Data Collection Survey on Septage Management for Facilitating the Environmental Development Project

Final Report

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Japan International Cooperation Agency (JICA)

Yokohama Water Co., Ltd. (YWC)

Contents

List of Figures, Tables, and Photographs

Abbreviations

ACWD: Angeles City Water District
CHD**:** Center for Health Development Office
C/P: Counter Part
CWD: Calamba Water District
DBP: Development Bank of the Philippines
DENR: Department of Environment and Natural Resources
DPWH: Department of Public Works and Highways
EDP: Environment Development Project
ESC: Environmental Sanitation Clearance
FIRR: Financial Internal Rate of Return
F/S: Feasibility Study
LWUA: Local Water Utilities Administration
NPV: Net Present Value
NSSMP: National Sewerage and Septage Management Program

PWRF: Philippines Water Revolving Fund
USAID: United States Agency for International Development
JICA: Japan International Cooperation Agency

Foreign Exchange Rates (December 2014)

1PHP (Philippine Peso) ＝ 2.433JPY (Japanese Yen)

1USD (US Dollar) ＝ 109.45JPY (Japanese Yen)

Summary

Table 1 Summary Sheet (CWD)

Septage Design Quantity				
	Target Year	Septage Design Quantity (m^3/d)	(Reference) Benefiting Population	
Immediate future	2017	50	99,070	
Future	2027	100	177,385	
Treatment Method				
Examined options	Option 1		Option 2	
Treatment method	Pretreatment + Mechanical dewatering + Johkasou		Pretreatment + Mechanical dewatering + Extended aeration	
Equipment specifications Pretreatment Mechanical dewatering machine Filtrate treatment	 Screen Volute Johkasou		 Screen Volute Extended aeration	
Number of Collection Trucks				
8.5 m^3 vacuum truck 4.5 m^3 vacuum truck 5 m^3 dump truck	1 2 1			
Construction Site				
Necessary area (m^2)	1,500			
Cost				
Treatment method	Option 1		Option 2	
Construction cost (PhP)	76,380,736		77,661,925	
Annual operation and maintenance cost (PhP)	8,806,441		9,562,234	
Financial Plan				
Basic conditions Interest Repayment period Weighted Average Cost of Capital Loan: Own capital Desludging fee (PhP/m^3)	 9.00% 15 years (with 3 year deferment) 9.80% 80:20 2.00			
Examination case (assuming Option 1 for the treatment method)	Case where land is purchased inside the Water District		Case where land is provided by the city authorities	
Cost share (Central Government: City: Water District)	0:0:100	40:0:60	0:0:100	40:0:60
NPV (in 1,000 PhP) FIRR	36,952 18.0	64,777 31.7	50,617 23.2	72,978 39.6

Table 2 Summary Sheet (ACWD)

Septage Design Quantity			
	Target Year	Septage Design Quantity (m^3/d)	(Reference) Benefiting Population
Immediate future	2020	100	167,535
Future	2030	150	287,726
Treatment Method			
Examined options	Option 1	Option 2	
Treatment method	Pretreatment + Mechanical dewatering + Johkasou	Pretreatment + Mechanical dewatering + Extended aeration	
Equipment specifications Pretreatment Mechanical dewatering machine Filtrate treatment	 Screen Volute Johkasou	 Screen Volute Extended aeration	
Number of Collection Trucks			
10 m^3 vacuum truck 5 m^3 vacuum truck 2.5 m^3 vacuum truck 5 m^3 dump truck	3 3 1 1		
Construction Site			
Necessary area (m^2)	2,000		
Cost			
Treatment method	Option 1	Option 2	
Construction cost (PhP)	96,485,906	98,527,519	
Annual operation and maintenance cost (PhP)	12,939,582	13,622,142	
Financial Plan			
Basic conditions Interest Repayment period Weighted Average Cost of Capital Loan: Own capital Desludging fee (PhP/m^3)	 9.00% 15 years (with 3 year deferment) 9.96% 84:16 2.00		
Examination case (assuming Option 1 for the treatment method)			
Cost share (Central Government: City: Water District)	0:0:100	40:0:60	
NPV (in 1,000 PhP) FIRR	22,128 13.9	57,227 25.3	

1. Outline of Project

1.1 Background

In the Philippines, sewage and septage are often released into water bodies without being treated first, and this has led to severe water contamination.

In response to these conditions, the Government of the Philippines enacted the Clean Water Act (RA 9275) in 2004 to address environmental degradation caused by water contamination. Furthermore, the government established the National Sewerage and Septage Management Program (NSSMP) led by the Department of Public Works and Highways (DPWH) in 2012, and has in other ways pursued measures focusing primarily on the development of legal and institutional frameworks.

Unfortunately, these plans, laws/ordinances and so forth have not always been implemented smoothly, and environmental degradation has continued unabated, worsening to the point that urgent measures are now needed to prevent further deterioration.

Meanwhile, the Japan International Cooperation Agency (JICA) has been implementing a two-step loan scheme called Environmental Development Project (hereinafter, EDP) through the Development Bank of the Philippines (hereinafter, DBP) since 2008 with the aim of contributing toward environmental improvement efforts through promoting construction of facilities (total committed amount: 24.8 billion yen).

Among environmental improvement facilities targeted for EDP financing, those in the fields of water supply and water quality control utilize a financing program known as the Philippines Water Revolving Fund (PWRF; a guarantee fund that aims to promote private-sector funding for water and sewerage works construction) established jointly by USAID and the DBP based on a Japanese-American water initiative.

Regarding environmental improvement facilities, the DBP (which implements the EDP) has made active efforts to encourage EDP financing for recipients (water districts) with the goal of promoting septage management projects. However, in water districts targeted for funding, the feasibility studies (hereinafter, F/S) for septage management are either nonexistent or the contents of existing F/S are insufficient, which creates a bottleneck in operations and thus obstructing financing efforts in this area.

In consideration of the factors outlined above, with the aim of promoting septage management projects through the EDP, the DBP has applied for support from JICA in basic data collection for the purpose of updating F/S and so forth in two water districts where existing F/S are available: the Calamba Water District (hereafter, "CWD") and Angeles City Water District (hereafter, "ACWD"). The relevant ordinances that are a key factor in actualizing these projects have already been approved by the city councils in both the CWD and ACWD and legal requirements and so forth needed to move forward have been fulfilled. Furthermore, many Japanese-owned enterprises have been established in these areas, and the projects are expected to provide great benefits to these enterprises as well as members of the local communities.

1.2 Objectives

Through collecting and confirming the latest information from the technical, organizational, institutional, and financial aspects concerning the F/S for septage management in ACWD and CWD, this Survey aims to revise existing F/S; to contribute to the disbursement of the EDP; and to promote collaboration with schemes for assisting small and medium enterprises.

1.3 Examination Contents

The contents of examination are as follows.

(1) Confirmation of existing F/S, etc. for septage management
(2) Careful examination of municipal ordinances
(3) Survey of septage management in Japanese-affiliated industrial parks, etc.
(4) Clarification of effluent quality standards and treatment methods
(5) Links with schemes for small and medium enterprises
(6) Careful examination of financial plans
(7) Confirmation of EDP-related documents
(8) Confirmation of environmental and social considerations

2. Outline of the Target Cities

2.1 Calamba City

Located in the Province of Laguna in the center of Luzon, the Philippines, Calamba City is the core city of Calabarzon Region. It is situated roughly 50 kilometers from the capital Manila.

According to the national census of 2010 (CENSUS 2010), the city's population was 389,377, however, it exceeds 500,000 in 2015 (in 2013 the figure was 507,180).

2.2 Angeles City

Angeles City is located in the Province of Pampanga, 90 kilometers northwest of the capital Manila. According to the national census of 2010 (2010 CENSUS), the city's population was 326,336, however, it is currently thought to be in excess of 400,000.

3. Outline of the Target Water Districts

3.1 Calamba Water District

As of 2013, the number of water supply customers is 46,230; average monthly water usage is 21.5 m^3; and the basic tariff for the first 10 m^3 of water usage is 183.00PhP. CWD has 329 employees.

3.2 Angeles Water District

As of 2013, the number of water supply customers is 44,664; average monthly water usage is 25.9 m^3; and the basic tariff for the first 10 m^3 of water usage is 192.00PhP. ACWD has 189 employees.

4. Septage Management - Current Conditions and Future Schedule

4.1 Calamba Water District

CWD currently does not implement septage collection and treatment at all. From now on, however, it plans to collect septage, construct and operate facilities, and dispose of sludge. Moreover, the city authorities will provide land for the construction site to CWD.

4.2 Angeles Water District

ACWD currently does not implement septage collection and treatment at all. It plans to implement all activities from the acquisition of land for the construction site to the collection of septage, construction and operation of facilities, and disposal of sludge from now on.

4.3 Septage Management Conditions on Japanese-Affiliated Industrial Parks

Calamba City has numerous industrial parks, and the Survey Team surveyed septage management conditions on eight of these. The Survey found that almost all industrial parks treat wastewater at their own sewage treatment plants and there is no particular need to manage septage from septic tanks. Moreover, even at the sole industrial park that doesn't have its own sewage treatment plant, septage and effluent quality management is implemented appropriately. Meanwhile, since many of the employees of Japanese-affiliated enterprises that have located in the two cities reside in the local area, the indirect beneficial effects of the septage program for Japanese-affiliated enterprises will be high.

5. Design Septage Quantity

5.1 Calamba Water District

The septage collection area for the immediate future shall be the current CWD water supply service area.

The following table shows the design daily quantity of septage (m^3/d) that has been calculated based on the future forecast population and number of households, septic tank ownership rate and access rate, the amount of septage removed from septic tanks, annual operating days, and collection frequency years. Incidentally, the septage collection frequency is assumed to be once every five years.

2012	2017	2022	2027
38.7	50.9	66.8	87.4

Based on the above figures and the level of ease of conducting phased expansion, the following table shows the immediate and future target years and septage design quantities.

	Immediate	Future
Target year	2017	2027
Septage design quantity (m^3/d)	50	100

5.2 Angeles Water District

The septage collection area for the immediate future shall be the area that currently receives water supply by ACWD.

The following table shows the design daily quantity of septage (m^3/d) that has been calculated based on the future forecast population and number of households, septic tank ownership rate and access rate, the amount of septage removed from septic tanks, annual operating days, and collection frequency years. Incidentally, the septage collection frequency is assumed to be once every five years.

2015	2020	2025	2030
72.3	90.3	114.9	150.6

Based on the above figures and the design quantities in each collection area, the following table shows the immediate and future target years and septage design quantities.

	Immediate	Future
Target year	2020	2030
Septage design quantity (m^3/d)	100	150

6. Treatment Method and Cost

6.1 Calamba Water District

(Planned Construction Site)

The planned construction site is situated in a mountain area with a lot of trees and large altitude differential, so it will cost a lot to cut trees and cut and level the land. Moreover, the road leading to the planned construction site is narrow and unpaved, meaning that more expense will be incurred in road construction. Furthermore, even following construction, since it is forecast that transporting septage and sludge to and from the site would be difficult, this is deemed to be inappropriate as the planned construction site.

As the future approach, it is desirable to request the city authorities to provide an alternative site. If this isn't possible, the option of having the Water District purchase land will also need to be examined.

(Design Septage Quality)

The design septage quality is as follows.

Important Item	Unit	Design Water Quality
BOD	mg/L	6,000
COD	mg/L	20,000

(Design Effluent Quality)

Since all rivers in the city are Class C, the design effluent quality is as follows.

Item	Unit	CLASS C
pH	—	6.5-9.0
BOD	mg/L	50
COD	mg/L	100
TSS	mg/L	70
Total Coliforms	MPN/mL	10,000

(Treatment Method)

In the existing F/S, the lagoon method is adopted as the treatment method, however, the survey proposes the following two treatment methods as a means of reducing the necessary site area and satisfying the required effluent quality. The survey recommends the adoption of Option 1, which entails cheap construction and maintenance costs and relatively simple construction and maintenance. Moreover, Option 1 also permits the relatively easy expansion of facilities.

	Pretreatment	Mechanical Dewatering	Filtrate Treatment
Option 1	Screen	Volute	Johkasou
Option 2	Screen	Volute	Activated Sludge (Extended Aeration)

(Collection Trucks)

Based on the septage removal time, transportation time and so on, the number of trucks needed to collect the design quantity of septage will be as follows.

8.5 m^3 vacuum trucks	1
4.5 m^3 vacuum trucks	2
5 m^3 dump truck	1

(Required Area for the Planned Construction Site)

The required area of the planned construction site, including the treatment facilities, management building, parking area and so on and taking future expansion into account, is approximately 1,500 square meters.

(Construction Cost)

The construction cost (PhP) is as follows. Option 1 is less expensive.

Item	Option 1	Option 2
Ⅰ. TREATMENT PLANT	44,280,736	45,561,925
Procurement of Lot	15,000,000	15,000,000
II. VACUUM TRUCKS	17,100,000	17,100,000
Total	76,380,736	77,661,925

(Operation and Maintenance Cost)

The annual operation and maintenance cost (PhP) is as follows. Option 1 is less expensive.

Item	Option 1	Option 2
Ⅰ. Treatment Operation	3,948,092	4,703,884
Ⅱ. Desludging Operation	2,362,800	2,362,800
Ⅲ. Sludge Disposal	1,055,549	1,055,549
Ⅳ. Headquarters	1,440,000	1,440,000
Total	8,806,441	9,562,234

6.2 Angeles Water District

(Planned Construction Site)

The planned construction site is located in Barangay Capaya adjacent to North Luzon Expressway on the city boundary. Moreover, the land here is flat and the lot covers a broad area of approximately 4.8 hectares. Road conditions are also relatively good, so this lot is deemed to be suitable as the planned construction site.

(Design Septage Quality)

The design septage quality is as follows.

Important Item	Unit	Design Water Quality
BOD	mg/L	6,000
COD	mg/L	20,000

(Design Effluent Quality)

Since all rivers in the city are Class C, the design effluent quality is as follows.

Item	Unit	CLASS C
pH	—	6.5-9.0
BOD	mg/L	50
COD	mg/L	100
TSS	mg/L	70
Total Coliforms	MPN/mL	10,000

(Treatment Method)

In the existing F/S, Septage Acceptance Unit + Screw Press + Activated Sludge (Extended Aeration) is adopted as the treatment method, however, the Survey proposes the following two treatment methods. The Survey recommends the adoption of Option 1, which entails cheap construction and maintenance costs and relatively simple construction and maintenance. Moreover, Option 1 also permits the relatively easy expansion of facilities.

	Pretreatment	Mechanical Dewatering	Filtrate Treatment
Option 1	Screen	Volute	Johkasou
Option 2	Screen	Volute	Activated Sludge (Extended Aeration)

(Collection Trucks)

Based on the septage removal time, transportation time and so on, the number of trucks needed to collect the design quantity of septage will be as follows.

10 m^3 vacuum trucks	3
5 m^3 vacuum trucks	3
2.5m^3 vacuum trucks	1
5 m^3 dump truck	1

(Required Area for the Planned Construction Site)

The required area of the planned construction site, including the treatment facilities, management building, parking area and so on and taking future expansion into account, is approximately 2,000 square meters.

(Construction Cost)

The construction cost (PhP) is as follows. Option 1 is less expensive.

Item	Option 1	Option 2
I. TREATMENT PLANT	49,285,906	51,327,519
Procurement of Lot	10,000,000	10,000,000
II. VACUUM TRUCKS	37,200,000	37,200,000
Total	96,485,906	98,527,519

(Operation and Maintenance Cost)

The annual operation and maintenance cost (PhP) is as follows. Option 1 is less expensive.

Item	Option 1	Option 2
I. Treatment Operation	4,382,916	5,065,476
II. Desludging Operation	5,367,900	5,367,900
III. Sludge Disposal	1,748,766	1,748,766
IV. Headquarters	1,440,000	1,440,000
Total	12,939,582	13,622,142

7. Financial Plan

7.1 Calamba Water District

(Examination Cases)

The construction cost is examined for two cases, i.e. the case including cost of land, and the case not including cost of land. The source of funding for the Water District will basically be loan and own capital, and consideration will also be given to sharing of cost with central government subsidies. Concerning the loan, the Philippines Water Revolving Fund (PWRF) will be utilized for the environment development project (EDP), which will be the ODA implemented by JICA via the Development Bank of the Philippines (DBP). Also, the desludging fee is set basically assuming an extra charge of 2 PhP per cubic meter of water usage.

The basic conditions are indicated below.

Loan Terms and Conditions	
Interest per annum	**9.00 %**
Repayment period (inclusive of grace)	15 years
Grace period	3 years
Weighted Average Cost of Capital (WACC)	**9.80 %**
Loan Share	80 %
Equity Share	20 %
Estimated desludging fee (per cu.m. of water consumed)	**PhP2.00**

(Examination Results)

The results of examination are shown below.

A desludging fee of 2PhP is appropriate, however, the business will stabilize if the national government provides a subsidy of 40%.

Examination Case	Case where CWD Purchases Land		Case where Land is Provided by the City	
Demarcation (NG:LGU:WD)	0:0:100	40:0:60	0:0:100	40:0:60
Net Present Value (in thousand pesos)	**36,952**	**64,777**	**50,617**	**72,978**
Financial Internal Rate of Return	**18.0%**	**31.7%**	**23.2%**	**39.6%**
Net Present Value (NPV)				
Cost (+20%)	8,961	42,352	25,359	52,192
Revenues (-20%)	1,571	29,396	15,235	37,596
Cost (+20%), Revenues (-20%)	**-26,420**	6,971	**-10,023**	16,810
Financial Internal Rate of Return				
Cost (+20%)	11.6%	22.3%	15.7%	28.3%
Revenues (-20%)	10.2%	20.4%	14.1%	26.0%
Cost (+20%), Revenues (-20%)	**4.1%**	12.0%	**7.3%**	16.2%

7.2 Angeles Water District

(Examination Cases)

The source of funding for the Water District will basically be loan and own capital, and consideration will also be given to sharing of cost based on subsidy from the central government. Concerning the loan, the Philippines Water Revolving Fund (PWRF) will be utilized for the environment development project (EDP), which will be the ODA implemented by JICA via the Development Bank of the Philippines (DBP). Also, the desludging fee is set basically assuming an extra charge of 2 PhP per cubic meter of water usage.

The basic conditions are indicated below.

Loan Terms and Conditions	
Interest per annum	**9.00 %**
Repayment period (inclusive of grace)	15 years
Grace period	3 years
Weighted Average Cost of Capital (WACC)	**9.96 %**
Loan Share	84 %
Equity Share	16 %
Estimated desludging fee (per cu.m. of water consumed)	**PhP2.00**

(Examination Results)

The results of examination are shown below.

A desludging fee of 2PhP is appropriate, however, the business will stabilize if the national government provides a subsidy of 40%.

Demarcation (NG:LGU:WD)	0:0:100	40:0:60
Net Present Value (in thousand pesos)	**22,128**	**57,227**
Financial Internal Rate of Return	**13.9%**	**25.3%**
Net Present Value (NPV)		
Cost (+20%)	**-16,790**	25,328
Revenues (-20%)	**-21,216**	13,883
Cost (+20%), Revenues (-20%)	**-60,135**	**-18,016**
Financial Internal Rate of Return		
Cost (+20%)	**7.3%**	16.0%
Revenues (-20%)	**5.8%**	14.0%
Cost (+20%), Revenues (-20%)	**-0.8%**	**5.2%**

8. Environmental and Social Considerations

Since the sewage and wastewater treatment sector is often regarded as exerting important environmental and social impacts, it is necessary to advance the projects upon paying ample attention to environmental and social considerations such as impacts on air, water, and soil, impacts on natural items such as ecosystems and biota, and social impacts such as involuntary resettlement and so on.

The septage treatment facilities planned here are relatively small in scale and will not exert as large an impact as sewage treatment facilities, however, it will still be necessary to pay attention to the following points in particular.

(1) Large-scale land reclamation and clearing (especially in Calamba Water District)

(2) Odor countermeasures

(3) Involuntary resettlement of residents

Moreover, when it comes to starting septage management activities in both water districts from now on, it will be necessary to obtain Environmental Sanitation Clearance (ESC) from the Center for Health Development Office (CHD). Accordingly, it will first be necessary to submit applications to the city authorities.

9. Future Measures

The items that need to be tackled from now on when it comes to advancing septage management are as follows.

(1) Establishment of dedicated departments

(2) Formulation of the project schedule

(3) Implementation design

(4) Securing of the planned construction sites

(5) Increase of water tariffs and application for subsidies from the central government

(6) EDP application

(7) Examination of sludge disposal

(8) Examination of outsourcing

(9) Implementation of monitoring

1. Outline of Project

1.1 Background

In the Philippines, sewage and septage are often released into water bodies without being treated first, and this has led to severe water contamination. Less than 10% of the population nationwide has access to sewerage systems, and the resulting annual economic loss is believed to be 78 billion pesos (according to the World Bank's 2008 report *Economic Impacts of Sanitation in the Philippines*). This economic loss includes effects on health, water resources, tourism and other such factors, and 72% of all loss can be traced to adverse effects on health. In particular, health-related economic losses stemming from early fatality among infants caused by water contamination are estimated to be 50.8 billion pesos annually.

In response to these conditions, the Government of the Philippines enacted the Clean Water Act (RA 9275) in 2004 to address environmental degradation caused by water contamination. In addition, the government has clearly expressed its commitment to environmental protection measures through its mid-term development plan (2011–16), which prioritizes development of the investment climate that encompasses the water environment infrastructure with the aim of achieving inclusive growth. Furthermore, the government established the National Sewerage and Septage Management Program (NSSMP) led by the Department of Public Works and Highways (DPWH) in 2012, and has in other ways pursued measures focusing primarily on the development of legal and institutional frameworks.

Unfortunately, these plans, laws/ordinances and so forth have not always been implemented smoothly, and environmental degradation has continued unabated, worsening to the point that urgent measures are now needed to prevent further deterioration.

Meanwhile, the Japan International Cooperation Agency (JICA) has been implementing a two-step loan scheme called Environmental Development Project (EDP) through the Development Bank of the Philippines (DBP) since 2008 with the aim of contributing toward environmental improvement efforts through promoting construction of facilities (total committed amount: 24.8 billion yen).

Among environmental improvement facilities targeted for EDP financing, those in the fields of water supply and water quality control utilize a financing program known as the Philippines Water Revolving Fund (PWRF; a guarantee fund that aims to promote private-sector funding for water and sewerage works construction) established jointly by USAID and the DBP based on a Japanese-American water initiative.

Regarding environmental improvement facilities, the DBP (which implements the EDP) has made active efforts to encourage EDP financing for recipients (water districts) with the goal of promoting septage management projects. However, in water districts targeted for funding, many septage management F/S are either nonexistent or the contents of existing F/S are insufficient, creating a bottleneck in operations and thus

obstructing financing efforts in this area.

In consideration of the factors outlined above, with the aim of promoting septage management projects through the EDP, the DBP has applied for support from JICA in basic data collection for the purpose of updating F/S and so forth in two water districts where existing F/S are available: the Calamba Water District (hereafter, "CWD") and Angeles City Water District (hereafter, "ACWD"). The relevant ordinances that are a key factor in actualizing these projects have already been approved by the city councils in both the CWD and ACWD and legal requirements and so forth needed to move forward have been fulfilled. Furthermore, many Japanese-owned enterprises have been established in these areas, and the projects are expected to provide great benefits to these enterprises as well as members of the local communities.

Through this survey, which envisions project actualization via the EDP, it is intended to collect and confirm the basic information necessary to update F/S on the septage-management administrative side (the two water districts targeted) and then revise the F/S.

Through this survey, it is also intended to introduce septage treatment technologies through JICA's ongoing small- and medium-sized enterprise support program while deepening collaborative ties with small- and medium-sized enterprise support efforts and international yen loan programs.

