Appendix 1

Investigation Results of Each Facility in Vietnam and Indonesia

1. Investigation results of each facility in Vietnam and Indonesia

1.1 Investigation sheets of each facility

1.1.1 Investigation sheet for Water treatment plants

Investigation sheet of WTP

■WTP

・A summury of the facility

Items	Specification				
Name of the Facility					
When was the facility opened to the public?	year :		month :		
Method of purification	Sedimentation ☐	Rapid filtration ☐	Slow filtration ☐	Disinfection ☐	the others ☐
The population planed	persons				
Capacity of Facility	m3/day				
The present quantity of service	m3/day				
Amount of Electricity in use	kWh/day				

・The source of water supply

The source？	Ground water ☐	Lake ☐	Underground water ☐	the others ☐

The water quality？	Good ☐	Bad ☐

Any dranaging system？（any Drying bed or dewatering machine）	Yes ☐	No ☐

Indicate the flow of the treatment？（Flow Diagram）

・The organization of the Operation & Maintenance

The organization ?

Classification	Number of persons
Manager	persons
Operation	persons
Maintenance	persons
Analyses of water quality	persons
Office workers	persons
the others	persons

Night works system for O&M ?

Items	Contents			
Working time	From	To		
Number	persons			
Group	Groups			
Contens of works	Operating ☐	Maintenance ☐	Analyses ☐	the others ☐

・Any special actions for troubls or accidents ?	Yes ☐	No ☐

・Operation

Controlling the quanty of service by estimating the demand？	Yes ☐	No ☐

Changing the operating methods in time of law or high turbidity？	Yes ☐	No ☐

Any special actions when the accidents of the source or plant？	Yes ☐	No ☐

The power failures？	Yes ☐	No ☐

Frequency of power faiure？

Frequency	Check
everyday	☐
within 100 times per 1year	☐
within 50 times per 1year	☐
within 10 times per 1year	☐
None	☐

Generator for emergency?	Yes	No
	☐	☐

How to deal with in time of the power failures？	Stop	Continuation

・Analysis of water quality

Is there the standard of water quality by laws ？	Yes	No
	☐	☐

Keeping the standard of water quality？	Yes	No
	☐	☐

Any item to exceed the standard of water quality？	Yes	No
	☐	☐

Items and Frequency of analysis

Items		Check	Frequency			
			everyday	1time/week	1time/month	the others
raw water	Turbidity	☐	☐	☐	☐	☐
	Color	☐	☐	☐	☐	☐
	ｐH	☐	☐	☐	☐	☐
	the others	☐	☐	☐	☐	☐
		☐	☐	☐	☐	☐
pure water	Turbidity	☐	☐	☐	☐	☐
	Color	☐	☐	☐	☐	☐
	Residual Chl.	☐	☐	☐	☐	☐
	ｐH	☐	☐	☐	☐	☐
	the others	☐	☐	☐	☐	☐
water faucet	Turbidity	☐	☐	☐	☐	☐
	Color	☐	☐	☐	☐	☐
	Residual Chl.	☐	☐	☐	☐	☐
	ｐH	☐	☐	☐	☐	☐
	the others	☐	☐	☐	☐	☐

Analyzers for water quality？	Specialist	General workers	the others
	☐	☐	☐

Any calibration and maintenance for water quality measuring instrument ？	Yes	No
	☐	☐

Enough expendables and parts for maintenance ?	Yes	No
	☐	☐

・Maintenance

Any plan ?	Yes	No
	☐	☐

Frequency of maintenance for machinary?

Frequency	Check	Contents of maintenance
everyday	☐	
1 / week	☐	
1 / month	☐	
1 / year	☐	
the others	☐	

Frequency of maintenance for Electric parts?

Frequency	Check	Contents of maintenance
everyday	☐	
1 / week	☐	
1 / month	☐	
1 / year	☐	
the others	☐	

Exchaning parts for instrument?	Yes	No
	☐	☐

Enough expendables and parts for maintenance?	Yes	No
	☐	☐

Term of delivery ?

Delivery	Check	Delivery	Check
about 1 week	☐	about 3 months	☐
2～3 weeks	☐	the others	☐
about 1month	☐		

Repairing of equipments in case of troubles?	Own	Outside
	☐	☐

・Operation of drainage system

Method of drainage system ?	Drying bed	Machine	Discharge to liver
	☐	☐	☐

Disposal of dewatering sludge？	Landfill	Reuse	the others
	☐	☐	☐

If reuse dewatering sludge？	Compositing	Materials	the others
	☐	☐	☐

・Maintenance of pipes for water supply

Do maintain pipes？	Yes	No
	☐	☐

・Traning

Any traning for operator, maintenance workers and water quality analyzers？	Yes	No

If yes, the contents of the traning ？

Contents	Check
Water purification	
Equipments	
Analyzing watwr quality	
Operating	
the others	

・Issues

If any issues for improvements of the assets and O&M of facility.

1.1.2 Investigation sheet for Wastewater treatment plants

Investigation sheet of WWTP

■WWTP

・A summury of the facility

Items		Specification
Name of the Facility		
When was the facility opened to the public?		year : month :
Method of treatment		Separate Combined the others
The population planed		persons
Capacity of Facility		㎥/day
The present quantity of Influent		㎥/day
Amount of Electricity in use		kWh/day
BOD Conc. of Influent	Planed	mg/L
	Present	mg/L
SS Conc. of Influent	Planed	mg/L
	Present	mg/L
BOD Conc. of Discharge	Planed	mg/L
	Present	mg/L
SS Conc. of Discharge	Planed	mg/L
	Present	mg/L
The point of discharge		River Sea Lake Gulf

・Composition of the facility

Check to select the method of treatment.

Treatment methods	Check
Standard Activated Sludge	
Oxidation Ditch	
Trickling Filter	
Aerated Lagoon	
Lagoon	
the others	

Indicate the flow of the treatment？（Flow Diagram）

Check to select the method of sludge treatment.

Treatment methods	Check
Concentration of sludge	
Digestion	
Dewatering	
Drying Bed	
the others	

・The organization of the Operation & Maintenance

Classification	Number of persons
Manager	persons
Operation	persons
Maintenance	persons
Analyses of water quality	persons
Office workers	persons
the others	persons

・Night works system for Operation & Maintenance

Items	Contents
Working time	From : To :
Number	persons
Groups	Groups
Contens of works	Operating Maintenance Analysis the others

・Any special actions for troubls or accidents	Yes	No

・Operation

Any plan?	Yes	No

Any items to pay attention?	Yes	No

Is there to change of operation methods on rainy days?	Yes	No

Applying the numerical value of measuring instruments?	Yes	No

Any chemical for wastwater treatment？	Yes	No

If yes, how much and what kind ?

The kind of chemicals	Amount of use
Sodium hypochlorite(NaOCl)	L/day
Flocculants	L/day
the others（ ）	L/day
the others（ ）	L/day

Any chemical to use for sludge treatment?	Yes	No

If use any chemical, how much and what kind ？

The kind of chemicals	Amount of use
Sodium hypochlorite(NaOCl)	L/day
Flocculants	L/day

If do use any chemical, manufactured in ？	Domestic	Foreign

If purchase chemicals, term of delivery？

Delivery	Check
1day～3days	
within 1 week	
within 2～3 weeks	
within 1 month	
the others	

Are there power failures？	Yes	No

Frequency of power faiure？

Frequency	Check
everyday	
within 100 times per 1year	
within 50 times per 1year	
within 10 times per 1year	
None	

Is there generator for emergency?	Yes	No

How to deal with in time of the power failures？	Stop	Continuation

Any troble on operation？ If yes, check below.	Yes	No

Calssification	Check
Bulking	
Scum occuring	
the others	

Disposal of dewatering sludge？	Landfill	Reuse	the others

If reuse dewatering sludge？	Compositing	Materials	the others

・Analysis of water quality

Is there the standard of water quality by laws ？	Yes	No

Keeping the standard of water quality？	Yes	No

Any item to exceed the standard of water quality？	Yes	No

Items and Frequency of analysis

Items		Check	Frequency			
			everyday	1time/week	1time/month	the others
Influent	ＳＳ					
	ＢＯＤ					
	ＣＯＤ					
	T-N					
	T-P					
Discharge	ＳＳ					
	ＢＯＤ					
	ＣＯＤ					
	T-N					
	T-P					
	Visual Depth					
the others						

Analyzers for water quality？			
	Specialist	General workers	the others

Any calibration and maintenance for water quality measuring instrument ?	Yes	No

Enough expendables and parts for maintenance ？	Yes	No

・Maintenance

Any plan ？	Yes	No

Frequency of maintenance for machinary？

Frequency	Check	Contents of maintenance
everyday		
1 / week		
1 / month		
1 / year		
the others		

Frequency of maintenance for Electric parts？

Frequency	Check	Contents of maintenance
everyday		
1 / week		
1 / month		
1 / year		
the others		

Exchaning parts for instrument？	Yes	No

Enough expendables and parts for maintenance？	Yes	No

Term of delivery ？

Delivery	Check	Delivery	Check
about a week		about 3 months	
2～3 weeks		the others	
about 1month			

Repairing of equipments in case of troubles？	Own	Outside

・Traning

Any traning for operator, maintenance workers and water quality analyzers？	Yes	No

If yes, the contents of the traning ？

Contents	Check
Wastewater treatment	
Equipments	
Analyzing watwr quality	
Operating	
the others	

・Maintence of drains and pipes

Maintain drains and pipes？	Yes	No

・Issues

If any issues for improvements of the assets and O&M of facility.

1.2 Investigation results of each facility in Indonesia

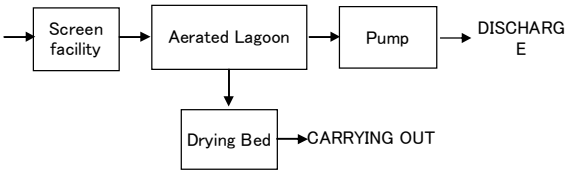
1.2.1 Setiabuti WWTP

Ⅰ. A summary of plant

Ⅰ－1 A summary

Items	Specification
Name of the Facility	Setiabuti Ponds
When was the facility opened to the public?	year : 1991
Method of sewerage drainage	Separate
The population planed（persons）	―
Capacity of Facility（m^3/day）	42,768.4
The present quantity of Influent（m^3/day）	20,753（Calculated from the water using）
Amount of Electricity in use（kWh/day）	23(694kWh/month)
BOD Conc. of Influent（mg/L）	West Pond(Planed:400、Present:81)、East Pond(Planed:400、Present:77)
SS Conc. of Influent（mg/L）	West Pond(Planed: 、Present:69)、East Pond(Planed: 、Present:71)
BOD Conc. of Discharge（mg/L）	West Pond(Planed:75、Present:53)、East Pond(Planed:75、Present:53)
SS Conc. of Discharge（mg/L）	West Pond(Planed: 、Present:48)、East Pond(Planed: 、Present:51)
The point of discharge	River(BOD Conc. of Discharge:It changed to 50mg/L with the water quality standard revision in 2005.)

Ⅰ－2 Composition of the facility

Items	Specification
The method of treatment	Aerated Lagoon
The method of sludge treatment	Drying Bed（Sludge is carried out every 2～3years.）
Flow Diagram	

Ⅱ. Organization for O&M and Duty system

Items	Contents
Organization for O&M	Manager:1 person, Operator:4 persons(includes the workers for maintenance) Analysis of water quality:1 person, Office worker:1 person, Others（Security） The floating garbage cleaning is an outside order(6 persons/day).
Night time	From 24 AM to 6 AM
Night duty system	1 group with 2 persons
Contens of works	Operating
Others（Any special actions for troubls or accidents）	No

Ⅲ. Operation & Maintenance

Ⅲ－1 The basics

Items	Contents
Any plan for operation?	Yes
Any items to pay attention?	No
Is there to change of operation methods on rainy days?	No
Applying the numerical value of measuring instruments?	Yes(DO is measured(East Pond))
Any chemical for wastwater treatment？	No
Any chemical for sludge treatment?	No
Are there power failures？ Frequency of power faiure？	No
Is there generator for emergency?	No
How to deal with in time of the power failures？	Continuation(aeration stops)
Any troble on operation？	Yes(Bubble)
Disposal of dewatering sludge？ If reuse dewatering sludge？	Landfill

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ?	Yes
Keeping the standard of water quality?	Yes
Any item to exceed the standard of water quality?	Yes
Items and Frequency of analysis	Influent（Items：SS・BOD・COD、Frequency：1time/week）
	Discharge（Items：SS・BOD・COD、Frequency：1time/week）
	the others（Items：$kMnO_4$ consumtion, pH, Oil, NH_4 and Detergent of Influent & Discharge）
Analyzers for water quality are specialist?	Yes
Any calibration and maintenance for water quality measuring instrument ?	Yes
Enough expendables and parts for maintenance ?	Yes

Ⅲ－3 Maintenance

Items	Contents
Any plan for maintenance?	Yes
Frequency of maintenance for machinary?	1time/year
Contents of maintenance for machinary?	—
Frequency of maintenance for Electric parts?	1time/year
Contents of maintenance for Electric parts?	—
Maintenance for instrument?	No
Enough expendables and parts for maintenance?	Yes
Term of delivery(expendables and parts) ?	2～3 weeks
Repairing of equipments in case of troubles?	Outside order

Ⅲ－4 Education and training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers?	Yes
If yes, the contents of the traning ?	Wastewater treatment, Analyzing watwr quality, Operating & maintenance

Ⅲ－5 Other Maintenance

Items	Contents
Checking drains and pipes?	No

Ⅳ. Issues

1.Present conditions and problems

・Bar screen is necessary to treat floating garbage.

・The flow meter is necessary.

・ Automatic operation of aerator is necessary.

・ Getting out the sludge in the pond

・ Sludge layer of the pond was 2.5 m（pond depth: 3.0 m, Mar.2009）.

・ In 2009, it is scheduled to get out sludge in the pond.（ The last time : 2005 year）

・ Under the examination of new WTTP（10,000m^3/day）

・Pond dues has not been payed to DINAS PU.

・Electricity charge : 30 Mil. Rp/month

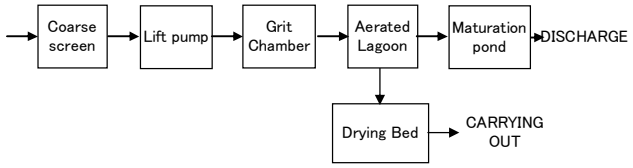
1.2.2 Sewon WWTP in Yogyakarta

Ⅰ. A summary of plant

Ⅰ－1 A summary

Items	Specification
Name of the Facility	Sewon Bantul WWTP
When was the facility opened to the public?	year : 1996（Grant aid of JICA）
Method of sewerage drainage	Separate
The population planed（persons）	273,000
Capacity of Facility（m^3/day）	15,500
The present quantity of Influent（m^3/day）	8000（Flashing water is included）
Amount of Electricity in use（kWh/day）	519（MAX729）（13600kWh/month）
BOD Conc. of Influent（mg/L）	Planed：332、Present：100
SS Conc. of Influent（mg/L）	Planed：70、Present：125
BOD Conc. of Discharge（mg/L）	Planed：50、Present：12
SS Conc. of Discharge（mg/L）	Planed：200、Present：10
The point of discharge	River

Ⅰ－2 Composition of the facility

Items	Specification
The method of treatment	Aerated Lagoon
The method of sludge treatment	Drying Bed
Flow Diagram	

Ⅱ. Organization for O&M and Duty system

Items	Contents
Organization for O&M	Manager：1 person、Operator：4 persons（3 groups, 2 shifts, 1 group with 2 persons） Analysis of water quality：3 persons, Office workers：2 persons others（Security）：18 persons
Night time	From 7:30 PM to 7:30 AM
Night duty system	3 groups, 2 shifts, 1 group with 2 persons
Contens of works at naight time	Operating
Others（Any special actions for troubls or accidents）	Yes

Ⅲ. Operation & Maintenance

Ⅲ－1 The basics

Items	Contents
Any plan for operation?	Yes（Sludge disposal is planed 2 times/year→Actually 1 time/year（Related to budget））
Any items to pay attention?	Yes（DO, Drawing out of sludge in the time of rainfall）
Is there to change of operation methods on rainy days?	Yes
Applying the numerical value of measuring instruments?	No
Any chemical for wastwater treatment？	No
Any chemical for sludge treatment?	No
Are there power failures？ Frequency of power faiure？	Yes、within 10 times per 1year（1time/month）
Is there generator for emergency?	Yes
How to deal with in time of the power failures？	Continuation
Any troble on operation？	No
Disposal of dewatering sludge？ If reuse dewatering sludge？	Reuse、Compositing（After the Drying Bed, sludge is used as a fertilizer.）

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ?	Yes
Keeping the standard of water quality?	Yes
Any item to exceed the standard of water quality?	No
Items and Frequency of analysis	Influent（Items：SS・BOD・COD、Frequency：everyday）
	Discharge（Items：SS・BOD・COD、Frequency：everyday）
	the others（Items：pH・DO・Temperature、Frequency：everyday）
Analyzers for water quality are specialist?	Yes
Any calibration and maintenance for water quality measuring instrument ?	No
Enough expendables and parts for maintenance ?	No

Ⅲ－3 Maintenance

Items	Contents
Any plan for maintenance?	Yes
Frequency of maintenance for machinary?	everyday
Contents of maintenance for machinary?	
Frequency of maintenance for Electric parts?	everyday
Contents of maintenance for Electric parts?	
Maintenance for instrument?	Yes
Enough expendables and parts for maintenance?	No
Term of delivery(expendables and parts) ?	2～3 weeks
Repairing of equipments in case of troubles?	Own（Routine）、Outside（Overhaul）

Ⅲ－4 Education and training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers?	No

Ⅲ－5 Other Maintenance

Items	Contents
Checking drains and pipes?	Yes

Ⅳ. Issues

1.Present conditions and problems

・After earthquake, JICA investigated the damage. The result of investigation is no problem to use.

・Connection lines : 18,000 lines

・Old, remshackle analysis equipments(There are some equipments can not use.）

・The operator are dispatched by Yogyakarta, Bantul, Sleman.

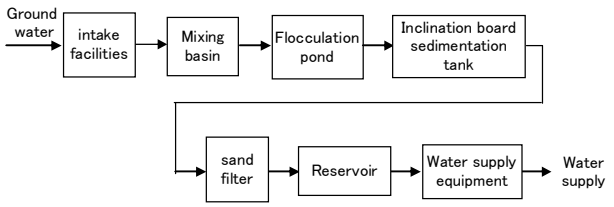
1.2.3 Cikokol WTP in Tangeran

Ⅰ. A summary of the water treatment plant

Ⅰ－1 A summury

Name of the Facility	Cikokol Water Treatment Plant
When was the facility opened to the public?	year : 1984 （Contract operation with ROT was started in Apr. 2004 for 15 years.）
Method of purification	Sedimentation・Rapid filtration・Disinfection
The population planed（persons）	
Capacity of Facility（m^3/day）	136,000（Old capacity: 100,000）
The present quantity of service（m^3/day）	136,000
Amount of Electricity in use（kWh/day）	24,000

Ⅰ－2 Composition of the facility

Items	Specification
The source of water supply	Ground water
The water quality？	Good
Any dranaging system？（any Drying bed or dewatering machine）	No（PDIM has owned the sludge reservoir only. Sludge is discharged without treatment to river
Flow Diagram	

Ⅱ. Organization for O&M and duty system

Items	Contents
Management organization	Manager：1 person、Operator：20 persons Maintenance workers : 11 persons, Analysis of water quality : 6 persons Planting : Outsourcing、Security: Outsourcing with about 9 persons The total employees of the SPC：57 persons
Working time	Unknown（3 Shifts）
Duty system	4 groups and 3 shifts, 1 group with 5 persons
Contens of works	Operating・Maintenance・Analysis of water quality
Others （Any special actions for troubls or accidents）	Yes

Ⅲ. Operation and maintenance

Ⅲ－1 The basics

Items	Contents
Controlling the quanty of service by estimating the demand？	Yes
Changing the operating methods in time of law or high turbidity？	Yes
Any special actions when the accidents of the source or plant？	Yes
Are there power failures？ Frequency of power faiure？	Yes、within 10 times every year （avg. : 5 times/year）
Is there generator for emergency?	Yes
How to deal with in time of the power failures？	Continuation（Electric charge：450Rp/kWh）

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ？	Yes
Keeping the standard of water quality？	Yes
Any item to exceed the standard of water quality？	No
Items and Frequency of analysis	raw water（Items：Turbidity・Color・pH、Frequency：everyday）
	pure water（Items：Turbidity・Residual Chl.・pH、Frequency：everyday）
Analyzers for water quality specialist？	Yes
Any calibration and maintenance for water quality measuring instrument ?	Yes
Enough expendables and parts for maintenance ？	Yes

Ⅲ－3 Management of maintenance

Items	Contents
Any plan ?	Yes
Frequency of maintenance for machinary?	everyday
Contents of maintenance for machinary?	
Frequency of maintenance for Electric parts?	everyday
Contents of maintenance for Electric parts?	
Exchaning parts for instrument?	Yes
Enough expendables and parts for maintenance?	Yes
Term of delivery ?	about 1 week、about 3 months（Imports）
Repairing of equipments in case of troubles?	Own、Outside order

Ⅲ－4 Waste water treatment

Items	Contents
Method of drainage system ?	Discharge to liver

Ⅲ－5 Other Maintenance

Items	Contents
Do maintain pipes?	No

Ⅲ－6 Educational training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers?	Yes
If yes, the contents of the traning ?	Water purification・Equipments・Analyzing watwr quality・Operating

Ⅳ. Issues

1.Present condition & Problems

・Coagulant dosage is controled automatically with turbidity and zeta potential.

・Supply charge to PDIM : 1260Rp/m^3

・Water tariff in Tangeran : 5000Rp/m^3

・Supply charge to KDI Jakarta by Tangeran city : 2300Rp/m^3（10% of produced water in Cikokol WTP is supplied to KDI Jakarta.）

・Volume of reservoir : 16,000m^3（8,000m^3×2 ponds）

・O&M cost of Lab. : 200 Mil. Rp（without of salary）

・Maintenance cost : 4.～5 Bil. Rp/year, Elctricity charge：600 Mil. Rp/year, Repairing cost og pumps ：100 Mil. Rp/year

・Water quality is watched every month by PDIM.

・TKIM(SPC for operaration WTP) has got ISO9001 and ISO14001.

・Rehabilitation cost without O&M cost for 15 years ：72.5 Bil. Rp（As it spent all for only 3 years, TKIM is under the negotiation for additional cost.）

・When WTP was transfered to TKIM, TKIM discovered that about 50～60 parts were out of order.

・The item to watch with on-line is tubidity only.

・Turbidity of raw water ：33NTU, Turbidity of treated water ：0.38NTU, Tubidity contracted with PDIM ：2NTU, Standard of Indonesia：5NTU

・Items of water analysis ： 36 items every week（Items analyzed in the WTP）, 42 items every month（Outside order）

・TKIM opens information to the public with the internet.

・Chlorine gas：6500Rp/kg, PAC：2000Rp/kg, Na_2CO_3：5000Rp/kg（For pH control）, Fuel oil：6000Rp/L

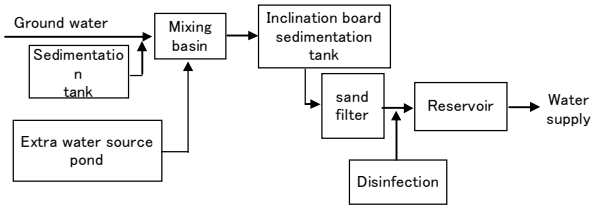
1.2.4 WTP in East Jakarta Industrial Park

Ⅰ. A summary of the water treatment plant

Ⅰ－1 A summury

Name of the Facility	WTP in East Jakarta Industrial Park
When was the facility opened to the public?	year : 1990
Method of purification	Sedimentation・Rapid filtration・Disinfection
The population planed（persons）	
Capacity of Facility（m^3/day）	9,000
The present quantity of service（m^3/day）	9,000
Amount of Electricity in use（kWh/day）	9,000

Ⅰ－2 Composition of the facility

Items	Specification
The source of water supply	Ground water
The water quality？	Good(seasonal variation)
Any dranaging system？（any Drying bed or dewatering machine）	No（Discharge to river）
Flow Diagram	

Ⅱ. Organization for O&M and duty system

Items	Contents
Management organization	Manager：1 person, Operator：9 persons, Maintenance ：4 persons Analysis of water quality ：4 persons, Office workers ：5 persons, others（Security）：3 persons The employees work in WTP and WTTP concurrently.
Night time	From 23:00 PM to 7:00 AM
Duty system in night time	3 groups, 1 group with 3 persons
Contens of works	Operating
Others（Any special actions for troubls or accidents）	No

Ⅲ. Operation and maintenance

Ⅲ－1 The basics

Items	Contents
Controlling the quanty of service by estimating the demand？	Yes
Changing the operating methods in time of law or high turbidity？	Yes
Any special actions when the accidents of the source or plant？	Yes（There is extra storage pond (extra water source) with 400,000m^3, but it has not used.）
Are there power failures？ Frequency of power faiure？	Yes、Frequency：within 10 times every year（Avg. 5times/year）
Is there generator for emergency?	Yes
How to deal with in time of the power failures？	Continuation

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ？	No（Only contracted standard with the customer）
Keeping the standard of water quality？	Yes
Any item to exceed the standard of water quality？	Yes
Items and Frequency of analysis	raw water（Items：Turbidity・pH・the others（Conducitivity・Hardness・SS）、Frequency：everyday（1time/day））
	pure water（Items：Turbidity・Residual Chl.・pH・the others（Conducitivity・Hardness・SS）、Frequency：everyday（1time/day））
Analyzers for water quality specialist？	Yes
Any calibration and maintenance for water quality measuring instrument ?	Yes
Enough expendables and parts for maintenance ？	Yes

Ⅲ－3 Management of maintenance

Items	Contents
Any plan ?	Yes
Frequency of maintenance for machinary?	everyday
Contents of maintenance for machinary?	
Frequency of maintenance for Electric parts?	everyday
Contents of maintenance for Electric parts?	
Exchaning parts for instrument?	Yes
Enough expendables and parts for maintenance?	Yes
Term of delivery ?	about 1 week
Repairing of equipments in case of troubles?	Own、Outside order（the principal equipments）

Ⅲ－4 Waste water treatment

Items	Contents
Method of drainage system ?	Discharge to liver

Ⅲ－5 Other Maintenance

Items	Contents
Do maintain pipes?	Yes（Under the renewal of pipes, from iron pipes to PE pipes）

Ⅲ－6 Educational training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers?	No
If yes, the contents of the traning ?	

Ⅳ. Issues

1.Present condition & Problems

・The pipes for supply become too old. (Under the renewal from iron pipes to PE pipes）

・Sand filters are mannualy-operated .（filtration, backwashing）

・Turbidity increase in the rainy season.

・As raw water source is not enough in the dry season, a weir is constructed in the lower reaches of the river.

・Extra raw water source(reservoir) is prepared to deal with the pollution and the lack of raw water.

・There is sedimentation pond for haigh-rate turbidity. They are pressed for disposal of the sludge.

・Chemical cost ：350,000 Japanese Yen/month（used for water purification only)

・10% of NaClO ：1,150Rp/kg、Dosage rate ：0.5mg/L(as Cl)

・PAC：1950Rp/kg, Dosagerate ： 70mg/L（PAC of the Kubota co. is used.）

・The minimum wage of operator ：100 US＄/month, Actual salary ：150～200US＄/month

・A union is very powerfull.

・A price increase rate is about 10%.

・receiving transmitted electricity with 2 lines（National and private electricity co.）

・Volume of Electricity received from national co.： 7,000～8,000kWh/day

・Volume of Electricity received from private co.：127,000kWh/day

・There is the generator for emergency.

