the water environment of the Province. The capacity of the treated water production will be outstripped by the rapidly increasing demand from the population and industry.

In Announcement 7038/TB-BNN-XD (Conclusion of Mr. Nguyen Ngoc Thuat, Deputy Minister of MARD at the meeting of Phuoc Hoa Hydraulic Project Steering Board (third time), 2007/12/24), it was decided that Binh Duong Water Supply Sewerage Environment Co., Ltd. (BIWASE) has water rights to intake raw water from the existing canal located in the north of the Binh Duong Province. In Decision No.1797/TTg-KTN (The construction investment of the raw water pipeline from Phuoc Hoa reservoir to Binh Duong urban central area, 2009/9/28), the Prime Minister permitted to start water treatment project in this area, so it is needed to start Feasibility Study as soon as possible.

1.2 Objective of the Preparatory Survey

The objective of this preparatory survey which is financed by JICA for private sector participated project is to clarify the necessity, viability and sustainability of the project in view of technical, financial, and environmental aspects, and to propose optimum implementation of water supply infrastructure on a PPP/BOT etc. basis or as a private project and operation and maintenance (O&M) schemes utilizing private funds, international funds, and public fund.

1.3 Terms of Reference of the Study

The preparatory survey shall cover the following items:

1) Study on Current Conditions of Vietnam and Binh Duong Province
   a) Social and economic conditions and government policy relating to the Project in Vietnam
   b) Social and economic conditions and government policy relating to the Project in Binh Duong Province
   c) Position of Binh Duong Province in the social and economic situation in Vietnam
2) Study on Current Situation and Future Plans of Water Supply Sector in Vietnam and Binh Duong Province
   a) Current situation and future plans of water supply sector in Vietnam
   b) Current situation and future plans of water supply sector in Binh Duong Province
   c) Current situation and future plans of urban development plan in Binh Duong Province
   d) Existing other major activities by private companies and international organizations related to a) to c)
3) Study on Laws and Regulations Relating to;
   a) Water supply service
   b) Water tariff
   c) Investment
   d) Land acquisition and use
   e) PPP, BOT and etc.
   f) Corporate tax and duties
   g) Investment license, business permission and other necessary licenses or permissions for the project implementation
4) Demand Forecast and Identification of the Service Area
   a) Demand for water supply

a-1 Survey of the existing plans and/or studies in the potential project area
a-2 Supplemental study for demand forecast
b) Identification of water supply area

5) Basic Design and Project Cost Estimate
   a) Applicable laws and regulations
   b) Basic design
   c) Construction schedule
   d) Project Cost Estimate
6) Development of the Project Scheme
   a) Identification of the scope of the Project
   b) Risk Analysis
   c) Optimum Financial Scheme
   d) Financial analysis of the project
      d-1 Identification of income and expense items
      d-2 Identification of other items
   e) Study on applicable laws and regulations on PPP projects
   f) Study on a possibility and the process of raising water tariff in the service area
   g) Confirmation of the construction plan of the related facilities (including pipelines) and budget allocation and implementation schedule of those facilities
   h) Design procurement package
   i) Demarcation between public sector and private sector
   j) Design of organization structure of SPC and management plan
   k) Implementation schedule of the Project
7) Financial Analysis of Related Organizations
   a) Off-Taker
   b) Guarantors
   c) Investors
8) Development of Business Plan
   a) Project Scheme
      a-1 Project Components
      a-2 Project implementation structure
      a-3 O&M plan
   b) Summary of cash flow analysis (including sensitivity analysis)
   c) Identification of related contract
   d) Drafting of security package (including government guarantee for Off-Taker payment or equivalent)
   e) Drafting of Term Sheet (Water Purchase Agreement)
9) Environmental and Social Consideration
   a) Assisting BIWASE in preparing Environmental Impact Assessment (EIA)
      a-1 Confirmation of Vietnamese laws and regulations related to EIA
      a-2 Review of existing survey based on JICA Guideline for Environmental and Social Consideration
      a-3 Assisting BIWASE in preparing EIA
      (It will be suggested to BIWASE that EIA needs to be started in August, 2014 in order to disclose and get approval of EIA in April, 2015.)
   b) Review of land acquisition and resettlement process
      b-1 Confirmation of progress of land acquisition and resettlement
      b-2 Review of Laws and existing materials
      b-3 Review of Resettlement Action Plan
      b-4 Review of completed resettlement process and comparative analysis with JICA Guideline
      b-5 Assisting preparation of supplemental resettlement plan based on the result of above items (if any)

1.4 Structure of the Report

The JICA Study Team carried out the investigations and analyses as listed in the above TORs during the period of November 2012 to August 2015. This Report is composed of the following Chapters:

Chapters 1 and 2:
These chapters describe the general background, objectives of the studies, and TOR of the preparatory survey, national policy related to water and sanitation, and laws and regulations relevant to the projects in the study area.

Chapters 3 and 4:
Chapter 3 describes the physical, socio-economic, and environmental conditions, existing water supply system, and the justification for the project. The planning basis for the water supply system including the design for raw water transmission pipeline, regulating reservoir, pumping station, and previous study for the project are presented and discussed in Chapter 4.

Chapters 5 to 8:
Chapter 5 reviews previous study and plan and discusses scope of the project. Preliminary engineering designs for raw water transmission pipeline, regulating reservoir, pumping station, water treatment plant, and distribution mains are presented in Chapter 6. Chapter 7 covers the environmental considerations including screening, environmental review and monitoring according to JICA guideline, and Chapter 8 discusses social considerations including the confirmation of present status of land acquisition and resettlement.

Chapter 9:
Chapter 9 presents Implementation Schedule and Cost Estimate.

Chapter 10 to 11
Preliminary financial and economic analysis is presented based on the cost estimate of the Project Phase I and discussion on anticipated risk analysis in Chapter 10.
Chapter 11 discusses business development plan, required procedure for implementation including business permit, implementation structure and O&M organization.

Chapter 12 presents Recommendations.

CHAPTER 2 NATIONAL POLICY AND STANDARDS

2.1 Present Status of the Water Sector

2.1.1 Laws and Regulations Related to the Water Sector

Fundamental legal documents on water supply in Vietnam are;

1. Decree No. 117/2007 ND-CP (11/7/2007) and Circular No. 01/2008 TT-BXD: Provide regulations on clean water production and consumption; benefits and responsibilities of service providers and consumers.
2. Decree No. 124/2011/ND-CP (28/12/2011) : Provide amendments to the decree No. 117 on clean water production and consumption; more detailed incentives and preferences in land use: the water operator is exempted from land use fee or lease for the water supply facilities including: exploitation and treatment works, pipes and facilities in the network, supporting works for management and operation of water supply system (admin house, executive and managing house, workshops, materials and equipment warehouse).
3. Decision No. 1929/QD-TTg (20/11/2009) on approval of the Orientation for Water Supply in Urban Areas and Industrial Zones in Vietnam to 2025 and Vision to2050.
4. Decision No.2147/QD-TTg (24/11/2010): on approval of the National Program on No-revenue Water Reduction to 2025
5. Circular No. 08/2012/TT-BXD (21/11/2012) by Minister of Construction: provide regulation on water safety plan
6. Inter-ministerial Circular No. 75/2012/TTLT-BTC-BXD-BNN (15/05/2012): provide guidelines to principles and methodology for pricing and jurisdiction to determine clean water consumption price in urban and rural areas as well as industrial zones

The other related laws and regulations of technical and institutional fields are summarized in Appendix 2 - A.

2.1.2 Relevant Organizations to the Water Sector

The central government is responsible for policy setting and promoting efficient and sustainable operations for the delivery of water supply services. Delivery of water has been decentralized to the province.

BIWASE is the service provider in the province having six water supply enterprises in the field of drinking water. The company deals consultancy, construction, and management services in the fields of environment, irrigation, water supply, solid waste, sewerage, civil and industrial construction, and other infrastructures with the organization structure presented in Figure 2.1.1.

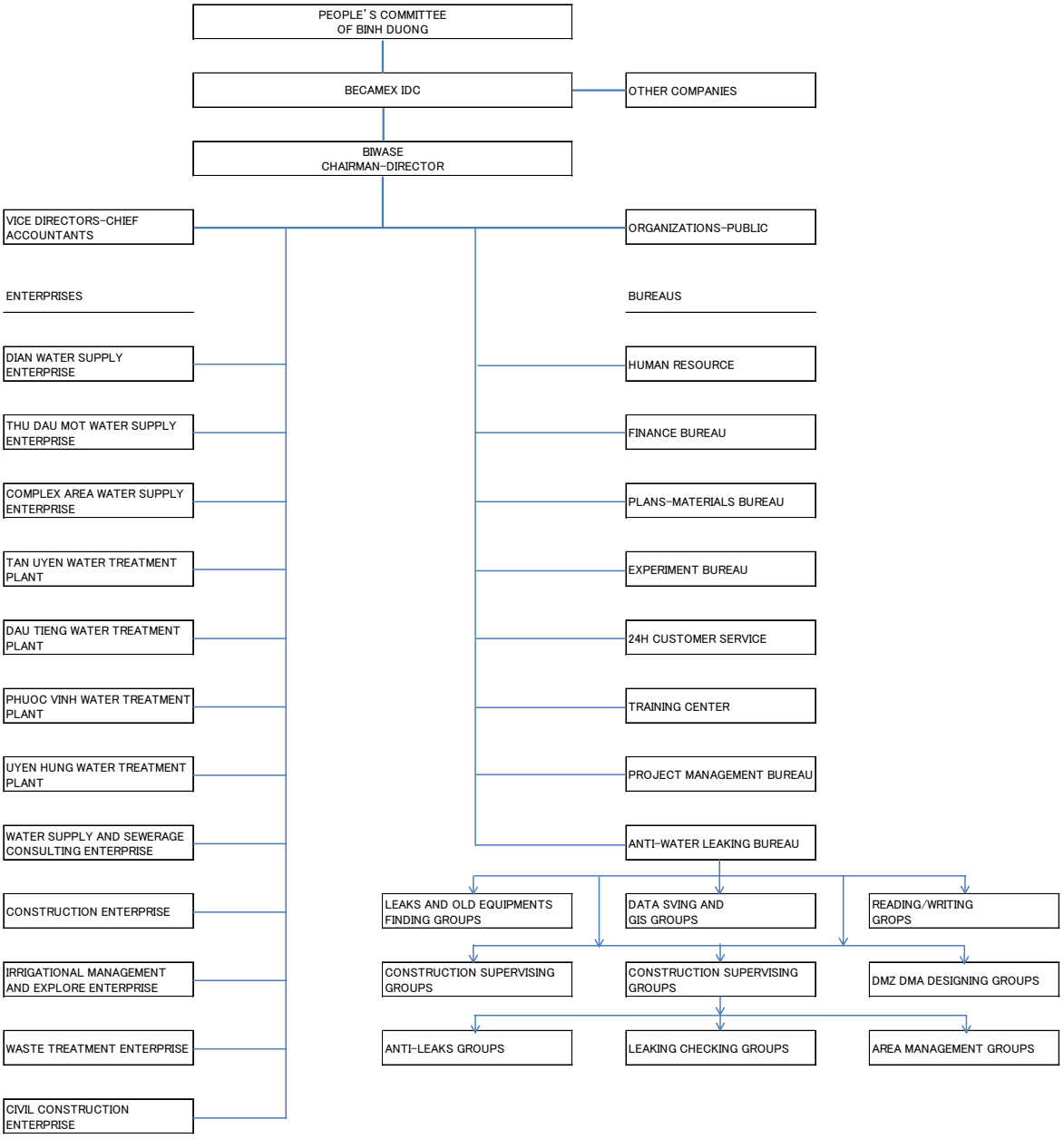


Figure 2.1.1 Organization Structure of BIWASE

2.2 National Policy and Sector Program of the Water Sector

2.2.1 National Policy and Sector Program

Vietnam's urban areas are classified into groups: two national special cities (Hanoi and Ho Chi Minh City), smaller national cities (class I; total 12), regional cities (class II; total 10), provincial cities (class III; 52), and district towns (class IV; total 58 and class V; total 631) in December, 2012. The Government plans to expand water supply coverage to meet the growing demand and this policy is reflected in Decision No. 1929.

The Orientation Plan for Water Supply in Urban Areas and Industrial Zones in Vietnam to 2025 and Vision toward 2050 (Decision No. 1929/QD-TTg dated November 20, 2009), which specifies:

1. Urban water supply coverage will reach 90% with the water supply standard of 120 liters/capita/day for the population in cities of classes I to IV, 70% and 100 liters/capita/day in

cities of class V by 2020; clean water quality shall meet the standards.
2. Non-revenue water will be less than 18% in cities of class IV upwards; less than 25 % for cities of class V; continuous water supply for 24 hours for cities of class IV upwards.

2.2.2 Policy and Program of Binh Duong Province

Master Plan of Binh Duong Urban until 2020, vision plan until 2030 approved by Decision No. 1701/QĐ-UBND June 26th, 2012 stipulates that:

- To calculate water use demand for Binh Duong according to the moderate saving alternative with the standard: 150 liters/capita/day. The water loss rate is under 20%.
- The rate of urban population using clean water reaches 99%, the rate of rural population using safe water reaches 98%.
- The demand is 522,519 m^3/day in 2010, 1,011,539 m^3/day in 2020 and 1,443,834 m^3/day in 2030.
- Water resources: to link surface water from Dong Nai river, Phuoc Hoa reservoir, Sai Gon river, to partly exploit and use ground water at the suburban district in the North.
  - The project of water supply and environment sanitation in the North of Binh Duong with the water treatment plant capacity is 600,000 m^3/day.
  - Tan Hiep water treatment plant expansion project with the capacity to 60,000 m^3/day.
  - Thu Dau Mot water treatment plant project with the capacity is 21,600 m^3/day.
  - Di An water treatment plant project with the capacity is 90,000 m^3/day.
- Planning solution of water supply is separated for three regions:
  - The distribution center of Southern region.
  - The distribution center of Center region.
  - The distribution systems of satellite urban in the North.

BIWASE has two options for expansion of water supply system between 2010 and 2020 as follows.

Option 1:

- Enlarge Tan Hiep WTP from 30,000m^3/d to 200,000m^3/d
- Enlarge DI An WTP from 90,000m^3/d to 200,000m^3/d
- Enlarge South Tan Uyen WTP from 3,000m^3/d to 50,000m^3/d
- Enlarge or build capacity at Bau Bang of 150,000m^3/d
- Rehabilitate Thu Dau Mot WTP and check options to increase capacity

The combined action of the above 5 will provide, more or less, the additional 500,000 m^3/d capacity required in 2020. The actions can be phased and implemented as the need arises, providing that the overall supply network for the area is linked, so that water can be provided anywhere in the network.

Option 2:

- Enlarge Tan Hiep WTP up to 90,000m^3/d and to 200,000m^3/d
- Develop and build the North Binh Duong (NBD) WTP with 600,000m^3/d capacity in phase of 150,000m^3/d each time, as demand develops.
- Enlarge South Tan Uyen WTP from 3,000m^3/d to 50,000m^3/d

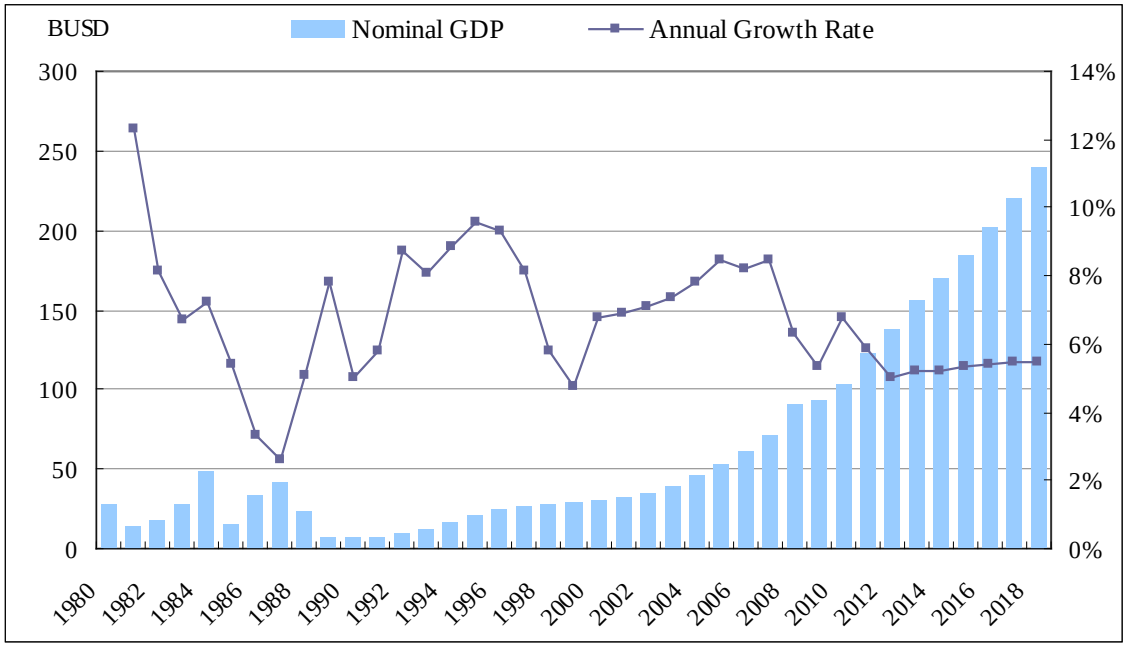
According to the above options, detailed design for expansion of Tan Hiep WTP up to 90,000m^3/d are currently prepared. The next step will be decided depending on the result of feasibility study and possible timing of NBD WTP commissioning.

CHAPTER 3 PRESENT CONDITIONS AND NEED OF THE PROJECT

3.1 Social and Economic Conditions

3.1.1 Social and Economic Conditions in Vietnam

Vietnam has developed at a rapid speed after experiencing the slowdown in the late 1990's due to the currency crisis in Asia. Especially, in the mid 00's, the real GDP growth rate had been over 7%. Although the growth faltered after the global credit crisis, IMF predicts that Vietnamese economy will maintain no less than 5% growth over the coming years. Currently, the nominal GDP reaches 138 billion USD and the real GDP growth rate is 5.0% in 2012. As for the GDP per person, it reaches 1,528 dollars in 2012. This is larger than that of India (1,492 USD) but smaller than that of the most of the countries in South East Asia (Philippines:2,614 USD, Indonesia:2,592 USD, Thailand:5,678, Japan:46,736).

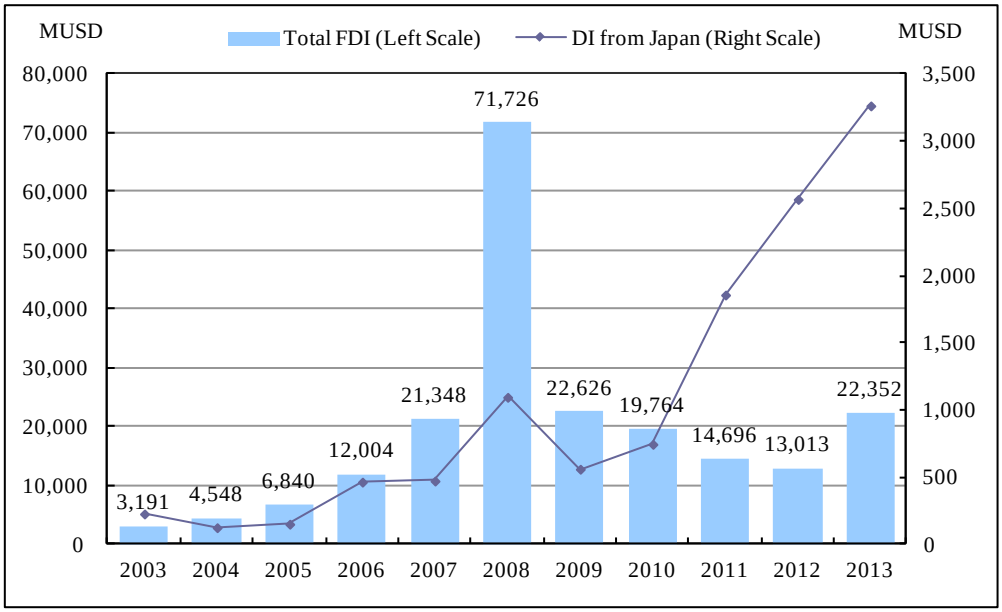


Source : IMF- World Economic Outlook Database: prediction after 2011

Figure 3.1.1 National GDP and Annual Growth Rate

From the viewpoint of foreign direct investment in Vietnam, the investment amount from overseas increased to the record-high level of 71.7 billion USD in 2008. Since then, the foreign direct investment has decreased gradually. However, it bottomed out in 2012 and showed the sign of reversing a downward trend in 2013. In relation to the investment from Japan, contrary to the recent trend of decline in foreign direct investment, Japan has increased its investment since 2009 and invested 2.5 billion USD in 2012. The top three countries investing in Vietnam in terms of investing amount in 2011 are Hong Kong (26%), Singapore (17%) and then Japan (16%).

The structure of interest rate in Vietnam can be divided into short term loan (within one year) and long term loan (over one year). In the short term, foreign company can borrow in domestic currency and foreign currency. However, borrowing of foreign currency is allowed for only the limited purposes: the settlement of foreign trade transactions, refinance (only permitted when conditions are improved) and foreign direct investment from Vietnam. There is an upper limit of 9% on the short term interest rate as determined in the circular 16/2013/TT-NHNN dated 27/06/2013. On the other hand, the market for the long term loan is undeveloped in Vietnam. Although some BOT projects procured long term loans with a tenor of over 10 years, generally, it is not common to mobilize such a long loan. Long term loans from overseas need to be registered at the central bank and the business plan in connected to the loan must be authorized by the government.



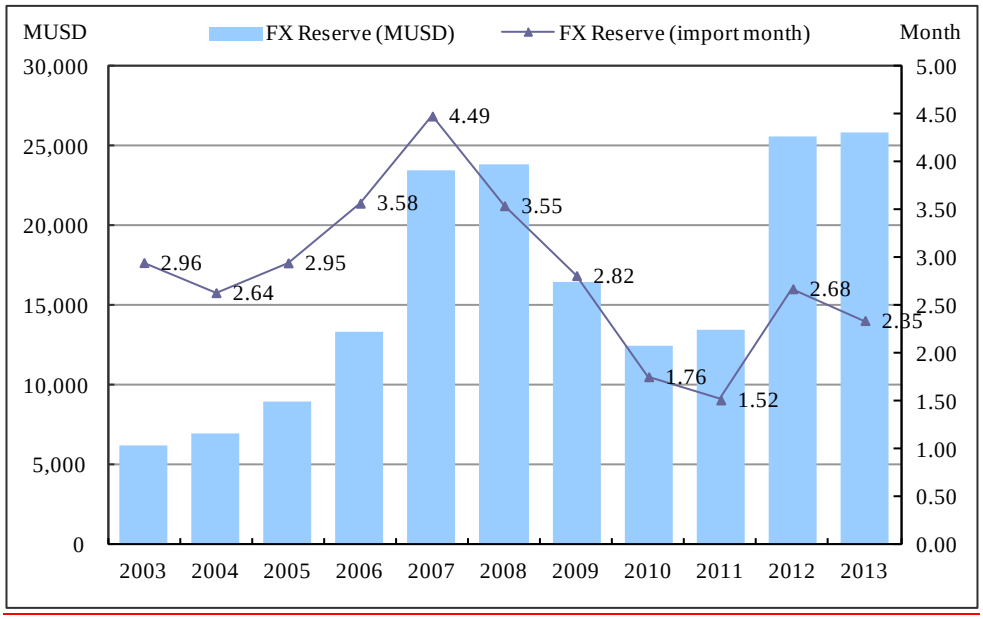
Source : JETRO Website

Figure 3.1.2 Total FDI and DI from Japan (including expansion, Approval Basis)

The swap market is one of the important factors when it comes to implementation of a long term project. The swap market in Vietnam has been, however, undeveloped, and there is limited availability in financial instruments to mitigate the fluctuation of interest rate and foreign exchange rate over the long period of time. Although there are future and forward markets which enable short term hedge for trade transactions, longer term hedge is hard to bring from these markets. One possible way to obtain long term hedge is to find a financial institution which agrees to exchange financial positions outside the markets, but it may be quite difficult to find such a financial institution.

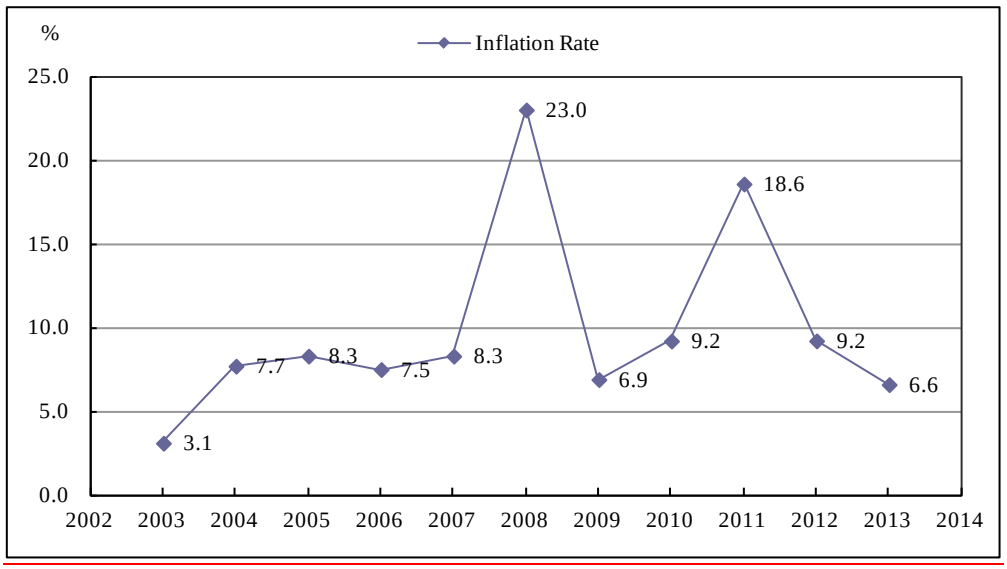
Another important aspect of social and economic condition is the foreign exchange reserve (FXR). It has been on a downward trend after peaked out in 2008 (23.9 billion USD). Typically, the equivalent amount of three months of import is required for the reserve at minimum. Given the import figures of 106.8 billion USD in 2011 and foreign exchange reserve of 13.5 billion USD, the reserve would be equal to only one and a half month of import in 2011. However, the reserve is recovering from the bottom of 2010.

Also, inflation rate is the important economic factor for the project. Inflation rate measured by CPI has been volatile in Vietnam; it reached 23.0% in 2008 and then it levelled off at the lower rate in the following yeas (2009:6.9%, 2010:9.2%). Currently, inflation rate has been gradually decreased at 9.2% in 2012 and 6.6% in 2013 after marking at 18.6% in 2011 due to devaluation of currency and increase in oil prices. In order to combat a surge in inflation, the government has tightened its financial policy and tried to put inflation under its control. However, it is said that tight financial policy put a dumper on Vietnamese economy as side effect.



Source : JETRO Website

Figure 3.1.3 Foreign Exchange Reserve



Source : JETRO Website

Figure 3.1.4 Inflation Rate

3.1.2 Social and Economic Conditions in Binh Duong Province

Binh Duong province is located at the north of Ho Chi Minh City. The provincial capital is Thu Dau Mot. The location of the province is the central hub of business and transportation in this region. It is surrounded by economically important cities such as Ho Chi Minh City, Dong Nai province and Tay Ninh province. Another example of the hub function of the province is developed transportation. National Road 13 runs from the northern part of the province to the south, while National Road 1 rolls through the province from east to west. Furthermore, National Road14 runs from northeast and connects with National Road 13 in the Binh Duong province.

Binh Duong province has experienced rapid economical growth. According to the Binh Duong province website, the GDP growth rate reaches 14.5% per year on average. One of the characteristic of the development in Binh Duong province is industrialization by leveraging its adjacency to Ho Chi Minh City. So far, over twenty industrial parks were built in the province. In terms of size of the province, the population in Binh Duong is 1,803 thousand in 2013, which is not necessarily large when compared to Ho Chi Minh City (7,818 thousand people inhabit in Ho Chi Minh City in 2013). However, in 2013, the population across the province is predicted to grow at approximately 16.6% per year. Above all, Ben Cat District, where the New Binh Duong City is planned, is predicted to experience as much as 15% growth. Meanwhile, the average income is already at the same level as Ho Chi Minh City in 2010 (Binh Duong:1,619 USD, Ho Chi Minh:1,642USD).

The investment has been made in industrial zones in Binh Duong province. A good illustration of this is the Vietnam – Singapore industrial park. This industrial park was jointly developed by Singapore Vietnam IP Pte Ltd., an industrial zone developer partly sponsored by Sembcorp Parks Management Pte Ltd. and Mitsubishi Corporation, and BECAMEX IDC Corporation (BECAMEX), a prominent infrastructure developer in Vietnam. Tens of Japanese companies (e.g. Nissin Food, Omron) operate in Vietnam- Singapore industrial park in March 2014. Furthermore, Binh Duong People's Committee approved the plan of building a new city called New Binh Duong City in the vicinity of Ben Cat District. The land use rights were granted to BECAMEX to develop the new city. Political and governmental functions were transferred to the new city from the current provincial capital, and the new city is scheduled to be completed in 2020. From the statistical perspective, the total investment amount in Binh Duong province between 1988-2011 ranked at 5th among 63 provinces in Vietnam. This fact backs up the continuous development in Binh Duong province.

With respect to the recent movement in the development of Binh Duong province, Tokyu established a joint venture with BECAMEX to promote its real estate and town development business in Vietnam. This company, which is called BECAMEX Tokyu Co,.Ltd.will develop "Tokyu Binh Duong Garden City" in the planned New Binh Duong City. This garden city will be capable of accommodating 7,500 households. Thus, Binh Duong province has been attracting Japanese companies.

3.1.3 Positioning of Binh Duong Province in Vietnam

The political position of Binh Duong province has been improving in accordance with its economic development. This is demonstrated by the upgrade of the provincial capital, Thu Dau Mot. It became the class III urban center in 2007 and then it satisfied the standards of class II urban center in 2010 (Binh Duong province websiete). Thu Dau Mot was officially authorized by the central government to become a class II urban center in 2014. Binh Duong province is aiming to be the class I urban center by 2015 and the centrally governed city by 2020. According to the Decree No.42/2009/ND-CP, urban centers are classified by six classes, namely special class, class I, class II, class III. class IV and class V. The primal standards of the urban classes are as follows:

	Population	Population Density	Non-agricultura labor
Special Class urban center	At least 5 million	At least 15,000 people/km2	At least 90% of total labor
Class I urban center	(i) Centrally run urban center: at least 1 million (ii) Provincially run urban center: at least 500,000	(i) Centrally run urban center: 12,000 people/km2 (ii) Provincially run urban center: at least 10,000 people/km2	At least 85% of total labor
Class II urban center	(i) Centrally run urban center: over 800,000 (ii) Other: at least 300,000	(i) Centrally run urban center: 10,000 people/km2 (ii) Provincially run urban center: at least 8,000 people/km2	At least 80% of total labor

Class III urban center	At least 150,000	6,000 people/km2	At least 75% of total labor
Class IV urban center	At least 50,000	4,000 people/km2	At least 70% of total labor
Class V urban center	At least 4,000	2,000 people/km2	At least 65% of total labor

Hanoi City and Ho Chi Minh City are Special Class urban center.

3.2 Description of the Study Area

As described in Chapter 1 of the report, the study area is new city and industrial parks located in Binh Duong Province.

(1) Topography and Geography

Binh Duong Province is located at the transition between the southern slope of the Truong Son mountain chain and the Mekong Delta provinces; plain terrain, light wavy. The center of the province is at the geographical coordinates of 10°50'-27'' to 11°24'-32'' north latitude, and from 106°20' to 106°25' east longitude.

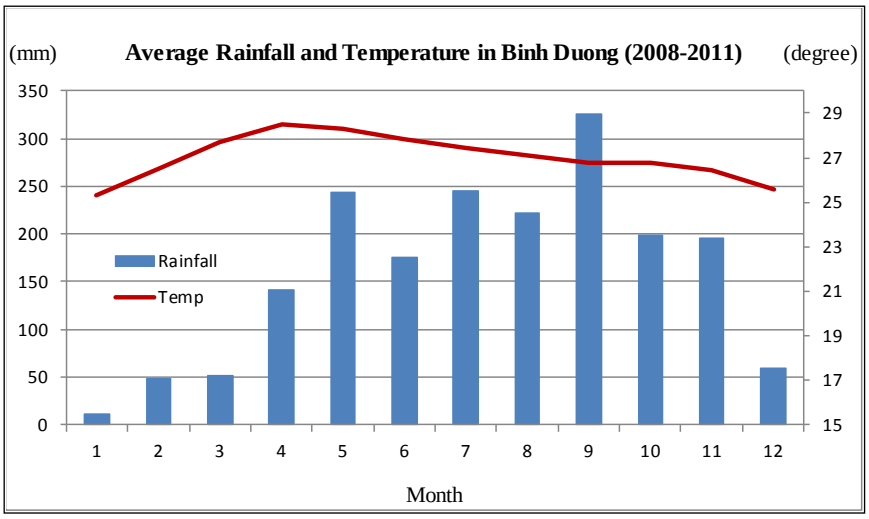
Terrain in Binh Duong is relatively flat, sloping from north to south. Across Binh Duong there are many different topographic regions, including low mountainous terrain with slight undulation, flat plains and alluvial valley. There are some low mountains, including Chau Thoi in Di An district and the Cau mountain in Dau Tieng district and some low hills.

The plentiful lands of Binh Duong include various types:

Gray on ancient alluvial soil is distributed over the districts of Dau Tieng, Ben Cat, Thuan An, and Thu Dau Mot town. This soil is suitable for intense cropping, especially industrial plantations and fruit trees. Yellow-brown on ancient alluvial soil is located on the low sloping hills in the districts of Tan Uyen, Phu Giao, Thu Dau Mot town and Thuan An. This land is suitable for vegetable crops as well as fruit and nut trees such as jackfruit or cashew. Alluvial Clay on slope convergence, located in the north of Tan Uyen, Phu Giao, Ben Cat, Dau Tieng, Thuan An, and Di An districts.

(2) Climate

Binh Duong has a tropical monsoon climate, with a pronounced rainy season from May through November, a dry season from December through April. The average temperature is 26.5 degree C. The highest and lowest average temperatures are recorded in May and January respectively but the difference is 3 to 4 degree C. The average rainfall is 1,800-2,000 mm. 120 days are rainy, which covers 85% of the whole rainfall. The relative humidity values in dry and rainy seasons are 60 to 80% and 85 to 90%. Typhoons are not found in the record but floods occur often between September and November. Average precipitation and temperature values in Binh Duong are shown in **Figure 3.2.1**.



Source: Statistical Yearbook, 2011

Figure 3.2.1 Average Rainfall and Temperature

(3) Hydrographical Features

There are three major rivers, many canals in the riverside areas and innumerous small streams.

The Dong Nai River is the largest river in the South East, with its source in the Lam Vien Plateau in Lam Dong province. The river is 635 km long but only flows through the territory of Binh Duong in Tan Uyen district. The Dong Nai River is valuable to provide agricultural water, water transport and fisheries.

The 256-km Saigon River originates in the mountains of Loc Ninh district in Binh Phuoc province with many tributaries, canals and streams. The Saigon River flows through Binh Duong to the west. The section from Lai Thieu to Dau Tieng is 143 km long and gently slopes, making it useful for transportation, agriculture, and fishery supply. Upstream, the river is narrow (20m) and meandering, gradually extending from Dau Tieng to the town of Thu Dau Mot where it becomes wider (200m).

The Be River is 360 km in length and is fed by the three rivers in the mountain area of Dak Lak province. Downstream, the section which flows into Binh Duong is 80 km long but difficult to navigate due to steep banks, rocks, and waterfalls, thus the Be River is not convenient for water transport. The existing canal leads from the Be River to the Saigon River. The Project plans to intake water ($15m^3$/sec) from the canal ($75m^3$/sec).

Raw water samples were collected and analyzed in Dec. 2012 and Mar. 2013 as the beginning and the end of the dry season. The water quality is shown in **Table 3.2.1**. The features of the raw water are; i) Color and Turbidity are low. ii) Alkalinity is high enough for coagulation in the water quality management. iii) Heavy metals are low enough to be safe for human health and Cyanide is not detected. Consequently, the raw water quality has no significant problems and suitable for water resource of water supply. E-coli is detected and should be sterilized in chlorination.

The water quality was tested in July 2013 (wet season) as well and it was similar to ones in dry season generally. However, color is significantly higher (72TCU). More than 60% of the color is solid because the filtrate has only 26TCU. In addition, dissolved color can be reduced by coagulation. Thus, it is expected to remove color from the raw water in the planned WTP. Otherwise, no significant problems were found, so the raw water will be adequate for water supply through the year.

Table 3.2.1 Raw Water Quality

Dry season-1 (Dec. 2012)					
General item			Heavy metals, etc.		
Item	Result	Unit	Item	Result	Unit
Temperature	31.7	Deg C	Sb	Not detected	mg/L
Odor	None	-	As	Not detected	mg/L
Color	1	TCU	Cd	Not detected	mg/L
Turbidity	4	NTU	Cr	Not detected	mg/L
pH	6.4	-	Hg	Not detected	mg/L
Hardness	15	mg/L	Se	Not detected	mg/L
Dissolved solid	101	mg/L	Ni	Not detected	mg/L
Alkalinity	52.5	mg/L	Pb	0.002	mg/L
Cl^-	8.2	mg/L	Fe	0.36	mg/L
$KMnO_4$ consumption	1.3	mg/L	Mn	Not detected	mg/L
Surfactants	Not detected	mg/L	Zn	0.08	mg/L
e-coli	460	Unit/100mL	Cyanide	Not detected	mg/L
Dry season-2 (Mar. 2013)					
General item			Heavy metals, etc.		
Item	Result	Unit	Item	Result	Unit
Temperature	29.0	Deg C	Sb	Not detected	mg/L
Odor	None	-	As	Not detected	mg/L
Color	12	TCU	Cd	Not detected	mg/L
Turbidity	2.0	NTU	Cr	Not detected	mg/L
pH	7.0	-	Hg	Not detected	mg/L
Hardness	16	mg/L	Se	Not detected	mg/L
Dissolved solid	114	mg/L	Ni	Not detected	mg/L
Alkalinity	23.5	mg/L	Pb	0.007	mg/L
Cl^-	4.0	mg/L	Fe	0.33	mg/L
$KMnO_4$ consumption	0.8	mg/L	Mn	Not detected	mg/L
Surfactants	Not detected	mg/L	Zn	Not detected	mg/L
e-coli	93	Unit/100mL	Cyanide	Not detected	mg/L
Wet season (July 2013)					
General item			Heavy metals, etc.		
Item	Result	Unit	Item	Result	Unit
Temperature	31.8	Deg C	Sb	Not detected	mg/L
Odor	None	-	As	Not detected	mg/L
Color	72	TCU	Cd	Not detected	mg/L
Turbidity	5.0	NTU	Cr	Not detected	mg/L
pH	6.9	-	Hg	Not detected	mg/L
Hardness	20	mg/L	Se	Not detected	mg/L
Dissolved solid	51.2	mg/L	Ni	Not detected	mg/L
Alkalinity	30	mg/L	Pb	Not detected	mg/L
Cl^-	4.6	mg/L	Fe	0.32	mg/L
$KMnO_4$ consumption	1.1	mg/L	Mn	Not detected	mg/L
Surfactants	Not detected	mg/L	Zn	0.03	mg/L
e-coli	< 3	Unit/100mL	Cyanide	Not detected	mg/L

Source：JICA Survey Team

(4) Protected Area

There is no protected area in and around Binh Duong Province.

(5) Fauna & Flora

1) Wildlife

There are no official surveys on wildlife in or around the proposed construction sites. The EIA study is going to be conducted by BIWASE.

2) Vegetation

Once, there were tropical rain forests in the northern Binh Duong Province but they were vanished in the Vietnam War. At present, there is no primary forest in the whole province. The agricultural land that covers 77% of the whole area consists of gum, cathew, acacia and eucalyptus trees.

(6) Socio-Economic Conditions

1) Population

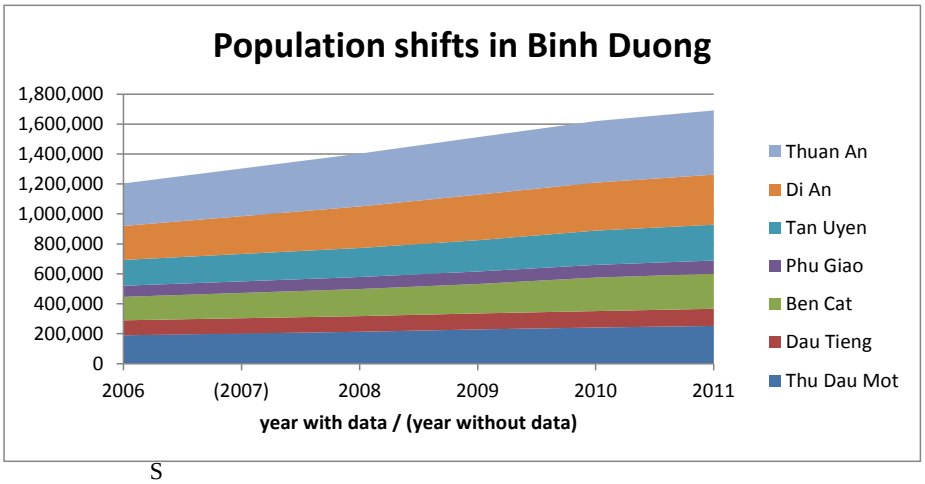
Binh Duong consists of 7 administrative districts and has a population of approximately 1.7 million. The average natural population growth rate was 1.30% in 2006 but descended to 1.00% in 2011. The populations in the target areas are shown in **Table 3.2.2**. The changes in population are shown in **Figure 3.2.2**. The population growth*) rate is 9% from 2006 to 2011. The gap from natural population growth rate indicates the rapid social population growth.

***) Population growth = Natural growth + Social growth**

Table 3.2.2 Shift of Population (2011)

No	District	Number of Commune	Area (km^2)	Population (person)	Population density ($pers/km^2$)
1	Thu Dau Mot	3	118.67	251,922	2,123
2	Dau Tieng	11	721.39	114,623	159
3	Ben Cat	14	583.58	233,800	408
4	Phu Giao	10	543.78	88,501	163
5	Tan Uyen	19	593.37	239,022	403
6	Di An	-	59.95	334,592	5,581
7	Thuan An	3	83.69	428,953	5,125
-	Total	71	2,694.43	1,691,413	628

Source: Statistical Yearbook, 2011



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Source: Statistical Yearbook, 2011

Figure 3.2.2 Shifts of Population (Target areas)

2) Ethnic groups

In 2011, ethnic minority groups population is 19,643(persons), 4,246 households (HH) and over 1% of the whole province. The most of their residents are located in the suburb and they live among ethnic majority. Representative ethnic minority groups are Cham (Hoa Loc hamlet, Minh Hoa commune, Dau Tieng district) and Khmer (An Binh commune, Phu Giao district). One Khmer HH inhabits in Ben Cat District and the socio-economic study in RAP will reveal

whether the HH is involved in the Project. In either case, misdistribution of benefits and damages to the ethnic minority is not expected in light of the past living conditions. In addition, ethnological or historical heritages do not exist in the project sites.

3) Poor people

Numbers of the Poor HH in 2009 and 2012 are shown in **Table 3.2.3**. The definition of Poor HH is "HH that earns 1,000,000 VND/Month or less in urban areas or 800,000 VND/Month or less in rural areas" (Decree No.49/2010/QD-UBND). The poverty rate of the whole Binh Duong Province was 1.36% in 2012 with various numbers for different districts. The rate was relatively low (approx.1%) in Ben Cat District, the target area of the Project.

Water tariff is currently discounted as countermeasure of poverty. Credit policy for improving livelihood of local people has been facilitated by several national and provincial programs by associations such as, i) Social Policy Bank, ii) Provincial Women Union, iii) Provincial Communist Youth Union and iv) Medicare Support.

Table 3.2.3 Poverty Rate

No	District	2009			2012			Category
		Total HH	Poor HH	Poverty Rate (%)	Total HH	Poor HH	Poverty Rate (%)	
1	Thu Dau Mot	39,743	1,378	3.46	63,957	773	1.21	Urban
2	Dau Tieng	28,666	1,252	4.36	29,539	633	2.14	Rural
3	Ben Cat	35,208	895	2.54	40,294	437	1.08	Rural
4	Phu Giao	19,267	1,406	7.29	20,292	942	4.64	Rural
5	Tan Uyen	32,618	677	2.07	33,169	183	0.55	Rural
6	Di An	27,960	483	1.70	40,218	199	0.49	Urban
7	Thuan An	31,215	1,326	4.25	37,973	448	1.18	Urban
-	**Total**	**214,686**	**7,417**	**3.45**	**265,442**	**3,615**	**1.36**	-

Source: Pre-FS / Binh Duong DOLISA, 2012

4) Population by Occupation

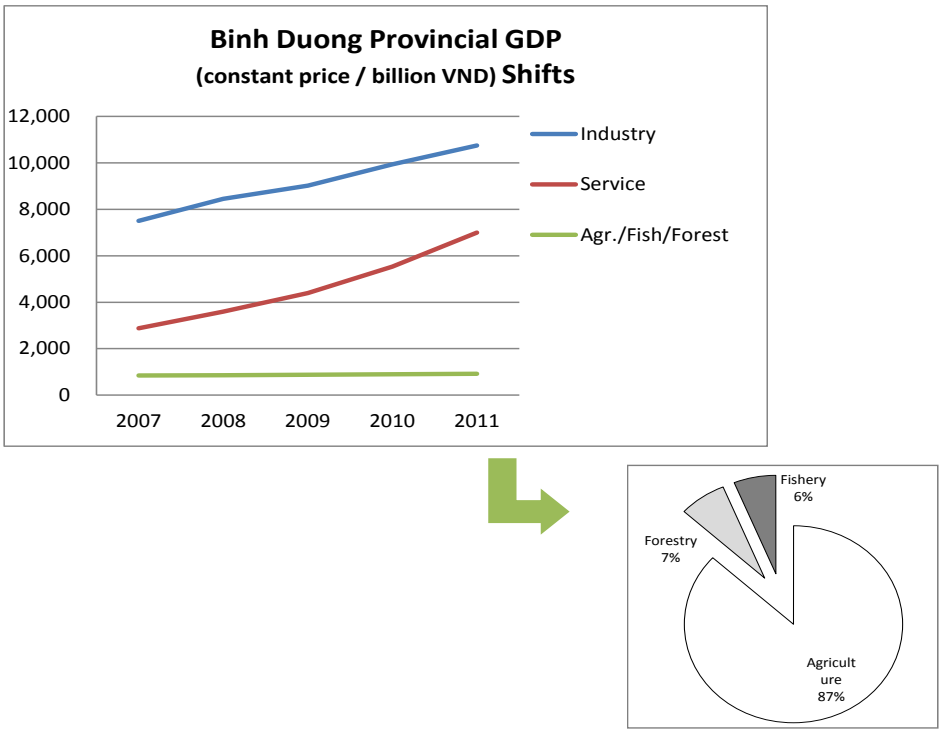
Population by occupation shown in **Table 3.2.4**, indicates that the number of Industrial workers is significantly large (59%) followed by Agriculture, Forestry & Fishery (11%) and Service (Hotel, restaurant, etc.). In addition, large numbers and growths in each year can be seen by GDP shifts as shown in **Figure 3.2.3**.