Figure-1.1.1 Locations of Angeles City and Calamba City

1.2 Objectives

Through collecting and confirming the latest information from the technical, organizational, institutional, and financial aspects concerning the F/S for septage management in ACWD and CWD, this survey aims to revise

existing F/S; to contribute to the disbursement of the EDP; and to promote collaboration with schemes for assisting small and medium enterprises.

1.3 Examination Contents

(1) Confirmation of Existing F/S, etc. for Septage Management

This Survey will collect the information that is necessary to update the existing F/S for septage management. In particular, organizational systems and personnel systems, owned materials and machinery, planned capabilities, potential for land procurement, specifications of equipment for collection, treatment and disposal, and financial analysis will be examined.

(2) Careful Examination of Municipal Ordinances

The ordinances regarding septage management have already been approved by the city councils in Calamba and Angeles. The contents of these regulations will be scrutinized and analyzed for necessary information from the viewpoint of the effectiveness of the ordinances. Also, information will be collected and analyzed regarding political links between the city authorities and water districts.

(3) Survey of Septage Management in Japanese-affiliated Industrial Parks, etc

The target water districts contain industrial parks occupied by numerous Japanese-affiliated companies. Concerning the state of sludge management and septage management in the concerned industrial parks, survey will be conducted on management systems, management bodies, sludge discharge frequency and the presence/absence of septage treatment operators, etc.

(4) Clarification of Effluent Quality Standards and Treatment Methods

Effluent quality standards in the case where septage treatment facilities are installed in the target water districts will be clarified, and information will be collected and confirmed regarding the necessary septage treatment systems. This information will be used to update existing F/S, etc.

(5) Links with Schemes for Small and Medium Enterprises

The Philippine side highly regards the dewatering technologies of small and medium-sized enterprises that have been utilized in the SME assistance scheme currently implemented by JICA. While appropriately introducing these technologies, information necessary for updating existing F/S etc. including financial plans (investment costs, maintenance costs, etc. envisaged when introducing the said technologies) will be collected, and the contents will be checked.

(6) Careful Examination of Financial Plans

The water tariffs set in the existing F/S will be revised to realistic settings, and financial plans including the amount invested and maintenance costs will be scrutinized. In addition, the feasibility of cost sharing with entities apart from the water districts (city authorities or the national government) will be reviewed, and if this is feasible, outline survey and clarification will be performed. The approach to outsourcing project operations will also be examined.

(7) Confirmation of EDP-related Documents

In this survey, since it is envisaged that projects will be implemented with EDP loans based on F/S, etc. revised in this survey, information concerning the documents that the water districts will need to submit in order to apply to the DBP for loans will be collected and checked.

(8) Confirmation of Environmental and Social Considerations

Since septage treatment systems are often regarded as troublesome facilities, information concerning environmental and social matters that merit particular attention, odor prevention measures, planning for compensation, and so on will be collected. In particular, concerning the acquisition and expropriation of the planned land (whether or not to remove residents), appropriateness and important points from the viewpoint of environmental and social consideration will be confirmed, and the measures that need to be taken and costs that need to be borne by the water districts will be ascertained.

2. Outline of the Target Cities

2.1 Calamba City

2.1.1 Outline

Located in the Province of Laguna in the center of Luzon, the Philippines, Calamba City is the core city of Calabarzon Region. It is situated roughly 50 kilometers from the capital Manila. The city is a famous resort area in the Philippines thanks to hot springs located south of Lake Laguna. It is also the birthplace of Jose Rizal, who is lauded as a national hero of the Philippine independence movement and is still a loved figure today.

According to the national census of 2010 (CENSUS 2010), the city's population was 389,377, however, it exceeds 500,000 in 2015 (in 2013 the figure was 507,180). Calamba is the largest city in the Province of Laguna.

The municipal area of Calamba is 14,950 hectares (149.5 square kilometers), making it the second largest city in the Province of Laguna behind San Pablo City. Land in the city is classified according to purpose of use into: Urban Redevelopment Zones, Growth Management Zones (1/2), Upland Conservation Zones, Forest Buffer Zones, and Agricultural Development Zones. Since the population is large in comparison to the city area, population density is extremely high at 2,600 people per square kilometer (2010). The populations of barangay range from a few hundred to a few thousand people per square kilometer in rural zones, tens of thousands of people per square kilometer in urban zones, and more than 70,000 in the densely populated areas containing municipal offices and commercial facilities.

Calamba is situated along the northern slopes of the dormant volcano Mount Makiling. To the north is located Cabuyao City, to the southeast is Los Banos City, to the southwest is the province of Gatangas, and to the east is Laguna de Bay, which is the largest lake in the country.

Calamba is located at the southern origin of the South Luzon Expressway, and the transport network stretches to cities in the Province of Laguna, as well as to the Province of Batangas, and the Province of Quezon in the south.

As one of the Premiere Industrial Hubs outside of Metro Manila, Calamba has numerous industrial parks that contain factories operated by Philippine, Japanese, Chinese, South Korean, European, and American corporations. The industrial parks are concentrated in peripheral barangay such as Canlubang, Milagrosa, and Punta. As may be gathered from the fact that Calamba Water District production wells are concentrated in such areas, since these industrial parks require sources of good quality water, they are located in the center of the city.

These industrial parks contain factories of various sectors ranging from the food processing plants of well-known Philippine fast food and beverage makers to Japanese and South Korean electronics factories, Japanese auto makers, and American cosmetics manufacturers.

2.1.2 Organization

According to city classifications in the Philippines, Calamba is ranked as First Class among the top rated Highly Urbanized Cities. Incidentally, Highly Urbanized Cities refer to cities with a population of 200,000 or more and municipal revenue of 500 million PHP or more.

The following figure shows the organization chart of Calamba City Office.

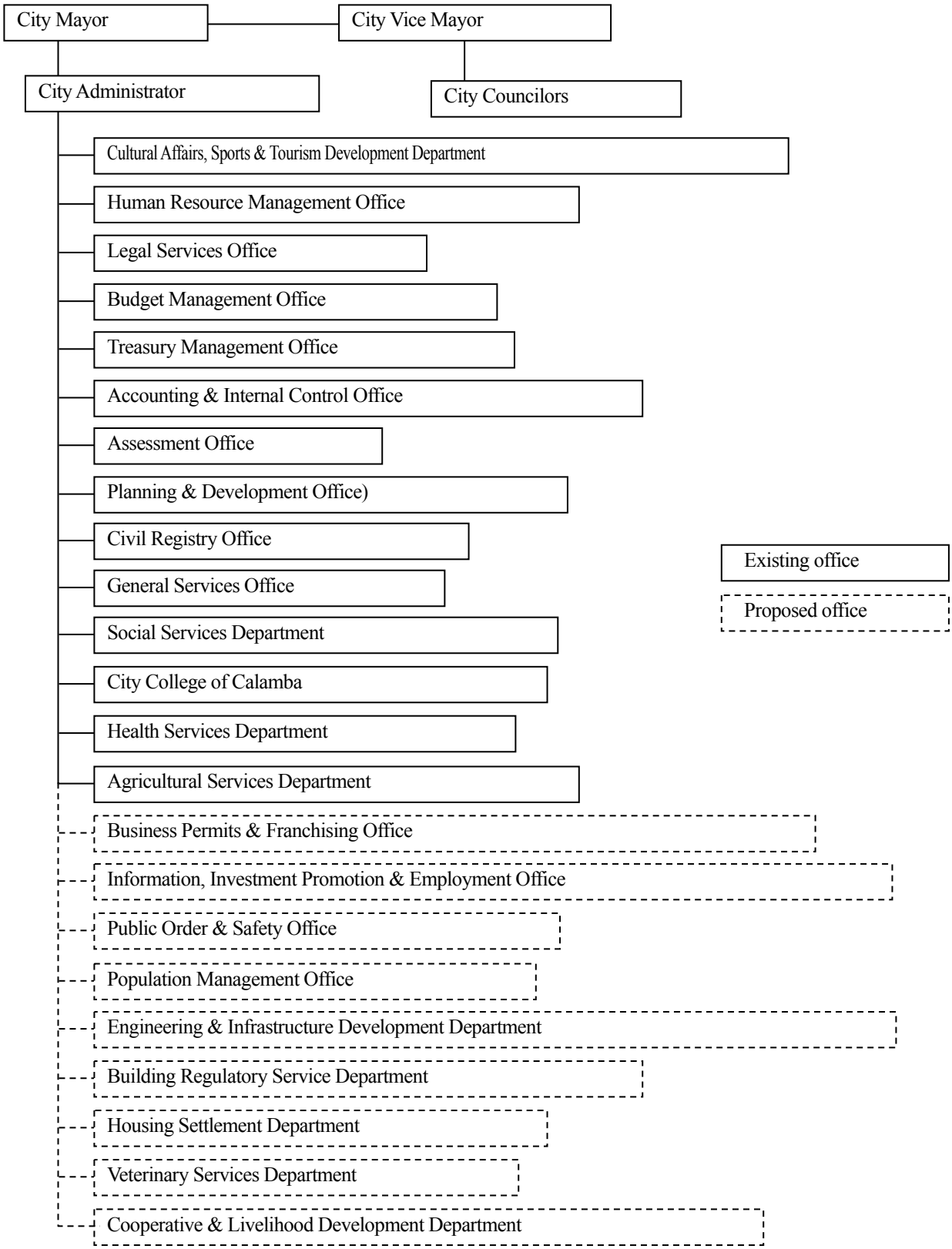

Figure-2.1.2.1 Calamba City Office Organization Chart

2.1.3 City Ordinances relevant to Septage

With respect to septage, Calamba City has enacted the "Ordinance for Establishment of a Sewage and Septage Management System and Implementation Procedure in Calamba City" (City Ordinance No.456, S-2009). In particular, Section 8 of this ordinance stipulates the design of septic tanks; Section 11 makes it obligatory to remove septage from (desludge) tanks once every 3~5 years; and Section 12 clearly states that user fees should be paid on top of the water tariff paid to Calamba Water District. In relation to this, non-users in CWD are able to receive septage removal services from CWD providing that they pay the commensurate fee.

2.2 Angeles City

2.2.1 Outline

Angeles City is located in the Province of Pampanga and is bordered by Ma Balacat City to the north, Mexico City to the east, Bacolor City to the south, and Porac City to the west. It is situated 90 kilometers northwest of the capital Manila. According to the national census of 2010 (2010 CENSUS), the city's population was 326,336, however, it is currently thought to be in excess of 400,000.

The area to the west of Angeles City was formerly Clark Air Base (then the largest United States military facility outside of the continental United States), however, this was returned to the Philippines in 1991. Since 1993, this area was developed as Clark Special Economic Zone (CSEZ) containing an airport, hotels, international conference center, golf resort, casinos and so on. Similarly, Subic Bay Naval Base was returned to the Philippines and designated as Subic Bay Freeport Zone in 1991, and these two zones were subsequently combined to form the present Clark Freeport Zone. Today, Angeles City and Clark Freeport Zone in Clark Municipality, the Province of Zambales form the center of business, industry (especially the aviation industry), tourism, leisure, and entertainment in Luzon.

2.2.2 Organization

According to the Philippine city classifications, Angeles City, like Calamba, is ranked as First Class among the top rated Highly Urbanized Cities.

The following figure shows the organization chart of Angeles City Office.

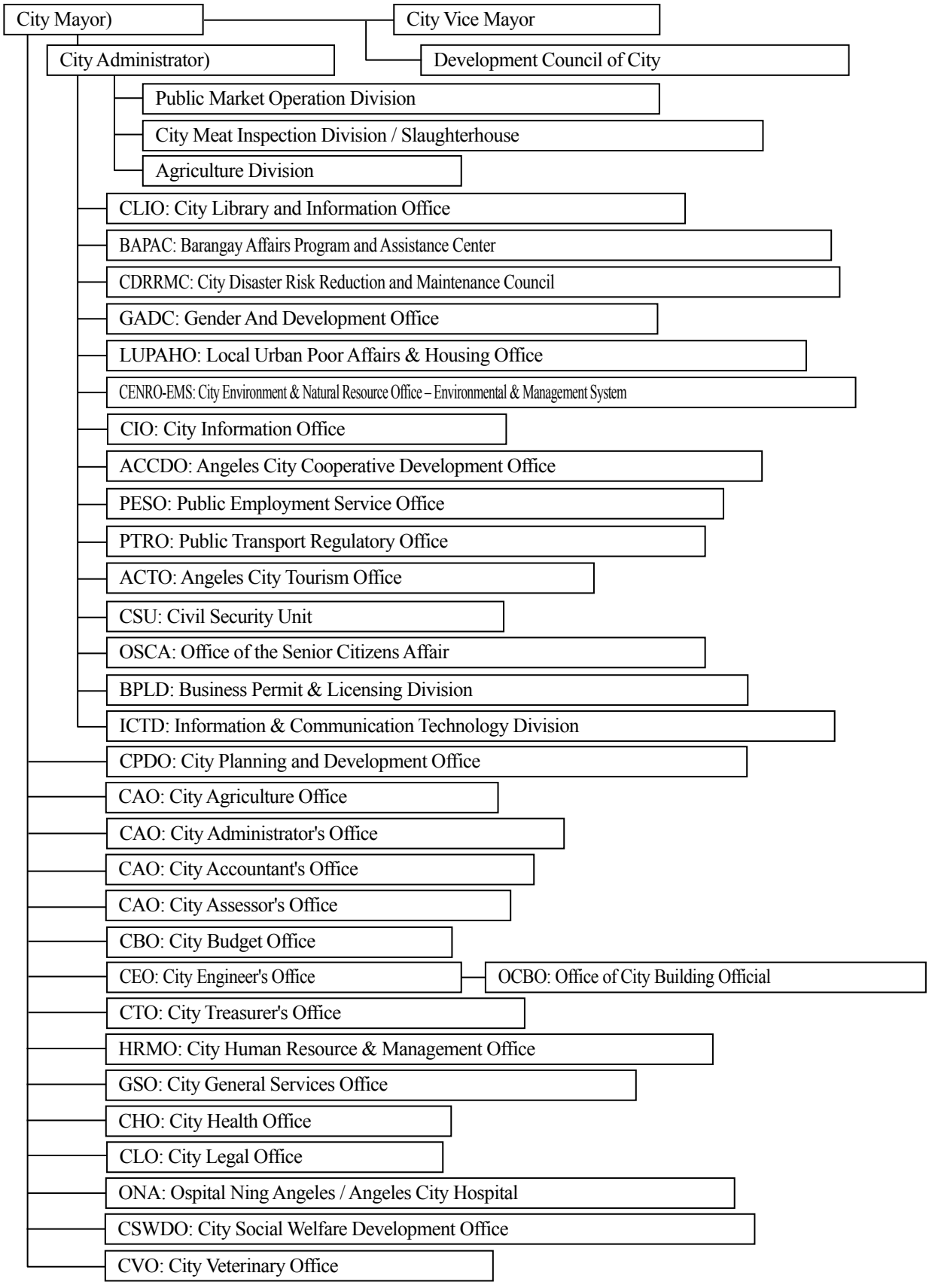

Figure-2.2.2.1 Angeles City Office Organization Chart

2.2.3 City Ordinances relevant to Septage

With respect to septage, the city council of Angeles City enacted the "Water Quality and Septage Management Ordinance" (City Ordinance No. 343. S-2014) in 2014.

Comprising economic and institutional measures geared to preserving the city's water resources, this established the City Water Resources Management Board, designated the Water Quality Management Area, and made it obligatory to compile a management plan for Sapangbao catchment basin. It also designated the structure of septic tanks in newly constructed buildings and made it obligatory to remove septage from (desludge) septic tanks once every 3~5 years.

Moreover, concerning septage management by the city, City Ordinance No.347, S-2014, which primarily revises Section 13 of City Ordinance No. 343. S-2014, recognizes the collection, treatment, and disposal of septage by the Water District, etc. based on Memorandum of Agreement.

In order to be certified to conduct septage collection, treatment, and disposal, operators are required to obtain an Environmental Compliance Certificate (ECC), a Wastewater Discharge Permit (WDP), a Certificate of Accreditation from the Pollution Control Officer of Department of Environment and Natural Resources (DENR) Region 3, Environmental Sanitation Clearance (ESC) from the Department of Health (DOH), a Sanitary Permit from the City Health Office, and City Environment Clearance from the City Environment and Natural Resources Office (CENRO).

3. Outline of the Target Water Districts

3.1 Calamba Water District

3.1.1 Outline of Operations

The water supply system of Calamba City was started by Calamba City Office in 1926. From 1956 it was passed on to the National Waterworks And Sewage Agency (NAWASA) and came under provincial management. However, it once more came under municipal jurisdiction by Calamba City in 1964. Water was primarily sourced from spring water (the districts of Bucal and Tigbe) and groundwater and was conveyed to households along 16.4 kilometers of small-diameter transmission and distribution pipes.

In 1974, based on the Provincial Water Utilities Act of 1973 according to Presidential Decree No. 198 (PD198), Calamba Water District (CWD) inherited the Calamba City water supply system and started operation as a semi-public service entity based on an independent accounting system. On September 4, 1976, CWD received Conditional Certificate of Conformance (CCC) No. 29 from the Local Water Utilities Administration (LWUA). This certificate (CCC) is recognized to possess authorization rights and concession rights under PD198.

Calamba Water District in those days only had 15 employees and very limited equipment, however, as the working environment came to be improved under assistance from the municipal government, it acquired the capability to maintain water supply facilities and operate the system. As the number of contract holders and employees subsequently increased, the business status picked up.

The following table shows the water supply situation of CWD.

Table-3.1.1.1 CWD Water Supply Situation

Items		Unit	2012	2013
Active Metered Customers		Conn.	43,537	46,230
Domestic/Government		Conn.	40,659	43,346
Commercial/Industrial		Conn.	2,878	2,884
Bulk		Conn.	1	0
Average Monthly Consumption		m^3/Conn.	21.6	21.5
Water Sales		1,000PHP	303,985	318,326
Collection Rate		%	97.3	97.4
Water Source	Well	Location	42	50

	Spring	Location	1		1	
Water Production Capacity		m^3/day	61,197		62,839	
Water Production		m^3/day	49,650	100%	50,555	100%
Revenue Water		m^3/day	31,383	63.2	32,777	64.8
Non-Revenue Water		m^3/day	18,267	36.8	17,778	35.2
Real Leakage		m^3/day	(------)	(----)	(------)	(----)
Identified Leakage		m^3/day	(5,054)	(10.2)	(7,558)	(15.0)
Illegal Connection		m^3/day	(------)	(----)	(------)	(----)
Water Meter Error		m^3/day	(------)	(----)	(------)	(----)
Maintenance by CWD		m^3/day	(233)	(0.5)	(403)	(0.8)
Uncollectable Bill		m^3/day	(1,341)	(2.7)	(1,314)	(2.6)
Other		m^3/day	(11,639)	(23.4)	(8,503)	(16.8)
Employee		Person	323		329	

Table-3.1.1.2 Calamba City Barangay Information

No.	Barangay	Area (ha:0.01km^2)	Population (2010)	Population Density (persons/km^2)	Classifi-cation	Zoning Classification					
						UR	GM1	GM2	UC	FB	AD
1	Bagong Kalsada	157.8	3,306	2,095	Urban	X					
2	Banadero	190.0	7,116	3,745	Urban						X
3	Banlic	274.9	12,780	4,649	Urban						X
4	Barandal	189.3	4,625	2,443	Rural		X				
5	Poblacion B1	29.2	6,569	22,497	Urban	X					
6	Poblacion B2	17.1	8,005	46,813	Urban	X					
7	Poblacion B3	29.8	4,408	14,792	Urban	X					
8	Poblacion B4	4.5	3,237	71,933	Urban	X					
9	Poblacion B5	25.6	6,285	24,551	Urban	X					
10	Poblacion B6	42.3	2,447	5,785	Urban	X					
11	Poblacion B7	81.8	2,519	3,079	Urban	X					
12	Batino	110.5	1,249	1,130	Rural	X	X				
13	Bubuyan	196.0	1,666	850	Rural				X		
14	Bucal	265.0	11,346	4,281	Urban	X			X		X
15	Bunggo	556.6	3,809	684	Rural				X		
16	Burol	258.2	1,783	690	Rural				X		
17	Camaligan	106.5	978	918	Rural			X			
18	Canlubang	3,912.0	54,655	1,397	Rural		X	X			
19	Halang	166.7	6,829	4,097	Urban	X					X
20	Hornalan	22.0	1,397	6,350	Rural				X		

21	Kay-Anlog	272.0	2,665	980	Rural			X			
22	La Mesa	294.1	11,836	4,024	Urban	X	X		X		
23	Laguerta	314.9	1,766	5,060	Rural				X		
24	Lawa	146.6	9,169	6,254	Urban	X					
25	Lecheria	157.5	8,391	5,328	Urban	X					X
26	Lingga	45.0	5,817	12,927	Urban						X
27	Looc	179.1	14,524	8,109	Urban						X
28	Mabato	273.1	705	258	Rural				X		
29	Majada Labas	180.2	5,172	2,870	Urban		X				
30	Makiling	465.7	7,510	1,613	Rural		X	X			
31	Mapagong	320.8	4,942	1,541	Rural		X				X
32	Masili	32.1	3,585	11,168	Urban	X					
33	Maunong	399.2	2,105	527	Rural		X	X	X		
34	Mayapa	116.3	21,826	18,767	Urban		X				
35	Milagrosa	209.4	5,308	2,535	Urban		X	X			
36	Paciano Rizal	126.8	11,958	9,431	Urban			X			
37	Palingon	15.3	6,403	2,339	Urban						X
38	Palo Alto	273.7	10,628	3,883	Rural		X				
39	Pansol	528.2	10,868	2,058	Urban	X			X	X	X
40	Parian	112.0	20,248	18,079	Urban	X					X
41	Prinza	95.3	3,996	4,193	Rural	X	X				
42	Punta	331.0	3,511	1,061	Rural		X	X			
43	Puting Lupa	542.0	1,720	317	Rural			X	X	X	
44	Real	132.9	13,805	10,388	Urban	UR					
45	Saimsim	194.5	5,504	2,830	Rural		X				
46	Sampiruhan	81.0	8,144	10,054	Urban						X
47	San Cristobal	119.0	12,584	10,575	Urban	X					
48	San Jose	89.6	4,203	4,691	Urban	X					
49	San Juan	15.3	4,780	31,242	Urban	X					
50	Sirang Lupa	198.4	8,225	4,146	Urban		X				
51	Sucol	31.6	4,765	15,079	Urban	X					
52	Turbina	51.5	4,475	8,689	Urban	X					
53	Ulango	227.6	858	377	Rural				X		
54	Uwisan	78.0	2,358	3,023	Urban						X