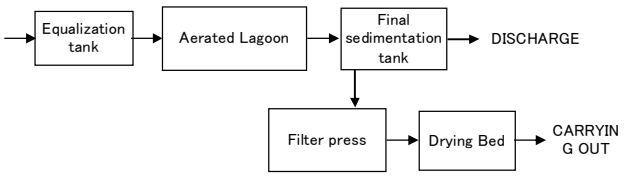
1.2.5 WWTP in East Jakarta Industrial Park

Ⅰ. A summary of plant

Ⅰ－1 A summary

Items	Specification
Name of the Facility	WWTP in EAST Jakarta Industrial Park
When was the facility opened to the public?	year : 1990
Method of sewerage drainage	Separate
The population planed（persons）	50,000
Capacity of Facility（m^3/day）	9,000（3000m^3×3 ponds）
The present quantity of Influent（m^3/day）	4,900～5,600（As no flowmeter, it was estimated 70% of water consumtion.）
Amount of Electricity in use（kWh/day）	6,000
BOD Conc. of Influent（mg/L）	Planed：500、Present：100～260
SS Conc. of Influent（mg/L）	Planed：200、Present：100
BOD Conc. of Discharge（mg/L）	Planed：50、Present：16～47
SS Conc. of Discharge（mg/L）	Planed：200、Present：2～50
The point of discharge	River（Discharged to the exclusive river which is not for raw water source）

Ⅰ－2 Composition of the facility

Items	Specification
The method of treatment	Activated Sludge（Long time aeration、Surface aeration）
The method of sludge treatment	Dewatering（After the dehydrating with no chemial(90% of water content), sludge is transported to drying bed.
Flow Diagram	

Ⅱ. Organization for O&M and Duty system

Items	Contents
Organization for O&M	Manager：1 person, Operator：9 persons, Maintenance workers ：4 persons Analysis of water quality ：4 persons, Office workers ：5 persons, others（Security）：3 persons The employees work in WTP and WTTP concurrently.
Night time	From 23:00 PM to 7:00 AM
Night duty system	3 groups, 1 group with 3 persons
Contens of works at naight time	Operating
Others（Any special actions for troubls or accidents）	Yes

Ⅲ. Operation & Maintenance

Ⅲ－1 The basics

Items	Contents
Any plan for operation?	Yes
Any items to pay attention?	Yes（Aeration）
Is there to change of operation methods on rainy days?	Yes（The number of pumps to be operated is changed.）
Applying the numerical value of measuring instruments?	No
Any chemical for wastwater treatment？	No
Any chemical for sludge treatment?	No
Are there power failures？ Frequency of power faiure？	Yes. Within 10 times every year
Is there generator for emergency?	Yes
How to deal with in time of the power failures？	Continuation
Any troble on operation？	No
Disposal of dewatering sludge？ If reuse dewatering sludge？	Reused with the materials for cement

1.3 Investigation results of each facility in Vietnam

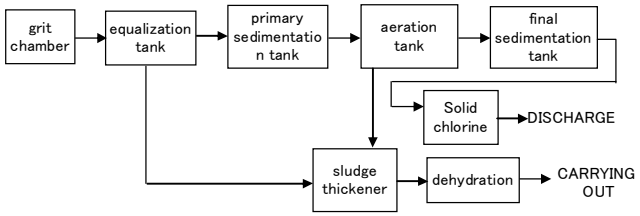
1.3.1 Kim Lien WWTP

Ⅰ. A summary of plant

Ⅰ－1 A summary

Items	Specification
Name of the Facility	Kim Lien WWTP
When was the facility opened to the public?	Sep. 2005
Method of sewerage drainage	Combined
The population planed（persons）	15,000（2010 year）
Capacity of Facility（m^3/day）	3,700
The present quantity of Influent（m^3/day）	3,700
Amount of Electricity in use（kWh/day）	3,700
BOD Conc. of Influent（mg/L）	Planed：250、Present：150
SS Conc. of Influent（mg/L）	Planed：200、Present：200
BOD Conc. of Discharge（mg/L）	Planed：30、Present：15～20
SS Conc. of Discharge（mg/L）	Planed：<60、Present：15～20
The point of discharge	River（Rainy season）、Lake（Dry season：KIM LIEN Lake）

Ⅰ－2 Composition of the facility

Items	Specification
The method of treatment	Anoxic-anaerobic-aerobic activated sludge method
The method of sludge treatment	Concentration of sludge・Dewatering
Flow Diagram	

Ⅱ. Organization for O&M and Duty system

Items	Contents
Management organization	Manager：1 person, Operator：20 persons HSDC has made a joint control for maintenance, analysis of water quality, office works and the others such as security with other WWTP.
Night time(Day time)	From 9:00 PM to 7:00 AM(7:00AM～3:00PM, 3:00PM～9：00PM)
Duty system	4 groups, 3shifts, 1 group with 5 persons
Contens of works	Operating、Maintenance
Others（Any special actions for troubls or accidents）	Yes

Ⅲ. Operation & Maintenance

Ⅲ－1 The basics

Items	Contents
Any plan?	Yes
Any items to pay attention?	Yes（reaction tank DO 2～3mg/L）
Is there to change of operation methods on rainy days?	No
Applying the numerical value of measuring instruments?	Yes
Any chemical for wastwater treatment？	Yes
If yes, how much and what kind ?	disinfection：NaClO・600L/day(for pH control)
	flocculant：$FeCl_3$・200kg/day(for phosphorus removal)
	the others：carrier（It is imported from Japan periodically.）、Solid chlorine
Any chemical to use for sludge treatment?	Yes
If use any chemical, how much and what kind ？	flocculant：polymer・9kg/day
If do use any chemical, manufactured in ？ term of delivery？	NaClO・$FeCl_3$：Domestic（Delivery：1day～3days）、polymer：Overseas（imported from Japan every 3～6 months）
Are there power failures？ Frequency of power faiure？	Yes, 6～8times/year, 8～10hours/time
Is there generator for emergency?	Yes（Automatic operation）
How to deal with in time of the power failures？	Continuation
Any troble on operation？	Yes（Bulking、Scum occuring）
Disposal of dewatering sludge？ If reuse dewatering sludge？	Landfill

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ?	Yes
Keeping the standard of water quality ?	Yes（TCVN 4945－2005 Class B）
Any item to exceed the standard of water quality ?	Yes
Items and Frequency of analysis	Influent（Items：SS・BOD・COD・T-N・T-P、Frequency：1time/week）
	Discharge (Items：SS・BOD・COD・T-N・T-P・Visual depth, Visual depth is cheked everyday and the others are 1time/week.)
Analyzers for water quality specialist ?	Yes
Any calibration and maintenance for water quality measuring instrument ?	Yes
Enough expendables and parts for maintenance ?	Yes

Ⅲ－3 Maintenance

Items	Contents
Any plan ?	Yes
Frequency of maintenance for machinary ?	everyday, weekly, monthly, yearly
Contents of maintenance for machinary ?	Check of oil grease、Inspection with the manual offered by manufacturer
Frequency of maintenance for Electric parts ?	monthly, harf-yearly
Contents of maintenance for Electric parts ?	Harf-yearly inspection is by the law.
Exchaning parts for instrument ?	Yes
Enough expendables and parts for maintenance ?	Yes
Term of delivery ?	Domestic：about a week, Overseas：about 3 months
Repairing of equipments in case of troubles ?	Own

Ⅲ－4 Educational training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers ?	Yes
If yes, the contents of the traning ?	Wastewater treatment, Analyzing watwr quality, Operating

Ⅲ－5 Other Maintenance

Items	Contents
Checking drains and pipes ?	No

Ⅳ. Issues

1.Present conditions and problems

・There is a lot of clloging up of pumps for inlet.

・They have been operating to change mechanical seals and bearings regularly.

・Filter cloth of belt-press is changed every year.

2.Demand

・As the control pannel is old type, they want to change with the new system such as it of North Thang Long WWTP.

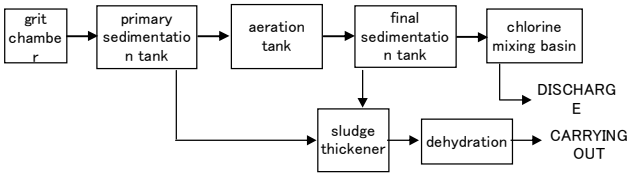
1.3.2 North Thang Long WWTP

Ⅰ. A summary of plant

Ⅰ－1 A summary

Items	Specification
Name of the Facility	North Than Ron WWTP
When was the facility opened to the public?	year : 2009 month : 2
Method of sewerage drainage	Separate
The population planed（persons）	110,000
Capacity of Facility（m^3/day）	42,000（38,000m^3/day of sewerage, 4,000m^3/day of I/I）
The present quantity of Influent（m^3/day）	3,700（from the Thang Long industrial Park only）
Amount of Electricity in use（kWh/day）	---
BOD Conc. of Influent（mg/L）	Planed：<220, Present：100
SS Conc. of Influent（mg/L）	Planed：<190, Present：：100
BOD Conc. of Discharge（mg/L）	Planed：50, Present：<50
SS Conc. of Discharge（mg/L）	Planed：100, Present：<100
The point of discharge	River（Discharge standard Class Ⅱ）

Ⅰ－2 Composition of the facility

Items	Specification
The method of treatment	Anaerobic-aerobic activated Sludge method
The method of sludge treatment	Dehydration
Flow Diagram	

Ⅱ. Organization for O&M and Duty system

Items	Contents
Management organization	Manager：1 persos,Operator：28 persons HSDC has made a joint control for maintenance, analysis of water quality, office works and the others such as security with other WWTP.
	others：7～8 persons（Management of pipes & canals etc）
Night time(Day time)	From 9:00 PM to 7:00 AM(7:00AM～3:00PM, 3:00PM～9：00PM)
Duty system	4 groups, 3shifts, 1 group with 7 persons
Contens of works	Operating,Maintenance
Others（Any special actions for troubls or accidents）	Yes

Ⅲ. Operation & Maintenance

Ⅲ－1 The basics

Items	Contents
Any plan?	Yes（operated by the mannual of manufacturer）
Any items to pay attention?	No
Is there to change of operation methods on rainy days?	No
Applying the numerical value of measuring instruments?	No（There is a DO meter in the aeration tank.）
Any chemical for wastwater treatment？	Yes
If yes, how much and what kind ?	disinfection：NaClO(Because of under the test run, amout of using is unknown.)
	flocculant：Because of under the test run, amout of using is unknown.
	the others：FeCl3,NaClO
Any chemical to use for sludge treatment?	Yes
If use any chemical, how much and what kind ？	flocculant：polymer,FeCl3
If do use any chemical, manufactured in ？ term of delivery？	NaClO・FeCl3：Domestic（Delivery：1day～3days）,polymer：Import
Are there power failures？ Frequency of power faiure？	Yes,Frequency：10 times/year, 1～2hours/time
Is there generator for emergency?	Yes（Automatic operation）
How to deal with in time of the power failures？	Continuation
Any troble on operation？	Yes（Bulking, Scum occuring）
Disposal of dewatering sludge？ If reuse dewatering sludge？	Landfill

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ?	Yes
Keeping the standard of water quality?	Yes
Any item to exceed the standard of water quality?	Yes
Items and Frequency of analysis	Influent（Items：SS・BOD・COD・T-N・T-P）
	Discharg（Items：SS・BOD・COD・T-N・T-P）
Analyzers for water quality specialist?	Yes
Any calibration and maintenance for water quality measuring instrument ?	Yes
Enough expendables and parts for maintenance ?	Yes

Ⅲ－3 Maintenance

Items	Contents
Any plan ?	Yes
Frequency of maintenance for machinary?	everyday, weekly, monthly, yearly
Contents of maintenance for machinary?	Check of oil grease, Inspection with the manual offered by manufacturer
Frequency of maintenance for Electric parts?	Monthly
Contents of maintenance for Electric parts?	Routine inspection is every 2 years.
Exchaning parts for instrument?	Yes
Enough expendables and parts for maintenance?	Yes
Term of delivery ?	Domestic：about a week, Overseas：about 3 months
Repairing of equipments in case of troubles?	Own

Ⅲ－4 Educational training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers?	Yes
If yes, the contents of the traning ?	Wastewater treatment, Analyzing watwr quality, Operating

Ⅲ－5 Other Maintenance

Items	Contents
Checking drains and pipes?	No

Ⅳ. Issues

1.Present conditions and problems

・End of construction：Aug. 2005, Start of test run： Sep. 2008, Start of treatment：Feb. 2009

・Because the treatment started after 3years from end of construction, there had not been maintained appropriately.

・In is difficult to discuss with constructor.

・Even now, as the volume of influent is very few, appropriate operation such as changing of treatment lines is not operated.

・Chemiclas such as activated carbon has been keeped long time, and situation of keeping is not good.

2.Demand

・They want to introduce general-purpose equipments.

・As it takes 3 months to import from japan, they want to shorten the period of delivery.

・It can not be done to up-date of PLC.

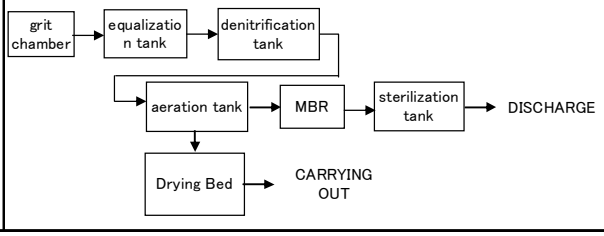
1.3.3 Thng Long Industrial Park WWTP

Ⅰ. A summary of plant

Ⅰ－1 A summary

Items	Specification
Name of the Facility	Thang Long Industrial Park WWTP
When was the facility opened to the public?	Feb. 1997
Method of sewerage drainage	Separate
The population planed（persons）	50,000（present : 40,000 ）
Capacity of Facility（m^3/day）	3,000
The present quantity of Influent（m^3/day）	2,500
Amount of Electricity in use（kWh/day）	1,000
BOD Conc. of Influent（mg/L）	Planed : 300,Present : 100
SS Conc. of Influent（mg/L）	Planed : 200,Present : 100
BOD Conc. of Discharge（mg/L）	Planed : 30,Present : <15
SS Conc. of Discharge（mg/L）	Planed : 50,Present : <20
The point of discharge	Lake

Ⅰ－2 Composition of the facility

Items	Specification
The method of treatment	MBR(Membrane Biological Reactor)
The method of sludge treatment	Drying Bed
Flow Diagram	

Ⅱ. Organization for O&M and Duty system

Items	Contents
Management organization	Manager : 1 persons,Operator : 4 persons,Analysis of water quality 1 person, Total 6 persons
Night time(Day time)	From :22:00 To :6:00（6:00～14:00, 14:00～22:00）
Duty system	4 groups, 3shifts, 1 group with 1 person
Contens of works	Operating、Maintenance、Analysis
Others（Any special actions for troubls or accidents）	Yes

Ⅲ. Operation & Maintenance

Ⅲ－1 The basics

Items	Contents
Any plan?	Yes（There are no details）
Any items to pay attention?	Yes
Is there to change of operation methods on rainy days?	No
Applying the numerical value of measuring instruments?	No（There is no meter）
Any chemical for wastwater treatment？	Yes
If yes, how much and what kind ?	disinfection : NaClO・134L/day（chlorine 10%、3,000 VND/L（about 200US $/$m^3$））
Any chemical to use for sludge treatment?	No
If do use any chemical, manufactured in ？ term of delivery？	NaClO : Domestic（Delivery : 1day～3days）
Are there power failures？ Frequency of power faiure？	No
Is there generator for emergency?	No
How to deal with in time of the power failures？	Stop
Any troble on operation？	Yes（Scum occuring）
Disposal of dewatering sludge？ If reuse dewatering sludge？	Landfill（Volume of sludge disposal : 20t/month, Disposal cost: 47,000 VND/t）

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ?	Yes
Keeping the standard of water quality?	Yes（TCVN 4945-2005 Class B）
Any item to exceed the standard of water quality?	Yes
Items and Frequency of analysis	Influent（Items：SS・BOD・COD・T-N・T-P、Frequency：COD→ everyday, the other→ monthly
	Discharg（Items：SS・BOD・COD・T-N・T-P、Frequency：COD→ everyday, the other→ monthly
Analyzers for water quality specialist?	Yes
Any calibration and maintenance for water quality measuring instrument ?	Yes
Enough expendables and parts for maintenance ?	Yes

Ⅲ－3 Maintenance

Items	Contents
Any plan ?	Yes
Frequency of maintenance for machinary?	everyday, weekly, monthly, tearly
Contents of maintenance for machinary?	There is a mannual of the manufacturer.
Frequency of maintenance for Electric parts?	everyday, harf-yearly
Contents of maintenance for Electric parts?	Harf-yearly inspections is by the law.
Exchaning parts for instrument?	Yes
Enough expendables and parts for maintenance?	Yes
Term of delivery ?	Domestic：about a week, Overseas：about 1month
Repairing of equipments in case of troubles?	Own, Outside order

Ⅲ－4 Educational training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers?	Yes
If yes, the contents of the traning ?	Wastewater treatment, Analyzing watwr quality, Operating

Ⅲ－5 Other Maintenance

Items	Contents
Checking drains and pipes?	Yes

Ⅳ. Issues

1.Present conditions and problems

・They has operated WWTP with the checking discharge water quality of each factory.

・They has set up the MBR method advanced as a treatment method, but they have many trobles to treat swwerage.

・Because they operate WTP and WWTP concurrently, O&M cost is resonable.

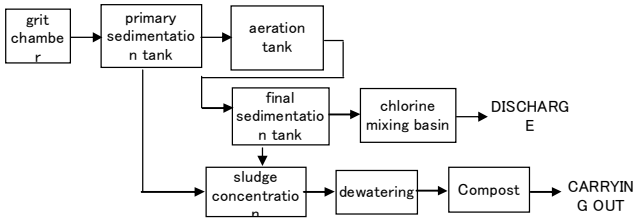
1.3.4 Bin Hung WWTP

Ⅰ. A summary of plant

Ⅰ－1 A summary

Items	Specification
Name of the Facility	Bin Hung WWTP
When was the facility opened to the public?	year : 2009 month : 2
Method of sewerage drainage	Combined
The population planed（persons）	400000（Presently）
Capacity of Facility（m^3/day）	141,000
The present quantity of Influent（m^3/day）	30000（During August entire quantity inflow schedule）
Amount of Electricity in use（kWh/day）	13,000
BOD Conc. of Influent（mg/L）	Planed：165、Present：<50
SS Conc. of Influent（mg/L）	Planed：165、Present：
BOD Conc. of Discharge（mg/L）	Planed：50、Present：12
SS Conc. of Discharge（mg/L）	Planed：100、Present：45
The point of discharge	River

Ⅰ－2 Composition of the facility

Items	Specification
The method of treatment	Modified aeration method
The method of sludge treatment	Concentration of sludge, Dewatering, Compost
Flow Diagram	

Ⅱ. Organization for O&M and Duty system

Items	Contents
Management organization	Under the test run
Night time(Day time)	From :22:00 To :6:00（6:00～14:00, 14:00～22:00）
Duty system	---
Contens of works	---
Others（Any special actions for troubls or accidents）	Yes

Ⅲ. Operation & Maintenance

Ⅲ－1 The basics

Items	Contents
Any plan?	Yes（There are no details）
Any items to pay attention?	Yes（There is few inflow quantity of water、Inflow load is low）
Is there to change of operation methods on rainy days?	Yes（There is no experience）
Applying the numerical value of measuring instruments?	No（There are no equipments to meter.）
Any chemical for wastwater treatment？	Yes
If yes, how much and what kind ?	Uncertain
Any chemical to use for sludge treatment?	Yes
If use any chemical, how much and what kind ？	Uncertain
If do use any chemical, manufactured in ？ term of delivery？	Domestic（within 1 week）、Foreign（within 2～3 weeks）
Are there power failures？ Frequency of power faiure？	Yes, Frequency：within 10 times/year
Is there generator for emergency?	Yes
How to deal with in time of the power failures？	Stop（Pumping only）
Any troble on operation？	Yes（Bubble occurring）
Disposal of dewatering sludge？ If reuse dewatering sludge？	Landfill（100t/day）, Compost（80t/day）

Ⅲ－2 Water quality management

Items	Contents
Is there the standard of water quality by laws ?	Yes
Keeping the standard of water quality?	Yes（TCVN 4945-2005 Class B）
Any item to exceed the standard of water quality?	No
Items and Frequency of analysis	Influent（Items：SS・BOD・COD・T-N・T-P, Frequency：Everyday）
	Discharge（Items：SS・BOD・COD・T-N・T-P, Frequency：Everyday ）
	the others（SV ：everyday）
Analyzers for water quality specialist?	Uncertain
Any calibration and maintenance for water quality measuring instrument ?	Uncertain
Enough expendables and parts for maintenance ?	Yes

Ⅲ－3 Maintenance

Items	Contents
Any plan ?	Yes（Inspection of the Japanese manufacturer base）
Frequency of maintenance for machinary?	everyday, weekly, monthly, tearly
Contents of maintenance for machinary?	There is a mannual of the manufacturer.
Frequency of maintenance for Electric parts?	Uncertain
Contents of maintenance for Electric parts?	Uncertain
Exchaning parts for instrument?	Yes
Enough expendables and parts for maintenance?	Yes
Term of delivery ?	Domestic：about a week、Foreign：about 1month
Repairing of equipments in case of troubles?	Uncertain

Ⅲ－4 Educational training

Items	Contents
Any traning for operator, maintenance workers and water quality analyzers?	Uncertain
If yes, the contents of the traning ?	Uncertain

Ⅲ－5 Other Maintenance

Items	Contents
Checking drains and pipes?	No

Ⅳ. Issues

1.Present conditions and problems

・There is not equipmet management system.

・It is necessary more considering in the method of nomalization.

・The effectiveness of composting system is not clear.

・As the overhaul of pumps, blowers and dehydrators has to be operated in japan, it takes about 6 months to ovehaul.

Appendix 2

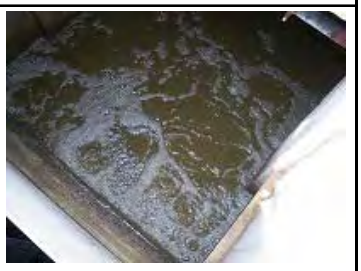
Success Cases and Problems in O&M of the Facilities

2.1 Success cases and problems in operation of the facilities
2.2 Success cases and problems in maintenance of the facilities

2. Succes cases and problems in O&M of the facilities

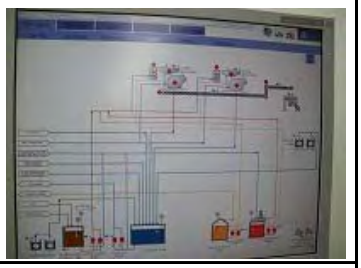
2.1 Succes cases and problems in operation of the facilities

◆ Kim Lien WWTP（Hanoi city, Vietnam）　　S:Success / P:Problem

Equipment	Case	Evaluation	Photo
Inlet	S	Measures against odor is necessary to be taken because of its urban location. Deodorization facility is functioning well. H_2S is not detected.	
Reaction tank	P	To meet to a nitrogen regulation, A2O method, which using carriers, is adopted.	
Reaction tank	S	DO meters are installed. DO values are utilized as an operational index.	
Reaction tank	S	Flow meters are installed to confirm circulating water rate.	
Reaction tank		Reaction tanks are covered to prevent odor emission. Pipes are distinguished by colors; water, air, and sludge.	
Final sedimentation tank	P	Final sedimentation tanks are covered. That makes it inconvenient to observe treated water quality or floating sludge.	

Equipment	Case	Evaluation	Photo
Disinfection equipment	P	Solid chlorine tends to foam a bridge and that may decrease contact efficiency. Daily check of residual chlorine is necessary.	
Dewatering equipment	P	Usage period of filter cloth is short. To extend the life, daily cleaning and drying, and regular acid cleaning are recommended. Sludge should be supplied with caution to prevent putrefaction and keep certain concentration.	

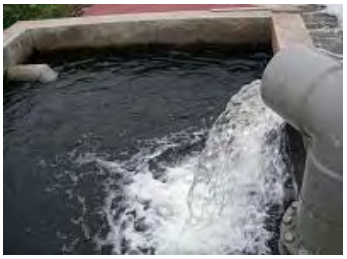
◆ North Thang Long WWTP（Hanoi city, Vietnam） S:Success / P:Problem

Equipment	Case	Evaluation	Photo
Central monitoring room	S	Facilities all over the plant are monitored and operated with the centralized system. Panel is tagged with operational notes or memorandums.	
Central monitoring room	S	A monitor is equipped for monitoring and operation. It enables centralization of monitoring and accumulation of operational data. By extending to external facilities, remote monitoring and operation can be realized. Bilingual mode, Vietnamese and English, is available.	
Grit chamber	S	Odor measurement is taken at grit chambers. Because yearly temperature is high, the measurement is effective for putrefaction prevention.	
Anaerobic part of reaction tank	S	A/O process is adopted at reaction tanks for the purpose of N and P removal. （Operational Standard:T-N15mg/L, T-P4mg/L) The first tank is utilized as anaerobic tank with mechanical mixer.	

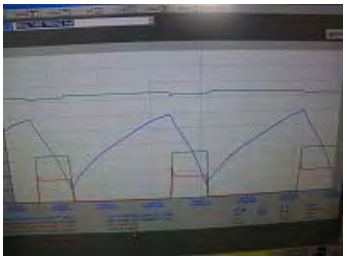
Equipment	Case	Evaluation	Photo
Aerobic part of reaction tank	S	2nd and 3rd reaction tanks adopt mechanical surface aeration method. are ready to adopt In the current situation with low influent rate, one tank is aerated intermittently according to load.	
Aerobic part of reaction tank	S	DO meters are installed only in main tanks. Though they are able to be utilized at other tanks too by moving the sensors to required sites.	
Final sedimentation tank	P	Thanks to the idea to use rubber belt, low-cost scum collecting devices are realized. Activated carbon and chemicals are stored in a heap in a grit chamber. Storage condition is not desirable. Efficient water tests at site are implemented with simple methods or using kits. Safety measure is secured by locking the shelf.	
Dewatering equipment	S	Belt press filter which thickens sludge just before dewatering without installing a gravity thickening tank. Inorganic coagulant(FeCl3) is supposed to be dosed according to dewatering properties and odor state. Appropriate dosing frequency and rate is necessary to be confirmed at an actual plant.	
Storage state of chemicals and other goods	P	Activated carbon and chemicals are stored in a heap in a building of grit chamber. Storage condition is not desirable.	
Water analysis room	S	Efficient water tests at site are implemented with simple methods or using kits. Safety measure is secured by locking the shelf.	

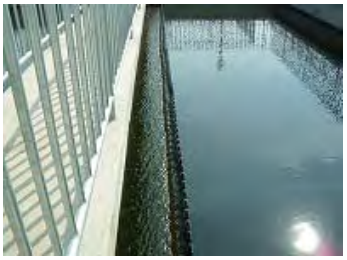
Equipment	Case	Evaluation	Photo
Head office of HSDC Water analysis room	S	Water analysis are implemented for all sample from three treatment plants (Kim Lien, North Tanh Long, Truc Bac). It is reliable and efficient because high skilled personnel takes charge of the analysis.	

◆ Thang Long Industrial Park WWTP（Hanoi city, Vietnam） S:Success / P:Problem

Equipment	Case	Evaluation	Photo
Equalization Tank	P	Foaming at equalization tanks. It is recommended to consider introducing antifoaming sprays and controlling aeration rate.	
Denitrification tank	P	Large amount of scum accumulates. Many workers were on the removal works. To improve the state, they are consulting the contractor on operational conditions.	
Treated effluent tank	P	Treated water is disinfected by chlorine. Chlorine feeding rate can be reduced because quality of membrane separated water is good.	
Sun drying bed	S	Depending on climatic characteristics, sun drying bed is adopted. Excess sludge is directly supplied to the drying bed. No thickening equipment is needed.	
Water analysis room	S	Water analysis is implemented at a water analysis room which is shared with a neighbor industrial water supply facility. Skilled annalists are taking charge of the water analysis from both facilities. That works efficiently.	

◆ Bin Hung WWTP（Ho Chi Minh city, Vietnam）　　S:Success / P:Problem

Equipment	Case	Evaluation	Photo
Central monitoring room	S	Operational state of whole facility can be monitored by computerized system.	
Central monitoring room	S	Trend data of each facility, such as operating time, is shown on the system. (Same as above)	
Central monitoring room	S	Operational data is recommended and summarized as a style of a daily reports and monthly reports.	
Central monitoring room	P	Although computerized system is working well, a graphical panel is also equipped.	
Distribution tank	P	COD of influent into primary sedimentation tanks is higher than that of influent into plant. This suggests that a load of recycle flow may be high.	
Primary sedimentation tank	P	Sludge accumulation may cause anaerobic conditions and advance putrefaction. Proper sludge control is required.	

Equipment	Case	Evaluation	Photo
Water treatment equipment	P	According to a large number of tanks, primary sedimentation tanks, reaction tanks, and final sedimentation tanks, the number of equipment such as influent gates and step gates is large.	
Primary sedimentation tank	S	Channels which enable to bypass the primary sedimentation tanks are constructed. They can be utilized in case of low influent load.	
Reaction tank	P	Terrible foaming is observed. The load should be checked if it is within a permissible range of high operational load by modified aeration method.	
Reaction tank	P	Amount of activated sludge in reaction tanks is extremely small, though it is affected that the tanks are during a trial operation. Regulations should be done on a field operation.	
Final sedimentation tank	P	Effluent rates vary widely depending on tanks. Inflow rate to each final sedimentation tanks should be equalized.	
Final sedimentation tank	P	Manual scum skimmers are installed at final sedimentation tanks in order to reduce an initial cost. Workload is large because many skimmers as the same number of tanks are prepared.	

Equipment	Case	Evaluation	Photo
Water treatment equipment	S	As for lighting to conduits, natural lightning is efficiently utilized.	
Gravity thickening tank	P	Sludge accumulation and putrefaction in gravity thickening tanks. To prevent putrefaction from advancing and dewatering efficiency from declining, proper operation should be implemented.	
Carrying out of dewatered sludge	P	Cake hopper is installed at high level. To prevent sludge scattering and odor emission, nylon curtain is installed.	
Composting facility	P	To stabilize sludge, composting facility is equipped. Manufactured compost is planned to be buried. Much chaff is designed to be mixed, which requires high running cost. By regulating operational conditions, such as return compost rate, it is recommended to consider to reduce running cost.	
Relay pumping station	P	Floor of an electrical room and a pumping room is adjoining. There is probability of flooding at the electrical room.	
Tan Quiy Dong Ssewage treatment plant	S	A small scale treatment facility, of which capacity is 500m^3/day, is operating.	

Equipment	Case	Evaluation	Photo
Pumping well of Tan Quiy Dong sewage treatment plant, Ho Chi Minh city	P	When the facility comes to be updated, it is recommended to consider connecting to Binh Hung treatment plant.	
Binh Hung Hwa sewage treatment plant, Ho Chi Minh city	S	It adopts an aerated lagoon method, of which treatment capacity is 15,000m^3/day. Although it takes large operation area, the treatment performance has recorded high enough with BOD15mg/L and below.	
Binh Hung Hwa sewage treatment plant, Ho Chi Minh city	S	Influent to the plant is contaminated river water. Being treated with aerated lagoon method and returned to the river, the river purification has been promoted.	
Binh Hung Hwa sewage treatment plant, Ho Chi Minh city	P	With large green area, the facility has nice view. Planting requires ground maintenance cost.	

◆ Setiabuti WWTP（DKI Jakarta、Indonesia） S:Success / P:Problem

Equipment	Case	Evaluation	Photo
Inlet	P	A screen on intake from city drainage has a gap. Amount of rubbish can inflow through the gap. Association between flood-related division which administers sewage channel and sewerage-related division which administers treatment tanks will be necessary to improve the problem.	
Treatment tank	P	The treatment tank accumulates sludge, which has decreased effective tank volume and has increased an organic load. By consulting flood-related division on an earlier dredge, water quality improvement can be expected remaining the present facility as it is now.	
Aeration device	P	Rubbish flowed into the plant causes a breakdown of aeration devices. Above preventing rubbish inflowing, some measurements to guard the aeration device against rubbish should be taken. Although being outsourced, rubbish removing works take many man-hours.	
Controller of aeration device	P	Although it is equipped with a timer, the aeration device is operated manually. It is recommended to utilize the timer effectively to solve some problems such as a foaming.	

◆ Sewon WWTP（Kota Yogyakarta, Indonesia） S:Success / P:Problem

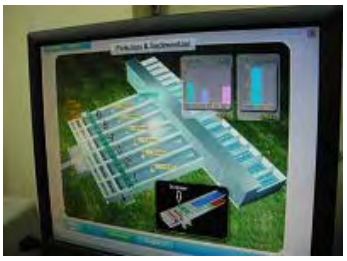
Equipment	Case	Evaluation	Photo
Inlet of river water, flushing system of Yogyakarta city	S	Flushing system, which withdraws river water to flat sewers to increase flow rate, is adopted.	
Distributing intersection in a manhole, flushing system of Yogyakarta city	S	Distributing intersection of flushing system in a manhole. The system distributes water to each district. Flow direction is changed regularly depending on level of odors.	

Equipment	Case	Evaluation	Photo
Aerated lagoon	S	A plant with an aerated lagoon method. Facilities are well arranged and no waste of space.	
Sludge inlet of septic tanks	S	Sludge inlet is installed for sludge collected from septic tanks in the city. The plant has some margin of capacity because actual inflow rate and quality load is low.	
Aerated lagoon	S	Accumulated sludge in lagoons is designed to be collected from a suction pump installed on land. A boat is planned to be used at four lagoons and so it is equipped with a lifting device.	
Aerated lagoon	S	A suction pump is planned to be used at four lagoons in common. Each lagoon has a suction inlet. Efficiently designed.	
Aerated lagoon	S	Sludge drying bed is installed. Because generated volume is small, sludge dredging is implemented about once a year. Dried sludge is utilized by neighbors for agriculture. No sludge remains for disposal.	