Table 3.2.4 Population Rate by Occupation

(%)

No.	Economic activity	2006	2008	2009	2010	2011
1	Industry	54.29	57.48	59.95	58.33	59.33
2	Agriculture, Forestry, Fishery	17.01	13.78	12.75	11.84	11.12
3	Hotel, restaurant, etc.	7.74	8.80	8.91	10.24	10.77
4	Construction	6.31	6.30	6.30	6.63	6.36
5	Transport, Storage and Communication	3.08	3.08	3.08	3.30	3.17
6	Public Administration and Defence; Compulsory social security	3.33	2.82	2.71	2.91	2.79
7	Education and training	1.77	1.57	1.57	1.52	1.73
8	Health and social work	0.49	0.49	0.50	0.47	0.46
9	Financial Intermediation	0.26	0.26	0.26	0.26	0.25
10	Others	5.72	5.42	3.97	4.50	4.01

Source: Statistical Yearbook, 2011



Source: Statistical Yearbook, 2011

Figure 3.2.3 Shifts of GDP by Industry (Binh Duong / Constant price)

5) Important Infrastructure

The important infrastructure in Binh Duong is shown in **Table 3.2.5**.

Table 3.2.5 Important Infrastructure

No	Important infrastructure	2006	2008	2009	2010	2011
Educational						
1	Primary School (Age; 5 – 10)	131	129	132	133	135
2	Primary & Middle	-	-	-	2	2
3	Middle School (Age; 11 – 15)	49	53	53	57	65
4	Middle & Secondary	14	12	12	10	6
5	Secondary School (Age; 16 – 18)	12	14	14	17	21
6	Primary, Middle & Secondary	-	2	2	4	4
7	Technical secondary	5	5	5	6	7
Medical						
1	Hospital	11	11	11	14	16
2	Clinics	6	8	9	9	12
3	Health unit in commune, township	89	89	89	91	91

(Source: Statistical Yearbook, 2011)

6) Cultural heritage

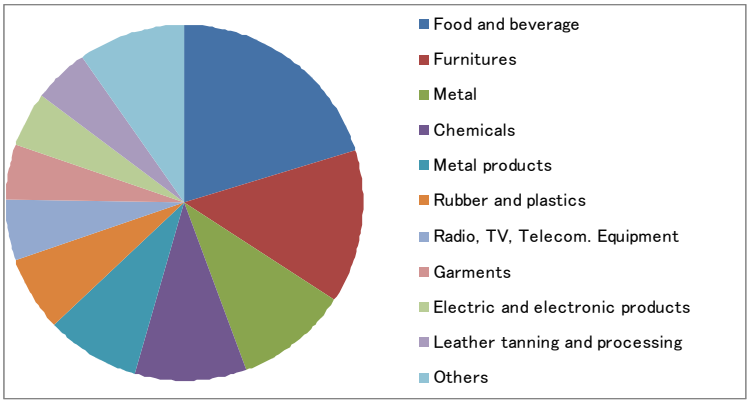
No Cultural heritages are found in the target area.

7) Industry

The breakdown of industrial activities which have the largest worker population in Binh Duong is shown in **Table 3.2.6**. In 2011, food and beverage industry occupies 18% of gross output followed by furniture and metal industries.

Table 3.2.6 Breakdown of Industrial Gross Output

Industry	Gross output (%)				
	2006	2008	2009	2010	2011
Food and beverage	16.40	17.55	19.04	17.48	17.94
Furniture	14.74	12.91	13.09	13.65	12.52
Metal	5.83	10.75	8.91	10.18	9.15
Chemicals	8.97	8.77	9.78	8.71	8.77
Metal products	8.06	8.07	6.76	7.12	7.70
Rubber and plastics	4.90	5.37	5.26	5.72	5.99
Radio, TV, Telecom. Equipment	3.02	3.59	3.38	4.83	4.88
Garments	4.56	4.10	4.62	4.44	4.55
Electric and electronic products	5.05	4.35	4.64	4.85	4.38
Leather tanning and processing	7.66	5.09	5.11	4.49	4.34
Others	20.81	19.45	19.41	18.53	19.8
Total	100	100	100	100	100



(Source: Statistical Yearbook, 2011)

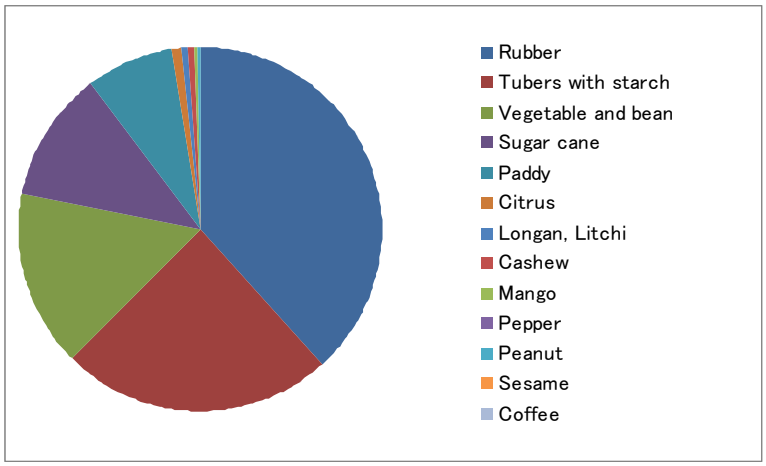
Figure 3.2.4 Breakdown of Industrial Gross Output (2011)

8) Agriculture

Agricultural output accounts for 87% of the primary industrial GDP. The breakdown of agricultural crop yield is shown in **Table3.2.7**. In 2011, rubber has the highest percentage (38%), followed by tubers (24%) and vegetable/bean (15%).

Table 3.2.7 Breakdown of Major Crops

Agricultural crop	Yield (ton)				
	2006	2008	2009	2010	2011
Rubber	146,613	174,353	177,554	188,260	190,442
Tubers with starch	131,564	128,588	123,996	122,865	119,687
Vegetable and bean	92,581	88,478	86,215	83,836	77,961
Sugar cane	52,588	43,110	36,585	40,232	57,783
Paddy	45,883	38,964	37,816	38,814	38,489
Citrus	4,365	4,241	4,056	4,355	5,003
Longan, Litchi	5,238	3,786	3,757	2,708	2,390
Cashew	5,575	5,506	3,461	2,495	2,173
Mango	3,250	1,331	1,375	1,244	1,416
Pepper	1,526	1,229	1,127	923	955
Peanut	4,663	3,726	3,055	2,567	508
Sesame	38	824	878	719	462
Coffee	645	13	10	8	8



(Source: Statistical Yearbook, 2011)

Figure 3.2.5 Breakdown of Major Crops (2011)

9) Land use

In 2011, the area of the whole Binh Duong Province is 2,694km^2 (269,443ha) occupying 0.83% of the whole country. The largest category is agricultural land (77%) and the main content is perennial crop land as represented by gum trees. As for non-agricultural land, the main purpose is industrial and commercial area which is shown as specially used land.

The majority of the planned sites (under acquisition) for the Project are lands for gum trees.

Ben Cat District where the Project will be taken place does not have protective forests. The protective forest area can be designated to other land category where productive activities are allowed. It is possible due to a certain procedure by the provincial People's Committee and no major problem is found for the project land use.

Land use situation in Binh Duong is shown in **Table 3.2.8**.

Table 3.2.8 Land Use (Binh Duong)

(%)

No.	LAND USE	Y2006	Y2007	Y2008	Y2009	Y2010
	TOTAL AREA	**100 (269,522ha)**				**100 (269,443ha)**
I	**Agricultural Land**	**81.05**	**80.82**	**80.59**	**79.60**	**77.45**
1	Agricultural production land	76.01	75.82	75.59	74.64	71.51
	- Annual crop land	11.39	10.80	10.05	9.62	4.96
	- Perennial crop land	64.62	65.02	65.55	65.02	66.53
2	Forestry land	4.69	4.65	4.65	4.64	5.62
	- Productive forest	4.15	4.11	4.11	4.11	4.36
	- Protective forest	0.54	0.54	0.54	0.54	1.26
3	Water surface land for fishery	0.19	0.19	0.19	0.19	0.13
4	Others	0.16	0.16	0.16	0.13	0.22
II	**Non-agricultural land**	**18.54**	**18.85**	**19.11**	**20.18**	**22.54**
1	Homestead land	2.72	2.76	2.85	3.01	5.04
2	Specially used land	11.19	11.46	11.62	12.55	12.86
3	Religious land	0.09	0.09	0.09	0.09	0.09
4	Cemetery	0.39	0.38	0.38	0.37	0.37
5	Rivers and specialized water surfaces	4.15	4.15	4.15	4.15	4.17
6	Others	0.01	0.01	0.01	0.01	0.01
III	**Unused land**	**0.41**	**0.33**	**0.29**	**0.22**	**0.01**

Source: Statistical Yearbook, 2011

10) Water use / water right

Total service coverage of water supply in Binh Duong is only 20% as estimated in section **3.4.1** and the main source of un-covered population is groundwater by individual wells. According to "Water Sector Review by Dr. Dang Dinh Phuc (2008), Department of Water Resources Management", annual storage of groundwater is 12,538 million m^3 , which accounts for 1,764.5m^3/year/person of Binh Duong Province, and that the potential of groundwater is still enough but BDPPC considers shortage in future and prepares restriction on ground water usage.

BDPPC shall not grant to extend the groundwater prospecting or exploitation permits for all the water bearing stratum except when approved by the PC. It is stipulated in Decision No. 1471/QĐ-UBND which was announced in May, 2011 by BDPPC and the targets were surrounding areas of the project sites, such as i) Thu Dau Mot town, ii) Thuan An town, iii) Di An town, iv) My Phuoc town and 5 industrial parks from Ben Cat commune, and v) 3 towns and 3 industrial parks from Tan Uyen commune, where water supply is already started. Thus, it is intended that exploitation of ground water in water supply service areas is going to be restricted more and more from now on.

Present water resources are surface water from the Dong Nan and the Saigon River and groundwater. There is no concern in shortage of water in the two rivers, but the Saigon River has relatively small amount of flow and saltwater intrusion is concerned up to the intakes of Thu Dau Mot WTP and Ho Chi Minh City and water quality deterioration in the future is also concerned for the both rivers by rapid development. Groundwater extraction becomes relatively expensive because of electricity expenses for pumping and chemical costs for PH adjustment. Because of the above background and safety of water resources by diversity of sources, intake of 15m^3/sec from the canal between Be and Saigon Rivers is planned for the Project. In addition, BIWASE already has obtained the water right for this intake.

3.3 Conformity of the Project with National Plans

As mentioned in Chapter 2, the Orientation Plan for Water Supply in Urban Areas and Industrial Zones in Vietnam to 2025 and Vision toward 2050 (Decision No. 1929/QD-TTg dated November 20, 2009) specifies that urban water supply coverage will reach 90% with the water supply standard of 120 liters/capita/day for the population in cities of classes I to IV. The water supply coverage in Binh Duong Province is around 20% in 2011 including Thu Dou Mot City (now class II and class I to be). It is obvious that the project to increase the coverage conforms to the national plans.

3.4 Need of the Project

3.4.1 Present Conditions of Existing Water Supply System

There are 3 major and several small-scale WTPs in Binh Duong Province. The outline, capacity and production of the WTPs in 2012 are summarized in **Table 3.4.1.** The location of the WTP are shown in **Figure 3.4.1.**

Table 3.4.1 Outline, Capacity and Production of WTPs in 2012

No.	WTP	Built year	Raw Water Sources	Capacity (m^3/d)	Production (m^3/d)	
				Daily Average	Daily Max.	Daily Average
1	Thu Dau Mot	1994-1997	Saigon River	21,600	21,906	18,868
2	Di An	2003-2008	Dong Nai River	90,000	117,000	105,000
3	Tan Hiep	2008-2010	Dong Nai River	60,000	18,124	14,155
4	My Phuoc I	2003	Groundwater	9,000	35,230	31,600
5	My Phuoc II	2003	Groundwater	8,800		
6	My Phuoc III-1	2006	Groundwater	3,000		
7	My Phuoc III-2	2006	Groundwater	7,700		
8	Bau Bang	2007	Groundwater	1,200	671	581
9	Uyen Hung	2002	Dong Nai River	5,000	2,100	1,550
10	South Tan Uyen	2007,2011	Groundwater Dong Nai River	13,000	3,900	3,500
11	Phuoc Vinh	2003	Gial Streem	1,200	1,900	1,000
12	Dau Tieng	2004	Groundwater	1,000	2,600	1,800
Total		-	-	**221,500**	**203,431**	**178,054**

Source: BIWASE

Service coverage of water supply in Binh Duong Province is estimated at about 20% by the house connection number given in **Table 3.4.2** assuming 5 persons per house as follow;

Service coverage =67,033 x 5 / 1,691,413 (Population of 7 districts in 2011) = 0.198

Table 3.4.2 Number of House Connections

No.	Water Supply Plant	2009	2010	2011	2012
1	Thu Dau Mot WTP	17,945	21,695	26,000	30,464
2	Di An WTP	17,356	22,438	27,990	32,995
3	Complex WTP (Tan Hiep)	4,704	6,352	7,753	9,374
4	Tan Uyen WTP	1,019	1,271	1,594	1,932
5	Phuoc Vinh WTP	949	1,051	1,196	1,442
6	Dau Tieng WTP	1,929	2,170	2,500	2,860
Total		**43,902**	**54,977**	**67,033**	**79,067**

Source: BIWASE

Detailed design to expand Tan Hiep WTP with the capacity from 60,000 m^3/d to 90,000 m^3/d is being undertaken in April, 2013. However, further expansion of water production capacity is urgently required for the area, since production in 2012 was equivalent to the production capacity and house connection is contentiously increasing.

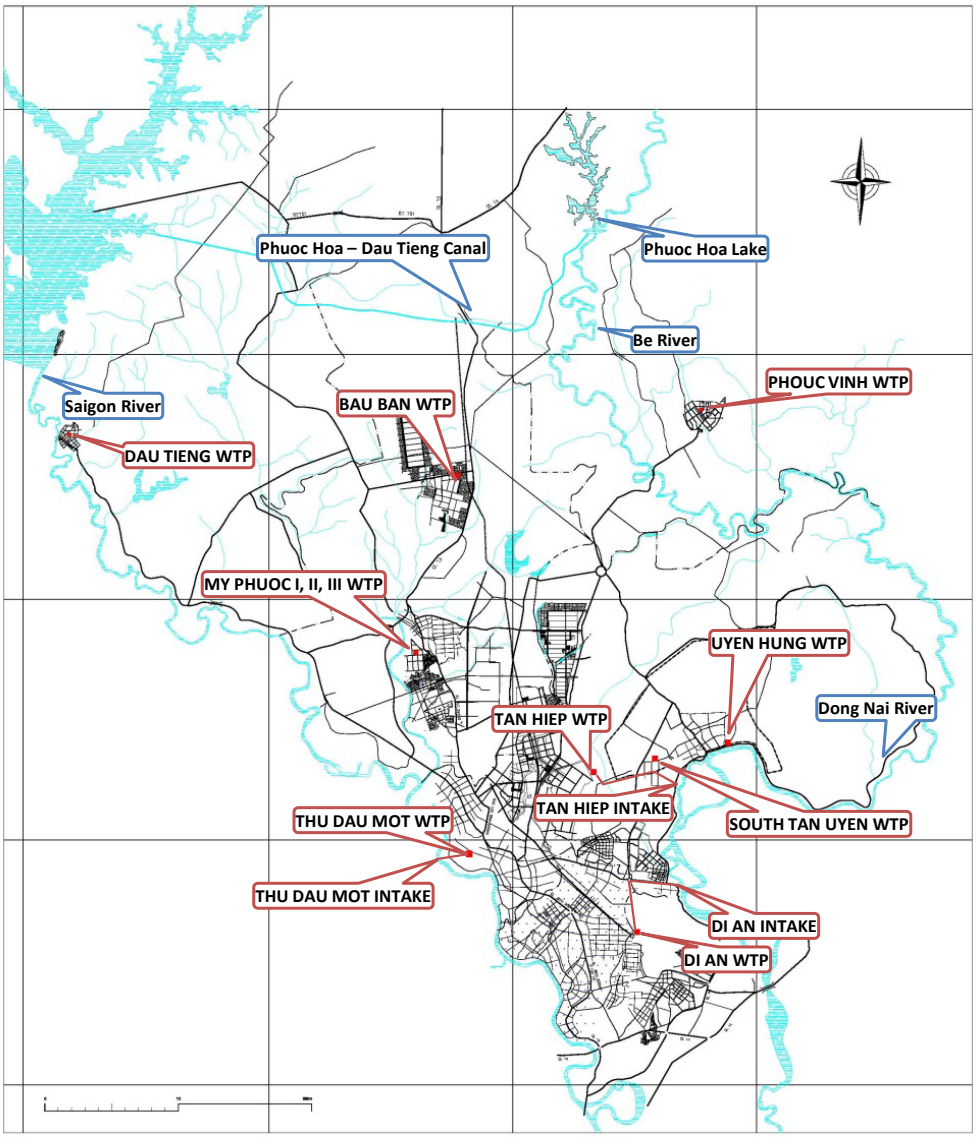


Figure 3.4.1 Existing WTPs and Raw Water Sources

3.4.2 Project Justification

The Vietnamese government declared policies in 2009 which include the expansion of water supply area and reduction of leakage ratio as stated in the Decision 1929/2009/QD-TTg. The targets of water supply coverage ratio in envisioned are 90% by 2015 and 100% by 2025, for urban areas of cities with a population of 50,000 or more. Binh Duong Province aims at increasing the water supply coverage ratio of the urban areas to 97% by 2015, as stipulated in Binh Duong Province Social Economy Development Plan (2011 to 2015). The water supply project in the new city and industrial park in the northern part of Binh Duong Province (the Project) will contribute to the above national target and development plan of Binh Duong Province.

CHAPTER 4 PLANNING AND DESIGN BASIS

4.1 Technical Guideline and Design Criteria for Water Supply Systems

The main technical guidelines for the planning and design criteria of water supply systems are contained in TCXD33-2006: Water Supply - Distribution System and Facilities, which made applicable to water supply works in the country. QCVN 01:2009/BYT (National technical regulation on drinking water quality) applies to all agencies, organizations, individuals and households to exploit business drinking water, including water supply facilities for the purpose of living with a capacity of 1,000 m^3/day or more.

These documents haves been supplemented by the use of some other documents as indicated below:

- QCVN04-05:2012/BNNPTNT, National technical regulation on hydraulic structures
  - The basic stipulation for design
- QCVN 07:2010/BXD, Vietnam Building Code, Urban Engineering Infrastructures
- TCVN4447-87, Standard of earthworks including excavation, backfill, and foundation of pipeline ditch

4.2 Previous Study and Situation of the Project

Final report on "Options Study for Rehabilitation and Expansion of Water Services in Urban Areas HCMC and Binh Duong Province" (Options Study) dated 14th April, 2011 funded by World Bank provides Pre-Feasibility Study for the Water Supply System for Northern Binh Duong Province.

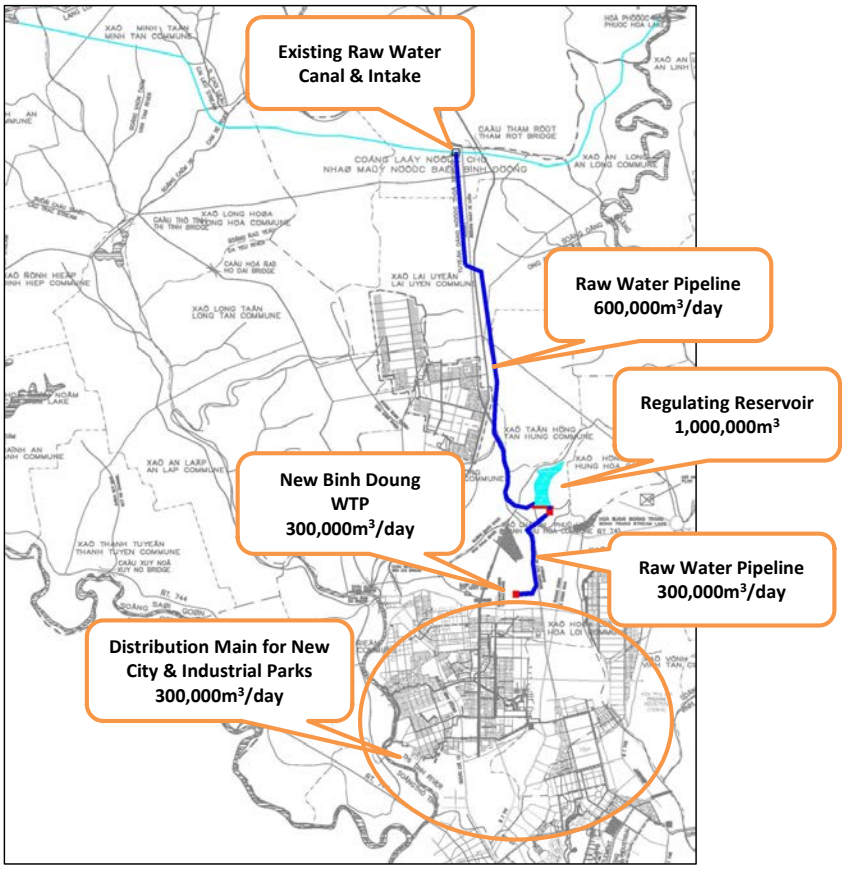
This is newly formulating system to take raw water from main canal of Phuoc Hoa lake to regulating reservoir at My Phuoc area and to construct pumping station to transmit raw water from regulating reservoir to new Water Treatment Plant (North Binh Duong WTP) to supply water for households, industrial parks and existing urban areas of North of Binh Duong Province, creating conditions for enhancing economic and social development of the Province.

According to the Options Study, North Binh Duong WTP is planned to have capacity of 1,200,000 m^3/day in final stage and phasing construction is planned. Assuming the first stage capacity of North Binh Duong WTP as 300,000 m^3/day, required facilities are extracted and summarized in **Table 4.2.1** and **Figure 4.2.1** from the Options Study.

Table 4.2.1 Summary of Facilities Proposed in Options Study for Water Supply Development of Northern Binh Duong Province

Facility	Required Capacity of the Facilities	
	Final Stage with 1,200,000 m^3/d WTP	Stage with 300,000 m^3/d WTP
Raw Water Pipeline	1,200,000 m^3/d (DN 2,600 mm and DN 2,400 mm : 2 lines)	600,000 m^3/d (DN 2,600 mm and DN 2,400 mm : 1 line)
Regulating Reservoir	About 3,100,000 m^3	About 1,000,000 m^3
Intake Pump	1,200,000 m^3/d	300,000 m^3/d
WTP	1,200,000 m^3/d	300,000 m^3/d
Distribution Main	Distribution for 1,200,000 m^3/d	Distribution for 300,000 m^3/d

Source : Options Study for Rehabilitation and Expansion Water Services in Urban Areas HCMC and Binh Duong Province Final Report Binh Duong Province (14 April 2011)



Source : Options Study for Rehabilitation and Expansion Water Services in Urban Areas HCMC and Binh Duong Province, Final Report Binh Duong Province (14 April 2011)

Figure 4.2.1 Summary of Facilities Proposed in Options Study for Water Supply Development of Northern Binh Duong Province

Binh Duong Province People's Committee has approved the policy allowing BIWASE to be investor of the project of Raw Water Pipeline from the main canal of Phuoc Hoa lake to the area in My Phuoc, Ben Cat and the districts and towns in the north of Binh Duong Province, and directed BIWASE to prepare report to looking for the investment capital in 20th February, 2008 by No. 399/UBND-SX. Development of Raw Water Pipeline from Phuoc Hoa reservoir to Binh Duong urban area was further approved in principle by the Prime Minister by No. 1797/TTg-KTN dated 28th September, 2009.

CHAPTER 5 TECHNICAL REVIEW OF THE WATER SUPPLY PLAN

5.1 Target Area

New North Binh Duong Water Treatment Plant (NBDWTP) will supply water to the area of southern part of the NBDWTP and the following areas are studied. The areas are indicated in **Figure 5.1.1**.

- Existing Supply areas of Thu Dau Mot, Ben Cat, Tan Uyen, Thuan An and Di An
- New Housing areas and Industrial Parks in following areas
  An Tay, My Phuoc, Expanded VSIP, and New City

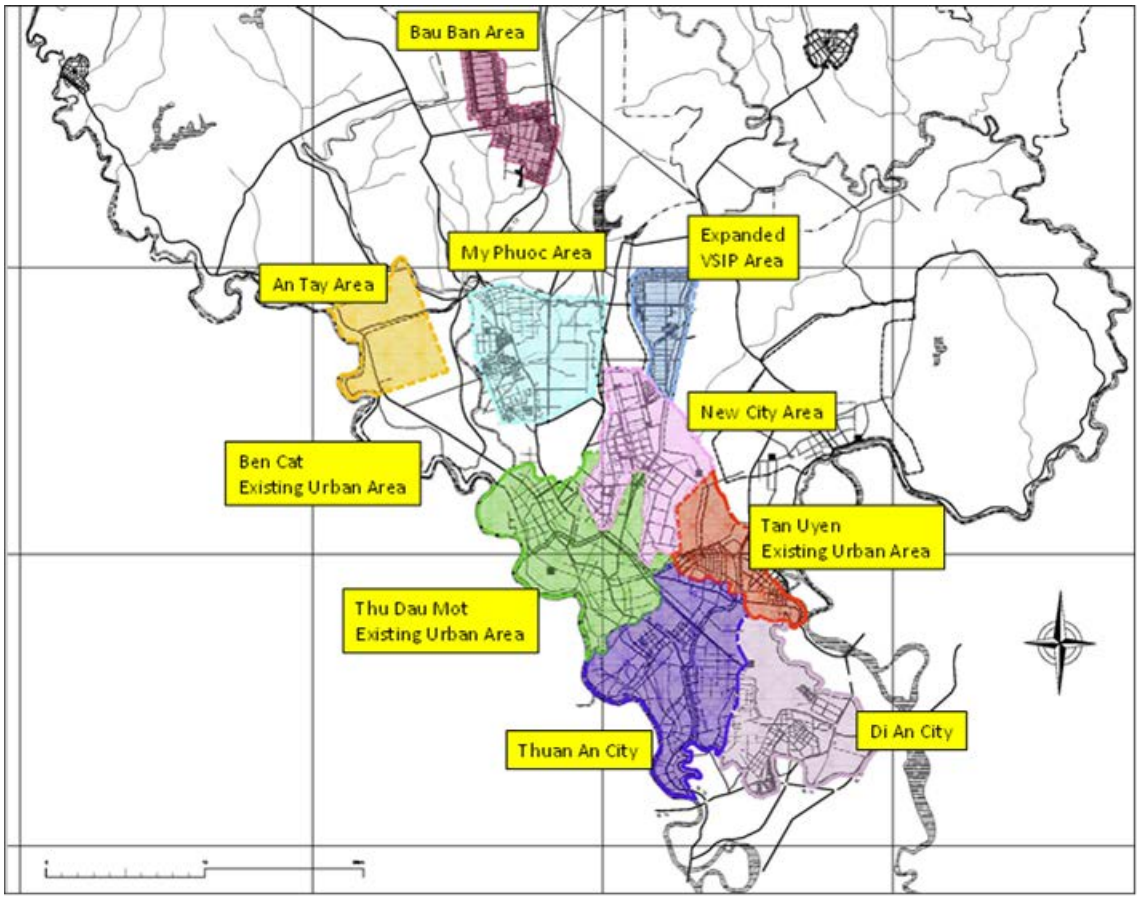


Figure 5.1.1 Study Area for Water Supply Plan

5.2 Target Horizon

Target horizon of the years 2020, 2030 and 2040 are considered by combination of four WTPs of Di An, Thu Dau Mot, Tan Hiep, and NBDWTP.

5.3 Water Demand Projection

According to the "Options Study for rehabilitation and Expansion of Water Services in Urban Areas HCMC and Binh Duong Province, World Bank, 2011" ("Options Study"), water demand in piped area in 2009 was 441,760 m^3/d and water production was 130,000 m^3/d. The connection ratio was varied between 25% and 35% in the piped area.

Since then, BIWASE had extended household connection at least 10,000 to 15,000 per year. Increases of house connection and water production since 2009 are shown in **Table 5.3.1** and **5.3.2**.

Table 5.3.1 Number of House Connections (No.)

No.	Water Supply Plant	2009	2010	2011	2012
1	Thu Dau Mot WTP	17,945	21,695	26,000	30,464
2	Di An WTP	17,356	22,438	27,990	32,995
3	Complex WTP (Tan Hiep)	4,704	6,352	7,753	9,374
4	Tan Uyen WTP	1,019	1,271	1,594	1,932
5	Phuoc Vinh WTP	949	1,051	1,196	1,442
6	Dau Tieng WTP	1,929	2,170	2,500	2,860
Total		**43,902**	**54,977**	**67,033**	**79,067**
Number of Increase		-	**11,075**	**12,056**	**12,034**

Source: BIWASE

Table 5.3.2 Water Production (m^3/d)

No.	Year	2009		2011		2012	
	WTP	Daily Max.	Daily Average	Daily Max.	Daily Average	Daily Max.	Daily Average
1	Thu Dau Mot	17,500	16,791	16,470	14,478	21,906	18,868
2	Di An	72,000	63,800	93,500	89,000	117,000	105,000
3	Tan Hiep	10,000	8,500	14,300	12,292	18,124	14,155
4	My Phuoc I, II, III	28,422	28,241	28,900	28,800	35,230	31,600
5	Bau Bang	311	271	500	399	671	581
6	Uyen Hung	1,100	900	1,500	1,150	2,100	1,550
7	South Tan Uyen	2,200	1,800	3,500	3,200	3,900	3,500
8	Phuoc Vinh	1,200	700	1,500	750	1,900	1,000
9	Dau Tieng	2,000	1,300	2,400	1,450	2,600	1,800
		134,733	**122,303**	**162,570**	**151,519**	**203,431**	**178,054**

Source: BIWASE

According to the above Tables, average increase in house connection number was 11,722/year and average annual increase of water production was 22,900 m^3/d for the last 3 years from 2009 to 2012.

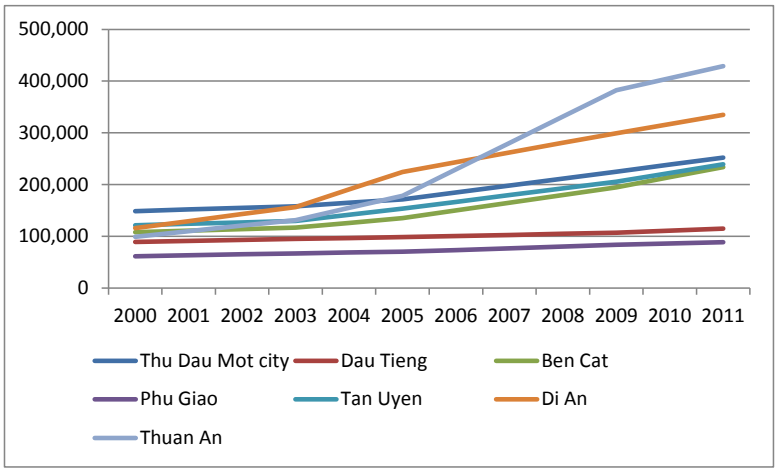
Under the above situation, water use amount (piped born water use) is estimated based on the water demand (demand in piped area) taking the following factors into account.

- Future Population in piped area
- Construction and occupation schedule of new city and industrial parks
- Extension of distribution pipe and connection ratio

5.3.1 Population Projection

Figure 5.3.1 shows population record by City/District/Town in Binh Duong Province since the year 2000. Highly developed Thuan An and Di An show eminent increase since 2003. Gradual increases were experienced in Thu Dau Mot, Ben Cat, and Tan Uyen, and population growth of Dau Tieng and Phu Giao was relatively slow.

Table 5.3.3 shows annual population growth by City/District/Town. Thuan An shows the highest of 14.27% of average annual growth during the last 11 years followed by Di An with 10.13%.



Source: The statistic year books

Figure 5.3.1 Population Records of City/District/Town

Table 5.3.3 Average Annual Population Growth

No.	City/District/Town	Annual Population Growth				
		2000～2003	2003～2005	2005～2009	2009～2011	**2000～2011**
1	Thu Dau Mot	2.06%	4.12%	7.04%	5.84%	4.91%
2	Dau Tieng	2.17%	1.71%	2.14%	3.54%	2.32%
3	Ben Cat	2.61%	7.63%	9.56%	9.61%	7.28%
4	Phu Giao	2.94%	2.30%	4.47%	3.00%	3.39%
5	Tan Uyen	2.28%	8.82%	7.57%	7.84%	6.37%
6	Di An	10.54%	19.82%	7.45%	5.74%	10.13%
7	Thuan An	9.91%	16.45%	21.06%	5.90%	14.27%
Total		4.75%	9.87%	9.78%	6.29%	7.77%

Source: JICA Study Team

According to “Options Study”, population in the Province is projected with 15% growth from 2009 to 2020 in highly developing area of Ben Cat and the lowest of 2% for Dau Tieng as show in **Table 5.3.4**. The annual population growth rates are predicted based on the past trends and experiences in the development areas. Average growth rate of the Province is assumed as 8.2% from 2009 to 2020 and 3.8% from 2020 to 2030.

Table 5.3.4 Population Projection by Options Study

City/District/town	2009 Record (Person)	Growth Ratio for 2009-2020 (%/Year)	Population Projection in 2020 (person)	Growth Ratio for 2020-2030 (%/Year)	Population Projection in 2030 (person)
Thu Dau Mot	224,904	6.0	426,935	3.0	573,765
Dau Tieng	106,920	2.0	132,942	1.0	146,851
Ben Cat	194,609	15.0	905,397	8.0	1,954,684
Phu Giao	83,413	4.0	128,410	1.0	141,845
Tan Uyen	205,527	6.0	390,152	3.0	524,332
Di An	299,248	6.0	568,062	1.0	627,494
Thuan An	382,496	6.0	726,092	1.0	802,057
Total	1,497,117	8.2	3,277,990	3.8	4,771,028

Source: Option Study

The assumption employed in the “Options Study” is quite reasonable and not much data accumulated since the finalization of the study in 2011, and then the projection is also applied in this study.

5.3.2 Water Demand/Use Projection

Domestic unit water consumption rates identified in the design standard for water supply systems (TCXDVN 33-2006) issued by MOC are used for water demand/use projection as follows.

Domestic water	:	150	ℓ/capita/day
Public Service Water	:	10	% of Domestic water
Commercial and Urban Service Water	:	15	% of Domestic water
Industrial Water	:	45	m^3/ha/day

Water use is finally estimated by area as follows.

Water use in residential area = (population) x (150 ℓ/capita/day) x (1+0.1+0.15) x (utilization factor)

Water use in industrial area = (area ha) x (45 m^3/ha/day) x (utilization factor)

where, utilization factors are:

In new residential and industrial parks	:	(Occupied ratio) x (Connection ratio)
Existing urban area	:	(Connection ratio) x (Piped population ratio)

(1) New Residential Area

New residential areas in the study area and their implementation status are summarized in **Table 5.3.5** and utilization factor by year are assumed based on the present situation of each development in **Table 5.3.6**.

Table 5.3.5 New Residential Areas in the Study Area

No.	Name of residential area *(Residential Area refferred to as Res. area)*	Location	Planning area (Ha)	Total households	Implementation progress
A	**Bau Bang area**				
26	Res. area 5F Hamlet 5 (LU)	Lai Uyen	386.3	6,730	Constructing infrastructure
27	Res. area 5C Hamlet 5 (LU)	Lai Uyen	94.7	1,000	Constructing infrastructure
28	Res. area 5D Hamlet 5 (LU)	Lai Uyen	162.2	2,966	Constructing infrastructure
29	Res. area 5B Hamlet 5 (LU)	Lai Uyen	164.8	2,676	Constructing infrastructure
30	Res. area 5E Hamlet 5 (LU)	Lai Uyen	72.0	1,300	Constructing infrastructure
31	Res. area 5A Hamlet 5 (LU)	Lai Uyen	179.7	3,206	Constructing infrastructure
32	Lai Hung Res. area	Lai Hung	105.7	1,866	Compensating
33	Royal Town area	Lai Hung	161.2	2,716	Compensating
34	Lai Hung Resettlement area	Lai Hung	31.0	513	Compensating
	Total A		**1,357.6**	**22,973.0**	
B	**An Tay area**				
36	Rach Bap Res. area		50.0	2,500	Constructing infrastructure
	Bac Ben Cat Urban area				
	Total B		**50.0**	**2,500.0**	
C	**My Phuoc area**				
37	Cau Do Res. area	My Phuoc	52.0	900	Leveling
38	My Phuoc 3 Res. area (Biconsi)	My Phuoc	31.0	862	Constructing infrastructure
39	Res. area My Phuoc 4 (Thieân Phuù)	My Phuoc	54.2	1,035	Leveling
40	Môû roäng KTÑC My Phuoc	My Phuoc	190.1	3,040	Constructing infrastructure
41	Res. area Hamlet 3(TH)	Thoi Hoa	144.0	3,053	Constructing infrastructure
42	Thoi Hoa Resettlement housing area	Thoi Hoa	90.4	1,566	Constructing infrastructure
43	Res. area Hamlet 5C	Thoi Hoa	208.3	3,610	Constructing infrastructure
44	Res. area Hamlet 5A	Thoi Hoa	138.8	3,206	Constructing infrastructure
45	Res. area Hamlet 5B	Thoi Hoa	136.5	1,773	Constructing infrastructure
46	Res. area Hamlet 2 (TH)	Thoi Hoa	166.0	2,636	Constructing infrastructure
47	Res. area Hamlet 3A (TH)	Thoi Hoa	181.3	3,053	Constructing infrastructure
48	Res. area Hamlet 3B (TH)	Thoi Hoa	158.5	2,526	Constructing infrastructure
49	Res. area Hamlet 1 (TH)	Thoi Hoa	164.8	3,206	Constructing infrastructure
50	My Phuoc 3 Res. area (TH)	Thoi Hoa	220.6	3,560	Constructing infrastructure
51	Res. area Hamlet 6 (TH)	Thoi Hoa	148.9	2,553	Constructing infrastructure
52	Res. area Hamlet 5 (CPH)	Chanh Phu Hoa	121.2	2,613	Constructing infrastructure
53	Res. area Hamlet 7 (CPH)	Chanh Phu Hoa	86.6	1,490	Constructing infrastructure
	Total C		**2,293.2**	**40,682.0**	
D	**Expanded VSIP II area**				
54	Res. area Hamlet 4 (TB)	Tan Binh	171.5	2,970	Constructing infrastructure
55	Suoi Tre Res. area	VT+TB	114.6	2,233	Constructing infrastructure
56	Res. area Hamlet 1 (Vinh Tan)	Vinh Tan	99.7	1,726	Constructing infrastructure
57	Res. area Hamlet 4 (Vinh Tan)	Vinh Tan	129.0	2,233	Constructing infrastructure
58	Res. area Hamlet 5 (VT)	Vinh Tan	128.0	2,166	Constructing infrastructure
59	Hoa Loi Res. area	Hoa Loi	72.6	1,317	Constructing infrastructure
35	Cong Xanh University area	Tan Binh	632.7		
	Total D		**1,348.1**	**12,645.0**	
E	**New City area**				
60	Hoa Loi Res. area	Hoa Loi	163.9	2,606	Constructing infrastructure
61	Hoa Loi Resettlement area	Hoa Loi	146.9	960	Constructing infrastructure
62	Dinh Hoa Resettlement area	Dinh Hoa	78.4	565	Constructing infrastructure
63	Phu My Resettlement area	Phuù Myõ	71.7	906	Constructing infrastructure
64	Tan Vinh Hiep Resettlement area	Tan Vinh Hiep	106.4	1,287	Constructing infrastructure
65	Phu Chanh Resettlement area	Phu Chanh	248.8	1,486	Constructing infrastructure
66	New City area	New City	709.6	38,014	Constructing infrastructure
	Total E		**1,525.7**	**45,824.0**	
	Grand total A + B + C + D + E		**6,574.6**	**124,624**	

Source: BIWASE

Table 5.3.6 Utilization Factors of Residential Areas by Year

No.	City District/town	Population as planned	Utilization Factor (%) by Year						
			2012	2015	2020	2025	2030	2035	2040
A	**Bau Bang area**								
26	Res. area 5F Hamlet 5 (LU)	26,920		1	5	15	25	35	45
27	Res. area 5C Hamlet 5 (LU)	4,000		1	5	15	25	35	45
28	Res. area 5D Hamlet 5 (LU)	11,864		1	5	15	25	35	45
29	Res. area 5B Hamlet 5 (LU)	10,704	1	5	15	25	35	35	45
30	Res. area 5E Hamlet 5 (LU)	5,200		1	5	15	25	35	45
31	Res. area 5A Hamlet 5 (LU)	12,824	1	5	15	25	35	45	55
32	Lai Hung Res. area	7,464	1	5	15	25	35	45	55
33	Royal Town area	10,864		1	5	15	25	35	45
34	Lai Hung Resettlement area	2,052		1	5	15	25	35	45
	Total A	**91,892.0**							
B	**An Tay area**								
36	Rach Bap Res. area	10,000		1	5	15	25	35	45
	Bac Ben Cat Urban area								
	Total B	**10,000.0**							
C	**My Phuoc area**								
37	Cau Do Res. area	3,600		1	5	15	25	35	45
38	My Phuoc 3 Res. area (Biconsi)	3,448		1	5	15	25	35	45
39	My Phuoc 4 Res. area (Thien Phu)	4,140		1	5	15	25	35	45
40	My Phuoc expanded Resettlement area	12,160	50	60	70	80	90	100	100
41	Res. area Hamlet 3(TH)	12,212	4	10	20	30	40	50	60
42	Thoi Hoa Resettlement housing area	6,264	4	10	20	30	40	50	60
43	Res. area Hamlet 5C	14,440		1	5	15	25	35	45
44	Res. area Hamlet 5A	12,824		1	5	15	25	35	45
45	Res. area Hamlet 5B	7,092		1	5	15	25	35	45
46	Res. area Hamlet 2 (TH)	10,544	4	10	20	30	40	50	60
47	Res. area Hamlet 3A (TH)	12,212	4	10	20	30	40	50	60
48	Res. area Hamlet 3B (TH)	10,104	4	10	20	30	40	50	60
49	Res. area Hamlet 1 (TH)	12,824	4	10	20	30	40	50	60
50	My Phuoc 3 Res. area (TH)	14,240	4	10	20	30	40	50	60
51	Res. area Hamlet 6 (TH)	10,212	4	10	20	30	40	50	60
52	Res. area Hamlet 5 (CPH)	10,452	4	10	20	30	40	50	60
53	Res. area Hamlet 7 (CPH)	5,960	4	10	20	30	40	50	60
	Total C	**162,728.0**							
D	**Expanded VSIP II area**								
54	Res. area Hamlet 4 (TB)	11,880		1	5	15	25	35	45
55	Suoi Tre Res. area	8,932		1	5	15	25	35	45
56	Res. area Hamlet 1 (Vinh Tan)	6,904		1	5	15	25	35	45
57	Res. area Hamlet 4 (Vinh Tan)	8,932	1	5	15	25	35	35	45
58	Res. area Hamlet 5 (VT)	8,664	1	5	15	25	35	35	45
59	Hoa Loi Res. area	5,268	1	5	15	25	35	45	55
35	Cong Xanh University area								
	Total D	**50,580.0**							
E	**New City area**								
60	Hoa Loi Res. area	10,424	5	10	20	30	40	50	60
61	Hoa Loi Resettlement area	3,840	5	10	20	30	40	50	60
62	Dinh Hoa Resettlement area	2,260	5	10	20	30	40	50	60
63	Phu My Resettlement area	3,624	5	10	20	30	40	50	60
64	Tan Vinh Hiep Resettlement area	5,148	5	10	20	30	40	50	60
65	Phu Chanh Resettlement area	5,944	5	10	20	30	40	50	60
66	New Urban area	152,056	2	5	15	25	35	45	55
	Total E	**183,296.0**							
	Grand total A+B+C+D+E = Z	**498,496**							

Source: JICA Survey Team

Water use of new residential areas are calculated in **Appendix 5 - A**.

(2) Industrial Parks

Industrial parks in the study area and their implementation status are summarized in **Table 5.3.7** and utilization factor by year are estimated based on the present situation of each development in **Table 5.3.8**.

Water uses of industrial parks are calculated in **Appendix 5 - A** using utilization factors indicated in **Table 5.3.8**.

Table 5.3.7 Industrial Parks in the Study Area

N0	Name of Industrial Park (IP)	Planning area (Ha)	Available area for rent (Ha)	Leased area (Ha)	Coverage ratio (%)	Implementation progress
A	**Bau Bang area**					
1	Cay Truong IP	500				Planning to 2015
2	Long Hoa IP	1,380				Planning to 2015-2020
3	Bau Bang IP (MR)	1,500	1,005.0		0.0	Investing infrastructure
4	Bau Bang IP	1,000	699.2	125.0	17.9	Investing infrastructure
5	Lai Hung IP	1,000				Planning to 2015
6	Lai Hung Industrial group	78	53.0		0.0	Investing infrastructure
	Total A	**5,458**	**1,757**	**125**	**7%**	
B	**An Tay area**					
7	An Tay IP	500	373.9	2.2	0.6	Investing infrastructure
8	An Tay IP (MR)	850				Investing infrastructure
9	Rach Bap IP	279	188.2	9.7	5.2	Investing infrastructure
10	Mai Trung IP	51	34.6	22.5	65.0	In operation
11	Viet Huong II IP	250	168.6	104.8	62.2	In operation
	Total B	**1,930**	**765**	**139**	**18%**	
C	**My Phuoc area**					
12	My Phuoc I IP	377	276.3	241.0	87.2	In operation
13	My Phuoc II IP	477	333.0	328.6	98.7	In operation
14	My Phuoc III IP	978	655.7	328.8	50.2	In operation
15	Thoi Hoa IP	202	134.6		0.0	Investing infrastructure
	Total C	**2,034**	**1,400**	**898**	**64%**	
D	**Tan Uyen area**					
16	Expanded VSIP II Industry-Service-Urban Complex	1,008	218.6	114.3	52.3	Investing infrastructure
17	Tan Binh IP	350				Preparing for investment
18	Binh Lap IP	500				Planning to 2015
	Total D	**1,858**	**219**	**114**	**52%**	
E	**New City area**					
19	Dong An II + Expansion IP	205	148.1	59.5	40.1	In operation
20	Phu Gia IP (Viet E.M.A.X)	133	85.6	30.6	35.7	In operation
21	VSIP II IP	345	231.2	226.5	98.0	In operation
22	Kim Huy IP	214	144.7	76.7	53.1	In operation
23	Song Than III IP	534	327.4	147.9	45.2	In operation
24	Dai Dang IP	274	166.0	74.2	44.7	In operation
25	Mapletree Hi-Tech Park	75	52.4		0.0	Investing infrastructure
	Total E	**1,780**	**1,155**	**615**	**53%**	
	Grand total A + B + C + D + E	**13,060**	**5,296**	**1,892**	**36%**	

Source: BIWASE

Table 5.3.8 Utilization Factors of Industrial Parks by Year

No.	Name of Industrial Park	Planning Area in 2030 (ha)	Available Area for Rent in 2030 (ha)	Utilization factor (%)						
				2012	*2015*	*2020*	*2025*	*2030*	*2035*	*2040*
A	**Bau Bang area**									
1	Cay Truong IP	500	345.0				5	15	25	35
2	Long Hoa IP	1,380	952.2				10	20	30	40
3	Bau Bang IP (MR)	1,500	1,035.0			5	15	25	35	50
4	Bau Bang IP	1,000	699.2	1.75	20	30	45	60	70	85
5	Lai Hung IP	1,000	690.0			5	15	25	35	50
6	Lai Hung Industrial group	78	53.0			5	15	25	35	50
	Total A	**5,458**	**3,774**							
B	**An Tay area**									
7	An Tay IP	500	373.9	1	10	20	35	50	60	75
8	An Tay IP (MR)	850	578.0			5	15	30	40	55
9	Rach Bap IP	279	188.2		5	15	25	40	50	65
10	Mai Trung IP	51	34.6		20	30	40	45	55	70
11	Viet Huong II IP	250	168.6		30	40	50	65	75	90
	Total B	**1,930**	**1,343**							
C	**My Phuoc area**									
12	My Phuoc I IP	377	276.3	75	85	95	100	100	100	100
13	My Phuoc II IP	477	333.0	60	70	80	90	100	100	100
14	My Phuoc III IP	978	655.7	30	40	50	65	75	90	100
15	Thoi Hoa IP	202	134.6		5	15	30	45	60	75
	Total C	**2,034**	**1,400**							
D	**Tan Uyen area**									
16	VSIP II expanded area	1,008	675.4	10	20	40	55	70	85	95
17	Tan Binh IP	350	241.5			5	15	30	45	60
18	Binh Lap IP	500	345.0			5	15	25	35	50
	Total D	**1,858**	**1,262**			5	15	25	40	55
E	**New City area**									
19	Dong An II + Expansion IP	205	148.1	15	25	40	55	70	85	100
20	Phu Gia IP (Viet E.M.A.X)	133	85.6	15	25	40	55	70	85	100
21	VSIP II IP	345	231.2	35	45	55	70	85	95	100
22	Kim Huy IP	214	144.7	15	25	40	55	70	85	100
23	Song Than III IP	534	327.4	15	25	40	55	70	85	100
24	Dai Dang IP	274	166.0	15	25	40	55	70	85	100
25	Mapletree Hi-Tech Park	75	52.4	5	15	30	45	60	75	100
	Total E	**1,780**	**1,155**							
	Grand total A + B + C + D + E	**13,060**	**8,935**							

Source: JICA Survey Team

3) Existing Urban Area

Water use of the existing urban area is estimated using the utilization factors indicated in **Table 5.3.9**. The population of the existing urban area by year is calculated by the following equation.