UR: Urban Redevelopment Zone

GM1: Growth Management Zone 1

GM2: Growth Management Zone 2

UC: Upland Conservation Zone

FB: Forest Buffer Zone

AG: Agricultural Development Zone

Table-3.1.1.3 Production Well Particulars

Pump Station	Production Capacity (m^3/hr)	Water Conveyance Method	Elevated Tank Capacity (m^3)	Remarks
01 Crossing	158	Direct water supply		
02 Parian	158	Direct water supply		
03 Landmark	109	Direct water supply		
04 Bucal Pump/Spring	828	Via elevated water tank	1,700	
05 Villa De Calamba	72	Via elevated water tank	455	
06 Pasong Kalabaw	109	Direct water supply		
07 Real	158	Direct water supply		
08 Lawa	148	Direct water supply		
09 Laguna Hills	54	Direct water supply		
10 Sirang Lupa	72	Direct water supply		
11 Lakeview Heights	4	Direct water supply		
12 Asiacon 1	43	Via elevated water tank	151	
13 Asiacon 2	64	Via elevated water tank	151	
14 Palao 1	79	Via elevated water tank	189	
15 Palao 2	72	Via elevated water tank	189	
16 Manfil	54	Via elevated water tank	189	
17 Asiacon Phase 2	50	Via elevated water tank	189	
18 MCDC 1	69	Via elevated water tank	151	
19 MCDC 2	43	Via elevated water tank	151	
20 SCGH	22	Via elevated water tank	151	
21 Villa Palao Banlic 1	41	Via elevated water tank	189	
22 Villa Palao Banlic 2	43	Via elevated water tank	189	
23 Major Homes	9	Via elevated water tank	56	
24 North Marie	12	Direct water supply		
25 Tibagan	6	Via elevated water tank	35	
26 Ulango 1	4	Direct water supply		
27 Ulango 2	4	Direct water supply		
28 Villa La Prinza 1	14	Via elevated water tank	55	
29 Villa La Prinza 2	13	Via elevated water tank	55	

30 Aztec	11	Via elevated water tank	189	
31 Barandal 1	9	Direct water supply		
32 Barandal 2	10	Direct water supply		
33 Makiling	50	Direct water supply		
34 Tulo	50	Direct water supply		
35 Homelands	52	Direct water supply		
36 Glenwood	23	Direct water supply		
37 Turbina	4	Direct water supply		
38 Woodlands	50	Direct water supply		
39 Maunong 1	5	Via elevated water tank	75	
40 Maunong 2	4	Via elevated water tank	5	
41 Maunong 3	11	Direct water supply		
42 Bunggo 1	4	Via elevated water tank	75	
43 Bunggo 3	4	Direct water supply		
44 Bunggo 4	11	Direct water supply		
45 Villa Consolacion	4	Via elevated water tank	189	
46 Maresco	11	Via elevated water tank	25	
47 Gumamela	4	Direct water supply		
48 Punta 1	11	Direct water supply		
49 Punta 2	11	Direct water supply		
50 Punta 3	11	Direct water supply		
51 Bubuyan 1	4	Direct water supply		
52 Bubuyan 2	4	Direct water supply		
53 Majada 1	50	Direct water supply		
54 Majada 2	45	Direct water supply		
55 Southville 1	36	Direct water supply		
56 Southville 2	43	Direct water supply		
Total	2,217			

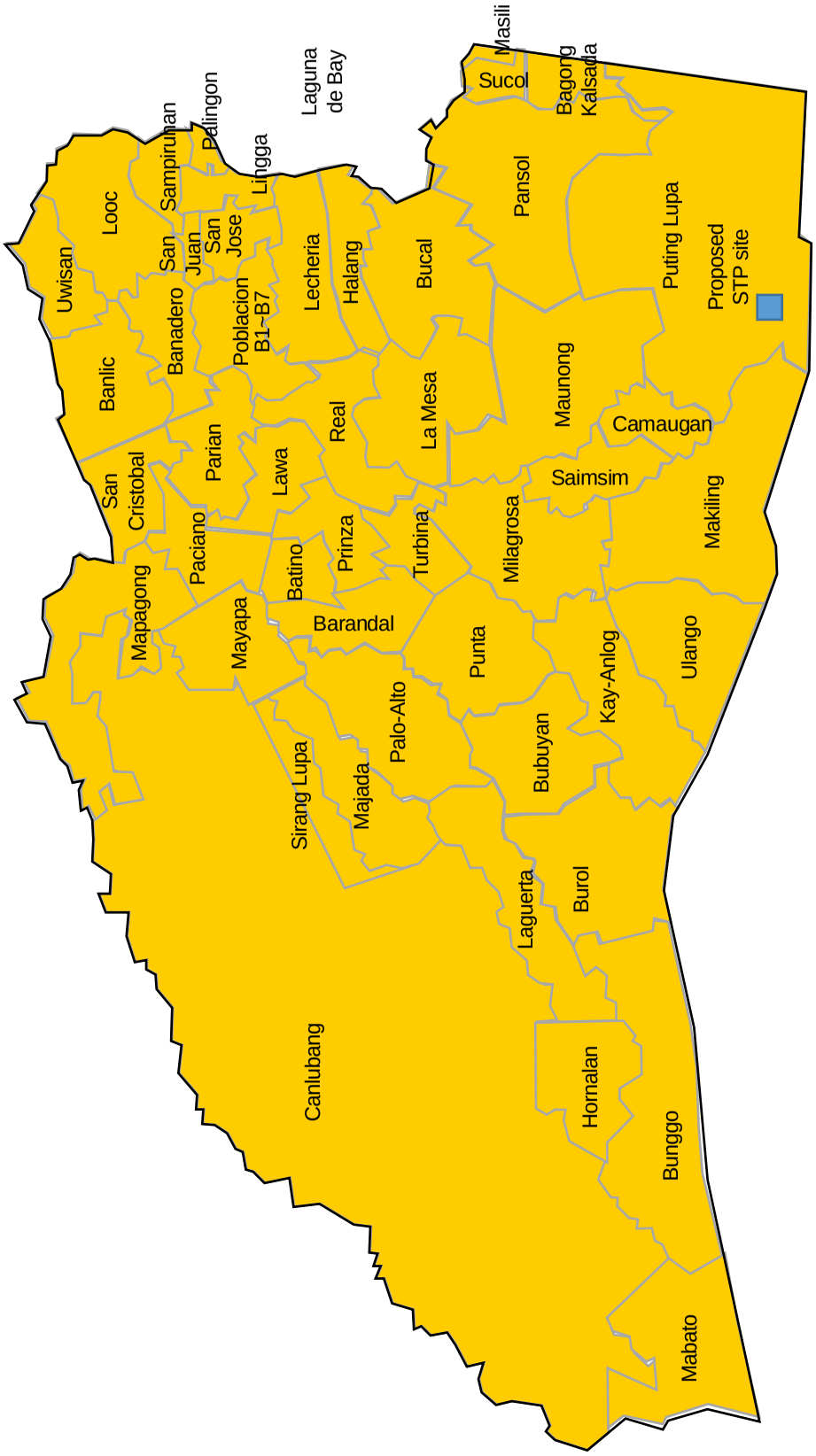

Figure-3.1.1.1 Map of Barangay in Calamba City

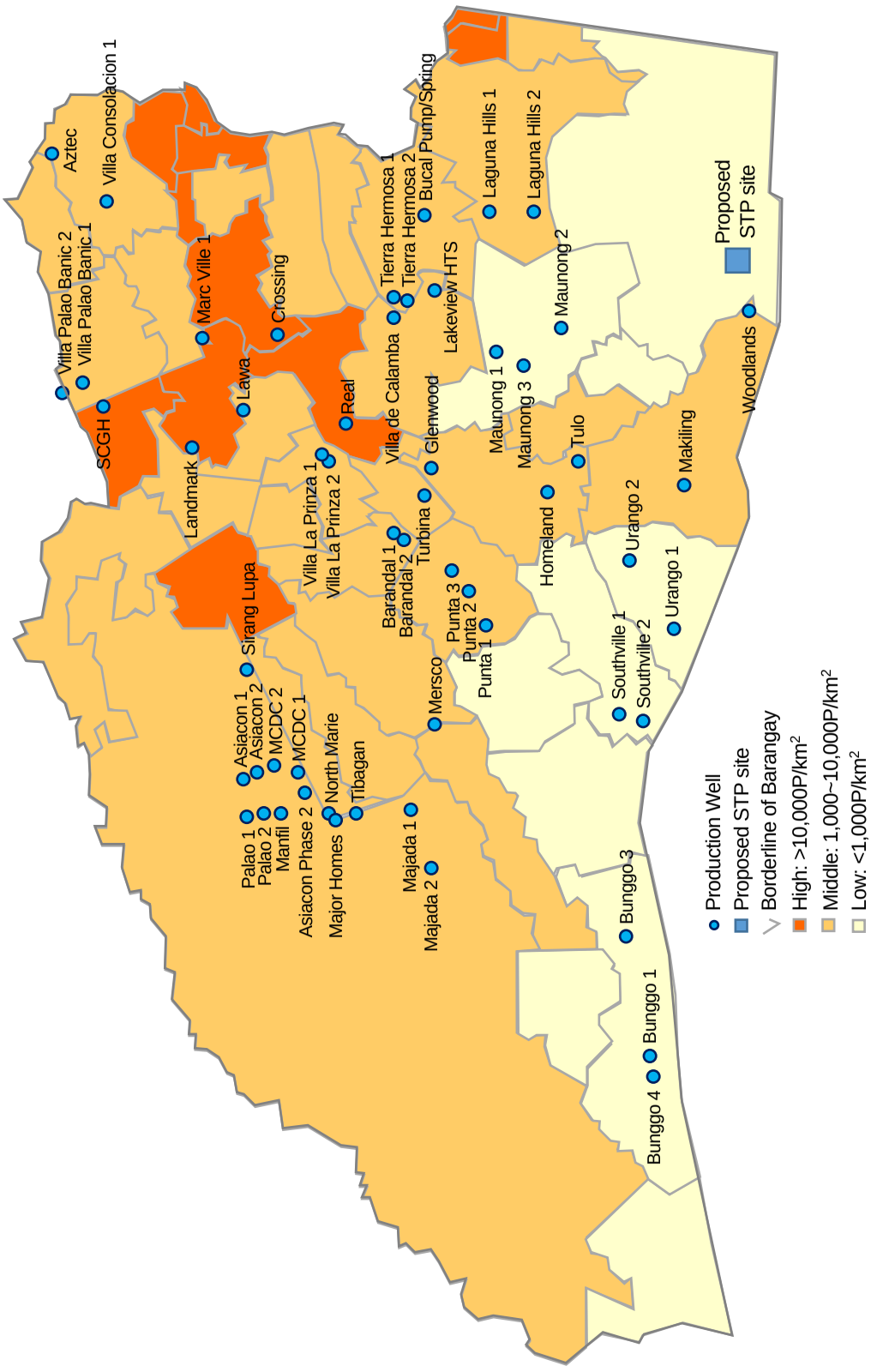

Figure-3.1.1.2 Population Density and Well Layout by Barangay

3.1.2 Organization

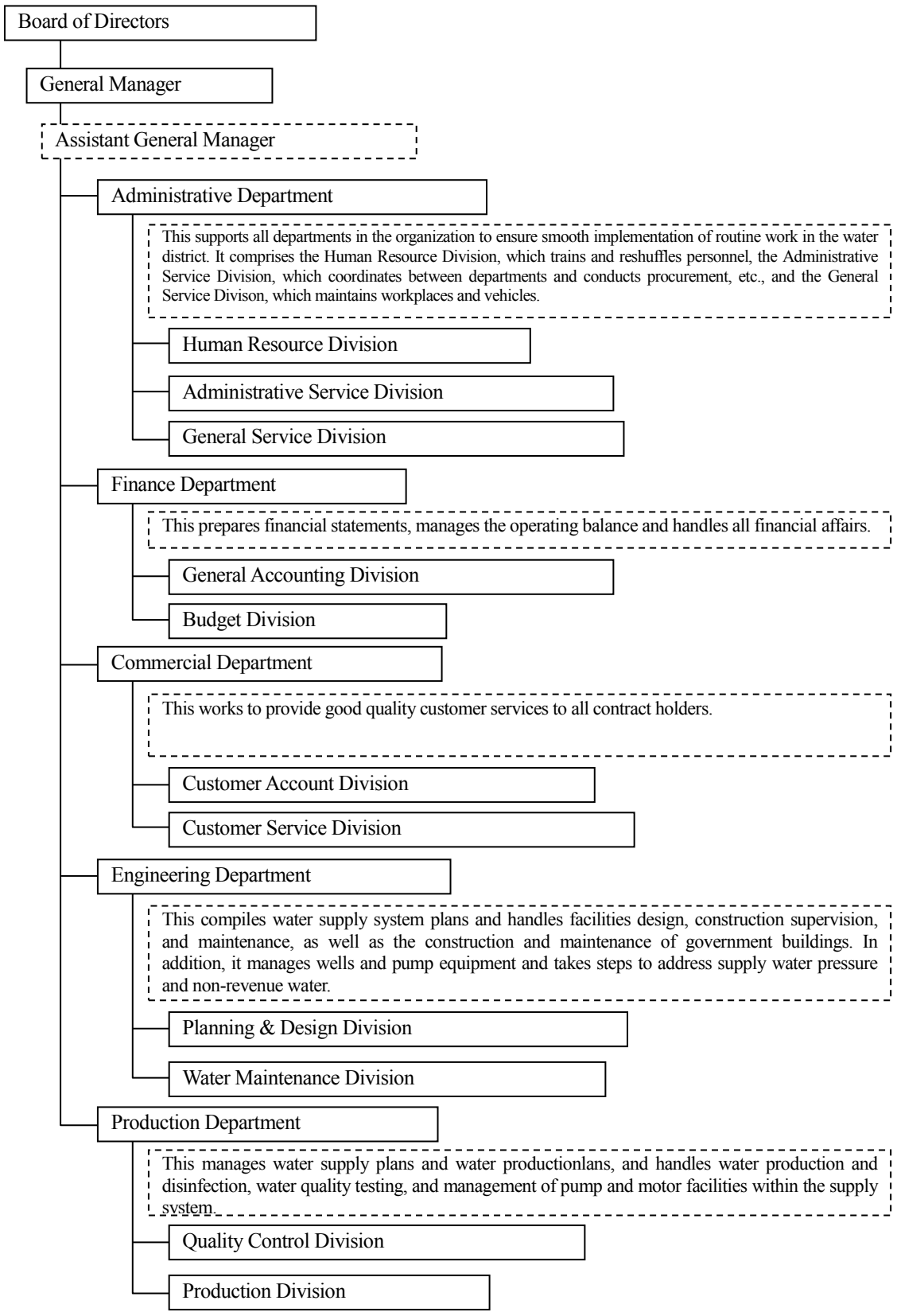

Figure-3.1.2.1 Calamba Water District Organization Chart

3.1.3 Financial Condition and Tariff Scheme

(1) Financial Condition

Table-3.1.3.1 Financial Data (PhP)

Item	2012	2013
1. REVENUE		
a. Operating	311,467,457	325,959,229
b. Non- Operating	3,796,889	2,698,701
TOTAL	315,264,346	328,657,930
2. EXPENSES		
a. Salaries & Wages	66,781,563	64,282,424
b. Pumping Cost (Fuel, Oil, Electric)	65,331,097	75,419,041
c. Chemical (Water Treatment)	2,657,113	2,637,351
d. Other O & M Expense	113,193,639	107,016,192
e. Depreciation Expense	31,171,775	37,669,091
f. Interest Expense	1,200,000	1,200,000
g. Others	16,478,468	14,497932
TOTAL	296,813,656	302,722,031
3. NET INCOME (LOSS)	18,450,691	29,538,898

(2) Tariff Scheme (revised July 2010)

a) Domestic/Government Use

Table-3.1.3.2 Water Tariffs (Domestic/Government Use)

Water Meter Diameter		Basic Tariff (PHP/10m^3)	Excess Charge (PHP/m^3)			
			11-20m^3	21-30m^3	31-40m^3	Over 41m^3
13mm	1/2”	183.00	20.30 (16.20)	24.05 (19.20)	30.80 (24.60)	36.45 (29.20)
20mm	3/4”	298.80				
25mm	1”	585.60				
40mm	1.5”	1,464.00				
50mm	2”	3,660.00				

Note: Figures in parentheses indicate tariffs in cases of water supply from wells of NHA (National Housing Authority) areas, VLP (Villa La Priniza), VPB (Villa Palac Banilic), and Major Homes.

b) Commercial/Industrial Use

Table-3.1.3.3 Water Tariffs (Commercial/Industrial Use)

Water Meter Diameter		Basic Tariff (PHP/10m^3)	Excess Charge (PHP/m^3)			
			11-20m^3	21-30m^3	31-40m^3	Over 41m^3
13mm	1/2”	366.00	40.60 (32.40)	48.10 (38.40)	61.60 (49.20)	72.90 (58.40)
20mm	3/4”	585.60				
25mm	1”	1,172.20				
40mm	1.5”	2,928.00				
50mm	2”	7,320.00				

Note: Figures in parentheses indicate tariffs in cases of water supply from wells of NHA (National Housing Authority) areas, VLP (Villa La Priniza), VPB (Villa Palac Banilic), and Major Homes.

3.2 Angeles Water District

3.2.1 Outline of Operations

Having been established in September 1987, Angeles City Water District (ACWD) is a relatively new water district. Before ACWD was established, Angeles City had operated a good quality water supply utility, however, management was handed over on the premise that a water district, being able to conduct private business management while having the status of a public agency, could better respond to rapid expansion works and business development made necessary by population increase in the rapidly growing city.

From 1986, a Japanese consulting firm was consigned by the Local Water Utility Administration (LWUA) to implement survey and design on works for improving the water supply. Since 1988, numerous water supply improvement projects for securing water supply through well drilling, improving water supply conditions through constructing booster pump stations, and installing water meters at all supply connections, have been implemented under direct financing from LWUA. Although only 30% of customers had water meters at the start, installation to all customers was completed by 1995. As a result, the ratio of non-revenue water was reduced from 70% to 45%. In turn, this led to greater revenue from water supply and helped stabilize operation of the ACWD water utility.

Effects from the eruption of Mount Pinatubo in June 1991 led to numerous design revisions and prolonged delays in improvement projects.

In 1995, a water supply improvement project was started under financing from the Overseas Economic Cooperation Fund (OECF) of Japan. By August 1997, 173,000 kilometers of water transmission and distribution pipes ranging in diameter from 75 millimeters to 700 millimeters had been laid, and seven production wells, 3,785 square meters (1 million gallons) of distribution reservoir, and booster pump stations had been constructed. As a result of these and ongoing improvement works, the number of supply connections increased from 9,675 faucets (1995) to the present 41,300, and water supply revenue increased greatly from 5 million PHP to the present 157 million PHP.

The ACWD Board of Directors, which currently has five members diversely comprising a a university professor and representatives from civic groups, the economics field, education, and the women's social development field, conducts active debate and offers a lot of helpful advice on ACWD utility operation.

Table-3.2.1.1 ACWD Water Supply Situation

Items		Unit	2012		2013	
Active Metered Customers		Conn.	43,403		44,664	
Domestic/Government		Conn.	(40,035)		(41,122)	
Commercial/Industrial		Conn.	(3,368)		(3,542)	
Served Population		Person	260,418		267,984	
Average Monthly Consumption		m^3/Conn.	24.9		25.9	
Water Sales		1,000PHP	298,511		337,636	
Collection Rate		%	93.6		93.4	
Water Source	Deep Well Pump	Location	29		29	
	Booster Pump	Location	27		27	
Water Production Capacity		m^3/day	45,821		45,821	
Water Production		m^3/day	43,849	100%	46,884	100%
Revenue Water		m^3/day	35,443	80.8	38,012	81.1
Non-Revenue Water		m^3/day	8,406	19.2	8,872	18.9
Leakage		m^3/day	(------)	(----)	(------)	(----)
Illegal Connection		m^3/day	(------)	(----)	(------)	(----)
(Water Meter Error)		m^3/day	(------)	(----)	(------)	(----)
Maintenance by CWD		m^3/day	(------)	(----)	(------)	(----)
Uncollectable Bill		m^3/day	(------)	(----)	(------)	(----)
Other		m^3/day	(8,406)	(19.2)	(8,872)	(18.9)
Employee		person	190		189	
Permanent		person	96		170	
Casual/Temporary		person	59		0	
Job Order		person	35		19	

Note 1: Water production capacity in January 2015 is 47,573m^3/d.

Note 2: Concerning Casual/Temporary employees, Casual denotes employees on 6-month contracts, and Temporary denotes those on 12-month contracts. Job Order employees work on 15-day contracts and are paid a daily wage. Each category of contract is open to renewal, and such workers sometimes become permanent employees.

Table-3.2.1.2 Barangay Population, etc.

pBarangay	Population	Households	Area (ha:0.01km^2)	Population Density (Persons/km^2)	Remarks
Agapito del Rosario	2,413	684	12.1	19,942	
Amsic	13,777	2,971	161	8,557	
Anunas	15,872	3,242	N/D	N/A (Low)	
Balibago	50,734	9,250	160	31,709	
Capaya	9,700	1,400	242	4,008	
Claro M. Recto	6,880	800	17.4	39,540	
Cuayan	6,661	1,332	460	1,448	
Cutcut	25,857	4,112	416	6,215	
Cutud	(16,531)	N/D	N/D	N/A (Low)	Data on 2012
Lourdes North West	(10,450)	N/D	N/D	N/A (High)	Data on 2012
Lourdes Sur	5,085	1,123	21.4	23,761	
Lourdes Sur East	6,828	570	21.4	31,907	
Malabanas	24,547	3,400	240	10,228	
Margot	4,082	796	250	1,633	
Marisol (Nonoi Aquino)	15,525	3,000	160	9,703	
Mining	3,066	459	113.7	2,697	
Pampang	19,953	4,637	444	4,494	
Pandan	17,895	3,178	667	2,683	
Pulungbulu	14,430	2,308	N/D	N/A (Mid)	
Pulung Cacutud	20,614	3,276	N/D	N/A (Mid)	
Pulung Maragul	15,122	4,112	222	6,812	
Salapungan	6,871	1,414	N/D	N/A (High)	
San Jose	10,320	N/D	N/D	N/A (High)	
San Nicolas	3,496	644	19.3	18,114	
Santa Teresita	8,806	1,806	34.2	25,748	
Santa Trinidad	5,007	997	7.3	68,589	
Santo Cristo	5,950	870	155	3,839	
Santo Domingo	15,651	3,830	253	6,186	
Santo Rosario	3,483	869	56.4	6,176	
Sapalibutad	15,205	2,523	N/D	N/A (Low)	
Sapangbato	11,262	2,253	N/D	N/A (Low)	
Tabun	6,760	1,690	81.2	8,325	
Virgen Delos Remedios	1,723	417	6.9	24,971	
Total	(400,556)				

Note: Population Density classifications are as follows:

Low < 5,000 persons/km^2, Mid 5,000 - 10,000 persons/km^2, High > 10,000 persons/km^2.

As for the barangay where calculation was impossible (N/A), classifications were assumed based on hearings with the ACWD.