◆ East Jakarta Industrial Park　WWTP（Bekasi,　Indonesia）　　S:Success / P:Problem

Equipment	Case	Evaluation	Photo
Flow equalization tank	P	Because of anaerobic conditions, water is dark in equalization tanks. If there is sludge accumulated, it should be removed.	
Flow equalization tank	P	Distribution ratio between two equalization tanks is far from even. One tank can equalize satisfactorily. Intend to shorten retention time and prevent putrefaction.	
Aeration device in reaction tank	P	Accumulated sludge in reaction tanks has possibility to increase load in the tanks. Inflow rates are uneven at series. Because an aerator is out of order, air volume is not enough. After removing accumulated sludge, it is necessary to check if air can be supplied or not.	
Aeration device in reaction tank	S	Thickened sludge is supplied to a sun drying bed. It is efficiency.	

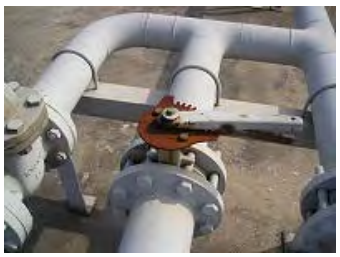
◆ **Chikokol　WTP（Kota Tangeran**, Indonesia）　　S:Success / P:Problem

Equipment	Case	Evaluation	Photo
Central monitoring room	S	It is easy to understand thanks to colored and 3D monitor. The system is connected with data recording, displaying and summarizing daily and monthly reports.	
Sedimentation tank	S	Without reforming civil structures, the facility performance has been improved by introducing plate settlers.	

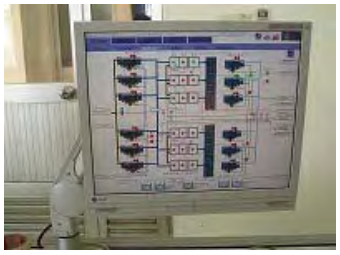
2.2 Succes cases and problems in maintenance of the facilities

◆ Kim Lien WWTP（Hanoi city, Vietnam） S:S / P:Problem

Equipment	Case	Evaluation	Photo
Gate Grit chamber	S	Ggrease trap is covered in the spindle of gates. It prevents to stain with garbage and sand.	
Grit chamber Coarse screen	S	Manual operation Frequency of using coarse screen is a few. In small plants, manual type is enough to operate. It is easy to operate. It is not necessary to use motors and reduction gears.	
Disinfection facility Solid chlorine dosage facility	S	It is easy to operate. In small plants, it is suitable with the view of safety and maintennace.	
Electric parts Sludge pumps in primary settling tank Field control pannel	S	Field control pannel is set up in the equipment. It is good for operation.	
A view from plant	S	In that area, houses are clustered close together. There is vegetation with the consideration of the circumference.	
Grit chamber Container for screenings	P	Because container was made by iron(heavy), it is difficult to carry out it.	

Equipment	Case	Evaluation	Photo
final sedimentation tank return sludge pump-incidental equipment	P	・hand-operated valve for shaft seal water ・reduced construction cost ・care for management and maintenance ・colse the valve when it stops ・operating with the valve closed causes burnout	
Chemical injection injection pump diaphragm-type	P	・pump and tanks are arranged compactly ・many troubles on injection pumps ・better to keep maintenance space	
grit chamber covering	P	・influenced by sulfidizing gas from inflow ・corroded covering ・better to corrosive-resistant material	
piping control valve	P	・rusted ・countermeasures are needed ・regular operation check is recommended	
electric equipment field-operating panel	P	・simple structure (only on/off switches) ・no indication on the switches it can cause operational error ・nameplates are recommended	
water treatment facilities covering	P	・covering is corroded and deteriorated ・better to set a caution as a precaution	

◆ North Tang Long WWTP（Hanoi City, Vietnam）　　S:S / P:Problem

Equipment	Case	Evaluation	Photo
grit chamber valve	S	・indication plate of valve-opening and closing ・good as a precaution	
grit chamber fine screen	S	・corrosion-resistance materials in grit chamber ・long-term use is possible	
grit chamber	S	・grit chamber in semi-underground room as a precaution of pump facility （photoの階段上部がpump facility） ・to measure against flood is important	
electrical instrumentation monitoring control system （monitoring room）	S	・concentrating-monitoring system ・whole working condition is visible ・recording function and historical data (easy data-collecting) ・able to manage facilities efficiently	
electrical instrumentation control panel （monitoring room）	S	・remote control equipment is manually-operated by control panel ・able to check data when the system break down	
electrical instrumentation monitoring control system desk （monitoring room）	S	・large- sized desks for buisiness office ・easy and effective to monitor ・easy to change layout	

Equipment	Case	Evaluation	Photo
electric equipment fieldoperating panel	S	・manual-automatic transfer switch, start-stop transfer switch, and indication lamp are set individually ・expensive ・easy to manipulate	
landscape	S	・vegetations in treatment station ・care for landscape	
electric equipment grit chamber power control panel	P	・power control panel in grit chamber floor ・better to move to pump room floor as a precaution against flood	
electric equipment pump facilities power control panel	P	・inverter control panels in pump room ・corrosion at cooling fan by moisture ・better to move to switch room ・It is necessary to concern about surrounding conditions of precision equipment installed ・It is preferable to install the equipment in a switch room to prevent from degradation	
final sedimentation tan	P	・low inflow ・many facilities are stopped ・necessary for maintenance system for long-term stop	

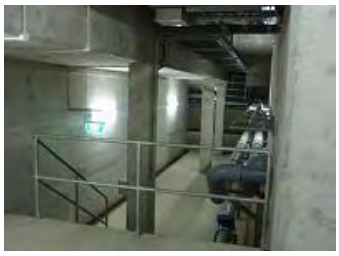
◆ Tang long industrial park WWTP（Hanoi City, Vietnam ） S:S / P:Problem

Equipment	Case	Evaluation	Photo
dehydration air drying bed	S	・air drying bed ・no dehydrator ・most appropriate in this place	
inflow sludge withdrawal pipe	S	・PVC pipes to reduce cost （sewgae inflow pipe、sludge withdrawal pipe）	
electric equipment operating panel	S	・start-stop transfer switch, operation indicator lamp, and fault lamp ・simple structure and easy to manipulate	
electrical instrumentation monitoring control system（monitoring room）	S	・simplified monitoring system in control panel ・easy to check operating condition ・effective in small-sized facilities	
MBR tank (membrane bioreactor)	P	・able to construct compact facilities and reduce the cost ・But necessary to manage appropreately(refilling membrane), if not it increases management cost ・very effective in small-sized facilities	
denitrification tank	P	・much scum on the surface of water ・no safety measures against falling etc. ・training in workplace safety	

◆ Bin Hung WWTP（Ho Chi Min City, Vietnam ） S:S / P:Problem

Equipment	Case	Evaluation	Photo
pipe gallery	S	・daylighting spaces in the roof ・good for daytime works	
pipe gallery work switches	S	・work switches at places ・good for maintenance ・waterproof caps are effective for electrical leakage	
final sedimentation tank scum skimmer	S	・spray nozzle infront of scum skimmer ・effective to crash scum and prevent laying-up/accumulation	
sludge withdrawal pipe	S	・many withdrawal pipes to reduce cost	
electric equipment emergency generator	S	・emergency generator with air cooling ・not need cooling water ・well managed	
electric equipment extra-high-voltage electric substation equipment	S	・electric substation equipment in outdoor ・no bluidings to cover, and fences are surrounding ・thought to be no P	

Equipment	Case	Evaluation	Photo
electrical instrumentation monitoring control system (monitoring room)	S	・concentrating-monitoring system ・whole working condition is visible ・recording function and historical data (easy data-collecting) ・able to manage facilities efficiently	
electrical instrumentation monitoring control panel graphic panel (monitoring room)	S	・graphic panels are effective for duplexed system ・increase construction cost	
landscape	S	・vegetations in treatment station ・care for landscape	
control building monitoring room	S	・monitoring room is located on the second floor ・able to command a panoramic view of plant	
control building monitoring room	S	・meeting space in monitoring room ・able to hold a meeting checking operating condition	
blower monitoring panel	S	・vibration measurement system attached to blowers ・able to collect data to keep up condition ・able to find trouble ealry	

Equipment	Case	Evaluation	Photo
electric equipment operating panel (filtration facilities)	S	・timer is attached on operating panel ・easy to adjust backwash time	
grit chamber inflow gate	P	・manually-operated inflow gate ・need time for emergency shutdown ・in case of emergency, electrically-operated or emergency shutdown device are needed	
grit chamber passageway-connection	P	・aisle connects screen room in grit chamber and pipe gallery ・no care for flood, measures are needed urgently	
water treatment facilities outdoor	P	・not care for the circulation of work (handrail runs between primary sedimentation tank and aeration tank)	
water treatment facilities outdoor	P	・carrying heavy loads many times ・better to set slopes that enables truck to go through	
pipe gallery lights	P	・many lights are set ・not easy to replace ・better to set lower place	

Equipment	Case	Evaluation	Photo
pipe gallery floor drainnage pump	P	・floor drainage pumps in the station ・able to reduce cost if setting can be customized depending on places	
pipe gallery stairs	P	・narrow steps ・fear of falling	
final sedimentation tank scum skimmer	P	・manually-operated scum skimmer ・handrails obstruct operating works ・necessary to improve working place	
final sedimentation tank scum skimmer	P	・a basket in a scum pit for trash separating ・heavy and not easy to carry, because of metal basket ・better to replace a plastic basket	
final sedimentation tank scum pit covering	P	・concrete coverings on scum pit ・heavy ・regular checking inside the pit is needed ・better to replace light materials for coverings over opening section	
disinfection hypochlorous acid-injection pump	P	・recommend washing water pipes as a care for clogging by the crystal of hypochlorous acid	

Equipment	Case	Evaluation	Photo
disinfection	P	・not easy to find chemical-injection place ・better to have visible inlet	
compost facility	P	・grating drain outlet ・fear of clogging by chaff	
compost facility deodorant soil filter (soil filter for deodorant)	P	・vinyl pipes(VP) for spray nozzle ・fear of UV degradation ・UV-resistant materials are desirable for outdoor facilities	
dehydration monitoring room	P	・individualized-monitoring room for dehydration facilities ・if it's included in the monitoring room for treatment facilities, cost would be able to be reduced	
electric equipment operating panel	P	・specification of switches on operating panel is not unified ・labels on switches ・specification should be unified in one facility	
  			

Equipment	Case	Evaluation	Photo
dehydration monitoring room	P	・precision equipment in monitoring room ・air conditioner is indispensable in thermal area ・a lot of free space (such as high ceiling) increases power cost	
landscape	P	・electric line in the plant ・not utilize under electric line ・vegetation are to be expanded and cost will increase	

◆ Bin Hung pump station（Ho Chi Minh, Vietnam ） S:S / P:Problem

Equipment	Case	Evaluation	Photo
switch room	P	・switch room underground ・important to check openeing section and to prepare for water stop ・better to move to overground,in the long run	
monitoring room	P	・no monitoring system ・few squipments ・easy to management	

◆ Setiabudi WWTP（DKI Jakarta, indonesia ）　　S:S / P:Problem

Equipment	Case	Evaluation	Photo
aerator	P	・some aerators in trouble ・need to be maintenanced	
electric equipment power control panel	P	・aged deterioration among electric parts ・recommend to replace	

◆ Sewon WWTP（DI Yogyakarta, indonesia）　　S:S / P:Problem

Equipment	Case	Evaluation	Photo
sludge withdrawal- enginepump	S	・enginepump for sludge withdrawal ・able to reduce the capacitance of substation equipment and receiving equipment ・it runs twice a year	
inflow water level gage	P	・water level gage is removed ・low inflow ・necessary to set water level gage or level switch	
sand separator	P	・separated sand accumulates around the device ・sanitarily, it isnecessary to care for sand spreading	
switch room	P	・switch room for extra-high-voltage electric substation equipment ・working hoses in the room. need to be cleared	

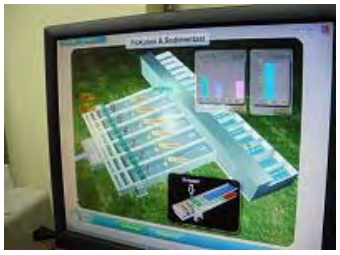
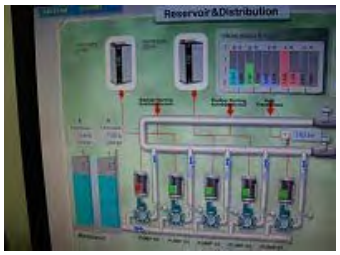
◆ East Jakarta Industrial Park WWTP（Bekasi, Indonesia ） S:S / P:Problem

Equipment	Case	Evaluation	Photo
balancing reservoir screen	S	・plastic container ・efficient cleaning and transporting	
final sedimentation tank scum pit	S	・froating trash is removed by hand ・simple structure	
final sedimentation tan	S	・no-operating facilites are maintenanced ・switch to operate regulally	
air drying bed	S	・air drying bed with roofs, and filter press dehydrator ・combined for dehydrating	
building care for flood	S	・around the building was flooded once ・water stop wall is placed in important facilities now	
intake pump care for flood	S	・relay box of submerged pump in a high place	

Equipment	Case	Evaluation	Photo
switch room	S	・switch boards around the room ・air conditioner works ・temperature is controled properly	
sparotor	P	・aerator was replaced with sparotors ・the shortage of DO in the pond ・current value is different from setting place ・load may be changed by water flow	

◆ Cikokol WTP（Tangerang, Indonesia ） S:S / P:Problem

Equipment	Case	Evaluation	Photo
screen in water-intake	S	・plastic truck for container ・easy to work	
old intake pump	S	・taking water from the river directly in previous ・now taking water with screen	
intake pump	S	・in pump checking, radiation thermometer measures the temperature of bearing ・Trend Control ・maintenanced properly	
inclined plate sdimenta	S	・addittional inclined plates were set to treat more sewage	

Equipment	Case	Evaluation	Photo
chemical injection	S	・inverter is set to adjust inject volume	
electric equipment power control panel	S	・case is set over the switches, as a care for switching error	
electrical instrumentation monitoring control system (monitoring room)	S	・concentrating-monitoring system ・whole working condition is visible ・ historical data (easy data-collecting) ・able to manage facilities efficiently ・3D graphics	
electrical instrumentation monitoring control system (monitoring room)	S	・water-supplying pressure is controled by inberter ・easy to check with the display of monitoring system	
intake pump switch room	S	・switch boards around the room ・air conditioner works ・temperature is controled properly	
intake pump emergency generator	S	・emergency generator with air cooling ・not need cooling water ・well managed ・general batteries for start-up	

Equipment	Case	Evaluation	Photo
electric equipment operating panel	S	・simple switches on the panel	
switch room air conditioner	S	・air conditioners for household use ・proper temperature control ・no functional Ps	
vent in distribution res	P	・vent is set in distribution reservoir ・care for dropping into by small animals	

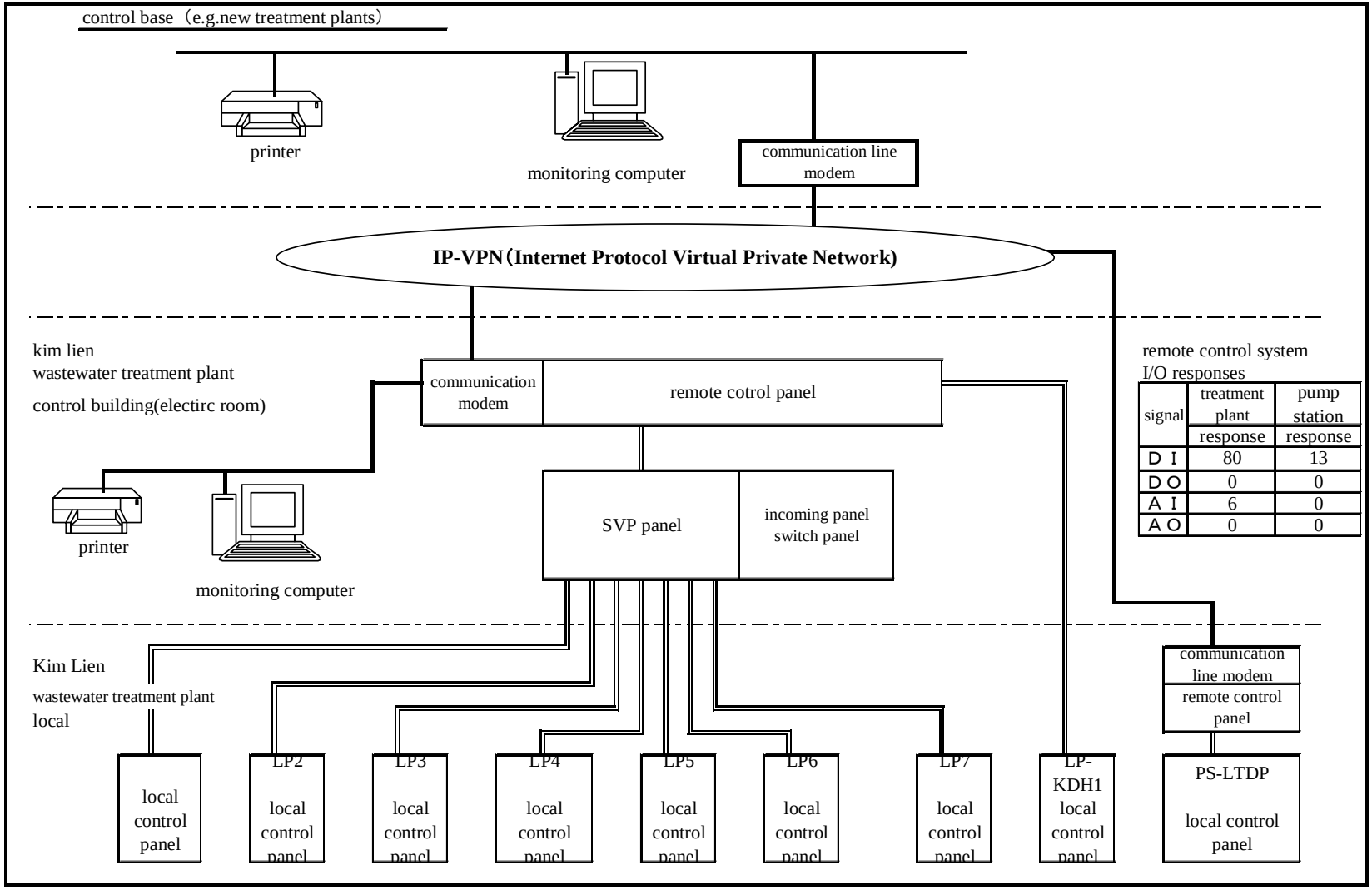
Appendix 3

Proposal for Remote Control System in Waste Water Treatment Plants in Hanoi

3. Proposal for remote control system in waste water treatment plants in Hanoi

3.1 Kim Lien wastewater treatment plant

3.1.1 Kim Lien wastewater treatment plant remote control system diagram（designed）



3.1.2 Monitoring items list for Kim Lien WWTP remote control system(designed)

Equipment	No.	Monitoring items			Remarks	DI		DO	AI	AO
		ON	OFF	TROUBL		single	common			
22kV power receive	—	○	○		power receiving/ blackout	1				
TRANSFORMER	—			○		1				
TRANSFORMER	—			○		1				
DISTRIBUTION PANEL	—			○		1				
LP1 （LOCAL CONTROL PANEL)	—			○		1				
LP2 （LOCAL CONTROL PANEL)	—			○		1				
LP3 （LOCAL CONTROL PANEL)	—			○		1				
LP4 （LOCAL CONTROL PANEL)	—			○		1				
LP5 （LOCAL CONTROL PANEL)	—			○		1				
LP6 （LOCAL CONTROL PANEL)	—			○		1				
LP7 （LOCAL CONTROL PANEL)	—			○		1				
SUPERVISERY PANEL	—			○		1				
EMERGENCY GENERATOR	—			○		1				
EMERGENCY GENERATOR	—			○		1				
FUEL TANK	—			○		1				
EMERGENCY GENERATOR	—	○	○			1				
GC FINE SCREEN	No.1	○	○	○ common	LP1	1	1			
GC FINE SCREEN	No.2	○	○		LP1	1				
GRIT PUMP	No.1	○	○		LP1	1				
GRIT PUMP	No.2	○	○		LP1	1				
GRIT SEPARATOR	—	○	○		LP1	1				
ET AGITATOR	No.1	○	○		LP1	1				
ET AGITATOR	No.2	○	○		LP1	1				
ET TRANSFER	No.1	○	○		LP1	1				
ET TRANSFER	No.2	○	○		LP1	1				
ET TRANSFER	No.3	○	○		LP1	1				
PST SLUDGE SCRAPER	—	○	○	○ common	LP2	1	1			
PST SLUDGE PUMP	No.1	○	○		LP2	1				
PST SLUDGE PUMP	No.2	○	○		LP2	1				
PST SCUM PUMP	—	○	○		LP2	1				
REACTOR FINE SCREEN	—	○	○		LP2	1				
ANAEROBIC MIXER	No.1	○	○		LP2	1				
ANAEROBIC MIXER	No.2	○	○		LP2	1				
ANOXIC MIXER	No.1	○	○		LP2	1				
ANOXIC MIXER	No.2	○	○		LP2	1				
AERATOR	No.1	○	○		LP2	1				
AERATOR	No.2	○	○		LP2	1				
RECIRCULATION PUMP	No.1	○	○	○ common	LP7	1	1			
RECIRCULATION PUMP	No.2	○	○		LP7	1				
FST SLUDGE SCRAPER	No.1	○	○		LP7	1				
FST SLUDGE SCRAPER	No.2	○	○		LP7	1				
RETURN SLUDGE PUMP	No.1	○	○		LP7	1				
RETURN SLUDGE PUMP	No.2	○	○		LP7	1				
RETURN SLUDGE PUMP	No.3	○	○		LP7	1				
FST SCUM PUMP	—	○	○		LP7	1				
RECYCLE WATER PUMP	No.1	○	○		LP7	1				
RECYCLE WATER PUMP	No.2	○	○		LP7	1				

Equipment	No.	Monitoring items			Remarks	DI		DO	AI	AO
		ON	OFF	TROUBL		single	common			
COAGULANT DOSING PUMP	No.1	○	○	○ common	LP3	1	1			
COAGULANT DOSING PUMP	No.2	○	○		LP3	1				
NaClO DOSING PUMP	No.1	○	○		LP3	1				
NaClO DOSING PUMP	No.2	○	○		LP3	1				
DEHYDRATOR	—	○	○	○ common	LP4	1	1			
COAGULATOR	—	○	○		LP4	1				
SLUDGE CAKE HOPER	—	○	○		LP4	1				
SLUDGE CAKE HOPER	—	○	○		LP4	1				
POLYMER TANK AGITATOR	—	○	○		LP4	1				
POLYMER DOSING PUMP	—	○	○		LP4	1				
SLUDGE FEED	—	○	○		LP4	1				
BOOSTER PUMP	—	○	○		LP4	1				
WASHWATER	—	○	○		LP4	1				
FILTRATE RETURN PUMP	No.1	○	○	○ common	LP5	1	1			
FILTRATE RETURN PUMP	No.2	○	○		LP5	1				
THICKENED SLUDGE SCRAPER	—	○	○		LP5	1				
ODOR EXTRACTION FAN		○	○	○ common	LP6(N.D.)	1	1			
THICKENED SLUDGE PUMP	—	○	○		LP6(N.D.)	1				
AERATION BLOWER	No.1	○	○		LP6	1				
AERATION BLOWER	No.2	○	○		LP6	1				
AERATION BLOWER	No.3	○	○		LP6	1				
DRAINAGE PUMP(DEHYDRATOR	—	○	○		LP6(N.D.)	1				
DEHYDRATOR	—				LP-KDH1					
COAGULATOR	—				LP-KDH1					
MOTOR FOR UPPER CLOTH	—				LP-KDH1					
MOTOR FOR LOWER CLOTH	—				LP-KDH1					
PRIMARY SLUDGE FLOW	—				SVP(integrating meter)	1				
EXCESS SLUDGE FLOW	—				SVP(integrating meter)	1				
INFLUENT SEWAGE FLOW	—				SVP(integrating meter)	1				
EQUALIZATION TANK WATER LEVEL	—			○ common	LP1					
EQUALIZATION TANK WATER LEVEL	—				LP1					
PST SCUM PIT WATER LEVEL LL	—			○ common	LP2					
PST SCUM PIT WATER LEVEL HH	—				LP2					
REACTOR(A)LL	—				LP2					
REACTOR(A)L	—				LP2					
REACTOR(B)LL	—				LP2					
REACTOR(B)L	—				LP2					
FST SCUM PIT WATER LEVEL LL	—				LP2					
FST SCUM PIT WATER LEVEL HH	—				LP2					
RECYCLE WATER PIT WATER LEVEL	—				LP2					
RECYCLE WATER PIT WATER LEVEL	—				LP2					
NaOCl strage tank LEVEL L	—			○ common	LP3					
NaOCl strage tank LEVEL HH	—				LP3					
Coagulant StorageTank LEVEL L	—				LP3					
Coagulant StorageTank LEVEL HH	—				LP3					
DEHYDRATOR LEVEL ALARM	—			○ common	LP4					
DEHYDRATOR LEVEL ALARM	—				LP4					
DEHYDRATOR LEVEL ALARM	—				LP4					
DEHYDRATOR LEVEL ALARM	—				LP4					
DEHYDRATOR LEVEL ALARM	—				LP4					
DEHYDRATOR LEVEL ALARM	—				LP4					

Equipment	No.	Monitoring items			Remarks	DI		DO	AI	AO
		ON	OFF	TROUBL		single	common			
FILTRATE RETURN PIT LEVEL LL	—			○ common	LP5					
FILTRATE RETURN PIT LEVEL HH	—				LP5					
DEHYDRATOR LEVEL ALARM	—			○ common	LP6					
DEHYDRATOR LEVEL ALARM	—				LP6					
UNKNOWN ARALM	—			○ common	LP7 (8 responses because real responses are unknown)					
UNKNOWN ARALM	—									
UNKNOWN ARALM	—									
UNKNOWN ARALM	—									
UNKNOWN ARALM	—									
UNKNOWN ARALM	—									
UNKNOWN ARALM	—									
UNKNOWN ARALM	—									
UPPER CLOTH LIMIT SWITCH	—			○ common	LP-KDH1		1			
UPPER CLOTHE	—				LP-KDH1					
CLOTH	—				LP-KDH1					
GRAVITY DEHYCRATION ZONE	—				LP-KDH1					
LOWER CLOTH LIMIT SWITCH	—				LP-KDH1					
LOWER CLOTHE	—				LP-KDH1					
CLOTH DEVIATION	—				LP-KDH1					
PLC BATTERY POWER	—				LP-KDH1					
					total	80		0	0	0

Monitoring items for instrumentation equipment (analog signal)

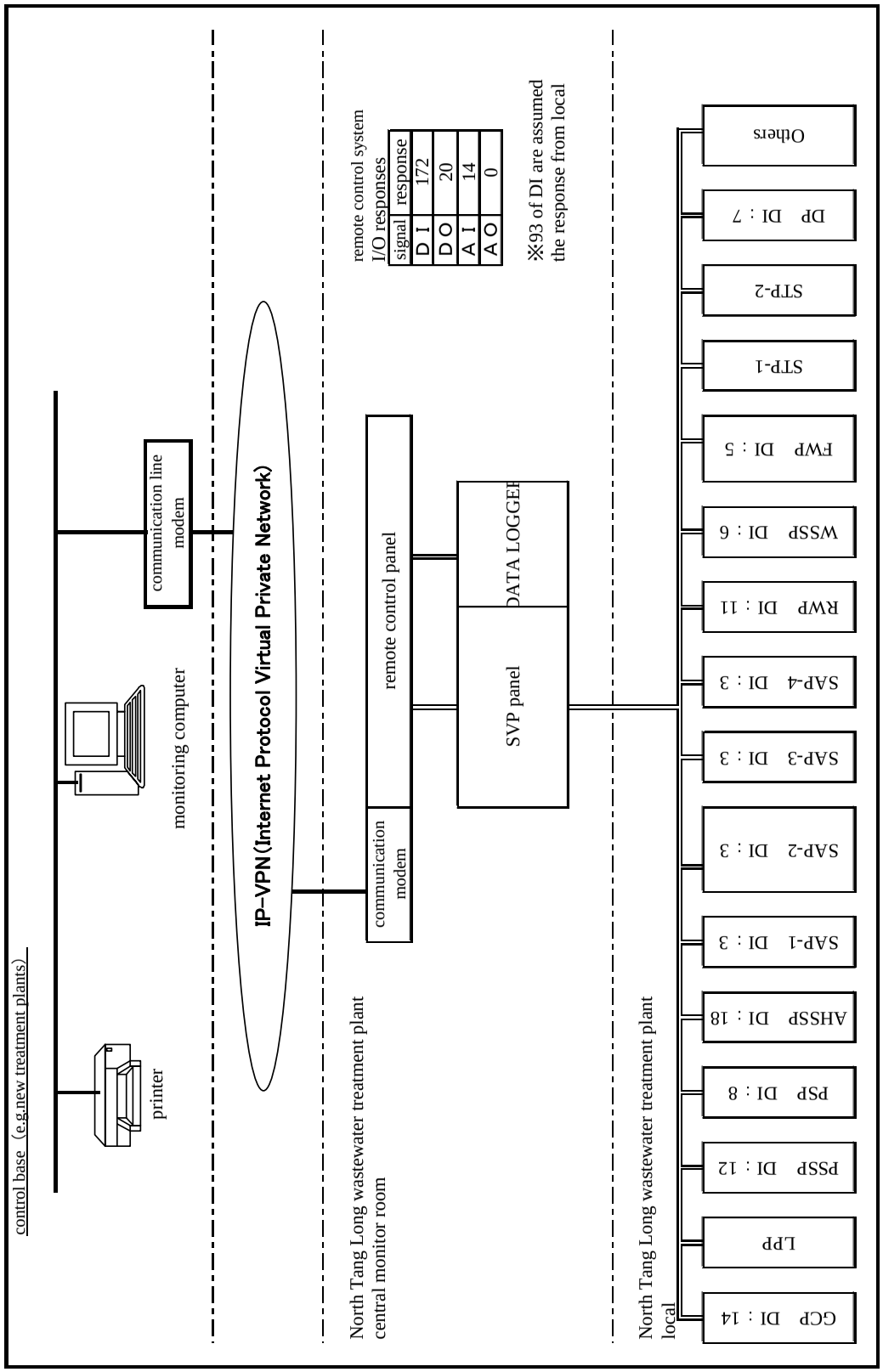
Equipment	No.	Monitoreing items			Remarks	DI		DO	AI	AO
		measure				single	common			
EQUALIZATION TANK WATER LEVEL	—	○			SVP(controller)				1	
PRIMARY SLUDGE FLOW	—	○			SVP(controller)				1	
EXCESS SLUDGE FLOW	—	○			SVP(controller)				1	
INFLUENT SEWAGE FLOW	—	○			SVP(controller)				1	
DISSOLVED OXYGEN(aeration tank)	No.1	○			SVP(RECORDER)				1	
DISSOLVED OXYGEN(aeration tank)	No.2	○			SVP(RECORDER)				1	
CIRCULATING FLOW	No.1	—			local only					
CIRCULATING FLOW	No.2	—			local only					
OUTFLOW WATER	—	—			local only					
TRANSPARENCY(SS)	—	○			only outflow				1	
					total	0	0	0	7	0