Population of existing urban area
= (Predicted population of city/district/town) - (Population of new residential area of city/district/town)

Water uses of existing urban area are calculated in **Appendix 5 - A**. Utilization factors in 2012 are estimated based on the present total production WTPs of Thu Dau Mot, Di An, Tan Hiep, and My Phuoc I, II, III of 192,931 m^3/d in 2012.

Table 5.3.9 Utilization Factors for Existing Urban Area (%)

Item	Estimation	Projection					
Year	2012	2015	2020	2025	2030	2035	2040
Thu Dau Mot	44	50	60	70	80	90	100
Ben cat	5	10	20	30	40	50	60
TanUyen	1	5	10	15	20	25	30
Thuan An	44	50	60	65	70	75	80
Di An	44	50	60	65	70	75	80

4) Water Use in Study Area

Water uses estimated results for new residential areas and existing urban area are summarized in **Table 5.3.10**, and Industrial Parks are in **Table 5.3.11**. Total water use by area is shown in **Table 5.3.12**.

Table 5.3.10 Water Use Prediction for New Residential and Existing Urban Areas (m^3/d)

Year	2012	2015	2020	2025	2030	2035	2040
BenCat1							
Bau Bang Area	**64**	**445**	**1,587**	**3,482**	**5,377**	**7,052**	**8,947**
BenCat2							
An Tay Area	-	21	103	309	516	722	928
My PhuocArea	2,120	3,765	6,558	9,914	13,270	16,626	19,732
Existing Urban Area	2,934	8,822	35,529	77,814	152,899	220,386	305,734
Total	5,054	12,607	42,190	88,037	166,684	237,735	326,394
Thu Dau Mot							
New City Area	949	2,212	5,993	9,773	13,554	17,334	21,115
Existing Urban Area	24,143	32,430	51,140	68,163	89,402	115,848	148,688
Total	25,092	34,642	57,133	77,937	102,956	133,182	169,803
Tan Uyen							
Expanded VSIP II	47	293	993	2,036	3,080	3,760	4,803
Existing Urban Area	500	2,948	7,715	13,121	19,968	28,734	39,723
Total	548	3,241	8,708	15,157	23,047	32,493	44,526
Thuan An	41,342	55,953	89,854	102,307	115,797	130,397	146,185
Di An	32,344	43,775	70,298	80,041	90,594	102,017	114,369
Ground Total (Except Bau Bang Area)	**104,381**	**150,219**	**268,182**	**363,479**	**499,079**	**635,824**	**801,276**
Ground Total	**104,445**	**150,664**	**269,769**	**366,961**	**504,457**	**642,876**	**810,224**

Table 5.3.11 Water Use Prediction for Industrial Parks (m^3/d)

Year	2012	2015	2020	2025	2030	2035	2040
BenCat1							
Bau Bang Area	606	6,922	13,076	34,344	54,757	73,441	98,255
BenCat2							
An Tay Area	185	5,163	10,382	17,956	27,759	34,408	44,382
My PhuocArea	29,885	36,480	43,408	51,608	57,501	63,369	67,615
Existing Urban Area	0	0	0	0	0	0	0
Total	30,070	41,643	53,789	69,564	85,261	97,778	111,997
Thu Dau Mot							
New City Area	10,608	16,328	24,334	32,913	41,492	49,499	57,192
Existing Urban Area	0	0	0	0	0	0	0
Total	10,608	16,328	24,334	32,913	41,492	49,499	57,192
Tan Uyen							
Expanded VSIP II	3,343	6,686	14,825	22,743	31,258	39,774	47,472
Existing Urban Area	0	0	0	0	0	0	0
Total	3,343	6,686	14,825	22,743	31,258	39,774	47,472
Thuan An	16,856	18,794	18,794	18,794	18,794	18,794	18,794
Di An	29,597	32,642	32,642	32,642	32,642	32,642	32,642
Ground Total (Except Bau Bang Area)	90,475	116,093	144,384	176,656	209,447	238,486	268,097
Ground Total	91,081	123,015	157,460	210,999	264,204	311,927	366,352

Table 5.3.12 Total Water Use Prediction by Area (m^3/d)

Year	2012	2015	2020	2025	2030	2035	2040
BenCat1							
Bau Bang Area	670	7,367	14,663	37,826	60,135	80,493	107,202
BenCat2							
An Tay Area	185	5,183	10,485	18,266	28,275	35,130	45,311
My PhuocArea	32,005	40,245	49,965	61,522	70,771	79,996	87,346
Existing Urban Area	2,934	8,822	35,529	77,814	152,899	220,386	305,734
Total	35,124	54,250	95,979	157,601	251,945	335,512	438,390
Thu Dau Mot							
New City Area	11,558	18,540	30,327	42,686	55,046	66,833	78,307
Existing Urban Area	24,143	32,430	51,140	68,163	89,402	115,848	148,688
Total	35,701	50,970	81,467	110,850	144,448	182,681	226,995
Tan Uyen							
Expanded VSIP II	3,390	6,979	15,818	24,779	34,338	43,534	52,275
Existing Urban Area	500	2,948	7,715	13,121	19,968	28,734	39,723
Total	3,891	9,927	23,533	37,900	54,306	72,267	91,998
Thuan An	58,198	74,747	108,648	121,101	134,591	149,191	164,979
Di An	61,941	76,417	102,940	112,683	123,236	134,659	147,011
Ground Total (Except Bau Bang Area)	**194,856**	**266,312**	**412,566**	**540,135**	**708,526**	**874,310**	**1,069,374**
Ground Total	**195,525**	**273,679**	**427,229**	**577,960**	**768,661**	**954,803**	**1,176,576**

As mentioned, increase of water use mainly depends on BIWASE's efforts for promotion of house connection as well as progress of development and occupation of new residential areas and industrial parks, which mainly depends on economic situation in the future.

Water uses in 2020 and 2030 were also estimated in "Option Study" according to the prediction of progress of development and occupation of new residential areas and industrial parks based on the forecasted economic situation made in 2010. **Table 5.3.13** provides comparison between water uses in the study area estimated by "Option Study" and this JICA survey.

Table 5.3.13 Water Use Projection in the Study Area (m3/d)

Study	2020	2025	2030
JICA Survey	412,566	540,135	708,526
Option Study	557,648	-	1,032,267

5.4 WTP Development Plan

The total production capacity of existing Water Treatment Plants (WTPs) in the study area is 218,100 m^3/d at present and expected to be 248,100 m^3/d in 2015 as shown in **Table 5.4.1**.

Table 5.4.1 Expected Production Capacity (m^3/d)

WTP	2012	2015
Thu Dau Mot	21,600	21,600
Di An	90,000	90,000
Tan Hiep	60,000	90,000
My Phuoc I, II, III	28,500	28,500
Uyen Hung	5,000	5,000
South Tan Uyen	3,000	3,000
Total	**218,100**	**248,100**

Compared with the production capacity in 2015, required production capacity by 2020 is 412,566 m^3/d for the prediction of JICA Survey and 557,648 m^3/d for "Option Study" as sown in **Table 5.3.13**. **Figure 5.4.1** shows water demand by the JICA survey and "Option Study".

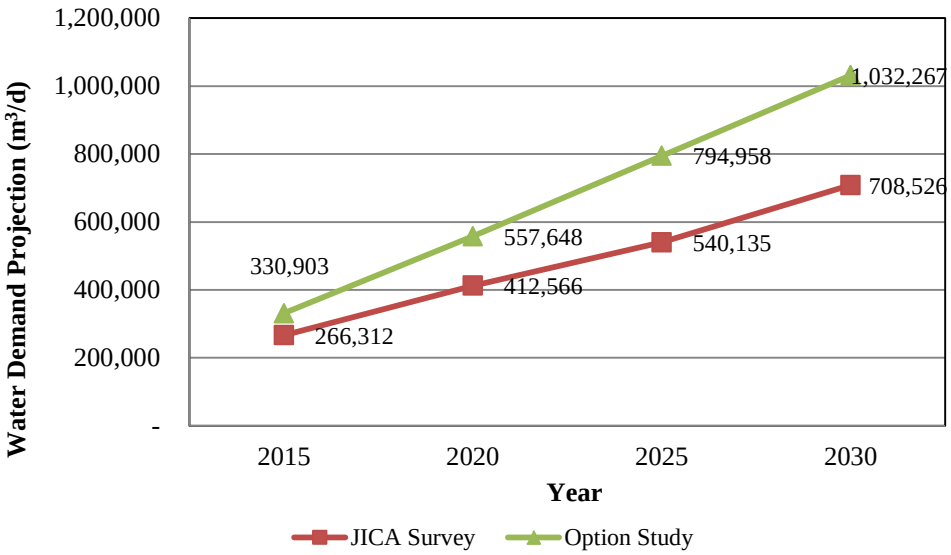


Figure 5.4.1 Water Use Projection

According to "Option Study", priority was given to expansion of Tan Hiep WTP to 120,000m^3/d and Di An WTP to 150,000m^3/d. On the other hand, both sites of the WTPs have enough areas for expansion of the capacity up to 200,000m^3/d, and it is recommended to expand the both WTPs to 200,000m^3/d by 2020, as the WTPs can gain raw water with the cheapest cost. After the expansion of Tan Hiep WTP and Di An WTP up to 200,000m^3/d, NBDWTP is recommended to be constructed to cover the gap between total production capacity and water demand. **Table 5.4.2** and **Figure 5.4.2** show the recommended pattern of future plan of WTP arrangement.

Table 5.4.2 Water Demand and Production Plan（m^3/d）

WTP		2012	2015	2020	2025	2030
Thu Dau Mot		21,600	21,600	21,600	21,600	21,600
Di An		90,000	90,000	200,000	200,000	200,000
Tan Hiep		60,000	90,000	200,000	200,000	200,000
My Phuoc I, II, III		28,500	28,500	28,500	28,500	28,500
Uyen Hung		5,000	5,000	5,000	5,000	5,000
South Tan Uyen		13,000	13,000	13,000	13,000	13,000
NBDWTP		-	-	-	150,000	300,000
Total Production		**218,100**	**248,100**	**468,100**	**618,100**	**768,100**
Water Use projection	JICA Survey	-	**266,312**	**412,566**	**540,135**	**708,526**
	Option Study	-	**330,903**	**557,648**	**794,958**	**1,032,267**

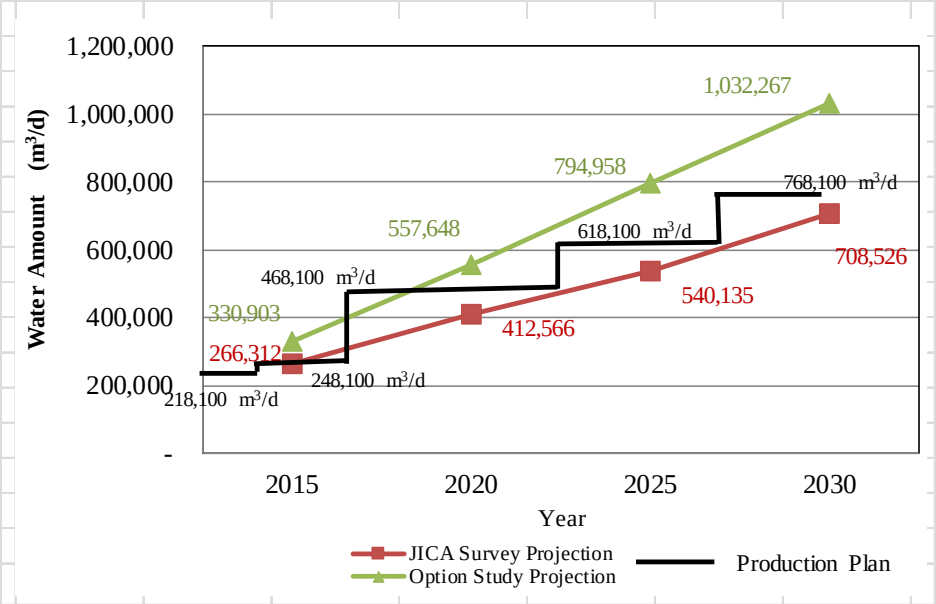


Figure 5.4.2 Water Demand and Production Plan

Since the future water demand depends on progress of urban development and occupation of the property caused by the economic situation, flexible solution is required and at the moment, NBDWTP would be reasonable to start construction as shown in **Table 5.4.3**. As NBDWTP was scheduled the first phase with 300,000 m^3/d, it is reasonable to divide into two Phases of 1A and 1B.

Table 5.4.3 Construction Schedule of NBDWTP Phase 1

Phase		Construction Commencement	Commissioning
The First Phase （300,000m^3/d）	Phase 1A （150,000 m^3/d）	January, 2020	June, 2022
	Phase 1B （150,000 m^3/d）	January, 2025	June, 2027

5.5 Facilities Plan

5.5.1 Raw Water Intake and Regulating Reservoir

(1) Raw Water Source and Intake

The raw water for NBDWTP will be taken from the existing intake of the Phuoc Hoa - Dau Tieng

Canal as shown in **Photo 5.5.1**. Dimensions of the existing intake gate are H3.40m x W4.00m. The intake is located in Tru Van Tho commune of Ben Cat district.

Photo 5.5.1 Existing Intake for New North Binh Duong WTP on Phuoc Hoa - Dau Tieng Canal

The Phuoc Hoa - Dau Tieng Canal of the Phuoc Hoa Water Resources Project is illustrated as shown in **Figure 5.5.1**.

The objectives of the Phuoc Hoa Water Resources Project are;

- Water supply for residential and industrial areas in Binh Duong, Binh Phuoc, Ho Chi Minh City and surrounding cities,
- Irrigation in project area,
- Prevention of saltwater intrusion, improvement of water quality and environment in downstream of Sai Gon river, and
- Effective management of water sources and maintain the stable flow in downstream of Be river.

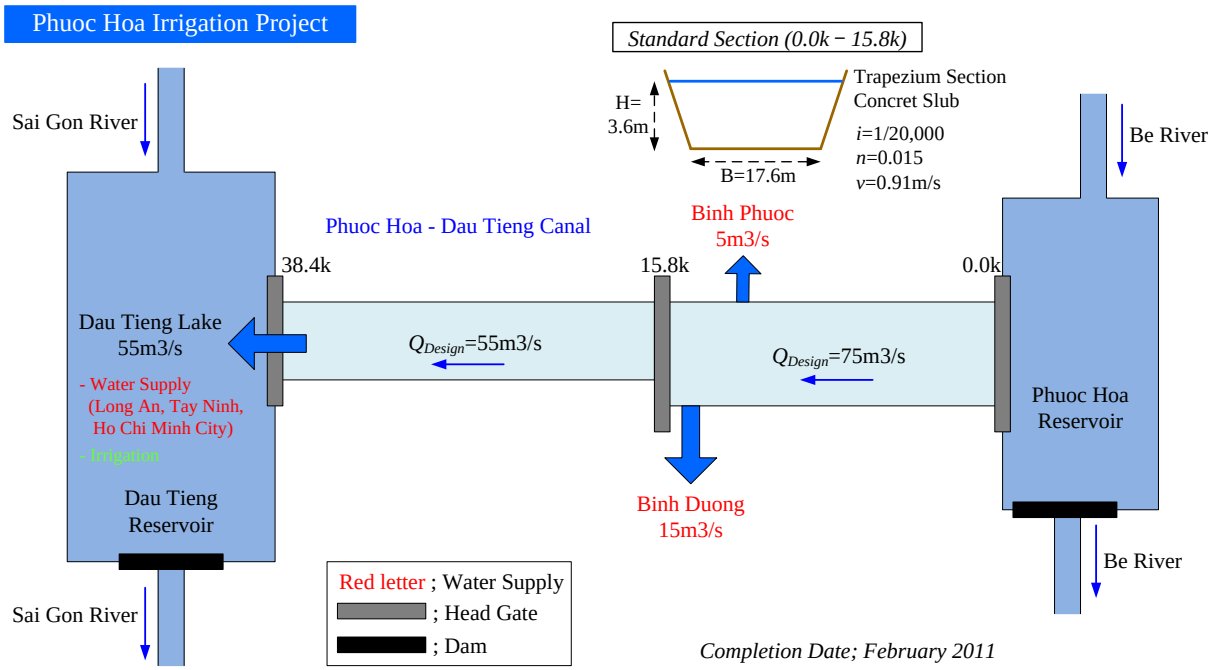


Figure 5.5.1 Description of Phuoc Hoa Water Resources Project

Dau Tieng - Phuoc Hoa Irrigation Mining Limited Liability Company is the administrator of Phuoc Hoa - Dau Tieng Canal for operation and maintenance. 15m^3/s of raw water can be taken continuously in and out of season from Phuoc Hoa - Dau Tieng Canal for water supply in Binh Duong Province under the 95% probability of hydrological condition in Phuoc Hoa Reservoir (Decision No. 2851

QD/BNN-XD: Approval of the Adjustment of Phuoc Hoa Irrigation Project, the Ministry of Agriculture and Rural Development, September 17th, 2008). The water supply for residential and industrial areas in Binh Duong, Binh Phuoc, Ho Chi Minh City and surrounding cities has priority over the irrigation water according to the administrator of the Canal. BIWASE has to pay the specified charge for raw water intake and will have an agreement with the administrator of the Canal including the maximum period and compensation payment for the dried water for maintenance.

(2) Regulating Reservoir

"Technical Process of Maintenance and Operation of the Work (temporary – second publish) No. 315D-12-B01B" prepared by Hydraulic Engineering Consultants Corporation No.II (HEC II) proposed that Phuoc Hoa – Dau Tieng canal needs to be periodically dried water once in 2 to 5 years for inspection and repair. The proposal of drying water for inspection was approved by Hydraulic Project Investment & Construction Management Board No. 9, Ministry of Agriculture and Rural Development by Decision No. 307 QD-BQL9 signed on May 23, 2012.

Based on the above approval, "Option Study" proposed regulating reservoir with 2 to 3 days capacity of WTP. The capacity of reservoir depends on the agreement between BIWASE and Dau Tieng - Phuoc Hoa Irrigation Mining Limited Liability Company in which maximum period of dried water for inspection and maintenance. At present the capacity of reservoir is determined as 1,000,000 m^3 for the first phase to cater for the drying water of 3 days with margin.

5.5.2 Raw Water Transmission System (Raw Water Transmission Pipeline and Regulating Reservoir)

According to "Option Study", two lines of raw water transmission with each capacity of 7.5 m^3/s and NBDWTP with capacity of 1,200,000 m^3/d were planned at the final stage. However, possible capacity of NBDWTP was found to be 1,000,000m^3/ d with detailed study on the shape and area of the planned site of NBDWTP. NBDWTP would be constructed with two phases of 1A and 1B from 2020 to 2027. Raw water transmission pipeline would be constructed with the capacity of 7.94m^3/sec in phase 1 as shown in **Table 5.5.1** in which raw water losses during transmission are included.

Table 5.5.1 Planned Raw Water Flow

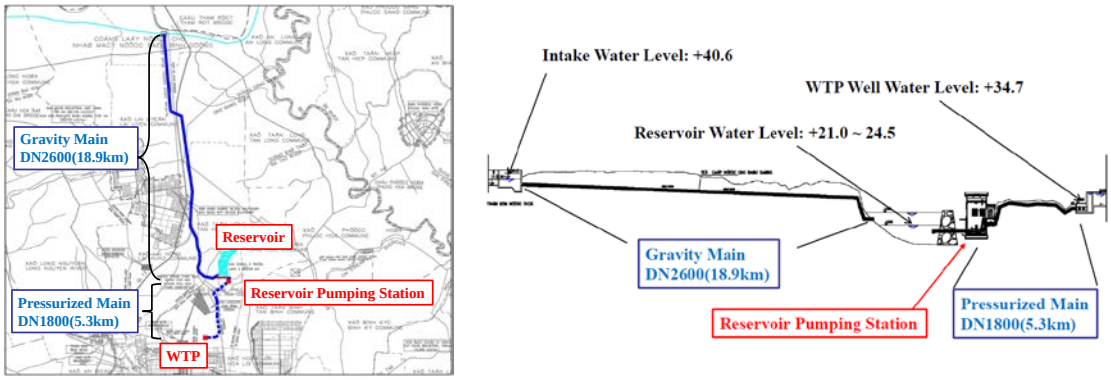
Facility	First pipe		Second Pipe	Total
	Flow rate at Phase I	Flow rate of pipeline	Flow rate of pipeline	Flow rate of pipeline
Raw Water Intake	343,200m^3/d 3.97m^3/s	686,400m^3/d =7.94m^3/s	457,600m^3/d =5.30m^3/s	1,144,000m^3/d =13.24m^3/s
Regulating Reservoir to WTP	343,200m^3/d 3.97m^3/s (312,000x10%loss*)	686,400m^3/d 7.94m^3/s (624,000x10%loss*)	457,600m^3/d 5.30m^3/s (416,000x10%loss*)	1,144,000 m^3/d 13.24m^3/s
WTP Capacity	312,000m^3/d 3.61m^3/s (300,000x4%loss**)	624,000m^3/d 7.22m^3/s (600,000x4%loss**)	416,000m^3/d 4.81m^3/s (400,000x4%loss**)	1,040,000 m^3/d 12.04m^3/s
Distribution Capacity	300,000m^3/d 3.47m^3/s	600,000m^3/d 6.94m^3/s	400,000m^3/d 4.63m^3/s	1,000,000 m^3/d 11.57m^3/s

* 10% loss is added for intake and transmission quantity
** QCVN 07:2010/BXD, Section 2.2 Urban water demands

Raw water transmission from intake to NBDWTP including regulating reservoir system is proposed by "Options Study" as shown in **Figure 5.5.2**.

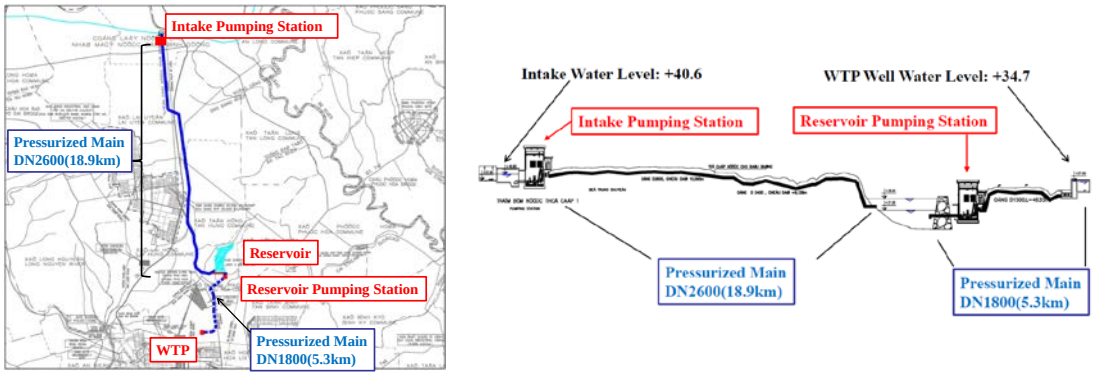
Design concept of the system proposed is employing gravity flow using deference of water levels between intake of 40.6m and normal water level of the reservoir of 24.5m, and pumping station is constructed to transmit raw water to NBDWTP by pressurized flow. As the following changes and disadvantages are found in the proposed plan and alternative plans are prepared as shown in **Figure 5.5.3** and **Figure 5.5.4**.

- Final production capacity of NBDWTP is changed from 1,200,000m^3/d to 1,000,000 m^3/d because of the restriction of planned site
- Raw water supply for Bau Bang area is excluded from this project.
- Trench depth for construction of gravity flow pipes with DN 2600mm are quite deep, for instance over 11 km length need excavation depth varying from 8m to 11m.
- Direct transmission from intake to NBDWTP without water head loss by releasing raw water to reservoir can be economical by energy saving.



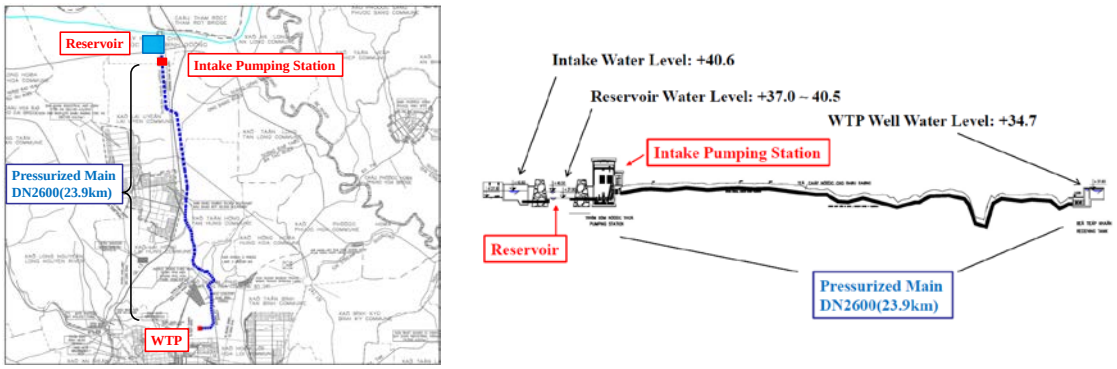
Plan Profile

Figure 5.5.2 Raw Water Transmission System Proposed in "Options Study"(G-1)



Plan Profile

Figure 5.5.3 Raw Water Transmission System Alternative (P-2)



Plan Profile

Figure 5.5.4 Raw Water Transmission System Alternative (P-3)

To prepare the alternative plans, pipes with higher internal pressure and lower external pressure than that of original plan are required. There are three types of materials of steel pipe (SP), ductile iron pipe

(DIP) and fiberglass reinforced plastic mortar pipe (FRP) are available in the country to cope with the above pressure conditions for relatively big diameters of DN 2600mm. FRP is used for gravity flow and DIP is used for pressurized flow in the alternative study.

(1) Location of Regulating Reservoir and Costs

There are following two locations of regulating reservoir in the alternative;

Case G-1 and Case P-2 : Ong Te River site
Case P-3 : Intake site

Details of regulating reservoir at Ong Te River site and intake site are presented in **Appendix 5-D** and **Appendix 5-E** respectively. Capacity and cost of reservoir of Phase 1 by site is calculated as shown in **Table 5.5.2** for Ong Te River site and **Table 5.5.3** for intake site.

Table.5.5.2 Required Capacity and Construction Cost for Reservoir at Ong Te Site

Phase	WTP Capacity	Required Capacity of Reservoir (m^3)	Normal Water Level (m)	Flood Water Level (m)	Inundation Area (ha)	Construction Cost (Million USD)
Phase 1	312,000	1,000,000	24.5	25.7	53.0	9.3

Table.5.5.3 Required Capacity and Construction Cost for Reservoir at Intake Site

Phase	WTP Capacity (m^3/day)	Required Capacity of Reservoir (m^3)	Reservoir with Stone masonry Wall with slope		
			Length of one side of Wall (m)	Area (ha)	Construction Cost (Million USD)
Phase 1	312,000	1,000,000	606	36.7	5.5

(2) Cost Estimate

Construction cost estimate for the above alternatives is summarized in **Table 5.5.4**. Detailed breakdown of the costs are presented in **Appendix 5-B**.

Table 5.5.4 Construction Costs of Alternatives (Million USD)

Item	G-1	P-2	P-3
Grit Chamber	-	0.7	-
Intake Pumping Station (IPS)	-	9.4	9.4
Transmission Pipeline	87.9	69.8	79.2
Regulating Reservoir	9.3	9.3	5.5
Reservoir Pumping Station (RRPS)	9.4	9.4	-
Land Acquisition and Compensation for Reservoir	21.7	21.7	17.0
Total	128.3	120.3	111.1

G-1 has one pumping station named Regulating Reservoir Pumping Station (RRPS), P-3 has Intake Pumping Station (IPS) and P-2 has two pumping stations, RRPS and IPS. Annual maintenance costs are calculated in **Appendix 5-B** and presented in **Table 5.5.5**.

Table 5.5.5 O&M Cost Comparison of Alternatives (Million USD/Year)

Item	G-1	P-1	P-3
Electricity Cost	0.554	0.953	0.399
E&M Replace Cost	0.078	0.155	0.077
Annual O&M Cost (Except Man Power)	0.632	1.108	0.476

Life cycle costs are estimated for the alternatives in **Table 5.5.6**. The costs are annual cost for the construction and maintenance for 50 years including 2 times replacement of mechanical and electric equipment and devices.

Table 5.5.6 Life Cycle Cost Comparison of Alternatives

Item	G-1	P-2	P-3
Construction Cost(mill USD)	128.300	120.300	111.100
M&E Initial Cost (mill USD)	7.800	15.500	7.700
O&M Cost (mill USD)	0.632	1.108	0.476
50 years (mill USD)	175.500	210.300	150.300
Annual Cost (mill USD/Y)	3.510	4.206	3.006

(50 years maintenance with 2 times replacement of M&E)

(3) Comparison of Alternatives
Comparison results are presented in **Table 5.5.7**.

Proposal of option study (G-1) shows the highest construction costs because of deep pipeline construction and high maintenance cost is expected due to the energy loss in the alignment of transmission pipeline. P-2 shows relatively lower construction cost than that of G-1, annual life cycle cost is higher than G-1 because of high O&M cost.

P-3 is the most economical because of sallow trench installation of pipeline construction with minimum earth covering and one pumping station. And thus, Case P-3 is selected. Case P-3 has regulating reservoir at intake site, and preparation for EIA report, investigation of resettlement, and land use right has to be obtained, as the site is newly decided.

Table 5.5.7 Comparison of Alternatives

Alternatives		G-1	P-2	P-3
Outline		19 km from intake to regulating reservoir at Ong Te river site by gravity flow and 5 km from regulating reservoir to WTP by pressurized flow	19 km from intake to regulating reservoir at Ong Te river site by pressurized flow and 5 km from regulating reservoir to WTP by pressurized flow	24 km from regulating reservoir at intake to WTP by pressurized flow
Pumping Station		One（Pump head : 24m）	Two（Pump head : 20m），（Pump head : 24m）	One（Pump head : 20m）
Raw water Transmission Pipeline		Trench depth : 8m to 11m for 11km length	Minimum earth covering for all lines	Minimum earth covering for all lines
Environment and Social Consideration		Investigation of EIA and resettlement for regulating reservoir at Ong Te River site was being carried out.		Investigation of EIA and resettlement for regulating reservoir at intake site is newly required
Cost	Construction (Million US$)	128.300	120.300	111.100
	O&M (Million US$/year)	0.632	1.108	0.476
Life Cycle Cost		3.510	4.206	3.006

（Million US$/year）			
Evaluation	Construction of raw water transmission pipeline is difficult and costly. Pump head is high causing high operation cost. Gate control is required for inflow of regulating reservoir.	Construction of raw water transmission pipeline is easy and cheap. O&M cost is high for 2 pumping stations	Construction of raw water transmission pipeline is easy and cheap. O&M cost is cheap. New location of regulating reservoir needs investigation for EIA and resettlement.
	△	×	○

5.5.3 North Binh Duong Water Treatment Plant (NBDWTP)

Water quality analyses were carried out in the dry and rainy seasons by taking water samples at the intake site of the existing raw water canal as shown in **Table 5.5.8**. It also shows results of jar tests which indicate that turbidity values can be decreased in any case and conventional coagulation treatment should be valid.

Table 5.5.8 pH, Turbidity and Jar Test Results

Date of sampling	pH	Turbidity (NTU)	Results of jar test		
			Dosage rate of PAC (mg/l)	pH	Turbidity (NTU)
February 21, 2013	7.3	6.7	8	6.8	1.2
March 6, 2013	7.0	7.1	12	6.8	0.95
March 20, 2013	7.1	5.5	11	6.8	0.80
April 5, 2013	7.1	6.0	11	6.8	0.83
April 20, 2013	6.8	3.3	8	6.8	0.96
May 6, 2013	6.6	9.4	12	6.8	0.92
May 20, 2013	6.7	4.3	9	6.8	0.86
June 5, 2013	6.8	5.8	10	6.8	0.89
June 20, 2013	6.9	11.8	17	6.8	0.82
July 03, 2013	7.0	10.9	16	6.8	0.80
July 17, 2013	7.0	20.7	22	6.8	0.95
August 5, 2013	6.7	7.3	12	6.8	0.92
August 20, 2013	6.8	8.4	14	6.8	0.87

Sampling data were collected from the dry season to the rain season. Although the turbidity values are fluctuated, it is quite likely that canal water turbidity can be treated. By this reason, conventional rapid sand filtration was selected.

Low pH of the raw water is usually disadvantageous for coagulation process of the water treatment, and pre-alkali treatment will be required to adjust pH and alkalinity to the preferable ranges. And as for coagulant, PAC will be used considering its better performance than other coagulants against pH fluctuation. Pre-chlorination will be provided to maintain the hygiene condition of sedimentation basins and filters.

Against risk of water quality accidents in the regulating reservoir such as odor and inflow of oil, powdered activated carbon will be provided.

The sequence of the proposed water treatment processes is shown in **Figure 5.5.5**.

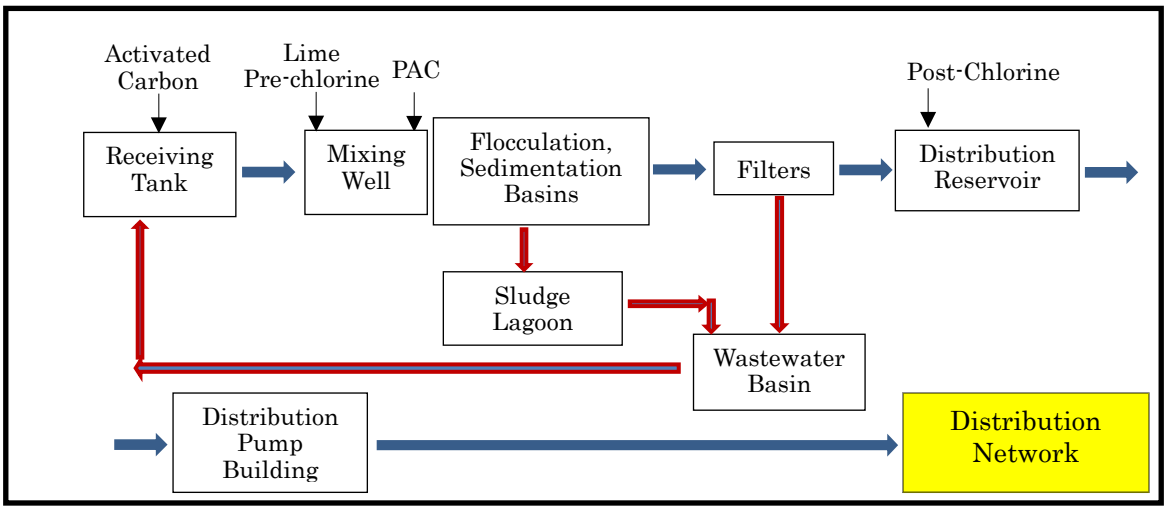


Figure 5.5.5 Water Treatment Processes

5.5.4 Distribution Mains

NBDWTP will supply water mainly for districts of Ben Cat, Tan Uyen, and Thu Dau Mot City, An Tay, My Phuoc, Expanded VSIP II areas. Since the other three major existing WTPs are involved in water distribution in the study area, detailed analysis is carried out to determine the exact locations and diameters in Chapter 6, Preliminary Design.

CHAPTER 6 PRELIMINARY ENGINEERING DESIGN

6.1 Raw Water Transmission System

Raw Water Transmission System consists of;

- Raw water intake (Existing Intake)
- Regulating Reservoir
- Pumping Station
- Raw Water Transmission Pipeline

6.1.1 Raw Water Intake Facilities

Raw water intake exists as shown in Photo 5.5.1. The location and layout plan of raw water intake and regulating reservoir are shown in **Figure 6.1.1**.

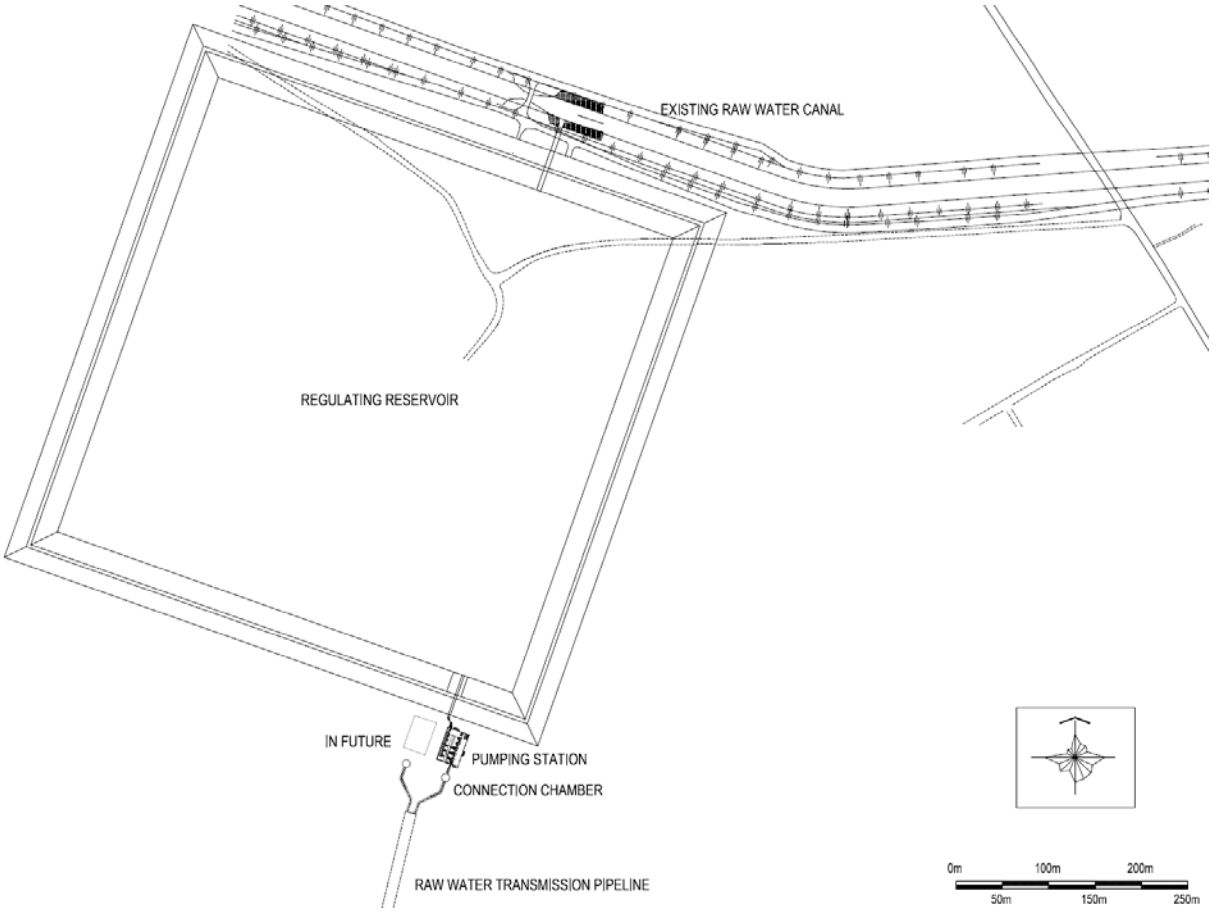


Figure 6.1.1 Layout of Raw Water Intake and Regulating Reservoir

(1) Regulating Reservoir

1) Functions of Reservoir

The functions of the regulating reservoir are followings;

- Ensure the stable and continuous water supply for urban area and industrial parks in the Northern Part of Binh Duong Province when water resource is stopped supplying from Phuoc Hoa – Dau Tieng Canal due to inspection and maintenance.

2) Construction Process and Reservoir Volume

Based on the approval by Hydraulic Project Investment & Construction Management Board No. 9, Ministry of Agriculture and Rural Development with Decision No. 307 QD-BQL9 （Approval of Technical process of works operation and maintenance (temporary)、 Phuoc Hoa Hydraulic Project, Binh Duong – Binh Phuoc Province） signed on May 23, 2012, 3 days capacity of NBDWTP is employed for planning of regulating reservoir. The construction process and the reservoir volume are determined as shown in **Table 6.1.1**.

- Phase 1: Construct the regulating reservoir with 1,000,000 m^3 of useful volume. NBDWTP capacity is 312,000 m^3/day.
- In the future; When NBDWTP capacity increases to 1,000,000 m^3/day, the reservoir area will be expanded to increase the reservoir volume to 3,000,000 m^3.

Table 6.1.1 WTP Capacity and Reservoir Volume

Phase	WTP Capacity	Reservoir Volume
Phase 1	312,000 m^3/day	1,000,000 m^3
In the future	1,000,000 m^3/day	3,000,000 m^3

3) Dimension of the Reservoir

On the basis of the dead volume and the useful volume, the normal water level is defined as the following **Table 6.1.2**.

Table 6.1.2 Capacity of the Reservoir

No.	Parameter	Unit	Value	
			Phase 1	In the future
1	Normal water level	m	40.5	40.5
2	Dead water level	m	37.0	37.0
3	Total volume (normal water level)	m^3	1,200,000	3,300,000
4	Dead volume	m^3	200,000	300,000
5	Useful volume	m^3	1,000,000	3,000,000

4) Design Outline of the Reservoir

There are two material alternatives for the levee body; stone masonry wall with slope and concrete retaining wall. The dimension of levee body is defined as the following **Table 6.1.3**.

Table 6.1.3 Dimension of Levee Body

No.	Parameter	Unit	Phase 1	
			Concrete retaining wall	Stone masonry wall with slope
1	Levee crest level	M	43.0	43.0
2	Levee bed level at lowest place	M	35.0	35.0
3	Highest levee height	M	8.0	8.0
4	Length of one side of wall	M	572	606
5	Area	M	32.7	36.7
6	Levee crest width	M	4.0	4.0

5) Levee Material

The levee height for the regulating reservoir is less than 15 m and relatively low scale. In order to consider the optimal alternative, two alternatives for levee material are studied.

Alternative1; Concrete Retaining Wall

The levee body is made of concrete M150 and covered around by reinforced concrete M200. Because the levee ground is weak soil and load-bearing capacity is smaller than ground stress, the ground treatment must be carried out by reinforced concrete pile M300.

Alternative2; Stone Masonry Wall with Slope

The levee body consists of a poor permeability soil (permeability coefficient kt $\leq 10^{-5}$cm/s). The upstream surface in the levee body is consolidated by ashlar with 30 cm thickness for erosion protection. The downstream surface in the levee body is planted with grass.

Two alternatives of the levee material are compared as shown in **Table 6.1.4**. Both levees have the structural stability as a result of water proof, erosion protection for levee body and ground load bearing capacity. The stone masonry wall with slope needs a complicated connection work with intake pipeline due to different materials, but is much cheaper than the concrete retaining wall. On the other hand, the concrete retaining wall needs a complicated construction work for ground treatment with many piles and is more expensive than the stone masonry wall with slope.

Based on the comparison of levee material alternatives, the stone masonry wall with slope was selected in this survey, which has the structural stability and lower cost.

Table 6.1.4 Comparison of Levee Material Alternatives

Item	Concrete Retaining Wall	Stone Masonry Wall with Slope
Levee Body	- Water proof and erosion protection by concrete material.	- Water proof and erosion protection by poor permeability soil and consolidated surface of ashlar.
Ground Load Bearing	- Maintain the load bearing capacity as a result of ground treatment with reinforced concrete piles.	- Specific weight is relatively small, so load bearing capacity is enough.
Construction Work	- Simple connection work with intake pipeline due to same material. - Complicated construction work for ground treatment with many piles.	- Complicated connection work with intake pipeline due to different material.
Construction Cost	14.0 million USD	5.5 million USD

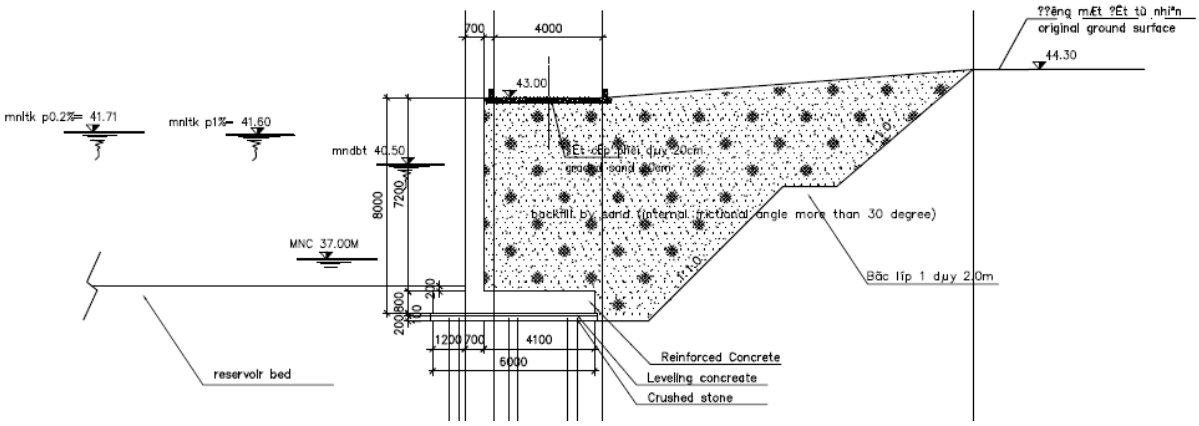


Figure 6.1.2 Cross Section of Concrete Retaining Wall

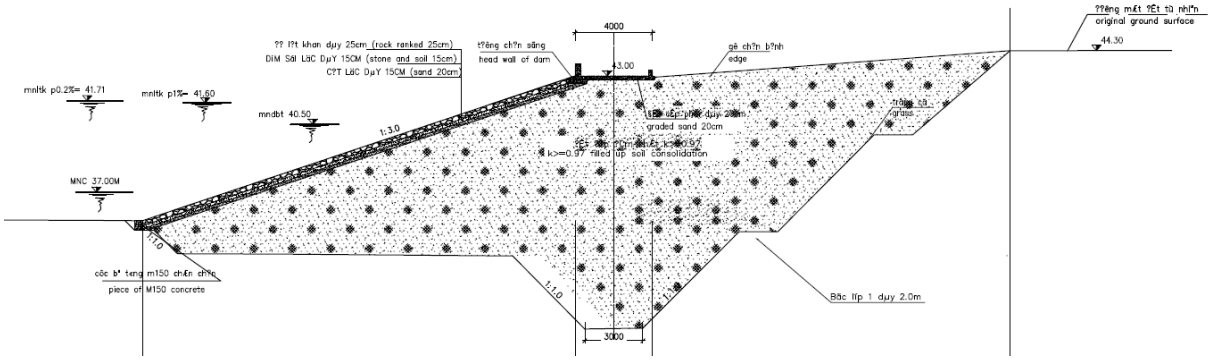


Figure 6.1.3 Cross Section of Stone Masonry Wall with Slope

6.1.2 Intake Pumping Station

(1) Connection Chamber

Connection chambers are installed to mitigate adverse effects of water hummer to pipeline by pump operation and to keep required water head to convey raw water through pipeline to North Binh Duong Water Treatment Plant (NBDWTP). Required water head in connection chamber is calculated by Hazen-William formula according to Vietnamese standard, TCXDVN 33:2006 Water Supply – Distribution System and Facilities Design Standard as follow.

$$H = J \times L$$

$$J = 6.824(V/C)^{1.852} D^{-1.167}$$

Where H : Required water head of chamber (m)
L : Pipe length (m)
J : Hydraulic gradient
V : Velocity (m/s)
D : Pipe diameter (m)
C : Flow coefficient (130 for plastic type surface pipe)

The required water heads and structural feature of chamber located at intake pumping station is illustrated in **Figure 6.1.4**. Detailed calculation for required water levels are given in **Appendix 5 - B**.The required capacity of the chamber is decided as retention time of 1.5 minutes as set for receiving well at WTP. The height is approximately 7.8 m from ground level.