Table-3.2.1.3 Production Well Particulars

Pump Station	Production Capacity (m^3/hr)	Operating Time (hr/day)	Daily Production (m^3/day)	Remarks
01 Anunas	58	16	928	
02 Bagum Bayan	82	24	1,968	
03 Belen Homesite	99	24	2,376	
04 City Hall	70	2	140	
05 Cuayan	30	15	450	
06 EPZA	86	10	860	
07 Feeder #1	145	24	3,480	
08 Feeder #2	45	24	1,080	
09 Feeder #3	58	24	1,392	
10 Feeder #4	86	24	2,064	
11 Feeder #5	105	24	2,520	
12 Feeder #6	32	24	768	
13 Feeder #7	90	24	2,160	
14 Feeder #8	73	24	1,752	Completed in 2014
15 Mabini	155	24	3,720	
16 Magalang Avenue	84	24	2,016	
17 Marquee Place	112	3	336	
18 MC Arthur	81	24	1,944	
19 Metro Gate	98	14	1,372	
20 North Ville	109	13	1,417	
21 Punta Verde	110	3	330	
22 Robinson	150	24	3,600	
23 Rosewood	72	24	1,728	
24 Sapalibutao	90	8	720	
25 Sapangbato	32	24	768	
26 St.Ignatius	98	14	1,372	
27 St.Vincent	106	24	2,544	
28 Sta.Teresita	18	24	432	
29 Town&Country	65	24	1,560	
30 Villa Belen South	74	24	1,776	
Total			47,573	December 2014
			45,821	December 2013

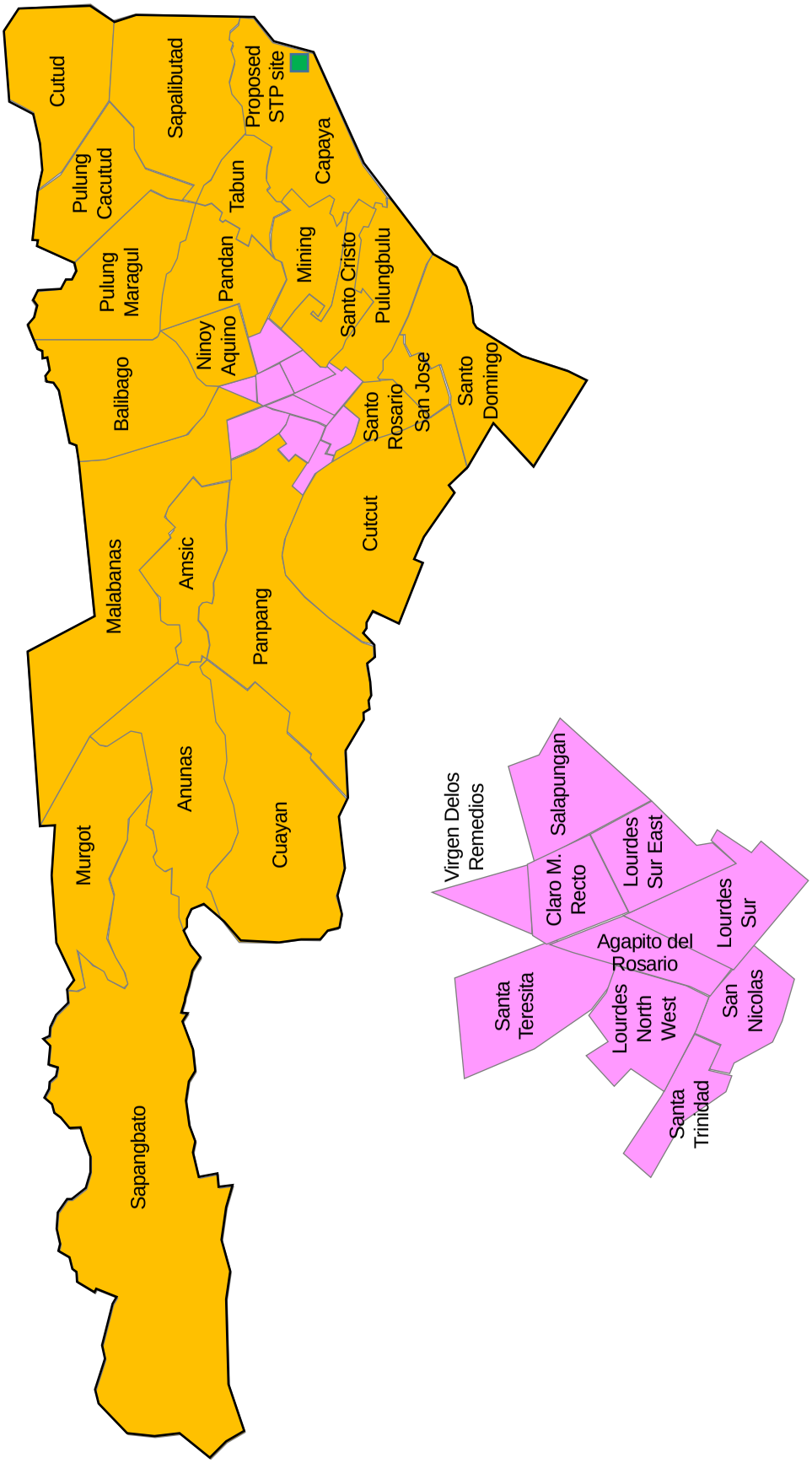

Figure-3.2.1.1 Map of Barangay in Angeles City

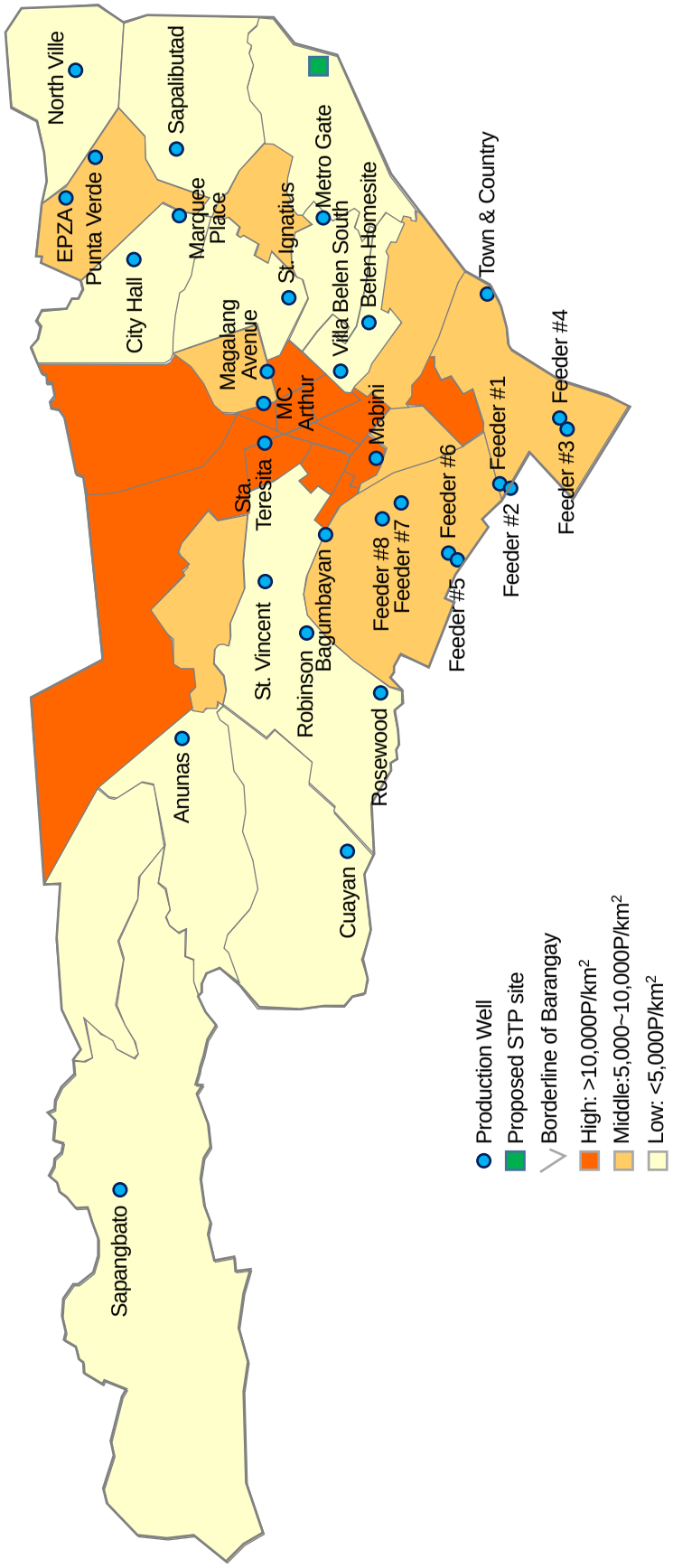

Figure-3.2.1.2 Population Density and Well Layout by Barangay

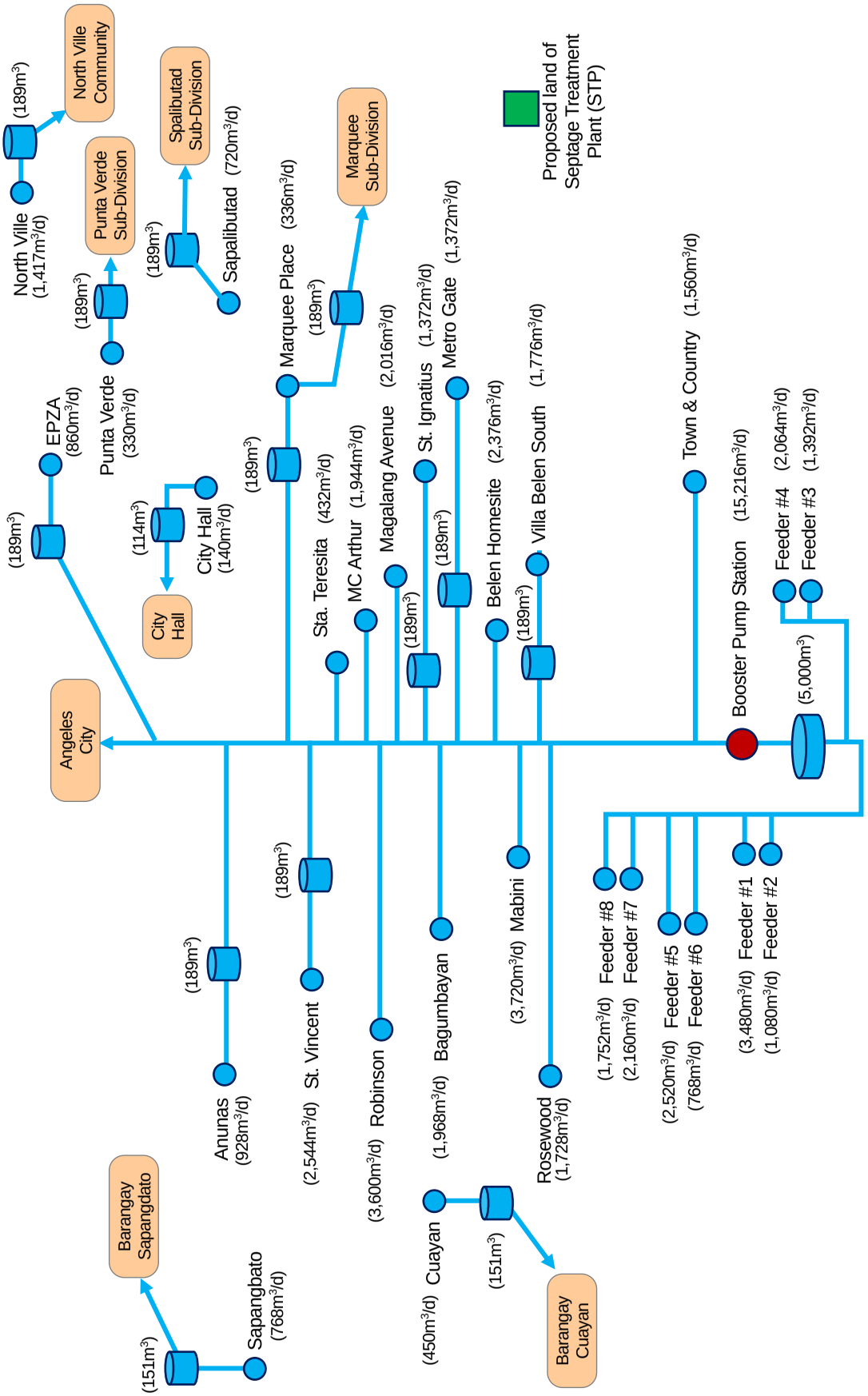

Figure-3.2.1.3 ACWD Waterworks Facilities

3.2.2 Organization

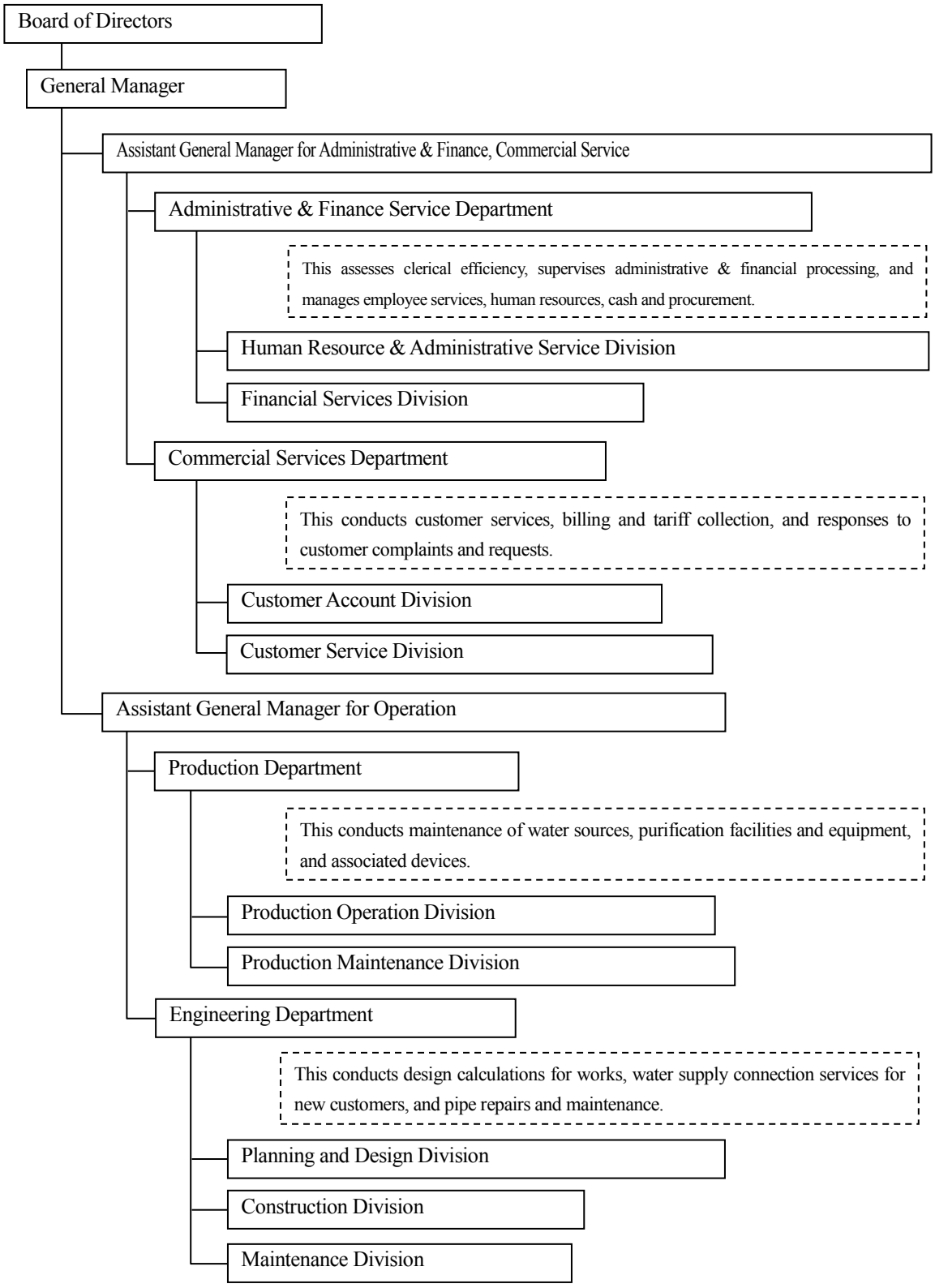

Figure-3.2.2.1 Angeles Water District Organization Chart and Division of Duties

3.2.3 Financial Condition and Tariff Scheme

(1) Financial Condition

Table- 3.2.3.1 FINANCIAL DATA (PhP)

Item	2012	2013
1. REVENUE		
c. Operating	300,752,440	333,498,150
d. Non- Operating	4,213,999	4,138,023
TOTAL	304,966,440	337,636,173
2. EXPENSES		
h. Salaries & Wages	40,835,643	38,012,609
i. Pumping Cost (Fuel, Oil, Electric)	51,692,454	54,646,498
j. Chemical (Water Treatment)	2,425,750	3,103,180
k. Other O & M Expense	134,969,877	133,713,922
l. Depreciation Expense	19,832,508	20,870,865
m. Interest Expense	25,235,695	24,859,892
n. Others	-	-
TOTAL	274,991,927	275,206,968
3. NET INCOME (LOSS)	29,974,513	62,429,206

(2) Tariff Scheme (revised July 2012)

a) Domestic/Government Use

Table-3.2.3.2 Water Tariffs (Domestic/Government Use)

Water Meter Diameter		Basic Tariff (PHP/10m^3)	Excess Charge (PHP/m^3)				
			11-20m^3	21-30m^3	31-40m^3	41-50m^3	51m^3-
13mm	1/2"	192.00	21.25	22.75	24.50	26.55	29.00
20mm	3/4"	307.20					
25mm	1"	614.40					
40mm	1.5"	1,536.00					
50mm	2"	3,840.00					
75mm	3"	6,912.00					
100mm	4"	13,824.00					
150mm	6"	23,040.00					
200mm	8"	36,864.00					
250mm	10”	51,992.00					

b) Commercial/Industrial Use

Table-3.2.3.3 Water Tariffs (Commercial/Industrial Use)

Water Meter Diameter		Basic Tariff (PHP/10m^3)	Excess Charge (PHP/m^3)				
			11-20m^3	21-30m^3	31-40m^3	41-50m^3	51m^3-
13mm	1/2"	384.00	42.50	45.50	49.00	53.10	58.00
20mm	3/4"	614.40					
25mm	1"	1,228.80					
40mm	1.5"	3,072.00					
50mm	2"	7,680.00					
75mm	3"	13,824.00					
100mm	4"	27,648.00					
150mm	6"	46,080.00					
200mm	8"	73,728.00					
250mm	10”	105,984.00					

4. Septage Management - Current Conditions and Future Schedule

4.1 Calamba Water District

4.1.1 Current Conditions of Septage Management

Currently, the water district and city authorities implement no collection and treatment of septage at all. Accordingly, there is no organization for the sewage and septic tank sector, and no vacuum trucks and other equipment are owned.

The team conducted hearings about collection and disposal by private sector enterprises, however, the local side had no information to give.

4.1.2 Future Schedule for Septage Management

The team conducted hearings about the currently envisaged division of roles of the city authorities and Water District when it comes to introducing septage management in the future. The results of hearings were as follows:

- Land acquisition → City
- Septage collection → Water District
- Facilities construction → Water District
- Facilities maintenance → Water District
- Sludge disposal (landfill) → Water District
- Sludge recycling → Private enterprises (contractors)

4.2 Angeles Water District

4.2.1 Current Conditions of Septage Management

Currently, the water district and city authorities implement no collection and treatment of septage at all. Accordingly, there is no organization for the sewage and septic tank sector, and no vacuum trucks and other equipment are owned.

The team conducted hearings about collection and disposal by private sector enterprises and found that there is one private company that implements collection, however, the local side had no information concerning how septage is treated and disposed after collection. The private company charges around 3,000~4,000 PHP per time for removing septage from septic tanks.

4.2.2 Future Schedule for Septage Management

The team conducted hearings about the currently envisaged division of roles of the city authorities and Water District when it comes to introducing septage management in the future. The results of hearings were as follows:

- Land acquisition → Water District
- Septage collection → Water District or private enterprises (contractors)
- Facilities construction → Water District
- Facilities maintenance → Water District
- Sludge disposal (landfill) → Water District
- Sludge recycling → Water District or private enterprises (contractors)

4.3 Septage Management Conditions on Japanese-Affiliated Industrial Parks

4.3.1 Survey Targets

As is indicated in Table-4.1, there are many industrial parks in Calamba City. The Survey Team conducted a survey of 25 Japanese-affiliated enterprises operating in these industrial parks. Incidentally, according to the hearings at Calamba City Office, since Calamba Premiere International Park (1) and Filinvest Technology Park Calamba (5) have their own sewer systems and sewage treatment facilities, meaning that enterprises do not need to have septic tanks, they were omitted from the survey.

Table-4.3.1.1 List of Industrial Parks

	Industrial Park	Address
1	Calamba Premiere International Park	Batino, Parian & Barandal ,Calamba City, Laguna
2	Carmelray Industrial Park I	Canlubang, Calamba City, Laguna
3	Carmelray Industrial Park II	Punta & Tulo, Calamba City, Laguna
4	Carmelray International Business Park	Canlubang, Calamba City, Laguna
5	Filinvest Technology Park Calamba	Punta, Burol & Bubuyan, Calamba City, Laguna
6	Light Industry & Science Park II	Real & La Mesa, Calamba City, Laguna
7	SMPIC Special Economic Zone	Barangay Paciano Rizal, Calamba City, Laguna
8	YTMI Realty Special Economic Zone	Brgy. Makiling, Calamba City, Laguna

4.3.2 Survey Contents

Questionnaire was implemented concerning the conditions of septic tank sludge management, management structure, management agencies, sludge removal and so on.

4.3.3 Survey Findings

Upon implementing a questionnaire survey of 25 enterprises, 11 gave responses. The following table shows the number of surveyed enterprises and number of responding enterprises in each industrial park.

Table-4.3.1.2 Breakdown of Responding Enterprises

	Industrial Park	Number of Surveyed Enterprise	Number of Responding Enterprise
2	Carmelray Industrial Park I	9	3
3	Carmelray Industrial Park II	7	4
4	Carmelray International Business Park	1	0

6	Light Industry & Science Park II	5	1
7	SMPIC Special Economic Zone	1	1
8	YTMI Realty Special Economic Zone	2	2
Total		25	11

According to the survey findings, leaving aside 4 Carmelray International Business Park and 8 YTMI Realty Special Economic Zone where no responses were given, the industrial parks have their own sewage treatment plants for treating wastewater. Accordingly, standards are established for wastewater discharge to the treatment plants, and discharges are managed and supervised. Moreover, some enterprises are connected to the sewage system and have also installed septic tanks; in these cases, private operators remove septage when the septic tanks become full. Desludging (septage removal) fees are paid to the private operators according to the amount of septage removed.

In 8 YTMI Realty Special Economic Zone, which is thought not to have its own sewage treatment plant, the amount of septage inside septic tanks is monitored and septage removal is consigned to private operators when tanks become full. In such cases, too, desludging fees are paid to the private operators according to the amount of septage removed. Moreover, concerning effluent quality, individually installed equipment is used to treat effluent and ensure compliance with the DENR environmental authorization.

4.3.4 Summary

Almost all industrial parks treat wastewater at their own sewage treatment plants, so there is no particular need for septage management inside septic tanks. Leaving aside 4 Carmelray International Business Park where no responses were given, even in 8 YTMI Realty Special Economic Zone, which is thought to be the only industrial park that does not have its own sewage treatment plant, septage is removed from septic tanks and effluent quality is managed by means of separately installed treatment equipment, so septage and effluent quality are appropriately managed. Meanwhile, since many of the employees of Japanese-affiliated enterprises that have located in the two cities reside in these cities, the indirect beneficial effects of the septage management program for Japanese-affiliated enterprises will be high.

5. Design Septage Quantity

5.1 Calamba Water District

5.1.1 Septage Collection Area

As is also the case in the existing F/S, the area where the Water District provides services as shown in Figure-5.1.1.1 will be targeted. In future, it will be desirable to expand the area to include all 54 barangay in the city in line with expansion of the area under Water District jurisdiction.