3.1.3 Monitoring items list for Kim Lien Pump station remote control system

Equipment	No.	Monitoring items			Remarks	DI		DO	AI	AO
		ON	OFF	TROUBL		single	common			
KL Pump Station Transfer Pump	No.1	○	○	○		1				
KL Pump Station Transfer Pump	No.1				AUTO	1				
KL Pump Station Transfer Pump	No.2	○	○	○		1				
KL Pump Station Transfer Pump	No.2				AUTO	1				
KL Pump Station Transfer Pump	No.3	○	○	○		1	1			
KL Pump Station Transfer Pump	No.3				AUTO	1				
KL Pump Station Transfer Pump	—	○	○	○		1				
Deodorizer for pumping station	—	○	○	○		1				
KL Pump Station Generator	—	○	○	○		1				
TRANSFER PIT WATER LEVEL LL	—			○		1				
TRANSFER PIT WATER LEVEL HH	—			○		1				
COMMECIAL POWER	—				BLACKOUT	1				
					total	13		0	0	0

3.2 North Tang Long wastewater treatment plant

3.2.1 North Tang Long wastewater treatment plant remote control system diagram (designed)



3.2.2 Monitoring items list for North Thang Long WWTP remote control system

Equipment	No.	Monitoring items			remarks	DI		DO	AI	AO
		ON	OFF	trouble		single	common			
COMMERCIAL	—	○			purchased power/ power receiving	1				
GENERATOR	—	○			in-house power generation	1				
GCP	—			○	breaker・thermal alarm		1			
LPP	—			○	breaker・thermal alarm		1			
PSSP	—			○	breaker・thermal alarm		1			
PSP	—			○	breaker・thermal alarm		1			
AFSSP	—			○	breaker・thermal alarm		1			
CMBP	—			○	breaker・thermal alarm		1			
RWP	—			○	breaker・thermal alarm		1			
WSSP	—			○	breaker・thermal alarm		1			
FWP	—			○	breaker・thermal alarm		1			
DP	—			○	breaker・thermal alarm		1			
RMU	—			○	breaker・thermal alarm		1			
GP	—			○	breaker・thermal alarm		1			
BCP	—			○	breaker・thermal alarm		1			
SAP-1	—			○	breaker・thermal alarm		1			
SAP-2	—			○	breaker・thermal alarm		1			
SAP-3	—			○	breaker・thermal alarm		1			
SAP-4	—			○	breaker・thermal alarm		1			
STP-1	—			○	breaker・thermal alarm		1			
STP-2	—			○	breaker・thermal alarm		1			
BP-4(BOOSTER PUMP)	—			○			1			
BP-4 LEVEL H	—									
BP-5 LEVEL HH	—									
BP-5	—			○			1			
BP-5 LEVEL H	—									
BP-5 LEVEL HH	—									
LVIP	—			○			1			
CSP	—			○			1			
LVDP	—			○			1			
INCOMING SEWAGE PIT LEVEL H	—			○		1				
LIFT PUMP PIT LEVEL H	—			○		1				
SECONDARY EFFLUENT TANK LEVEL	—			○		1				
FILTERED WATER TANK LEVEL H	—			○		1				
DEEP WELL LEVEL H	—			○		1				
NaClO STORAGE TANK LEVELH	—			○		1				
MIXED SLUDGE STORAGE TANK LEV	—			○		1				
FILTRATE TANK LEVEL H	—			○		1				
FeCl3 STORAGE TANK LEVEL H	—			○		1				
DEODORIZATION FACILITY NaClO STORAGE TANK LEVEL H	—			○		1				
DEODORIZATION FACILITY NaOH STORAGE TANK LEVEL H	—			○		1				
WATER SUPPLY UNIT LEVEL H	—			○		1				
LIFT PUMP PIT LEVEL L	—			○		1				
SECONDARY EFFLUENT TANK LEVEL	—			○		1				
FILTERED WATER TANK LEVEL L	—			○		1				
DEEP WELL LEVEL L	—			○		1				
NaClO STORAGE TANK LEVEL L	—			○		1				
NaClO STORAGE TANK FOR WELL WATER LEVEL L	—			○		1				

Equipment	No.	Monitoring items			Remarks	DI		DO	AI	AO
		ON	OFF	trouble		single	common			
MIXED SLUDGE STORAGE TANK LEV	－			○		1				
FILTRATE TANK LEVEL L	－			○		1				
FeCl3 STORAGE TANK LEVEL L	－			○		1				
FeCl3 STORAGE TANK FOR WELL WATER LEVEL L	－			○		1				
DEODORIZATION FACILITY NaClO STORAGE TANK LEVEL L	－			○		1				
DEODORIZATION FACILITY NaOH STORAGE TANK LEVEL L	－			○		1				
WATER SUPPLY UNIT LEVEL L	－			○		1				
POLYMER MAKE-UP UNIT L	－			○		1				
INCOMING SEWAGE FLOW	－				pulse integration	1				
RAS-1 WATER FLOW	－				pulse integration	1				
RAS-2 WATER FLOW	－				pulse integration	1				
PRIMARY SLUDGE FLOW	－				pulse integration	1				
WAS WATER FLOW	－				pulse integration	1				
EFFLUENT WATER FLOW	－				pulse integration	1				
INFLOW GATE	－	○	○		open－close	1		2		
LIFT PUMP(1)A fixed-speed	－	○	○			1		2		
LIFT PUMP(2)A adjustable-speed	－	○	○			1		2		
LIFT PUMP(2)B fixed-speed	－	○	○			1		2		
LIFT PUMP(1)B adjustable-speed	－	○	○			1		2		
DISCHARGE VALVE A	－	○	○		open－close	1		2		
DISCHARGE VALVE C	－	○	○		open－close	1		2		
DISCHARGE VALVE D	－	○	○		open－close	1		2		
DISCHARGE VALVE B	－	○	○		open－close	1		2		
SURFACE AERATOR A	－	○	○			1				
SURFACE AERATOR B	－	○	○			1				
SURFACE AERATOR C	－	○	○			1				
SURFACE AERATOR D	－	○	○			1				
SURFACE AERATOR E	－	○	○			1				
SURFACE AERATOR F	－	○	○			1				
SURFACE AERATOR G	－	○	○			1				
SURFACE AERATOR H	－	○	○			1				
SURFACE AERATOR I	－	○	○			1				
SURFACE AERATOR J	－	○	○			1				
SURFACE AERATOR K	－	○	○			1				
SURFACE AERATOR L	－	○	○			1				
LAMP TEST	－									
BUZZER STOP	－							1		
RESET	－				forced reset			1		
					Total	79		20	0	0

Monitoring items for instrumentation equipment (analog signal)

Equipment	No.	Monitoring items			Remarks	DI		DO	AI	AO
		measure				single	common			
LIFTING PUMP PIT LEVEL	－	○							1	
SLUDGE STORAGE TANK LEVEL	－	○							1	
INCOMING SEWAGE FLOW	－	○							1	
RAS-1 WATER FLOW	No.1	○							1	
RAS-2 WATER FLOW	No.2	○							1	
PRIMARY SLUDGE FLOW	－	○							1	
WAS WATER FLOW	－	○							1	
EFFLUENT WATER FLOW	－	○							1	
AERATION TANK-1 DO	No.1	○							1	
AERATION TANK-2 DO	No.2	○							1	
NaOH STORAGE TANK pH	－	○							1	
LIHTING PUMP ROTATION SPEED	No.1	○							1	
LIHTING PUMP ROTATION SPEED	No.2	○							1	
TRANPARENCY(SS)	－	○			check outflow quality				1	
					Total	0	0	0	14	0

3.2.2 Monitoring items list for North Thang Long WWTP remote control system（motors）

Equipment	Number	Monitoring items			Remarks	Panel	DI	DO
		ON	OFF	Trouble				
Inflow gate	1	○	○	○	trouble：SVP panel alarm	GCP		
Grit chamber inflow gate	3							
Coarse screen	3							
Grit pump	9	○	○	○	trouble：SVP panel alarm	GCP	9	
Grit separator	1	○	○	○	trouble：SVP panel alarm	GCP	1	
Grit container	2							
Fine screen	3	○	○	○	trouble：SVP panel alarm	GCP	3	
Fine screenings conveyor	1	○	○	○	trouble：SVP panel alarm	GCP	1	
Screenings container	4							
Grit chamber outflow stoplog	3							
Grit pump hoist	1					GCP		
Container hoist	1					GCP		
Lift pump(1)	2	○	○	○	trouble：SVP panel alarm	LPP		
Lift pump(2)	2	○	○	○	trouble：SVP panel alarm	LPP		
Discharge valve	4	○	○	○	trouble：SVP panel alarm	LPP		
Drainage pump	1					LPP		
Lift pump hoist	1					LPP		
PST Inflow gate	6							
Primary sedimentation tank sludge	6	○	○	○	trouble：SVP panel alarm	PSSP	6	
Primary sedimentation tank scum	6	○	○	○	trouble：SVP panel alarm	PSSP	6	
Primary sludge valve	6	○	○	○	trouble：SVP panel alarm	PSP	6	
Primary sludge pump	2	○	○	○	trouble：SVP panel alarm	PSP	2	
PST bypass gate	1							
Reactor Inflow weir	6							
RAS flow control weir	6							
Anaerobic tank mixer	6	○	○	○	trouble：SVP panel alarm	AHSSP	6	
Surface aerator	12	○	○	○	trouble：SVP panel alarm	SAP-1～4	12	
Channel mixing blower	2					CMBP		
Gas filter	1							
Blower hoist	1							
FST Inflow valve	6							
Final sedimentation tank sludge scraper	6	○	○	○	trouble：SVP panel alarm	AHSSP	6	
Final sedimentation tank scum skimmer	6	○	○	○	trouble：SVP panel alarm	AHSSP	6	
RAS pump	4	○	○	○	trouble：SVP panel alarm	RWP	4	
WAS extraction valve	2	○	○	○	trouble：SVP panel alarm	RWP	2	
Drainage pump	5	○	○	○	trouble：SVP panel alarm	RWP	5	
PST inflow channel stoplog	2							
Bypass channel stoplog	1							
Reactor inflow channel stoplog	2							
FST inflow channel stoplog	2							
Disinfection tank inflow gate	1							
Disinfection tank bypass gate	1							
NaClO storage tank	1							
NaClO dosing pump	2	○	○	○	trouble：SVP panel alarm	WSSP	2	
NaClO dosing pump for well water	2	○	○	○	trouble：SVP panel alarm	WSSP	2	
NaClO storage tank for well water	1							
Spray pump	2	○	○	○	trouble：SVP panel alarm	FWP	2	
Auto-strainer for spray pump	1					FWP		
Sand filter supply pump	2	○	○	○	trouble：SVP panel alarm	FWP	2	
Auto-strainer for sand filter	1					FWP		
Sand filter	1							
Air compressor for sand filter	2					FWP		
Water supply unit for wastewater treatment faclilty	2					FWP		
Water supply unit for sludge treatment faclilty	2					FWP		

Equipment	Number	Monitoring items			Remarks	Panel	DI	DO
		ON	OFF	Trouble				
Belt washing pump	2			○	trouble：SVP panel alarm			
Sand filter supply pump from deep well	1	○	○	○	trouble：SVP panel alarm	FWP	1	
Sand filter for domestic use	1							
Water supply unit for domestic use	2					FWP		
Drainage pump	2					FWP		
Mixed sludge mixer	1			○	trouble：SVP panel alarm	STP-1		
Mixed sludge pump	2			○	trouble：SVP panel alarm			
Sludge dewaterer	2			○	trouble：SVP panel alarm			
Flocculator	2			○	trouble：SVP panel alarm			
Cake conveyor(1)	1			○	trouble：SVP panel alarm			
Cake conveyor(2)	1			○	trouble：SVP panel alarm			
Cake conveyer(2)				○	trouble：SVP panel alarm			
Cake hopper	1					STP-1		
Automatic polymer make-up unit	1							
Polymer feeder	1							
Polymer dosing pump	2			○	trouble：SVP panel alarm			
FeCl3 storage tank	1							
FeCl3 dosing pump	2	○	○	○	trouble：SVP panel alarm		2	
FeCl3 dosing pump for well water	2			○	trouble：SVP panel alarm	WSSP		
Air compressor for sludge treatment	2							
Air dryer	1							
Filtrate pump	2			○	trouble：SVP panel alarm	STP-2		
Drainage pump	2					STP-2		
Sludge dewaterer hoist	2					STP-2		
Maintenance hoist	1							
FeCl3 storage tank for well water	1							
Shovel loader	1							
Drainage pump	2							
Maintenance crane	1							
Tripod	1							
NaClO storage tank	1							
NaClO dosing pump	2	○	○	○	trouble：SVP panel alarm	DP	2	
NaOH storage tank	1							
NaOH dosing pump	2	○	○	○	trouble：SVP panel alarm	DP	2	
Circulation pump	2	○	○	○	trouble：SVP panel alarm	DP	2	
mist separator	1							
Deodorization fan	1	○	○	○	trouble：SVP panel alarm	DP	1	
Chemical scrubber	2							
Oil supply pump	1							
Service tank	1							
Emergency Generator	0				automatic start & stop			
					Total		93	0

Appendix 4

Annual O&M Plan of Bin Hung Sewage Treatment Plant in Ho-Chi-Minh City, Vietnam (Draft)

Annual O&M plan
of
Bin Hung sewage treatment plant
in
Ho-Chi-Minh city, Vietnam
（Draft）

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CONTENTS

4.1 Outline of service –Example–

O&M service on Binh Hung sewage treatment plant are as follows:

(1) Operational works

- Operate and monitor a water treatment facility, a sludge treatment facility, a composting facility and relay pumping stations.
- Based on an operational procedure and a work implementation schedule, and under supervision by general manager, implement operation and monitoring appropriately.
- If necessity for the plant to take some measurements such as shut down or recession in operation, consult with the consignor.

(2) Maintenance and inspection works

- Implement maintenance and inspection of mechanical, electrical, and instrumental facilities, building exteriors, and buildings.
- Check function and efficiency of machineries by some measuring instruments in needed. Conduct periodic facility check to find any faults in early stages and to prevent breakdowns.
- Besides prevention of breakdowns, to maintain performances and extend lives of machineries, daily and periodic maintenance is required.
- Prepare a ledger to rationalize maintenance works and record maintenance history.
- Implement ground maintenance at the treatment plant and at the relay pumping stations.

(3) Repair works

- Repair the facilities and equipment adequately in order to exercise their full capacity.

(4) Water quality control works

- Water quality assessment will be implemented in accordance with the attached schedule.
- Maintenance of water analysis meters and water quality monitoring devices.
- Other works regarding water quality control in need of O&M.

(5) Utility Procurement works

- Procure consumable electrical or mechanical goods, chemicals for analysis, analysis instruments, industrial chemicals, fuel, and other subjects appropriately.

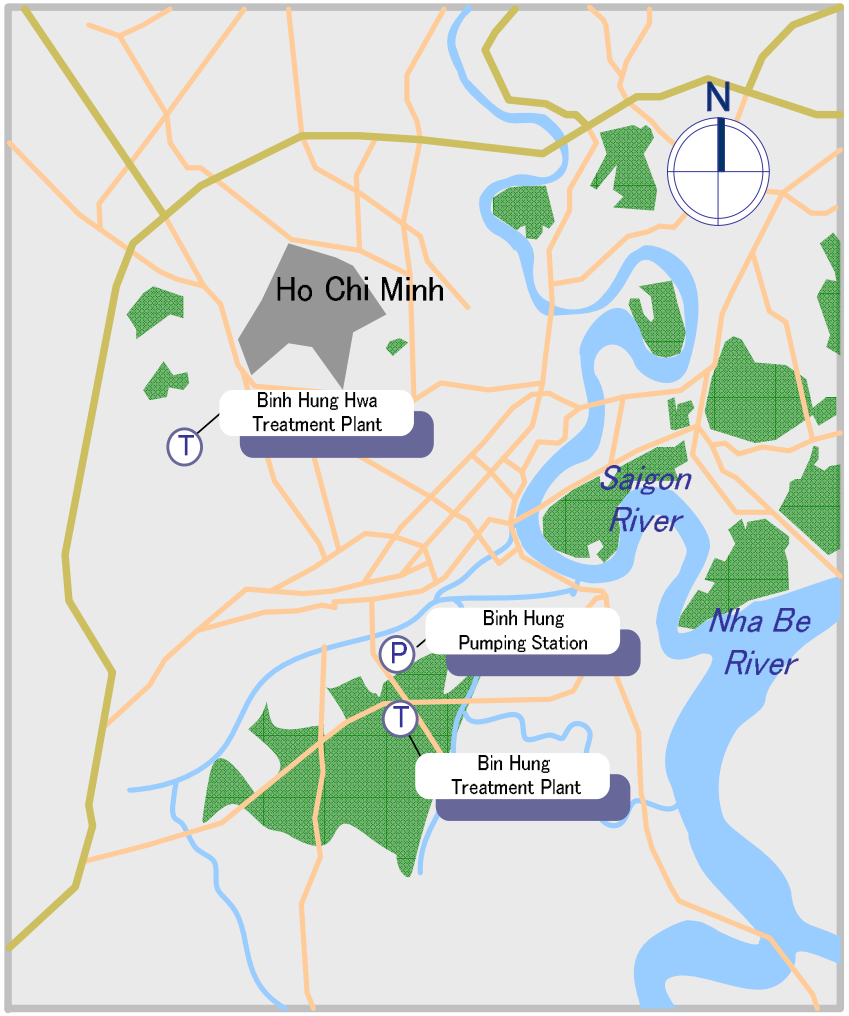
(6) Works for Emergency State

- Prepare work system to secure staff for emergency state, such as, heavy rain, typhoon, earthquake, serious accidents or breakdowns, unexpected power failure, abnormal influent rate or quality, and equipment troubles.
- In case of some accidents, take necessary measurements immediately. and report the causes, damage states, and developments of accidents to the consignor without delay.

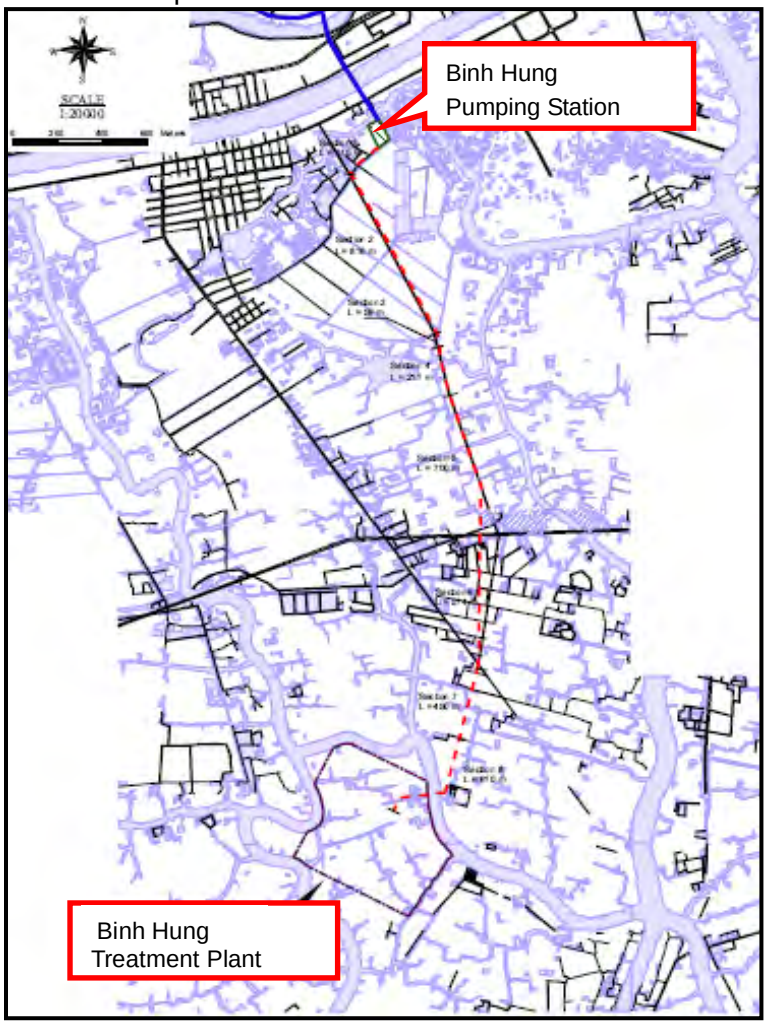
(7) Others

- Provide sufficient patrol and guard to protect the plant against unconcerned person and equipment to be damaged or goods to be stolen.
- By regulating safety code and taking required measurements, try to prevent workmen's accidents.

4.2 Service Implementation Map



Detailed Map



4.3 List of Facilities

<table>
<tr><th>Facility Classification</th><th>Name of Facility</th><th>Year of Commencement of Operations</th><th>Capacity m^3/day</th><th>Current Influent Volume m^3/day</th><th>Discharge</th></tr>
<tr><td rowspan="2">Pumping station</td><td>Binh Hung relay pumping station</td><td>2009</td><td>141,000</td><td>30,000</td><td>To Binh Hung treatment plant</td></tr>
<tr><td colspan="5">The relay pumping station consists of pumping facility and a grit chamber. Planned capacity is 192,000m3/day. It located on wet land between Dong Dieu Road and the Nho canal. The plottage is about 0.6 ha.</td></tr>
<tr><td rowspan="2">Treatment plant</td><td>Binh Hung treatment plant</td><td>2009</td><td>141,000</td><td>30,000</td><td>To Tac Ben Ro River</td></tr>
<tr><td colspan="5">The treatment plant was constructed for Binh Chanh district and Binh Hung district. The plottage is about 41.3 ha.
This site is surrounded by Ben Ro river on the north and east sides, Xom Cui channel on the west side, and a small channel on the south side. And the site is divided into two, north and south, by a high voltage power cable running east to west.
On a total project plan, the plant adopts Conventional activated sludge method for water treatment. The plant was designed based on the total project plan.
On the other hand, on the 1st and 2nd phase, the plant adopts a Modified aeration method because the method has priority as follows; an initial cost is lowest, it can achieve the effluent criteria BOD 50mg/L, and it can be easily converted into conventional activated method.
Water treatment facility consists of :(i) influent pumps, (ii) primary sedimentation tanks, (iii)aeration tanks, (iv)final sedimentation tanks, and (v) chlorination tanks.
Sludge treatment facility consists of : (i)gravitational thickeners, (ii) centrifugal thickeners , (iii)dewatering machines, and (iv)composting facility.
Design condition
<table><tr><th>Phase</th><th>Designed sewage volume</th><th>Designed influent quality</th><th>Designed effluent quality</th></tr><tr><td>1st present phase</td><td>141,000 m^3/day</td><td rowspan="3">BOD : under 163mg/L
SS : under 163mg/L</td><td>BOD: under 50mgL
SS: under 100mg/L</td></tr><tr><td>2nd</td><td>469,000 m^3/day</td><td>BOD: under 50mgL
SS: under 100mg/L</td></tr><tr><td>3rd</td><td>512,000 m^3/day</td><td>BOD: under 20mgL
SS: under 50mg/L</td></tr></table></td></tr>
</table>

4.4 List of Major Facility Specifications

(1) Pumping station

CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Grit Chamber – Lift Pump Facility	EMERGENCY GATE	Cast Iron Made Sluice Gate	1500mmW×1500mmH	3.7	1	
	Fine Screen	Steel Made	3500mmW×3800mmH	3.7	1	
	Lift Pump(1)	Submerged sewage pump	φ700mm x 66.7m3/min x 14m	220	2	1
	Grit Removal Equipment	Grab bucket Type	5000mmW×19500mmH	6.2kW×2、0.4kW×2、1.5kW×2		

(2) Wastewater treatment plan

CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Grit Chamber – Lift Pump Facility	Inflow Gate	Square Gate	W1,500mm x H1,500mm	–	2	0
	Coarse Screen	Bar screen	Slit Width 100mm x mounting angle 60°	–	2	0
	Chain Block	Manual type	1ton x 4.5m	–	1	0
	Lift Pump(1)	Submerged sewage pump	φ700mm x 66.7m3/min x 14m	220	2	1
	Siphon Break Valve	Motor Opereted Ball Valve	φ150mm	Motor 0.2	2	1
	Connecting Gate	Square Gate	W1,500mm x H1,500mm	–	1	0
	Hoist	Normal type	10ton x 12m	Hoisting 10	1	0

CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Grit Chamber – Lift Pump Facility	Floor Drainage Pump	Submerged wastewater pump	φ65mm x 0.3m3/min x 10m	2.2	6	6
	Distribution Weir	Movable Weir	W1,000mm x H1,000mm	–	4	0
Blower Facility	Blower(1)	Gear-accelerated single-stage turbo blower	φ600mm x φ500mm x 360m3/min x 66.6kPa	Main Motor 480 Motor for Aux. Oil Pump 2.2 Motor for Inlet Guide Vane Actuator 0.4	1	1
	Suction Silencer	Vertical	φ600mm x φ600mm	–	1	1
	Discharge Silencer	Vertical	φ500mm x φ500mm x φ500mm	–	1	1
	Blowoff Silencer	Horizontal	φ500mm x φ500mm	–	1	1
	Discharge Valve(1)	Motor-operated, outside screw, sluice valve	φ500mm	2.2	1	1
	Check Valve(1)	Swing type	φ500mm	–	1	1
	Anti Surge Valve(1)	Butterfly Valve	φ250mm	0.2	1	1
	Air Filter	Streaming dry type air filter	360m3/min	0.2	1	1
	Floor Drainage pump	Submerged wastewater pump	φ65mm x 0.3m3/min x 10m	2.2	2	0
	Crane	Double-Rail Hoist Type Overhead Crane	10ton x 14m	Hoisting 10 Traversing 0.85 Travelling 1.5 x 2	1	0
Wastewater Treatment Plant	Inflow Weir	Movable Weir	W500mm x H400mm	–	10	0
	Sludge Scraper	Chain flight type	W5,000mm x L13,000mm x water depth 3,000mm	0.4	10	0
	Scum Skimmer	Manual Pipe skimmer	φ300mm x about L4,500mm	–	20	0

CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Wastewater Treatment Plant	Scum Pump	Non-clogging type	φ80mm x 0.8m3/min x 10m	5.5	1	1
	Raw Sludge Pump	Non-clogging type	φ80mm x 0.5m3/min x 14m	5.5	2	1
	Raw Sludge Valve	Motor-operated sluice valve	φ150mm	0.2	10	0
	Bypass Gate	Square Gate	W1,000mm x H1,000mm	-	1	0
	Spray Nozzle			-	60	0
	Inflow Weir	Movable Weir	W500mm x H500mm	-	10	0
	Step Feeding Weir	Movable Weir	W500mm x H500mm	-	30	0
	Diffuser	Diffuser tube	120to150L/min・Tube x 24Tubes/header x 1header/riser	-	20sets	0
	Diffuser	Diffuser tube	120to150L/min・Tube x 18Tubes/header x 1header/riser	-	140sets	0
	Air Flow Control Valve	Motor-operated butterfly valve	φ350	0.4	10	0
	Antifoaming Spray	Spray Nozzle	φ20	-	200	0
	Inflow Gate	Square Gate	W500mm x H500mm	-	10	0
	Sludge Scraper	Chain flight type	W5,000mm x L26,000mm x water depth 3,500mm	0.4	10	0
	Scum Skimmer	Manual Pipe skimmer	φ300mm x about L4,500mm	-	20	0
	Scum Pump	Non-clogging type	φ80mm x 0.8m3/min x 10m	5.5	1	1
	Return Sludge Pump(25%)	Centrifugal screw impeller pump	φ250mm x 5.6m3/min x 6m	15	4	0

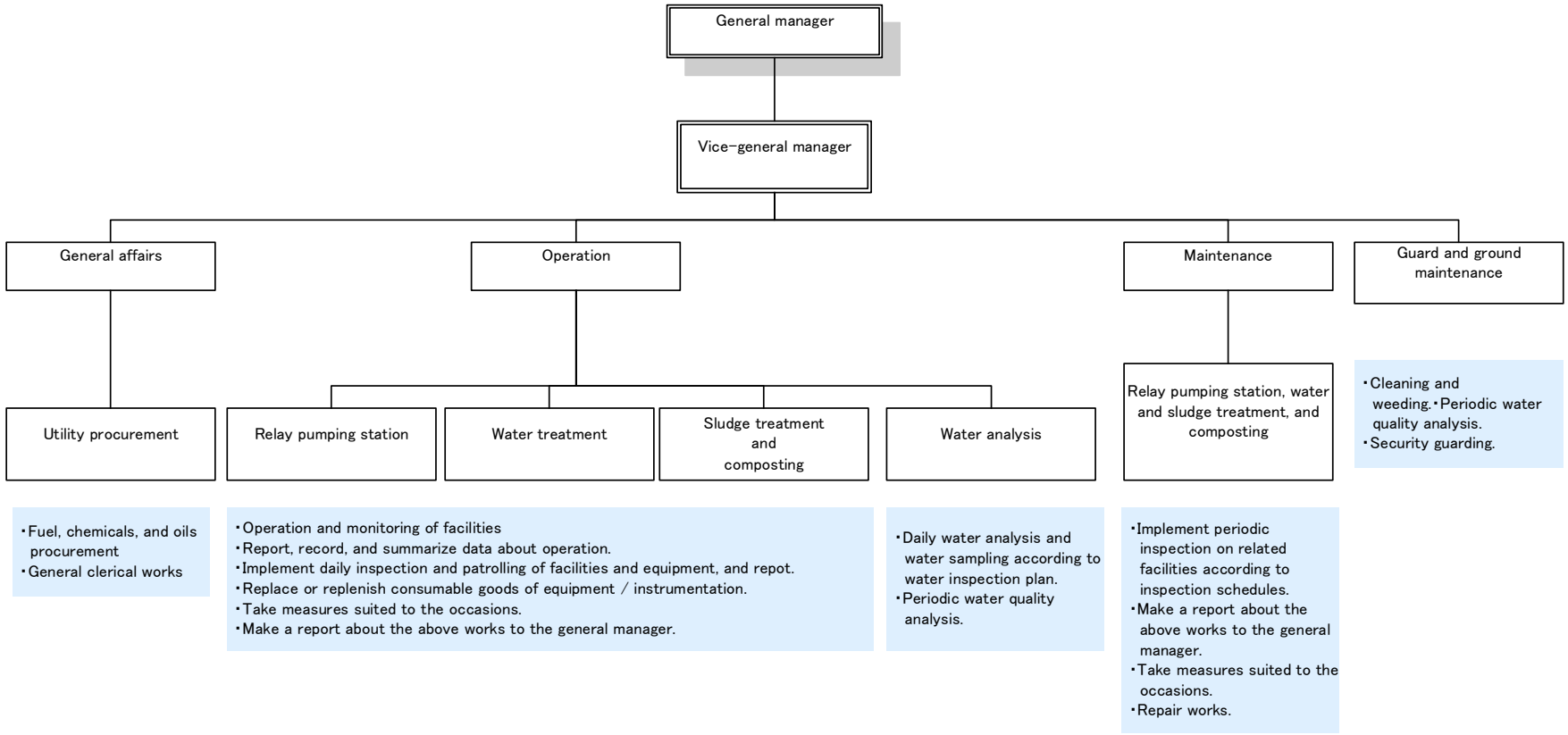
CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Wastewater Treatment Plant	Return Sludge Valve	Motor-operated sluice valve	φ350mm	0.4	10	0
	Excess Sludge Pump	Non-clogging type	φ100mm x 1.2m3/min x 13m	11	2	1
	Excess Sludge Valve	Motor-operated sluice valve	φ150mm	0.2	10	0
	Sludge Valve	Outside screw type	φ350mm	-	10	0
	Floor Drainage Pump	Submerged wastewater Pump	φ65mm x 0.3m3/min x 15m	5.5	7	7
Disinfection Facility	Inflow Gate	Square Gate	W2,000mm x H2,000mm	-	1	0
	Bypass Gate	Square Gate	W2,000mm x H2,000mm	-	1	0
	Sodium Hypochlorite Tank	Vertical stationary type	Maximum storage capacity 13m3	-	2	0
	Sodium Hypochlorite Pump	Diaphragm pump	φ25mm x 0.81～1.62L/min x 0.8MPa	0.4	2	1
Water Supply Facility	Secondary Effluent Gate	Square Gate	W1,000mm x H1,000mm	-	1	0
	Treared Water Supply Pump(1)	Horizontal shaft volute pump	φ150mm x φ125mm x 3.2m3/min x 30m	30	1	1
	Treared Water Strainer(1)	Automatic washing strainer	φ250mm x 6.4m3/min・unit x 0.3MPa	0.4	1	0
	Treared Water Supply Pump(2)	Horizontal shaft volute pump	φ125mm x φ100mm x 2.2m3/min x 30m	22	1	1
	Treared Water Strainer(2)	Automatic washing strainer	φ250mm x 6.6m3/min・unit x 0.3MPa	0.4	1	0
	Floor Drainage Pump	Submerged wastewater pump	φ65mm x 0.3m3/min x 15m	5.5	4	4
	Crane	Manual Operation Type Owerhead Crane	2.0ton x 4.5m	-	1	0

CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Water Supply Facility	Filtration Supply Pump	Horizontal shaft volute pump	φ80mm x φ65mm x 0.7m3/min x 17m	5.5	1	1
	Filtration Supply Strainer	Automatic washing strainer	φ100mm x 0.7m3/min・unit x 0.1MPa	0.4	1	1
	Sand Filter	Two-layer type pressure sand filter	φ2,400mm x H3,300mm x 36m3/h・unit	–	1	1
	Filtered Water Supply Pump	Horizontal shaft volute pump	φ125mm x φ100mm x 1.0m3/min x 38m	22	1	1
	Backwash Pump	Horizontal shaft volute pump	φ125mm x φ100mm x 2.7m3/min x 19m	15	1	1
	Air Wash Blower	Roots blower	φ100mm x 4.5m3/min x 44.1kPa	7.5	1	1
	Backwash Wastewater Pump	Non-clogging type	φ80mm x 0.4m3/min x 10m	3.7	1	1
	Air Comprssor	Transporable small-size air compressor	400L/min x 0.83MPa	3.7	1	1
	Dehumidifier	Refrigeration type	400L/min x 0.83MPa	0.25	1	0
Sludge Treatment Facility	Gravity Thickener	Centre-driven suspended type	φ14,000mm x side water depth 3,500mm	1.5	1	0
	Scum Skimmer	Manual pipe skimmer	φ250mm	–	1	0
	Thickened Sludge Pump	Non-clogging type	φ80mm x 0.7m3/min x 10m	5.5	1	1
	Thickener Effluent Pump	Non-clogging type	φ80mm x 0.4m3/min x 15m	7.5	1	1
	Floor Drainage Pump	Submerged wastewater pump	φ65mm x 0.3m3/min x 10m	2.2	1	1
	Excess Sludge Mixer	Vertical mixer	φ2,000mm	11	1	0
	Excess Sludge Feed Pump	Progressing cavity pump	φ250mm x φ200mm x 35to105m3/h x 35m	18.5	1	1

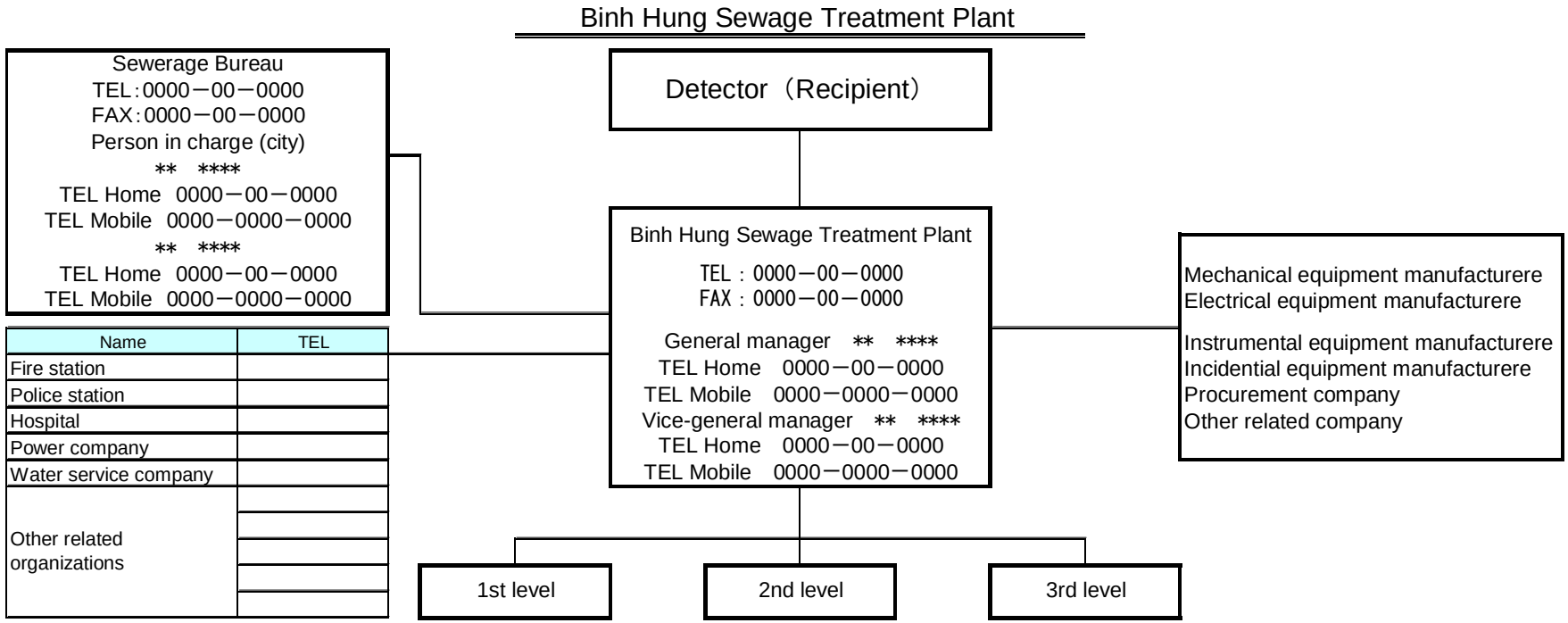
CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Sludge Treatment Facility	Centrifugal Thickener	Horizontal continuous centrifugal thickener	70m3/hr	Main Motor 90	1	1
	Crane	Double-Rail Hoist Type Overhead Crane	20ton x 18m	Hoisting 17 Traversing 1.5 Travelling 1.5 x 2	1	0
	Mixed Sludge Mixer	Vertical mixer	φ2,000mm	11	2	0
	Mixed Sludge Feed Pump	Progressing cavity pump	φ125mm x 15to45m3/h x 25m	7.5	1	1
	Centrifugal Dehydrator	Horizontal continuous centrifugal thickener	30m3/h	Main Motor 90 Oil Pressure Apparatus 45	1	1
	Cake Hopper	Motor-driven square type	10m3	1.5 x 2	1	1
	Polymer Hopper and Polymer Feeder	Varible continupus constant-rate feeder	Macimum 2L/min Maximum storage capacity 150l	0.4	1	1
	Polymer Dissolution Tank	Vertical agitation tank	φ2,400mm x H2,400mm x maximum10m3	5.5	1	1
	Polymer Feed Pump	Progressing cavity pump	φ80mm x 40to130L/min x 25m	2.2	1	1
	Water Supply Pump Unit	Pressure tank rype feed water unit	φ125mm x 2.62m3/min x 35m	18.5 x 2	1	0
	(Water Tank)	Tank Capacity 12m3	φ200mm (UNIT DISCHARGE SIZE)	-	1	0
	Air compressor	Transportable small-size air compressor	600L/min x 0.83MPa	5.5	1	1
	Dehumidifier	Refrigeration type	600L/min x 0.83MPa	0.5	1	0
	Crane	Double-Rail Hoist Type Overhead Crane	20ton x 18m	Hoisting 17 Traversing 1.5 Travelling 1.5 x 2	1	0

CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT (kW)	DUTY	STANDBY
Sludge Treatment Facility	Treated Water Inflow Valve	Motor-operated Sluice valve	φ250mm	0.4	1	0
	Dump Truck	Dump Truck	10ton	-	2	0
	Recycle Flow Mixer	Vertical Mixer	φ2,000mm	11	1	0
	Recycle Flow Pump	Non-clogging type	φ200mm x 5.1m3/min x 15m	30	1	1
Compost Facility	Mixing Machine	Automatic traverse and travel paddle type	φ2,200mm	Drive 90 Traversing 1.5 Travelling 1.5 x 2	2	0
	Suction Fan	Single-suction turbo fan	45m3/min x 3.5kPa	5.5	4	0
	Humidifying Pump	Submerged wastewater pump	φ65mm x 0.1m3/min x 20m	5.5	2	0
	Dump Truck	Dump Truck	10ton	-	4	0
	Shovel Loader	Shovel loader	2m3	-	9	0
	Truck Scale	Load cell type	Range 0to30 tons (measuring 0to20 tons)	1.1kVA	1	0
	Deodorization Soil Filter	Forced Ventilation	Air Flow 500m3/min x Filler 420m3	-	1set	0
	Deodorization Fan	Single-suction turbo fan	250m3/min x 3.0kPa	22	2	0
	Spray Water Pump	Submerged wastewater pump	φ65mm x 0.2m3/min x 25m	7.5	1	0
	Wastewater Drainage Pump	Submerged wastewater pump	φ65mm x 0.2m3/min x 25m	7.5	1	0

4.5 Organization Chart



4.6 Emergency Contact Network



Name	TEL
Fire station	
Police station	
Hospital	
Power company	
Water service company	
Other related organizations	

Emergency Dispatch System			
Dispatch level	Personnel	Name	TEL
1st level	Experts related to the concerned	① *** *****	0000-00-0000
		② *** *****	0000-00-0000
2nd level	Day shift workers adding to 1st level	③ *** *****	0000-00-0000
		④ *** *****	0000-00-0000
		⑤ *** *****	0000-00-0000
3rd level	Cooperators adding to 2nd level	⑥ *** *****	0000-00-0000
		⑦ *** *****	0000-00-0000
		⑧ *** *****	0000-00-0000
		Neighbor supportive system	0000-00-0000

4.7 Operation Schedule（Example Extracted）

4.7.1 Policy of operation

The operation policy of Binh Hung treatment plant（Present capacity 141,000m^3／day）is as follows:

- Set operational index as to maximize capacity of each facility or equipment,
- Operate according the above index and considering operational data and water quality test result, and
- Produce effluent which conforms to required quality level / effluent criteria.

Required quality level

Items	Required level	Effluent Criteria	Remarks
BOD(mg/L)			
SS (mg/L)			

4.7.2 Concept and procedure of operation

(1) Concept of sewage treatment

1) From inflow to disinfection process, operate the plant efficiently in corresponded to inflow quality and quantity.
2) Control MLSS in reaction tanks with index of BOD-SS load which leads good treated water quality.
3）Make it an operational rule to change aeration rate in proportion to inflow load. Adjust the rate with consideration of daily fluctuation and return flow load.
4）As for sludge generated from each process, prevent accumulation and putrefaction by controlling process volume basically corresponding to estimated generation rate and also to sludge-liquid surface, sludge concentration, and pH.

(2) Concept of sludge treatment

1) Process sludge based on a schedule by estimating sludge generation rate based on past record and on current water quality.
2) Control feed rate and withdrawing rate of sludge by confirming solids mass balance.
3) Control retention time and sedimentation time at each process to keep good conditions of sludge.
4) Maintain targeted water content and stabilize sludge condition to be fed to composting facility.

(3) Operation of each process

1) Sewage treatment capacity

i) Treatment rate

Estimate treatment volume by adding influent volume and recycle flow volume. Then set operational conditions within design criteria corresponding to the estimated load.

ii) Influent quality

Sampling points should be decided where influent of recycle flow can be avoided. From result of daily water tests and observation at patrol, monitor abnormal influent.

2) Pumping Well and Sewage Pump

i) Setting of pumping rate

Monitoring water level of pumping wells, operate pumps within the set pumping rate.

ii) Prevention of putrefaction

To prevent sludge accumulation and scum generation, lower the water level and flush regularly. It restrains putrefaction and prevents odor and bulking generation.

3) Primary sedimentation tank

i) Proper usage of tanks

Determine the number of tanks to be used in consideration of settling time and surface load. A nd reconsider it by checking effluent SS and BOD and their removal ratio.

ii) Prevention of putrefaction

Determine sludge withdrawal rate on solids basis. At primary sedimentation tanks, maintain soli d liquid interface as low as possible to suppress anaerobiosis.

iii) Effluent

Understand fluctuation of effluent load from primary sedimentation tanks to reaction tanks by di urnal examination of effluent quality.

4.8 Major Indexes of Monitoring and Control Items

Division	Item		Purpose	Max.	Min.	unit
Influent	Quantity of water		Check the fluctuation of the influent	○○	○○	m^3
	Water level		Cooperate with the pumping station	○○	○○	m
	Water	Transparency	Check the abnormal inflow water	○○	○○	cm
		pH		○○	○○	—
Primary Sedimentation Tank	Sludge-Liquid interface		Check the situation of sedimentation	○○	○○	m
	Water	pH	Prevent putrefaction	○○	○○	—
		SS	Check the load to the aeration tank	○○	○○	mg/L
	Raw Sludge	Volume	Set the volume of the withdrawn sludge	○○	○○	m^3
		Concentration		○○	○○	%
Aeration Tank	Water	MLSS	Check MLSS, BOD/SS load	○○	○○	mg/L
		DO	Check the air volume	○○	○○	mg/L
		pH	Check the condition of treated water	○○	○○	—
		NH4-N,NOx-N		○○	○○	mg/L
		SV_{30} ・SVI	Check the situation of sedimentation	○○	○○	—
	Volume of air		Check the air volume	○○	○○	m^3
Secondary Sedimentatio Tank	Sludge-Liquid interface		Check the situation of sedimentation	○○	○○	m
	Return sludge	Volume	Set the volume of return sludge ratio	○○	○○	%
		Concentration		○○	○○	mg/L
	Excess Sludge	Volume	The setting of the quantity of drained sludge	○○	○○	m^3
Discharge	Water	Transparency	Check the air volume	○○	○○	cm
		Residual Chlorine	Check the disinfection	○○	○○	mg/L
Gravity Thickening Tank	Thickend Sludge	Volume	The setting of the volume of withdrawn sludge	○○	○○	m^3
		Concentration		○○	○○	%
Centrifugal thickener	Thickend Sludge	Concentration	Check the situation of thickend sludge	○○	○○	%
Dehydrator	Watrer Content		Check the sludge cake properties	○○	○○	%
Hopper	Weight of Sludge Cake		Check the sludge cake volume	○○	○○	t
Compost	Volume of Compost		Check the compost volume	○○	○○	m^3

4.9 Daily Work Plan（Extracted）

Facility	Section	Works	Frequency	
Bihn Hung Treatment Plant	Operation	Operation and monitoring in the monitoring room.	Continuous	365/year
		Water treatment, suludge treatment and composing facility.		
		Oeration at site. (Scum skimmer, etc.)	3-5times/day	-
		Preparation of work transfering sheets.	At any time	365/year
		Daily water analysis.		
		Daily work reports.		
		Daily patrolling inspection.		
		Regulation of chemical dasage. Stock management of chemical.		
		Preparation of operation reports of outside facilities.		
	Maintenance	Weekly inspection on equipment.	once/week	52/year
	Water quality control	Water analysisi regarding operation.	daily	365/year
	Ground maintenance	Cleaning of the monitoring roon.	daily	365/year
		Cleaning of inside the building.(For each section)	5times/week	250/year
	Others	Lock and check.	daily	365/year
Relay Pumping Station	Operation	Operation and monitoring in the monitoring room.	Continuous	365/year
		Oeration at site.(Grit removal by the grab crane)	3times/week	156/year
		Preparation of work transfering sheets.	At any time	365/year
		Daily water analysis.		
		Daily work reports.		
		Daily patrolling inspection		
	Water quality control	Regular water sampling	According to the schedule	
		Irregular water sampling	Irregular	-
	Ground maintenance	Cleaning of inside the building.(For each section)	once/week	52/year
		Cleaning the premisis.	once/week	52/year
	Others	Lock and check.	daily	365/year
Others	Emergency	Correspondence at an emergency.	-	-
		Liaison	-	-
		Various correspondence on operational works.	-	-

4.10 Water Quality Inspection Schedule

(1) Schedule

Marks ◎:Daily ○:3-5times/week ◇:1-4times/month □:Monthly ■:Once-twice a year

	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Remarks
1. Daily examination	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	
2. Periodic examination	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	◇	
3. Diurnal examination					■					■			
4. Legal-required examination	□	□	□	□	□	□	□	□	□	□	□	□	

(2) List of Water Quality Inspection

Marks ◎:Daily ○:3-5times/week ◇:1-4times/month □:Monthly ■:Once-twice a year

Examination	Item	Influent	Primary Sedimentation Tank		Aeration Tank		Secondary Sedimentation Tank	Discharge	Primary/Secondary Sedimentation Tank		Gravity Thickening Tank	Centrifugal Thickener	Dehydrator	Compost
			Inflow	Outflow	Outflow	Return Sludge			Raw Sludge	Excess Sludge				
Daily	Water temperature	◎	○	◎	◎			◎			○			
	Transparency	◎	○	◎			◎	◎						
	pH	◎	○	◎	◎			◎	○	○	○			
	DO				◎									
	SV_{30}				◎									
	Residual Chlorine							◎						
	Watrer Content												◎	◎
	SS	○	○	○			○	○			◇	◇		
	COD	○	○	○			○	○						
Periodic	BOD	◇		◇				◇						
	MLSS (RSSS)				○	○								
	MLVSS				◇									
	TS								◇	◇	◇	◇		
	VTS								◇		◇			
Diurnal	SS, BOD	■		■				■						
Legal-required	Leagal Items	□						□						

(3) Method of Water Analysis

Item	Out-sourcing	Test method	Remarks

4.11 Periodic Work Schedule (Extracted)

department	Service Contents		Enforcement frequency	20XX												Note
				1	2	3	4	5	6	7	8	9	10	11	12	
Maintenance Service	Vibration Measurement	Blower Facility	Every 3 months		○			○			○			○		
		Return Sludge Pump	Every 6 months				○						○			
	Oil Diagnosis	Sludge Scraper	Yearly						○							
	Monthly inspection	Blower Facility	monthly	○	○	○	○	○	○	○	○	○	○	○	○	
		Sludge Scraper	monthly	○	○	○	○	○	○	○	○	○	○	○	○	
	Every 3 months inspection	Blower Facility	Every 3 months		○			○			○			○		
		Return Sludge Pump	Every 3 months	○			○			○			○			
		Sludge Scraper	Every 3 months			○			○			○			○	
	Every 6 months inspection	Blower Facility	Every 6 months	○						○						
		Return Sludge Pump	Every 6 months	○						○						
		Sludge Scraper	Every 6 months			○						○				
	Yearly inspection	Blower Facility	Yearly							○						
		Return Sludge Pump	Yearly							○						
		Sludge Scraper	Yearly									○				

4.12 Inspection Criteria of Equipment

Machinery

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
Blower Facility	Blower	MB single-stage turbo blower	The main body	Check and record the meters (air flow rate, discharge pressure, axle hole temperature, etc.)	-	242	A	-
				Check for abnormal noise, vibration, fever, and nasty smell.	-	242	B	-
				Appearance inspection (rust, leak, and damage)	-	242	A	-
				Check operation situation of the solenoid valve and the flow relay.	-	12	A	-
				Check the volume of bearing cooling water.	-	242	A	-
				Check for loss of resilience and crack of the vibration proof rubber.	-	242	A	-
				Measure and a record vibration values.	-	4	C	f
				Tighten attachment bolts of main body.	-	2	B	-
				Check operation and display of protection instruments.	-	4	B	-
			Motor	Measure insulation resistances.	-	1	C	e
				Check for abnormal noise, vibration, fever, and nasty smell of motors	-	242	B	-
				Check and record current value.	-	242	A	-
				Check for tightness of attachment bolts.	-	1	B	-
				Check for damages, discoloration, and the stains of the brush repatriation device, the retainer, and the slip ring.	-	4	A	-
				Check damages, discoloration, and stains of the current collector part (bounds, a bearing, firm resolution, a coil).	-	4	A	-

Method・・・ A:Visual inspection B:Palpation/ Audio inspection C:Measurement

Tool・・・ a:Aquameter b:Grease gun c:Stopwatch d:Caliper e:Insulation resistance meter f:Vibration indicator g:tachometer h:Thickeness gauge i:Centralized oiling device j:Noise meter k:Ruler l:Circuit tester m:Thermometer n:Hydrometer o:Submersible pump p:Measure q:Calibrator r:Infrared thermometer s:Earth-resistance meter t:Electric relay tester u:Densimeter v:Clamp meter

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Meth od	Tool
Blower Facility	Blower	MB	Starting equipment	Check for abnormal noise, vibration, fever, and nasty smell.	–	156	B	–
		single-stage	Motor	Check and record current value.	–	1	C	v
		turbo blower		Check for tightness of attachment bolts.	–	1	B	–
				Check for tightness and heat signs of terminals.	–	2	A	–
			Starting equipment	Check for tightness of tightening bolts of each part.	–	1	B	–
				Check for abnormal noise, vibration, fever, and nasty smell of clutches.	–	156	B	–
				Check abrasion degree of the guide bush.	–	2	A	–
				Centering adjustment of clutches.	–	2	–	–
				Check for abrasion of linings.	–	2	A	–
Blower Facility	Discharge Valve	Motor type	The main body	Check opening.	–	156	A	–
				Appearance inspection (rust, leak, and damage)	–	156	A	–
				Check switching action. Check for abnormal noise, and vibration.	–	4	B	–
				Check position of complete opening and shutting. Check if water stops on shutting position.	–	4	A	–
				Inspection of the inside (the abrasion , the transformation, and the damage of the seat and the stem).	–	1	A	–
				Check for abrasion and transformation of the shaft bearing.	–	2	A	–
				Check tightness of the taper pin and the seat suppression.	–	1	B	–
				Adjust and tighten the ground gaskets.	–	4	B	–
				Tighten the attachment bolts of the main body.	–	2	B	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
Blower Facility			Motor	Measure insulation resistances.	–	2	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value.	–	1	C	v
				Check for tightness of installed parts.	–	1	B	–
				Check for tightness and heat signs of terminals.	–	2	A	–
			Valve control	Greasing.	–	12	–	–
				Check for tightness of the attachment bolts.	–	1	B	–
	Anti Surge Valve	Motor-operated, outside screw, sluice valve	The main body	Check opening.	–	104	A	–
				Appearance inspection (rust, leak, and damage)	–	104	A	–
				Check switching action. Check for abnormal noise, and vibration.	–	4	B	–
				Spread grease on the screw parts.	–	4	–	–
				Check position of complete opening and shutting. Check if water stops in shutting position.	–	2	A	–
				Check for abrasion and transformation of the shaft bearing.	–	1	A	–
				Check for tightness of the taper pin and the seat suppression.	–	1	B	–
				Adjust and tighten the ground gaskets.	–	2	B	–
				Tighten the attachment bolts of the main body.	–	1	B	–
			Motor	Measure insulation resistances.	–	1	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value	–	1	C	v
				Check for tightness of installed parts of the motors.	–	1	B	–
				Check for tightness and heat signs of the terminals.	–	2	A	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
			Valve control	Greasing.	–	12	–	–
				Check the attachment parts for tightness.	–	1	B	–
Blower Facility	Motor for Inlet Guide Vane Actuator		The main body	Check opening.	–	156	A	–
				Appearance inspection (rust, leak, and damage)	–	156	A	–
				Check and record the oil pressure gauge.	–	156	A	–
				Check the limit switch and the pressure switch.	–	2	B	–
				Check the screws on the lever and the link of the position meter for tightness.	–	1	B	–
				Check tightness of screws on a limit switch.	–	1	B	–
				Check the coupling part of the pressure switch for oil leakage.	–	2	A	–
				Clean the oil filter of the oil pump.	–	1	–	–
				Tighten attachment bolts of main body.	–	2	B	–
			Motor	Measure insulation resistances.	–	1	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value	–	1	C	v
				Check the attachment bolts for tightness.	–	1	B	–
				Check the terminals for tightness and heat signs.	–	2	A	–
Final sedimentation	Return Sludge Pump	Centrifugal screw impeller pump	The main body	Check and record meters (discharge pressure, etc.)	–	156	A	–
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check the shaft seal for leakage.	–	156	A	–
				Appearance inspection (rust, leak, and damage)	–	156	A	–
				Disassemble and clean the strainer for the axis seals water.	–	4	–	–
				Measure and record vibration	–	2	C	f
				Check the body and the shaft of the check valve for damage, abrasion, and rust.	–	2	A	–
				Tighten attachment bolts of main body.	–	2	B	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
			Motor	Measure insulation resistances.	–	1	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value	–	156	A	–
				Check for tightness of attachment bolts of the motors.	–	1	B	–
				Check for tightness and heat signs of terminals.	–	2	A	–
			V belt	Check for crack and discoloration of the belt.	–	156	A	–
				Adjust tension and centering of the belt.	–	4	B	–
				Check for damage and slack of the pulley.	–	1	A	–
Final sedimentation	Sludge Scraper	Chain flight type	The main body	Check and record the meters.	–	242	A	–
				Check for abnormal noise, vibration, fever, and nasty smell	–	242	B	–
				Appearance inspection (rust, leak, and damage)	–	242	A	–
				Check for damage and tightness of the sprocket, the set pin, and the key.	–	4	B	–
				Check for damage, abrasion, and rust of the shear pin.	–	1	A	–
				Check for slack, tension, and abrasion of the chain.	–	1	B	–
				Check for damage and tightness of the axis, the sprocket, the flight board and the shoe.	–	1	A	–
				Check greased situations.	–	1	A	–
			Motor	Measure insulation resistances.	–	2	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value.	–	1	C	v
				Check for tightness of the attachment bolts.	–	1	B	–
				Check for tightness and heat signs of terminals.	–	2	A	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
Final sedimentation	Sludge Scraper	Chain flight type	Cycloid reduction gears	Oil exchange	–	1	–	–
				Check volume of oil and oil leakage.	–	12	A	–
				Check tightness of the attachment bolts.	–	1	B	–
				Diagnosis of lubricating oil	–	1	C	–
				Check and clean inside the oil filter.	–	1	–	–
			Chain	Adjust tension and alignment of the drive chain.	–	4	B	–
				Check for damage and tightness of the sprocket wheel.	–	1	A	–

4.13 Scope of Ground Maintenance Work

Scope of ground maintenance（Cleaning）

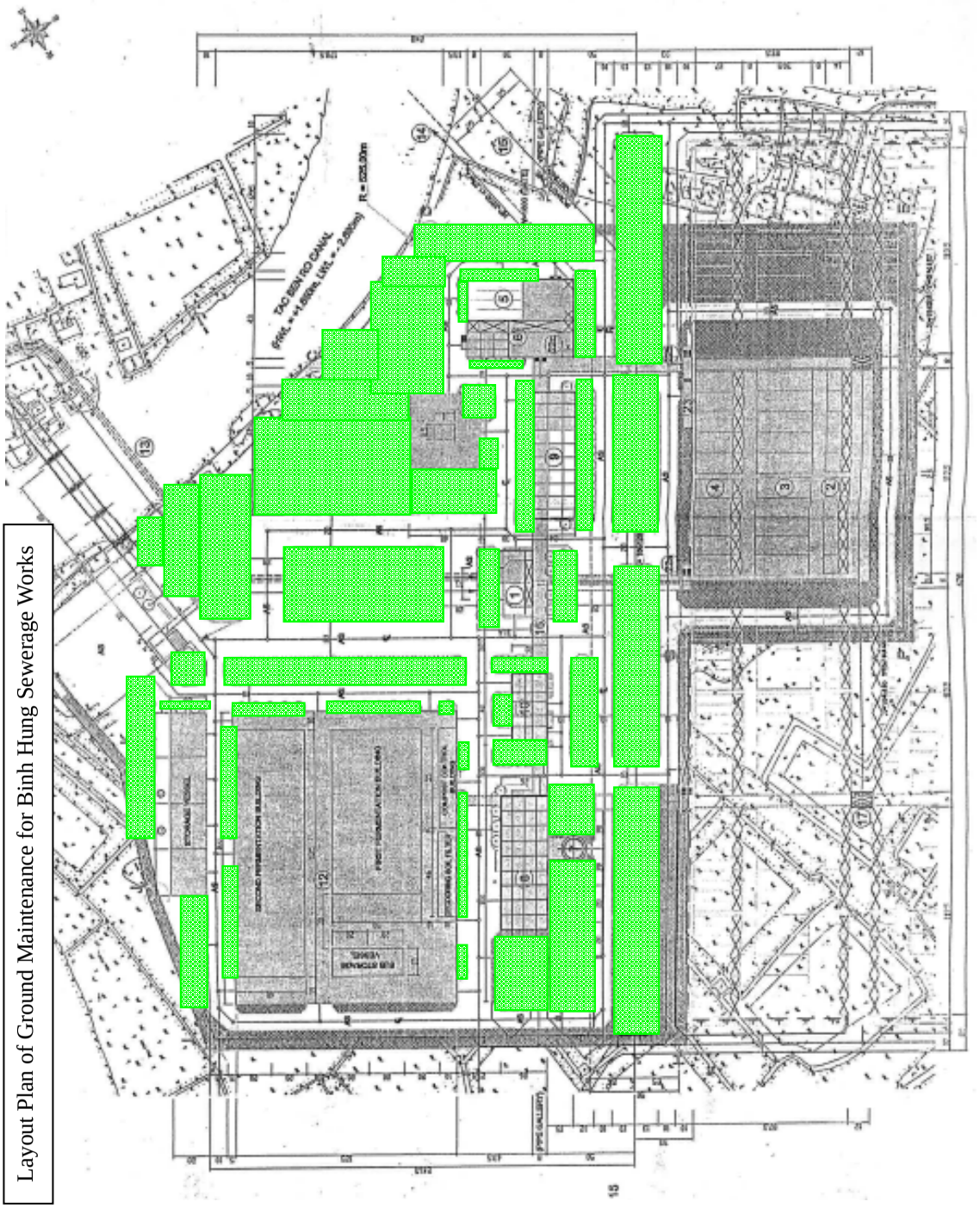
Place	Subject	Frequency	Tools	Duty description
Electrical room	Floors	Monthly	Vacuum cleaners and wax mops	Clean floors by vacuum cleaners and then mop the floors by wax mops. Moving shelves or the like is excluded.
Conduit and building	Steps (concrete floor)	Once every two month	Vacuum cleaners	Clean floors by vacuum cleaners.
Conduit (able to be sprinkled/ concrete floor)	Floors and handrails	Floor；12times/year Handrail ; Once every three months	Scrapers, nylon brushes and floor clothes	Sprinkle water over floors and scrape it with scrapers. In case of severe dirt, use nylon brushes. As for handrails, wipe with dry floor clothes.
Ventilation mechanical room	Floors	Once every three months	Vacuum cleaners	Clean floors by vacuum cleaners.