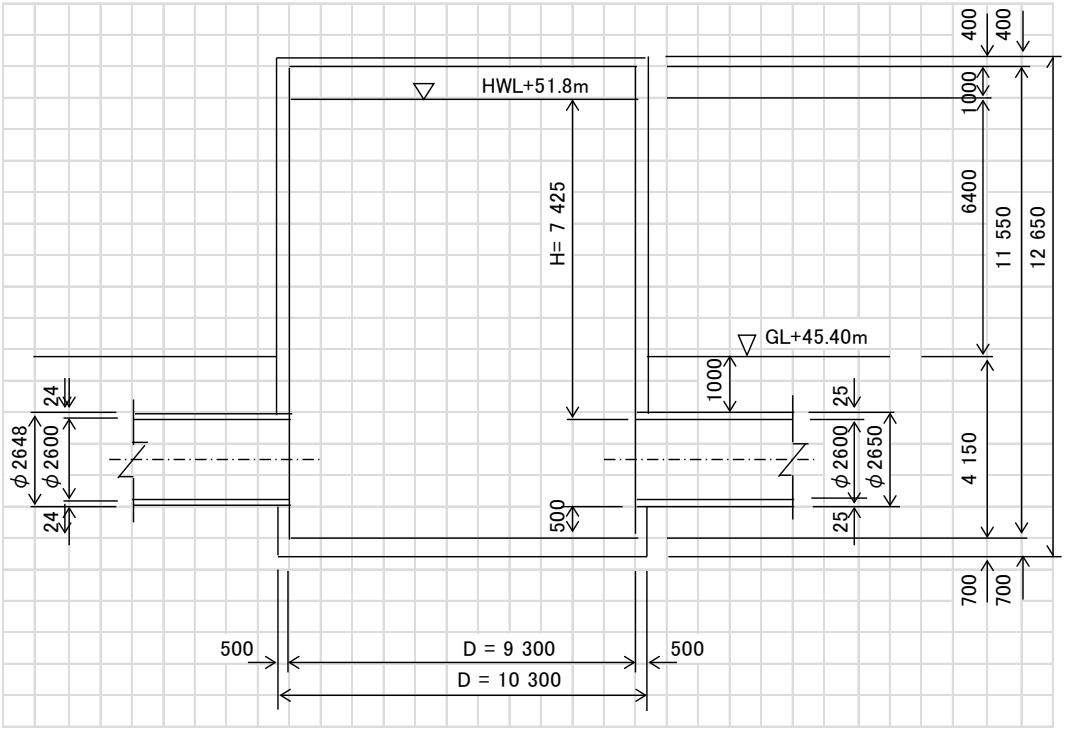


Figure 6.1.4 Dimensions of Connection Chamber

(2) Specification of Pump

Total pump head of Intake Pumping Station in Phase I with transmission flow rate of 343,200 m^3/d for production capacity of 300,000 m^3/d at NBDWTP is estimated as higher level of safety suction at connection chamber and required level to clear the critical point where hydraulic gradient line is lower than ground level, since hydraulic gradient is quite moderate in initial stage as 0.000159 as estimated in **Appendix 5 - B**.

Safety suction level: 2 D from center of outflow pipe
= 2 x 2.6 + 45.4 – (1.0 + 0.025 + 2.6/2)
= 48.28 (m)

Required water level to clear critical point (critical point is 5,534.4m downstream with GL = 47.2 (m))
= 5,534.4 x 0.000159 +47.2
= 48.08 (m)

The required water level in connection chamber is estimated at 48.28 m (48.3m) and required total pump head of Intake Pumping Station in Phase I is calculated in **Table 6.1.5**.

Table 6.1.5 Calculation for Required Total Pump Head of Intake Pumping Station in Phase 1

Item	Phase 1
a. Difference in level between Connection Chamber and water level at intake (37.0)	H_1= 48.3-37.0 =11.3 m
b. Excessive pressure at Connection Chamber	H_2= 2.00 m
c. Pumping Station internal loss	H_3 = 3.00 m
d. Required total pump head $H = H_1 + H_2 + H_3$	H = 16.3 m

Table 6.1.6 shows the description of raw water Intake Pumping Station.

Table 6.1.6 Description of Intake Pumping Station

Flow rate:	3.97m^3/sec = 343,200m^3/day
Number of pumps:	- 3 pumps including 1 standby in Phase 1 - 2 pumps in future
Total pump head	- 16.3 m
Dimensions:	W24.0m x L36.0m

Power substation and emergency generator will be provided.

6.1.3 Raw Water Transmission Pipeline

Pipeline to be constructed in Phase 1 caters for the next Phase with NBDWTP capacity of 600,000 m^3/d. Raw water is once lifted up to connection chamber by intake pumps and flows by gravity in transmission pipeline without impulse by operation of the pumps. Internal pressure of the transmission pipeline is around 0.1 Mpa and the maximum pressure is about 0.3 Mpa at crossing point of the Ong Te River.

There are three types of materials of steel pipe (SP), ductile iron pipe (DIP) and fiberglass reinforced plastic mortar pipe (FRP) are considerable. The transmission pipeline is quite large and long and safety is the most important factor. DIP is employed for this project taking Japanese practice into account.

Total length of raw water transmission pipeline is summarized in **Table 6.1.7**. Detailed plan and longitudinal profile are presented in **Appendix 6 - A**.

Table 6.1.7 Raw Water Transmission Pipeline

Item/Section	Diameter and/or length	Remarks
Intake pumping Station to WTP	DN 2600 mm: 23,858.5 m, DIP	

Reference is made in **Appendix 5-B** with regard to the required water head and dimension of connection chamber, total pump head of Intake Pumping Station.

6.2 North Binh Duong Water Treatment Plant (NBDWTP)

6.2.1 Planned Capacity of NBDWTP

The planned production capacity of the proposed North Binh Duong Water Treatment Plant (NBDWTP) in Phase 1 will be 300,000m^3/day. Four percent (4%) loss in the treatment processes will be added to the production capacity.

Table 6.2.1 Production Capacity and Treatment Capacity

Production capacity (m^3/day)	Treatment capacity (m^3/day)
300,000	312,000

The water treatment facilities of Phase 1 will be constructed by two times, namely 156,000 m^3/day in Phase 1A and156,000 m^3/day in Phase 1B.

Some of the water treatment facilities will be constructed in Phase 1A in consideration of the efficiency of operation and ease of expansion as shown in **Table 6.2.2**.

Table 6.2.2 Designed Capacities of Water Treatment Facilities in Phase 1

Name of facility	Designed Treatment Capacity	
	Phase 1A	Phase 1B
a) Receiving & distribution tank	: 624,000 m^3/day	: Not Applicable
b) Rapid mixing well	: 156,000 m^3/day	: 156,000 m^3/day
c) Flocculation basin	: 156,000 m^3/day	: 156,000 m^3/day
d) Sedimentation basin	: 156,000 m^3/day	: 156,000 m^3/day
e) Rapid sand filter	: 156,000 m^3/day	: 156,000 m^3/day
f) Wastewater basin	: 312,000 m^3/day	: Not Applicable
g) Sludge drying bed	: 312,000 m^3/day	: Not Applicable
h) Chemical dosing facility	: 156,000 m^3/day	: 156,000 m^3/day
i) Buildings (administration, chemical, etc.)	: 312,000 m^3/day	: Not Applicable
j) Distribution reservoir	: 156,000 m^3/day	: 156,000 m^3/day
k) Distribution pump station	: 624,000 m^3/day	: Not Applicable
l) Distribution pump	: 156,000 m^3/day	: 156,000 m^3/day

6.2.2 Layout of NBDWTP

NBDWTP land area of 31.3 ha will be acquired by BIWASE. The area is for water production capacity of 1,000,000 m^3/day. The planned ground elevations of NBDWTP will be varied from +29.80 to +27.00 m. NBDWTP layout is shown in **Figure 6.2.1**.

6.2.3 Hydraulic Profile of NBDWTP

Hydraulic profile is shown in **Figure 6.2.2**.

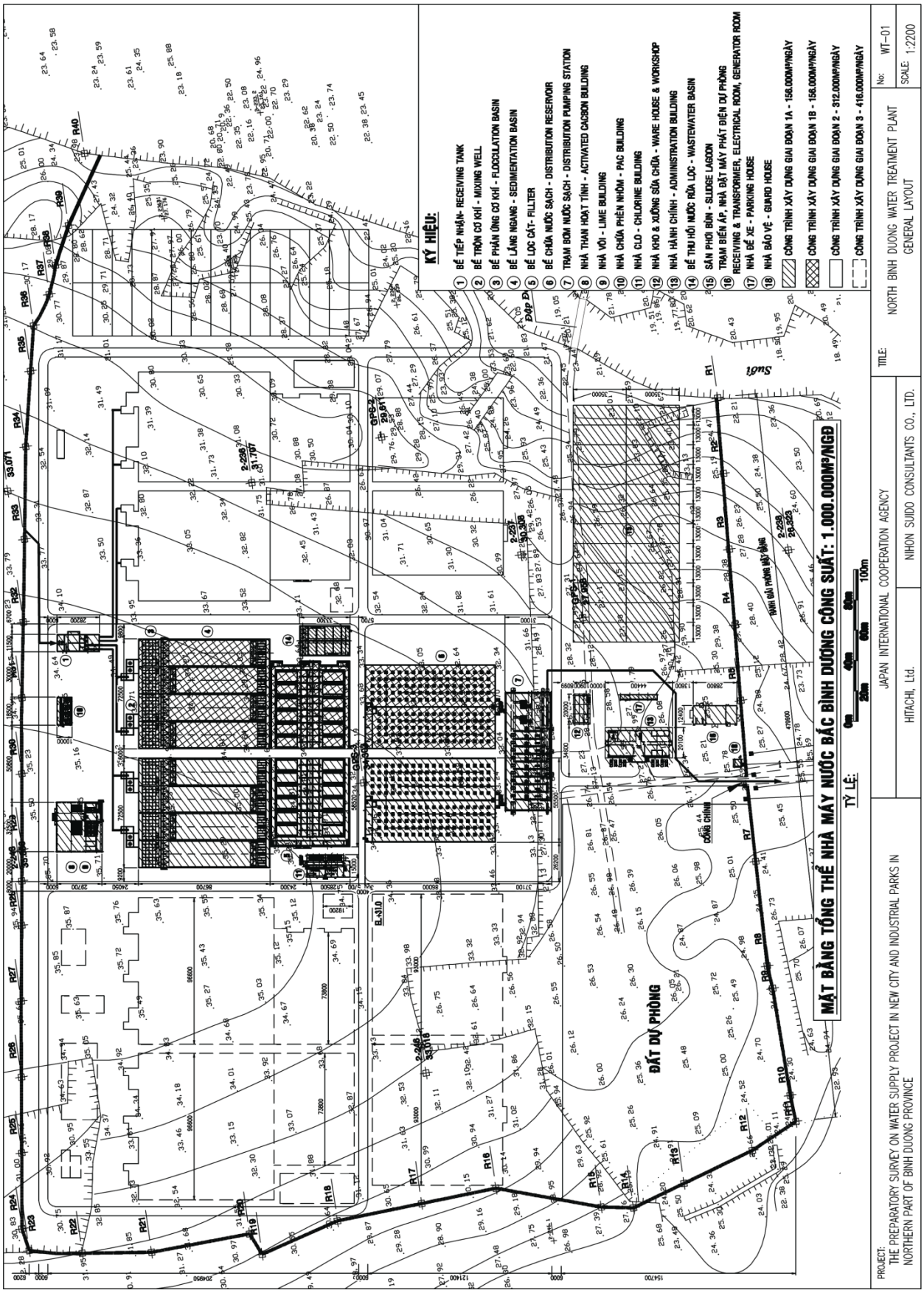


Figure 6.2.1 NBDWTP Layout

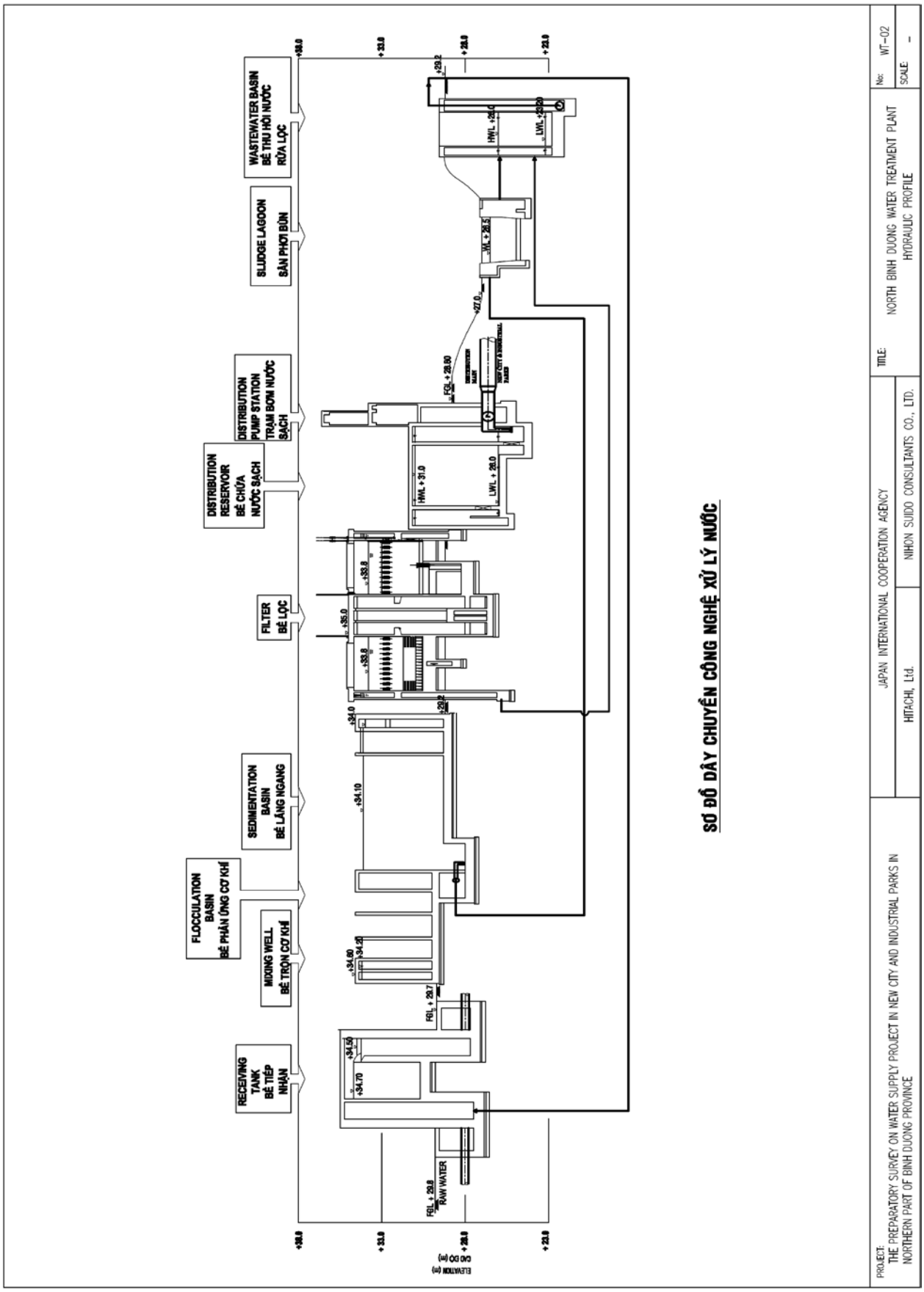


Figure 6.2.2 Hydraulic Profile of NBDWTP

6.2.4 Water Treatment Facilities in NBDWTP

Table 6.2.3 shows the descriptions of water treatment facilities of NBDWTP.

Table 6.2.3 Descriptions of Water Treatment Facilities of NBDWTP

Name of facility	Description		Remarks
	Phase 1A	Phase 1B	
Receiving & distribution tank	- Flow rate: 624,000m^3/day = 433.3m^3/min - Retention time: 1.5min - No. of tanks: 1 - Effective depth: 5.0m - Dimensions: W10.7m x L12.4m x D5.0m = 663.4m^3	Not Applicable	Powdered activated carbon will be dosed in the tank in emergency case.
Rapid mixing well	- Flow rate: 156,000m^3/day = 108.3m^3/min - Type of mixing: Mechanical type - Retention time: 2.5min - No. of wells: 2 - Effective depth: 4.0m - Dimensions: W4.2m x L4.2m x D4.0m x 2 stages = 141.1m^3/well	- Flow rate: 156,000m^3/day = 108.3m^3/min - Type of mixing: Mechanical type - Retention time: 2.5min - No. of wells: 2 - Effective depth: 4.0m - Dimensions: W4.2m x L4.2m x D4.0m x 2 stages = 141.1m^3/well	Pre-alkali, pre-chlorine and coagulant will be dosed in the well.
Flocculation basin	- Flow rate: 156,000m^3/day = 108.3m^3/min - Type of flocculation: Hydraulic type - Retention time: 20min - No. of basins: 4 - Effective depth: 3.5m - No. of stages: 5 - Dimensions: W2.0m x L17.4m x D3.5m x 5stages = 609m^3/basin	- Flow rate: 156,000m^3/day = 108.3m^3/min - Type of flocculation: Hydraulic type - Retention time: 20min - No. of basins: 4 - Effective depth: 3.5m - No. of stages: 5 - Dimensions: W2.0m x L17.4m x D3.5m x 5stages = 609m^3/basin	
Sedimentation basin	- Flow rate: 156,000m^3/day - Type: Horizontal flow type - Overflow rate: 25mm/min = 36m/day - Mean velocity: 0.4m/min - No. of basins: 4 - Effective depth: 4.5m - Required area: 156,000/36/4 = 1,083m^2/basin - Desludging: Submerged sludge collector - Dimensions: W17.5m x L62.0m x D4.5m = 4,882.5m^3/basin	- Flow rate: 156,000m^3/day - Type: Horizontal flow type - Overflow rate: 25mm/min = 36m/day - Mean velocity: 0.4m/min - No. of basins: 4 - Effective depth: 4.5m - Required area: 156,000/36/4 = 1,083m^2/basin - Desludging: Submerged sludge collector - Dimensions: W17.5m x L62.0m x D4.5m = 4,882.5m^3/basin	
Rapid sand filter	- Flow rate: 156,000m^3/day - Type: Gravity type, out flow control - Filtration rate: 135m/day - No. of filters: 12 - Required area in total: 156,000/135 = 1,156m^2 - Required area per filter: 1,156/12 =	- Flow rate: 156,000m^3/day - Type: Gravity type, out flow control - Filtration rate: 135m/day - No. of filters: 12 - Required area in total: 156,000/135 = 1,156m^2 - Required area per filter: 1,156/12 =	

Name of facility	Description		Remarks
	96.3m^2/filter - Dimensions per filter: W16.3m x L6.0m = 97.8m^2/filter - Water backwashing and air scouring	96.3m^2/filter - Dimensions per filter: W16.3m x L6.0m = 97.8m^2/filter - Water backwashing and air scouring	
Distribution reservoir	- Total volume: 150,000 m^3/day x 15% = 22,500 m^3 - No. of reservoirs: 2 - Effective depth: 5.0m - Dimensions per reservoir: W27.0m x L85.0m x D5.0m = 11,475m^3/reservoir	- Total volume: 150,000 m^3/day x 15% = 22,500 m^3 - No. of reservoirs: 2 - Effective depth: 5.0m - Dimensions per reservoir: W27.0m x L85.0m x D5.0m = 11,475m^3/reservoir	Post-chlorine will be dosed at the influent channel for disinfection.
Distribution pump station	- For the production capacity of 600,000m^3/day - Basement floor and 1st floor - Dimension: W30.0m x L77.0m	Not Applicable	
Distribution pump	- Type: Horizontal shaft double suction volute pump - Production capacity: 150,000 m^3/day - Hourly peak factor: 1.25 - No. of pumps: 3 including 1standby - Rated capacity: 65.2m^3/min - Rated head: 50m - Motor output: 710kW	- Type: Horizontal shaft double suction volute pump - Production capacity: 150,000 m^3/day - Hourly peak factor: 1.25 - No. of pumps: 2 - Rated capacity: 65.2m^3/min - Rated head: 50m - Motor output: 710kW	
Backwash pump	- Type: Horizontal shaft double suction volute pump - No. of pumps: 2 including 1 standby - Rated capacity: 58.7m^3/min - Rated head: 20m - Motor output: 280kW	Not Applicable	
Plant water pump	- No. of pumps: 1 - Rated capacity: 1.0m^3/min - Rated head: 40m - Motor output: 18.5kW	No. of pumps: 1 - Rated capacity: 1.0m^3/min - Rated head: 40m - Motor output: 18.5kW	
Sludge lagoon	- For the treatment capacity of 312,000m^3/day - Average raw water turbidity: 20NTU - Average PAC dosage rate: 20mg/liter - Dry solid: 8.9 tons/day = 3,250 tons/year - Sludge loading rate: 50kg/m^2 - Filling cycle: 6 times/year - Required area: 3,250/(6*50) = 10,830m^2 - No. of lagoons: 24 - Dimensions per lagoon: W13m x L35m = 455m^2/lagoon	Not Applicable	
Wastewater basin	- Backwashed wastewater from filter: 921m^3 per 1 filter washing - No. of basins: 2 - Effective depth: 3.5m - Dimensions: W9.0m x L32.1m x D3.5m = 1,011m^3/basin	Not Applicable	Return pump - Type: Submersible sand pump - No. of pumps: 6 including 2 standby

Name of facility	Description		Remarks
			- Rated capacity: 5.2m^3/min - Rated head: 20m - Motor output: 37kW
Administration building	- Second-story - Total area: 1,568m^2 - Dimension: W19.6m x L40.0m x 2-story	Not Applicable	
Activated carbon & Lime building	- For the treatment capacity of 624,000m^3/day - One-story - Total area: 965m^2 - Dimension: W32.5m x L29.7m x H10.0m - Chemical feeding system: for 156,000m^3/day	- Chemical feeding system: for 156,000m^3/day	
PAC building	- For the treatment capacity of 312,000m^3/day - One-story - Total area: 162m^2 - Dimension: W9.0m x L18.0m x H12.0m - Chemical feeding system: for 156,000m^3/day	- Chemical feeding system: for 156,000m^3/day	
Chlorine building	- For the treatment capacity of 312,000m^3/day - One-story - Total area: 406m^2 - Dimension: W14.5m x L28.0m x H6.0m - Chemical feeding system: for 156,000m^3/day	- Chemical feeding system: for 156,000m^3/day	
Power receiving, transformer, electrical & generator rooms	- For the treatment capacity of 312,000m^3/day - One-story - Total area: 426m^2 - Dimension: W13.4m x L31.8.m	Not Applicable	
Workshop & ware house	- One-story - Total area: 162m^2 - Dimension: W 9.0m x L18.0m	Not Applicable	
Garage	- One-story - Total area: 41m^2 - Dimension: W3.4m x L12.0m	Not Applicable	
Guard house	- One-story - Total area: 18m^2 - Dimension: W 4.0m x L4.5m	Not Applicable	

6.3 Distribution Pipeline

6.3.1 Distribution Area

NBDWTP mainly covers Ben Cat District and parts of Thu Dau Mot city and Tan Uyen district. However, water supply system of southern part of the Province consists of all in one system including Thuan An and Di An District, and hydraulic calculation for network analysis of distribution mains are conducted for the area covered by WTPs of Tan Hiep, Thu Dau Mot, and Di An as well as NMDWTP as shown in **Figure 6.3.1**.

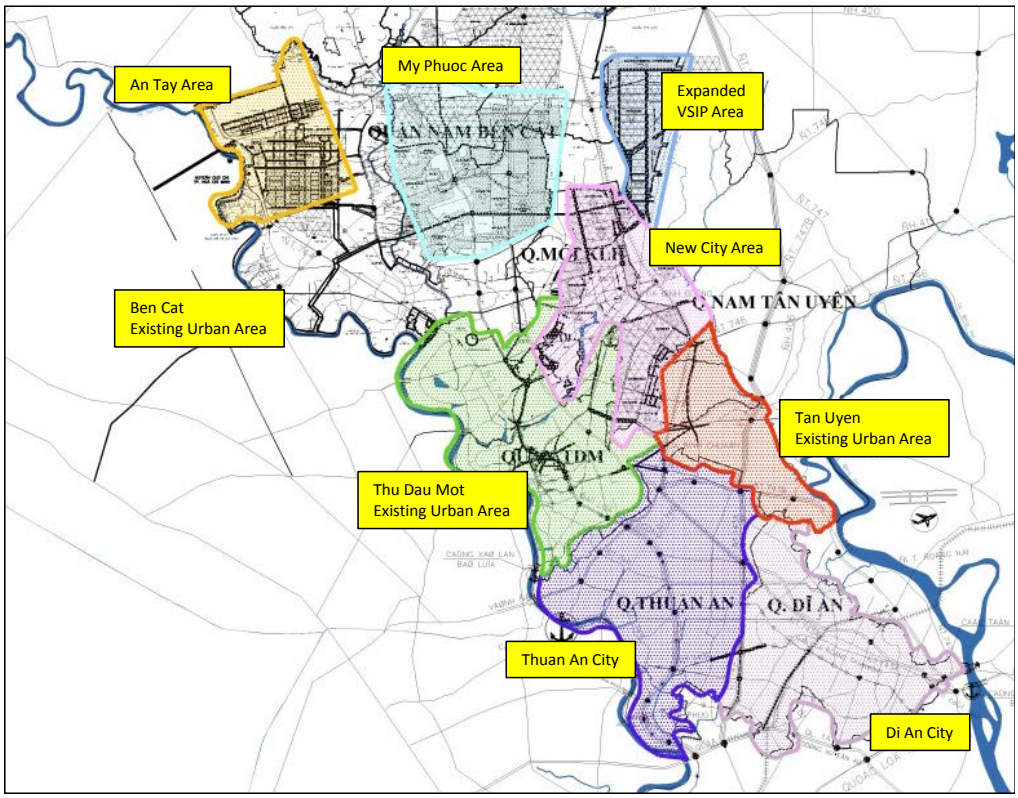


Figure 6.3.1 Distribution Area for Hydraulic Analysis

6.3.2 Pipe Material

BIWASE uses three types of pipes of HDPE, Cast Iron (Ductile Cast Iron), and PVC at the present depending on the diameter as shown in **Table 6.3.1**.

Table 6.3.1 Pipe Materials Used for Distribution Pipeline by Diameter

Pipe Type	Diameter Applied	Remarks
PVC	200 mm and below	
HDPE	300 mm - 600 mm	Depend on soil conditions
Cast Iron (Ductile Cast Iron)	300 mm and above	

Source: BIWASE

The above practice of BIWASE is followed in this survey. HDPE is applied for 300 mm - 600mm in diameter and DCI is used for the diameter of more than 600 mm.

6.3.3 Distribution Mains

Hydraulic calculation to estimate pipe sizes of distribution mains is conducted in following conditions.

Hydraulic calculation formula	:	Hazen-Williams equation
Flow coefficient	:	130
Daily maximum factor	:	1.2
Hourly maximum factor	:	1.25
Applied software	:	EPANET ver2.0
Objective distribution main	:	300 mm in diameter and above
Effective pressure	:	30 m -50m

The Hydraulic calculation results are shown in **Figure 6.3.2**, and **Table 6.3.2** shows distribution mains required in initial stage with distribution capacity from NBDWTP of 300,000m3/d.

Table 6.3.2 Distribution Mains Required in Initial Stage

Diameter (mm)	Length (m)				Total
	Type 1	Type 2	Type 3	Pipe Bridge	
DN 400	4,220	2,126	0	0	6,348
DN 500	2,497	0	0	0	2,497
DN 600	3,400	11,581	1,743	0	16,724
DN 800	3,496	3,137	0	0	6,633
DN 1000	0	6,426	0	0	6,426
DN 1200	0	1,478	0	0	1,478
DN 1500	6,170	2,254	0	50	8,474
Total	19,785	27,002	1,743	50	48,580

Note: Asphalt reinstatement type; Type3: National Road, Type2: Main Road,
Type1: Other road

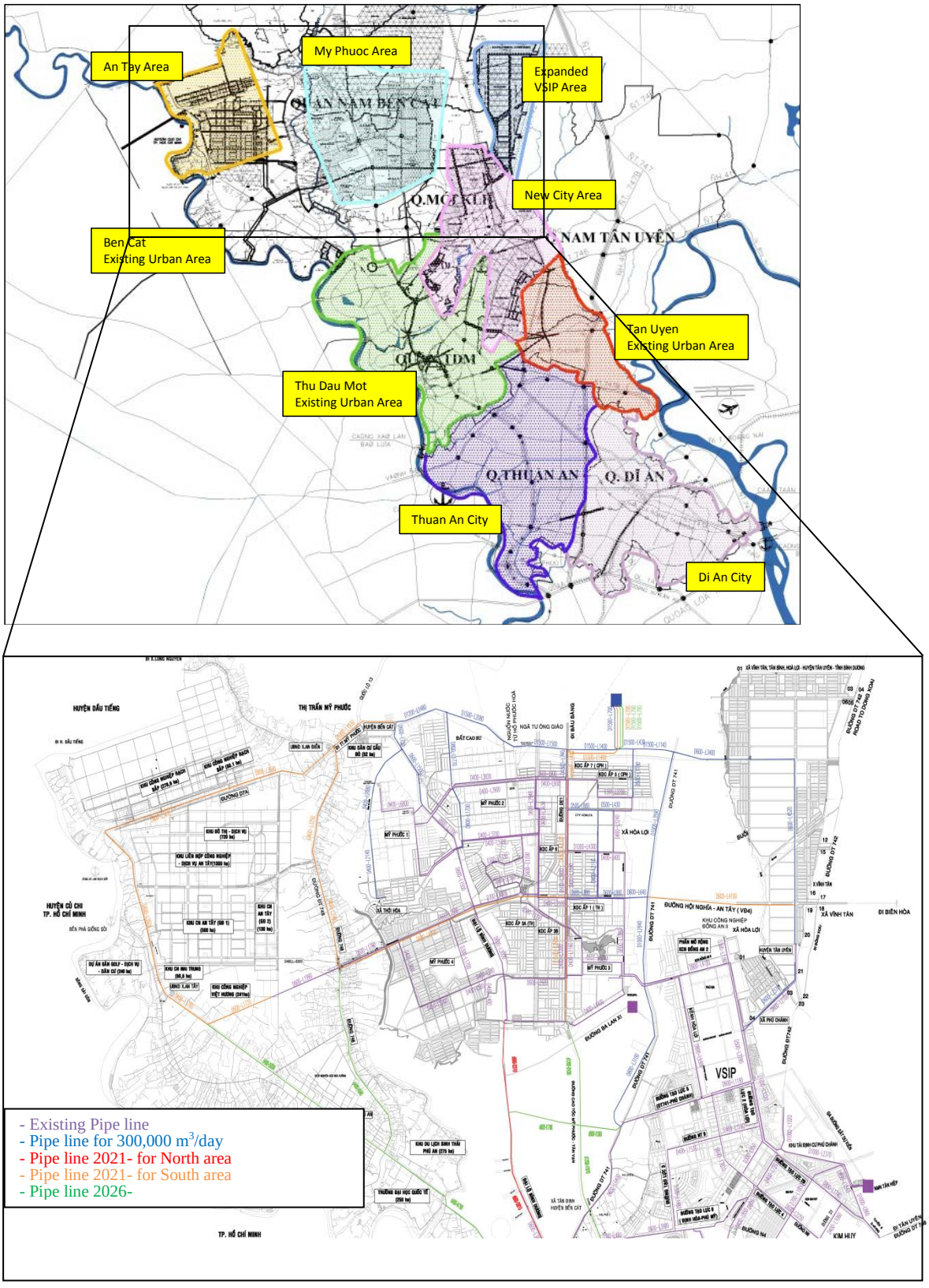


Figure 6.3.2 Existing and Proposed Distribution Mains

6.3.4 Standard Section and Accessories

Standard section of installing distribution mains is determined as shown in **Figure 6.3.3**, taking Vietnamese standard and BIWASE's practice into account. Location of installing distribution mains is assumed on driveway and asphalt reinforcements is set by road type as indicated in **Table 6.3.3**. Average earth covering is assumed as 1.0 m.

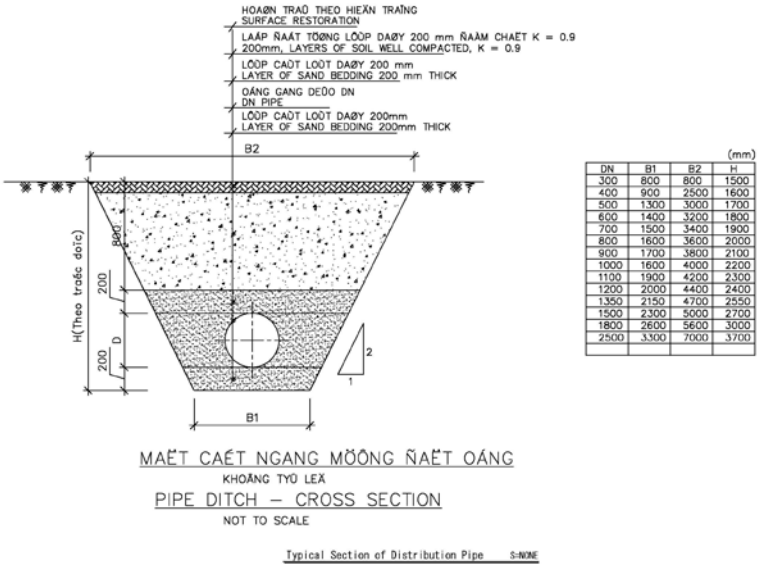


Figure 6.3.3 Cross Section and Backfilling Standard

Table 6.3.3 Asphalt Reinstatement Structure by Road Type

Type	Asphalt Reinstatement Structure
Asphalt road type 1	+ Red gravel: 250mm thick. +Gravel mix stone 0x4mm: 200mm thick + Coarse grained asphalt concrete: 50mm thick. + Fine grained asphalt concrete: 30mm thick
Asphalt road type 2	+ Red gravel: 250mm thick. + Gravel mix stone 0x4mm: 250mm thick + Coarse grained asphalt concrete: 70mm thick. + Fine grained asphalt concrete: 30mm thick.
Asphalt road type 3	+ Red gravel: 250mm thick. + Gravel mix stone 0x4mm: 400mm thick + Coarse grained asphalt concrete: 70mm thick. + Fine grained asphalt concrete: 50mm thick.

Note: Asphalt reinstatement type; Type3: National Road, Type2: Main Road, Type1: Other road

6.4 Planning for Reducing Non-Revenue Water

6.4.1 General Measures against Non-Revenue Water

(1) Non-Revenue Water Elements

As shown in **Table 6.4.1**, Non revenue water is classified into 3 categories. First category is unclaimed authorized consumption, second one is commercial loss, and the last one is physical loss. Commercial loss come from unauthorized consumption and all types of inaccurate metering. Physical loss come from leaks and overflows on pipes and reservoirs.

Table 6.4.1 Water Balance and Non-Water Revenue Elements

<table>
<tr><td rowspan="10">Input Volume</td><td rowspan="3">Authorized Consumption</td><td rowspan="2">Revenue Water</td><td rowspan="2">Billed Authorized Consumption</td><td>Billed Metered Consumption</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="8">Non-Revenue Water</td><td rowspan="2">(1)Unbilled Authorized Consumption</td><td>Unbilled Metered Consumption</td></tr>
<tr><td>Unbilled Unmetered Consumption</td></tr>
<tr><td rowspan="7">Water Losses</td><td rowspan="2">(2)Commercial Losses</td><td>Unauthorized Consumption</td></tr>
<tr><td>Customer Meter Inaccuracies and Data Handling Errors</td></tr>
<tr><td rowspan="5">(3)Physical Losses</td><td>Leakage on Transmission and Distribution Mains</td></tr>
<tr><td>Leakage and Overflows from the Utilities Storage Tanks</td></tr>
<tr><td>Leakage on Service Connections up to the Customer Meter</td></tr>
</table>

(2) Measures against Non-Revenue Water

Regarding measures against commercial and physical loss, their outlines are shown in **Table 6.4.2**.

Table 6.4.2 Outline of Measures against Non-Revenue Water

Category	cause/event	measure	
Commercial Loss	・ Customer meter inaccuracy ・ Unauthorized consumption ・ Meter reading errors ・ Data handling and accounting errors	Meter Management	appropriate spec, proper installation, maintenance and replace
		Meter readers training	reducing reading error, immediate report of meter failure, illegal connection, etc
		Site inspection	Finding and reducing illegal connections and meter bypassing, Preventing illegal use of fire hydrants
		Billing system	robust database, active check of customer information
Physical Loss	・ Leakage from transmission and distribution mains ・ Leakage and overflows from the utility's reservoirs and storage tanks ・ Leakage on service connections up to the customer's meter	Active Leakage Control	DMA development, flow metering and leak locating
		Pressure management	Install and control of pressure reducing valves, Appropriate Discharge pump operation
		Speed and quality of repairs	Efficient organization and procedures, Appropriate standards for materials and workmanship
		Assets management	Priority setting and decisions on whether to repair, replace, rehabilitate

6.4.2 Specific Measures for BIWASE against Non-Revenue Water

(1) Risk of Non-Revenue Water in BIWASE

According to the interviews with BIWASE, Non-Revenue Water ratio is kept only about 4% now. However, since the portion of old network is relatively small, it is concerned that leakage will increase along with the pipe aging in the long term. According to the World Bank study, supply pervasion is still 17% in 2009. In the near future, there is also risk that pipe deterioration is accelerated by high discharge pressure to meet rapid demand increase.

(2) Basic Idea

The subject of this survey is construction and management of water conveyance, water treatment, and water supply facilities in new city and industrial parks in Northern part of Binh Duong province. More specifically, it is planning and design of raw water transmission pipeline, regulating reservoir, water treatment plants, and water distribution mains.

On the other hand, most of NRW measures are related to customer meters and water distribution network including branch and connection pipes. We examined the pressure management, as the only measure that can be taken within the scope of this survey. The pressure management is intended to adjust the supply pressure in the water distribution network under the control of the discharge pressure from the water treatment plant.

In general, the higher supply pressure gets, the larger leakage from distribution network becomes. Therefore, maintaining proper supply pressure can reduce the amount of leakage. Furthermore, since the excessive pressure leads to deterioration or fracture of the pipe network, it is effective in suppressing leakage in the long term. In addition, it can be expected to provide significant energy savings.

6.4.3 Measure against Non-Revenue Water by Pressure Management

(1) Problems Related to Pressure Management after Completion of North Binh Duong WTP

Figure 6.4.1 is a schematic description of the target area of hydraulic calculations shown in **Figure 6.3.1**. Distribution network of the three existing major water treatment plants will be connected after completion. Therefore, pump operation at each plant will be affected each other.

Improper operation of distribution pump at the treatment plants would lose the balance of water among all the plants. If discharge pressure is too high in some plant, water is provided too much and is over the capacity of the plant. On the contrary, less water will end up inefficient operation. Therefore, it is necessary to balance the distribution amount supplied from the water treatment plant.

It is necessary to operate appropriate pressure management in order to reduce the leakage under difficult conditions as described above.

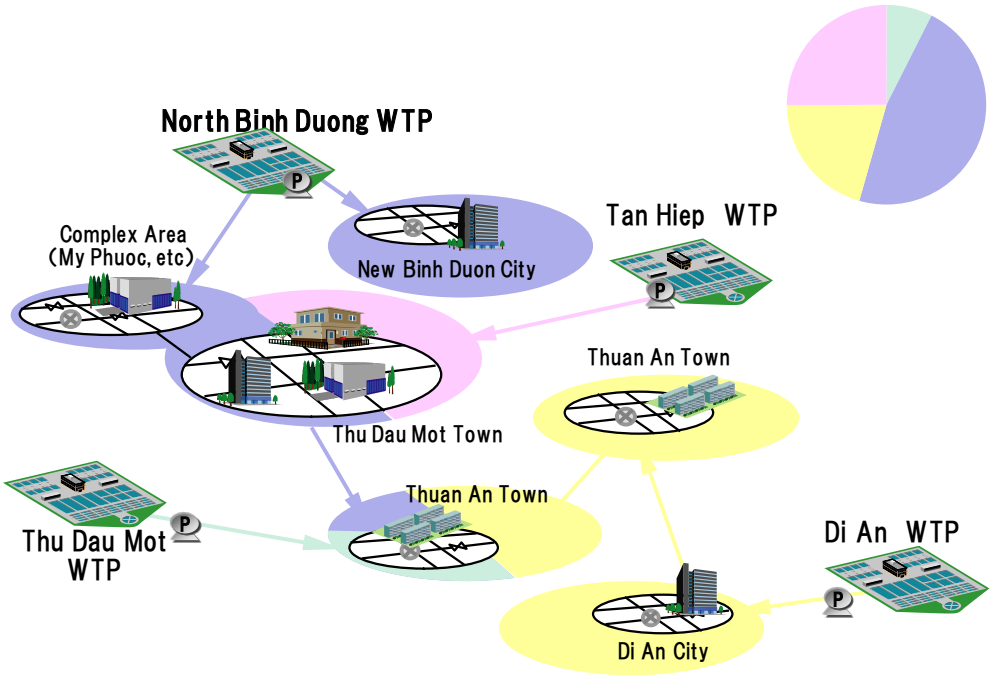


Figure 6.4.1 Connected Water Supply Areas and Water Distribution

(2) Pressure Management by Water Distribution Control System

To perform pressure management, which will satisfy the conditions in the above section, it is effective to introduce an advanced control system based on centralized management of the target pipe network and distribution facilities. **Figure 6.4.2** shows an example of system architecture that meets the requirements. The system, combined with geographic information system, centrally controls distribution facilities scattered in a wide area. It controls pumps automatically, based on the real-time pipe network analysis. By using the latest information from geographic information system, , this new system can follow the changes in the pipe network and perform precise control, which will be effective for leakage and energy reduction.

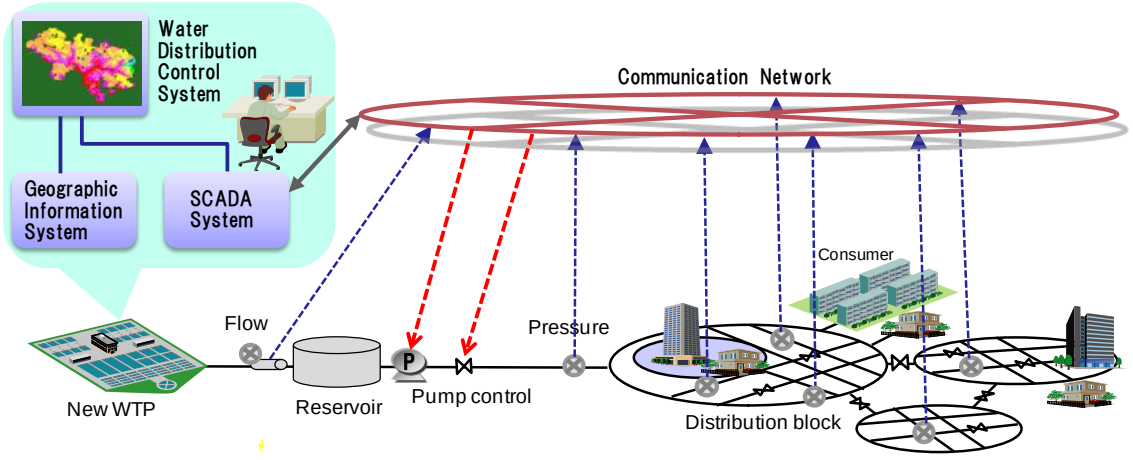
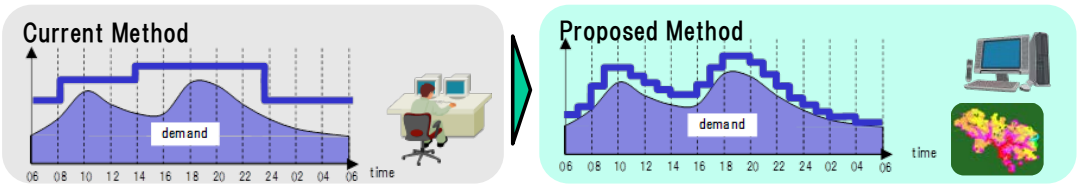


Figure 6.4.2 An Architecture of Water Distribution Control System

Figure 6.4.3 is a comparison chart of current method and proposed advanced method. Under current method, pump discharge pressure is controlled based on predetermined set point value. The value is decided by operator and is manually input to system. Pressure level is changed by pump on-and-off a few times a day.

On the other hand, under proposed method, pump discharge pressure is controlled based on calculated optimal value. The set point value is automatically decided by simulation based computation. Pressure level is adjusted by inverter control about every 5 minutes..



Point of Difference	Current Method	Proposed Method
Goal Setting	Set by operator beforehand	Set by computer On-line
	Human operator's expertise	Simulation based computation
pressure level adjusting	Pump on-and-off	Inverter controlled pump
	A few times a day	Every 5 minutes

Figure 6.4.3 Comparison Chart of Current and Proposed Method

6.4.4 Introduction Effect Evaluation of Water Distribution Control System

In this section, the effectiveness of the proposed control system described in the previous section is verified. Since the water leakage are in functional relationship with the end pressure of the pipe network, prevention of excessive pressure leads to leakage reduction. Besides, prevention of excessive pressure also produce energy-saving effect. For the above reasons, we regarded energy saving as quantitative validation of effectiveness in this evaluation.

(1) Simulation Conditions

Assumptions of the simulations are presented in **Figure 6.4.4**. As for the distribution network, based on the design results described in Section 6.3.3, the distribution main that is required for North Binh Duong water treatment plant to operate at 300,000 m3/day was used in this simulation. Total demand is set to about 326,000 m3 / day. This corresponds to about 160,000 m3/day from North Binh Duong that might be required in early period after the new treatment plant starts operation. Variation pattern of demand is assumed to be same as the current pattern.

For pressure control, the points located farthest from the purification plants on the pipe network is set as target points. Referring to the current operating conditions, goal pressure level is above 200kPA in normal operation, and is 180kPA in further energy-saving operation.

Assuming the above, we conducted a simulation of four cases under the conditions shown in **Table 6.4.3**. In the case 1, water distribution is operated with the same control method as current one in the new water treatment plant. In the case 2, a proposed method is applied only to the new water treatment plant. And in the case 3, the proposed method is applied to all the water treatment plants. Goal pressure is 200kPA in the case 1, 2, 3(1) and 180kPA in the Case 3(2).