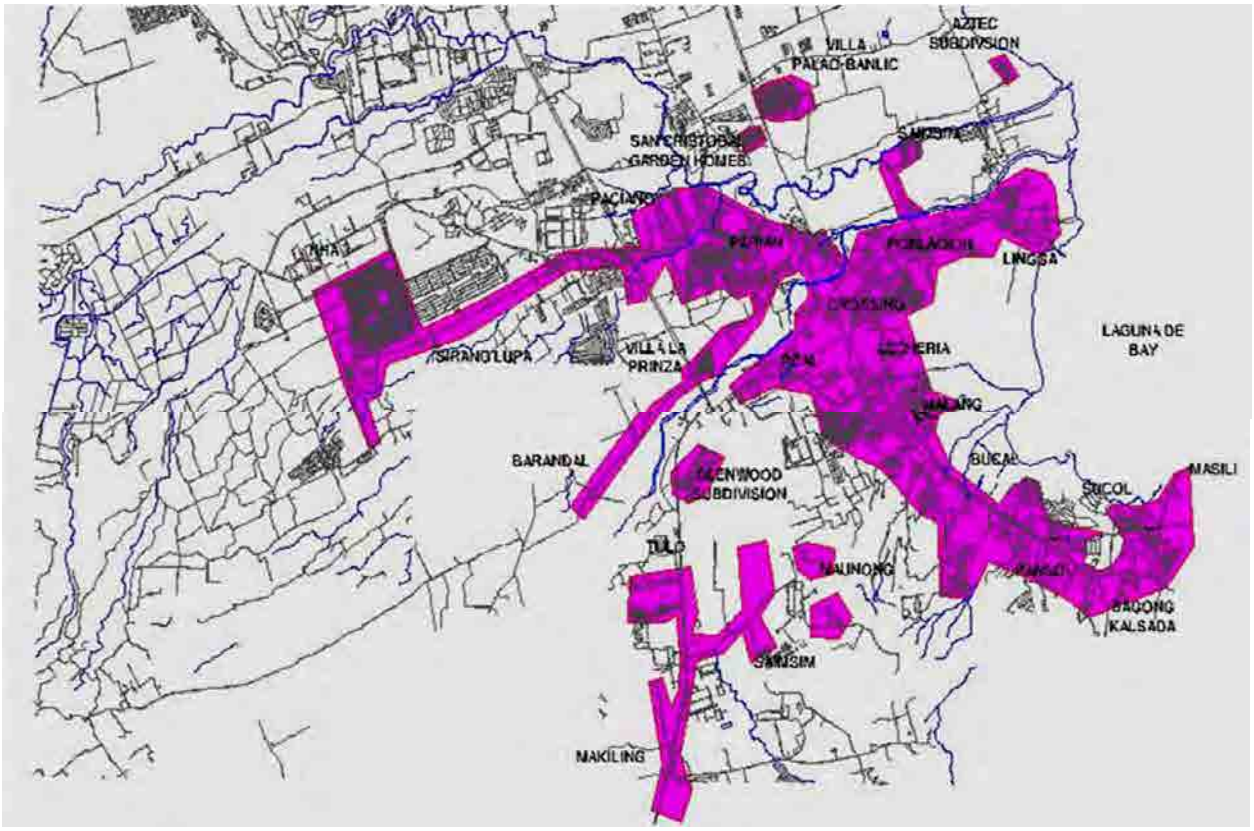

Figure-5.1.1.1 Target Area for Septage Collection

5.1.2 Population Forecast

According to Table 3-2 in the existing F/S, the population of Calamba City is as shown below. The number of households in 2007 was 72,056.

Table-5.1.2.1 Calamba City Population Forecast

Actual	Population Forecast			
2007	2012	2017	2022	2027
360,281	423,341	498,018	589,870	699,904

Population of the target area for septage collection was set as shown in Table-5.1.2.2 based on the results of population forecast in Calamba City and the existing F/S 8.1 CWD Service Area per Zone. Also, the numbers of residential customer and commercial customers were set as shown in Table 5.1.2.3.

Table-5.1.2.2 Population Forecast in the Septage Collection Area

2012	2017	2022	2027
310,001	364,685	431,946	512,521

Table-5.1.2.3 Forecast Number of Households in the Septage Collection Area

	2012	2017	2022	2027
Residential (Customers)	43,508	51,183	60,623	71,931
Residential (Non-Customers)	18,492	21,754	25,766	30,573
Commercial	2,447	2,879	3,410	4,046

5.1.3 Forecast Quantity of Septage Generation

The generated quantity of septage was forecast based on the following formula:

Quantity of septage generation (Va) = Vh1 + Vh2 +Vh3

Residential (Customers) septage generation (Vh1)

Vh1 = Number of households (Nh1) * Ownership rate (βh1) * Access rate (σh1) * Removal quantity (vh1) * Target ratio (θh1)

Residential (Non-Customers) septage generation (Vh2)

Vh2 = Number of households (Nh2) * Ownership rate (βh2) * Access rate (σh2) * Removal quantity (vh2) * Target ratio (θh2)

Commercial septage generation (Vh3)

Vh3 = Number of businesses (Nc) * Ownership rate (βc) * Access rate (σc) * Removal quantity (vc) * Target ratio (θc)

(1) Preconditions

Regarding Calamba Water District, since the quantity of septage generation has not been confirmed in the existing F/S, forecast was conducted in the Survey. In calculating the quantity of septage generation, the following parameters were set.

a) Septic tank ownership rate (β)

In light of past survey findings in Calamba City, the same values as the existing F/S were used.

Table-5.1.3.1 Septic Tank Ownership Rate (β)

	2012	2017	2022	2027
Residential	0.80	0.81	0.82	0.83
Commercial	1.00	1.00	1.00	1.00

b) Septic tank access rate (σ)

The access rate to residential septic tanks was set in light of past survey findings in Calamba City. As for commercial septic tanks, since there were no past survey findings, the same values as adopted in the existing F/S for Angeles City were set.

Table-5.1.3.2 Septic Tank Access Rate (σ)

	2012	2017	2022	2027
Residential	0.42	0.47	0.52	0.57
Commercial	0.80	0.80	0.80	0.80

c) Quantity of septage removal from septic tanks (v)

Concerning the quantity of septage removal from residential septic tanks, the same values as adopted in the existing F/S for Angeles City were newly set upon referring to the NSSMP septage removal standards, etc. The same figure as in the existing F/S was also adopted for the quantity of septage removal from commercial septic tanks.

Table-5.1.3.3 Quantity of Septage Removal from Septic Tanks (v(m^3))

	2012	2017	2022	2027
Residential	2.5	2.5	2.5	2.5
Commercial	5.0	5.0	5.0	5.0

d) Target ratio of septage removal (θ)

The same values as adopted in the existing F/S were used.

Table-5.1.3.4 Target Ratio of Septage Removal (θ)

	2012	2017	2022	2027
Residential (Customers)	1.00	1.00	1.00	1.00
Residential (Non-Customers)	0.01	0.04	0.07	0.10
Commercial	1.00	1.00	1.00	1.00

(2) Generated Quantity of Septage (Va)

The generated quantity of septage was forecast as shown in the following table.

Table-5.1.3.5 Generated Quantity of Septage (Va(m^3))

	2012	2017	2022	2027
Residential (Customers)	36,547	48,713	64,624	85,077
Residential (Non-Customers)	155	828	1,923	3,616
Commercial	9,788	11,515	13,638	16,182
Total	46,490	61,056	80,185	104,875

5.1.4 Target Year and Septage Design Quantity

The septage design quantity was forecast based on the following formula.

Septage design quantity (Vd) = Va / (Annual operating days (τ) * Collection frequency year (μ))

(1) Preconditions

In calculating the septage design quantity, the following parameters were set.

a) Annual operating days (τ)

As in the existing F/S, this was set as 240 days.

b) * Collection frequency year (μ)

Related ordinances stipulate that septage collection be carried out once every 3~5 years. Also referring to the existing F/S in Angeles City, the collection frequency was set at 5 years.

(2) Septage Design Quantity (Vd)

The septage design quantity was forecast as shown in the following table.

Table-5.1.4.1 Septage Design Quantity (Vd(m^3/day))

	2012	2017	2022	2027
Residential(Customers)	30.5	40.6	53.9	70.9
Residential(Non-Customers)	0.1	0.7	1.6	3.0
Commercial	8.2	9.6	11.4	13.5
Total	38.7	50.9	66.8	87.4

(3) Target Design Year and Septage Design Quantity

a) Immediate future

The immediate target year and septage design quantity were set based on Table-5.1.4.1. Table-5.1.4.2 shows the values from this revision and the existing F/S.

Table-5.1.4.2 Immediate Septage Design Quantity

	Revised Plan	Existing F/S
Target year	2017	2012
Septage design quantity (m^3/d)	50	60

b) Future

The future target year and septage design quantity were set based on Table-5.1.4.1 and the ease of implementing the phased expansion of facilities. Table-5.1.4.3 shows the values from this revision and the existing F/S.

In the future, in addition to the forecast design quantity shown in Table-5.1.4.1, it will also be necessary to consider expansion of the septage collection area and higher frequency of septage collection. Assuming that the septage collection area is expanded to cover the entire city, the population will increase by roughly 40%; while in the case where the frequency of septage collection is increased to once every three years, the quantity of septage will increase roughly 70%, resulting in a maximum increase of 2.3 times to approximately 200 cubic meters, so particular attention will need to be paid to securing the land for future construction.

Table-5.1.4.3 Future Septage Design Quantity

	Revised Plan	Existing F/S
Target year	2027	2027
Septage design quantity (m^3/d)	100	100

5.2 Angeles Water District

5.2.1 Septage Collection Area

As in the existing F/S, the 31 barangay in which the Water District currently operates will be targeted. In future, it will be desirable to expand the area to include all 33 barangay in the city in line with expansion of the area under Water District jurisdiction. Moreover, according to the Water District, consideration is also being given to the idea of receiving septage from surrounding cities in the future.

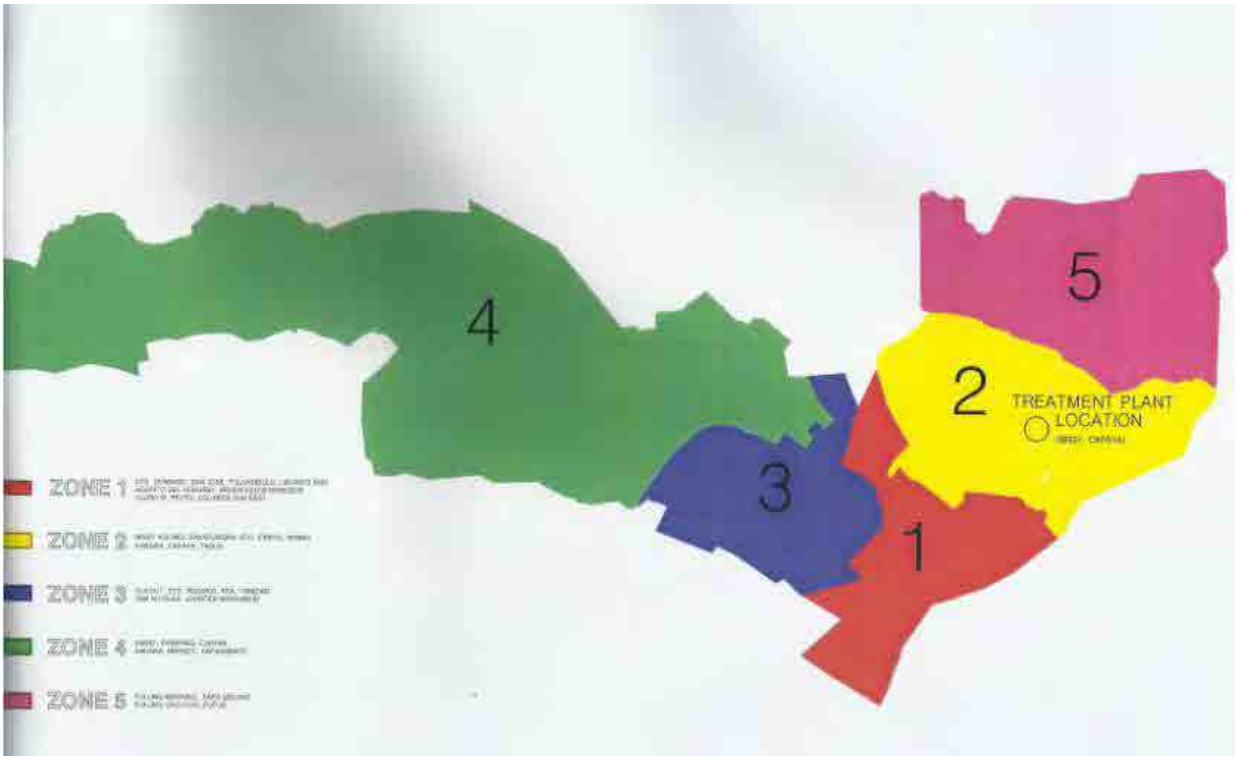

Figure-5.2.1.1 Target Area for Septage Collection

Table-5.2.1.1 Target Area for Septage Collection

SCA	Barangay
Zone 1	1. Sto. Domingo 2. San Jose 3. Pulungbulu 4. Lourdes Sur 5. Agapito Del Rosario 6. Virgen Delos Remedios 7. Claro M. Recto 8. Lourdes Sur East
Zone 2	9. Ninoy Aquino 10. Salapungan 11. Sto. Cristo 12. Mining 13. Pandan 14. Capaya 15. Tabun
Zone 3	16. Cutcut 17. Sto. Rosario 18. Sta. Trinidad 19. San Nicolas 20. Lourdes North West 21. Sta. Teresita
Zone 4	22. Amsic 23. Pampang 24. Cuayan 25. Anunas 26. Margot 27. Sapangbato
Zone 5	28. Pulung Maragul 29. Sapalibutad 30. Pulung Cacutud 31. Cutud

5.2.2 Population Forecast

According to Table 5-5 in the existing F/S, population of Angeles City is as shown below.

Table-5.2.2.1 Angeles City Population Forecast

2015	2020	2025	2030
391,215	480,988	610,430	805,079

According to Table 5-5 in the existing F/S, population of the target area for septage collection was set as shown in the following table.

Table-5.2.2.2 Population Forecast in the Septage Collection Area

2015	2020	2025	2030
328,860	410,670	531,084	715,494

According to Tables 5-8a, 5-8b, and 5-9 in the existing F/S, the number of households and number of businesses in the target area for septage collection are as shown in the following table.

Table-5.2.2.3 Forecast Number of Households in the Septage Collection Area

	2015	2020	2025	2030
Residential (Customers)	41,990	47,622	54,222	61,990
Residential (Non-Customers)	23,742	34,512	51,955	81,109
Commercial	3,813	4,347	5,036	5,941

5.2.3 Forecast Quantity of Septage Generation

The generated quantity of septage was forecast based on the following formula:

Quantity of septage generation (Va) = Vh1 + Vh2 +Vh3

Residential (Customers) septage generation (Vh1)

Vh1 = Number of households (Nh1) * Ownership rate (βh1) * Access rate (σh1) * Removal quantity (vh1) * Target ratio (θh1)

Residential (Non-Customers) septage generation (Vh2)

Vh2 = Number of households (Nh2) * Ownership rate (βh2) * Access rate (σh2) * Removal quantity (vh2) * Target ratio (θh2)

Commercial septage generation (Vh3)

Vh3 = Number of businesses (Nc) * Ownership rate (βc) * Access rate (σc) * Removal quantity (vc) * Target ratio (θc)

(1) Preconditions

The same values as adopted in the existing F/S were used for parameters when calculating the quantity of septage generation.

a) Septic Tank Ownership Rate (β)

Table-5.2.3.1 Septic Tank Ownership Rate (β)

	2015	2020	2025	2030
Residential	0.97	0.97	0.97	0.97
Commercial	0.90	0.92	0.94	0.95

b) Septic Tank Access Rate (σ)

Table-5.2.3.2 Septic Tank Access Rate (σ)

	2015	2020	2025	2030
Residential	0.65	0.70	0.75	0.80
Commercial	0.80	0.80	0.80	0.80

c) Quantity of septage removal from septic tanks (v)

Table-5.2.3.3 Quantity of Septage Removal from Septic Tanks (v(m^3))

	2015	2020	2025	2030
Residential	2.5	2.5	2.5	2.5
Commercial	5.0	5.0	5.0	5.0

d) Target ratio of septage removal (θ)

Table-5.2.3.4 Target Ratio of Septage Removal (θ)

	2015	2020	2025	2030
Residential (Customers)	1.00	1.00	1.00	1.00
Residential (Non-Customers)	0.00	0.05	0.10	0.15
Commercial	1.00	1.00	1.00	1.00

(2) Generated Quantity of Septage (Va)

The generated quantity of septage was forecast as shown in the following table.

Table-5.2.3.5 Generated Quantity of Septage (Va(m^3))

	2015	2020	2025	2030
Residential (Customers)	66,187	80,838	98,616	120,261
Residential (Non-Customers)	0	2,929	9,457	23,603
Commercial	13,727	15,997	18,935	22,576
Total	79,914	99,765	127,008	166,439

5.2.4 Target Year and Septage Design Quantity

The septage design quantity was forecast based on the following formula.

Septage design quantity (Vd) = Va / (Annual operating days (τ) * Collection frequency year (μ))

(1) Preconditions

In calculating the septage design quantity, the following parameters were set.

a) Annual operating days (τ)

As in the existing F/S, this was set as 221 days.

b) Collection frequency year (μ)

As in the existing F/S, this was set as 5 years.

(2) Septage Design Quantity (Vd)

The septage design quantity was forecast as shown in the following table.

Table-5.2.4.1 Septage Design Quantity (Vd(m^3/day))

	2015	2020	2025	2030
Residential (Customers)	59.9	73.2	89.2	108.8
Residential (Non-Customers)	0.0	2.7	8.6	21.4
Commercial	12.4	14.5	17.1	20.4
Total	72.3	90.3	114.9	150.6

(3) Target Design Year and Septage Design Quantity

a) Immediate future

Based on Table-5.2.4.1 and Table 6.2.5.1, the future target year and septage design quantity are set. Table-5.2.4.2 shows the values in the revised plan and the existing F/S.

The immediate target year and septage design quantity were set based on Table-5.2.4.1. Table-5.2.4.2 shows the values from this revision and the existing F/S.

Table-5.2.4.2 Immediate Septage Design Quantity

	Revised Plan	Existing F/S
Target year	2020	2020
Septage design quantity (m^3/d)	100	85

b) Future

The future target year and septage design quantity were set based on Table-5.2.4.1. Table-5.2.4.3 shows the values from this revision and the existing F/S.

As in the case of Calamba City, in the future, in addition to the forecast design quantity shown in Table-5.2.4.1, it will also be necessary to consider expansion of the septage collection area and higher frequency of septage collection. Assuming that the septage collection area is expanded to cover the entire city, the population will increase by roughly 10%; while in the case where the frequency of septage collection is increased to once every three years, the quantity of septage will increase roughly 70%, resulting in a maximum increase of 1.9 times to approximately 280 cubic meters, so particular attention will need to be paid to securing the land for future construction.

Table-5.2.4.3 Future Septage Design Quantity

	Revised Plan	Existing F/S
Target year	2030	2025
Septage design quantity (m^3/d)	150	110

6. Treatment Method and Cost

6.1 Calamba Water District

6.1.1 Planned Construction Sites

(1) Currently Planned Construction Sites

In the existing F/S, two planned construction sites are cited and compared.

Barangay Real is situated relatively close to the central urban area, while Barangay Putting Lupa is located in the mountains away from the city center. The sites are 1.3 hectares and 2.3 hectares respectively, meaning that both comfortably provide the 1.0 hectare plot required for the planned construction according to the existing FS. The sites are at altitude of 33-60 meters and 213-239 meters respectively, meaning that both have an altitude differential of at least 20 meters. Whereas the Water District would need to purchase expensive land in the case of Barangay Real, the site in Barangay Putting Lupa is scheduled to be lent by the city for free, so the Water District plans to implement construction here.

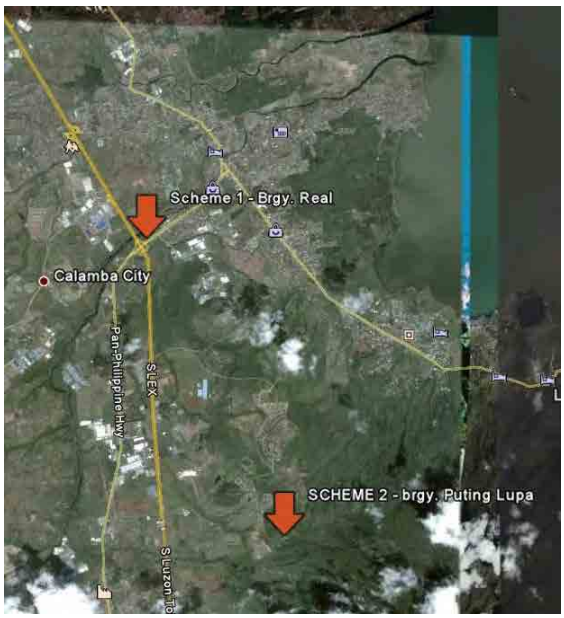

Figure-6.1.1.1 Candidate Construction Sites

(2) Observations on the Currently Planned Construction Site

As is shown in Photograph-6.1.1.1, the planned construction site is situated in a mountain area with a lot of trees and large altitude differential, so it will cost a lot to cut trees and cut and level the land. Moreover, as is shown in Photograph-6.1.1.2, the road leading to the planned construction site is narrow and unpaved, meaning that more expense will be incurred in road construction. Furthermore, even following construction, since it is forecast that transporting septage and sludge to and from the site would be difficult, this is deemed to be

inappropriate as the planned construction site.

Photograph-6.1.1.1
Conditions on the Planned Construction Site

Photograph-6.1.1.2 Road Conditions

(3) Future Approach

As the future approach, it is desirable to request the city authorities to provide an alternative site. If this isn't possible, the option of having the Water District purchase land will also need to be examined. Since a large site area will be required if the currently planned lagoon method is adopted, this could be reduced a lot and the quality of effluent could be improved through adopting a mechanical treatment method. Accordingly, it will be necessary to carefully scrutinize the required area of land. When doing so, it will also be necessary to consider future development plans.

（Future Approach）

- Request the city authorities to provide an alternative site
- Have the Water District purchase land

6.1.2 Design Septage Water Quality

BOD and COD were adopted as the important items of design septage water quality. As the design water quality values, the same values as adopted in the existing F/S for Angeles City were adopted upon considering the results of past sampling analysis in Calamba City and the design water quality in the said existing F/S.

Table-6.1.2.1 Design Septage Quality

Important Item	Unit	Design Water Quality	Sampling Analysis Result
BOD	mg/L	6,000	5,472
COD	mg/L	20,000	15,542

6.1.3 Design Effluent Quality

Concerning the quality of effluent following filtrate treatment in the newly constructed facilities, as is shown in the following table, standard values were prescribed according to the water quality of the discharge destination in DENR Administrative Order No. 35.

Table-6.1.3.1 Effluent Quality Standards

Item	Unit	River Classification			
		CLASS A,B,SB	CLASS C	CLASS D	CLASS SC
pH	—	6.0-9.0	6.5-9.0	6.0-9.0	6.0-9.0
BOD	mg/L	30	50	120	100
COD	mg/L	60	100	200	200
TSS	mg/L	50	70	150	150
Total Coliforms	MPN/mL	3,000	10,000	—	—

Effluent from the currently planned construction site will be discharged to a Class C river. The Survey proposes that the planned construction site be changed, however, since all rivers in the city are Class C, the design effluent quality will be as follows.

Table-6.1.3.2 Design Effluent Quality

Item	Unit	CLASS C
pH	—	6.5-9.0
BOD	mg/L	50
COD	mg/L	100
TSS	mg/L	70
Total Coliforms	MPN/mL	10,000

6.1.4 Treatment Method

(1) Treatment Method in the Existing F/S

In the existing F/S, as is shown in Figure-6.1.4.1, the lagoon method is adopted as the treatment method. Moreover, the layout of facilities is as indicated in Figure-6.1.4.2, leaving room to make additional installations. Moroever, according to the existing F/S, it is anticipated that residents will need to be resettled.