Scope of ground maintenance（Weeding）

Place	Subject	Frequency	Tools	Duty description
Yard around the administration building	Lawn	Weeding 6times / year Sprinkle herbicide Twice a year	Mowers, pruning shears and etc. Sprinklers	Mowing（As for 0.3m margins of plantings or curbs, trim weeds by shears.） Sprinkle herbicide as required.（Herbicide should be prepared with an appropriate mix proportion according to an instruction manual） ide should be prepared according to the chemical instruction manual.)

Scope of ground maintenance（Pruning）

Place	Subject	Frequency	Tools	Duty description
Yard around the administration building	Trees	Once a year	Saws and pruning shears	Prune off branched by pruning shears and saws.

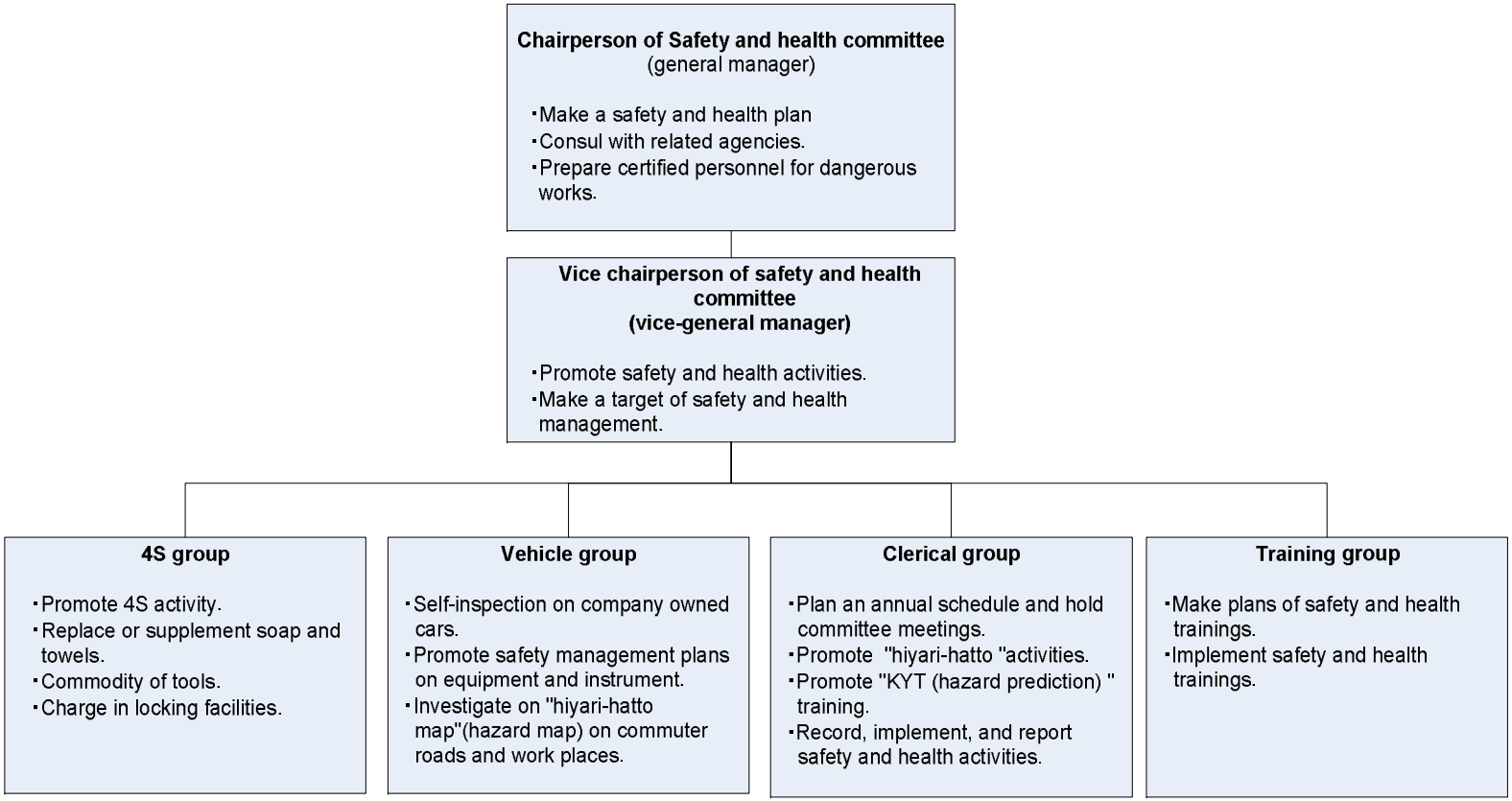


Layout Plan of Ground Maintenance for Binh Hung Sewerage Works

4.14 Ground Maintenance Schedule (Extracted)

Division	Work description	Frequency	20XX												Remarks
			1	2	3	4	5	6	7	8	9	10	11	12	
Cleaning	Generator room of administration building	4times/year													
Weeding	East side of administration building	6times/year													
	Wast side of administration building	6times/year													
	South side of administration building	6times/year													
	North side of administration building	6times/year													
Pruning	Section No.1	once a year													
	Section No.2	once a year													
	Section No.3	once a year													
	Section No.4	once a year													

4.15 Organization Chart of Safety and Health Committee



4.16 Schedule of Safety and Health Control

(1) Schedule of Safety and Health Control

Target		P : Plan			D : DO			C : CHECK			A : ACTION		
Subject	Detail	1	2	3	4	5	6	7	8	9	10	11	12
Three minute meeting	a) Three minute meeting before and after work. Assignments to be improved should be taken thoroughly.	Instruct the way of the meeting.			Make them do by themselves.			Check implemented result.			Let assignments to be improved known in common.		
4S-activity	a) Improve working environment.	・Enforce monthly safety patrol.											
Educational training	a) Training of safety and health control.	・Training on personnel who are hired throughout the year and who changed the type of works. ・OJT											
	b) Training by personnel who own qualifications or careers	・Special lecture by qualified or careered personnel.											
	c) Intend to promote a sense of dangerous through ”hiyari-hatto”activity and KYT	・Monthly summarize “hiyari-hatto” activity. ・Fill a KYT sheet and hold a reflection meeting everyday.											
Committee	a) Hold a periodic meeting and activate it.	・Hold a periodic meeting（Base on PDCA cycle）									Asssignments to be reflected on annual plan of next year		
Health control	a) Health check by complexion and measurement.	・Encourage personnel who are to be rechecked to do self health care. ・Enforcer daily check by complexion and by asking body condition in order to secure personnel health and safety.											
	b) Health promotion activity	・Radio exercise at morning gatherings.											
Traffic safety	a) Prevent traffic accident by safety driving	・Instruction and confirmation on fastening seatbelt ・Instruction on driving within limit speed											
	b) Prevent traffic accident of commuters by revising KYmap.	・Prepare, revise, and utilize KY map. ・Correct dangerous driving manners.											

(2) Schedule of Safety and Health Subcommittee

Section and Explanation		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Safety	Confirmation of "hiyari-hatto" (hazard map)	P				D			C			A	
Machinery	Commodity of tools	P				D				C		A	
	Lecture on machinery		P			D		C		A			
Electricity	Lecture on electricity		P			D		C		A			
	KYT on electrical works			P			D			C		A	
Hygiene	Establish 4S policy		P			D			C			A	
	Preparation of first-aid kits	P		D			C				A		
Remarks													

4.17 Annual Schedule of Education and Training

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Technical	Plan												
Sewage treatment	Done												
Technical	Plan												
Electricity 1	Done												
Technical	Plan												
Machinery 1	Done												
Technical	Plan												
Machinery 2	Done												
Safety and health	Plan												
	Done												
Accident	Plan												
prevention training	Done												
Others 1	Plan												
	Done												
Others 2	Plan												
	Done												

4.18 Estimation of Utility Consumption（20XX）

Utility	Object	Annual quantity of procurement	unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Remarks
Electricity	Relay pumping station	2,460,000	kWh	205,000	205,000	205,000	205,000	205,000	205,000	205,000	205,000	205,000	205,000	205,000	205,000	
	Binh Hung Treatment Plant	10,750,000	kWh	895,833	895,833	895,833	895,833	895,833	895,833	895,833	895,833	895,833	895,833	895,833	895,833	
Chemical	For water treatment 10% sodium hypochlorite	857,800	L	71,483	71,483	71,483	71,483	71,483	71,483	71,483	71,483	71,483	71,483	71,483	71,483	
	For sludge treatment Coagulant	138,900	kg	11,575	11,575	11,575	11,575	11,575	11,575	11,575	11,575	11,575	11,575	11,575	11,575	
	For composting Chaff	84,900	m3	7,075	7,075	7,075	7,075	7,075	7,075	7,075	7,075	7,075	7,075	7,075	7,075	
Fuel	For standby generator Heavy oil A		L													
	For shovel loader Gasoline		L													
	For dump Gas oil		L													
Others																
Electrical/mechanical consumable goods				←											→	
Water analysis consumable goods				←											→	
Other consumable goods				←											→	

Appendix 5

Step-wised Sewerage System Development

5. Step-wised Sewerage System Development

5.1 Demand-bases service level of sewerage system

Roles of sewerage system are;

- Environmental sanitation is improved through human excreta treatment and wastewater drainage, and ground water contamination is improved too.
- Safety of public life and urban activity are protected through storm water drainage and inundation mitigation.
- Water environment restoration contributes to public amenity, urban revitalization and water resource conservation.

Metropolis in developing countries varies in culture of water environment due to difference of natural environment, economic condition or historical behavior. Therefore service level of conventional sewerage system applied in developed countries can not be practicable to developing countries, and financial capacity or purchasing equipments are also diverse. Most appropriate policy goal and tool for wastewater management and water environment conservation shown in Fig. below is selected alternately among only drainage, pit latrine/on-site treatment, off-site system or advanced wastewater treatment in accordance with public demand and financial capacity. Water supply influences flushing toilet choice in sanitation service level.

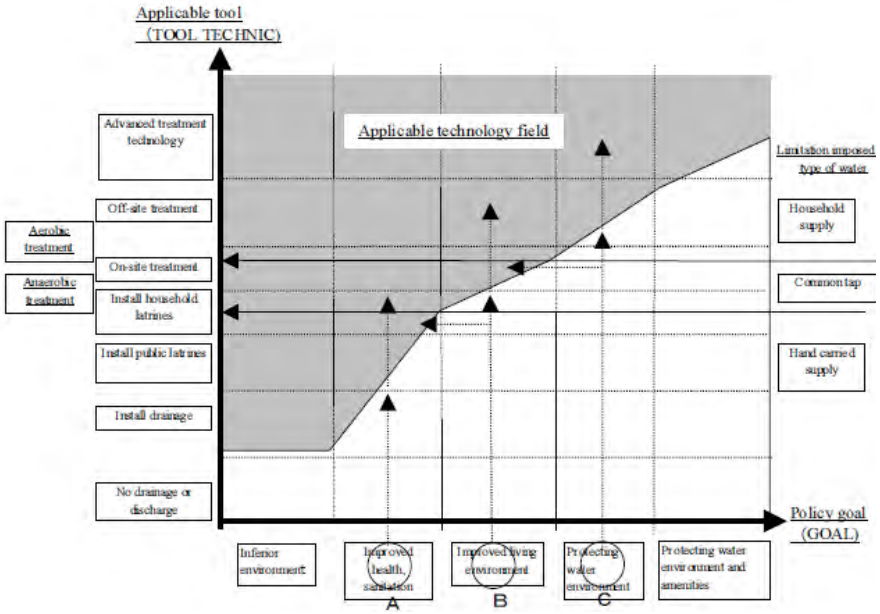


Fig. 5.1 Policy goal and tool

5.2 Implementation Methodology of Collection System

(1) Kinds of sewer systems

Conventional sewerage system is disadvantageous in big amount of project cost and retardant result of project. Implementation methodology is to scrutinize a prior role among wastewater/storm water drainage, human excreta removal/septic leachate control or water environment restoration in accordance with financial capacity and public need. And project result is also to be attained as soon as possible. Sewerage treatment area can be composed with proper collection system in each district such as conventional sewerage for principal facilities and low cost sewerage for modest resident area.

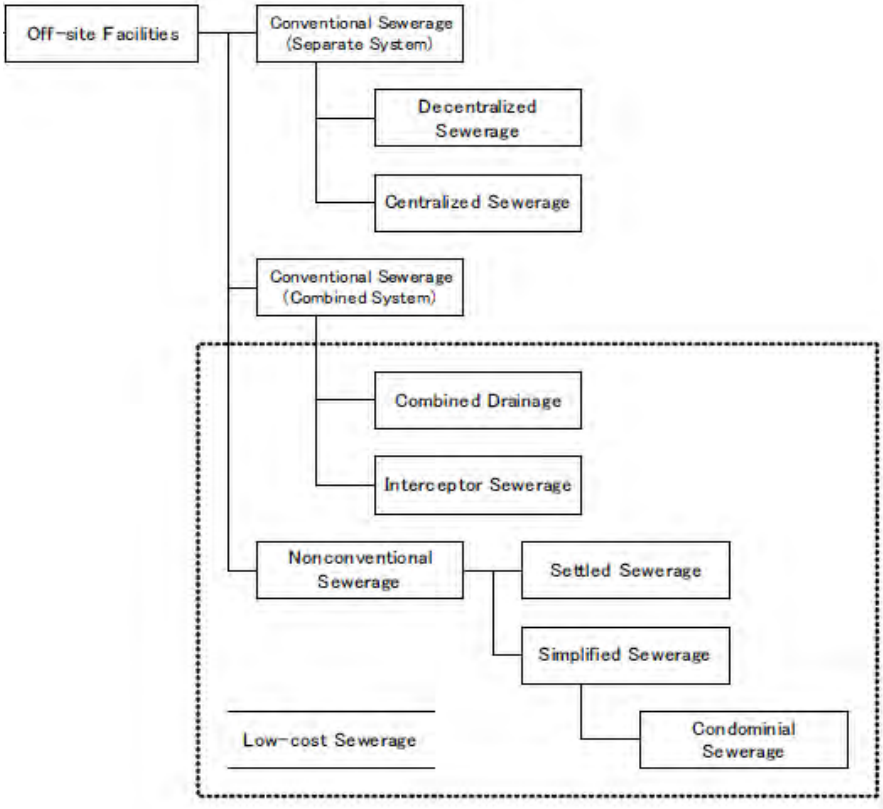


Fig. 5.2 Categorization of collection system

(2) Low-cost Sewerage System

Source: Guideline for low-cost sewerage system in developing countries, Infrastructure Development Institute-Japan 2004

1) Interceptor Sewerage

Interceptor sewerage is a sewerage system in which the existing watercourses and drainage facilities are used for collection and drainage. Interceptor sewer collects wastewater before the waterway joins river, and conveys wastewater to treatment. The design fundamentals are the same as those for conventional sewage. The system is usually designed as a first step to provide an low initial cost of sewer construction; basically it is a transitional state of upgrading to eventual conventional sewerage.

Interceptor sewerage is transitional to combined sewerage system and separate sewerage system. Upgrading methodology is as follows;

In Japan and Korea, existing drainage system is assigned to sewerage system on the beginning of sewer construction and interceptor integrated to combined sewerage system. In European countries, combined sewerage system originates in drainage system, and water pollution control policy demands interceptor and treatment facility of conventional sewerage system. Some large cities in developing countries are implementing combined sewerage system in accordance with proper intercepting ratio, elaborate intercepting design and CSO (combined sewer overflow) mitigation.

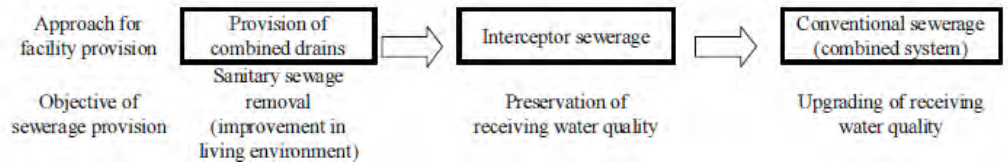


Fig. 5.3 Step-wised upgrading collection system

2) Settled Sewerage

Settled sewerage is a sewerage designed with the aim of cost reduction by using the existing septic tank as interceptor tanks to remove settleable solids. Leachate is conveyed to public sewer which is installed at a shallower depth and small pipe diameter for construction cost reduction.

3) Simplified Sewerage

Simplified sewerage is a sewerage designed with aiming construction cost reduction. Sewer is laid in shallower depth under front yard or side walk, and

is small pipe diameter with simplified manhole structures.

4) Condominial Sewerage

Condominial sewerage is a type of simplified sewerage developed in Brazil whereby sewers are laid in back yards or through gardens and under sidewalks so as to reduce the total length, diameter and depth and to reduce the need for structural protection against heavy traffic loads.

(3) Interceptor Project in Kaohsiung, Taiwan

Source: The Revitalization of Love River Kaohsiung, Taiwan(Oct.,2007, Chi-tze Chen : Former Director General of Public Works Bureau, Kaohsiung City Government

Kaohsiung City has developed rapidly as a port city, and population increase and urbanization seriously affected water environment of Love River. Therefore sewerage project adopted interceptor system because of urgently improving water pollution. River and urban aesthetic were revitalized through collaboration of sewerage project and urban culture renovation project.

Sewerage system treats almost whole wastewater and connects approximate 50% of residents through three phased projects in 30 years.

Phase-1(1977－1986)

- Sewer: 24km of trunk sewer and lateral sewer
- Interception Station: 11
- Pumping station: 2 Treatment plant: 1

Phase-2(1990－2001)

- Sewer: 127 km of trunk sewer, lateral sewer and house connection

Phase-3(2001－2007)

- Sewer: 320 km and Interception facilities
- Rate connected to public sewer: 50.7%

Fig. 5.4 River revitalization

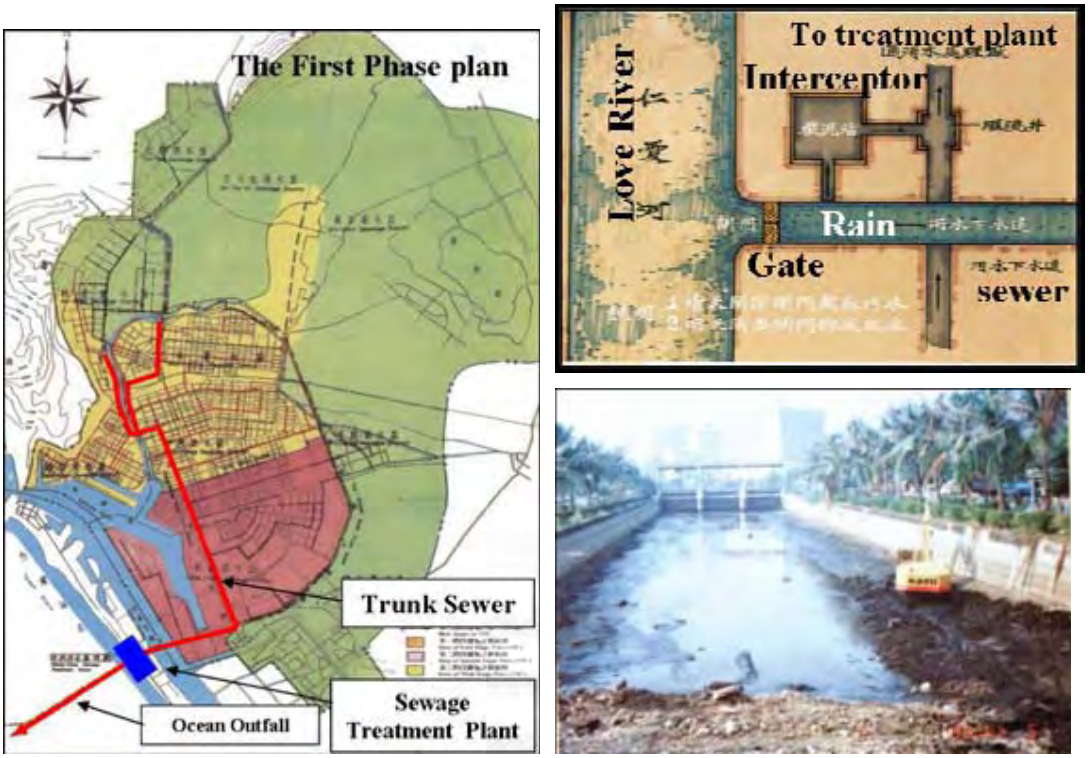


Fig. 5.5 Interceptor System (Kaohsiung, Taiwan)

(4) Risk in Storm-event of Interceptor Sewerage

Tidal water and torrential storm water cause habitual inundation in Ho Chi MinhCity. Sluice gate equipped with outfall chamber prevents tidal water infiltration.

Interceptor sewerage system conveys increased wastewater flow in storm events, and is characteristic of CSO which discharges to river. CSO, combined sewer overflow, is defined a overflow exceeding sewer capacity. Large amount of storm water and tidal water infiltrates into sewer at inundation.

Fig. 5.6 Inundation

1) Water pollution

Disease-causing bacteria, sanitation, water pollution and debris/offensive odor result from CSO. Furthermore CSO causes flooding in pumping station and brings a serious damage on water treatment performance.

Fig. 5.7 Combined sewer overflow

2) Flow control&flooding measure

Diversion chamber is to facilitate flow regulator such as diversion weir, orifice or vortex valve. Flap gate and emergency gate are to be properly operated to prevent river water filtration.

Pumping station equips ventilation duct, piping/cable duct or door, openings of which causes flooding on electric and machinery equipments.

3) CSO mitigation

CSO becomes remarkable issue since sewerage service is prevailed and water environment is restored. CSO mitigation projects are implemented such as raising interceptor rate, retaining first flush in storm event, reducing storm water flow through infiltration and storm water reuse, treatment and disinfection.

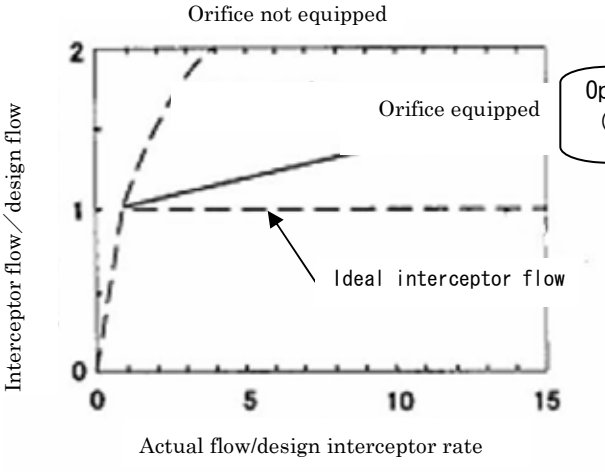


Fig. 5.8 Opening of pumping station

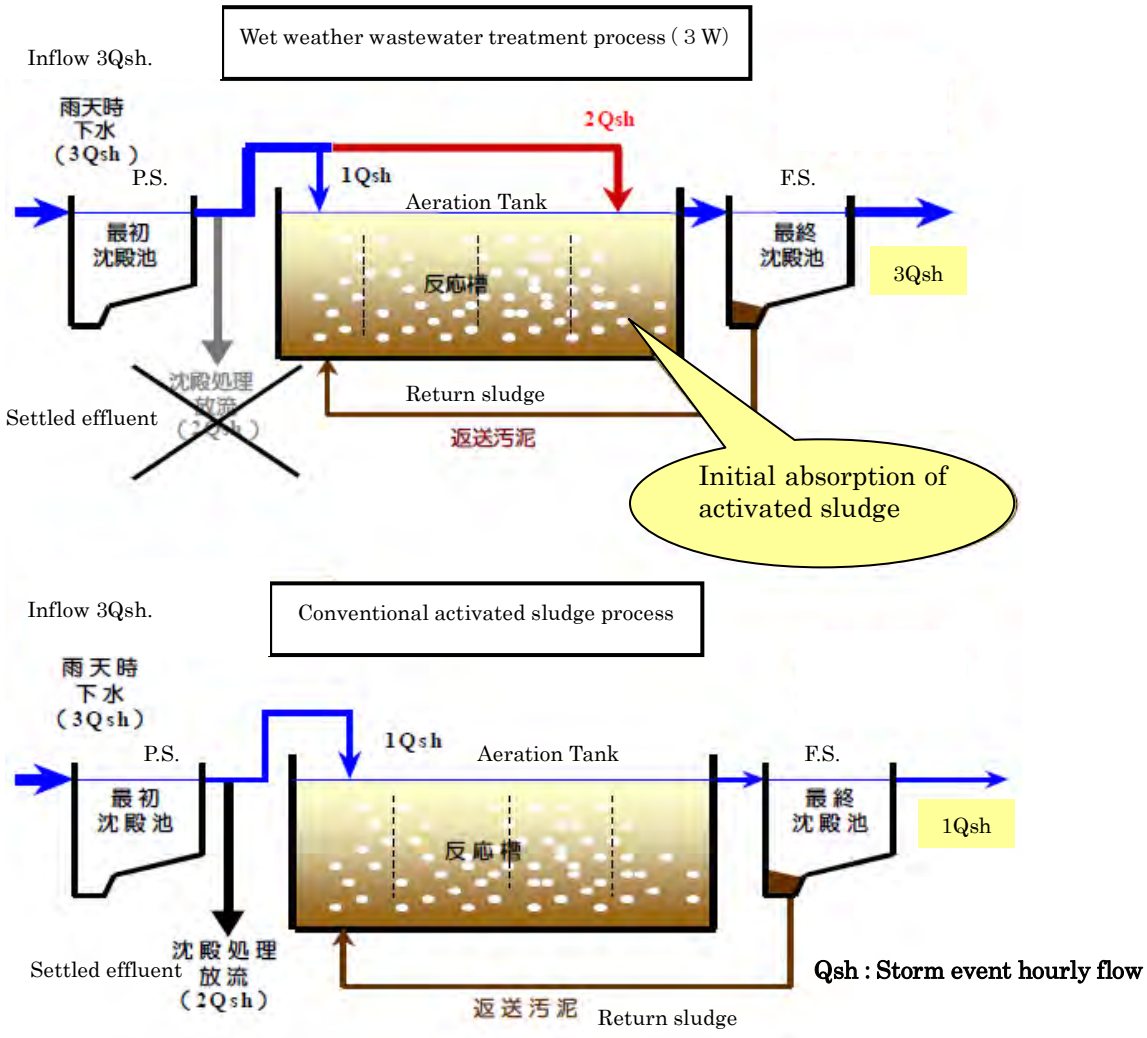


Fig. 5.9 CSO mitigation（Treatment in storm event）
（Source： Japan Sewage Works Agency）

Appendix 6

Regulations on Urban Development Project (Public and Private Collaboration)

6. Regulations on Urban Development Project (Public&Private Collaboration)

Sewerage ordinance prescribes rules of using sewerage system and regulates obligations on service users. Regarding urban development projects, sewerage ordinance also prescribes technical and financial rules which contributes smooth procedure on building construction/renovation approval and properly maintains sewerage system management.

(1) Stipulations of sewerage ordinance

1) Aim of ordinance
2) Human excreta, which is drained to public sewer through flushing toilet.
3) Industrial wastewater discharge restrictions, which is to comply with follows;
   - pH：5 - 9
   - BOD：less than 600 mg/L
   - SS: less than 600 mg/L
   - Normal hexane extracts
   - Mineral oils content: less than 5mg/L
   - Animal and vegetable oil and fat: less than 30mg/L
   - 31 heavy metals as cadmium, and toxic substances as dioxin
4) Guideline for pretreatment facility installation and approval procedure
   - Discharge standards to sewerage, and temperature and iodine consumption of 220mg/L are stipulated.
   - Nitrogen and phosphorus if effluent standard stipulated
5) Private sewer: obligation to connect public sewer, guideline of private sewer design/construction, approval and inspection
6) Designation of qualified plumber, obligation, and licensing and dismissal
7) Application for public sewer connection
8) Restrictions on public sewer connection
9) Sewerage tariff rate, levy, calculation of wastewater flow and exemption of levy
10) Sharing house connection expenses for out of service area
11) Charge for building project
12) Monitoring, penalty and levy

(2) Outline of regulations for urban developing project

Sewerage ordinance stipulates to urban developing project for counseling infrastructures before submitting building approval in view points of creating sound living environment and safe/comfortable urban development.

Regarding sewerage system development, ordinance regulates developers of procedure and design guideline of sewerage facility construction and transfer. Ordinance also regulates new urban developing project to facilitate sewerage system in accordance with sewerage development plan through pubic and private allocate appropriate resource each other.

(3) Ordinance for Urban Development Project

1) Counseling category
   - Restrictions on building outline, infrastructure development and approval of adjacent residents

2) Designation of urban development project
   - Building site area : $500\mathrm{m}^2$ or more
   - No. of residents: 10 residents or more
   - Housing land project: Site area $500\mathrm{m}^2$ or more

3) Infrastructure development
   - Road, storm water drainage, park･green space, gardening, fire extinguishing facilities, water supply, parking, bicycle depot, cleansing depot, assembly hall, others(mail box, resident list, service room)

4) Stipulation on sewerage
   - Accordance with sewerage development plan
   - Separate sewer in project area, and to connect public sewer by gravity flow
   - Construction/rehabilitation of sewerage related facility outside of project site

Fig. 6.1 Urban development project（UR Agency）

Appendix 7

Role of Private and Public for Wastewater Management

7. Role of Private and Public for Wastewater Management

7.1 Change of Roles of Sewerage

Roles of sewerage have been changed to water quality control and sound water environment & water cycle from drainage in accordance with public need to water pollution caused by urbanization and industrialization. Sewerage system, at present, has a principal role to sustain global environment so as to mitigate negative impact of human activities. Sewerage system is also to work as vein-infrastructure of collecting and recycling water related waste into resources. Treated wastewater and storm water are focusing their resources of treated water reuse, water environment restoration, ground water recharge and renewable energy use of sewage sludge. Sewerage system is to develop and operate as regional system/integrated river basin management, since water resource conservation and urbanization can be attained by regional collaboration of relevant sectors.