Table 6.4.3 Simulation Conditions

CASE		Pressure Control Method		Goal Pressure (kPA)
		New WTP (North Binh Duong)	Existing WTP (Tan Hiep, Thu Dou Mot, Di An)	
1		Current	Current	**200**
2		**Proposed**	Current	**200**
3	(1)	**Proposed**	**Proposed**	**200**
	(2)	**Proposed**	**Proposed**	**180**

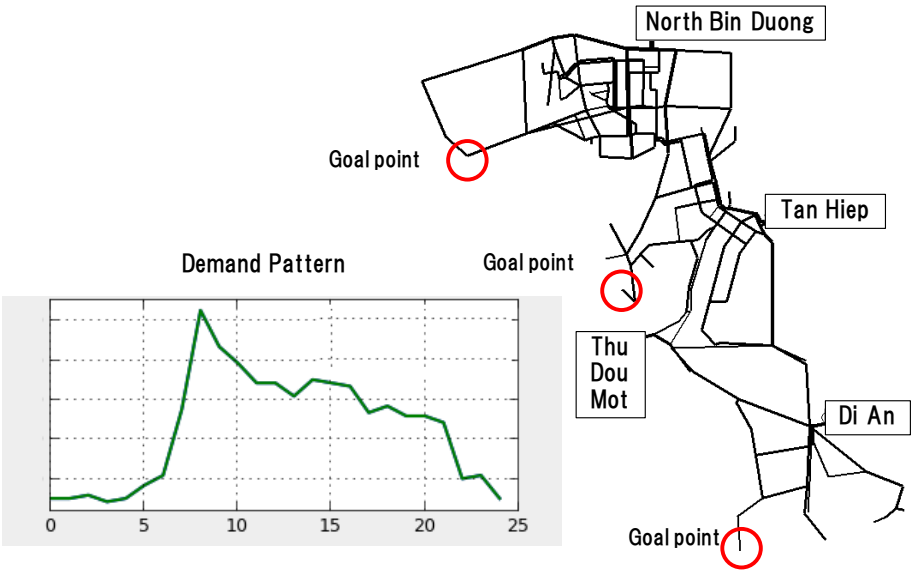


Figure 6.4.4 Demand Pattern and Goal Points for Pressure Control

(2) Simulation Results and Evaluations

Energy-saving effect in each case is shown in **Table 6.4.4**. Detail simulation result is shown in appendix 6-C. The comparison between case 1 and case 3(2) is shown in **Figure 6.4.5**. In the case 1, discharge pressure from each water treatment plant is kept same as the predetermined settings. In the case 3(2), the discharge pressure from each water treatment plant is keeping up with demand fluctuation pattern. In the case3(2), the goal pressure is 180kPA, set to lower than usual. It is assumed that setting a lower goal with small margin is possible because the pressure can be controlled precisely with advanced control method. In this case, it becomes a saving of about 13%, which is equivalent to saving approximately 4000MVND year, and substantial amount of leakage reducing effects can be expected. End pressure and distribution balance is properly maintained. Water distribution in a proper pressure continues stably, which is also effective for suppressing fracture and deterioration of pipes.

Table 6.4.4 Simulation Results

***1kwh = 2,085VND (= 10JPY)**

CASE			Goal Pressure (kPA)	Energy Consumption (kWh/d)	Energy Saving Ratio(%)	Cost Saving* Amount (MVND/year)
1		Current Method	200	41,017	-	-
2		Proposed Method (applied to NBD WTP)	200	39,403	3.9	1,243
3	(1)	Proposed Method (applied to All WTPs)	200	38,093	7.1	2,252
	(2)		180	35,728	12.9	4,073

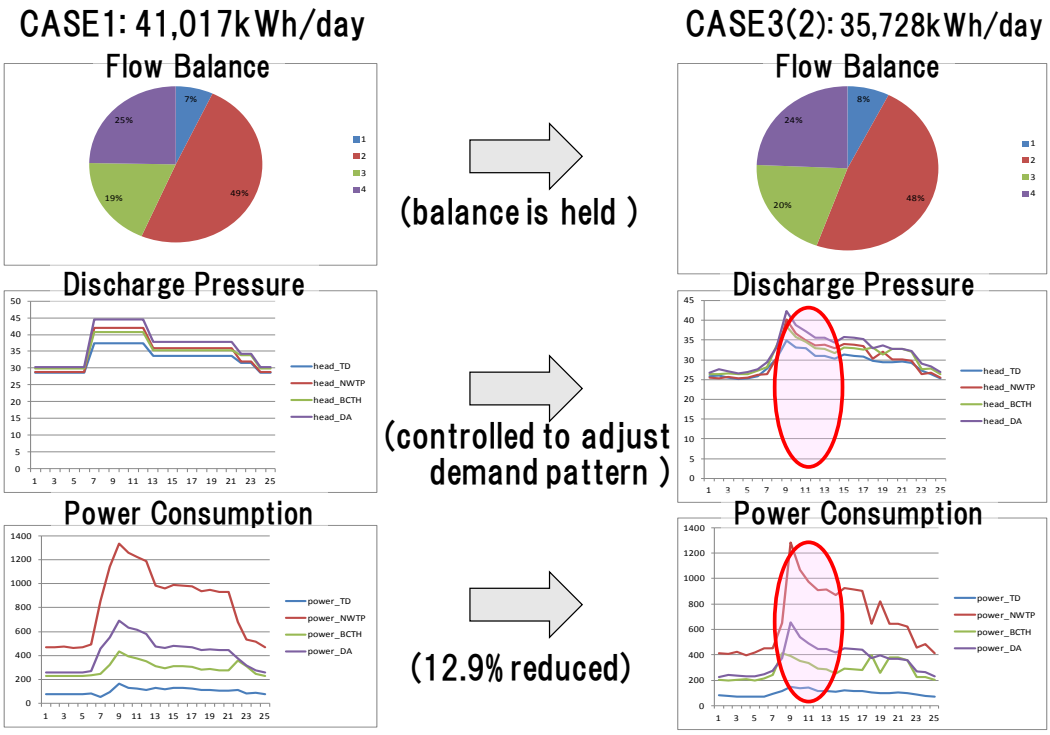
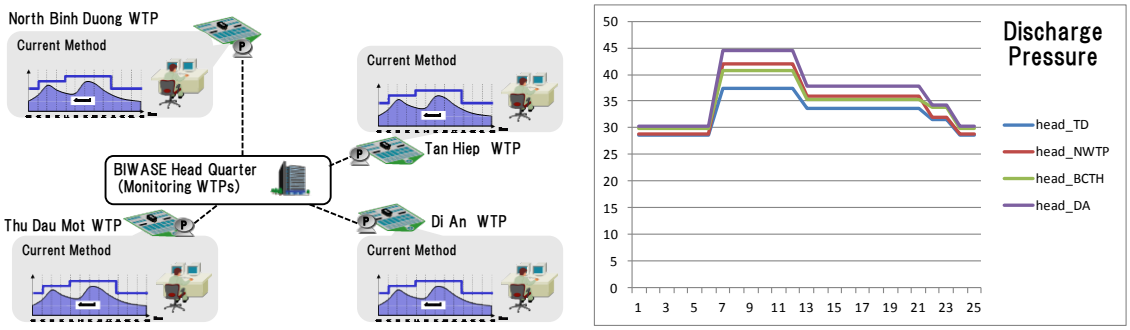


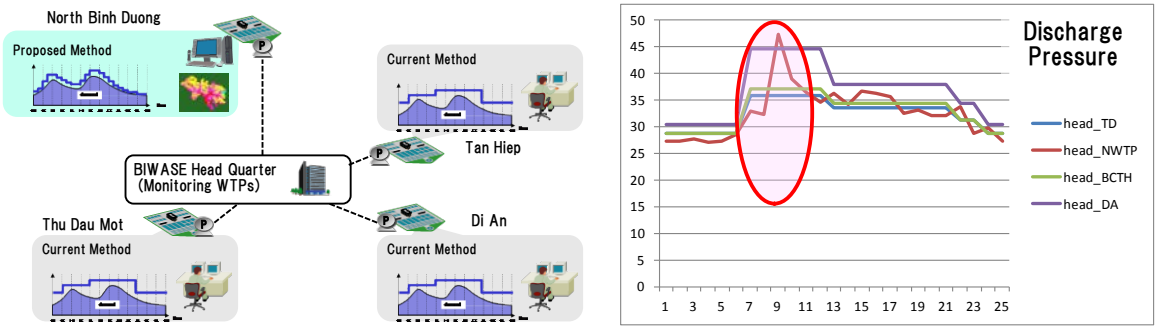
Figure 6.4.5 Evaluation of the Simulation Result

(3) Effect of Phased Introduction

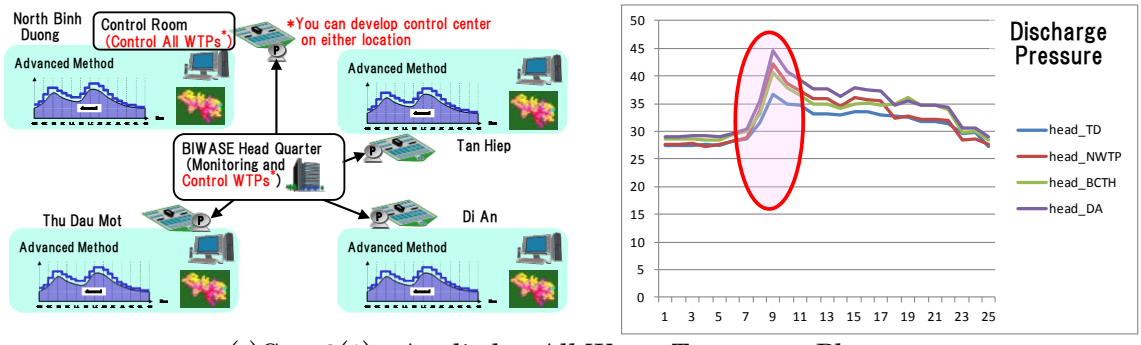
System introduction state of case 1, case 2 and case 3(1) and control results of discharge pressure is presented in **Figure 6.4.6**. In the case1, under the current control method, goal settings of discharge pressures of each plants is independently determined. The headquarter monitors and coordinates all of the water purification plants. In the case 2, only North Binh Duong water treatment plant controls its discharge pressure considering balance with the other water treatment plants. About 4% energy savings is obtained in this case. In the case 3(1), Discharge pressure from all water purification plants are controlled centrally from one place. Goal pressure in this case is 200kPA, same as current goal pressure. Energy-saving effect is about 7%. It is possible to implement centralized control place both in the head quarter and in North Binh Duong water treatment plant. First, the advanced control system will be introduced into North Binh Duong and then advanced control method will be applied in stages to the other water treatment plants by modifying their existing systems. Such a system construction is possible and significant effect is obtained in each stage.



(a)Case 1 Water Distribution Control with Current Control Method



(b)Case2 Applied only to North Binh Duong Water Treatment Plant



(c)Case3(1) Applied to All Water Treatment Plants

Figure 6.4.6 Phased Introduction of Water Distribution Control System

CHAPTER 7 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

7.1 Outline of Project Components that have Environmental and Social Impacts

The project consists of i) Raw Water Pipeline with an Intake Facility, ii) Raw Water Regulating Reservoir with a Pumping Station, iii) WTP and iv) Distribution Pipelines. Some of the planned sites for facilities are occupied, so land acquisition with resettlement issue is in progress.

The majority of planned sites are agricultural land (gum trees) and no wildlife habitat is expected and the related authorities agreed that no significant considerations for the ecosystem are necessary. This issue will be studied by EIA.

Evaluations by the JICA Survey Team confirmed whether there are any significant adverse impacts caused by the project.

The environmental and social considerations check list which summarizes the survey results was prepared to cover every aspect to check.

The field studies were finished in July, 2013 but it was requested that the location of the reservoir should be changed by BIWASE. In addition, additional studies will be required if the project is granted by ODA loan because it was not planned by the time the studies were completed.

7.2 Existing Environmental Conditions

The existing environmental conditions are described in Section 3.2 (1)-(5).

7.3 Existing Social Conditions

The existing social conditions are described in Section 3.2 (6).

7.4 Project Sites Appearance (Pictures taken by JICA Survey Team, November and December, 2012)

Picture-1 Existing canal

Picture-2 Intake gate

	
Picture-3 Regulating Reservoir planned site	Picture-4 Gum trees near the transmission pipeline planned site
	
Picture-5 Gum lifecycle: Harvest - Logging (sold as wood or charcoal) - Seeding	Picture-6 Gum trees in the WTP planned site (the opposite side of a red stake)

7.5 Environmental Social Consideration Regulation and Organization

7.5.1 Outline of Environmental Social Consideration Related Laws and Regulations

Institution of Environmental Impact Assessment (EIA) in Vietnam is prescribed by Law on Environmental Protection (LEP; No.52/2005/QH11) , Decree No. 80/2006/ND-CP, No. 21/2008/ND-CP and No. 29/2011/ND-CP. LEP was made public by No. 29/2005/L/CTN and came into effect in 2006. It prescribes Strategic Environment Assessment, EIA and Environment Conservation Pledge.

Decree No. 80/2006/ND-CP, No. 21/2008/ND-CP and No. 29/2011/ND-CP prescribe LEP administrative instruction, EIA target project list, EIA procedure, contents of EIA report and so on. By these decrees, it is prescribed that projects involving reservoirs of 100,000m^3 or more and projects utilizing surface water of 50,000m^3/day or more need to prepare EIA reports. It applies to the project because the reservoir will impound 1,000,000 m^3 and the WTP will consume surface water of 300,000m^3/day.

EIA report should be prepared within 24 months before the commencement of the project. The procedure to be followed is shown in section 7.5.3.

The approval authority for the project is Ministry of Natural Resources and Environment (MONRE). Stakeholder consultation should be held at the stage of EIA report preparation, which is prescribed by Decree No. 29/2011/ND-CP.

For information disclosure, the decree describes that the authority send the EIA report to the proponent

and the environmental departments and the Provincial PC distributes the copies to local PCs.

Preparation of the draft EIA report was supported within this study and the EIA report will be completed by BIWASE.

Table 7.5.1 shows laws and standards related to environmental social consideration.

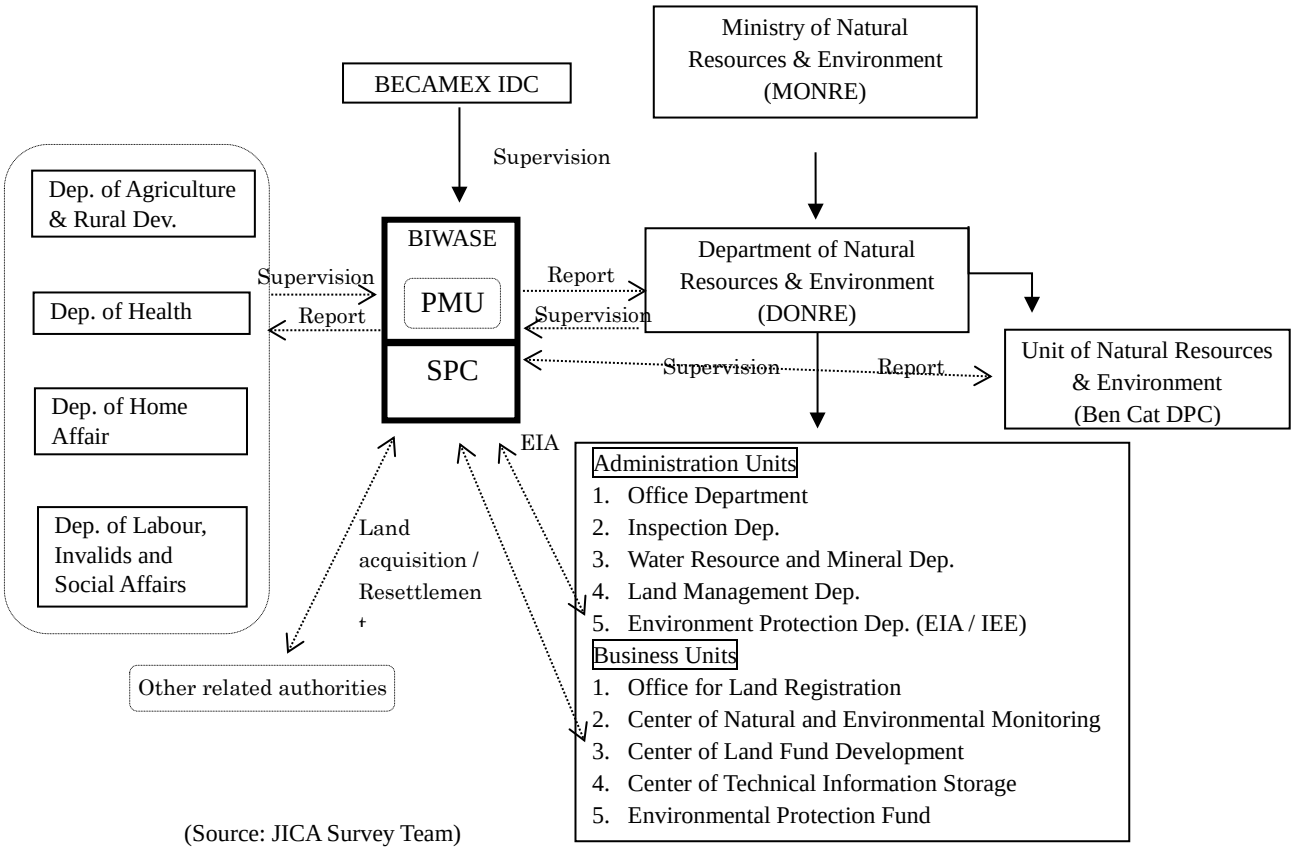
Table 7.5.1 Laws and Standards Related to Environmental Social Consideration

No.	Laws and standards
Laws and regulations	
1	LEP(No.52/2005/QH11)
2	Decree No. 80/2006/ND-CP
3	Decree No. 21/2008/ND-CP
4	Circular No 26/2011/TT-BTNMT
Environmental standards	
1	QCVN 05-2009
2	QCVN 06-2009
3	QCVN 19-2009
4	QCVN 20-2009
5	QCVN 24-2009
6	QCVN 08-2008
7	QCVN 09-2008
8	QCVN 10-2008
9	QCVN 26-2010
10	QCVN 14-2008
11	TCVN 7222-2002

(Source: JICA Survey Team)

7.5.2 Environmental and Social Consideration Organizations

Organizations related to Environmental and Social Consideration and their roles are shown below. BIWASE proceeds land acquisition and other plans and will conduct EIA study for the time being. After the foundation of PMU and SPC, they will be the executor of Environmental and Social Consideration. They will consider and report of monitoring and other aspects according to the Environmental Management Plan (EMP) under the supervision of authorities shown in **Figure 7.5.1**.

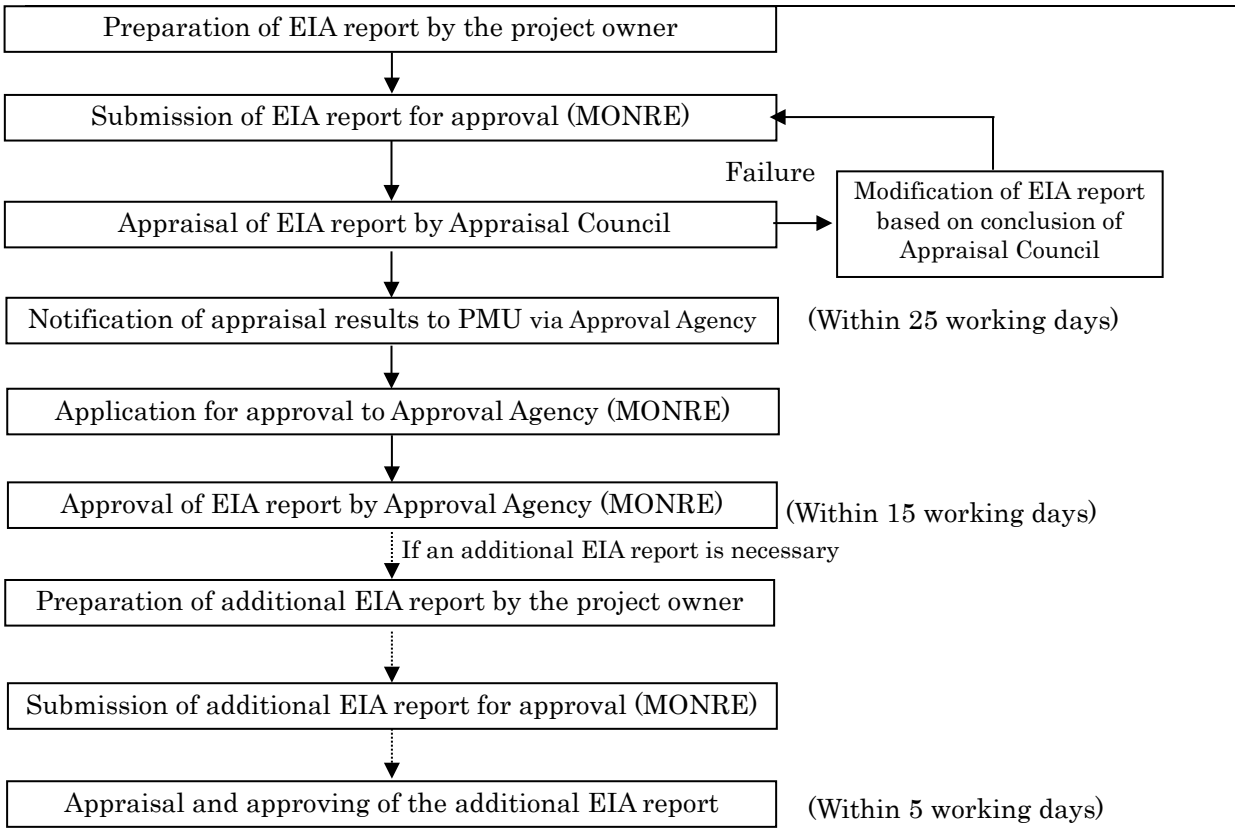


(Source: JICA Survey Team)

Figure 7.5.1 Environmental and Social Consideration Organizations

7.5.3 EIA Procedure

The procedure for appraisal and approval of the EIA report is shown in **Figure 7.5.2**.



(Source: JICA Survey Team)

Figure 7.5.2 Procedure for Appraisal and Approval of EIA Report

Contents of EIA reports are as follows.

1) Enumeration and detailed description of the project's construction components, construction area, time and workload; operational technology for each component and the entire project.

2) Overall assessment of the environmental status at the project site and neighboring areas; the sensitivity and load capacity of the environment.

3) Detailed assessment of possible environmental impacts when the project is executed and environmental components and socio-economic elements to be impacted by the project; prediction of environmental incidents possibly caused by the project.

4) Specific measures to minimize bad environmental impacts prevent and respond to environmental incidents.

5) Commitments to take environmental protection measures during project construction and operation.

6) Lists of project items, the program on management and supervision of environmental issues during project execution.

7) Cost estimates for building environmental protection works within the total cost estimate of the project.

8) Opinions of the commune/ward or township People's Committees (hereinafter collectively referred to as commune-level People's Committees) and representatives of population communities in the place where the project is located; opinions against the project location or against environmental protection solutions must be presented in the EIA report.

9) Citation of sources of figures and data, assessment methods.

7.5.4 Schedule of EIA

The upcoming schedule of the EIA procedure is shown in **Figure 7.5.3**.

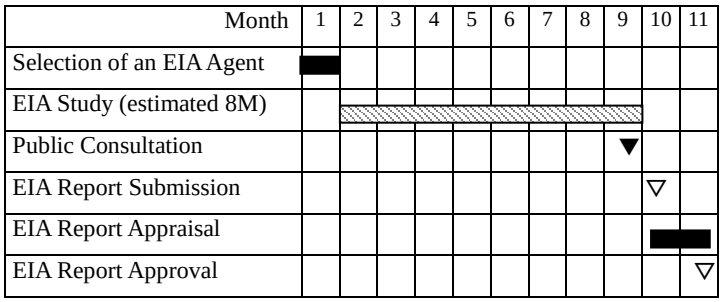


Figure 7.5.3 Schedule of the EIA procedure

7.6 Comparison of Alternatives

7.6.1 Water Sources

Four alternatives for raw water sources are considered: i) without the Project / ii) groundwater / iii) river water / iv) canal water

i) Without the Project
Binh Duong Province has developed to one of the main province formulating the HCM urban area in recent years. On the other hand, the water treatment amount in 2012 was less than 24% of the whole water demand (as estimated in **Section 3.3.1**). Furthermore, the water demand values in 2020 and 2030 are intended to be increased rapidly. Thus, the Project implementation is considered essential.

ii) Groundwater
The main water source up to date is groundwater in Binh Duong. It is reported that the capacity of ground water is still enough but BDPPC started restriction on exploiting groundwater considering shortage in future. On top of that, it is said that 100 or more wells will be necessary for raw water of 300,000 m^3/day. Accordingly, it is judged not to use groundwater.

iii) River water
There are three candidates as water source. That is, Saigon, Dong Nai and Be Rivers. For the both of Saigon and Dong Nai Rivers, the amount is enough but the quality is deteriorating. It is also worried that shortage and salinity intrusion in future take place in Saigon River because of excessive demand. The water quality of Be River is better than other two but the intake from it is not recommended because a canal was constructed upstream and the amount should be maintained. As the result, usage of river water is available but not suitable.

iv) Canal water
The canal leads from Phuoc Hoa Reservoir that was constructed by building a dam in Be River to Dau Tieng Lake that is located upstream of Saigon River. The water quality is comparatively good because the water is from Be River. The intake right for 15m^3/sec or 1,296,000m^3/day was already obtained.
As the result of comparison shown above, Canal water was adopted because it has better water quality and water right was obtained. The detail of comparison is shown in **Table 7.6.1**.

Table 7.6.1 Alternatives Comparison (Water Sources)

	Without the project	Groundwater	River water	Canal water
Water supply	×	○	○	○
Amount	―	△	○	○

	Without the project	Groundwater	River water	Canal water
Quality	—	◎	△	○
Exploitation / Restriction	—	×	△	○
Ground environment	—	×	—	△
Cost	—	△	○	△
Ecosystem	—	—	△	—
Land use	—	—	△	△
Resettlement	—	—	△	△
Result of comparison	Rejected	Rejected	Rejected	Adopted
Conclusive aspect	Short of water supply	Short of water supply	Problem of quality and intake	Quality and water right

【Legend】 — : No impact, × : Large adverse impact, △ : Adverse impact, ○ : Positive effect, ◎ : Significant positive effect

7.6.2 Alternative Routes of Transmission Pipeline

For the transmission pipeline to be constructed from the canal to the regulating reservoir, 2 alternative routes were considered; i) utilizing the route 13 and ii) land acquisition of gum tree fields.

Alternative i);
Smaller land acquisition but more social impact during the construction because it is one of the main traffic roads and there are many facilities along it such as residences, business establishments, industrial factories, hospitals, schools and so on.

Furthermore, the construction would be double phased. There will be a possibility of land acquisition along the road according to the construction methods. Other infrastructures can be impacted because the space under and along the road is congested already. The above mentioned are aspects against the alternative i).

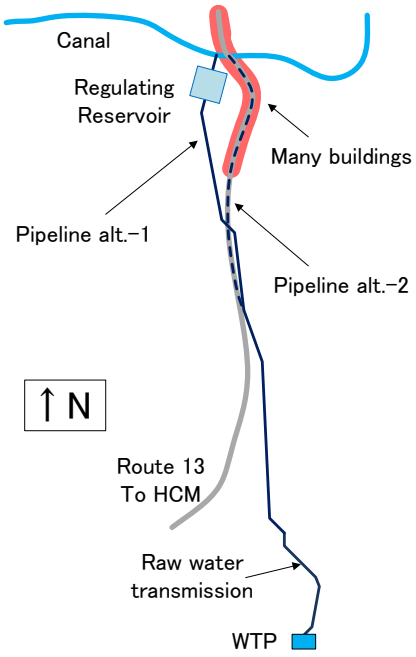


Figure 7.6.1 Transmission Pipeline Routes

Alternative ii);
More land acquisition but better environment for the second construction, maintenance, rehabilitation, etc. The main land is the field of gum trees, which makes the cost lower than residential, commercial and industrial lands. The route is fixed in light of the minimum residences to be displaced and there are only 7 residences along the carefully selected route with length of approx. 20km

The alternative ii) was selected because;
a) The alternative i) will have social impacts and problems against other infrastructures.
b) Budget plans for alternative ii) were approved by the BDPPC according to the reasons related to the alternative i) and BIWASE had started land acquisition already.
c) The alternative ii) has convenience for construction, potential for additional construction, etc.
The comparison is shown in **Table 7.6.2**.

Table 7.6.2 Alternatives Comparison (Transmission Pipeline Routes)

	Alternative i) The route 13	Alternative ii) Gum tree land acquisition
Land acquisition	△	×
Resettlement	(unknown)	△

Cost	Δ	×
Traffic	×	―
Surrounding residents	×	Δ（limited）
Surrounding businesses	×	Δ（limited）
Specially considered facilities (schools and hospitals)	×	Δ
Construction conveniences	Δ	○
Maintenance	Δ	○
Expandability	Δ	○
Other infrastructures	×	―
Result of comparison	Rejected	Adopted
Conclusive aspect	Social impact Construction inconvenience	Minimum impacts

【Legend】 ―: No impact, ×: Large adverse impact, △: Adverse impact, ○: Positive effect, ◎: Significant positive effect

7.6.3 Alternatives to Maintain Raw Water

Conventional method to obtain raw surface water is to intake water from a nearby facility and to transfer it to a WTP. For the Project, there are two features; a) to intake from the constructed canal. b) to transfer water in a long distance (approx.25km).

With those features, there will be risks for maintaining raw water in case of rehabilitation and maintenance of the canal and the transmission pipeline.

In order to avoid the problem, a plan was considered to maintain water for 2 to 3 days by constructing a reservoir near the intake.

For the construction of the dam for the regulating reservoir, consideration on prevention of water quality deterioration would be necessary and construction cost would be increased but it is still necessary to maintain raw water for the stable water supply. Consequently, The construction plan of the regulating reservoir should be adopted.

Table 7.6.3 Alternatives Comparison (Maintaining Raw Water)

	Regulating reservoir	No reservoir
Land use change	― （rehabilitation only）	―
Water quality deteriorate	Δ	―
Construction cost	Δ	―
Generated soil	― （usable for the dam）	―
maintaining raw water in case of rehabilitation and maintenance of the canal	○	×
maintaining raw water in case of rehabilitation and maintenance of the transmission pipe	○	×
Result of comparison	Adopted	Rejected
Conclusive aspect	Stable water supply	Rack of risk management

【Legend】 ―: No impact, ×: Large adverse impact, △: Adverse impact, ○: Positive effect, ◎: Significant positive effect

7.6.4 Alternatives to WTP Planned Site

Some candidate sites were chosen with conditions such as;
- Close to the service area
- On the side of the canal (to the north of the service area)
- Higher altitude (to utilize gravity for supplying)

The **Figure 7.6.2** shows candidates A～D.

Figure 7.6.2 WTP site candidates A-D

The current land use and the plan in future for each site are as followings.

A: Current – Graveyard
B: Current – Productive forest with high voltage cables
C: Current – Productive forest / Future – Residential area
D: Current – Productive forest / Future – Agricultural land

Candidate A and B are not suitable in light of current usage. Candidate C and D are productive forests where development is allowed. Candidate C will be a residential area which has many procedures to change the purpose of land use while Candidate D will be an agricultural land which has fewer problems to be considered. Consequently, Candidate D is the most possible site. In addition, BIWASE had already started land acquisition of Candidate D site.

7.7 Scoping

7.7.1 Intake and Transmission Facilities

Scoping of the intake and associated facilities is shown in **Table 7.7.1**. The components are the intake facility with a pumping facility and transmission pipeline (1) which is between the intake and the reservoir.

Table 7.7.1 Scoping – Evaluation and the Reason (Intake and Transmission Facilities)

Item	Evaluation	Reason
1 Air pollution	B	Impacts caused by dust
2 Water pollution	B	Impacts caused by production of muddy water
3 Soil pollution	B	Soil pollution caused by oil leakage
4 Waste	B	Due to producing soil waste
5 Noise and vibrations	B	Due to noise and vibration caused by earthwork and transfer
6 Ground subsidence	B	Impact is unknown so drilling investigation is ongoing

Item	Evaluation	Reason
7 Offensive odors	D	No adverse impacts are expected
8 Geographical features	D	No adverse impacts are expected
9 Bottom sediment	D	No adverse impacts are expected
10 Biota and ecosystems	C	Impact is unknown so EIA investigation will be conducted
11 Water usage	D	No adverse impacts are expected due to deep permeable layer
12 Accidents	B	Due to possible accidents during construction
13 Global warming	D	No adverse impacts are expected due to no gases emitted under normal operation
14 Involuntary resettlement	B	Due to and land acquisition and resettlement of residents
15 Local economies	C	Impact is unknown so consultation with the related authority should be made
16 Land use	B	Due to change of land use
17 Social institutions	D	No institutions establishment is expected
18 Existing social infrastructures and services	C	Impact is unknown so consultation with the related authority should be made.
19 Poor, indigenous, or ethnic people	C	Impact is unknown so consultation with the related authority should be made.
20 Misdistribution of benefits and damages	C	Impact is unknown so consultation with the related authority should be made.
21 Local conflicts of interest	D	No adverse impacts are expected
22 Gender	D	No adverse impacts are expected
23 Children's rights	D	No adverse impacts are expected
24 Cultural heritage	D	No adverse impacts are expected
25 Infectious diseases such as HIV/AIDS	C	Impact is unknown so consultation with Department of Health will be held
26 Protection aria	D	No protection area exists in and around the target area
27 Hydrology	D	No impacts are expected to natural water environment
28 Scenery	D	The facilities are out of sight of public areas
29 Working conditions	B	Necessity for consideration of occupational safety

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

7.7.2 Regulating Reservoir

Scoping of the reservoir and associated facilities is shown in **Table 7.7.2**. The components are the reservoir, pumping facility and raw water transmission line (2) which is between the reservoir and the WTP.

Table 7.7.2 Scoping – Evaluation and the Reason (Regulating Reservoir)

Item	Evaluation	Reason
1 Air pollution	B	Due to dust caused by earthwork
2 Water pollution	B	Due to necessary consideration on the downstream river
3 Soil pollution	B	Impacts caused by oil leakage
4 Waste	B	Due to excavated soil and construction waste
5 Noise and vibrations	B	Due to noise and vibration caused by earthwork and transfer
6 Ground subsidence	B	Impact is unknown so drilling investigation is ongoing
7 Offensive odors	D	No adverse impacts are expected
8 Geographical features	A	Topographical change for the dam will take place.
9 Bottom sediment	D	No adverse impacts are expected
10 Biota and ecosystems	B	Impact is unknown so EIA should be conducted

Item	Evaluation	Reason
11 Water usage	D	No adverse impacts are expected
12 Accidents	B	Due to possible accidents during construction and accidents along the reservoir
13 Global warming	D	No adverse impacts are expected due to no gases emitted under normal operation
14 Involuntary resettlement	A	Due to land acquisition , resettlement of residents and the economic change / support
15 Local economies	C	Due to necessity of a socio-economic survey to find out problems
16 Land use	B	The site is originally a reservoir but due to some change of land use (gum trees)
17 Social institutions	D	No adverse impacts are expected
18 Existing social infrastructures and services	C	Impact is unknown so consideration should be made.
19 Poor, indigenous, or ethnic people	C	Impact is unknown so consideration should be made.
20 Misdistribution of benefits and damages	C	Impact is unknown so consideration should be made.
21 Local conflicts of interest	D	No adverse impacts are expected
22 Gender	D	No adverse impacts are expected
23 Children's rights	D	No adverse impacts are expected
24 Cultural heritage	D	No adverse impacts are expected
25 Infectious diseases such as HIV/AIDS	C	Impact is unknown so consultation with Department of Health will be held
26 Protection aria	D	No protection area exists in and around the target area
27 Hydrology	D	No adverse impacts are expected
28 Scenery	D	The facilities are out of sight of public areas
29 Working conditions	B	Necessity for consideration of occupational safety

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

7.7.3 WTP and Distribution Pipes

Scoping of the reservoir and distribution pipes is shown in **Table 7.7.3**.

Table 7.7.3 Scoping – Evaluation and the Reason (WTP and Related Facilities)

Item	Evaluation	Reason
1 Air pollution	B	Impacts caused by dust
2 Water pollution	B	Impacts caused by production of muddy water
3 Soil pollution	B	Soil pollution caused by oil leakage
4 Waste	B	Due to construction waste and sludge from WTP
5 Noise and vibrations	B	Due to noise and vibration according to earthwork and transfer
6 Ground subsidence	B	Impact is unknown so drilling investigation is ongoing
7 Offensive odors	D	No adverse impacts are expected
8 Geographical features	B	Due to ground leveling
9 Bottom sediment	D	No adverse impacts are expected
10 Biota and ecosystems	C	Impact is unknown so EIA investigation will be conducted
11 Water usage	D	No adverse impacts are expected due to no wastewater emission
12 Accidents	B	Due to possible accidents during construction
13 Global warming	D	No adverse impacts are expected due to no gases emitted under normal operation

Item	Evaluation	Reason
14 Involuntary resettlement	B	Due to and land acquisition and resettlement of residents
15 Local economies	C	Impact is unknown so consultation with the related authority should be made.
16 Land use	B	Due to dust, noise and vibration according to earthwork and transfer
17 Social institutions	D	No institutions establishment is expected
18 Existing social infrastructures and services	C	Impact is unknown so consultation with the related authority should be made.
19 Poor, indigenous, or ethnic people	C	Impact is unknown so consultation with the related authority should be made.
20 Misdistribution of benefits and damages	C	Impact is unknown so consultation with the related authority should be made.
21 Local conflicts of interest	D	No adverse impacts are expected
22 Gender	D	No adverse impacts are expected
23 Children's rights	D	No adverse impacts are expected
24 Cultural heritage	D	No heritages are found in the sites
25 Infectious diseases such as HIV/AIDS	C	Impact is unknown so consultation with Department of Health will be held
26 Protection aria	D	No protection area exists in and around the target area
27 Hydrology	D	No impacts are expected to natural water environment
28 Scenery	D	The facilities are out of sight of public areas
29 Working conditions	B	Necessity for consideration of occupational safety

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

7.8 TOR of Environmental and Social Consideration

7.8.1 Purpose of Environmental and Social Consideration

The purpose is to predict and assess the contents and scale of possible impacts to natural and social environment by the Project which is outline-designed in "the Preparatory Survey on Water Supply Project in New City and Industrial Parks in Northern Part of Binh Duong Province".

7.8.2 Items to be Targeted in the Study and Evaluation

In principle, items with A, B and C in evaluation in **7.7 Scoping** should be studied and evaluated. In addition, other items that are assumed to be considered as the survey proceeds should also be targets.

7.8.3 Target Areas

Target areas are construction planned sites and the surrounding areas of the project facilities. In addition, in case that access roads are necessary, they and their surrounding areas should also be targeted.

7.8.4 Target Periods

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

7.8.5 Contents and Methods of Environmental and Social Consideration Study

The study methods are shown in **Table 7.8.1** and **2**.

Table 7.8.1 The Study for the Reservoir

Evalu-ation	No.	Item	Study / Countermeasure		Status
A	8	Geographical features	Drilling study		Done
	14	Involuntary resettlement	Preparation of the draft Abbreviated Resettlement Plan (ARP)		Done
			Consideration on prevention of troubles in land acquisition procedure		ARP
B	1	Air pollution	Suggestion on prevention of dust produced by excavation and so on		Done
	2	Water pollution	Water quality test before construction		Done
			Consideration on the downstream area by bypassing the existing river		Done
			Consideration on prevention of water quality deterioration by circulate the dam water periodically		Done
			Suggestion on treatment of muddy water		Done
	3	Soil pollution	Confirmation on construction components, methods, sites, etc.		DD stage
	4	Waste	Estimate of soil produced and used		Done
			Consultation with the related authorities on treatment methods of construction, general, and human wastes.		Done
	5	Noise and vibrations	Noise measurement before construction, prediction and countermeasure		EIA
			Suggestion on countermeasure such as reducing noise and vibration of transport of construction materials and so on		Done
	6	Ground subsidence	Designing according to drilling study results		Done
	10	Biota and ecosystems	Flora survey	Document investigation / Acquisition of information from the authorities concerned	Done
				Site survey (frequency and contents will be suggested according to consultation with associated authorities)	EIA
			Fauna survey	Document investigation / Acquisition of information from the authorities concerned	Done
				Suggestion from specialists	EIA
				Site survey (frequency and contents will be suggested according to consultation with associated authorities) in and around the planned sites. e.g. Surveys for mammal, bird, reptile, amphibian and insects	EIA
	12 29	Accidents Working conditions	Suggestion on safety measures under construction		Done
			Ensuring the safety of the reservoir and the pumping station in the design		Done
	16	Land use	The regulating reservoir will be constructed in a site where a reservoir existed and no significant change will be made for the land use. However, the water will cover some fields and consideration should be made.		ARP
C	15	Local economies	Survey of impacts to local economies by the socio-economic survey		ARP
	18	Existing social infrastructures and services	Consultation with related authorities (PC)		Done
	19	Poor, indigenous, or ethnic people	Resource research (DOLISA)		Done
			Confirmation by the initial baseline survey in ARP preparation		Done
	20	Misdistribution of benefits and damages	Consultation with related authorities (PC, DOLISA)		Done
	25	Infectious diseases such as HIV/AIDS	Consultation with associated authorities (Department of Health)		Done

Table 7.8.2 The Study for the Related Facilities

Evaluation	No.	Item	Study / Countermeasure	Status
B	1	Air pollution	Suggestion on prevention of dust produced by excavation and so on	Done
	2	Water pollution	Suggestion on treatment of muddy water	Done
	3	Soil pollution	Confirmation on construction components, methods, sites, etc.	DD stage
	4	Waste	Estimate of soil produced and used	Done
			Confirmation on treatment methods of construction wastes, general wastes and human wastes / Confirmation on reception facilities	Done
			Estimate of sludge produced by WTP	Done
	5	Noise and vibrations	Noise measurement before construction, prediction and countermeasure	EIA
			Study on construction site and surrounding area including special facilities such as hospitals, school and so on	Done
			Suggestion on low-noise and vibration type machineries	Done
			Suggestion on countermeasure such as reducing noise and vibration of transport of construction materials and so on	Done
	6	Ground subsidence	Designing according to drilling study results	Done
	8	Geographical features	Drilling study	Done
			Minimizing the scale of topographical change when constructing facilities	Done
	12 29	Accidents Working conditions	Suggestion on thorough safety measures under construction / in operation of WTP	Done
	14	Involuntary resettlement	Preparation of the draft Abbreviated Resettlement Plan (ARP)	Done
	16	Land use	Prevention of dust by watering under construction of WTP and so on.	Done
C	10	Biota and ecosystems	Fauna and flora field surveys by EIA	EIA
	15	Local economies	Consultation with related authorities	Done
	18	Existing social infrastructures and services	Consultation with related authorities	Done
	19	Poor, indigenous, or ethnic people	Consultation with related authorities	Done
	20	Misdistribution of benefits and damages	Consultation with related authorities	Done
	25	Infectious diseases such as HIV/AIDS	Consultation with associated authorities (Department of Health) and related organization	Done

7.9 Environmental Impact Prediction / Assessment based on the Study Results

Based on the scoping shown in **Table 7.7.1**, **2** and **3**, evaluation of predicted impacts and the mitigation measures are presented (**Table 7.9.1**, **2** and **3**) as a result of Initial Environmental Examination (IEE). Many of them are described in the Environmental Management Plan (EMP) or Abbreviated Resettlement Plan (ARP).

Table 7.9.1 IEE Result (Intake and Transmission Facilities)

Items	Scoping	IEE result	Reason / Mitigation measure
1 Air pollution	B	B	Impacts by dust produced by excavation and so on
	EMP		Prevention by watering, covering, etc.
2 Water pollution	B	B	Water with turbidity will be produced during construction
	EMP		Coagulation treatment will be necessary
3 Soil pollution	B	B	Impacts by oil leakage
	DD		Countermeasures are necessary in the DD stage
	B	B	Oil waste will be produced from pumping facilities
	EMP		Adequate treatment
4 Waste	B	B	Re-use on site is possible but some will be left
	EMP		Adequate disposal
5 Noise and vibrations	B	B	Due to Noise and vibration according to earthwork
	EMP		Noise and vibration measure before construction, prediction and consideration of mitigation / Adoption of low-vibration and low-noise machineries / Slowing down construction vehicles
6 Ground subsidence	B	D	Ground subsidence does not take place by designing in light of drilling test results
10 Biota and ecosystems	C	B	It was found that the target areas are all secondary forests and consideration on biota and ecosystems is not necessary according to interviews with related authorities. However, EIA investigation will be conducted to check the fields.
	EIA		• Flora study (Inventory study of existing vegetation with location) • Fauna study (A series of field studies targeting Mammal, Bird, Reptile/Amphibian and Insect)
12 Accidents	B	B	Due to accident risks during construction
	EMP		Safety management
14 Involuntary Resettlement	B	B	Due to and land acquisition and resettlement of residents
	ARP		To be compensated according to the regulation.
15 Local economies	C	D	No possible adverse impacts are expected according to authorities concerned.
16 Land use	B	B	Impacts by dust produced by excavation and so on
	EMP		Prevention by watering, covering, etc.
18 Existing social infrastructures and services	C	D	No possible adverse impacts are expected according to authorities concerned.
19 Poor, indigenous, or ethnic people	C	D	No possible adverse impacts are expected according to authorities concerned.
20 Misdistribution of benefits and damages	C	D	No possible adverse impacts are expected according to authorities concerned.
25 Infectious diseases such as HIV/AIDS	C	B	External workers' stay is expected for a long period.
	EMP		Utilization of sanitary program / Consultation with local health authority
29 Working conditions	B	B	Risk during construction
	B	B	Consideration for safety during operation
	EMP		Safety management

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

Table 7.9.2 IEE Result (Reservoir)

Items	Scoping	IEE result	Reason / Mitigation measure
1 Air pollution	B	B	Due to dust caused by earthwork
	EMP		e.g. watering
2 Water pollution	B	B	Water with turbidity will be produced during construction
	EMP		Coagulation treatment will be necessary
3 Soil pollution	B	B	Impacts by oil leakage
	DD		Countermeasures are necessary in the DD stage
	B	B	Oil waste will be produced from pumping facilities
	EMP		Adequate treatment
4 Waste	B	B	Due to excavated soil and construction waste
	EMP		Management of adequate dumping
5 Noise and vibrations	B	B	Due to Noise and vibration according to earthwork and transfer
	EMP		Noise and vibration measure before construction, prediction and consideration of mitigation / Adoption of low-vibration and low-noise machineries / Slowing down construction vehicles
6 Ground subsidence	B	D	Designing to prevent ground subsidence or corruption according to drilling test results
8 Geographical features	A	B	Topographical change for the dam will take place.
	Design		The scale of the dam was minimized by the design. It is not planned to change geographical features in other parts of the reservoir.
10 Biota and ecosystems	B	B	No protected flora or fauna are expected. In addition, it was found that the target areas are all secondary forests and consideration on biota and ecosystems is not necessary according to interviews with related authorities. However, site studies will be conducted in order to confirm the existing environment.
	EIA		・ Flora study (Inventory study of existing vegetation with location) ・ Fauna study (A series of field studies targeting Mammal, Bird, Reptile/Amphibian and Insect)
12 Accidents	B	B	Due to possible accidents during construction
	B	B	Consideration for restriction and/or fencing
	EMP		Safety management
14 Involuntary resettlement	A	B	Due to land acquisition , resettlement of residents and the economic change / support (area reduced by the change of locations)
	ARP		To be compensated according to the regulation.
15 Local economies	C	D	No possible adverse impacts are expected according to authorities concerned.
16 Land use	B	B	It is necessary to check possible impacts.
	EIA		Field survey and prediction of possible impacts
18 Existing social infrastructures and services	C	D	No possible adverse impacts are expected according to authorities concerned.
19 Poor, indigenous, or ethnic people	C	D	No possible adverse impacts are expected according to authorities concerned.
20 Misdistribution of benefits and damages	C	D	No possible adverse impacts are expected according to authorities concerned.
25 Infectious diseases such as HIV/AIDS	C	B	External workers' stay is expected for a long period.
	EMP		Utilization of sanitary program / Consultation with local health authority
29 Working conditions	B	B	Risk during construction
	B	B	Consideration for safety during operation
	EMP		Safety management

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

Table 7.9.3 IEE Result (WTP and Related Facilities)

Items	Scoping	IEE result	Reason / Mitigation measure
1 Air pollution	B	B	Due to dust caused by earthwork
	EMP		e.g. watering
2 Water pollution	B	B	Water with turbidity will be produced during construction
	EMP		Coagulation treatment will be necessary
3 Soil pollution	B	B	Impacts by oil leakage
	DD		Countermeasures are necessary in the DD stage
4 Waste	B	B	Due to construction waste and sludge from WTP
	EMP		Management of adequate dumping
5 Noise and vibrations	B	B	Due to Noise and vibration according to earthwork and transfer
	EMP		Noise and vibration measure before construction, prediction and consideration of mitigation / Adoption of low-vibration and low-noise machineries / Slowing down construction vehicles
6 Ground subsidence	B	D	Ground subsidence does not take place by designing in light of drilling test results
8 Geographical features	B	D	Large scale change of geographical features is not necessary according to the survey results
10 Biota and ecosystems	C	B	It was found that the target areas are all secondary forests and consideration on biota and ecosystems is not necessary according to interviews with related authorities. However, EIA investigation will be conducted to check the fields.
	EIA		• Flora study (Inventory study of existing vegetation with location) • Fauna study (A series of field studies targeting Mammal, Bird, Reptile/Amphibian and Insect)
12 Accidents	B	B	Due to accident risks during construction
	EMP		Safety management
14 Involuntary Resettlement	B	B	No resettlement is planned but land acquisition is necessary.
	ARP		To be compensated according to the regulation.
15 Local economies	C	D	No possible adverse impacts are expected according to authorities concerned.
16 Land use	B	B	Impacts by dust produced by excavation and so on
	EMP		Prevention by watering, covering, etc.
18 Existing social infrastructures and services	C	D	No possible adverse impacts are expected according to authorities concerned.
19 Poor, indigenous, or ethnic people	C	D	No possible adverse impacts are expected according to authorities concerned.
20 Misdistribution of benefits and damages	C	D	No possible adverse impacts are expected according to authorities concerned.
25 Infectious diseases such as HIV/AIDS	C	B	External workers' stay is expected for a long period.
	EMP		Utilization of sanitary program / Consultation with local health authority
29 Working conditions	B	B	Risk during construction
	B	B	Consideration for safety during operation
	EMP		Safety management

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

7.10 Costs of Implementing Mitigation Measures

a. Mitigation

Impacts and related mitigation measures are identified in **7.9 Environmental Impact Prediction / Assessment** and in **7.11 Draft Environmental Management Plan and Monitoring Plan**. Mitigation

measures should be updated according to the results of the subsequent EIA or the detailed design.

b. Cost

Mitigation consists of measures to be taken by the construction contractor as well as monitoring activities undertaken by the PMU. The cost for monitoring is going to be estimated at the EIA stage and should be admitted by the PMU. Mitigation costs are included in the overall construction and O/M cost estimate and are not identified separately.