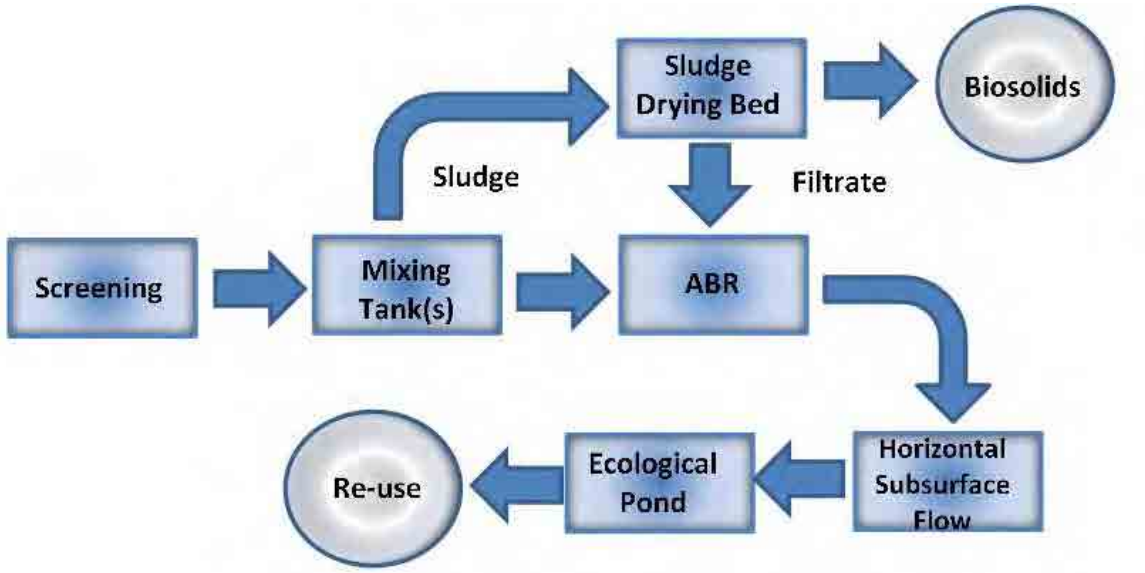

Figure-6.1.4.1 Treatment Process

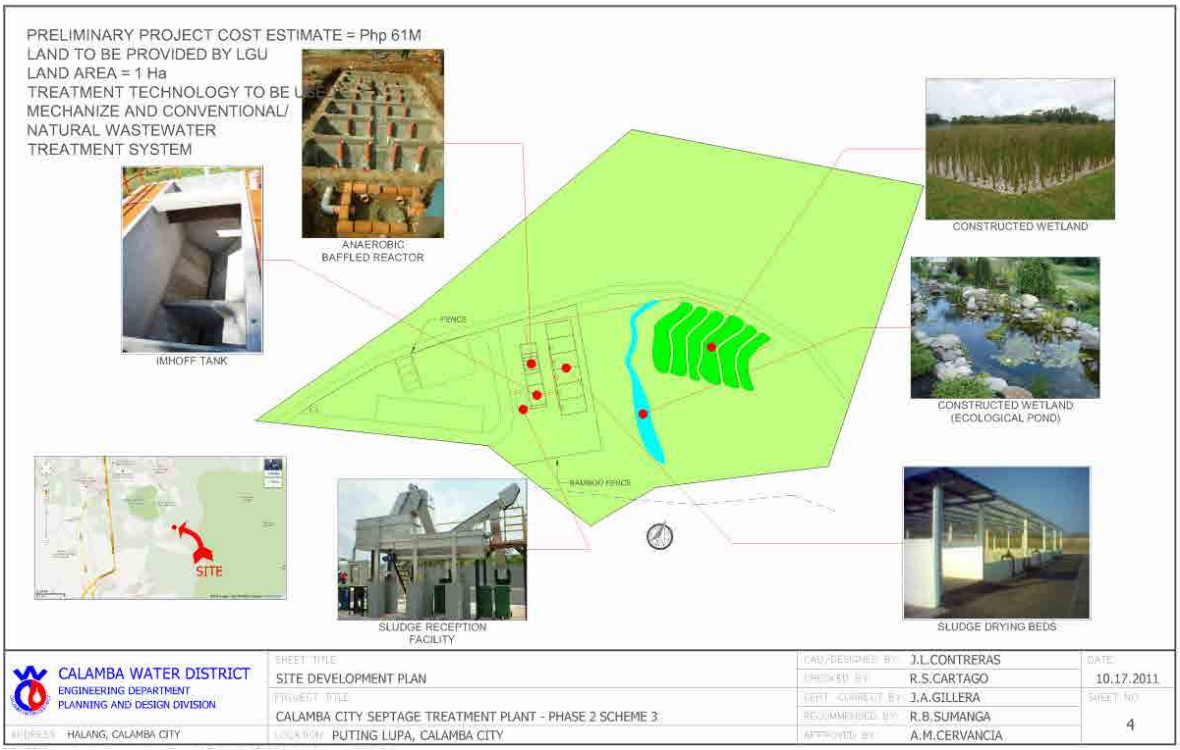

Figure-6.1.4.2 Layout of Treatment Facilities

(2) Examination of Treatment Method

In the current lagoon method, a large land area is required. The Survey proposes that land for a new site be acquired, however, since it is likely to be difficult to secure a large site area, the following two treatment methods were examined as a means of reducing the necessary site area and satisfying the required effluent quality. Pretreatment and mechanical dewatering are the same in both methods. The two treatment processes are shown in Figure-6.1.4.3 and Figure-6.1.4.4 respectively.

(Case 1) Pretreatment + Mechanical dewatering + Johkasou

(Case 2) Pretreatment + Mechanical dewatering + Extended aeration

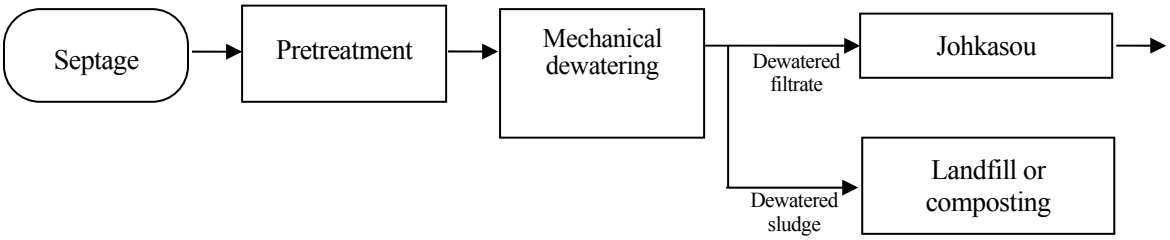

Figure-6.1.4.3 Treatment Process (Case 1)

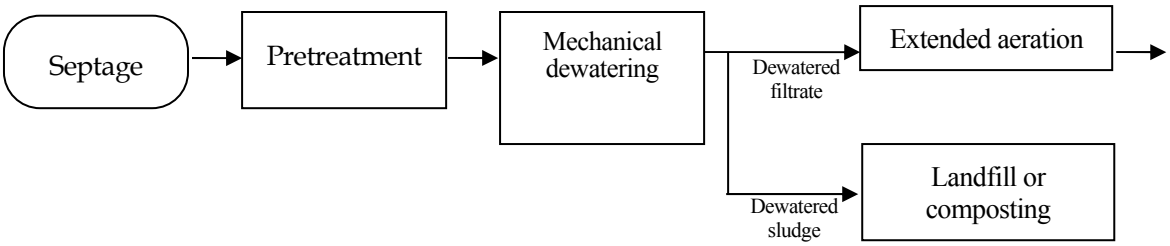

Figure-6.1.4.4 Treatment Process (Case 2)

(3) Equipment Specifications

a) Pretreatment

As equipment for pretreatment, the following two options were compared.

(Option a-1) Screen

(Option a-2) Septage Acceptance Unit

Option a-1 has already been implemented in Cebu City, while Option a-2 has been implemented in Metro

Manila. Option a-2 is highly systemized and fairly expensive, whereas Option a-1 is extremely simple and inexpensive. Moreover, since there have been no problems of note in Cebu City, Option a-1 is proposed in this Survey.

Photograph-6.1.4.1 Option a-1

Photograph-6.1.4.2 Option a-2

b) Mechanical dewatering

The following two types of equipment were compared for the mechanical dewatering.

(Option b-1) Volute

(Option b-2) Screw Press

Option b-1 has already been implemented in Cebu City, while Option b-2 has been implemented in Metro Manila.

Generally when the filtration unit of the dewatering machine becomes clogged, the discharge of filtrate is badly impeded and dewatering functions decline. However, in the case of the volute in Option b-1, since the filtration unit mechanically cleans itself as dewatering is performed, it is possible to conduct stable continuous dewatering without clogging. Therefore, this option is advantageous in terms of the following points. Good operating performance has also been confirmed in Cebu City.

- 24 hours fully automatic unmanned operation is possible.
- Excellent dewatering performance is possible.
- Energy and water savings can be made and noise and vibration levels are low.

Photograph-6.1.4.3 Option b-1

Photograph-6.1.4.4 Option b-2

Therefore, in the Survey, Option b-1, which enables easy maintenance and entails inexpensive lifecycle costs, is proposed.

The results of comparing lifecycle costs are shown below. In Option b-1, it is possible to greatly reduce electricity charges and water charges. Moreover, although not reflected in this comparative examination, because dewatering functions are also excellent and an additional effect can be anticipated in terms of reducing the volume of dewatered sludge and the filtrate treatment load, this will also contribute to reducing the overall cost.

Table-6.1.4.1 Comparison of Dewatering Machine Lifecycle Costs

	Volute	**Screw Press**
Initial Cost	**10,275,380**	**9,000,000**
Running Cost (Annual)		
Water Consumption	11,520	76,800
Electric Consumption	93,600	192,000
Polymer Consumption	288,000	288,000
Total Running Cost (annual)	393,120	556,800
Running Cost (15 years)	**5,896,800**	**8,352,000**
Total Cost	**16,172,180**	**17,352,000**

<Condition>

Capacity: 10m^3/h
Operation: 10h/d, 240d/y

Water Consumption	0.12m^3/h	0.80m^3/h
Electric Consumption	1.95kWh	4.00kWh
Polymer Consumption	1.5kg/h	1.5kg/h

Water: 40PhP/m^3
Electric: 20PhP/kWh
Polymer: 80PhP/kg

c) Filtrate treatment

In designing the filtrate treatment facilities, the water volume, influent quality, and effluent quality were assumed as follows. If however, the T-N value becomes more than 200 mg/L, there is a possibility that the value of the designed effluent quality of water will not be satisfied; therefore a separate examination will become necessary in that case.

Table-6.1.4.2 Design Conditions

Water volume	50m^3/day
Influent quality (BOD)	600mg/L
Effluent quality (BOD)	50mg/L

As the equipment for treating filtrate, the following two types were compared.

(Option c-1) Johkasou

(Option c-2) Extended aeration method

- Johkasou

The Johkasou is a treatment technology that has been uniquely developed in Japan. Johkasou tanks are installed for purifying and discharging raw sewage in households or small communities in areas not served by sewerage systems. The Johkasou is composed of three stages: septic tank, oxidation tank, and disinfecting tank, and it purifies sewage by means of sedimentation, biological oxidation, and disinfecting before discharging the treated effluent.

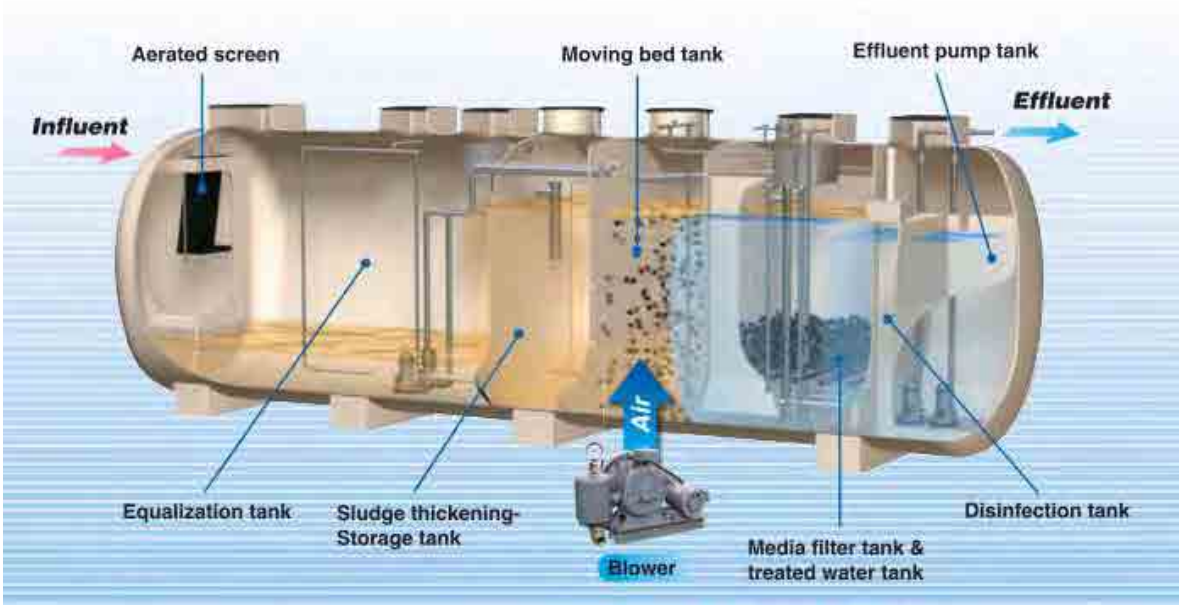

Figure-6.1.4.5 Cross Section of Johkasou

Specifications of the Johkasou in the case of the design conditions in Table-6.1.4.2 are as indicated below. The retention time is roughly 24 hours.

Table-6.1.4.3 Specifications of Johkasou

Unit specifications	1st: 6,100mm * φ2,050mm * H2,350mm 2nd: 6,100mm * φ2,050mm * H2,350mm 3rd : 9,950mm * φ2,050mm * H2,350mm
（Breakdown）	
Equalization tank	10,800mm
Sludge thickening-Storage tank	1,400mm
Moving bed tank	7,200mm
Media filter tank & treated water tank	1,750mm
Effluent pump tank and Disinfecting tank	1,000mm

- Extended Aeration

Extended aeration, which requires no initial sedimentation tank, is an integrated treatment method that entails conducting activated sludge treatment in a reaction tank with extended HRT, high MLSS concentration, low load conditions and long SRT, and then performing solids-liquid separation in the final sedimentation tank. Specifications of the reaction tanks and final sedimentation tank are as shown below. Incidentally, this treatment method is the same as that proposed in the existing F/S for Angeles City.

Table-6.1.4.4 Reaction Tank Particulars

HRT (h)	16-24
MLSS (mg/L)	3,000-4,000
Returned sludge ratio (%)	100-200
Oxygen requirement (kgO2/kgBOD)	1.4-2.2

Table-6.1.4.5 Final Sedimentation Tank Particulars

Sedimentation time (h)	6-12
Effective wet depth (m)	3-4
Water surface area load (m^3/m2/d)	8-12
Overflow load (m^3/m/d)	50 or less

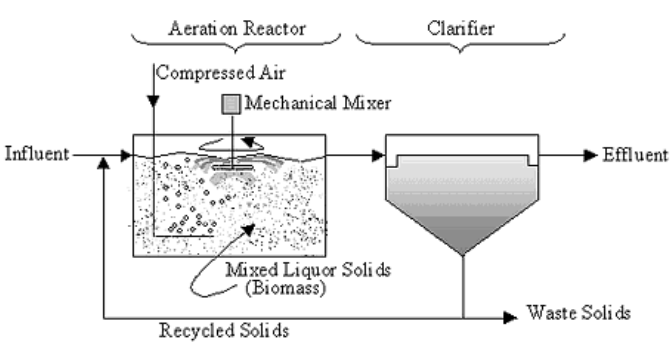

Figure-6.1.4.6 Extended Aeration Method

In terms of construction cost, Option c-1 is inexpensive; moreover, since this entails mechanized units, the construction works are relatively easy. Therefore, Option c-1 is proposed in this Survey.

For reference purposes, the following table shows a comparison of the Johkasou, extended aeration method, and the lagoon method that is adopted in the existing F/S.

Table-6.1.4.6 Comparison of Treatment Methods

Item	Johkasou	Extended Aeration Method	Lagoon Method
Construction Cost	△	△	○
Running Cost	△	△	○
Maintenance Cost	△	△	○
Effluent Quality	○	○	×
Required Area	○	○	×
Ease of Construction	○	△	△
Ease of Maintenance	○	△	△
Ease of expanding facilities	○	△	×
Overall Assessment	○	△	×

(4) Proposed Treatment Method and Equipment

In consideration of the above points, the proposed treatment method and equipment in this Survey are as shown in the following table.

Table-6.1.4.7 Treatment Method and Equipment

Preliminary	Dewatering	Filtrate Treatment
Screen	Volute	Johkasou

6.1.5 Collection Trucks

In the existing F/S, the basis for calculation is unknown, however, assuming the case where the collection area is divided into five zones, the amount of septage collection in the collection area each year is roughly the same at 50 m^3/day, and the average transportation distance to treatment facilities is 5 kilometers, it should be possible to transport septage with the number of trucks stated in the F/S so long as the daily operating time is 9.5 hours.

Also, one dump truck will be added for transporting the sludge that is generated in treatment.

Moreover, vacuum trucks of varying capacity will be adopted, for example, 4.5 m^3 type trucks that can gain access to narrow streets, and 8.5 m^3 type trucks that can efficiently collect septage in large quantities. Moreover, trucks will be equipped with 30~50 meters of hoses and water traps for addressing the issue of odor.

Table-6.1.5.1 Number of Collection Trucks

8.5 m^3 vacuum trucks	1
4.5 m^3 vacuum trucks	2
5 m^3 dump truck	1

6.1.6 Required Area for the Planned Construction Site

In the existing F/S, the treatment method is assumed to be the lagoon method, and the required area for facilities is approximately 2,500 square meters, rising to approximately 5,000 square meters when the facilities layout is taken into consideration.

Assuming the treatment method proposed in 6.1.4, the required area will be approximately 1,200 square meters. Moreover, considering the design quantity in 2027, it will be desirable to secure an area of approximately 1,500 square meters to accommodate future expansion of the treatment facilities.

Table-6.1.6.1 Required Area for Planned Construction Site

Pretreatment + mechanical dewatering	10 * 10 = 100 m^2
Johkasou	7.5 * 20 = 150 m^2
Building	10 * 15 = 150 m^2
Parking Area	25 * 30 = 750 m^2
Total	**1,500 m^2** (1,200 m^2)

6.1.7 Cost

(1) Construction Cost

Based on 6.1.4, Option 1 is proposed, but costs in Option 2 were also calculated here for comparison. In addition, construction cost of Johkasou is a condition that is buried underground. Moroever, in this estimate, it is assumed that Johkasou will be constructed underground.

Table-6.1.7.1 Construction Cost Estimation Cases

Option	Preliminary	Dewatering	Filtrate Treatment
1	Screen	Volute	Johkasou
2	Screen	Volute	Activated Sludge (Extended Aeration)

The results of exanmination are as indicated below.

Table-6.1.7.2 Construction Cost Calculation Results (PhP)

Item	Option 1	Option 2
Ⅰ. TREATMENT PLANT	44,280,736	45,561,925
Procurement of Lot	15,000,000	15,000,000
II. VACUUM TRUCKS	17,100,000	17,100,000
Total	**76,380,736**	**77,661,925**

(2) Operation and Maintenance Cost

The results of exanmination are as indicated below.

Table-6.1.7.Operation and Maintenance Cost (Annual) Calculation Results (PhP)

Item	Option 1	Option 2
Ⅰ. Treatment Operation	**3,948,092**	**4,703,884**
Personnel	1,680,000	1,680,000
Power Consumption	608,160	1,389,600
Water Consumption	11,520	11,520
Chemical Consumption	341,564	341,564
Water Testing and Monitoring	714,000	714,000
Consumable Spare Parts	592,848	567,201
Ⅱ. Desludging Operation	**2,362,800**	**2,362,800**
Personnel	1,440,000	1,440,000
Fuel Consumption	580,800	580,800
Consumable Spare Parts	342,000	342,000
Ⅲ. Sludging Disposal	**1,055,549**	**1,055,549**
Personnel	240,000	240,000
Fuel Consumption	26,400	26,400
Disposal fee	789,149	789,149
Ⅳ. Headquarters	**1,440,000**	**1,440,000**
Personnel	1,440,000	1,440,000
Total	**8,806,441**	**9,562,234**

6.2 Angeles Water District

6.2.1 Planned Construction Site

(1) Planned Construction Site

As is shown in the map below, the planned construction site is located in Barangay Capaya adjacent to North Luzon Expressway on the city boundary. Moreover, as is shown in Photograph-6.2.1.1, the land here is flat and the lot covers a broad area of approximately 4.8 hectares. As is shown in Photograph-6.2.1.2, road conditions are also relatively good, so this lot is deemed to be suitable as the planned construction site.

Figure-6.2.1.1 Location of the Planned Construction Site

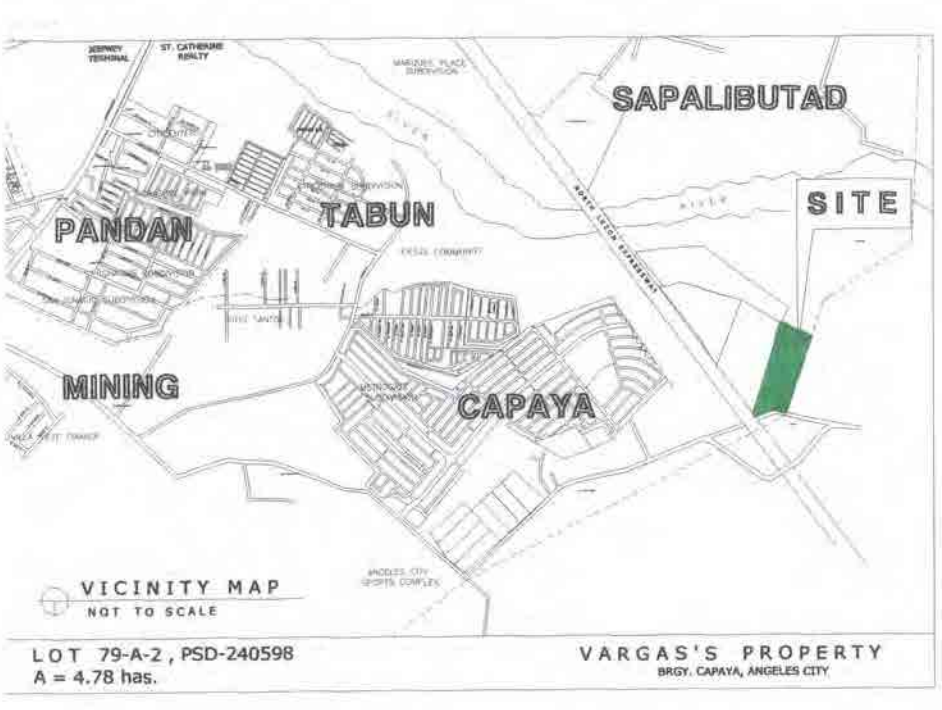

Figure-6.2.1.2 Details of the Planned Construction Site

Photograph-6.2.1.1
Conditions on the Planned Construction Site

Photograph-6.2.1.2 Road Conditions

(2) Future Schedule

The Water District intends to purchase approximately 2,000 square meters of this planned construction site. It will enter into negotiations with the landowner from now on, however, with the city authorities also offering support, it does not expect any difficulties in the land purchase. Moreover, according to the existing F/S, the required area for construction of faciltiies is given as approximately 1,300 square meters.

6.2.2 Design Septage Quality

BOD and COD were adopted as the important items of design septage quality. As the design water quality values, the same values as adopted in the existing F/S were used.