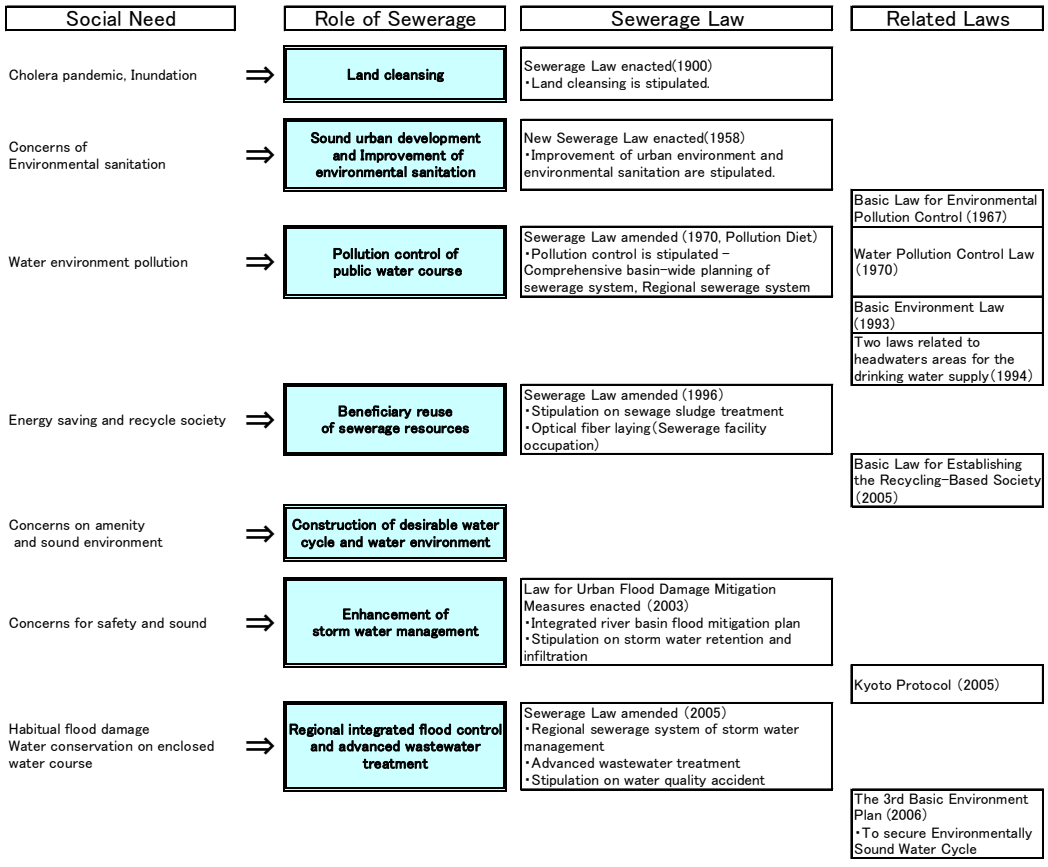


Fig. 7.1 Roles of sewerage & Laws in Japan

7.2 Definition of Sewage and Sewerage

Sewerage varies to participate in wastewater and storm water management due to history of each country. Jakarta defines wastewater as all disposed wastewater from industry activity residue and others that can not be used anymore. UK, USA and Japan has treated wastewater as sewage(sanitary sewage and storm water) in urban area, since sewerage system originates from drainage system and role of pollution control is integrated to sewerage.

Jakarta : Wastewater means all disposed wastewater from industry activity residue and others that can not be used anymore.

Japan : Wastewater(sanitary wastewater) originated life and business, and storm water. Sewerage aims sound urban development, environmental sanitation improvement and water resource conservation through comprehensive basin-wide planning of sewerage system, stipulation of sewerage construction and management, and sewerage system development.

UK : The water-bone wastes of a community, Industrial sewage is from a mixed residential and industrial area. Storm sewage is that flowing to a treatment works in wet weather or discharged from storm overflows.

USA : Amended Water Act 1987 aims water quality restoration in accordance with environmental sanitation improvement and water environment conservation. Water pollution control also focuses non-point source of storm water of farm, forest, construction site and urban. Approval of pollutant discharge elimination and sewerage system development are principal measures.

7.3 Role of Public and Private

Sewerage works referred to experience and institutional option in Indonesia are recommended by World Bank as follows; (Indonesia Overview of Sanitation and Sewerage Experience and Policy Options (World Bank, 6/3/2001)) This is common to Japanese technical and financial experience as comprehensive basin-wide planning of sewerage system and subsidizing of National Government. Therefore it is important to integrate such know-how and experience.

- Plan on low-cost sanitation proposed by WB is very poor, and satisfactory conclusions are not obtained. Solutions for drainage treatment are not yet found.
- In the sanitation project (MCK), most of the 3000 planned lavatories were not constructed and sanitation/health issues were not improved. Reasons: Cost of toilet is very high (2,600 US$), difficulty of land acquisition, insufficient permeability of ground, high user charge (100 Rp./time) and usage frequency is less than 30%.

- Water quality is aggravated by the disposal of septic tank sludge to drainage canals..

WB proposed raised comments related to sewage works based on Indonesia's experiences and political options as follows. (Indonesia Overview of Sanitation and Sewerage Experience and Policy Options by World Bank, 6/3/2001).

- Supervisory authority is unclear for septic tank sludge
- Community-based project does not solve urban issues and public investment to sewerage system/septic tank.
- Proposed project should be flexible, and promote investment to the improvement of sanitation. Frameworks of laws and regulations should have information on service type and level selected by stakeholder. It depends on demands to serve the residences
- Solution of sanitation issues should depend on the demands of all levels according to geography and levels of society.
- Planning method of sanitation issues should be at each basin utilizing common agencies and methods with water resource management. For municipalities/villages, drainage management and measures should be discussed to meet environmental standards.
- In the financial aspect, for example, individuals should take the burden for securing the facilities in their lands. Municipalities should take the burden for maintaining terminal sewer pipes and treatment facilities while central government provide the main sewer pipes and public treatment facilities for other areas. Operation and maintenance cost should be collected as part of user charges.
- For poverty program, collection system for user charges should be adjusted to community level, and financial plan and cross subsidy should be considered.
- Wide range quality level should be proposed. Firstly, basic level service is purchased, and should be shifted to high quality service when the household account becomes sufficient. When user charge system utilized exemption for construction cost, cross subsidy from high-income group/commercial facilities to low-income group should be applied.

Sewerage system development and management is responsible of municipality government. Institution of National Government & provincial government, municipal government and community are defined as follows;

- National & provincial governments support inter cities/region coordination

to protect watershed from human waste pollution through PROKASIH or similar program.

- Wastewater infrastructure service is based on demand responsive and size & feature of cities. It categorized to off site/sewerage system for metropolitan & large cities, integrated system of existing on-site and improving septage treatment for medium & small cities, shallow sewer & small scale sewerage for old city, and to encourage sewerage development for new town through private investment. Community is responsible to develop appropriate system of on-site sanitation and small scale sewerage system.

7.4 Wastewater Management Sector

Municipality Governments in Vietnam and Indonesia structure wastewater management sectors of construction, operation and maintenance, and project implementation and regulations as follows.

(1) Hanoi City

- Peoples Committee: Budgeting and sewerage tariff decree
- DONRE（Department of Natural Resources and Environment）: regulation on wastewater discharge
- DOC・PMB（Department of Construction）: Sewerage facilities construction
- HSDC （Hanoi Sewerage and Drainage Company）: Operation and maintenance, and establishing enterprises for drainage or wastewater treatment

(2) Ho Chi Minh City

- Peoples Committee: Budgeting and sewerage tariff decree
- DONRE（Department of Natural Resources and Environment）: regulation on wastewater discharge
- PMB（Department of Construction）: Sewerage facilities construction
- Flood Control Center : Project implementation and asset management
- HCM UDC : Operation and maintenance

(3) DKI Jakarta

- LHD（Dept. of Environment & Health）: Sewerage decree & tariff system, budgeting and regulation on wastewater discharge
- PD PAL JAYA : Operation and maintenance, and sewerage facilities construction
- Dinas PU（Department of Public Works）: Storm water management

Responsibility of sewerage administrator is wide-ranging to guiding sewerage use and

levying to public, monitoring industrial wastewater discharge, approval of housing development, sewerage facilities construction and O/M, and administration and regulations. Since many sectors relate to wastewater management, it is important to allocate municipal roles properly and to collaborate with each sector.

(Reference) Institutional system in Japan

Administration system of sewage works in Japan has worked hard to solve following issues;

- Facilities implementation: Sewer and treatment plant were executed by deferent organization, therefore progress of project implementation was disharmonious.
- Regulation: Water supply and sewerage are differently managed, and amendment of sewerage laws required time and efforts.
- Public service: Human excreta and sewerage system are differently managed, and it took time to execute comprehensive project implementation program.

Wastewater management system requires an integrated organization system and to provide a sustainable operation and financial system. At present, wastewater management system is renovating to integrate sewerage system and storm water drainage system, or to unify water supply and wastewater management in view points of construction an operation of facilities, public service and sewerage tariff and administration.

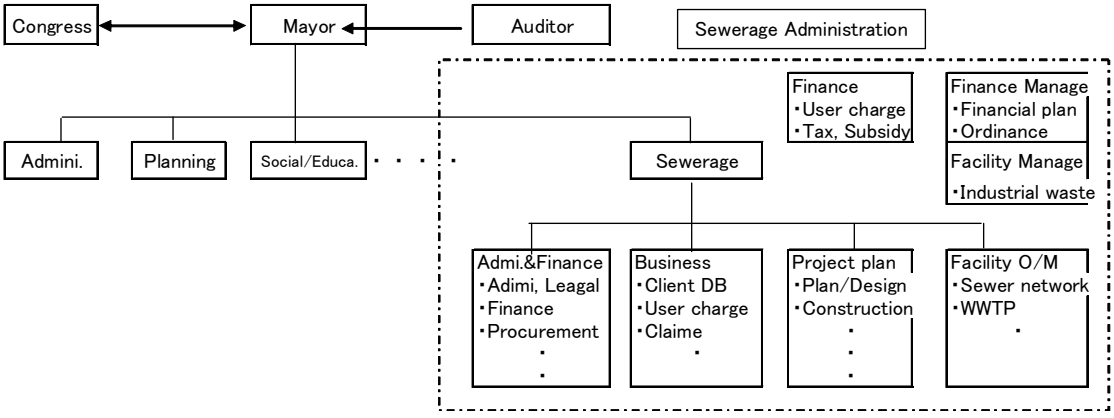


Fig. 7.2 Sewerage Bureau of large city in Japan

(Collection system – treatment plant)

- Collection system is an interface with users and administration for house connection procedure, private sewer installment, levying tariff and trouble

shooting of claime.

- Sewerage facilities require guideline and monitoring system of industrial wastewater, and pretreatment facility in order to protect system from facility corrosion and biological damage.
- Collection system and treatment plant are to be operated under common direction in order to prevent flooding of pumping station and treatment plant, and to mitigate inundation for urban activities.

(Sewerage ordinance & financial plan)

- Since construction and O/M requires a large amount cost, institution of tariff structure and financial plan, ordinance and lobbying is to be executed coincidentally.

7.5 Financial System in Japan

Financial system for construction : National Government subsidizes to principal facilities since sewerage project requires a large amount of cost and project implementation is urgent (legal basis- Sewerage Law). And municipal government issues bonds because of public interest. Beneficiary user charge also allocated to lateral sewer.

Financial system for O/M cost : Repayment of bond and O/M cost is covered by user charge and general budget of local government.

(Sewerage construction)

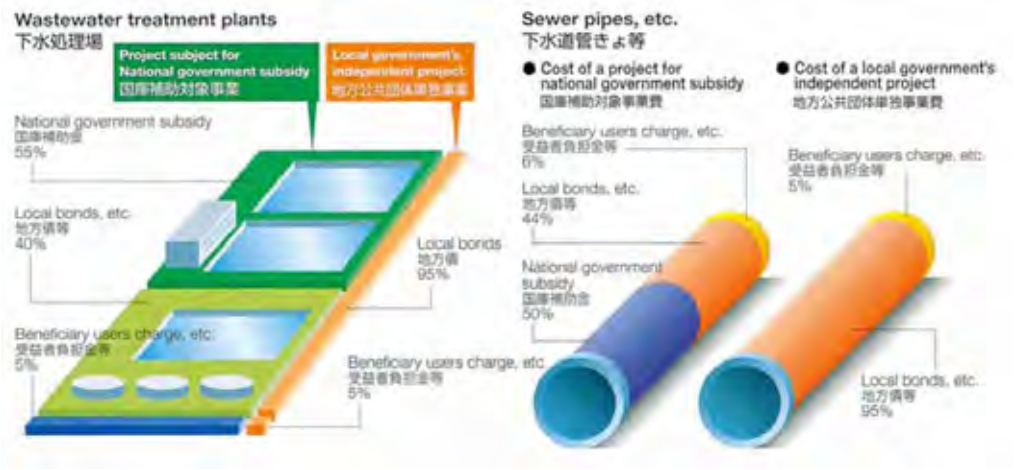


Fig. 7.3 Financial system of construction project in Japan

(O/M)

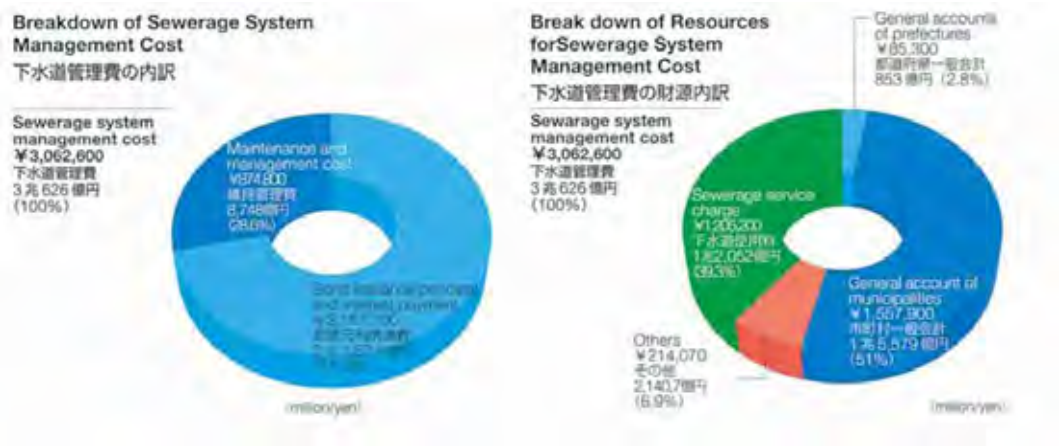


Fig. 7.4 O/M financial system in Japan

Appendix 8

Clean River Program & Public Relations

8.1 Practice in Indonesia
8.2 Practice in National and Municipal Level

8. Clean River Program & Public Relations

8.1 Practice in Indonesia

(1) Amendment of the Water Laws

New Water Laws describe background issues and policies against them as part of the revisions. This is evaluated as an excellent approach since the view point of integrated river basin management was enhanced. Regarding wastewater management/water environment, it is expected the Laws play an important roll widely in the following aspects: conservation of water resources, residence participation, mitigation of drought, flood mitigation in urban areas, and storm water reuse.

< Water Resources Issues in Indonesia >

- Degradation of water resources, both in quantity and quality
- Increase of sediments
- Poor performance of water resources and irrigation infrastructures
- Increase of flood and drought intensities
- Lack of beneficiaries' role and community participation
- Suspiciously low effective government's investment on water resource infrastructures due to supply-side approach of investment

< Water Resources Management Targets >

- Achieve water resources management pattern in an integrated and sustainable manner
- Control the potential of water conflict
- Control groundwater usage
- Improve the water capacity to fulfill the needs for household, settlement, agriculture, and industry with priority for domestic and traditional agriculture
- Reduce the impacts of flood and drought
- Control water pollution
- Protect coastal areas from abrasion especially in remote islands, strategic areas, and international boundary regions
- Enhance public participation
- Improve the quality of coordination and cooperation among stakeholders
- Establish sustainable mechanism for water resources financing
- Develop data and information system which is accurate, actual, and accessible

- Revitalize water sources and water infrastructures conditions
- Ensure bulk water availability for public needs
- Control flood particularly in urban areas

(2) Clean River Program

Fig. 8.1 Clean River Program（PROKASHI）
(Children playing in clean river)

The Environment Impact Management Agency（BAPEDAL）, in cooperation with the local governments, promotes "PROKASIH (Clean River Program)" to mitigate water pollution, with the implementation of a ranking program for companies on water quality conservation activities. Performance Level Evaluation Program (PROPER) is the company evaluation system adopted by BAPEDAL based on the environmental information from companies. The companies' categories classified as gold, green, blue, red, and black, are announced to the public. The companies evaluated with an excellent environmental mitigation have met the following requirements. Moreover, said companies have adopted the total amount control / pollution charging system.

- Duty for reporting the activities on environmental mitigation
- Complied with water quality standard of discharge
- Complied with water pollution standard
- Complied with hazardous chemical substance disposal standard

Fig. 8.2 Clean River Program (PROKASHI)
(Zero Waste Our Code River Clean, Beautiful, Smile, Environment, therefore Health）

Fig. 8.3 Clean River Program (PROKASHI）
(Family enjoying clean-up community)


Fig. 8.4 Discharged Wastewater
（Drainage in low ground）

8.2 Practice in National and Municipal Level

(1) PI of Japan Sewage Works Association

Sewerage works can not be sustained if public does not afford sewerage service and financing. Japan Sewage Works Association is supporting municipal governments through information disclosure and public involvement (PI). PI aims to elaborate sewerage programming and project implementation along with collaboration and consensus between public and governments, or disclosing information of project formation process.

(Manual and tools)

- pamphlet/brochure
- Public relation manual & PR tool
- Event promotion of Sewerage Day and Sewerage Exhibition

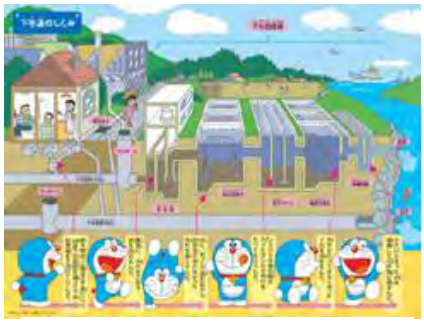


Fig. 8.5 Sewerage PR

(2) Municipality Level

- Open school
- Supporter' circle
- Sanitation education of community-base
- Social education in primary school and kindergarten

Fig. 8.6 Open school（concert）

Fig. 8.7 Supporter meeting

Fig. 8.8 Community-based Education

Fig. 8.9 Picture Show (indergarden)

Appendix 9

Annual O&M plan of Astana City Sewage Treatment Plant in Kazakhstan (Draft)

Annual O&M plan
of
Astana city sewage treatment plant
in
Kazakhstan
（Draft）

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CONTENTS

9.1 Outline of service –Example–

O&M service on Astana sewage treatment plant are as follows:

(1) Operational works

- Operate and monitor a water treatment facility, a sludge treatment facility, a composting facility and relay pumping stations.
- Based on an operational procedure and a work implementation schedule, and under supervision by general manager, implement operation and monitoring appropriately.
- If necessity for the plant to take some measurements such as shut down or recession in operation, consult with the consignor.

(2) Maintenance and inspection works

- Implement maintenance and inspection of mechanical, electrical, and instrumental facilities, building exteriors, and buildings.
- Check function and efficiency of machineries by some measuring instruments in needed. Conduct periodic facility check to find any faults in early stages and to prevent breakdowns.
- Besides prevention of breakdowns, to maintain performances and extend lives of machineries, daily and periodic maintenance is required.
- Prepare a ledger to rationalize maintenance works and record maintenance history.
- Implement ground maintenance at the treatment plant and at the relay pumping stations.

(3) Repair works

- Repair the facilities and equipment adequately in order to exercise their full capacity.

(4) Water quality control works

- Water quality assessment will be implemented in accordance with the attached schedule.
- Maintenance of water analysis meters and water quality monitoring devices.
- Other works regarding water quality control in need of O&M.

(5) Utility Procurement works

- Procure consumable electrical or mechanical goods, chemicals for analysis, analysis instruments, industrial chemicals, fuel, and other subjects appropriately.

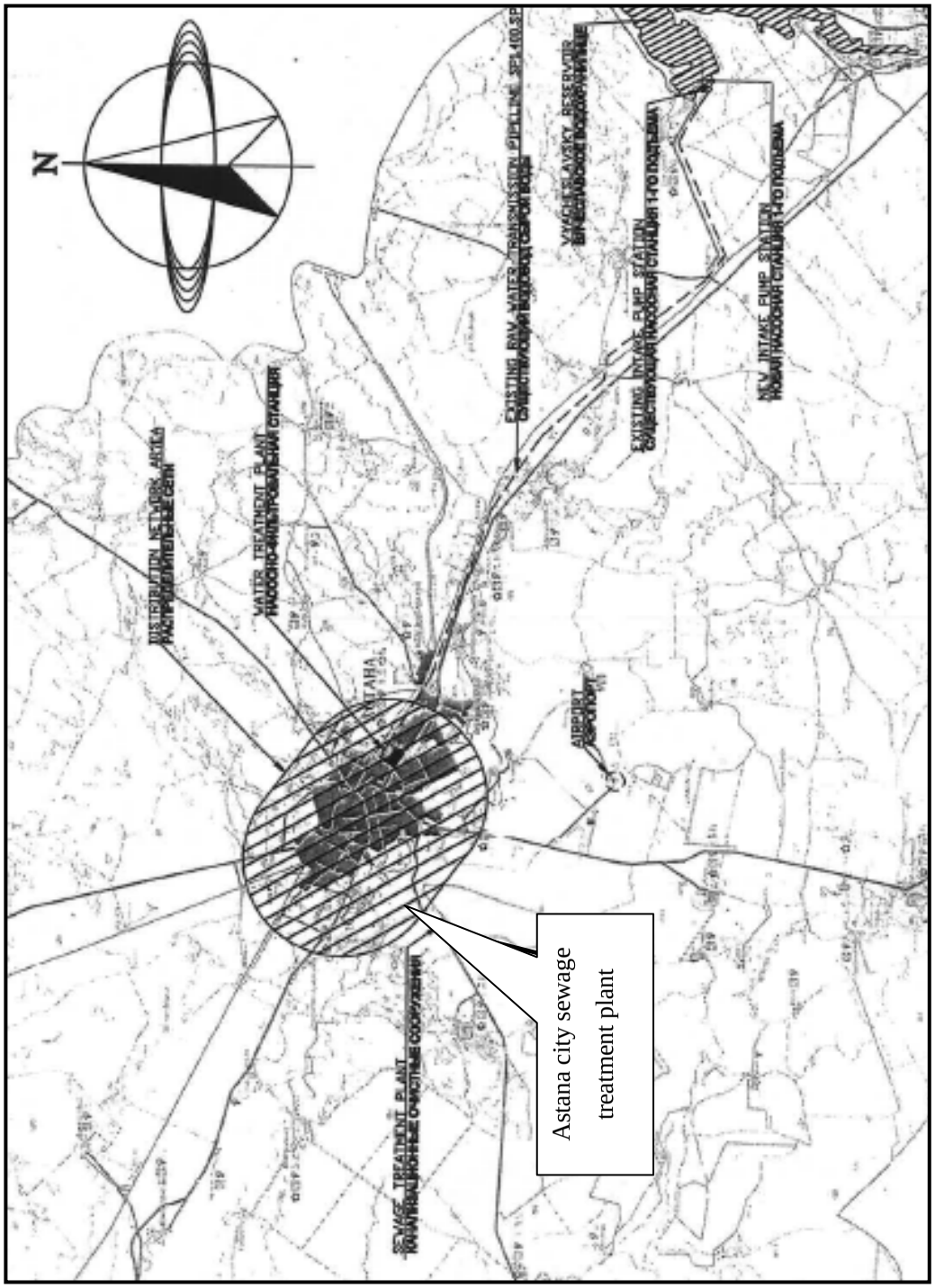
(6) Works for Emergency State

- Prepare work system to secure staff for emergency state, such as, heavy rain, typhoon, earthquake, serious accidents or breakdowns, unexpected power failure, abnormal influent rate or quality, and equipment troubles.
- In case of some accidents, take necessary measurements immediately. and report the causes, damage states, and developments of accidents to the consignor without delay.

(7) Others

- Provide sufficient patrol and guard to protect the plant against unconcerned person and equipment to be damaged or goods to be stolen.
- By regulating safety code and taking required measurements, try to prevent workmen's accidents.

9.2 Service Implementation Map



9.3 List of Facilities

Name of Facility	Year of Commencement of Operations	Capacity m^3/day	Current Influent Volume m^3/day	Discharge
Astana city sewage treatment plant	1959	136,000141,000	100,000	Toldy Kol reservoir

Current treatment area is about 3,500ha. Nominal treatment capacity of the plant is 136,000m3/day (Daily maximum).

Total constructed sewer pipes are 227km. The number of the relay pumping stations is 39.

Average daily flow was about 100,000 m3/day (2000-2001). Maximum daily flow of 158,000 m3/day was recorded when it thawed in spring of 2001.

Having no outlet, the reservoir is equipped with an emergency siphon which enable reserved water to be discharged to neighboring wetland.

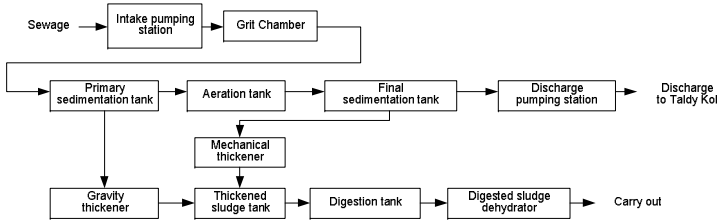
Treated water is discharged into Taldy Kol reservoir. This reservoir with 21km2 area and 36,000,000m3 volume, locates on the south west of the city area.

Passing through the wetland, discharged water reaches to Ishim river. Basically the water reserved in Taldy Kol reservoir is reduced by evaporation and permeation to the underground.

Quality of raw water is similar to the one of domestic wastewater.

Quality of final effluent, such as BOD and SS, is below 20mg/L. It suggests that the treatment performance is good enough as activated sludge method.

Because final effluent is not required to be disinfected before discharging to Taldy Kol reservoir, it is not implemented.