7.11 Draft Environmental Management Plan and Monitoring Plan

A draft Environmental Management Plan (EMP) based on the results of the survey is shown below for each major component of the proposed project.

Table 7.11.1 Draft Environmental Management Plan (Reservoir)

No.	Activities	Negative impacts	Mitigation measures	Cost Component	Implementation Unit	Supervision Unit
I	**Preparation phase**					
1	Land acquisition	Loss of vegetation, buildings and land	Replace or compensate lost assets according to current regulations of GOV and BDPPC	Resettlement and compensation cost	Center of Land Fund Development	BDPPC
2	Environmental background	Dust	Identify baseline data and parameters to monitor the impact of the project.	Monitoring cost	Contractor / PMU / Environmental Consultant	DONRE / Environmental Consultant
3		Noise / Vibration				
4		Surface water quality				
II	**Construction phase**					
1	Construction and transfer of materials and waste	Dust	Use watering agents to prevent or reduce dust. Drive construction vehicles slowly with load covers / Monitor potential impacts	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	DONRE / BDPPC / PMU / Consultant
2		Noise / Vibration	Drive construction vehicles slowly when transferring soil. Maximize use of low-vibration & low-noise machineries. Prevent or minimize operation of heavy equipment at night / Monitor potential impacts			
3		Surface water quality	Reduce turbidity of discharged water by coagulation on site / Monitor potential impacts			
4		Land use	Watering / collection and treatment of high-turbidity water, coagulation and sedimentation			

5		Worker & public injury	Follow workplace health and safety regulations of MoLISA / DoLISA. Utilize sanitary programs. Consultation with local health authority Use sufficient signage and fencing at construction sites	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	BDPPC (Division of health) / PMU / Consultant
6	Construction worker presence, and camp operation	Solid waste and domestic waste pollution	Institute a regular solids waste collection and disposal program including placement of disposal bins throughout camp and at all construction sites. Ensure adequate number of latrines at camp cleaned regularly. Temporary latrines maintained at construction sites.	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	DONRE / BDPPC / PMU / Consultant
7		Worker and public health problems	Ensure proper hygiene in worker camps. Workers should be tested for communicable diseases. Locate worker camp away from residential areas	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	BDPPC (Division of health) / PMU / Consultant
8		Worker & public safety	Follow workplace health and safety regulations of MoLISA / DoLISA. Sufficient signage and fencing at construction sites			
9	General construction activities	Production of solid wastes, and waste construction fluids (e.g., oils) causing soil and surface water pollution	Implement solid waste collection and disposal program. Contain waste liquids for regular disposal with solid wastes in designated landfill. Decreasing water turbidity by coagulation	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	DONRE / BDPPC / PMU / Consultant
III	**Operation phase**					

1	Operation of the pumping station	Production of oil waste causing soil and surface water pollution	Implement oil waste collection and disposal program.	Operation / Monitoring cost	PMU	DONRE / BDPPC

Table 7.11.2 Draft Environmental Management Plan (Intake, Transmission & WTP Facilities)

No.	Activities	Negative impacts	Mitigation measures	Cost component	Implementation Unit	Supervision Unit
I	**Preparation phase**					
1	Land acquisition	Loss of vegetation, buildings and land	Replace or compensate lost assets according to current regulations of GOV and BDPPC	Resettlement and compensation cost	Center of Land Fund Development	BDPPC
2	Environmental background	Dust Noise / Vibration	Identify baseline data and parameters to monitor the impact of the project.	Monitoring cost	Contractor / PMU / Environmental Consultant	DONRE / Environmental Consultant
II	**Construction phase**					
1	Construction and transfer of materials and waste	Dust	Use watering agents to prevent or reduce dust. Drive construction vehicles slowly with load covers / Monitor potential impacts	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	DONRE / BDPPC / PMU / Consultant
2		Noise / Vibration	Drive construction vehicles slowly when transferring the soil. Maximize use of low-vibration & low-noise machineries. Prevent or minimize operation of heavy equipment at night / Monitor potential impacts			
3		Surface water quality	Reduce turbidity of discharged water by coagulation on site / Monitor			

			potential impacts			
4		Land use	Watering / collection and treatment of high-turbidity water, coagulation and sedimentation			
5		Worker & public injury	Follow workplace health and safety regulations of MoLISA / DoLISA. Utilize sanitary programs. Consult local health authority Use sufficient signage and fencing at construction sites	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	BDPPC (Division of health) / PMU / Consultant
6	Construction worker presence, and camp operation	Solid waste and domestic waste pollution	Institute regular solids waste collection and disposal program including placement of disposal bins throughout camp and at all construction sites. Ensure adequate number of latrines at camp cleaned regularly. Temporary latrines maintained at construction sites.	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	DONRE / BDPPC / PMU / Consultant
7		Worker and public health problems	Ensure proper hygiene in worker camps. Workers should be tested for communicable disease. Locate worker camp away from residential areas	Construction cost / Monitoring cost	Contractor / PMU / Environmental Consultant	BDPPC (Division of health) / PMU / Consultant
8		Worker & public safety	Follow workplace health and safety regulations of MoLISA / DoLISA. Sufficient signage and fencing at construction sites			
9	General construction activities	Production of solid wastes, and waste construction fluids	Implement solid waste collection and disposal program. Contain waste liquids for regular	Construction cost / Monitoring	Contractor / PMU / Environmental Consultant	DONRE / BDPPC / PMU / Consultant

		(e.g., oils) causing soil and surface water pollution	disposal with solid wastes in a designated landfill. Decreasing water turbidity by coagulation	cost		
III	**Operation phase**					
1	Operation of the pumping station	Production of oil waste causing soil and surface water pollution	Implement oil waste collection and disposal program.	Operation / Monitoring cost	PMU	DONRE / BDPPC

For the execution of the project, a monitoring plan is needed to compare predicted and actual impacts. A draft monitoring plan is presented below. The contents should be updated during the subsequent EIA or the detailed design stage.

Table 7.11.3 Draft Monitoring Plan (Reservoir)

Summary of Impact / Mitigation	Monitoring Indicators	Location	Frequency	Environmental Standard	Responsibility Supervision / Implementation	Reporting
Pre-Construction Phase						
Resettlement & physical asset loss / Resettlement Plan	See Abbreviated Resettlement Plan (ARP)	See ARP	See ARP	See ARP	See ARP	See ARP
M-1: Dust	TSP / PM10	Areas in and around the site (3+3stations)	twice with an interval greater than 2 months	TCVN 5937: 2005	PMU / Environmental Consultant	Monitoring reports prepared quarterly for DONRE
M-2: Noise / Vibration	Decibel (dBa) levels	Residential area around the site (3st.)	As above	TCVN 6962: 2001	As above	As above
M-3: Surface water quality	Turbidity	Downstream spot of the planned	As above	QCVN 08:2008 /BTNMT	As above	As above

		discharge area (1st.)				
Construction Phase						
M-4: Dust	TSP / PM10	Areas in and around the site (3+3stations)	Quarterly	TCVN 5937: 2005	PMU / Environmental Consultant	As above
M-5: Noise / Vibration	Decibel (dBa) levels	As above	As above	TCVN 5949: 1998	As above	As above
M-6: Surface water quality	Turbidity	Downstream spot of the planned discharge area (1st.)	2 times / month	QCVN 08:2008 /BTNMT	As above	As above
M-7: Solid waste pollution / Regular waste collection & disposal, placement of disposal bins throughout construction sites.	Amount of solid waste uncontained & littering construction areas and worker camp	All construction areas (5st.)	As above	N/A	As above	As above
M-8: Soil contamination / Implement solid waste collection and disposal program. Contain waste liquids for regular disposal with solid wastes in designated landfill.	As, Cd, Cu, Pb, Zn	Excavated and reused soil (5samples)	quarterly	QCVN 03:2008/BTNMT	As above	As above
M-9: Worker & public safety / Follow workplace health and safety regulations of MoLISA / DoLISA. Sufficient signage and fencing at construction sites	Number of worker and public injuries	All construction areas (5st.)	As above	Decree 06/1995, Decree 10/2002/ ND-CP	As above	Monitoring reports prepared quarterly for MoLISA / DoLISA
M-10: Worker and public	Incidence of sexually	Worker camp	As above	N/A	As above	Monitoring reports

health problems / Ensure proper hygiene in worker camps. Workers should be tested for communicable disease. Locate worker camp away from residential areas	transmitted & other communicable diseases	and nearby community (5st.)				prepared quarterly for BDPPC(Division of health)
Operation phase						
M-11: Operation of the pumping station	Record of oil waste collection and disposal	Pumping station	Operation cost	N/A	PMU	DONRE / BDPPC

Table 7.11.4 Draft Monitoring Plan (Intake, Transmission & WTP Facilities)

Summary of Impact / Mitigation	Monitoring Indicators	Location	Frequency	Environmental Standard	Responsibility Supervision / Implementation	Reporting
Pre-Construction Phase						
Resettlement & physical asset loss / Resettlement Plan	See Abbreviated Resettlement Plan (ARP)	See ARP	See ARP	See ARP	See ARP	See ARP
M-1: Dust	TSP / PM10	Areas in and around the site (3+3stations)	twice with an interval greater than 2 months	TCVN 5937: 2005	PMU / Environmental Consultant	Monitoring reports prepared quarterly for DONRE
M-2: Noise / Vibration	Decibel (dBa) levels	Areas around the site & along pipelines (8st.)	twice with an interval greater than 2 months	TCVN 6962: 2001	As above	As above
M-3: Surface water quality	Turbidity	Downstream spots of the planned discharge area	As above	QCVN 08:2008 /BTNMT	As above	As above

		(1st. for intake / 1st. for WTP)				
Construction Phase						
M-4: Dust	TSP / PM10	Areas in and around the site (3+3stations)	Quarterly	TCVN 5937: 2005	PMU / Environmental Consultant	As above
M-5: Noise / Vibration	Decibel (dBa) levels	Areas around the site & along pipelines (8st.)	Quarterly	TCVN 5949: 1998	PMU / Environmental Consultant	Monitoring reports prepared quarterly for DONRE
M-6: Surface water quality	Turbidity	Downstream spots of the planned discharge area (1st. for intake / 1st. for WTP)	As above	QCVN 08:2008 /BTNMT	As above	As above
M-7: Solid waste pollution / Regular waste collection & disposal, placement of disposal bins throughout construction sites.	Amount of solid waste uncontained & littering construction areas and worker camp	All construction areas (5st.)	As above	N/A	As above	As above
M-8: Soil contamination / Implement solid waste collection and disposal program. Contain waste liquids for regular disposal with solid wastes in designated landfill.	As, Cd, Cu, Pb, Zn	Excavated and reused soil (5smpl)	As above	QCVN 03:2008/BTN MT	As above	As above
M-9: Worker & public safety / Follow workplace health and safety regulations of MoLISA / DoLISA. Sufficient signage and	Number of worker and public injuries	All construction site locations (10smpl)	As above	Decree 06/1995, Decree 10/2002/ ND-CP	As above	Monitoring reports prepared quarterly for MoLISA / DoLISA

fencing at construction sites						
M-10: Worker and public health problems / Ensure proper hygiene in worker camps. Workers should be tested for communicable disease. Locate worker camp away from residential areas	Incidence of sexually transmitted & other communicable diseases	Worker camp and nearby community (10smpl)	As above	N/A	As above	Monitoring reports prepared quarterly for BDPPC(Division of health)
Operation phase						
M-11: Operation of the pumping station	Record of oil waste collection and disposal	Pumping station	Operation cost	N/A	PMU	DONRE / BDPPC

7.12 Stakeholder Meeting

Stakeholder meetings, interviews and hearings were conducted with PAP and authorities concerned. The outline of them is shown below. Stakeholder meetings were held by BIWASE. BIWASE informed to all affected PCs and targeted all people who would like to attend. No adverse opinions against the Project implementation. Refer to Appendix 8A -Annex A for details.

Table 7.12.1 Outline of Stakeholder Meetings, Interviews and Hearings

No.	Date	Venue	Participants (pers)		Contents
1	Mar 8th, 2011	Lai Hung Commune's PC, Ben Cat District	Lai Hung CPC Ben Cat LFDC BIWASE	5	- Introduction of the Project (Benefits of the Project, planning sites, land acquisition area, affected households, etc.) - Policies on compensation, assistance and resettlement for the PAP; - Plan on compensation and land clearance plan - Grievance redness mechanism. (by BIWASE & Ben Cat LFDC)
			Institute of Rubber Research Lai Khe.	2	
2	Mar 9th, 2011	Chanh Phu Hoa Commune's PC, Ben Cat District	Chanh Phu Hoa CPC Ben Cat LFDC BIWASE	13	
			PAP	89	
3	Mar 11th, 2011	Lai Uyen Commune's PC, Ben Cat District	Lai Uyen CPC Ben Cat LFDC BIWASE	12	
			PAP	74	
4	Mar 12th, 2011	Tan Hung Commune's PC, Ben Cat District	Tan Hung CPC Ben Cat LFDC BIWASE	10	
			PAP	53	
5	Mar 15th, 2011	Tru Van Tho Commune's PC, Ben Cat District	Tru Van Tho CPC Ben Cat LFDC BIWASE	9	
			PAP	53	
6	Mar 26th, 2011	Chanh Phu Hoa Commune's PC, Ben Cat District	Chanh Phu Hoa CPC Ben Cat LFDC BIWASE	10	
			PAP	30	
7	Dec. 13th, 2012	DONRE, Binh Doung PPC	Manager / Staff	2	- Introduction of the Project (Outline, components, draft scoping, etc.) - Hearing of opinions (by JICA Survey Team)
8	Dec. 14th, 2012	DARD, Binh Doung PPC	Staff	3	
9	Dec. 17th, 2012	DOLISA, Binh Doung PPC	Manager	1	
10	Dec. 18th, 2012	DOHA, Binh Doung PPC	Director / Staff	2	
11	Dec. 18th, 2012	DOH, Binh Doung PPC	Deputy Manager	1	
12	Dec. 19th, 2012	DONRE, Binh Doung PPC	Deputy Director / Staff	2	
13	Dec. 21st, 2012	DONRE, Ben Cat DPC	Manager / Staff	4	
14	Mar. 13th, 2013	BIWASE-Enterprise Management of Wastes	Deputy Manager / Staff	2	
15	Mar. 18th, 2013	DONRE, Binh Doung PPC	Staff	4	
16	June 19th, 2013	Proposed project sites	PAP	20	- Interview with PAP(mainly DP) - Hearing of opinions (by JICA Survey Team)
17	June 20th, 2013		PAP	20	

CHAPTER 8 LAND ACQUISITION AND RESETTLEMENT

8.1 The Need for Land Acquisition and Resettlement

8.1.1 Outline of Land Acquisition and Resettlement

This project will supply treated water for residents, industrial parks, new cities in northern part of Binh Duong province. This JICA Preparatory Study formulates the scope and examines its viability for this project. This Project is expected to cause land acquisition and involuntary resettlement. The component of land acquisition and resettlement are followings.

- Raw Water Intake Facilities;
- Raw Water Transmission Pipeline;
- Regulating Reservoir; and
- North Binh Duong Water Treatment Plant

8.1.2 Approach and Methodology for Social Considerations

It is important to ensure that proper compensation is paid to the Project Affected Persons (PAP) and Displaced Persons (DP) so that living conditions of these people do not deteriorate. It is universally accepted that a Resettlement Action Plan (RAP) is the best instrument to implement a successful resettlement program.

In the Vietnamese regulations the terminology used for the RAP is Compensation, Support and Resettlement Plan (CSRP). This CSRP document prepared by the PMU was submitted to Binh Duong Provincial People Committee (PPC) for approval in August, 2012 (Adjustment based on Announcement No. 202/TB-UBND date August 15th 2012).

Field activities for compensation planning for the project was started in December 2012 and is now being continued by the PMU and the Land Fund Development Center (LFDC), an agency attached with Ben Cat District People Committee (DPC).

For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, Abbreviated Resettlement Plan (ARP) is to be prepared. ARP preparation and execution is entirely a responsibility of Vietnamese side. The JICA Survey Team provides advice and support towards ARP preparation. The JICA Survey Team and PMU thus carried out the following activities;

JICA Survey Team activities;

- Ensuring Vietnamese relevant laws;
- Gap assessment between Vietnamese laws and JICA's GL;
- Recommending project policy;
- Recommending and supporting on the ARP preparation;

PMU activities;

- Census Survey and Detailed Measurement Survey (DMS) for the PAP;
- Assess and survey the socioeconomic situation of the PAP; and
- Conduct consultation with PAP to obtain their view on resettlement process;

8.1.3 Mitigation Measures

Along with positive impacts on socio-economic development and social lives, the Project will also cause negative impacts to households involved in land acquisition and site clearance, and in the area through which the Project passes. Identifying the negative impacts of land acquisition and site clearance, and proposing mitigation measures, is essential to eliminate or reduce negative impacts.
During Project preparation and design, the resettlement consultant has been closely cooperated with

the PMU to minimize the impacts of the project on the lives of people in the project area. To mitigate the impacts on these households, in the Project and ARP implementation process, the following mitigation measures have been and would be applied:

In the Project preparation stage, technical and social teams have worked together to reduce the social impacts of the Project. Appropriate technical designs and construction alternatives have been made to avoid or detour around residential areas, acquiring public land without structures thereon, etc. Avoiding impacts is the Project's most effective mitigation measure and avoids any original negative impacts. At the same time, the technical consultant recommended the different alternatives to choose an optimal one, minimizing land acquisition and resettlement impacts. If negative impacts on properties are unavoidable, adequate compensation plans will be made to at least cover or restore any damages.
In the early stages of the Project's preparation, activities for disseminating information about the Project, land acquisition, site clearance, compensation and resettlement have been widely propagated to gain people's participation and support. On the other hand, getting the right information from the initial phase will help people prepare spirit and facilities for expected impacts from the project. The LFDC conducted public consultations over the project sites to (i) publicize project information and (ii) publicize some projected impacts, land acquisition and compensation scale, compensation and support for production. After populating project information, many opinions were exchanged. In general, local people strongly supported the Project and hoped that it would be soon executed to solve the social issues during construction period.

During implementation for compensation, the PAPs are compensated according to the replacement cost (market price). The unit price for compensation is surveyed by the LFDC and submits to the PPC for approval. Beside market price - based-compensating, the PAPs also get assistance depending on the level of impacts, socio-economic situation of the PAPs. Monitoring and evaluating activities for compensation and site clearance are closely implemented to mitigate the impacts arising from construction.
For the households with their trees and crops affected, they would harvest their trees and crops before land acquisition. They are also informed about the cut-off date of the project to stop cultivating on the affected land.
Particularly pay attention to the vulnerable group, including the poor, loneliness elderlies, single female headed households, disable persons, none-land person. Some PAPs who have no LURC and PAPs who eligible to acquire LURC but have yet receive LURC, the project implementation may strongly impact to those groups. Therefore, full compensation, supports and legally entitlements for them would be taken into account in ARP preparation stage. Especially, the majorities of displaced households are low-income households without land ownership and belong to the vulnerable group, so in the process of ARP implementation, they must be consulted and prioritized choosing income restoration programs.
To the agricultural and business households, beside the compensation according the replacement cost, the ARP will provide assistances such as livelihood stability assistance, support for vocational training and career change, and income restoration for them, etc.

In the construction stage, the Project will encourage the contractors to use the local labors in order to raise jobs and income for people in the project area, especially poor households and directly relocated households by the project.

8.2 Legal Framework for Land Acquisition and Resettlement

8.2.1 Vietnamese Legal Framework

1) Vietnamese Laws, Decrees, and Circulars
The Constitution of the Socialist Republic of Viet Nam (1992) confirms the right of citizens to

own and protect the ownership of a house. In addition, the Government has enacted a number of laws, decrees and regulations that constitute the legal framework for land acquisition, compensation and resettlement. The principal documents include:

* Decree No.197/2004/ND-CP, on compensation, rehabilitation and resettlement in the event of land recovery by the State, as amended by Decree No.17/2006/ND-CP;
* Decree 69/2009/ND-CP of 13/8/2009 (Supplementary Regulations Regarding Land Use Planning, Land Pricing, Land Acquisition, Compensation, Assistance and Resettlement) amends Decree No. 197/2004/ND-CP, extends eligibility and provides additional entitlements, compensation and assistance over previous legislation.
* Circular No.14/2009/TT-BTNMT dated 01/10/2009 of Ministry of Natural Resources and Environment regulated details on compensation, assistances and resettlement and procedures for land acquisition, handing over land, land lease takes effect;
* The Land Law No. 13/2003/QH11, providing a comprehensive land administration law;
* Decrees No. 188/2004/ND-CP and 123/2007, specifying the methods for land pricing and land price frameworks in the event of land recovery by the State. There is also Decree No.84/2007/ND-CP, which stipulates issue of Land User Rights Certificate (LURC), land acquisition, land use right implementation, procedure of compensation, and assistance in the event of land recovery by the state and grievance redress.

Other laws, decrees and regulations relevant to land management, land acquisition and resettlement include the Construction Law 16/2003/QH11 on compensation and relocation of people affected by ground clearance for investment projects, Decree 16/2005-ND-CP on the implementation of the Construction Law, Decree 182/2004/ND-CP on penalties for administrative violations in land issues, Decree 198/2004/ND-CP on land use fees.

Laws, decrees and decisions relevant to public disclosure of information include Land Law, No.13/2003/QH11, Article 39, requiring disclosure of information to affected people prior to recovery of agricultural and non-agricultural land of, respectively, 90 and 180 days minimum and Decision 3037/QD-BGTVT, 2003, making the Project Management Unit (PMU) together with the Resettlement Committee responsible for public disclosure through mass media of the Project policies and the extent of site clearance to local people, particularly those that will be affected. The Decree 69/2009/ND-CP, Article 29, regulated about introduction of location and notice of land acquisition.

Decrees relevant to protection and preservation of cultural property include Decree No.172/1999/ND-CP, Article 25, requiring that sites currently recognized for cultural and historical preservation and that are situated within the boundaries of waterway safety corridors, should be kept intact according to current legal regulations.

2) Binh Duong Province Regulations on Resettlement

Binh Duong Province Regulations on Resettlement is followings;

- Decision No. 87/2009/QĐ-UBND dated 21 December 2009 on compensation, assistance and resettlement in Binh Duong Province. This decision applied the Decree No. 69/2009/ND-CP of the Central Government.
- Decision No. 58/2011/QĐ-UBND dated 19/12/2011 regulated on unit price on compensation, assistance for housing, asset, architecture, trees and crops when the State acquires land in Binh Duong Province in 2012.
- Decision No.66/2011/QĐ-UBND regulated on land unit price in 2012 in Binh Duong province.
- Decision No. 67/2011/QĐ-UBND, issued the regulation on of land price adjustment coefficient (K) in 2012 in Binh Duong province.

8.2.2 JICA's Policy on Involuntary Resettlement

JICA's policy on involuntary resettlement is summarized in **Table 8.2.1**:

Table 8.2.1 JICA's Policy on Involuntary Resettlement

The key principle of JICA policies on involuntary resettlement is summarized below.

I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
II. When, population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
IV. Compensation must be based on the full replacement cost as much as possible.
V. Compensation and other kinds of assistance must be provided prior to displacement.
VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
VIII. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows

X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits.)
XI. Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
XII. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
XIII. Provide support for the transition period (between displacement and livelihood restoration.
XIV. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.

Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes.

Source: JICA GL

8.2.3 The Comparison between JICA Guideline and Vietnamese Laws and Decrees

The contents of JICA Guideline(JICA GL) on involuntary resettlement are compared with the Government's Laws and Decrees. The differences between the Government's Laws and Decrees and JICA GL with regard to resettlement and compensation for this Project, and how to address these gaps are shown in **Table 8.2.2**.

Table 8.2.2 Comparison Table between JICA Guideline and Laws of Vietnam

No.	JICA GL	Laws of Vietnam	JICA GL not covered by Laws of Vietnam	Counter-measures
1.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	"Location options should be in line with construction planning and provide solutions to minimize the social and environmental impacts" and "assessment of conditions and reasoning for selected location". Decision 48/2008/QD-TT on development of F/S	Alternatives	Alternatives were considered in Chapter 7 and Mitigation measures.
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	Decision 48/2008/QD-TT	Equivalent	Not necessary
3.	People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	Decision 48/2008/QD-TT	Equivalent	Not necessary
4.	Compensation must be based on the full replacement cost as much as possible. (JICA GL)	Decision 48/2008/QD-TT	Equivalent	Not necessary
5.	Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	Land hand over: "Within twenty (20) days after being fully paid the compensation and support money, the person having land recovered shall hand over land to the compensation and ground clearance organization." Article 29; Circular 14/2009/TT-BTNMT Dated 01 October 2009	Equivalent	Not necessary

No.	JICA GL	Laws of Vietnam	JICA GL not covered by Laws of Vietnam	Counter-measures
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	The scale-criterion is not yet specified for involuntary resettlement.	Specific countermeasures for large-scale resettlement	Abbreviated resettlement plan will be adopted because DP are estimated less than 200.
7.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	RAP should include information of public consultation. Decision 48. Issuing general guidelines on feasibility study reports of projects using ODA funds of the 5 bank group	Equivalent	Not necessary
8.	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	Not properly specified. RAP should include information of public consultation. Decision 48. Issuing general guidelines on feasibility study reports of projects using ODA funds of the 5 bank group	Language designation	Explanations were given in local language
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	Not specified	Participation promotion	Participation of affected people is promoted
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	Properly specified at Article 138 of Land Law (2003); Article 63 & 64, Decree 84/2007/ND-CP and Decree 136/2006/ND-CP	Equivalent	Not necessary
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	An initial baseline survey is not specified. Decree 136/2006/ND-CP	Cut-off-date specification	Cut-off-date shall be defined
12.	Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or	Compensation will be paid to current users of land recovered by the State who fully satisfy the conditions specified in Clauses 1, 2, 3, 4, 5, 7, 9, 10 and 11, Article 8 of Decree No. 197/2004/ND-CP and Articles 44, 45 and 46 of Decree No. 84/2007/ND-CP.	Similar	Eligibility is defined.

No.	JICA GL	Laws of Vietnam	JICA GL not covered by Laws of Vietnam	Counter-measures
	assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	For land users who are ineligible for compensation, provincial level PC shall consider these cases in order to provide support.		
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	"Land used for a certain purpose which is recovered by the State shall be compensated with new land with the same use purpose," Decree 69; Article 14[2] Compensation and support principles	Preference specification	Livelihoods of displaced persons are basically land-based.
14.	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	Supports include: (i) support for relocation and resettlement in case of recovery of residential land; (ii) support for life and production and stabilization; (iii) support for job-change training and job creation in case of recovery of agricultural land; (iv) support upon recovery of agricultural land in residential areas or garden or pond land not recognized as residential land and other supports. Article 17; Decree 69.	Covered	Not necessary
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	Not specified.	Vulnerable groups specification	PPCs are in charge of attention in the process of important decisions
16.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP4.12 Para.25)	Not specified.	Preparation of ARP	Preparation of ARP

Source: JICA Survey Team

8.2.4 The Project's Land Acquisition and Resettlement Policy

With consideration of **Section 8.2.3**, the Project's principle is shown in **Table 8.2.3**.

Table 8.2.3 The Project's Principle for Land Acquisition and Resettlement

I.	The Government of Vietnam will use the Project Resettlement Policy (the Project Policy) for the Project specifically because existing national laws and regulations have not been designed to address involuntary resettlement according to international practice, including JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitate themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs

based on the type and degree of their losses. Where there are gaps between the Vietnam legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.

II. Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.

III. Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.

IV. Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:
- Standard of living adversely affected;
- Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;
- Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

V. All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

VI. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.

VII. People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition.

VIII. Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities.

IX. The resettlement plans will be designed in accordance with Vietnam's National Involuntary Resettlement Policy and JICA's Policy on Involuntary Resettlement.

X. The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups.

XI. Payment for land and/or non-land assets will be based on the principle of replacement cost.

XII. Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal land titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skill development, wage employment, or self-employment, including access to credit. Solely cash compensation will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project.

XIII. Replacement lands, if the preferred option of PAPs, should be within the immediate vicinity of the affected lands wherever possible and be of comparable productive capacity and potential. As a second option, sites should be identified that minimize the social disruption of those affected; such lands should also have access to services and facilities similar to those available in the lands affected.

XIV. Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.

XV. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled) and

ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.

XVI. PAPs will be involved in the process of developing and implementing resettlement plans.

XVII. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.

XVIII. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Government.

XIX. Displacement does not occur before provision of compensation and of other assistance required for relocation. Sufficient civic infrastructure must be provided in resettlement site prior to relocation. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases. (Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be on going activities.)

XX. Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.

XXI. Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system.

Cut-off-date of Eligibility

The cut-off-date of eligibility refers to the date prior to which the occupation or use of the project area makes residents/users of the same eligible to be categorized as PAPs and be eligible to Project entitlements. In the Project, cut-off dates for titleholders will be the date of notification under the land acquisition and for non-titled holders will be the beginning date of the population census. Cut-off-date has been disclosed to each affected village by the relevant local governments and the villages have disclosed to their populations. The establishment of the eligibility cut-off date is intended to prevent the influx of ineligible non-residents who might take advantage of Project entitlements

Principle of Replacement Cost

All compensation for land and non-land assets owned by households/shop owners who meet the cut-off-date will be based on the principle of replacement cost. Replacement cost is the amount calculated before displacement which is needed to replace an affected asset without depreciation and without deduction for taxes and/or costs of transaction as follows:

a. Productive Land (agricultural, aquaculture, garden and forest) based on actual current market prices that reflect recent land sales in the area, and in the absence of such recent sales, based on recent sales in comparable locations with comparable attributes, fees and taxes or in the absence of such sales, based on productive value;

b. Residential land based on actual current market prices that reflect recent land sales, and in the absence of such recent land sales, based on prices of recent sales in comparable locations with comparable attributes; fees and taxes.

c. Existing local government regulations* for compensation calculations for building, crops and trees will be used where ever available.

d. Houses and other related structures based on actual current market prices of affected materials;

e. Annual crops equivalent to current market value of crops at the time of compensation;

f. For perennial crops, cash compensation at replacement cost that should be in line with local government regulations, if available, is equivalent to current market value given the type and age at the time of compensation.

g. For timber trees, cash compensation at replacement cost that should be in line with local government regulations, if available, will be equivalent to current market value for each type, age and relevant productive value at the time of compensation based on the diameter at breast height of each tree.

* (Decision No. 58/2011/QĐ-UBND, Decision No.66/2011/QĐ-UBND, Decision No. 67/2011/QĐ-UBND)

8.3 Scope of Land Acquisition and Resettlement

8.3.1 Scope of Abbreviated Resettlement Plan

There are around 500 of households who are acquired their land. Total of acquired area is 1,679,830m^2. There is no any school, health and religion facilities as well as the architects are affected by the Project.
Summary of Land Acquisition and Resettlement is shown in **Table 8.3.1**.

Table 8.3.1 Summary of Land Acquisition and Resettlement

Work Items		Acquired (m^2)				Number of relocated households	Number of relocated Persons
		Residential Land	Agricultural Land	Public Land	TOTAL		
1	Raw Water Intake Facilities	0	10,500	0	10,500	0	0
2	Raw Water Transmission Pipeline	2,000	259,330	120,000	381,330	9	32
3	Regulating Reservoir	1,500	899,140	74,360	975,000	18	60
4	North Binh Duong Water Treatment Plant	0	310,900	2,100	313,000	0	0
Total		**3,500**	**1,478,870**	**196,460**	**1,679,830**	**27**	**92**
		0.2%	**88.1%**	**11.7%**			

Source: JICA Survey Team(This table will be updated by BIWASE because Regulating Reservoir's location will be changed)

8.3.2 Population Census Survey

To find out population census, population census survey is conducting with all affected households. The contents of population census survey is followings;

- Household population and labor force

8.3.3 Property and Land Survey

To find out all assets, property and land survey is conducted with all affected households. The contents of property and land survey are followings;

-Land
-Building (residential building, shops, public institution)
-Trees and agricultural crops, livestock and fish

- Accommodations and household furniture

8.3.4 Socio-economic Profile of PAP

To find out the socioeconomic conditions, a socioeconomic survey is conducted with the participation of 100% relocated households and 20% other affected households. The contents of socio-economic survey for PAP are followings;

- Education
- Household occupation
- Living standards, income and expenditure
- Infrastructures and services

8.3.5 Socio-economic Profile of the Socially Vulnerable

Survey for the socially vulnerable groups that require special assistance; the poor, the people who do not have the land, the elderly, people with disabilities, women, children, ethnic minorities, indigenous people, and the people who are not protected under domestic laws is conducted.

8.4 Compensation and Support Policy

8.4.1 Objectives for Resettlement

The objectives of the Vietnamese legislation governing resettlement and rehabilitation of displaced persons, and that of JICA's Policy concerning involuntary resettlement, have been adapted for the preparation of this ARP. Where there are gaps between the Vietnam legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Vietnamese law and JICA's Policy. The main objective of the ARP is to ensure that all PAPs will be compensated for their losses at replacement cost.

8.4.2 Eligibility

Any person who at the cut-off-date was located within the area affected by the project, its components, or other project's parts thereof, and would;
(a) The parson have formal legal rights to land (including customary and traditional rights recognized under the Vietnamese laws); or
(b) The person does not have formal legal rights to land at the time the census begins but have a claim to such land or assets - provided that such claims are recognized under the laws of Vietnam or become recognized through processes identified in the resettlement plan; or
(c) The person does not have legal nor recognizable by law rights to the land they are occupying or land have properties/assets within the project areas before the cut-off date.

Persons covered under (a) and (b) are provided compensation for the land they lose and other assistance at full replacement cost. Persons covered under (c) are provided resettlement assistance in lieu of compensation for the land they occupy, and other assistance, as necessary, to achieve the objectives set in this ARP, if they occupy the project area prior to the cut-off date. Persons who encroach on the area after the cut-off date are not entitled to compensation or other form of resettlement assistance. All persons in (a), (b) or (c) are provided compensation for loss of assets other than land.

8.4.3 Compensation Policy

1) Principles of Compensation for resettlement
   The principle of compensation for resettlement in the ARP will be as follows:
   (i) Acquisition of land and other assets, and resettlement of people will be minimized as much as possible.
   (ii) DP residing, working, doing business or cultivating land within the recovered area under the Project as of the cut-off-date are entitled to be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-Project living standards, income earning capacity and production levels.
   (iii) Compensation for loss of land and trees at replacement cost
   (iv) Adequate budgetary support will be fully committed and be made available to cover the costs of land acquisition and resettlement and rehabilitation within the agreed implementation period. Physical resources for resettlement and rehabilitation will be made available as and when required.
   (v) Civil works contractors will not be issued a notice of possession or a notice to proceed for

any sub-project unless the Government has;

a. Completed, satisfactorily and in accordance with the approved ARP for that sub-project, compensation payments, and
b. Entitlements been provided to PAPs no later than one month prior to expected start-up of civil works at the respective project site.

(vi) Institutional arrangements will ensure effective and timely design, planning, consultation and implementation of the ARP.

2) Cut-off Date and Eligibility

For the Project, the cut-off-date for eligibility for entitlement is defined as the completion of the measurement survey on affected land. Should the design be developed further to require more, or different land, the inventory of loss will be updated and the cut-off date revised in accordance.

8.4.4 Rehabilitation

The project ensures to fully compensate and to assist for affect land/assets/works basing on replacement price. Besides, the policies of rehabilitation supports for affected person will be implemented based on the JICA's and Viet Nam Government's policies, to ensure their livelihood is equal or better in comparison to the Pre-project.

The rehabilitation includes:

(i) Supports for Living and Production Stabilization (include supports for PAPs with affected agricultural land, supports for PAPs with affected business and production, support for relocating and temporary residence, support for temporary impacts on production and business,
(ii) Support for Vocational Training and Job Creation, and
(iii) Special supports for the affected vulnerable groups.

8.4.5 Site Preparation and Relocation

Through the consultation meetings, the relocated households expected and can arrange to resettle by themselves, therefore, it would have no resettlement site to be prepared.

In case the PAPs arises the need of resettlement land, the Project will provide the resettlement land lots will full infrastructure meeting their needs.

8.4.6 Project Entitlements

The Entitlement Matrix covers the impacts currently identified during project preparation. It covers also the impacts which could arise during the construction period. The Entitlement Matrix covers type of loss, beneficiaries, compensation and responsible organization.

8.5 Grievance Redress Procedure

PAP will be able to lodge their complaints regarding any aspect of compensation policy, rates, land acquisition, resettlement and entitlements relating to rehabilitation assistance programs. Complaints by PAPs can be lodged verbally or in written form, but if they are lodged verbally, the committee to which it is lodged will write it down during the first meeting with the PAPs. PAPs will be exempted from administrative and legal fees.

A four-stage procedure for redressing grievances is proposed as follows:

Stage 1- Complaints from PAPs regarding any aspect of the resettlement program or losses not previously addressed shall first be lodged verbally or in written form at the PC at the commune level. The complaint can be discussed in an informal meeting with the plaintiff and the chairperson of the PC

at commune level. The PC at the commune level will be responsible for resolving the issue within 15 days from the day it is lodged.

Stage 2 - If no understanding or amicable solution can be reached, or if the PAP receives no response from the Commune PC within 15 days of registering the complaint, he/she can appeal to the DPC. The DPC will provide a decision within 15 days of the registering of the appeal.

Stage 3 - If the PAPs are not satisfied with the decision of the DPC or its representative, or, in the absence of any response by the DPC, the PAPs can appeal to the PPC. The PPC will provide a decision on the appeal within 15 days from the day it is lodged with the PPC.

Stage 4 - If the PAPsare still not satisfied with the decision of the PPC on appeal, or in absence of any response from the PPC within the stipulated time, the PAPs may submit his/her case to the district court.

8.6 Institutional Arrangements

8.6.1 Land Acquisition and Resettlement Procedure

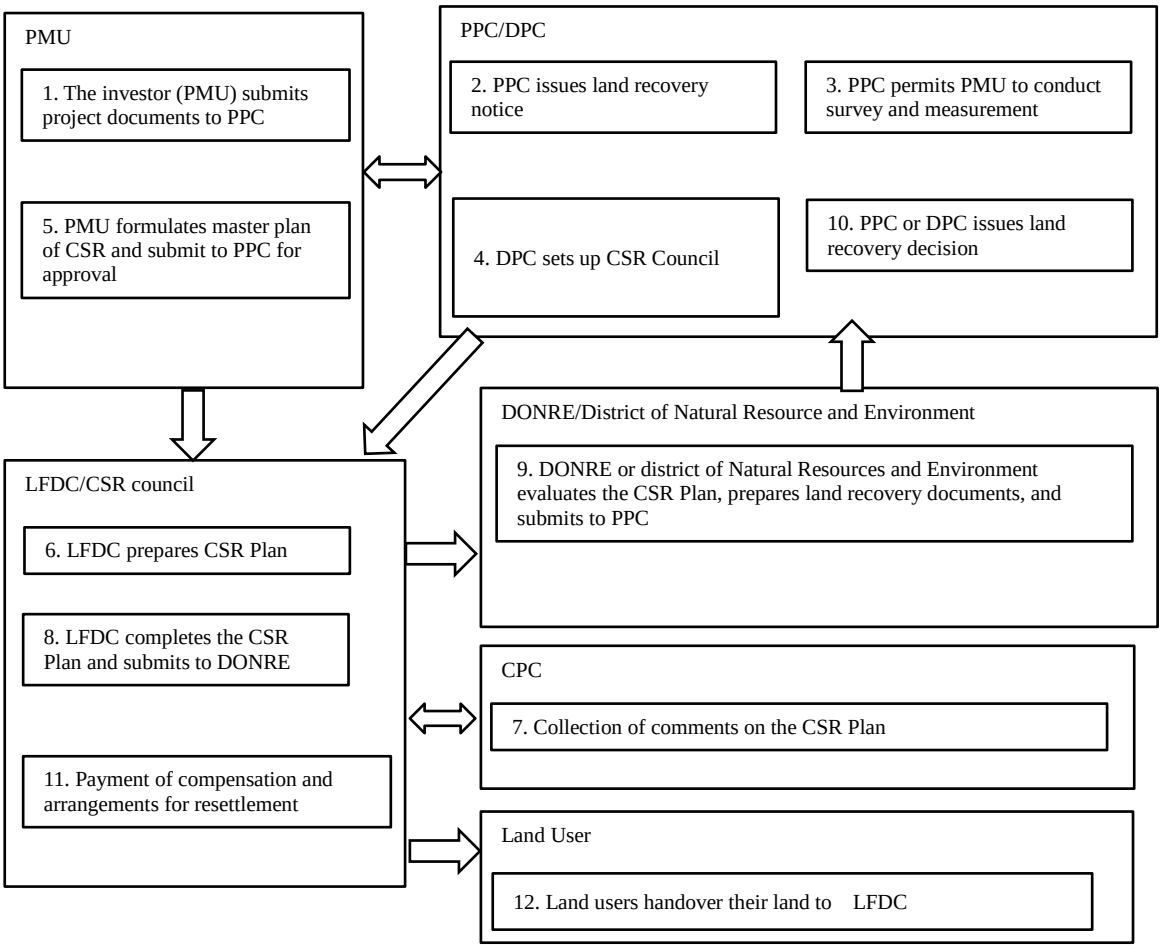
Land acquisition and resettlement procedure are based on the Decree 69/2009/ND-CP, section 4 described as in **Table 8.6.1**. Relationship of organization is described in **Figure 8.6.1**.

Table 8.6.1 Major Procedures of Land Acquisition and Resettlement

	Major Procedures	Responsible Organization	Remarks
1	The investor (PMU) submits project documents to PPC	PMU, PPC	-
2	PPC issues land recovery notice	PPC or DPC	Reasons, area and location, etc., information disclosure by local mass media
3	PPC permits PMU to conduct survey and measurement	PPC	CPC shall coordinate with PMU for the survey and measurement
4	DPC sets up CSR Council	DPC or LFDC	-
5	PMU formulates master plan of CSR and submit to PPC for approval	PMU	Following Decree No.197/2004/ND-CP and No.17/2006/DN-CP
6	LFDC prepares CSR Plan	LFDC	1) Names and address of land users, 2) area, type, location of the land, assets loss, 3) land and house prices, no. of households, 4) compensation and supports amounts, 5) resettlement arrangement
7	Collection of comments on the CSR Plan	CPC	More than 20 days, posted up at CPC office and the areas where to be recovered land and replacement
8	LFDC completes the CSRP and submits to DONRE	LFDC, DONRE	-
9	DONRE or district of Natural Resources and Environment evaluates the CSRP, prepares land recovery documents, and submits to PPC	DONRE or district of Natural Resources and Environment, PPC, DPC	-
10	PPC or DPC issues land recovery decision	PPC, DPC	-
11	Payment of compensation and arrangements for resettlement	CSR Council or LFDC	-
12	Land users handover their land to LFDC	Land Users	Within 20 days after receiving compensation

Source: Decree 69/2009/ND-CP, Section 4, JICA Survey Team

Note: PC-People's Committee, PPC-Provincial PC, DPC-District PC, CPC-Commune PC, CSR-Compensation, Support and Resettlement, LFDC-Land Fund Development Center, DONRE- Department of Natural Resources and Environment, PMU- Project Management Unit



Source: JICA Survey Team

Figure 8.6.1 Relationship of organization

8.6.2 Institutional Arrangement

The implementation of resettlement activities requires the involvement of agencies at the national, provincial, district and commune level. The following is a general overview of key responsibilities with respect to land acquisition and resettlement at/for each level/unit involved in Project implementation.

1) Binh Duong Water Supply and Sewerage – Environment Co.LTD (BIWASE)
BIWASE is responsible as the Executing Agency (EA) for overall coordination and direction of the Project, including the implementation of the ARP. The BIWASE is responsible for preparing the ARP for the Project. The latter includes decisions relating to compensation rates and rehabilitation assistance measures for PAPs. The BIWASE is also responsible for providing the budget for resettlement compensation. BIWASE is responsible for implementation of the Project.

After detailed engineering designs have been completed, the number of PAPswill be revised, and compensation unit rates and allowances will be updated for all categories of lost assets, based on replacement cost surveys carried out during project implementation. Following approval by JICA

of the updated ARP, the BIWASE will be responsible for directing and supervising ARP implementation. This will include ensuring speedy resolution of any grievances voiced by PAPsor town/district authorities. Based on local requirements for implementing resettlement, in each project implementation stages, the BIWASE will delegate responsibilities for resettlement implementation to agencies at the appropriate level, in accordance with Decree No. 197/2004/ND-CP and Decree 69/2009/ND-CP.

2) The Project Management Unit (PMU)
The BIWASE will set up PMU for daily project implementation. The PMU will include technical, institutional, social and resettlement, administrative management, and representatives of accounting divisions. Key responsibilities of the PMU will include, but not be limited to, the following:
   (i) Updating the ARP at the time of project implementation, when the detailed design is available, and then submitting the updated ARP to JICA for approval.
   (ii) Coordinating civil works with land acquisition and resettlement activities;
   (iii) Instigating information campaigns, in accordance with established Project guidelines. This includes preparation and distribution of the public information booklet, and stakeholder consultation with the PAPs. It includes having primary responsibility for letters, forms and other relevant documents, although the preparation of these may be delegated as required;
   (iv) Developing the mechanisms through which resettlement disbursements and compensation payments for PAPs will be made, and preparing any associated documents that may be required;
   (v) Coordinating with other departments for the effective implementation of the ARP, as approved for the project, and in compliance with the JICA resettlement principles and objectives. This will include ensuring that rehabilitation measures and supporting activities are properly implemented;
   (vi) Ensuring a timely resettlement budget flow for the delivery of compensation payments and the rehabilitation of PAPs, and providing the compensation payments to the PAPs, and
   (vii) Implementing project accounting and auditing with respect to resettlement implementation, and preparing and submitting regular progress reports to the BIWASE and PPC on the civil works and status of ARP activities.