Table-6.2.2.1 Design Septage Quality

Important Item	Unit	Design Water Quality
BOD	mg/L	6,000
COD	mg/L	20,000

6.2.3 Design Effluent Quality

Concerning the quality of effluent following filtrate treatment in the newly constructed facilities, as is shown in the following table, standard values were prescribed according to the water quality of the discharge destination in DENR Administrative Order No. 35.

Table-6.2.3.1 Effluent Quality Standards

Item	Unit	River Classification			
		CLASS A,B,SB	CLASS C	CLASS D	CLASS SC
pH	—	6.0-9.0	6.5-9.0	6.0-9.0	6.0-9.0
BOD	mg/L	30	50	120	100
COD	mg/L	60	100	200	200
TSS	mg/L	50	70	150	150
Total Coliforms	MPN/mL	3,000	10,000	—	—

Since effluent from the currently planned construction site will be discharged to Abakan River, which is a Class C river, the design effluent quality will be as follows.

Table-6.2.3.2 Design Effluent Quality

Item	Unit	CLASS C
pH	—	6.5-9.0
BOD	mg/L	50
COD	mg/L	100
TSS	mg/L	70
Total Coliforms	MPN/mL	10,000

6.2.4 Treatment Method

(1) Treatment Method in the Existing F/S

In the existing F/S, the following three methods were compared, and Option 1 was adopted.

Table-6.2.4.1 Treatment Methods

Option	Preliminary	Dewatering	Filtrate Treatment	Biosolids Disposal
1	Septage Acceptance Unit	Screw Press	Activated Sludge (Extended Aeration)	Landfill or Land Application
2	Screen	Screw Press	Activated Sludge (Extended Aeration)	Landfill or Land Application
3	Screen	Drying Bed	Facultative Ponds	Landfill or Land Application

(2) Examination of Treatment Method

Here, in addition to the following Case 2 that is adopted in the existing F/S, Case 1, which adds Johkasou for filtrate treatment, was also examined. The two treatment processes are shown in Figure-6.2.4.1 and Figure-6.2.4.2 respectively.

(Case 1) Pretreatment + Mechanical dewatering + Johkasou

(Case 2) Pretreatment + Mechanical dewatering + Extended aeration

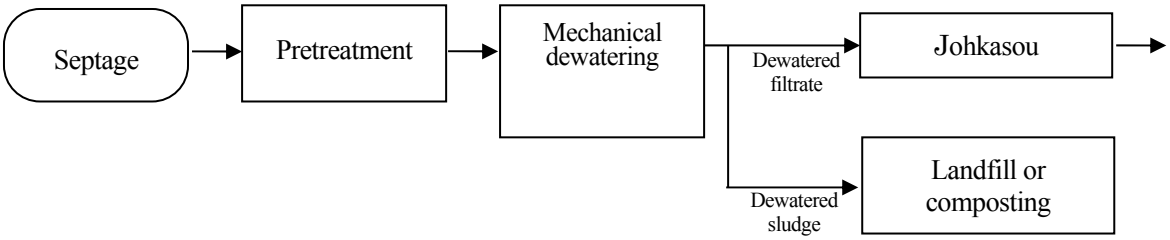

Figure-6.2.4.1 Treatment Process (Case 1)

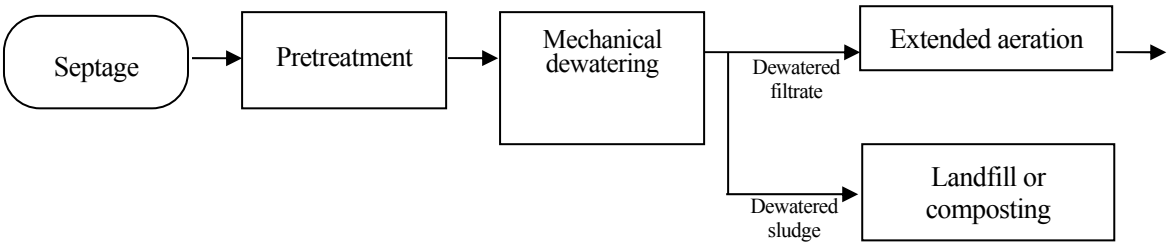

Figure-6.2.4.2 Treatment Process (Case 2)

(3) Equipment Specifications

a) Pretreatment

As equipment for pretreatment, the following two options were compared as in the existing F/S.

(Option a-1) Screen

(Option a-2) Septage Acceptance Unit

Option a-1 has already been implemented in Cebu City, while Option a-2 has been implemented in Metro Manila. Option a-2 is highly systemized and fairly expensive, whereas Option a-1 is extremely simple and very inexpensive. Moreover, since there have been no problems of note in Cebu City, Option a-1 is proposed in this Survey.

Photograph-6.2.4.1 Option a-1

Photograph-6.2.4.2 Option a-2

b) Mechanical dewatering

The following two types of equipment were compared for the mechanical dewatering.

(Option b-1) Volute

(Option b-2) Screw Press

Option b-1 has already been implemented in Cebu City, while Option b-2 has been implemented in Metro Manila.

Generally speaking, when the filtration unit of the dewatering machine becomes clogged, the discharge of filtrate is badly impeded and dewatering functions decline. However, in the case of the volute in Option b-1, since the filtration unit mechanically cleans itself as dewatering is performed, it is possible to conduct stable continuous dewatering without clogging. Therefore, this option is advantageous in terms of the following points. Good operating performance has also been confirmed in Cebu City.

- 24 hours fully automatic unmanned operation is possible.
- Excellent dewatering performance is possible.
- Energy and water savings can be made and noise and vibration levels are low.

Photograph-6.2.4.3 Option b-1

Photograph-6.2.4.4 Option b-2

Therefore, in the Survey, Option b-1, which enables easy maintenance and entails inexpensive lifecycle costs, is proposed.

The results of comparing lifecycle costs are shown below. In Option b-1, it is possible to greatly reduce electricity charges and water charges. Moreover, although not reflected in this comparative examination, because dewatering functions are also excellent and an additional effect can be anticipated in terms of reducing the volume of dewatered sludge and the filtrate treatment load, this will also contribute to reducing the overall cost.

Table-6.2.4.2 Comparison of Dewatering Machine Lifecycle Costs

	Volute	**Screw Press**
Initial Cost	**10,275,380**	**9,000,000**
Running Cost (Annual)		
Water Consumption	11,520	76,800
Electric Consumption	93,600	192,000
Polymer Consumption	288,000	288,000
Total Running Cost (annual)	393,120	556,800
Running Cost (15 years)	**5,896,800**	**8,352,000**
Total Cost	**16,172,180**	**17,352,000**

<Condition>
Capacity: 10m^3/h
Operation: 10h/d, 240d/y
Water Consumption 0.12m^3/h 0.80m^3/h
Electric Consumption 1.95kWh 4.00kWh

Polymer Consumption Water: 40PhP/m^3 Electric: 20PhP/kWh Polymer: 80PhP/kg	1.5kg/h	1.5kg/h

c) Filtrate treatment

In designing the filtrate treatment facilities, the water volume, influent quality, and effluent quality were assumed as follows. If however, the T-N value becomes more than 200 mg/L, there is a possibility that the value of the designed effluent quality of water will not be satisfied; therefore a separate examination will become necessary in that case.

Table-6.2.4.3 Design Conditions

Water volume	100m^3/day
Influent quality (BOD)	600mg/L
Effluent quality (BOD)	50mg/L

As the equipment for treating filtrate, the following two types were compared.

(Option c-1) Johkasou

(Option c-2) Extended aeration method

- Johkasou

The Johkasou is a treatment technology that has been uniquely developed in Japan. Johkasou tanks are installed for purifying and discharging raw sewage in households or small communities in areas not served by sewerage systems. The Johkasou is composed of three stages: septic tank, oxidation tank, and disinfecting tank, and it purifies sewage by means of sedimentation, biological oxidation, and disinfecting before discharging the treated effluent.

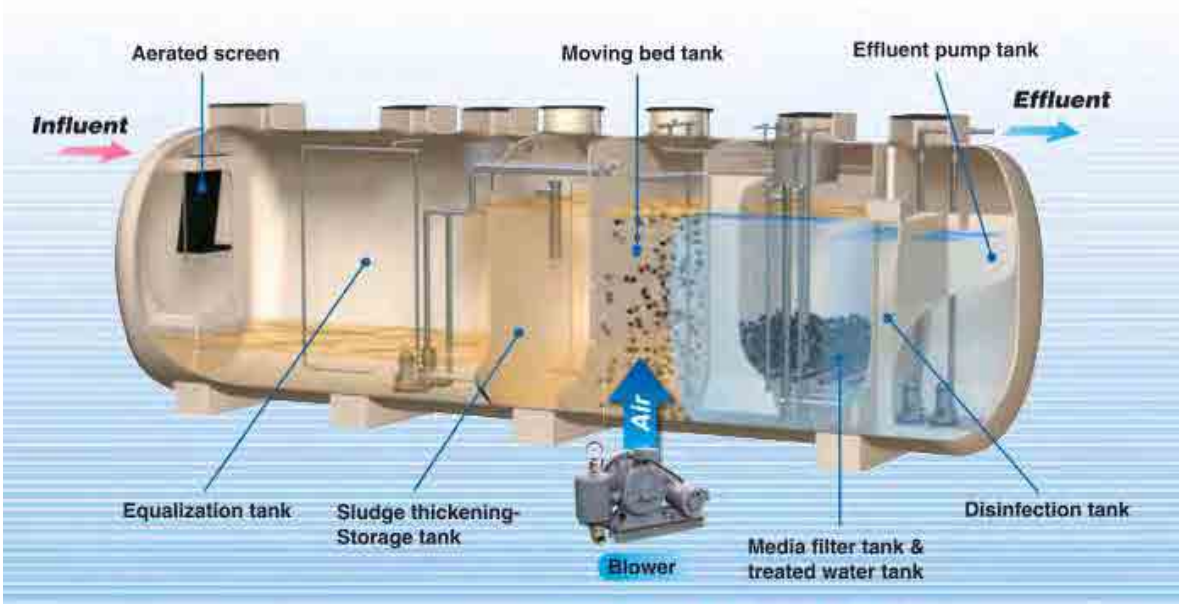

Figure-6.2.4.3 Cross Section of Johkasou

Specifications of the Johkasou in the case of the design conditions in Table-6.2.4.3 are as indicated below. The retention time is roughly 24 hours.

Table-6.2.4.4 Specifications of Johkasou

Unit specification	1st: 7,000mm * φ2,050mm * H2,350mm 2nd: 7,000mm * φ2,050mm * H2,350mm 3rd: 7,000mm * φ2,050mm * H2,350mm 4th: 4,500mm * φ2,050mm * H2,350mm 5th: 9,300mm * φ2,050mm * H2,350mm 6th: 9,300mm * φ2,050mm * H2,350mm
(Breakdown)	
Equalization tank	23,400mm
Sludge thickening-Storage tank	2,350mm
Moving bed tank	14,600mm
Media filter tank & treated water tank	3,000mm
Effluent pump tank and Disinfecting tank	1,000mm

- Extended Aeration

Extended aeration, which requires no initial sedimentation tank, is an integrated treatment method that entails conducting activated sludge treatment in a reaction tank with extended HRT, high MLSS concentration, low load conditions and long SRT, and then performing solids-liquid separation in the final sedimentation tank. Specifications of the reaction tanks and final sedimentation tank are as shown below. Incidentally, this treatment method is the same as that proposed in the existing F/S for Angeles City.

Table-6.2.4.5 Reaction Tank Particulars

HRT (h)	16-24
MLSS (mg/L)	3,000-4,000
Returned sludge ratio (%)	100-200
Oxygen requirement (kgO2/kgBOD)	1.4-2.2

Table-6.2.4.6 Final Sedimentation Tank Particulars

Sedimentation time (h)	6-12
Effective wet depth (m)	3-4
Water surface area load (m^3/m2/d)	8-12
Overflow load (m^3/m/d)	50 or less

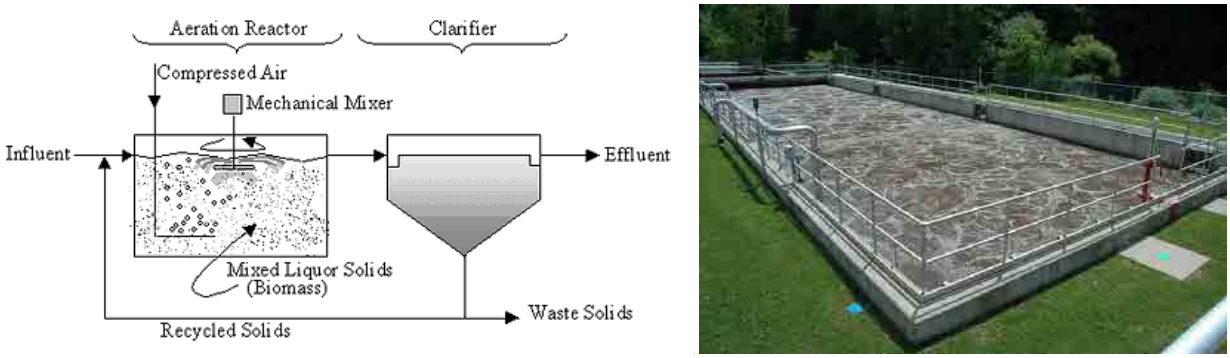

Figure-6.2.4.4 Extended Aeration Method

In terms of construction cost, Option c-1 is inexpensive; moreover, since this entails mechanized units, the construction works are relatively easy. Therefore, Option c-1 is proposed in this Survey.

For reference purposes, the following table shows a comparison of the Johkasou, extended aeration method, and the lagoon method that is adopted in the existing F/S.

Table-6.2.4.7 Comparison of Treatment Methods

Item	Johkasou	Extended Aeration Method	Lagoon Method
Construction Cost	△	△	○
Running Cost	△	△	○
Maintenance Cost	△	△	○
Effluent Quality	○	○	×
Required Area	○	○	×
Ease of Construction	○	△	△
Ease of Maintenance	○	△	△
Ease of expanding facilities	○	△	×
Overall Assessment	○	△	×

(4) Proposed Treatment Method and Equipment

In consideration of the above points, the proposed treatment method and equipment in this Survey are as shown in the following table.

Table-6.2.4.8 Treatment Method and Equipment

Preliminary	**Dewatering**	**Filtrate Treatment**
Screen	Volute	Johkasou

6.2.5 Collection Trucks

In the existing F/S, the collection area is divided into five zones and the septage quantities shown in underlined bold figures in the following table are collected each year. Since the number of trucks assumed in the existing F/S is enough to conduct transportation, the same figure is adopted here.

Moreover, vacuum trucks of varying capacity will be adopted, for example, 2.5 m^3 type trucks that can gain access to narrow streets, and 10 m^3 type trucks that can efficiently collect septage in large quantities. Moreover, trucks will be equipped with 30~50 meters of hose and water traps for addressing the issue of odor.

Table-6.2.5.1 Quantity of Septage Collection in Each Year

SCA	2016	2017	2018	2019	2020
1	**97.33**	100.04	102.74	105.45	108.15
2	92.17	**96.77**	101.36	105.95	110.54
3	79.62	82.58	**85.55**	88.51	91.48
4	58.34	63.49	68.63	**73.78**	78.92
5	52.10	54.66	57.22	59.78	**62.34**

Table-6.2.5.2 Number of Collection Trucks

10 m^3 vacuum trucks	3
5 m^3 vacuum trucks	3
2.5m^3 vacuum trucks	1
5 m^3 dump truck	1

6.2.6 Required Area for the Planned Construction Site

In the existing F/S, the required area for facilities is approximately 1,300 square meters, and the Water District is reported to be planning to purchase approximately 2,000 square meters.

Assuming the treatment method proposed in 6.2.4 here, the required area will be approximately 1,500 square meters. Moreover, considering the design quantity in 2030, since it will be desirable to secure an area of approximately 2,000 square meters to accommodate future expansion of the treatment facilities, the Water District's plan to purchase the said area is approrpiate.

Table-6.2.6.1 Required Area for Planned Construction Site

Pretreatment + mechanical dewatering	10 * 10 = 100 m^2
Johkasou	15 * 20 = 300 m^2
Building	10 * 15 = 150 m^2
Parking Area	30 * 30 = 900 m^2
Total	**2,000 m^2** (1,500 m^2)

6.2.7 Cost

(1) Construction Cost

Based on 6.2.4, Option 1 is proposed, but costs in Option 2 were also calculated here for comparison. In addition, construction cost of Johkasou is based on the condition that is buried underground.

Table-6.2.7.1 Construction Cost Estimation Cases

Option	Preliminary	Dewatering	Filtrate Treatment
1	Screen	Volute	Johkasou
2	Screen	Volute	Activated Sludge (Extended Aeration)

The results of exanmination are as indicated below.

Table-6.2.7.2 Construction Cost Calculation Results (PhP)

Item	Option 1	Option 2
Ⅰ. TREATMENT PLANT	49,285,906	51,327,519
Procurement of Lot	10,000,000	10,000,000
II. VACUUM TRUCKS	37,200,000	37,200,000
Total	**96,485,906**	**98,527,519**

(2) Operation and Maintenance Cost

The results of exanmination are as indicated below.

Table-6.2.7.3 Operation and Maintenance Cost (Annual) Calculation Results (PhP)

Item	Option 1	Option 2
Ⅰ. Treatment Operation	**4,382,916**	**5,065,476**
Personnel	1,680,000	1,680,000
Power Consumption	1,059,840	1,742,400
Water Consumption	10,560	10,560
Chemical Consumption	375,976	375,976
Water Testing and Monitoring	714,000	714,000
Consumable Spare Parts	542,540	542,540
Ⅱ. Desludging Operation	**5,367,900**	**5,367,900**
Personnel	3,360,000	3,360,000
Fuel Consumption	1,263,900	1,263,900
Consumable Spare Parts	744,000	744,000
Ⅲ. Sludging Disposal	**1,748,766**	**1,748,766**
Personnel	240,000	240,000
Fuel Consumption	48,840	48,840
Disposal fee	1,459,926	1,459,926
Ⅳ. Headquarters	**1,440,000**	**1,440,000**
Personnel	1,440,000	1,440,000
Total	**12,939,582**	**13,622,142**

7. Financial Plan

7.1 Calamba Water District

7.1.1 Examination Cases

(1) Examination Conditions

a) Construction cost and sources of revenue

The construction cost is as shown in Table 6.1.7.2. Since it wasn't certain whether the planned construction site can be lent for free by the city or needs to be purchased by the Water District, examination was conducted on both cases. As for the sources of revenue, basically it was assumed that the Water District will bear the cost, but consideration was also given to sharing of costs with subsidies from the national government and city authorities.

The cost to be borne by the Water District will be financed by loan and own capital, and the ratio of loan will be 80%, the same as in the existing F/S. Concerning the loan, the Philippines Water Revolving Fund (PWRF) will be utilized for the environment development project (EDP), which will be the ODA implemented by JICA, and this will be implemented via the Development Bank of the Phiippines (DBP).

b) Setting of septage tariffs

For the immediate future, because septage will be collected from public water supply customers, the tariff will be levied on top of the water tariff. Concerning the amount of the extra charge, since 2PhP per cubic meter of water usage is envisaged, this was basically assumed. Concerning the forecast amount of revenue water, as in the existing F/S, increase of 1% per year was assumed.

In the case where septage is collected from parties other than public water supply customers in future, it will be desirable to levy the same charge per collection as for water supply users.

Table-7.1.1.1 Basic Conditions

Loan Terms and Conditions	
Interest per annum	**9.00 %**
Repayment period (inclusive of grace)	15 years
Grace period	3 years
Weighted Average Cost of Capital (WACC)	**9.80 %**
Loan Share	80 %
Equity Share	20 %
Estimated desludging fee (per cu.m. of water consumed)	**PhP2.00**

(2) Examination Cases

Examination was conducted for the following cases.

Concerning the sharing of construction cost by the national government, city authorities, and Water District, based on Table-6.1.7.2, the total amount including land cost was used for Case 1, and the amount with the land cost deducted was used for Case 2.

Case 1: When the planned construction site is purchased by the Water District

1-a) Desludging Fee 2.0PhP/m3, NG : LGU : WD= 0 : 0 : 100

1-b) Desludging Fee 2.0PhP/m3, NG : LGU : WD= 40 : 0 : 60

1-c) Desludging Fee 1.5PhP/m3, NG : LGU : WD= 40 : 0 : 60

1-d) Desludging Fee 1.5PhP/m3, NG : LGU : WD= 40 : 30 : 30

1-e) Desludging Fee 1.0PhP/m3, NG : LGU : WD= 40 : 30 : 30

Case 2: When the planned construction site is lent by the city at no charge

2-a) Desludging Fee 2.0PhP/ m^3, NG : LGU : WD= 0 : 0 : 100

2-b) Desludging Fee 2.0PhP/ m^3, NG : LGU : WD= 40 : 0 : 60

2-c) Desludging Fee 1.5PhP/ m^3, NG : LGU : WD= 40 : 0 : 60

2-d) Desludging Fee 1.5PhP/ m^3, NG : LGU : WD= 40 : 30 : 30

2-e) Desludging Fee 1.0PhP/ m^3, NG : LGU : WD= 40 : 30 : 30

(3) Sensitivity Analysis

Analysis was conducted for the following scenarios.

Scenario 1: Cost (+10%)

Scenario 2: Revenues (-10%)

Scenario 3: Cost (+10%), Revenues (-10%)

Scenario 4: Cost (+20%)

Scenario 5: Revenues (-20%)

Scenario 6: Cost (+20%), Revenues (-20%)

Scenario 7: Cost (+30%)

Scenario 8: Revenues (-30%)

Scenario 9: Cost (+30%), Revenues (-30%)

7.1.2 Examination Results

The results of exmination are shown below.

In Case 1, 2PhP is appropriate, however, the business will stabilize if the national government provides a subsidy of 40%. In the case where 1.5PhP is set, it will be desirable to have subsidies from both the national government and city authorities.

Table-7.1.2.1 Examination Results (Case1)

	1-a	1-b	1-c	1-d	1-e
Demarcation (NG:LGU:WD)	0:0:100	40:0:60	40:0:60	40:30:30	40:30:30
WD Principal (in thousand pesos)	76,381	45,828	45,828	22,914	22,914
Loan	61,105	36,663	36,663	18,331	18,331
Equity	15,276	9,166	9,166	4,583	4,583
Desludging Fee (PhP/ m^3)	2.00	2.00	1.50	1.50	1.00
Net Present Value (in thousand pesos)	**36,952**	**64,777**	**20,551**	**41,420**	**-2,806**
Financial Internal Rate of Return	**18.0%**	**31.7%**	**17.4%**	**37.0%**	**7.6%**
Sensitivity Tests					
Net Present Value (NPV)					
Cost (+10%)	22,957	53,564	9,338	32,294	**-11,932**
Revenues (-10%)	19,261	47,087	7,283	28,152	**-11,652**
Cost (+10%), Revenues (-10%)	**-8,909**	27,264	**-12,540**	14,590	**-25,214**
Cost (+20%)	8,961	42,352	**-1,875**	23,168	**-21,058**
Revenues (-20%)	1,571	29,396	**-5,985**	14,884	**-20,497**
Cost (+20%), Revenues (-20%)	**-26,420**	6,971	**-28,411**	**-3,368**	**-38,749**
Cost (+30%)	**-5,034**	31,139	**-13,088**	14,042	**-30,184**
Revenues (-30%)	**-16,120**	11,706	**-19,253**	1,616	**-29,342**
Cost (+30%), Revenues (-30%)	**-58,106**	**-21,933**	**-52,891**	**-25,762**	**-56,720**
Financial Internal Rate of Return					
Cost (+10%)	14.6%	26.7%	13.0%	29.7%	**0.7%**
Revenues (-10%)	14.2%	26.2%	12.6%	28.9%	**-0.1%**
Cost (+10%), Revenues (-10%)	**8.1%**	17.5%	**5.8%**	17.9%	**-9.0%**
Cost (+20%)	11.6%	22.3%	**9.2%**	23.3%	**-6.3%**
Revenues (-20%)	10.2%	20.4%	**7.4%**	20.4%	**-10.0%**
Cost (+20%), Revenues (-20%)	**4.1%**	12.0%	**-1.0%**	**7.6%**	—
Cost (+30%)	**8.9%**	18.5%	**5.6%**	17.6%	**-14.0%**
Revenues (-30%)	**5.7%**	14.2%	**1.4%**	11.0%	—
Cost (+30%), Revenues (-30%)	**-3.2%**	**2.5%**	**-13.1%**	**-9.1%**	—

In Case 2, 2PhP is appropriate. Moreover, in the case where 1.5PhP is set, it will be desirable to have subsidies from both the national government and city authorities.