3) Ben Cat District People's Committee (DPC)
The Ben Cat District People's Committees will be responsible for identification of land and trees loss and assigning functional tasks for the various agencies. The District People's Committee (DPC) will be responsible for the DMS in collaboration with town/commune People's Committees.

4) Land Fund Development Center (LFDC)
Land Fund Development Center responsible for conducting the loss survey of land and assets, consultation with affected communities and organizations, making compensation plans, submits to the DONRE for approval and pay compensation, and site clearance for the Project.

5) Commune People's Committees (CPC)
Commune People's Committees will be responsible for the following:
   (i) Assigning concerned ward/commune officials/professionals to carry out all resettlement activities in its ward/commune;
   (ii) Assisting other bodies/agencies, including the PMU, in the dissemination of project information and facilitating public meetings and consultation with PAP;
   (iii) Assisting other agencies, including the PMU, in census surveys, a replacement cost survey, DMS and other resettlement related activities;
   (iv) Checking and confirming the legal status of affected land, houses, structures and other assets/losses of organizations; and

(v) Ensuring the PAPs grievances redress mechanisms are appropriate and properly put in place, documenting PAP grievances and maintaining records of PAP grievances, and assisting and advising PAP with respect to the speedy redress of grievances.

6) Institutional Capacity
If necessary, specific training courses on resettlement will be required for an agency involved.

8.7 Implementation Schedule

The implementation schedule is as follows:

(i) Updating Compensation Rates.
During the preparation of CSRP process, the PMU will update unit rates at replacement cost for all categories of loss. This will be done in consultation with PAP and local government agencies.

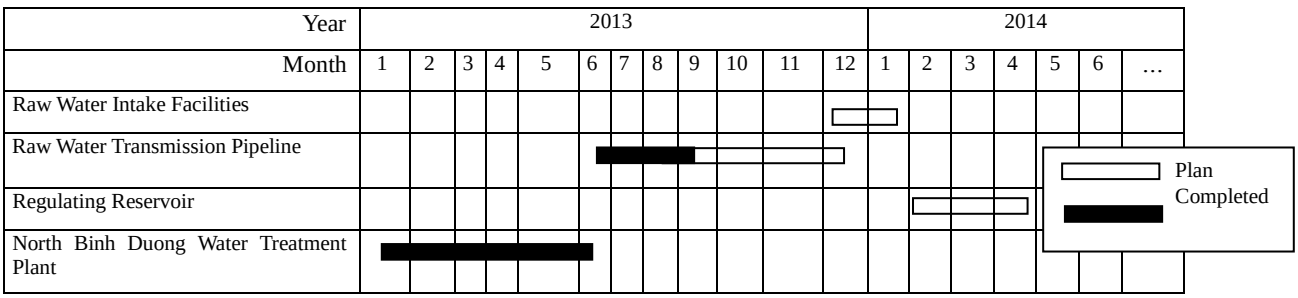
(ii) Detailed Measurement Survey and Census Survey.
These surveys will serve as a basis for compensation and updating ARP. Data will be computerized by the PMU.

(iii) Pricing Application and Compensation to PAPs.
DPC will be responsible for price application (calculating payments on the basis of the market survey) and preparing compensation charts for each affected commune/district. Unit prices, quantity of affected assets, PAP entitlements, etc. will be subject to verification by the PMU and PPC before being posted in each commune for people to review and comment on. All compensation forms must be checked and signed by the PAPs to indicate their agreement.

(iv) Compensation to PAPs.
Compensation will be handled under the supervision of representatives of Commune/Town People's Committee, DPC and representatives of PAP.

PMU shall ensure that civil works contractors are not issued a notice of possession of site for construction works until PMU has (i) satisfactorily completed, in accordance with the approved ARP, compensation payments and relocation to new sites; and (ii) ensured that required rehabilitation assistance is in place and the area required for civil works is free of all encumbrances.

The compensation has been paid to the affected households part by part since December, 2012. And it is expected to complete the compensation payment and the site clearance in Mar, 2014. The PMU will not allow construction activities in specific sites until all resettlement activities have been satisfactorily completed, agreed rehabilitation assistance is in place, and that the site is free of all encumbrances.
Land acquisition is implemented. Schedule of land acquisition is shown in **Figure 8.7.1**.



Source: JICA Survey Team

Figure 8.7.1 Schedule of Land Acquisition

8.8 Cost Estimate and Budget

8.8.1 Flow of Funds

Funds for compensation and implementation of the plan will be from PMU and PPC. PMU will be responsible for channeling funds for the compensation for land acquisition and resettlement to Binh Duong PPC (or Binh Duong LFDC) which will be responsible for making payments directly to displaced persons.

8.8.2 Adjustment for Inflation

The rates for compensation and cash entitlements for rehabilitation as well as allowances payable to PAPs will be adjusted annually, based on the current annual inflation rate. PPC will determine the annual inflation rates and all cash entitlements.

8.8.3 Cost Estimates

Table 8.8.1 presents the cost estimates for ARP at December 2012. This amount covers administration and implementation activities. A contingency of 10% has been added.

Table 8.8.1 Implementation Costs of ARP

No	CONTENT	COST(VND)
1	A. Compensation, support costs	354,594,175,000
2	B. Cost of implementation of compensation	12,377,775,000
3	C. Cost of project management	6,690,322,000
3.1	Cost of project appraisal	75,500,000
3.2	Cost of project preparation	1,652,243,000
3.3	Cost of appraisal, approval of finalization : A x 0.1%	452,388,000
3.4	Cost of audit : A x 0.15%	678,583,000
3.5	Other related costs:	3,831,108,000
4	D. Contingency of Spiraling price : A x 10% (10% per year x 1 year)	35,459,418,000
5	E. Contingency of unexpected occurred quantity: A x 10%	35,459,418,000
	Total cost of implementation(A+B+….+E)	444,581,108,000

Source: CSRP

8.9 Monitoring and Evaluation

8.9.1 Monitoring

Monitoring is the continuous process of assessing ARP implementation in relation to agreed schedules, the use of inputs, and the provision of infrastructure and services by the project. Monitoring provides all stakeholders with continuous feedback on implementation. It identifies actual or potential successes. It also identifies problems as early as possible to facilitate timely correction during ARP operation. Monitoring has two purposes:

(i) To verify that resettlement activities have been effectively completed including quantity, quality, and timeliness, and
(ii) To assess whether and how well these activities are achieving the stated goal and purpose of ARP.

Regular monitoring of ARP implementation will be conducted by the PMU.

8.9.2 Monitoring Evaluation

Monitoring implementation of ARP will be the responsibility of the PMU. The implementing agencies will oversee the progress in resettlement preparation and implementation through regular progress reports.

The main indicators that will be monitored regularly are:

(i) Payment of compensation to PAPs in various categories, according to the compensation policy described in ARP;
(ii) Public information dissemination and consultation procedures;
(iii) Adherence to grievance procedures and outstanding issues requiring management's attention; and
(iv) Coordination and completion of resettlement activities in context of the awarding of civil works contracts.

The implementing agencies will submit a quarterly monitoring report to the PPC on the progress of the implementation of ARP. The monitoring reports shall include the following topics:

(i) The number of PAPs, by category of impact per component, and the status of compensation payment and relocation and income restoration for each category;
(ii) The amount of funds allocated for operations or for compensation;
(iii) The eventual outcome of complaints and grievances and any outstanding issues requiring action by management;
(iv) Implementation problems; and
(v) Revised actual resettlement implementation schedules.

8.10 Public Participation, Consultation

8.10.1 Objectives of Public Information and Consultation

Information dissemination to PAPs and involved agencies is an important part of ARP preparation and implementation. Consultation with PAPs and ensuring their active participation will reduce the potential for conflicts and minimize the risk of the Project delays. The objectives of the public information and consultation program are as follows:

(i) To ensure that both local authorities and representatives of PAPs, are included in the planning and decision-making processes. The PMU will work closely with PPC, DPC and CPC during ARP implementation.
(ii) To share information about the Project components and activities with the PAPs;

(iii) To obtain information about the needs and priorities of the PAPs, as well as information about their reactions to proposed policies and activities;
(iv) To ensure that PAPs are able to make fully informed decisions that will directly affect their incomes and living standards, and that they will have the opportunity to participate in activities and decision-making about issues that will directly affect them;
(v) To obtain the co-operation and participation of the PAPs and communities in activities necessary for resettlement planning and implementation;
(vi) To ensure transparency in all activities related to land acquisition, resettlement, and rehabilitation.
(vii) To ensure that basically all PAPs should be informed in advance of public consultation and all or parts of PAPs should be accepted to the consultation meetings.

8.10.2 Consultation during Project Preparation

A consultation with local authorities and PAPs will be organized from 2011. The consultation meetings will be continuously organized after that. In these meetings, local authorities and administrative leaders at all levels and potential affected people were informed about the Project and its objectives and various components. They were thoroughly consulted and actively participated in discussions about their demands for development and their priorities, as well as their awareness of the Project's objectives. PAPs were consulted about impacts and applicable measures to minimize negative impacts and improve the benefits for local residents. Local authorities will be also consulted about their agreement with and commitment to implementing the resettlement policies.

In the meantime, PMU combined with LFDC also conducted community consultations (meeting with the affected communities) to disseminate information includes characteristics of the project, scope of land acquisition, policy on resettlement (essentially concept of replacement costs), schedule of work, grievances mechanism as well as collect information about demographic status, sources of income, expectations for compensation prices, etc. After the Project is officially approved, project information including the project objectives and components and policy, were published via the national and local presses and televisions as well as the PPC's papers to disseminate to the project areas.In general, 100% people and other stakeholder agreed to implement the Project.

1) Information Dissemination and Consultation
During ARP implementation, the PMU will undertake the following:
(i) Disseminate information to and consult with PAP throughout the life of the Project.
(ii) Update the provincial unit prices, and confirm the land acquisition requirements and impact on properties through a DMS, carried out in consultation with PAPs.

DPC will then apply prices, calculate compensation entitlements, and complete The Compensation Forms for each affected household. Information on entitlements will then be presented on an individual basis to PAPs in a DMS follow-up visit to each household.
The Compensation Form, showing a household's affected assets and compensation entitlements, will then need to be signed by the PAPs to indicate their agreement with the assessment. Any complaints the PAPs have about the contents of the form will be recorded at the time.

2) Public Meetings
During ARP preparation process for the Project, the LFDC have been conducted community meetings in affected wards or communes to provide additional information for PAPs and create opportunities for them to participate in open discussions about resettlement policies and procedures. The ward or commune PCs or resettlement consulting groups held meetings to consider and resolve issues related to compensation policies, household land use status, and land use origins.

There are community meetings were organized, the part of summaries on community meetings are showed in the **Table 8.10.1**.

The affected communes will be consulted about following issues:

(a) Representative of each affected household should participate in the measurement and inventory of their assets, and sign in minute of inventory.
(b) Affected households receive the detailed calculation list of compensation, assistance for livelihood and production stabilization for review and check the information.
(c) Any complaint of the PAPs on the compensation plan will be collected and considered carefully based on the real situation, include the issues related to the compensation price.
(d) After that, the LFDC will calculate compensation based on the determined prices and complete the compensation plan for affected assets. The PMU together with the LFDC will present information on entitlements for PAPs in the next consultation.
(e) Next, the compensation plan shall clearly state affected assets and the compensation to which PAPs are entitled, and this shall be signed by the PAPs to show their agreement with the evaluation results. Any questions of PAPs on the contents of the plan shall be noted at this time.
(f) Sending PAPs letters and/or questions related to ARP to inform them about the plans and clearly explain the consequences of each plan.
(g) Each household has the right to reflect, raise their questions related to resettlement such as prices, installment payments and procedures for documenting ownership in the new place, etc. Their questions will be resolved satisfactorily and timely.
(h) Requesting PAPs confirm their choice of resettlement sites and the location of the resettlement sites. It is necessary to introduce to the PAPs about the resettlement sites.
(i) Requesting PAPs to state services clearly they are currently using such as education, health care, and markets, and the distance they travel for these services.
(j) Consultation with affected people about their desire to the support and recovery plan. This section applies for severely affected and vulnerable PAP. The PMU will inform PAPs about the plan and their entitlement to technical assistance before requesting them to present their desires for restoration assistance clearly.

Table 8.10.1 Community Meeting Consultations

Project communes	Time	Location	Number of Meeting	Total of Participants
Tru Van Tho	15/3/2011	PPC's Office	1	53
Tan Hung	12/3/2011	PPC's Office	1	53
Lai Uyen	11/3/2011	PPC's Office	1	74
ChanhPhuHoa	9&26/3/2011	PPC's Office	2	119
Lai Hung		PPC's Office	1 (Institute of Gum Tree Research)	2
			6	**301**

Source: JICA Survey Team

3) Information Disclosure

Beside the public consultation for the PAPs and the communities in the project area, ARP will be available at the PMU office (address: BIWASE, No.11 NgôVănTrị, PhuLoi Ward, Thu Dau Mot Town, Binh Duong Province), Ben Cat district PC, Project Commune PC's Offices (TrừVănThố, TânUyên, TânHưng, Lai Hưng, Lai Uyên, ChánhPhúHòa).

The main content is designed as a brochure to provide information for each affected household.

The mass media, directly is the City's and ward's and village's radio system, disseminate the information of the project's policies.

CHAPTER 9 IMPLEMENTATION SCHEDULE AND COST ESTIMATE

9.1 Implementation Schedule

The target date of a commercial operation to be started is July 2022 and after. **Figure 9.1.1** shows a schedule of project implementation.

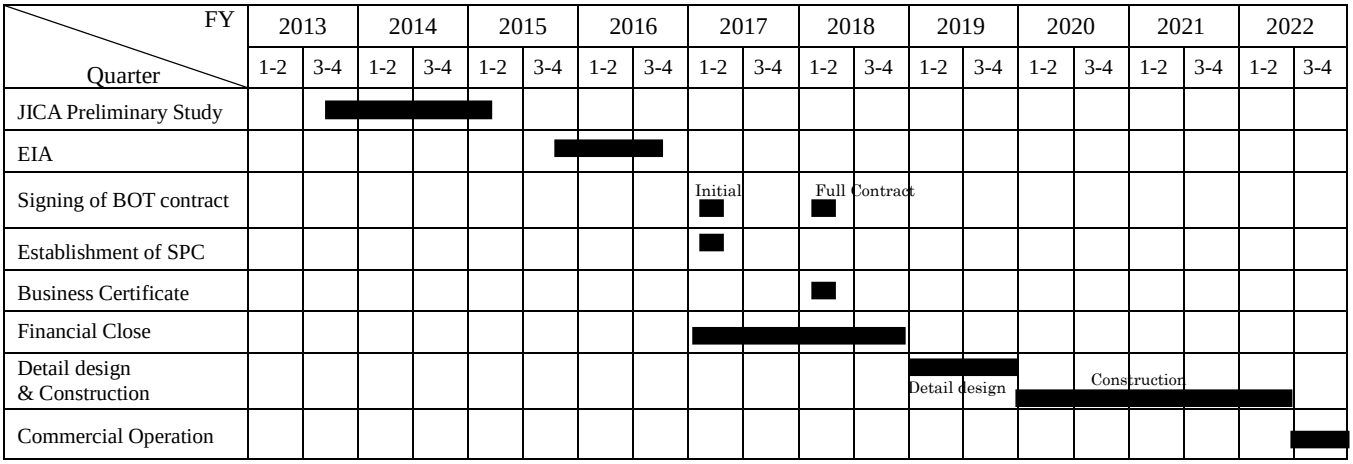


Figure 9.1.1 Schedule of Project Implementation

9.2 Construction Cost

Construction cost is estimated under the following conditions, and to be adjusted by actual yearly inflation Indexes. The assumptions of the inflation rates of this survey are 3.5% per year in Vietnam, 2.2% per year in U.S.A, and 2.0% per year in Japan from 2013. (Draft Final Report in Sept. 2014) Final adjustment shall be made in the BOT contract.

The report has been adjusted with the actual inflation rates (Consumer Price Indexes) of 4.39% in 2013, and 0.93% in 2014, with the revised assumptions of the future inflation rates from 2015 on.
The results are shown as an additional analysis in the "Financial and Economic Analysis".

1) Exchange Rates:
As of March 2013
VND1.0 = JPY 0.0044
US$1.0 = JPY 91.84
As of March 2013
VND1.0 = JPY 0.0056
US$1.0 = JPY 119.03

2) Date of Estimate of Construction Cost:
As of March 2013
Date of Adjusted Construction Cost:
As of March 2015

3) FC: Foreign Currency Portion
LC: Local Currency Portion

The construction cost of Phase 1A and Phase 1B will be JPY30.8 billion as shown in **Table 9.2.1**.
Tables 9.2.2 and **9.2.3** shows the construction cost for Phase 1A and Phase 1B, respectively. Breakdown of the construction cost is shown in **Appendix 9-A**.

Discussions with BIWASE on financial arrangement have been made using the cost with FRP material for raw water pipeline and the total construction cost was JPY27.5 billion as explained in note of Table 9.2.1.

Table 9.2.1 Construction Cost in Phase 1A & 1B

	Item	FC	LC	Combined Equivalent Total
		JPY	VND	JPY
1.	Procurement and Construction			
(1)	Regulating Reservoir	0	114,482,460,006	503,722,824
(2)	Raw Water Intake Pumping Station Phase 1A	445,515,840	35,875,221,899	603,366,816
(3)	Raw Water Intake Pumping Station Phase 1B	261,652,160	0	261,652,160
(4)	Raw Water Pipeline	0	1,652,713,235,058	7,271,938,234
(5)	Water Treatment Plant Phase 1A	3,077,785,600	403,408,968,819	4,852,785,063
(6)	Water Treatment Plant Phase 1B	3,050,006,400	194,465,075,957	3,905,652,734
(7)	Distribution Mains	0	891,000,800,833	3,920,403,524
	Subtotal 1	6,834,960,000	3,291,945,762,572	21,319,521,355
(8)	Overhead & Profit (15%)	0	493,791,864,386	2,172,684,203
	Subtotal 2	6,834,960,000	3,785,737,626,958	23,492,205,559
(9)	Physical Contingency (5%)	341,748,000	189,286,881,348	1,174,610,278
	Subtotal 3	7,176,708,000	3,975,024,508,306	24,666,815,837
(10)	VAT (10%)	717,670,800	397,502,450,831	2,466,681,584
	Total Cost of Procurement and Construction	7,894,378,800	4,372,526,959,137	27,133,497,420
2.	Land Acquisition and Compensation including price and physical contingencies (source: BIWASE)	0	444,581,108,000	1,956,156,875
3.	Administration and Consulting Services (PMU, Detailed Design, Construction Supervision, 8% of Subtotal 1)	-	-	1,705,561,708
Total Cost				30,795,216,003

Note) The total construction cost was JPY27.5 billion with the cost for raw water pipeline of FRP pipe as VND1,126,770,120,218 shown in Appendix 9-A.

Table 9.2.2 Construction Cost in Phase 1A

	Item	FC	LC	Combined Equivalent Total
		JPY	VND	JPY
1.	Procurement and Construction			
(1)	Regulating Reservoir	0	114,482,460,006	503,722,824
(2)	Raw Water Intake Pumping Station 1A	445,515,840	35,875,221,899	603,366,816
(3)	Raw Water Pipeline	0	1,652,713,235,058	7,271,938,234
(4)	Water Treatment Plant Phase 1A	3,077,785,600	403,408,968,819	4,852,785,063
(5)	Distribution Mains	0	891,000,800,833	3,920,403,524
	Subtotal 1	3,523,301,440	3,097,480,686,615	17,152,216,461
(6)	Overhead & Profit (15%)	0	464,622,102,992	2,044,337,253
	Subtotal 2	3,523,301,440	3,562,102,789,607	19,196,553,714
(7)	Physical Contingency (5%)	176,165,072	178,105,139,480	959,827,686
	Subtotal 3	3,699,466,512	3,740,207,929,087	20,156,381,400
(8)	VAT (10%)	369,946,651	374,020,792,909	2,015,638,140
	Total Cost of Procurement and Construction	4,069,413,163	4,114,228,721,996	22,172,019,540

Table 9.2.3 Construction Cost in Phase 1B

	Item	FC	LC	Combined Equivalent Total
		JPY	VND	JPY
1.	Procurement and Construction			
(1)	Raw Water Intake Pumping Station Phase 1B	261,652,160	0	261,652,160
(2)	Water Treatment Plant Phase 1B	3,050,006,400	194,465,075,957	3,905,652,734
	Subtotal 1	3,311,658,560	194,465,075,957	4,167,304,894
(3)	Overhead & Profit (15%)	0	29,169,761,394	128,346,950
	Subtotal 2	3,311,658,560	223,634,837,351	4,295,651,844
(4)	Physical Contingency (5%)	165,582,928	11,181,741,868	214,782,592
	Subtotal 3	3,477,241,488	234,816,579,219	4,510,434,437
(5)	VAT (10%)	347,724,149	23,481,657,922	451,043,444
	Total Cost of Procurement and Construction	3,824,965,637	258,298,237,141	4,961,477,880

9.3 O&M Cost

Operation and maintenance cost will be VND1,054/m3(Phase 1A&1B), VND1,176/m^3(Phase 1A) and VND960/m3(Phase 1B) at 2013 excluding raw water resource and heavy repair fund. Breakdown of the operation and maintenance cost is shown below, and to be adjusted by actual yearly inflation Indexes. The assumptions of the inflation rates of this survey are 3.5% per year in Vietnam, 2.2% per year in U.S.A, and 2.0% per year in Japan from 2013. (Draft Final Report in Sept. 2014) Final adjustment shall be made in the BOT contract.

The report has been adjusted with the actual inflation rates (Consumer Price Indexes) of 4.39% in 2013, and 0.93% in 2014, with the revised assumptions of the future inflation rates from 2015 on.
The results are shown as an additional analysis in the "Financial and Economic Analysis".

Table 9.3.1 O&M Cost in Phase 1A & 1B (300,000m^3/d)

No	Type of Expense	Cost (VND/m^3)
1	Personal expense (Fixed wages + Variable wages)	84
2	Insurance (Labor + Healthcare + others)	18
3	Electricity	205
4	Chemical	382
5	Sludge Treatment	3
6	Repair and Maintenance	226
7	Others (Overall management cost, etc)	136
	Total	1,054

Table 9.3.2 O&M Cost in Phase 1A (150,000m^3/d)

No	Type of Expense	Cost (VND/m^3)
1	Personal expense (Fixed wages + Variable wages)	133
2	Insurance (Labor + Healthcare + others)	28
3	Electricity	214
4	Chemical	385
5	Sludge Treatment	3
6	Repair and Maintenance	272
7	Others (Overall management cost, etc)	141
	Total	1,176

Table 9.3.3 O&M Cost in Phase 1B (150,000m^3/d)

No	Type of Expense	Cost (VND/m^3)
1	Personal expense (Fixed wages + Variable wages)	37
2	Insurance (Labor + Healthcare + others)	8
3	Electricity	214
4	Chemical	385
5	Sludge Treatment	3
6	Repair and Maintenance	181
7	Others (Overall management cost, etc)	132
	Total	960

CHAPTER 10 FINANCIAL AND ECONOMIC ANALYSIS

10.1 Identification of the Scope of the Project

10.1.1 Objectives of the Identification

The objectives of the identification of the scope of the project are the followings.

a. Introduction of BOT Structure with an Optimum Demarcation

To provide an economically feasible water supply infrastructure for the water supply area introducing BOT structure with an optimum demarcation between the public and the private sector.

b. Providing Competitive Tariff

To propose a competitive bulk water supply tariff to the public (Off-taker, i.e. Binh Duong Water Supply - Sewerage - Environment Co., Ltd.), the competitive tariff enables the area economically attractive for both domestic and foreign investors.

c. Enabling Private Sector's Investment

To make the private sector ready to invest for the project with its own scope of work with acceptable IRR point of view.

10.1.2 Project Cost Estimation

According to the "Options Study for Rehabilitation and Expansion of Water Services in Urban Areas HCMC and Binh Duong Province (14 April 2011)", the EPC cost was recognized as USD 215.8 Million in total with the plant capacity of 300,000 m^3/d, shown in "Appendix 10-A Project Cost Estimation of North Binh Duong Water Treatment Plant ".
At the starting point of the preparatory survey, total project cost was estimated as USD256.3Million (10-A.1) in consideration with the additional cost of USD 40.5 Million as project finance cost to implement the project on a BOT structure basis. Preliminary design work was completed in April 2013, and the total project cost was estimated as USD 386.0 Million (10-A.2) including project finance cost, due to the design change and the increased scope of work on raw water intake pipeline from the canal to the water treatment plant, and the transportation & distribution main pipelines. The design change to the raw water intake pipeline including the reservoir and the scope change to the transportation & distribution main pipeline were made on to the preliminary design work and the project cost came down to USD 303.0 Million (10-A.3) in Nov. 2013.
Based on the preliminary design work mentioned above, 3(three) optional design for raw water intake pipeline were studied as G-1, P-2, P-3 to select most economical LCC (Life Cycle Cost) design in April 2014.
P-3 with the project cost of USD 297.9 Million (10-A.5) was confirmed as final one after comparison against G-1 with the project cost of USD 322.3 Million (10-A.4) in July 2014.

10.1.3 Identification of an Optimum Project Demarcation

To identify an optimum project demarcation between the public and the private sector, project scope was split into three options and considered, shown in "Appendix 10-B Demarcation between the Public and the Private Sector" to fulfill those objectives mentioned 10.1.1 a., b. and c. above.
The Option1 offers full scope of the project to be invested by the private sector. The Option2 offers the transportation & distribution main pipeline to be invested by the public sector and the balance of the scope to be constructed by the private sector. The Option3 offers the transportation & distribution main pipeline and the raw water intake pipeline (including the regulating reservoir) to be invested by

the public sector and the balance of the scope to be invested by the private sector. According to the analysis of those three options above, together with 10.3.1 Optimum Financial Scheme, the most competitive Bulk Water Supply Tariff is available from the option 3. As shown in
"Appendix 10-C Financial Structure and Bulk Water Supply Tariff", an available finance source, including JICA- Private Sector Investment Finance (JICA-PSIF) as an option, is for the private sector and a potential Japanese ODA Loan Program, which is under discussion between Government of Vietnam and JICA, may be available for the public sector, and the combination of those two finance source enables the total project finance cost minimize. In case of 300,000m3/d capacity case, the bulk water supply tariff offered by SPC is VND 5,300/m^3 (Current price in the year 2013, USD 0.2539/m^3), shown in "Appendix 10-D Water Supply Tariff ", and additional water tariff covering the public portion (The transportation & distribution main pipeline and the raw water intake pipeline including the reservoir) is VND 1,900/m^3 (Current price in the year 2013, USD 0.0910/m^3), VND 7,200/m^3 (Current price in the year 2013, USD 0.3449/m^3) in total, which is lower than the current weighted average of End User Tariff of VND 8,000/m^3 shown in 10.1.4.

10.1.4 Possible Bulk Water Supply Tariff

The possible Bulk Water Supply Tariff shall be settled as "Current Price (P0) "to make the End User Water Tariff to be competitive, to keep Off-Taker's (BIWASE) profitability stable, and to offer investors a reasonable return (IRR).

From the End User Water Tariff point of view, "Overall average of Water Tariff crossing all customer groups in Binh Duong Province was VND 3,670 per cubic meters (USD 0.1758/m^3) in 2005 to VND 5,777 per cubic meters (USD 0.2768/m^3) in 2010" has been reported in "Options Study for Rehabilitation and Expansion of Water Services in Urban Areas HCMC and Binh Duong Province (14 April 2011)". In the year 2010, the overall averaged water tariff of VND 5,777 per cubic meters (USD 0.2768/m^3) was covering all the water production and distribution cost in Binh Duong Province.

In the year 2010, the calculations above are based on the End User Water Tariff of VND 4,000 per cubic meters (USD 0.1916/m^3) for Household (Up to 20m^3/person/month), VND 6,000 per cubic meters (USD 0.2875/m^3) for Manufacturing, VND 6,500 per cubic meters (USD 0.3114/m^3) for Government Offices, and VND 8,000 per cubic meters (USD 0.3833/m^3) for Service & Trading.

From April 2013 on, the End User Water Tariff has been changed to VND6,100 per cubic meters (USD 0.2922/m^3) for Household (Up to 20m^3/person/month), VND 8,500 per cubic meters (USD 0.4072/m^3) for Manufacturing, VND 8,500 per cubic meters (USD 0.4072/m^3) for Government Offices, and VND13,000 per cubic meters (USD 0.6228/m^3) for Service & Trading, and the overall average of Water Tariff crossing all customer groups in Binh Duong Province is supposed to be at around VND 8,000 per cubic meters (USD 0.3833/m^3) to cover all the water production and distribution cost in Binh Duong Province. Those End User Water Tariff levels are lower than that of Ho Chi Minh City having the same income level (Average income per person) of Binh Duong Province.

Based on the plant capacity of 300,000m^3/d, offered Bulk Water Supply Tariff is VND 5,300 per cubic meters (USD 0.2539/m^3) covering water production cost, VND 1,900 per cubic meters (USD 0.091/m^3) covering pipelines' cost (Raw water intake & Distribution main), and VND 7,200 per cubic meters (USD 0.3449/m^3) in total, shown in "Appendix 10-D". Option3 with Direct Loan" enables the private sector's investment. Po (Current Bulk Water Supply Tariff in 2013) shall be settled in the BOT contract and/or Water Purchase Agreement considering those points mentioned above in the range from VND 6,100 per cubic meters (USD 0.2922/m^3) to VND 5,300 per cubic meters (USD 0.2539/m^3).

In case of splitting the plant capacity into 2(two) phases, according to the water use forecast, Bulk Water Supply Tariff can be offered as follows.

Phase1 150,000m3/d Case; Po (Current Bulk Water Supply Tariff in 2013)
VND 5,920 per cubic meters (USD 0.2836/m^3) covering water production cost, VND 3,810 per cubic

meters (USD 0.1825/m^3) covering pipelines' cost (Raw water intake & Distribution main), and VND 9,730 per cubic meters (USD 0.4662/m^3) in total.

Phase2 150,000m^3/d Case; Po (Current Bulk Water Supply Tariff in 2013)
VND 4,900 per cubic meters (USD 0.2348/m^3) covering water production cost, and no charge for water transportation & distribution cost (all the pipelines are included in Phase1), VND 4,900 per cubic meters (USD 0.235/m^3) in total.

The possible Bulk Water Supply Tariff of VND 7,200 per cubic meters (USD 0.3449/m^3) covering water production cost and pipelines' cost available from the plant capacity of 300,000m^3/d is 10% lower than the overall average of Water Tariff crossing all customer groups of VND 8,000 per cubic meters (USD 0.3833/m^3) in Binh Duong Province in 2013.

The report (Draft Final Report in Sept. 2014) has been adjusted with the actual inflation rates (Consumer Price Indexes) of 4.39% in 2013, and 0.93% in 2014, with the revised assumptions of the future inflation rates from 2015 on, and the results are the followings.

Based on the plant capacity of 300,000m^3/d, Po (Current Bulk Water Supply Tariff in 2015) is VND 5,050 per cubic meters (USD 0.2370/m^3) covering water production cost, VND 2,330 per cubic meters (USD 0.1110/m^3) covering pipelines' cost (Raw water intake & Distribution main), and VND 7,380 per cubic meters (USD 0.3470/m^3) in total.

In case of splitting the plant capacity into 2(two) phases, Bulk Water Supply Tariff are shown below.

Phase1 150,000m3/d Case; Po (Current Bulk Water Supply Tariff in 2015)
VND 5,690 per cubic meters (USD 0.2680/m^3) covering water production cost, VND 4,660 per cubic meters (USD 0.2190/m^3) covering pipelines' cost (Raw water intake & Distribution main), and VND 10,350 per cubic meters (USD 0.4870/m^3) in total.

Phase2 150,000m^3/d Case; Po (Current Bulk Water Supply Tariff in 2015)
VND 4,590 per cubic meters (USD 0.2160/m^3) covering water production cost, and no charge for water transportation & distribution cost (all the pipelines are included in Phase1), VND 4,590 per cubic meters (USD 0.2160/m^3) in total.

10.2 Risk Analysis

It is important to materialize the project commercially feasible by allocating the potential risks to the parties concerned to the project, i.e. the Central Government of Vietnam, People's Committee of Binh Duong Province (BDPC), Binh Duong Water Supply-Sewerage-Environment Co., Ltd (BIWASE) and the SPC.
The risks are recognized by the project implementation phases; those are project Planning & Design Phase, Construction Phase, and Commercial Operation Phase shown in "Appendix 10-G" and allocated. The detailed terms and conditions are described in "Appendix 11-C Term sheet for BOT Contract" and "Appendix 11-D Term sheet for Water Purchase Agreement".

10.3 Financial Analysis

10.3.1 Optimum Financial Scheme

a. JICA-PSIF and Japanese ODA

The Scope of the project shall be shared by the private sector and the public sector based on the optimum demarcation mentioned 10.1.3.
For the private sector, the Project Company borrows 70% of the project cost directly from an available finance source, including JICA- Private Sector Investment Finance (JICA-PSIF) as an option, and the remaining 30% will be provided by the sponsors' investment to the project company.
For the public sector, potential Japanese ODA Loan Program which is under discussion between Government of Vietnam and JICA may be available, and the pledge timing shall be coordinated with the pledge timing of an available finance source, including JICA-PSIF to provide the water supply infrastructure based on a BOT structure with an optimum demarcation between the public and the private sector.

b. Two Step Loan, and Direct Loan

JICA-PSIF is expected to be available for bulk water supply special purpose company (SPC) to be established by private sector in two ways shown in "Appendix 10-C", one is Two step loan, and the other is Direct loan. In case of Two step loan, SPC is able to obtain JICA-PSIF in Vietnamese Dong(VND) through a Vietnamese commercial bank from JICA, and pay back the loan to JICA via the Vietnamese bank in VND without taking any currency exchange risk.
In case of Direct Loan, SPC obtain the JICA-PSIF directly from JICA in Japanese Yen (JPY), and pay back the loan to JICA in JPY, taking currency exchange risk in case of no countermeasure, because SPC's revenue comes in VND from the Off-Taker. From the loan interest rate point of view, in case of Two step loan, Vietnamese bank offers SPC at around 13%/year, because Vietnamese bank takes currency exchange risk, putting their risk premium rate on to the interest rate offered by JICA.
For the direct loan case, JICA offers SPC at around 4%/year to be expected, and studied to become much less than that.

c. Competitive Bulk Water Supply Tariff

Taking those loan interest rate and currency exchange rate risk into consideration, the available bulk water supply tariff from the SPC (private sector) is shown in " Appendix 10-D Bulk Water Supply Tariff ". To provide the most competitive Bulk Water Supply Tariff, SPC's (private sector) project scope shall be Option 3, together with Direct loan, and currency exchange risk shall be taken by Off-Taker (public) under the terms and conditions defined in the water purchase agreement between SPC and Off-Taker and/or BOT contract between SPC and Binh Duong Province. The public sector's scope shall be financed by potential Japanese ODA Loan Program which is under discussion between Government of Vietnam and JICA or equivalent finance source.

d. Asian Development Bank as a finance source

According to ADB' s "Country Partnership Strategy (CPS, July2012) and "Updated CPS results framework (Dec.2013)", "Water supply and other municipal infrastructure and services." is one of the selected seven sectors in Viet Nam on which ADB is focusing to support. "ADB Indicative Resource Allocation" for "Water supply and other municipal infrastructure and services" is USD758Million in 2013-2015 and USD342Million has been approved in 2012.
In 2013, over USD200million loan agreement were signed between ADB and State Bank of Vietnam including piped water supply project in Binh Duong Province.
ADB is expected to continue financial support for water supply project and "Updated CPS results framework (Dec.2013)" reported the project names with the cost, mainly as follows.

*2014 Water Sector Investment: USD180.7Million
*2015 Water Sector Investment: USD185.8Million

For "Water Supply Project in New City and Industrial Parks in Northern Part of Binh Duong Province", the construction work is scheduled to start in 2020, and financial arrangement for the project shall be done well in advance by available finance source including ADB as an option.

10.3.2 Financial Analysis of the Project

For financial analysis, all income and expense items are included in the cash flow summery shown in "Appendix 10-E Cash Flow Summary.
In case of splitting the plant capacity into 2(two) phases, for Phase1, private sector's investment is available at bulk water supply tariff of VND 5,920 per cubic meters (USD 0.2836/m^3) with option 3 with the financial structure of direct loan.
In addition to the cash flow analysis above, SPC's profit might become less than that of "Appendix 10-E Cash Flow Summary", caused by increased debt value in VND on its Balance Sheet (B/S) derived from the devaluation of VND against JPY on SPC's debt in JPY.
Sponsors of the SPC might be exposed to the risk of IRR down side fluctuation of the project by the risk above. Those are the issues to be solved.

10.4 Sensitivity Analysis

In this analysis, the following three case scenarios are considered for sensitivity analysis based on the following conditions.

a. Inflation Rate;

Vietnam 3.5 % per annum, U.S.A 2.2 % per annum, Japan 2.0 % per annum (2020 -)

b. Vietnamese Dong Devaluation against Japanese Yen;

Devaluation goes 3.5%, 5.0%, 5.5% per annum (2020 -)

c. Water Tariff Adjustment;

Water tariff is subject to foreign exchange rate fluctuation adjustment (FOREX adjustment) for "Capital Cost Recovery "portion and subject to Vietnamese inflation rate for the other portion shown in "Appendix 11-D Term sheet for Water Purchase Agreement" in case of "Base Case" below.

d. Water Tariff (VND/m3, Base Case)

2013	2017	2020 (PCOD)
5,920	6,800	7,280 (The water price excludes VAT, but includes Intake Fee.)

Case 1

After the starting point of commercial operation, VND devaluation goes 3.5% per annum without having FOREX adjustment and the water tariff increases at 3.5% per annum according to the Vietnamese Inflation.

Case 2

After the starting point of commercial operation, VND devaluation goes 5.0% per annum without having FOREX adjustment and the water tariff increases at 3.5% per annum according to the Vietnamese Inflation.

Case 3

After the starting point of commercial operation, VND devaluation goes 5.5% per annum without having FOREX adjustment and the water tariff increases at 3.5% per annum according to the Vietnamese Inflation.

Table 10.4.1 Sensitivity Analysis from the SPC Cash Flow

Case	Initial Water Price	Project IRR	Minimum DSCR
Base Case	7,280VND/m^3	14.1%	1.51
Case 1	7,530VND/m^3	17.4%	1.49
Case 2	7,530VND/m^3	17.5%	1.22
Case 3	7,530VND/m^3	17.5%	1.02

In the Case 1 and Case 2 indicates, SPC could survive without having FOREX adjustment.
In the Case 3, Minimum DSCR goes low. This indicates, if VND devaluation goes over 5.5% without having FOREX adjustment to the Water Tariff Adjustment then VND devaluation would drive SPC into bankruptcy.

The report (Draft Final Report in Sept. 2014) has been adjusted with the actual inflation rates (Consumer Price Indexes) of 4.39% in 2013, and 0.93% in 2014, with the revised assumptions of the future inflation rates from 2015 on, and the results are the followings.

a. **Inflation Rate;**

Vietnam 3.5 % per annum, U.S.A 2.2 % per annum, Japan 2.0 % per annum (2022 -)

b. **Vietnamese Dong Devaluation against Japanese Yen;**

Devaluation goes 3.5%, 5.0%, 5.5% per annum (2022 -)

c. **Water Tariff Adjustment;**

Water tariff is subject to foreign exchange rate fluctuation adjustment (FOREX adjustment) for "Capital Cost Recovery "portion and subject to Vietnamese inflation rate for the other portion shown in "Appendix 11-D Term sheet for Water Purchase Agreement" in case of "Base Case" below.

e. **Water Tariff (VND/m3, Base Case)**

2015	2019	2022 (PCOD)
5,690	6,680	7,060 (The water price excludes VAT, but includes Intake Fee.)

Case 1

After the starting point of commercial operation, VND devaluation goes 3.5% per annum without having FOREX adjustment and the water tariff increases at 3.5% per annum according to the Vietnamese Inflation.

Case 2

After the starting point of commercial operation, VND devaluation goes 5.0% per annum without having FOREX adjustment and the water tariff increases at 3.5% per annum according to the Vietnamese Inflation.

Case 3

After the starting point of commercial operation, VND devaluation goes 5.5% per annum without having FOREX adjustment and the water tariff increases at 3.5% per annum according to the Vietnamese Inflation.

Table 10.4.2 Sensitivity Analysis from the SPC Cash Flow (Rev. in 2015)

Case	Initial Water Price	Project IRR	Minimum DSCR
Base Case	7,060VND/m^3	14.3%	2.12
Case 1	7,220VND/m^3	16.8%	2.02
Case 2	7,220VND/m^3	16.9%	1.60
Case 3	7,220VND/m^3	16.9%	1.45

The SPC cash flow analysis based on the Project Cost and the Operation Cost Increase is shown below as Table 10.4.3.
The Project Cost and the Operation Cost increased by 1.4 times, the cost increase would drive SPC into bankruptcy.

Table 10.4.3 Sensitivity Analysis from the SPC Cash Flow
(In case of Project Cost Increase, Operation Cost Increase)

		Project Cost Increase				
		x 1.0	x 1.2	x 1.4	x 1.6	x 1.8
Operation Cost Increase	x 1.0	2.12	1.79	1.55	1.36	1.19
	x 1.2	1.81	1.53	1.31	1.14	1.01
	x 1.4	1.45	1.20	1.03	0.89	0.79
	x 1.6	1.04	0.86	0.75	0.65	0.57
	x 1.8	0.64	0.52	0.43	0.37	0.32

CHAPTER 11 DEVELOPMENT OF BUSINESS PLAN

11.1 Laws and Regulations for Water Supply Service

11.1.1 General legal frameworks for Water Supply Service

There are laws, degrees and regulations governed water supply service. The areas that the government currently emphasizing on are:

- Master Plan of Government's strategy on water industry
- Water quality
- Water Purchase Agreements
- Mechanism to Determine Output Water Price
- Rights and obligations of water supply companies and water-using customers
- Government management of water supply

The general legal framework is presented in the Appendix 11-A in the hierachical style, starting by the highest influence position of Law 17/2002/QH13 issued by National Asembly then followed by decrees (issued by the Government) and regulations (issued by Ministries) on each area.

Two most relevant areas in the project of " Water Purchase Agreement" and " Mechanism to Determine Output Water Price" are presented in 11.1.2 and 11.1.3.

11.1.2 Water Purchase Agreement

Two types of water purchase/supply agreements/ contracts governed under Decree 117/2007/ND-CP include:

- Agreement on provision of water supply services (Article 31 of Decree 117/2007/ND-CP), which is entered between a water supply company and the People's Committees of towns/ communes where the water is supplied to. This type of agreement, is, however, applicable in case the water is supplied to individual households or business units;

- Water supply/purchase service contracts (Article 44 of Decree 117/2007/ND-CP), which is entered between a water supply company and customers. This type of contracts include retail contracts entered between a water supply company and individual households/ business units and wholesale contracts entered between a water supply company acting in the wholesaler role and a water supply company acting in the retailer role.

As it is intended that the Project Company will supply its output water to BIWASE, it is likely that only a wholesale water supply/ purchase service contract between the Project Company and BIWASE is required. However, such a contract must be approved in writing by the People's Committees of towns/ communes of the water supply region of the Project, who have signed agreements on provision of water supply services with BIWASE.

A template of a wholesale water supply contract, containing compulsory terms and conditions are provided under Circular 01/2008/TT-BXD of the MOC.

11.1.3 Mechanism to Determine Output Water Price

It is provided under Article 54 of Decree 117/2007/ND-CP that: "*Clean water wholesale prices are agreed upon by water supply wholesale units and water supply retail units; in case of failure to reach agreement, either party (or both parties) may request the organization of negotiations on prices*

according to law." Article 7 (1) of Circular 75/2012/TTLT-BTC-BXD-BNNPTNT also reinforces the mutual agreement principle set under the above Article 54 of Decree 117/2007/ND-CP and further clarifies that the agreed price should "*ensure that the wholesale water supply units and retail water supply units can cover the cost of production, sale and reach a reasonable rate of profit but not contrary to regulations in Article 6 (giving guidance on determining average retail water prices) and not higher than the retail price set by the competent agencies"*.

The price setting process of the authorities can be summarized as follows:

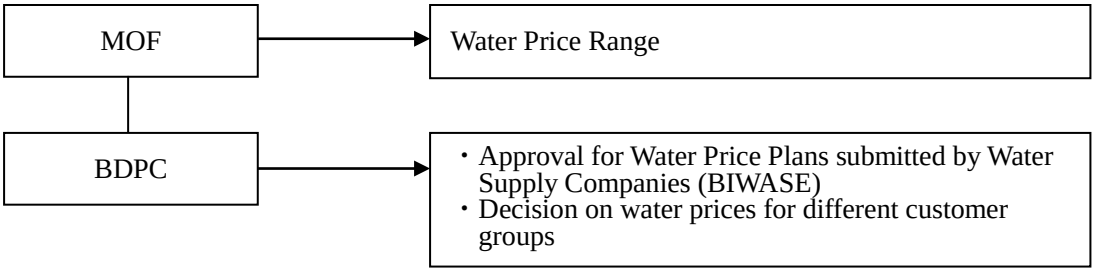


Figure 11.1.1 Price Setting Process

(1) Water Price Range

The latest water price range is provided under Circular 88/2012/TT-BTC of the MOF, specially:

Table 11.1.1 The Latest Water Tariff Range in Vietnam

Descriptions	Minimum price (VAT of 5% inclusive)		Maximum price (VAT of 5% inclusive)	
	VND/m^3	US$	VND/m^3	UD$
Special urban areas, urban areas in Class I	3,500	0.18	18,000	0.90
Urban areas in Class II – V	3,000	0.15	15,000	0.75
Clean water in rural areas	2,000	0.10	11,000	0.55

Thu Dau Mot City of Binh Duong Province is currently an urban area of Class II. The New Binh Duong City is, however, expected to be an urban zone of Class I after completion.
The range serves as the basis for local People's Committees to decide detailed retail water prices for different groups of consumers.

(2) Retail Water Price Determination

It is provided under Article 9 (2) of Circular 75/2012/TTLT-BTC-BXD-BNNPTNT that the detailed retail water prices decided by local People's Committee must be within the MOF's promulgated range. Special cases where a provincial People's Committee can decide water prices which are up to 50% higher than the maximum price promulgated by the MOF include:

- Salt-water;
- Coastal areas;
- Areas with difficult water production condition; and
- Costs for production and supply of clean water higher than the maximum price promulgated by the MOF.

In case of Binh Duong, the latest BDPC's Decision on water prices is Decision 11/2013/QĐ-UBND dated 22 March 2013. Accordingly, the current retailing water prices (VAT of 5% included) in Binh Duong range from **VND 6,100 (**equivalent to approximately **USD 0.29)** to **VND 13,000 (**equivalent to approximately **USD 0.62)**, depending on groups of consumers and consumption quantity.
Appendix 11-B shows the history of retail water price of Binh Duong province.

11.2 Investment Scheme

In Vietnam, there are three investment frameworks, a Normal, BOT and PPP.
If the authorities have not determined yet which method is adopted, the investor can choose a framework himself based on self-assessment of an advantage and a disadvantage, and when choosing a BOT or PPP framework, the investor can propose a business plan himself. In each framework, required approval processes and timeline are summarized into below with the relevant regulations.

11.2.1 Normal Investment Framework

Procedure and relevant laws and regulation is as follows.

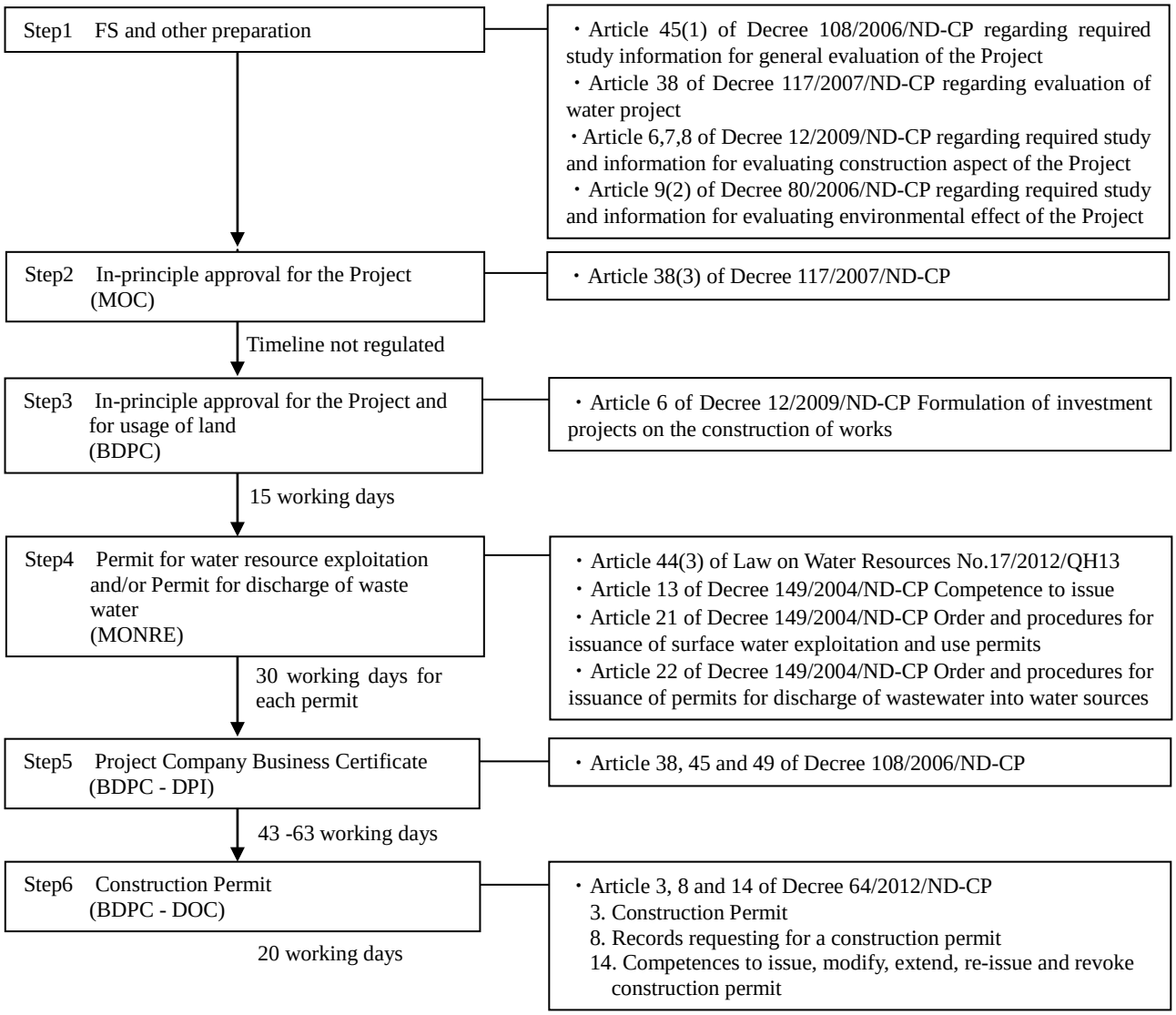


Figure 11.2.1 Normal Investment Framework

(1) Step1 Feasibility Study ("FS")

To be able to be utilized for the Project's approval and for applying for an Investment Certificate, the Project's FS must contain the following:

- Sociological investigations and surveys and public polling; selection of technical and technological options and capacity; water charge calculation options and draft agreement on water supply service provision (to be entered into with the BDPC) are required under Article 6

of Law 17/2012/QH13 on Water Resources and Article 38 (2) of Decree 117/2007/ND-CP in case the Project *"substantially alter the service quality conditions and clean water supply charge rates"* in the area;

- Detailed project description and basic design (including drawing and explanation) as specified under Article 7 and 8 of Decree 12/2009/ND-CP;

- Environmental impact assessment report is required if the Project involves:
  - ✓ Risks of directly and badly affecting water sources in river basins, coastal areas and areas having protected eco-systems (Item 3, Appendix to Decree 21/2008/ND-CP); or
  - ✓ Constructing reservoirs (lakes) with a capacity of **300,000 m3 or more** of water (Item 52, Appendix to Decree 21/2008/ND-CP); or
  - ✓ Exploiting surface water with exploitation capacity of **50,000 m3 or more** of water per day and night (Item 70, Appendix to Decree 21/2008/ND-CP).

(2) Step2 In-principle Approval of the MOC

Article 38 (3) of Decree 117/2007/ND-CP requires that project to invest in water treatment plants in urban zones (except for urban zones of special grades i.e. Hanoi, Ho Chi Minh City) with capacity of **10,000 m^3/day must** be approved in writing by the MOC before being licensed. Accordingly, with the expected capacity of 300,000 m^3/day, the Project must receive the approval from the MOC.

(3) Step3 In-principle approval for the Project and for usage of land by BDPC

In case the land for constructing all necessary construction works of the Project have been included in the approved water supply plan and master construction plan of Binh Duong, then this Step might **not** be necessary.
However, if the land for the Project has **not** been identified and agreed to by the BDPC, then this step is required under Article 6 of Decree 12/2009/ND-CP. (Water supply project with the investment capital of **VND 1,000 billion** (equivalent to approximately **USD 50 million**) or more is categorized into Group A projects under Decree 12/2009/ND-CP, for which provincial People's Committee is authorized to decide on the usage of land).

(4) Step4 Permit for water resource exploitation and/or Permit for discharge of waste water by MONRE

In accordance with Article 44(3) of Law on Water Resources No. 17/2012/QH13, a permit for water resource exploitation must be obtained before the investors can start project company licensing procedures.
Permits for water resource exploitation are within the authority of the MONRE in case of *"exploiting, using surface water for other purposes with flow of **50,000 m^3/day and night** or more"*. MONRE will also decide to grant permits for discharge of waste water for projects *"discharging wastewater into water sources with the flow of **5,000 m^3/and nigh** or more"*.
Accordingly, given the estimated intake raw water of **300,000 m^3/day**, the permits that the Project might need to obtain are subject to the approval of the MONRE.

(5) Step5 Project Company Business Certificate by BDPC

According to Article 37 and Article 38 of Decree 108/2006/ND-CP, a water plant project does **not** fall into the list of projects that need to be approved by the Vietnamese Prime Minister but the provincial People's Committee, in this case being BDPC.

(6) Step6 Construction Permit

Construction permit might be exempt if the construction works of the Project is considered to fall *into "construction works by lines not passing through urban areas but in accordance with the construction plans which have been approved by the competent State agencies*" or *"Works under construction investment projects decided on the investment by the Prime Minister, ministers, heads of ministerial-level agencies, the presidents of People's Committees at all levels"*.
Otherwise, before starting construction work, a construction permit must be obtained from Binh Duong DOC.

11.2.2 BOT Framework

Figure 11.2.2 BOT Framework

(1) Step1 Approval for Project Proposal by BDPC

As the Project has **not** been included in the list of approved BOT projects of Binh Duong Province, as per Article 1 (4) of Decree 24/2011/NĐ-CP, to conduct the Project under the BOT framework, the Investors will need to submit a Project Proposal for the BDPC's consideration and approval to include the Project into the list of Binh Duong Province's BOT projects.

Before approving the Project, BDPC will need to obtain the PM's approval in case government guarantee or disbursement of budget of the central government is required for the Project.

(2) Step2 FS and other preparation work BDPC

It is provided under Article 1 (4) of Decree 24/2011/NĐ-CP that: "*The **competent state agencies** organize to make feasibility study reports for using as a basis for making a bidding dossier and negotiating a project contract with the investor*". The competent state agency in this case is the BDPC.
It is also provided that the fund to carry out the FS will be arranged from the Vietnamese state budget or other fund and the investor winning the tender in the next step will need to reimburse such expenses to the Vietnamese authorities.

(3) Step3 Tender for selection of investor by BDPC

Tender for selection of investor is a compulsory procedure, even in case the Project is proposed by the Investors. After the Project is approved to be performed under the BOT framework, BDPC must publish the tender request on their website and the Bidding Newspapers in 3 executive issues.
Tender procedure can only be replaced by appointment of investor in case:

- Within at least 30 days from the date of the last publication, no investor other than the investor making the Project Proposal expresses the interest for the tender; or
- The project should be implemented to meet urgent needs for use of infrastructure facilities as decided by the Prime Minister at the proposal of the BDPC.

(4) Step4 BOT Contract Signing

After an investor is selected, the BOT contract should be initially signed between the selected investor and the BDPC to enable other licensing steps. Official contract signing should be conducted after the Project Company obtains the Business Certificate.
The content of other licensing steps is the same as under the Normal Investment Structure.

(5) Obligations of Investor(s) and Project Company

Under the BOT investment framework, the investor(s) and the Project Company of a BOT project has the following obligations/ restrictions under Decree 108/2009/ND-CP (which are **not** applicable in case the Project is performed under the Normal Investment Framework):

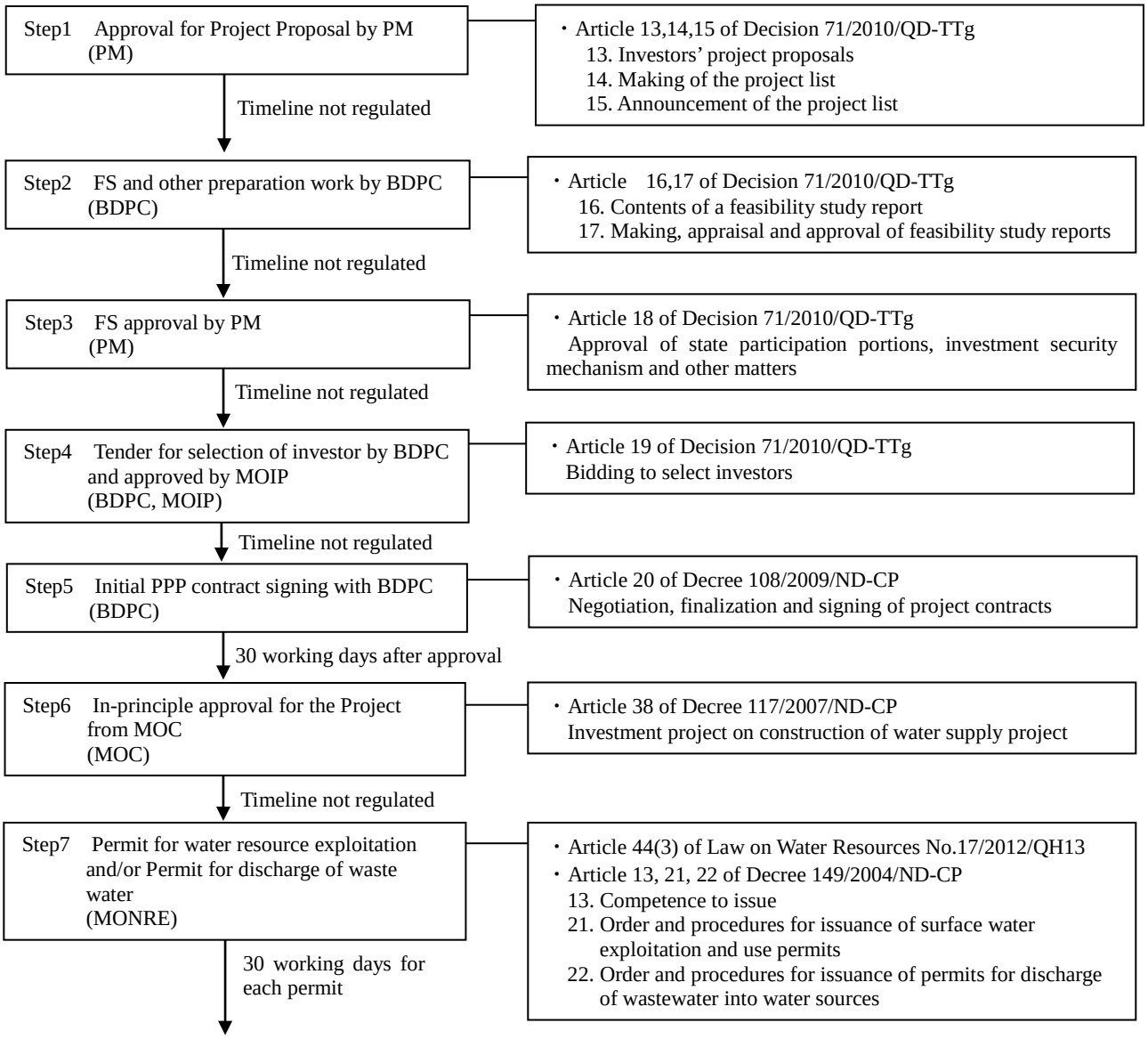
- The Project must be transferred without any compensation to the Government of Vietnam when the BOT contract expires;
- Minimum charter capital is required (15% of the total investment capital up to VND 1,500 billion and 10% of the total investment capital exceeding VND 1,500 billion, which is equivalent to approximately USD 75 million);
- The Project Company is exempt from land rental but has to pay for land compensation and household resettlement from its own investment capital unless the Project is considered to be

urgent by the Vietnamese authorities (then the expenses will be paid out of the state budget);

- The Project Company must apply measures to secure project performance obligations from the effective date of the BOT contract until the date when the construction works are completed. Specifically, with regard to projects with total investment capital of above VND 1,500 billion (equivalent to approximately USD 75 million), then:
-
  - ✓ With regard to the investment capital of up to VND 1,500 billion, the monetary amount for securing the project contract performance obligation must not be lower than 2% of this capital portion; and
  - ✓ With regard to the investment capital of above VND 1,500 billion, the monetary amount for securing the project contract performance obligation must not be lower than 1% of this capital portion.
  - ✓
- The pledge or mortgage of assets of the Project Company is subject to approval of the Vietnamese authorities and must not affect the Project' objectives, progress and operation.

11.2.3 PPP Framework

PPP frame work is shown as follows.



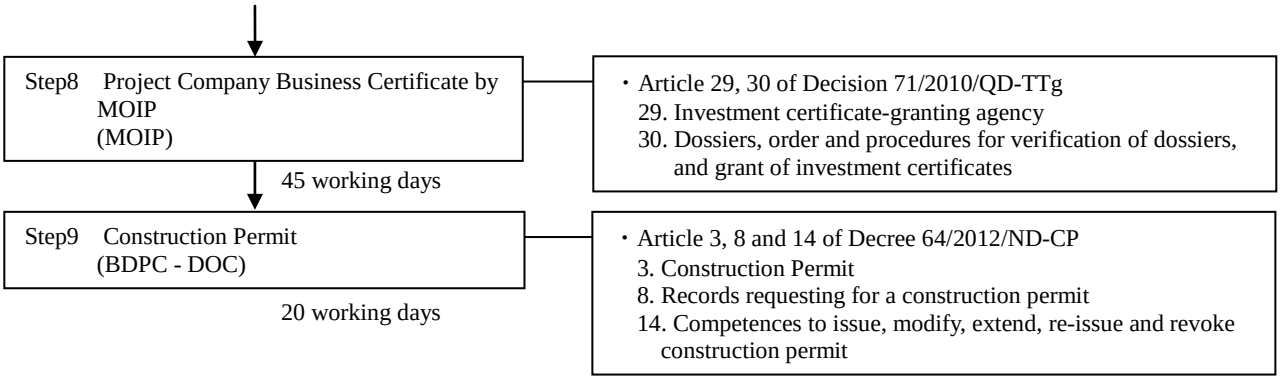


Figure 11.2.3 PPP Framework

The typical differences between PPP investment framework, which is currently governed under Decision 71/2010/QD-TTg dated 09 November 2010 and the BOT framework include:

- The Vietnamese Government guarantees to take part in PPP projects up to 30% of the total investment capital in form of state capital (including state budget capital, official development assistance, government bonds, state-guaranteed credit, state development investment credit, development investment capital of state enterprises and other capital sources which give rise to public debts managed by the State), investment incentives and relevant financial policies. The state participation will not be in form of equity capital contribution.

- The approval and licensing process of a PPP project, however, requires the direct involvement of higher ranking government authorities, for example, the Prime Minister, Ministry of Investment of Investment and Planning.

- Whether or not the Project to be transferred to the Vietnamese Government at the end of the PPP contract is negotiable.

- Minimum equity capital of the Project Company is required to reach at least 30% of the total private capital (which can be higher than 15% or 10% of total investment capital for BOT projects).

- It is required that the monetary amount for securing the PPP contract performance obligation must not be lower than 2% of total investment capital, which is higher than the combination of 1% and 2% based on the level of investment capital applicable for BOT contracts.

Most importantly, currently, PPP in Vietnam is still treated as a pilot investment scheme which has not been well regulated as well as tested in practice.

11.2.4 Investment Incentive and Obligations

Table 11.2.1 Investment Incentive

No.	Investment Incentives	NIF	BOT	PPP
Non Tax Incentives				
1	Direct funding from the state budget up to 30% of total investment capital (not equity capital of the Project).	No	No	Yes (Article 9(2) of Decision 71/2010/QD-TTg)
2	Government guarantee for project loan(s).	No	May be (Article 40 of Decree	May be (Article 10(3) of

			108/2009/ND-CP)	Decision 71/2010/QD-TTg)
3	Government guarantees regarding state enterprise obligations to sell materials and/or purchase Project's products/services.	No	May be (Article 40 of Decree 108/2009/ND-CP)	May be (Article 45 and 46 of Decision 71/2010/QD-TTg)
4	Support for expenses of compensation, site clearance and infrastructure outside the approved Project Site.	Yes (Article 1(8) of Decree 124/2011/NĐ-CP amending Article 30(3) of Decree 117/2007/NĐ-CP)	May be (Article 6(2) of Decree 108/2009/ND-CP)	May be (Article 10(1) of Decision 71/2010/QD-TTg)
5	Government's acknowledgment that acknowledges that prices of goods and charges of services provided by Project Company should be agreed on the principle of fully offsetting expenses, taking into account market prices and ensuring benefits of the Project Company, users and the State of Vietnam.	No	Yes (Article 33 of Decree 108/2009/ND-CP)	Yes (Article 33 of Decree 108/2009/ND-CP)
6	Project Company can request competent state agencies to assist in collecting charges and other revenues.	No	May be (Article 34 of Decree 108/2009/ND-CP)	Not regulated
7	Subsidize or support from the BDPC in case the Project's approved water price is higher than the water prices promulgated by the BDPC.	Yes (Article 3(4) of Circular 75/2012/TTLT-BTC-BXD-BNNPTNT)	No	Not regulated
Tax Incentives				
8	Corporate income tax rate of **10% for 15 years** (can be extended to 30 years based on PM's approval) from the first of year of revenue generation (and 20% afterwards) and **CIT exemption for 4 years and 50% CIT reduction for the following 9 years** from the first year of taxable profit generation or the fourth year of revenue generation in case no taxable profit is generated until then.	Yes (Article 19(2) and Article 20(1) of Decree 123/2012/TT-BTC)	Yes (Article 19(2) and Article 20(1) of Decree 123/2012/TT-BTC)	Yes (Article 19(2) and Article 20(1) of Decree 123/2012/TT-BTC)
9	**Exemption of import duty** for imports to form fixed assets i.e. equipment and machinery, spare parts and building materials to construct the equipment and machinery if **not** yet producible in Vietnam.	Yes (Article 12(6) of Decree 87/2010/NĐ-CP)	Yes (Article 12(6) of Decree 87/2010/NĐ-CP)	Yes (Article 12(6) of Decree 87/2010/NĐ-CP)
10	**Exemption of land rental**	**during construction and 3 years** after construction completion (Article 14 (4.a) of Decree 142/2005/ND-CP)	Whole project duration (Article 38(3) of Decree 108/2009/ND-CP)	Whole project duration (Article 41 (3) of Decision 71/2010/QD-TTg)

Note:

- **"Yes"** means the incentive is definitely available for the relevant investment framework under the regulations.

- **"No":** the incentive is definitely not available for the relevant investment framework under the regulations.
- **"May be":** the incentive is not automatically available for the relevant investment framework under the regulations but subject to the assessment and decision of the authorities (and negotiation power of the investors).

Table11.2.2 Investment Obligations

No.	Obligations	NIF	BOT	PPP
1	The Project must be transferred without any compensation to the Government of Vietnam.	No	Yes (Article 2(1) of Decree 108/2009/ND-CP)	May be (Article 40 (1) of Decision 71/2010/QD-TTg)
2	Minimum charter capital is required.	No	Yes, 15% or 10% of total investment capital (Article 5 of Decree 108/2009/ND-CP)	Yes, 30% of total private capital (Article 3(3) of Decision 71/2010/QD-TTg)
3	Payment of land compensation and resettlement expenses.	No, if paid then offset against payable land rental (Article 2 of Circular 93/2011/TT-BTC)	May be (Article 30(2) of Decree 108/2009/ND-CP)	May be (Article 10(1) of Decision 71/2010/QD-TTg)
4	Monetary obligations to secure project performance.	No	Yes, at least 1% or 2% of total investment capital (Article 23 of Decree 108/2009/ND-CP)	Yes, at least 2% of total investment capital (Article 28 of Decision 71/2010/QD-TTg)
5	The pledge or mortgage of assets of the Project Company is subject to approval of the Vietnamese authorities.	No	Yes (Article 41 of Decree 108/2009/ND-CP)	Yes (Article 43 of Decision 71/2010/QD-TTg)
6	Competitive bidding to select contractors/ suppliers	Not required if being non-state owned company and if fund from state budget is less than **30%** of total investment capital (Article 1 of Law 61/2005/QH11)	Not required if being non-state owned company and if fund from state budget is less than **30%** of total investment capital (Article 1 of Law 61/2005/QH11)	Not required if being non-state owned company and if fund from state budget is less than **30%** of total investment capital (Article 1 of Law 61/2005/QH11)

11.2.5 Conclusion on Investment Frameworks

With the objective of balancing between the need to have the Project timely approved and licensed by the Vietnamese authorities and the need to of the Investors to have the Vietnamese Government Guarantee to ensure free inflow and outflow of capital and returns, and certain obligations of Vietnamese partners such as the off-taker and suppliers of key materials, it appears that the current BOT framework is the optimum investment scheme for this Project.

11.3 Project Company

11.3.1 Project Company's Legal Form, Organization and Management

Under the current Vietnamese Law on Enterprise, The Project Company might be either registered as a limited liability company or a joint stock company. In the later case, it is required that the minimum number of investors must be three (3). A joint-stock company is, however, more appropriate in case the long-term objective of the shareholders is to list the Project Company on the Vietnamese stock exchanges. Otherwise, in most cases, the most preferable legal form of organizational foreign investors is a limited liability company.

In a limited liability company, each shareholder is legally responsible for the Project Company's

operation within the equity capital committed to invest into the Project Company and is entitled to the Project Company's performance results corresponding to the capital contribution ratio.
A limited liability company can easily increase the charter capital but can only decrease the committed charter capital under certain limited circumstances.
A limited liability company having two shareholders and above are organized as follow:

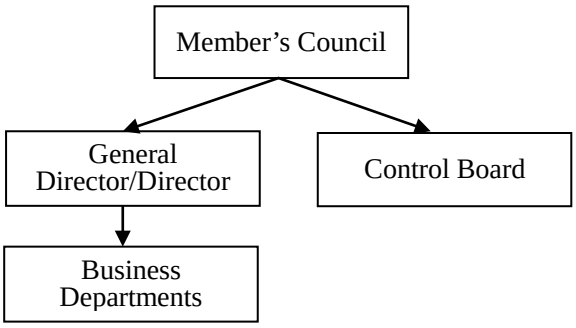


Figure 11.3.1 Organization of Project Company

Shareholders being organizations appoint its representatives to participate in the member's council to execute its shareholders' right. The Member's Council must meet at least once a year to outline and determine significant business strategies, issues and contracts of the Project Company. Decisions of the Member's Council are made through voting procedures. A decision is considered lawful if voted by members representing for 65% or 75% (depending on the type of decisions) of the shareholding participating in the meeting (which is required to be 75% if meeting can be held on the first call, 50% on the second call but unlimited on the third call).
Daily operation of the Project Company might be responsible by the General Director/ Director. Either the Chairman of the Member's Council or the General Director/ Director might be appointed to be the Legal Representative of the Project Company.
A Control Board is indispensable when the number of the shareholders of a Project Company amounts to eleven (11) or more.

Profits of a limited liability company can be distributed to the shareholders after fulfilling tax and other financial obligations, and the Company is still capable of paying off due debts and other property liabilities afterward.

11.3.2 Project Implementation Structure

The Project Company should be established after signing an initial BOT contract between Hitachi and BDPC as a limited liability company in Vietnam.
The Project Company borrows 70% of the project cost directly from an available finance source, including JICA- Private Sector Investment Finance as an option, and the remaining 30% will be provided by the sponsors' investment to the project company.

The Project Company should get the right of Business certification and Construction Permit from BDPC, the Approval for Project from MOC and the Permit for water resource exploitation and/or the Permit for discharge of waste water from MONRE.

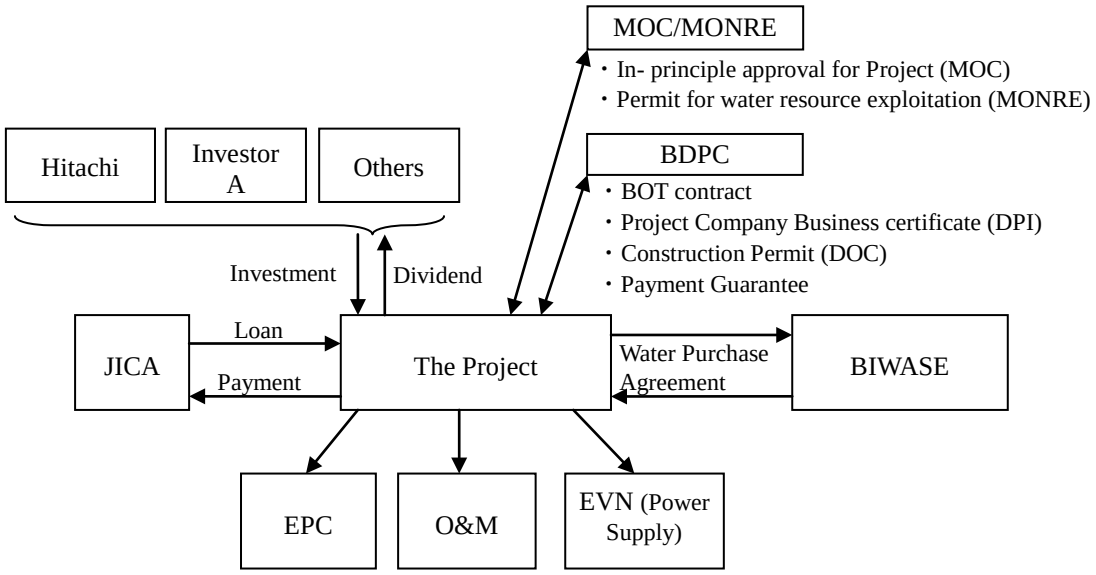


Figure 11.3.2 Project Scheme

In addition, the Project Company is planning to enter into a power purchase agreement with EVN (Vietnam Electricity Holding Company) and a operation and maintenance agreement with BIWASE to keep a stable operation.

11.3.3 Operation and Maintenance Plan

In examining the O&M organization of a new water purification plant, we investigated the organization of Tan Hiep water treatment plant as reference. Tan Hiep Water Treatment Plant has the capacity of 60,000m^3/d and also has a plan to extend more 90,000m^3/d. The total length of distribution pipeline is about 500km.
The WTP employs 120 people in total, and breakdown is as follows.

Table 11.3.1 Example of Number of Stuff (Tan Hiep WTP)

NO	Role	Numbers of staff
1	Manager	3 (1Director+2Vice Director)
2	Administration staff	2
3	Securities	3
4	Operator	24 (12×2team,including 2Pump station)
5	Engineer	6
6	Laboratory	3
7	Others	80
	Total	120

Others include customer management, service area management, billing, water quality record (meter reading), plumber repair, NRW team, etc.

Referring to the above, the Project Company that only bulk water supply business is as follows generally.

Table 11.3.2 Number of Operating Staff (SPC)

NO	Role	Numbers of staff	
		Phase1A(150,000m^3/d)	Phase1A+1B(300,000m^3/d)
1	Manager	2 (1Director+1Vice Director)	←
2	Administration staff	2	←
3	Securities	3	←
4	Operator	14 (4×3team+2)	21(6×3team+3)
5	Engineer	6	←
6	Laboratory	1	←
7	Others	α	←
	Total	28+α	35+α

11.4 Related Contract

11.4.1 BOT Contract

Appendix 11-C is the draft of Terms and Conditions of BOT contract between Binh Duong PC and the Project Company.

11.4.2 Water Purchase Agreement

Appendix 11-D is the draft of Terms and Conditions of Water Purchase Agreement BIWASE and the Project Company.

11.5 Land Compensation, Clearance, Resettlement and Land Rental

In case the Project is conducted under the Normal Investment Framework, the state budget should bear land compensation/ clearance/ resettlement costs, if any. However, in Vietnam, especially with regard to projects requiring a significant area of land, it is not uncommon that to speed up project progress, investors have to first reimburse the fund for land compensation/ clearance/ resettlement purposes. These payments, if in line with the regulations, are deductible from the land rental payable of the Project.

In case the Project is conducted under the BOT framework, the state budget bears land compensation/ clearance/ resettlement if *"the Project is to meet urgent needs for the use of infrastructure facilities"*. Otherwise, these costs must be paid and born by the Project Company and will be accounted into the Project's costs to calculate prices of output goods/ services.

Prices for land compensation/ household and business resettlement are governed in detail by the Government. Compensation/ resettlement plans with detailed costing will be reviewed by the provincial Department of Finance and approved by the provincial People's Committee before implementation. Disputes between existing land users and the Projects/ the authorities regarding prices for land compensation/ resettlement, however, are usually observed, which sometimes ends up in delay in project implementation or investors having to pay higher than the prices stipulated by the Government despite that these additional payments are not deductible against land rental payable and even CIT non-deductible.

(1) Land Rental

Land rental is payable when the Project obtains land from the State (unless being exempted)

In case the Project is conducted under the BOT framework, the Project is **exempt** from land rental for the whole Project's duration.

In case the Project is conducted under the Normal Investment Framework, the Project Company is exempted from land rental during construction period and within 3 years after construction completion. After that, land rental is payable for the remaining project duration. Based on its decision, the Project Company can pay land rental as one shot from the beginning of the Project or annually.

If being paid one shot, land rental is calculated as follow (assuming that the land use duration is less than 70 years):

Land rental (equal to land use fee) (n years) =
[Land price for the relevant use purpose as stipulated by BDPC]
– [Land price for the relevant use purpose as stipulated * (70–n)*1.2% by BDPC]

In case the land price stipulated by BDPC is lower than the market price, then BDPC must base on the market price to determine the applicable land price for the Project. Once determined one shot land rental is final and will not be adjusted during the project duration.

According to Decision 04/2011/QĐ-UBND dated 18 February 2011 of the BDPC, on the basis that the Project is an encouraged investment project under current investment regulations, annual land rental is calculated as follow:

Annual land rental payable=
[Land price for the relevant use purpose as stipulated by BDPC]*0.75

Current land prices for calculation of land rental in Binh Duong province is stipulated under Decision 58/2012/QD-UBND dated 18 December 2012 of the BDPC. Land prices can be adjusted by the BDPC on annual basis but for the purpose of calculation of annual land rental payable, relevant land prices will be kept unchanged for 5 years. Any price adjustments only take place after every 5 years. Any land compensation/ clearance/ resettlement if paid by the Project Company will be offset against payable land rental.

(2) Land Use Tax (for Using of Non-Agriculture Land)

On an annual basis, the Project Company will need to pay a land use tax, which is calculated as follow:

Land use tax payable = 50% * land area (m2) * land price (VND/m2) * 0.03, of which:

- 50% is applicable as water treatment plant projects are treated as encouraged investment projects
- land area: only land area for the water treatment plant should be counted, land area used for construction of lakes, pipelines are not subject to this tax
- land price: stipulated by BDPC on annual basis. The 2013 land price applicable for land used for production and business at Ben Cat District (where the water treatment plant is to be constructed) ranges from VND 230,000 to VND 840,000 depending on the position of the land area (Decision 58/2012/QĐ-UBND dated 18 December 2012 of BDPC)

11.6 Tax and Accounting Implications

11.6.1 Corporate Income Tax and Dividend Tax Implications

(1) Corporate Income Tax

Under current Vietnamese CIT implications, the Project is subject to the following CIT incentives (regardless of the Project's investment structure):

- CIT rate of **10%** for 15 years from the first of year of revenue generation (and 20% afterwards). In case the Project Company is considered to be large-scale or applying hi-tech, or project that need to attract investment, the duration to apply CIT rate 10% can be extended up to 30 years under the Prime Minister's decision based on the proposal from the Minister of Finance.
- CIT exemption for **4 years** and **50%** CIT reduction for the following **9 years** from the first year of taxable profit generation or the fourth year of revenue generation in case no taxable profit is generated until then as shown below.

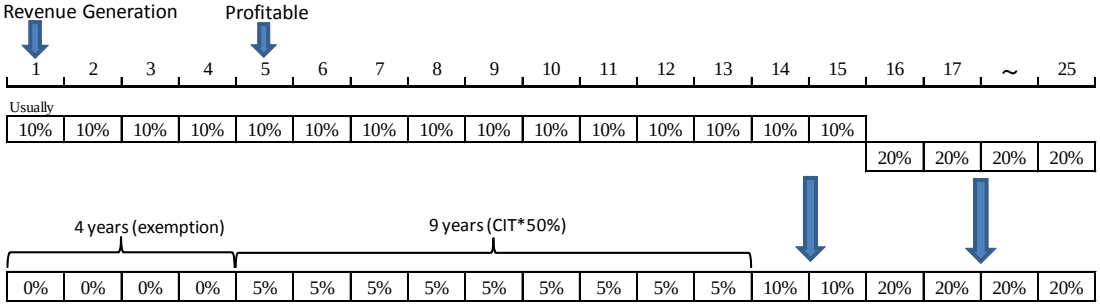


Figure 11.6.1 Corporate Income Tax for BOT Project Company

Usually, these incentives will be maintained throughout the Project's life even though later on these incentives might be omitted in later CIT regulations (in case later on, better incentives are available, however, the Project Company can claim for such better incentives).

The above CIT incentives are, however, only applicable to income from the main business activity of the Project Company and not applicable to financial incomes (i.e. difference between interest income and interest expenses, foreign exchange revaluation, etc…) and other incomes (i.e. liquidation of assets, etc…). Financial incomes and other incomes are subject to CIT at the standard rate 25%.

The above incentives are also not applicable for any income from investment expansion after the size of the Project has been approved.
CIT taxable incomes are defined to be the difference between CIT taxable revenue and CIT deductible expenses.
Any loss can be carried forward within a 5 year period.
CIT taxable year is also the accounting/ fiscal year of the Project Company. Quarterly provisional CIT filings and payments are required together with an annual CIT finalization.
In accordance with a new Law revising the current Law on CIT which will come into effect from 1 January 2014, the standard CIT tax rate of 25% will reduced to **22%** from 2014 and **20%** from 2016. The Project, therefore, is able to apply these new reduced CIT standard rates.

(2) Dividend Tax Implications

Currently, Vietnam does not impose any further tax on dividend income distributed by the Project Company to its organization shareholders, both Vietnamese or non-Vietnamese organizations (Individuals, however, are taxed at 5% on dividend income).

11.6.2 VAT Implications

VAT payable of the Project Company is the difference between payable output VAT and creditable input VAT (credit method).

Output water of the Project Company is subject to VAT at the rate of **5%**. The triggering point of output VAT is the time of transfer of ownership or right to use the goods to the purchaser, irrespective of whether money was received.

Input VAT (from purchase invoices) can be credited against output VAT (from sale invoices) to determine the VAT payable or refundable. Payments for transactions valued at **VND 20 million** and above must be made via a bank for corresponding input VAT creditability.

Machinery, equipment and other imports for construction and operation of the Project is also subject to VAT and should be treated as both output VAT (payable at importation) and creditable input VAT of the Project Company.

From 1 January 2014, Input VAT can, generally, be claimable for credit at any point before a tax audit is open by the tax authorities.

Time for VAT refund includes:

- During construction period, if any, where output VAT has not yet been incurred, VAT refund may be claimed (i) on an annual basis or (ii) when the accumulated input VAT exceeding VND 300 million.

- During the operation, VAT may be refunded if monthly input VAT is not fully credited against output VAT after 12 consecutive months or 4 consecutive quarters.

It is mandatory to issue VAT invoices when selling goods or services. Generally, VAT invoices could be either self-printed by the Project Company or ordered from registered printing companies.
VAT filing is required on a monthly basis with due date at the 20th of the following month.
No annual VAT finalization is required under the credit method.

11.6.3 Royalty on Raw Water

In case the Project Company directly exploits raw water from rivers, then the Project Company is subject to royalty on raw water.

Royalties are calculated as follow:

Royalty amount payable in a period	=	Output of royalty liable natural resources	x	Royalty taxable price of a unit of natural resource	x	Royalty rate

For natural water used for industrial purposes, the natural resource output used for royalty calculation shall be determined in cubic meter (m3) or liter (l). The Project Company is required to install devices to measure the output of exploited natural water for use as grounds for royalty calculation. Installed devices must have inspection certificates of a Vietnamese agency in charge of measurement and quality and notified to tax offices.

Prices for calculation of royalty on raw water is stipulated by the BDPC. According to the latest Decision No. 43/2010/QĐ-UBND dated 19 November of the BDPC, the price for surface water exploited for industrial purposes is VND 2,000/ m3 (equivalent to USD 0.1/ m3).

The royalty rate for surface raw water used for produce clean water is 1% in accordance with Resolution 928/2010/UBTVQH12 dated 19 April 2010 of the Standing Committee of the Vietnamese National Assembly.

Monthly provisional royalty declarations must be submitted and royalty payment must be made by the 20th of the following month. Annual finalization declaration is required and payment of outstanding tax amount, if any must be made within 90 days following calendar year-end.

However, according to the information obtained from BIWASE, raw water for this project needs to be obtained from Phuoc Hoa Lake, which is invested under a project of the Ministry of Agriculture and Rural Development and Ministry may charge a higher royalty rate to recover their investment, specifically the current royalty rate charged by the Ministry to another water treatment project in Ho Chi Minh City is **VND 750/m3.**

11.6.4 Others

Apart from these above key Vietnamese tax implications, the Project Company is also subject to other Vietnamese taxes in the same way like other local Vietnamese companies, including personal income tax and compulsory insurance for the employees, foreign contractor withholding tax with regard to payments made to overseas lenders, contractors and suppliers under certain circumstances, environment protection fee, etc.

From 10 April 2015, the BOT framework is considered as one of the forms of private-public partnership (others include BTO, BT, BOO, BTL, BLT, O&M) governed under the Decree No. 15/2015/ND-CP dated 14 February 2015. Appendix 11-E is the revision of the original "CHAPTER 11" based on the new PPP Decree showing a comparison of BOT Investment framework and Normal Investment and framework.

11.7 Drafting of Security Package (Including government guarantee for Off-Taker Obligation)

11.7.1 Objectives of Security Package

In this section, we will discuss security package for Special Purpose Company for Water Treatment Plant ("Project Company").

11.7.2 Necessity of Security Package

Security package is necessary for Project Company to cover the risks and make the project feasible. Especially for foreign investors, adequate security package is considered as a precondition for their investment. Looking at precedence, most of the successful projects developed by international investors in Vietnam, particularly power generation projects did have sufficient security package such as guarantees from the central government.

11.7.3 Effect of Security Package

Security package works as a protection to secure cash collection of Project Company especially in case contingency events occur.

11.7.4 Potential Security Package

The potential security package that can be considered for this project consists of 1) guarantees and 2) security interests.

(1) Guarantees

One potential security is guarantee from related entities such as parent companies and/or governmental entities including the provincial government and/or the central government.

It is most desirable that the guarantee covers not only payment obligation of an off-taker of a project but also (i) all contractual obligations of the off-taker, which can be an assurance for private sector to carry out the project, (ii) all obligations of the provincial government under the [BOT contract] and (iii) Project Company's revenue conversion into a foreign currency and its remittance to overseas.

It is often the case that infrastructure projects, which are to be build and operate for the purpose of wide public use, are fully supported by the provincial government and, as the case may be, the central government.

(2) Security Interests

1) On-shore Escrow Account

Another measure to protect cash collection of a project is to take security interest from an off-taker.

As a potential way for cash flow protection, we can consider requesting an off-taker to establish its new revenue account for the purpose of this project and have payments from water users such as residents in New Binh Duong City and/or industrial park to be made into such account ("Escrow Account"). Hypothecating such Escrow Account will be a valid method of securing such cash collection.

While guarantee by the provincial government and/or the central government can be considered as a last resort for investors and sometimes require time-consuming process, this security interest may

rather work as a practical protection based on a bilateral agreement between Project Company and an off-taker.

Further to the above, we may also request an off-taker to undertake minimum cash reserve requirement in the off-taker's revenue account in case of contingency events.

One point we have to note is that an off-taker can be a public corporate entity and may not be permitted to hypothecate their assets due to restriction of law and/or under agreements with its current financing parties. As such, this mechanism needs further investigation through the discussion with a potential off-taker.

2) Payment to Off-shore Account

In addition to the arrangement of an on-shore Escrow Account for cash collection from daily operation, it is also necessary for foreign investors to secure their termination payments to be paid by the provincial government as a result of the termination events.

Termination payments can be secured in such a way that it is to be paid into investors' offshore accounts to avoid various potential risks including restriction of overseas remittance.

11.7.5 Structure of Security Package

The security package can be designed as shown in the chart below.

(1) Water Tariff Payments

First off, both the off-taker and the Project Company open new accounts for the purpose of this project in the same agent bank. As the chart shows, the source of the project cash flow is water tariff payment made by users in New Binh Duong City and the industrial park. The payments are directed to the off-taker's newly established revenue account with the agent bank. Then, off-taker makes water tariff payment to the Project Company whose account is also with the same agent bank.

As a security interest, the off-taker's revenue account, as an Escrow Account, needs to be hypothecated and charged by way of first ranking and sole and exclusive charge in favor of the Project Company. In addition, Project Company may also request the off-taker to deposit certain amounts of cash in its revenue account as a minimum cash reserve requirement to prepare for sudden cash shortage. This mechanism enables Project Company to be protected from non-payment by the off-taker due to sudden cash shortage.

In the event that there still remains a certain cash shortage in Escrow Account, guarantee from governmental entity (entities) will kick in to make up such shortage.

(2) Termination Payments

It needs to be agreed with the provincial government and its guarantor that the termination payment will be directly paid into investors' off-shore accounts without any deduction and/or any delay (TP Account in the following chart). The payment to off-shore account ensures investors security to receive termination payment.

11.7.6 Summary of Security Package

We have discussed the security package in general and its applicability to this project. To what extent should Project Company require security package may be subject to further due diligence and further

discussion among project parties including the off-taker, the provincial government and the central government as the case may be.

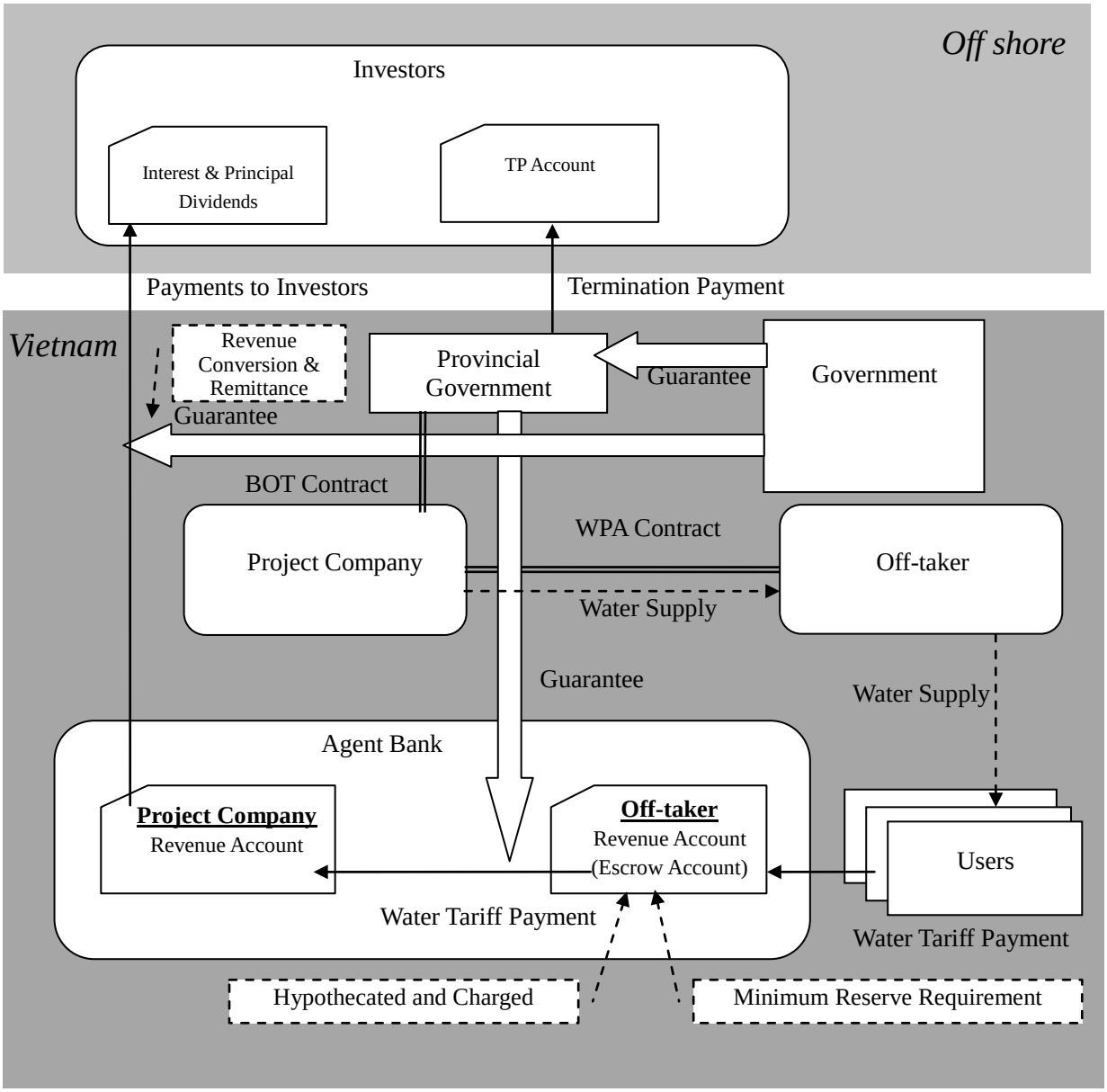


Figure 11.7.1 Structure of Security Package

CHAPTER 12 RECOMMENDATIONS

The proposed water supply system development is composed of five main components, namely regulating reservoir, intake pumping station, raw water transmission pipeline, North Binh Duong water treatment plant (NBDWTP) and distribution mains.

In the proposed business scheme, the above components are divided into two sub-projects. One consists of regulating reservoir, raw water transmission pipeline, and distribution mains and would be constructed, operated, and managed by Binh Duong Province. The other contains NBDWTP and intake pumping station, and would be constructed, operated, and managed by a private investor. A steering committee would be required for the comprehensive coordination at each stage of the implementation, such as financing, design, tender/contract, construction and operation.

The public sector partner should be responsible for securing funding for the construction of regulating reservoir, raw water transmission pipeline, and distribution mains in the proposed water supply system development. Binh Duong PPC's own source of financing may not be sufficient. It would be necessary to seek support from the central government and/or funding from donor agencies through the central government. In competing with other candidate projects for donor funding, Binh Duong PPC would have to show strong leadership, such as establishing a sector program for the joint development and management of the water supply project.

To implement the project, Japan International Cooperation Agency (JICA) is expected to continue to support the project. A potential Japanese ODA Loan Program and a JICA-Private Sector Investment Finance are the favorable finance source.

Binh Duong PPC may also wish to make special efforts to discuss with relevant agencies to seek their support and assistance in this process.