Table-7.1.2.2 Examination Results (Case2)

	2-a	2-b	2-c	2-d	2-e
Demarcation (NG:LGU:WD)	0:0:100	40:0:60	40:0:60	40:30:30	40:30:30
WD Principal (in thousand pesos)	61,381	36,828	36,828	18,414	18,414
Loan	49,105	29,463	29,463	14,731	14,731
Equity	12,276	7,366	7,366	3,683	3,683
Desludging Fee (PhP/ m^3)	2.00	2.00	1.50	1.50	1.00
Net Present Value (in thousand pesos)	**50,617**	**72,978**	**28,751**	**45,521**	**1,294**
Financial Internal Rate of Return	**23.2%**	**39.6%**	**22.5%**	**45.9%**	**11.0%**
Sensitivity Tests					
Net Present Value (NPV)					
Cost (+10%)	37,988	62,585	18,358	36,805	**-7,422**
Revenues (-10%)	32,926	55,287	15,483	32,253	**-7,551**
Cost (+10%), Revenues (-10%)	8,854	37,924	**-1,881**	19,921	**-19,884**
Cost (+20%)	25,359	52,192	7,964	28,089	**-16,138**
Revenues (-20%)	15,235	37,596	2,214	18,985	**-16,397**
Cost (+20%), Revenues (-20%)	**-10,023**	16,810	**-18,572**	1,553	**-33,829**
Cost (+30%)	12,730	41,799	**-2,429**	19,373	**-24,854**
Revenues (-30%)	**-2,456**	19,905	**-11,054**	5,717	**-25,242**
Cost (+30%), Revenues (-30%)	**-40,343**	**-11,274**	**-42,233**	**-20,431**	**-51,391**
Financial Internal Rate of Return					
Cost (+10%)	19.2%	33.5%	17.4%	37.1%	**3.1%**
Revenues (-10%)	18.8%	32.9%	16.9%	36.2%	**2.2%**
Cost (+10%), Revenues (-10%)	11.8%	22.6%	**9.1%**	23.0%	**-7.7%**
Cost (+20%)	15.7%	28.3%	12.9%	29.4%	**-4.8%**
Revenues (-20%)	14.1%	26.0%	10.9%	26.0%	**-8.9%**
Cost (+20%), Revenues (-20%)	**7.3%**	16.2%	**1.5%**	11.0%	**-**
Cost (+30%)	12.6%	23.8%	**8.9%**	22.7%	**-13.1%**
Revenues (-30%)	**9.1%**	18.8%	**4.0%**	15.0%	**-**
Cost (+30%), Revenues (-30%)	**-0.9%**	**5.4%**	**-11.8%**	**-7.9%**	**-**

7.2 Angeles Water District

7.2.1 Examination Cases

(1) Examination Conditions

a) Construction cost and sources of revenue

The construction cost is as shown in Table-6.2.7.2. Concerning the sources of revenue, basically it was assumed that the Water District will bear the cost, but consideration was also given to sharing of costs with subsidies from the national government and city authorities.

The cost to be borne by the Water District will be financed by loan and own capital, and the ratio of loan will be 84%, the same as in the existing F/S. Concerning the loan, the Philippines Water Revolving Fund (PWRF) will be utilized for the environmental development project (EDP), which will be the ODA implemented by JICA, and this will be implemented via the Development Bank of the Phiippines (DBP).

b) Setting of desludging fees

For the immediate future, because septage will be collected from public water supply customers, the fee will be levied on top of the water tariff. Concerning the amount of the extra charge, since 2PhP per cubic meter of water usage is envisaged, this was basically assumed. Concerning the forecast amount of revenue water, as in the existing F/S, increase of 2.5% per year was assumed over the first 10 years, after which it will be pegged.

In the case where septage is collected from parties other than public water supply customers in future, it will be desirable to levy the same charge per collection as for water supply users.

Table-7.2.1.1 Basic Conditions

Loan Terms and Conditions	
Interest per annum	**9.00 %**
Repayment period (inclusive of grace)	15 years
Grace period	3 years
Weighted Average Cost of Capital (WACC)	**9.96 %**
Loan Share	84 %
Equity Share	16 %
Estimated desludging fee (per cu.m. of water consumed)	**PhP2.00**

(2) Examination Cases

Examination was conducted for the following cases.

Concerning the sharing of construction cost by the national government, city authorities, and Water District, the total amount shown in Table-6.2.7.2 was used.

a) Desludging Fee 2.0PhP/m^3, NG : LGU : WD= 0 : 0 : 100
b) Desludging Fee 2.0PhP/m^3, NG : LGU : WD= 40 : 0 : 60
c) Desludging Fee 1.5PhP/ m^3, NG : LGU : WD= 40 : 0 : 60
d) Desludging Fee 1.5PhP/ m^3, NG : LGU : WD= 40 : 30 : 30
e) Desludging Fee 1.0PhP/ m^3, NG : LGU : WD= 40 : 30 : 30

(3) Sensitivity Analysis

Analysis was conducted for the following scenarios.

Scenario 1: Cost (+10%)
Scenario 2: Revenues (-10%)
Scenario 3: Cost (+10%), Revenues (-10%)
Scenario 4: Cost (+20%)
Scenario 5: Revenues (-20%)
Scenario 6: Cost (+20%), Revenues (-20%)
Scenario 7: Cost (+30%)
Scenario 8: Revenues (-30%)
Scenario 9: Cost (+30%), Revenues (-30%)

7.2.2 Examination Results

The results of exmination are shown below.

2PhP is appropriate, however, the business will stabilize if the national government provides a subsidy of 40%. In the case where 1.5PhP is set, it will be desirable to have subsidies from both the national government and city authorities.

Table-7.2.2.1 Examination Results

	a	b	c	d	e
Demarcation (NG:LGU:WD)	0:0:100	40:0:60	40:0:60	40:30:30	40:30:30
WD Principal (in thousand pesos)	96,486	57,892	57,892	28,946	28,946
Loan	81,048	48,629	48,629	24,314	24,314
Equity	15,438	9,263	9,263	4,631	4,631
Desludging Fee (PhP/ m^3)	2.00	2.00	1.50	1.50	1.00
Net Present Value (in thousand pesos)	**22,128**	**57,227**	**3,046**	**29,370**	**-24,810**
Financial Internal Rate of Return	**13.9%**	**25.3%**	**10.9%**	**25.6%**	**-6.6%**
Sensitivity Tests					
Net Present Value (NPV)					
Cost (+10%)	2,669	41,277	**-12,903**	16,053	**-38,127**
Revenues (-10%)	456	35,555	**-13,208**	13,116	**-35,646**
Cost (+10%), Revenues (-10%)	**-36,814**	8,814	**-39,949**	**-5,728**	**-54,490**
Cost (+20%)	**-16,790**	25,328	**-28,853**	2,736	**-51,444**
Revenues (-20%)	**-21,216**	13,883	**-29,462**	**-3,138**	**-46,482**
Cost (+20%), Revenues (-20%)	**-60,135**	**-18,016**	**-61,361**	**-29,772**	**-73,117**
Cost (+30%)	**-36,250**	9,378	**-44,802**	**-10,581**	**-64,761**
Revenues (-30%)	**-42,888**	**-7,790**	**-45,716**	**-19,392**	**-57,318**
Cost (+30%), Revenues (-30%)	**-101,266**	**-55,638**	**-93,565**	**-59,343**	**-97,270**
Financial Internal Rate of Return					
Cost (+10%)	10.4%	20.4%	**6.3%**	18.0%	**-15.4%**
Revenues (-10%)	10.0%	19.9%	**5.8%**	17.2%	**-16.4%**
Cost (+10%), Revenues (-10%)	**4.3%**	12.0%	**-0.7%**	**7.3%**	—
Cost (+20%)	**7.3%**	16.0%	**2.0%**	11.3%	—
Revenues (-20%)	**5.8%**	14.0%	**-0.1%**	**8.1%**	—
Cost (+20%), Revenues (-20%)	**-0.8%**	**5.2%**	**-10.5%**	**-6.6%**	—
Cost (+30%)	**4.4%**	12.1%	**-2.1%**	**5.1%**	—
Revenues (-30%)	**1.0%**	**7.5%**	**-7.4%**	**-2.5%**	—
Cost (+30%), Revenues (-30%)	**-9.6%**	**-5.9%**	—	—	—

8. Environmental and Social Considerations

Since the sewage and wastewater treatment sector is often regarded as having exerting important environmental and social impacts, it is necessary to advance projects upon paying ample attention to environmental and social considerations such as impacts on air, water, and soil, impacts on natural items such as ecosystems and biota, and social impacts such as involuntary resettlement and so on.

The septage treatment facilities planned here are relatively small in scale and will not exert as large an impact as sewage treatment facilities, however, it will still be necessary to pay attention to the following points in particular.

(1) Large-scale Land Reclamation and Clearing

Especially in Calamba Water District, since the currently planned construction site will require large-scale reclamation and clearing over an area of 1 hectare or more, it will be necessary to consider the impacts on biota and the ecosystem in the case where this is actually implemented. This is another reason for examining the acquisition of an alternative site as proposed in 6.1.1.

(2) Odor Countermeasures

Since the quantities of septage are relatively small and the currently planned construction sites are not situated close to residences, there should be no major problems providing odor countermeasures that is addressed through considering the layout of facilities and firmly sealing the septage receiving and storage tanks.

(3) Involuntary Resettlement of Residents

The construction plan that is currently intended by Calamba Water District assumes the resettlement of residents and payment of 4.8 million PhP in monetary compensation. In the case where residents are actually relocated, CWD plans to first obtain consent from the targeted residents.

In Angeles City Water District, there are currently no plans for resettlement of residents, however, concerning acquisition of land for the planned construction site, ACWD plans to negotiate with the landowners while receiving cooperation from the city authorities. According to ACWD, this will not entail any major problems.

Moreover, when starting the septage management utility in both water districts, it will be necessary to obtain Environmental Sanitation Clearance (ESC) from the Center for Health Development Office (CHD), so it will first be necessary to make applications to the respective city authorities. The required documents for ESC application are stated in the “Operations Manual on the Rules and Regulations Governing Domestic Sludge and Septage” (Department of Health, June 2008).

9. Future Measures

The items that need to be addressed from now on in promoting septage management are described in the following sections.

(1) Establishment of a Specialist Department

In order to examine the items described below in (2)-(9), the most important thing is first to establish a dedicated department in charge of septage management. For the immediate future, it will be necessary to assign a manager and staff members in charge of planning, design, and maintenance, in the headquarters. After the treatment facilities have been constructed, it will be necessary to recruit additional staff to work on the collection and transportation of septage and operation and maintenance of treatment facilities. For example, it will be necessary to establish the Septage Management Division with the following staff members under the Engineering Department.

Table-9.1 Main Work Contents of the Septage Management Division

Work	Main Work Contents	Necessary Staff
Septage collection and management	Manage the septage collection trucks. Keep records in a ledger. Conduct outsourcing management.	1 member + a few support staff
Operation of septage treatment facilities, and sludge disposal	Operate the treatment facility screens, dewatering equipment, Johkasou, etc. Record and report effluent quality. Also, manage the disposal of sludge. Also, coordinate with the city authorities.	2-3 members + a few support staff
Septage planning, design, and procurement	Keep the septage ledger organized. Update septage plans and coordinate with the city authorities. Conduct basic design for expansion plans.	1 member (can also be shared with other divisions)

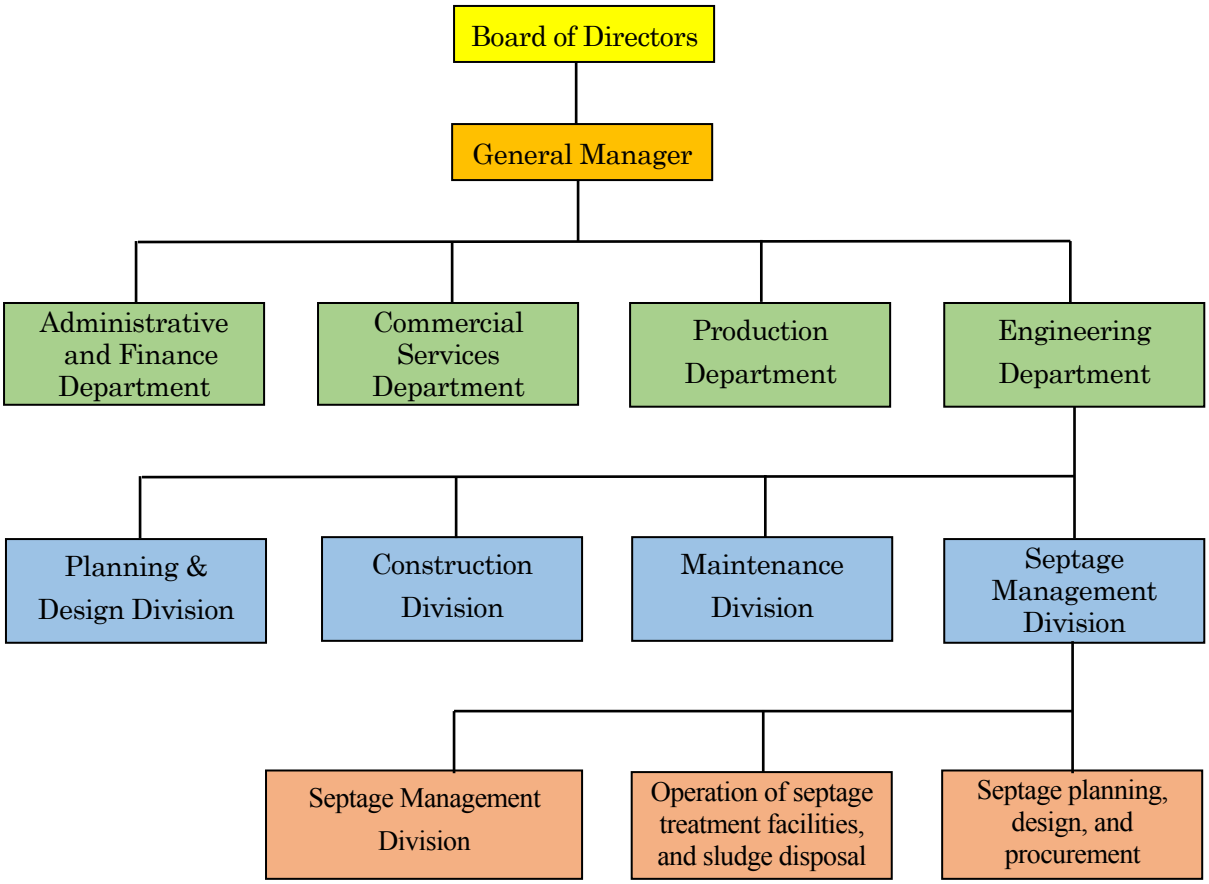

Figure-9.1 Establishment of the Septage Management Division

(2) Compilation of the Project Schedule

It will be important to compile a general project schedule that includes the securing of construction sites, design and construction of treatment facilities, raising of tariffs, and making of EDP applications.

(3) Implementation Design

It will be necessary to implement the detailed design, execution planning, and cost estimation for treatment facilities. Moreover, since the cost of vacuum trucks occupies a relatively large weight, it will be necessary to scrutinize the collection areas each year. Also, since it is important to closely manage the septage removal situation, it will be necessary to examine the method of management, for example, through grasping the areas collected based on ledgers and so on.

(4) Securing of Planned Construction Sites

Since it will take time to secure the planned construction sites, it will be necessary to cooperate with the city authorities in promptly giving explanations to the landowners and local residents. Particularly, in Calamba

Water District, the request to find an alternative site should be made to the city immediately, and if this is difficult it will be necessary to consider the option of having the Water District purchase land.

In securing the land, it will be important to secure sufficient area while taking future expansion plans into account. Moreover, because the location of planned construction sites will impact the number of vacuum trucks and distances travelled, it will be important to take these factors into account when selecting the sites.

(5) Increase of Water Tariffs and application for Subsidies from the Central Government

In order to advance the project, it will be essential to secure funding and thus to increase water tariffs. Accordingly, it will be necessary to promptly implement the procedure geared to doing this. It is planned to initially collect septage from public water supply customers, however, in the case where septage is collected from non-customers in the future, it will be desirable to set and levy the same tariff per collection as charged to public water supply customers. It will thus be necessary to conduct examination for this purpose.

For reference, the important points to remember and procedures for increasing water tariffs as stated in the LWUA Manual on Water Rates & Related Practices are indicated below.

(Reference) Important Points to Remember and Procedures for Increasing Water Tariffs

The water tariff needs to be set at an amount that covers the operating cost and other costs including all maintenance costs of the public water supply service while also taking the rate of inflation into account, and it needs to be set at an appropriate and rational level that reflects public services. The water tariff covers all users from large-scale consumers to low-income citizens, and it is necessary to set tariffs that are fair in consideration of low-income users (in the case of water connecctions with minimum diameter size of 13 mm and basic water usage of 10 m^3/month, the tariff must not exceed 5% of the average income of low-income groups in the water supply area). When increasing the water tariff, the markup must not exceed 60% of the current tariff; moreover, it is necessary to make sure that the markup doesn't exceed the users' ability to pay.

The water tariff is divided into 1) the basic tariff for covering the fixed costs necessary for improving water supply facilities (capital) and repaying loans, etc., and 2) the unit use charge corresponding to the amount used, which covers operation and maintenance costs. For large-scale users that receive water supply through large-diameter pipes, the basic tariff is set according to the amount of usage to ensure a fair cost burden.

The method for calculating water tariffs in each water district are established in the manual, thereby allowing water tariffs and new connection fees, etc. to be calculated according to the scale of water supply in each district.

When proposing tariff increases, it is deemed essential for the Water District to stage public hearings in

order to confirm appropriateness. In the public hearings, which are divided into three, preliminary hearings, main hearings, and follow-up hearings, the utility operation at the current water tariff is explained, the new water tariff (new utility operation) is proposed, and the reasons for increasing the tariff are explained.

Water tariff revisions by the Water District undergo review and approval by the LWUA based on a written resolution concerning adoption of the new water tariff by the Water District Board of Directors (BOD), minutes of the public hearings, cash-flow forecast, water usage pattern analysis, and Water District profile (designated format) that are submitted by the Water District.

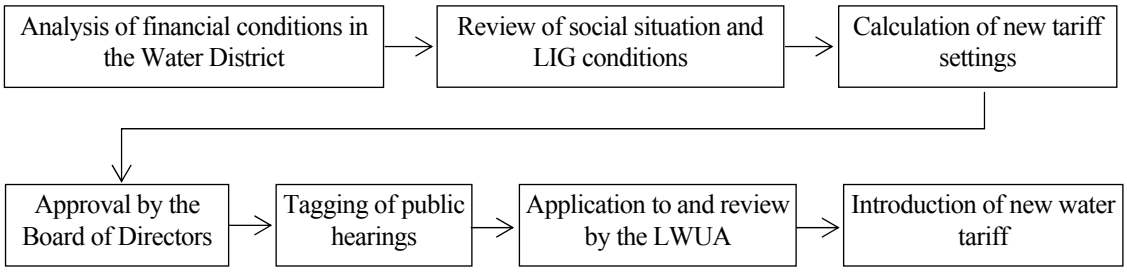

Figure-9.2 Water Tariff Revision Flow

Moroever, following revision of the NSSMP, since it appears that the central government will grant a 40% subsidy to the septage utility in addition to the sewerage utility, it will be desirable to apply for this subsidy.

(6) EDP Application

It is envisaged that the EDP will be utilized via the DBP in the project. Since it is expected that a lot of time will be needed to prepare the application, it will be necessary to start work on this immediately.

(7) Examination of Sludge Disposal

It will be necessary to examine the disposal of sludge generated in the treatment facilities with a view to putting it to effective use.

In putting sludge to effective use, it will be necessary to survey needs of the destinations of effective use.

Standards about how to make effective use of sludge (compost, fertilizer, etc.) are stated in 5.5 of the "Operations Manual on the Rules and Regulations Governing Domestic Sludge and Septage," and it is necessary to satisfy these.

Table-9.2 Specifications for Fertilizers and Compost/Soil Conditioner

	Plain Organic Fertilizer	Compost/Soil Conditioner	Fortified Organic Fertilizer
Total NPK	5-7%	3-4%	8% minimum
C:N	12:1	12:1	12:1
Moisture Content	≤ 35%	≤ 35%	≤ 35%
Organic Matter	≥ 20%	≥ 20%	≥ 20%

NPK - nitrogen, phosphorous, potassium; C:N – carbon nitrogen ratio

Table-9.3 Test for Pathogens for Organic Fertilizer/Soil Conditioner

Fecal streptococci	$<5 \times 10^3$/g compost
Total coliforms	$<5 \times 10^2$/g compost
Salmonella	0
Infective parasitic	0

Table-9.4 Allowable Levels of Heavy Metals in Organic Fertilizer/Compost Soil Conditioner

Heavy Metals	mg/kg dry weight
Zn	1000
Pb	750
Cu	300
Cr	150
Ni	50
Hg	5
Cd	5

Since the sludge will have to be landfilled if it cannot be effectively used, it will be necessary to secure a landfill site. Moreover, since it costs money to transport sludge, it will also be necessary to consider the location of the landfill site.

(8) Examination of Outsourcing

Particularly in Angeles City, since private sector enterprises already collect septage, it will be desirable to examine the feasibility of outsourcing collection to them if this is likely to be less costly.

Moreover, it will also be desirable to examine the feasibility of outsourcing for sludge disposal in cases where effective utilization is possible.

(9) Implementation of Monitoring

In the Philippines, septage management is only implemented in such places as Metro Manila and Cebu, and experience is still limited. As a result, septage treatment methods have not yet been established, and it will be necessary to find the optimum treatment method based on actual performance.

For this purpose, it will be necessary to closely monitor the treatment situation at the treatment facilities that are constructed from now on. In particular, it will be important to periodically monitor the influent quality of septage, the quality of dewatered filtrate, the quality of effluent, and the water content of dewatered sludge.

It will also be important to monitor the quantity of septage that is removed from septic tanks and reflect this in the plans. Currently septage is removed once every five years, but it will also be important to set the proper septage removal frequency upon monitoring the conditions of septage discharge from septic tanks.

According to a survey implemented by Calamba city authorities, the access rate to septic tanks is low, and there are many septic tanks that do not meet structural standards for having septage outlets or the ability to remove septage. In order to improve environmental hygiene, it will be necessary to certainly remove septage, and for this reason it will be important to improve access to septic tanks. In Calamba City, based on Ordinance Article 5, it will be important to conduct medium- to long-term guidance on installing septic tanks that satisfy design standards.

10. Annexes

Septage Management Program in 2015 for Calamba Water District

Septage Management Program in 2015 for Angeles City Water District