9.4 List of Major Facility Specifications

CLASSIFICATION	DESCRIPTION (Equipment)	TYPEModel)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
INFLOW TANK	Inlet Chamber Gate	Electric Motor Sluice Gate	ϕ 1,400mm	2.2	1	
	Bypass Gate	Electric Motor Sluice Gate	dia.2,000mm	5.5	1	
INFLUENT PUMP STATION	Hoist Block (container)	Electrically Operated Hoist	2.0ton	1.5	1	
	HOIST BLOCK	Geared Trolley Chain Block	2.0ton	–	1	
	Exhaust Fan	Centrifugal Fan	60m3/min x 0.15kPa	0.75	1	
	Air Intake Fan(1)	Centrifugal Fan	60m3/min x 0.15kPa	0.75	1	
	Air Intake Fan(2)	Centrifugal Fan	260m3/min x 0.15kPa	3.7	1	
	Air Intake Fan(3)	Centrifugal Fan	60m3/min x 0.15kPa	0.75	1	
	Delivery Valve A	Motorized Butterfly Valve	dia.700mm	0.75	2	
	Check Valve B	Swing Type Check Valve with Dashpot	dia.450mm	–	2	
	Delivery Valve B	Motorized Butterfly Valve	dia.450mm	0.4	2	
	Connection Valve	Motorized Gate Valve	dia.800mm	3.7	4	
	Bridge Crane	Electrically Operated	5.0ton	4.6kw, 0.4kw x 2, 0.75kw	1	
	Temporary Pump	Removable Submersible Pump	25m3/min x 14m	110	3	
	Sump Drainage Pump	Removable Submersible Pump	0.3m3/min x 15m	1.5	2	
	Channel Gate	Motor Driven	W1.68m x H2.0m	0.4	3	

CLASSIFICATION	DESCRIPTION (Equipment)	TYPEModel)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
INFLUENT PUMP STATION	Fine Screen	Mechanically Cleaning Bar Screen	W1.68m x H2.0m x OP6mm	0.75	3	
	Influent Pump A	Vertical Shaft Volute Type Mixed Flow Pump	54m3/min x 15m	200	2	
	Influent Pump B	Vertical Shaft Volute Type Mixed Flow Pump	27m3/min x 15m	110	2	
	Suction Valve A	Motorized Gate Valve	dia.800mm	3.7	2	
	Suction Valve B	Motorized Gate Valve	dia.500mm	1.5	2	
	Check Valve A	Swing Type Check Valve with Dashpot	dia.700mm	–	2	
GRIT CHAMBER	Grit Scrubber	Screw Grit Conveyor	2.0m3/h	1.5kw + 2.2kw x 2	1	
	Scum Screen	Automatic Disc Screen	0.5m3/min x OP3mm	0.4	1	
	Inlet Gate	Electric Motor Sluice Gate	W1,200mm x H1,000mm	1.5	2	
	Bypass Gate	Electric Motor Sluice Gate	dia.1,500mm	2.2	1	
	Grit Collector	Vortex Type	dia.2,000mm	1.5w	2	
	Grit Pump	DISCHARGE PUMP	0.5m3/min x 8m	3.7	2	
	Grit Chamber Outlet Gate	Electric Motor Sluice Gate	dia.1,200mm	1.5	2	
PRIMARY SEDIMENTATION TANK	Distribution Tank Weir	Adjustable Weir	900mm	–	8	
	Sludge Collector	Circumference Drive	dia.28m x WD3.5m	1.5	8	
	Suction Sludge Valve	Motorized Eccentric Valve	ϕ 150	0.4	8	
	Primary Sludge Pump	Non-Clog Sludge Pump	1.0m3/min x 9m	5.5	2	2

CLASSIFICATION	DESCRIPTION (Equipment)	TYPEModel)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
PRIMARY SEDIMENTATION TANK	Scum Pump	Non-Clog Sludge Pump	0.5m3/min x 12m	3.7	2	2
	Suction Scum Valve	Motorized Sluice Valve	φ100	0.2	4	
	Delivery Valve	Motorized Gate Valve	φ150	0.4	2	
	Hoist Block	Geared Troller Chain Block	1.0ton	-	1	
	Sump Drainage Pump	Submersible Sewage Pump	0.1m3/min x 15m	0.75	2	
	Exhaust Fan	Centrifugal Fan	12m3/min x 0.15kPa	0.2	2	
SECONDARY SEDIMENTATION TANK	Return Sludge Inlet Weir	Adjustable Weir	W600mm x H600mm	-	12	
	Distribution Tank Weir	Adjustable Weir	900mm	-	12	
	Sludge Collector	Circumference Drive	dia.28m x WD3.5m	1.5	12	
BLOWER HOUSE	Air Blower	Multistage Turbo Blower	255m3/min x 50kPa	315	3	2
	Delivery Valve	Motorized Gate Valve	dia.400mm	0.75	3	2
	Air Filter	Automatic Air Filter	255m3/min	0.2	3	2
	Clear Water Supply Pump	Volute Pump	0.3m3/min x 20m	2.2	1	1
	Hoist Block	Motor Trolley Hoist	5ton	4.6kw, 0.75kw,	1	
	Sump Drainage Pump	Submersible Sewage Pump	0.1m3/min x 7m	0.4	1	
	Clear Water Tank	PVC TANK	5m3	-	1	

CLASSIFICATION	DESCRIPTION (Equipment)	TYPEModel)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
RETURN SLUDGE PUMP STATION	Sump Drainage Pump	Removable Submersible Pump	0.3m3/min x 10m	55	3	1
	Connection Valve A	Motorized Gate Valve	φ1,100	5.5	2	
	Connection Valve B	Motorized Gate Valve	φ1,200	7.5	1	
	Return Sludge Pump	Vertical Shaft Volute Type Mixed Flow Pump	32m3/min x 6m	?	?	2
	Waste Sludge Pump	Non-Clog Sludge Pump	4.7m3/min x 10m	22	1	1
	Delivery Valve	Motorized Gate Valve	φ500	0.75	3	2
	Suction Valve	Motorized Sluice Valve	φ600	1.5	3	2
	Partition Valve	Motorized Butterfly Valve	φ900	3.7	4	
	Check Valve	Swing Type Check Valve with Dashpot	φ500	-	5	
	Bridge Crane	Electrically Operated	5.0ton	4.6kw, 0.4kw x 2, 0.75kw	1	
DISCHARGE PUMP STATION	Suction Valve A	Motorized Gate Valve	dia.800mm	3.7	2	
	Suction Valve B	Motorized Gate Valve	dia.500mm	1.5	2	
	Connection Valve	Motorized Gate Valve	dia.800mm	3.7	4	
	Bridge Crane	Electrically Operated	5.0ton	4.6kw, 0.4kw x 2, 0.75kw	1	
	Sump Drainage Pump	Removable Submersible Pump	0.3m3/min x 10m	1.5	1	1
	Temporary Pump	Removable Submersible Pump	25m3/min x 15m	110	3	

CLASSIFICATION	DESCRIPTION (Equipment)	TYPEModel)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
RETURN SLUDGE PUMP STATION	Sump Drainage Pump	Removable Submersible Pump	0.3m3/min x 10m	55	3	1
	Connection Valve A	Motorized Gate Valve	φ1,100	5.5	2	
	Connection Valve B	Motorized Gate Valve	φ1,200	7.5	1	
	Return Sludge Pump	Vertical Shaft Volute Type Mixed Flow Pump	32m3/min x 6m	?	?	2
	Waste Sludge Pump	Non-Clog Sludge Pump	4.7m3/min x 10m	22	1	1
	Delivery Valve	Motorized Gate Valve	φ500	0.75	3	2
	Suction Valve	Motorized Sluice Valve	φ600	1.5	3	2
	Partition Valve	Motorized Butterfly Valve	φ900	3.7	4	
	Check Valve	Swing Type Check Valve with Dashpot	φ500	-	5	
	Bridge Crane	Electrically Operated	5.0ton	4.6kw, 0.4kw x 2, 0.75kw	1	
DISCHARGE PUMP STATION	Suction Valve A	Motorized Gate Valve	dia.800mm	3.7	2	
	Suction Valve B	Motorized Gate Valve	dia.500mm	1.5	2	
	Connection Valve	Motorized Gate Valve	dia.800mm	3.7	4	
	Bridge Crane	Electrically Operated	5.0ton	4.6kw, 0.4kw x 2, 0.75kw	1	
	Sump Drainage Pump	Removable Submersible Pump	0.3m3/min x 10m	1.5	1	1
	Temporary Pump	Removable Submersible Pump	25m3/min x 15m	110	3	

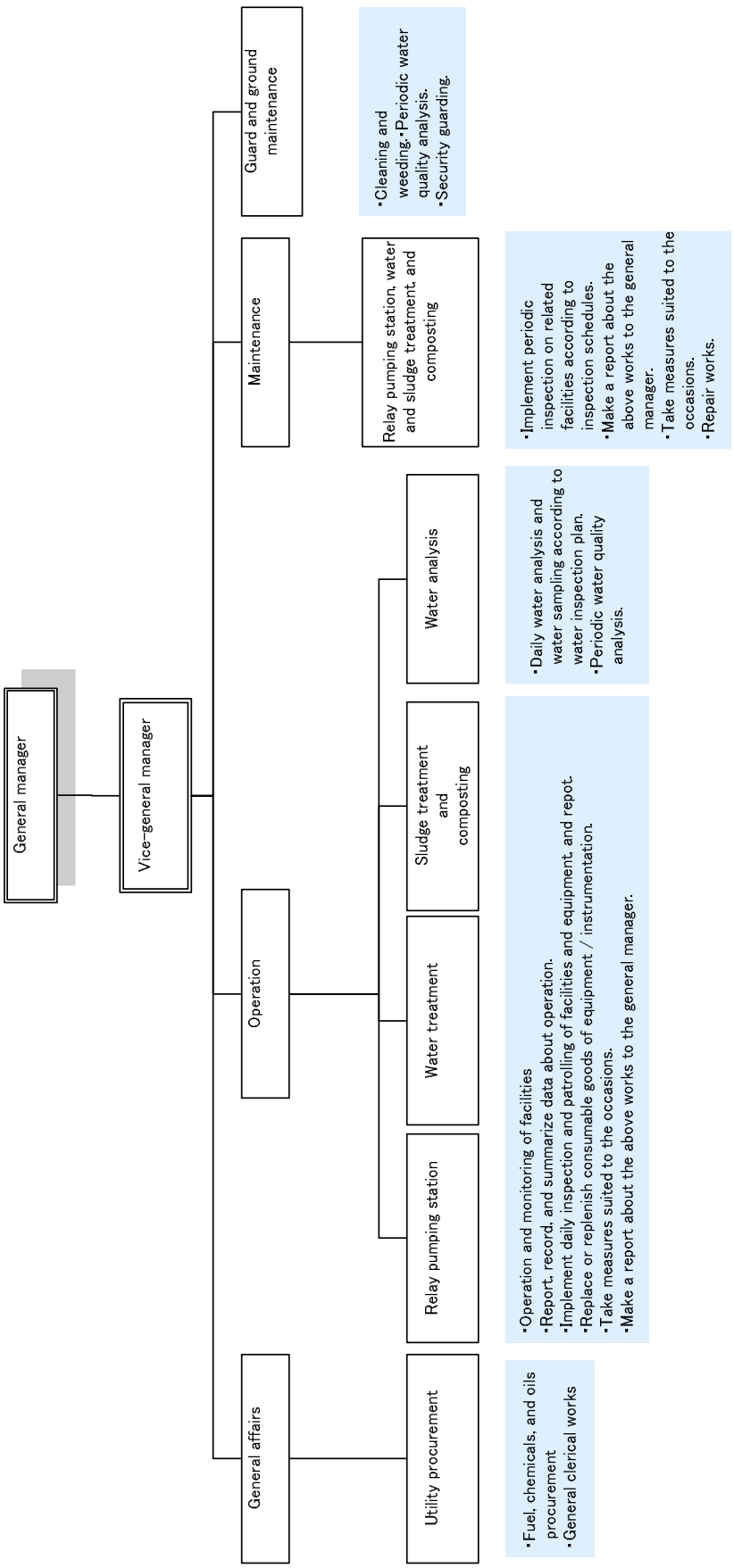
CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
SLUDGE TREATMENT BUILDING	Hoist Block	Geared Troller Chain Block	2.0ton	–	3	
	Sludge Grinder	In-Pipeline Type	dia.150mm x 1.5m3/min	3.7	1	
	Waste Sludge Mixer	Vertical Propeller Mixer	dia.2,000mm	7.5	2	
	Waste Sludge Feed Pump	Progressive Cavity Pump	34～104m3/Hr x 20m	30	2	1
	Mechanical Thickener	Screw Press Thickener	75m3/Hr(3m2)	1.5 + 0.75kw x 2	2	1
GRAVITY THICKENER	Inlet Weir	Adjustable Weir	W600mm	–	2	
	Thickener Sludge Collector	Center Drive	dia.20m x WD3.5m	0.75	2	
	Thickened Sludge Pump	Non-Clog Type Sludge Pump	1.0m3/min x 5m	3.7	1	1
	Suction Sludge Valve	Motorized Eccentric Valve	dia.150mm	0.2	2	
	Sump Drainage Pump	Submersible Sewage Pump	0.1m3/min x 7m	0.4	1	
	Hoist Block	Geared Troller Chain Block	1.0ton	–	1	
	Exhaust Fan	Centrifugal Fan	12m3/min	0.2	1	
GAS HOLDER	Gas Holder	Wet Type Gas Holder	1,300m3	–	1	
DIGESTER & PUMP HOUSE	Sludge Pump	Non-Clog Type Sludge Pump	5.5m3/min x 12m	22	1	1
	Sump Drainage Pump	Submersible Sewage Pump	0.3m3/min x 15m	1.5	1	
	Desulfurizer	Water Sproy Type	460m3/Hr	–	1	
	Inhalation Fan	Centrifugal Fan	40m3/min	1.5	2	2

CLASSIFICATION	DESCRIPTION (Equipment)	TYPE (Model)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
DIGESTER & PUMP HOUSE	Sludge Valve	Motorized Gate Valve	φ250	0.4	5	
	Exhaust Fan	Centrifugal Fan	90m3/min	5.5	1	1
HOPPER HOUSE	Cake Conveyor	Belt Conveyor	W600mm x L19m	1.5	2	1
	Cake Hopper	Motor Driven Cut Gate Type	15m3	2.2kw x 2	4	2
	Cake Tripper	Motor Driven		0.4	2	1
SLUDGE TREATMENT BUILDING	Polymer Feeder	Constant Chemical Feeder	4,000cc/min	0.4	2	
	Polymer Feed Pump	Progressive Cavity Pump	1.5～4.8m3/Hr x 20m	2.2	2	1
	Hoist Block Dewatering	Geared Troller Chain Block	3.0ton	–	3	
	Polymer Container	Polymer Container	1.0m3	–	8	
	Waste Water Mixer	Vertical Propeller Mixer	dia.2,000mm	7.5	1	
	Waste Water Pump	Non-Clog Sludge Pump	3.0m3/min x 17m	22	1	1
	Sump Drainage Pump	Submersible Sewage Pump	0.3m3/min x 10m	1.5	2	2
	Digested Sludge Mixer	Vertical Propeller Mixer	dia.2,000mm	7.5	2	
	Sludge Feed Pump	Progressive Cavity Pump	7.5～23m3/Hr x 20m	7.5	2	1
	Dewatering Machine	Screw Press Type	dia.900mm x 450kg/Hr	(3.7+1.5)kw	2	1
	Polymer Tank	Vertical Cylindrical Tank	10m3	5.5	2	
	Hoist Block	Geared Troller Chain Block	3.0ton	–	1	
	Hoist Block	Geared Troller Chain Block	0.5ton	–	2	

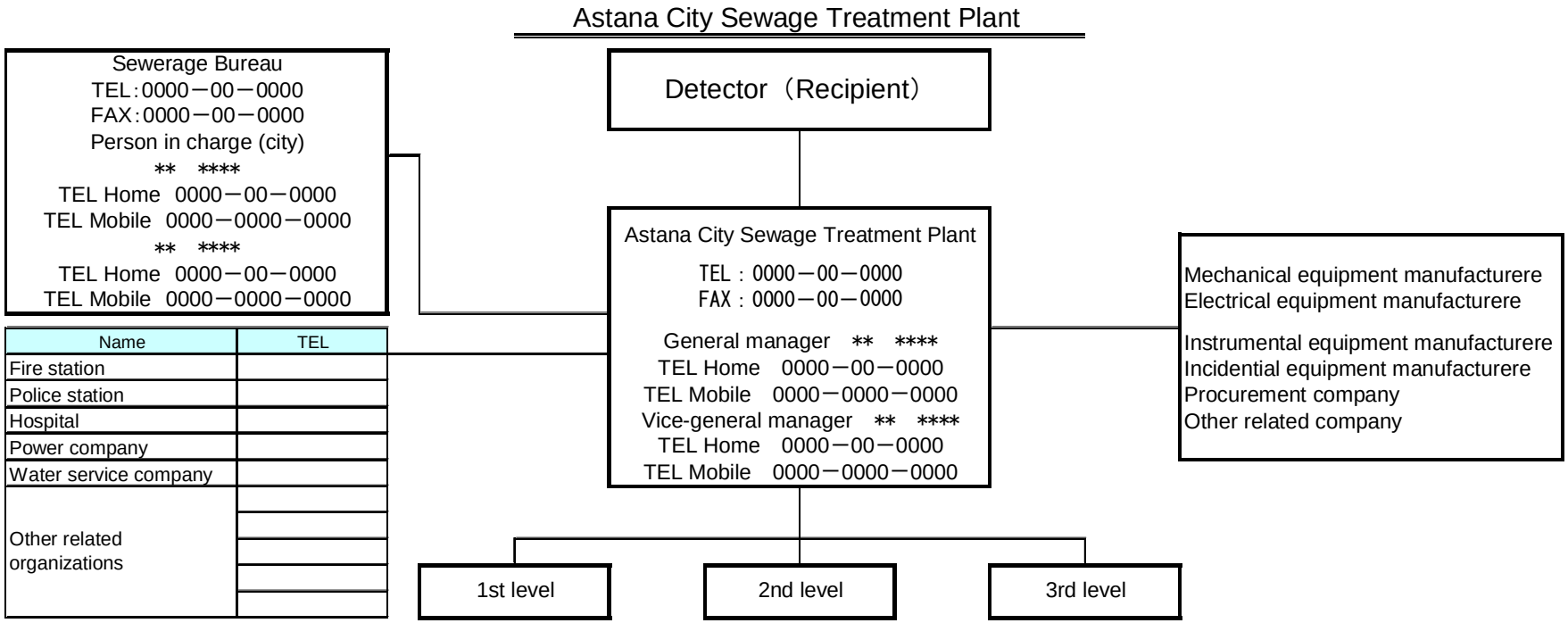
CLASSIFICATION	DESCRIPTION (Equipment)	TYPEModel)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
SLUDGE TREATMENT BUILDING	Treated Water Valve	Motorized Butterfly Valve	ϕ 400	0.4	1	
	Elutriation Water Pump	Volute Pump	0.17m3/min x 25m	3.7	1	1
	Treated Water Supply Unit	Pressure Tank Type	0.3m3/min x 25m	3.7	1	1
	Desulfurize Pump	Volute Pump	6.1m3/min x 23m	45	1	1
	Strainer Odor Scrubber	Automatic Backwashing Type	dia.65mm x 0.34m3/min	0.4	1	
	Water Supply Unit	Pressure Tank Type	2.2m3/min x 40m	15	1	1
	Strainer Grit Scrubber	Automatic Backwashing Type	dia.65mm x 0.3m3/min	0.4	1	
	Strainer Desulfurizer	Automatic Backwashing Type	dia.250mm x 6.1m3/min	0.4	1	
SLUDGE TREATMENT BUILDING	Scrubber	Biological Scrubber	90m3/min	0.75	1	
	Odor Fan	GRP Centrifugal Fan	90m3/min x 2.5KPa	5.5	1	1
	Mist Separator	Mist Separator	180m3/min	–	1	
BOILER BUILDING	Water Softeing Unit		0.22m3/min	0.2	1	1
	Soft Water Pump	Multistage Pump	2.2m3/min	45	1	1
	Cler Water Tank	PVC Tank	10m3	–	1	
	Condenser		12m3	–	1	
	Heating Pump	Volute Pump	0.9m3/min	11	1	1
	Heat Exchanger	Double Layered	0.9m3/min	–	2	

CLASSIFICATION	DESCRIPTION (Equipment)	TYPEModel)	SPECIFICATION	DUTPUT(kW)	DUTY	STANDBY
BOILER BUILDING	Exhaust Fan	Propeller Fan		0.75	1	
	Coal Boiler		4.0ton/hr	11	1	1
	Gas Boiler					
	Coal Grinder	Two Axis Grinder	ϕ 400mm x 1.5m	11	1	1
	Coal conveyor	Scip Hoist	Tilt 10m x Level 28m	22	1	
	Ash Conveyor(1)	Chain Flight Conveyor	W400mm x L28m	1.5	1	
	Ash Conveyor(2)	Chain Flight Conveyor	W400mm x L31m	1.5	1	
	Water Supply Unit	Volute Pump	0.2m3/min	5.5	1	1

9.5 Organization Chart



9.6 Emergency Contact Network



Name	TEL
Fire station	
Police station	
Hospital	
Power company	
Water service company	
Other related organizations	

Emergency Dispatch System			
Dispatch level	Personnel	Name	TEL
1st level	Experts related to the concerned	① *** *****	0000-00-0000
		② *** *****	0000-00-0000
2nd level	Day shift workers adding to 1st level	③ *** *****	0000-00-0000
		④ *** *****	0000-00-0000
		⑤ *** *****	0000-00-0000
3rd level	Cooperators adding to 2nd level	⑥ *** *****	0000-00-0000
		⑦ *** *****	0000-00-0000
		⑧ *** *****	0000-00-0000
		Neighbor supportive system	0000-00-0000

9.7 Operation Schedule（Example Extracted）

9.7.1 Policy of operation

The operation policy of Astana city sewage treatment plant（Present capacity 136,000m^3／day）is as follows:

- Set operational index as to maximize capacity of each facility or equipment,
- Operate according the above index and considering operational data and water quality test result, and
- Produce effluent which conforms to required quality level / effluent criteria.

Required quality level

Items	Required level	Effluent Criteria	Remarks
BOD(mg/L)			
SS (mg/L)			

9.7.2 Concept and procedure of operation

(1) Concept of sewage treatment

1) From inflow to disinfection process, operate the plant efficiently in corresponded to inflow quality and quantity.
2) Control MLSS in reaction tanks with index of BOD-SS load which leads good treated water quality.
3) Make it an operational rule to change aeration rate in proportion to inflow load. Adjust the rate with consideration of daily fluctuation and return flow load.
4) As for sludge generated from each process, prevent accumulation and putrefaction by controlling process volume basically corresponding to estimated generation rate and also to sludge-liquid surface, sludge concentration, and pH.

(2) Concept of sludge treatment

1) Process sludge based on a schedule by estimating sludge generation rate based on past record and on current water quality.
2) Control feed rate and withdrawing rate of sludge by confirming solids mass balance.
3) Control retention time and sedimentation time at each process to keep good conditions of sludge.
4) Maintain targeted water content and stabilize sludge condition to be fed to composting facility.

(3) Operation of each process

1) Sewage treatment capacity

i) Treatment rate

Estimate treatment volume by adding influent volume and recycle flow volume. Then set operational conditions within design criteria corresponding to the estimated load.

ii) Influent quality

Sampling points should be decided where influent of recycle flow can be avoided. From result of daily water tests and observation at patrol, monitor abnormal influent.

2) Pumping Well and Sewage Pump

i) Setting of pumping rate

Monitoring water level of pumping wells, operate pumps within the set pumping rate.

ii) Prevention of putrefaction

To prevent sludge accumulation and scum generation, lower the water level and flush regularly. It restrains putrefaction and prevents odor and bulking generation.

3) Primary sedimentation tank

i) Proper usage of tanks

Determine the number of tanks to be used in consideration of settling time and surface load. And reconsider it by checking effluent SS and BOD and their removal ratio.

ii) Prevention of putrefaction

Determine sludge withdrawal rate on solids basis. At primary sedimentation tanks, maintain solid liquid interface as low as possible to suppress anaerobiosis.

iii) Effluent

Understand fluctuation of effluent load from primary sedimentation tanks to reaction tanks by diurnal examination of effluent quality.

9.8 Major Indexes of Monitoring and Control Items

Division	Item		Purpose	Max.	Min.	unit
Influent	Quantity of water		Check the fluctuation of the influent	○○	○○	m^3
	Water level		Cooperate with the pumping station	○○	○○	m
	Water	Transparency	Check the abnormal inflow water	○○	○○	cm
		pH		○○	○○	—
Primary Sedimentation Tank	Sludge-Liquid interface		Check the situation of sedimentation	○○	○○	m
	Water	pH	Prevent putrefaction	○○	○○	—
		SS	Check the load to the aeration tank	○○	○○	mg/L
	Raw Sludge	Volume	Set the volume of the withdrawn sludge	○○	○○	m^3
		Concentration		○○	○○	%
Aeration Tank	Water	MLSS	Check MLSS, BOD/SS load	○○	○○	mg/L
		DO	Check the air volume	○○	○○	mg/L
		pH	Check the condition of treated water	○○	○○	—
		NH4-N,NOx-N		○○	○○	mg/L
		SV_{30} ・SVI	Check the situation of sedimentation	○○	○○	—
	Volume of air		Check the air volume	○○	○○	m^3
Secondary Sedimentatio Tank	Sludge-Liquid interface		Check the situation of sedimentation	○○	○○	m
	Return sludge	Volume	Set the volume of return sludge ratio	○○	○○	%
		Concentration		○○	○○	mg/L
	Excess Sludge	Volume	The setting of the quantity of drained sludge	○○	○○	m^3
Discharge	Water	Transparency	Check the air volume	○○	○○	cm
		Residual Chlorine	Check the disinfection	○○	○○	mg/L
Gravity Thickening Tank	Thickend Sludge	Volume	The setting of the volume of withdrawn sludge	○○	○○	m^3
		Concentration		○○	○○	%
Centrifugal thickener	Thickend Sludge	Concentration	Check the situation of thickend sludge	○○	○○	%
Dehydrator	Watrer Content		Check the sludge cake properties	○○	○○	%
Hopper	Weight of Sludge Cake		Check the sludge cake volume	○○	○○	t
Compost	Volume of Compost		Check the compost volume	○○	○○	m^3

9.9 Daily Work Plan（Extracted）

Facility	Section	Works	Frequency	
Bihn Hung Treatment Plant	Operation	Operation and monitoring in the monitoring room.	Continuous	365/year
		Water treatment, suludge treatment and composing facility.		
		Oeration at site. (Scum skimmer, etc.)	3-5times/day	-
		Preparation of work transfering sheets.	At any time	365/year
		Daily water analysis.		
		Daily work reports.		
		Daily patrolling inspection.		
		Regulation of chemical dasage. Stock management of chemical.		
		Preparation of operation reports of outside facilities.		
	Maintenance	Weekly inspection on equipment.	once/week	52/year
	Water quality control	Water analysisi regarding operation.	daily	365/year
	Ground maintenance	Cleaning of the monitoring roon.	daily	365/year
		Cleaning of inside the building.(For each section)	5times/week	250/year
	Others	Lock and check.	daily	365/year
Others	Emergency	Correspondence at an emergency.	-	-
		Liaison	-	-
		Various correspondence on operational works.	-	-

9.10 Water Quality Inspection Schedule

(1) Schedule

Marks ◎:Daily ○:3-5times/week ◇:1-4times/month □:Once-twice a year ◆:On demand

	Apr	May	Jun	Jly	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Remarks
1. Daily examination	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	◎/○	
2. Periodic examination	○/◇	○/◇	○/◇	○/◇	○/◇	○/◇	○/◇	○/◇	○/◇	○/◇	○/◇	○/◇	
3. Diurnal examination					□					□			
4. Legal-required examination	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	

(2) List of Water Quality Inspection

Marks ◎:Daily ○:3-5times/week ◇:1-4times/month □:Once-twice a year ◆:On demand

Examination	Item	Influent	Primary Sedimentation		Aeration Tank		Secondary Sedimentation Tank	Discharge	Primary/Secondary Sedimentation		Gravity Thickening Tank	Centrifugal Thickener	Digester	Dehydrator
			Inflow	Outflow	Outflow	Return Sludge			Raw Sludge	Excess Sludge				
Daily	Water temperature	◎	○	◎	◎			◎			○		◎	
	Transparency	◎	○	◎			◎	◎						
	pH	◎	○	◎	◎			◎	○	○	○		◇	
	DO				◎									
	SV_{30}				◎									
	Residual Chlorine							◎						
	Watrer Content													◎
	SS	○	○	○			○	○			◇	◇		
	COD	○	○	○			○	○						
	Gas volume												◎	
Periodic	BOD	◇		◇				◇						
	MLSS (RSSS)				○	○								
	MLVSS				◇									
	TS								◇	◇	◇	◇	◇	
	VTS								◇		◇		◇	
Diurnal	SS, BOD	□		□				□						
Legal-required	Leagal Items	◆						◆						

(3) Method of Water Analysis

Item	Out-sourcing	Test method	Remarks

9.11 Periodic Work Schedule (Extracted)

	Service Contents		Enforcement frequency	20××												Note
				1	2	3	4	5	6	7	8	9	10	11	12	
Maintenance Service	Vibration Measurement	Blower Facility	Every 3 months		○			○			○			○		
		Return Sludge Pump	Every 6 months				○						○			
	Oil Diagnosis	Sludge Scraper	Yearly						○							
	Monthly inspection	Blower Facility	monthly	○	○	○	○	○	○	○	○	○	○	○	○	
		Sludge Scraper	9times/year			○	○	○	○	○	○	○	○	○		
	Every 3 months inspection	Blower Facility	Every 3 months		○			○			○			○		
		Return Sludge Pump	Every 3 months	○			○			○			○			
		Sludge Scraper	Every 3 months			○			○			○			○	
	Every 6 months inspection	Blower Facility	Every 6 months	○						○						
		Return Sludge Pump	Every 6 months	○						○						
		Sludge Scraper	Every 6 months				○						○			
	Yearly inspection	Blower Facility	Yearly							○						
		Return Sludge Pump	Yearly							○						
		Sludge Scraper	Yearly									○				

9.12 Inspection Criteria of Equipment

Machinery

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
Blower Facility	Blower	MB Multistage Turbo Blower	The main body	Check and record the meters (air flow rate, discharge pressure, axle hole temperature, etc.)	–	242	A	–
				Check for abnormal noise, vibration, fever, and nasty smell.	–	242	B	–
				Appearance inspection (rust, leak, and damage)	–	242	A	–
				Check operation situation of the solenoid valve and the flow relay.	–	12	A	–
				Check the volume of bearing cooling water.	–	242	A	–
				Check the vibration proof rubber for loss of resilience and crack.	–	242	A	–
				Measure and a record vibration values.	–	4	C	f
				Tighten attachment bolts of main body.	–	2	B	–
				Check operation and display of protection instruments.	–	4	B	–
			Motor	Measure insulation resistances.	–	1	C	e
				Check motors for abnormal noise, vibration, fever, and nasty smell.	–	242	B	–
				Check and record current value.	–	242	A	–
				Check attachment bolts for tightness.	–	1	B	–
				Check the brush repatriation device, the retainer, and the slip ring for damages, discoloration, and the stains.	–	4	A	–
				Check damages, discoloration, and stains of the current collector part (bounds, a bearing, firm resolution, a coil).	–	4	A	–

Method・・・ A:Visual inspection B:Palpation/ Audio inspection C:Measurement

Tool・・・ a:Aquameter b:Grease gun c:Stopwatch d:Caliper e:Insulation resistance meter f:Vibration indicator g:tachometer h:Thickeness gauge i:Centralized oiling device j:Noise meter k:Ruler l:Circuit tester m:Thermometer n:Hydrometer o:Submersible pump p:Measure q:Calibrator r:Infrared thermometer s:Earth-resistance meter t:Electric relay tester u:Densimeter v:Clamp meter

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
Blower Facility	Blower		Starting equipment	Check for abnormal noise, vibration, fever, and nasty smell.	–	156	B	–
			Motor	Check and record current value.	–	1	C	v
				Check attachment bolts for tightness.	–	1	B	–
				Check terminals for tightness and heat signs.	–	2	A	–
			Starting equipment	Check each part for tightness of tightening bolts.	–	1	B	–
				Check clutches for abnormal noise, vibration, fever, and nasty smell.	–	156	B	–
				Check abrasion degree of the guide bush.	–	2	A	–
				Centering adjustment of clutches.	–	2	–	–
				Check linings for abrasion.	–	2	A	–
Blower Facility	Discharge Valve	Motor type	The main body	Check opening.	–	156	A	–
				Appearance inspection (rust, leak, and damage)	–	156	A	–
				Check switching action. Check for abnormal noise, and vibration.	–	4	B	–
				Check position of complete opening and shutting. Check if water stops on shutting position.	–	4	A	–
				Inspection of the inside (the abrasion , the transformation, and the damage of the seat and the stem).	–	1	A	–
				Check the shaft bearingfor abrasion and transformation.	–	2	A	–
				Check tightness of the taper pin and the seat suppression.	–	1	B	–
				Adjust and tighten the ground gaskets.	–	4	B	–
				Tighten the attachment bolts of the main body.	–	2	B	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
Blower Facility			Motor	Measure insulation resistances.	–	2	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value.	–	1	C	v
				Check the attachment parts for tightness.	–	1	B	–
				Check the terminals for tightness and heat signs.	–	2	A	–
			Valve control	Greasing.	–	12	–	–
				Check the attachment bolts for tightness.	–	1	B	–
	Anti Surge Valve	Motor–operated, outside screw, sluice valve	The main body	Check opening.	–	104	A	–
				Appearance inspection (rust, leak, and damage)	–	104	A	–
				Check switching action. Check for abnormal noise, and vibration.	–	4	B	–
				Spread grease on the screw parts.	–	4	–	–
				Check position of complete opening and shutting. Check if water stops in shutting position.	–	2	A	–
				Check the shaft bearing for abrasion and transformation.	–	1	A	–
				Check the taper pin and the seat suppression for tightness.	–	1	B	–
				Adjust and tighten the ground gaskets.	–	2	B	–
				Tighten the attachment bolts of the main body.	–	1	B	–
			Motor	Measure insulation resistances.	–	1	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value	–	1	C	v
				Check the attachment parts of the motors for tightness.	–	1	B	–
				Check the terminals for tightness and heat signs.	–	2	A	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Method	Tool
			Valve control	Greasing.	–	12	–	–
				Check the attachment parts for tightness.	–	1	B	–
Blower Facility	Motor for Inlet Guide Vane Actuator		The main body	Check opening.	–	156	A	–
				Appearance inspection (rust, leak, and damage)	–	156	A	–
				Check and record the oil pressure gauge.	–	156	A	–
				Check the limit switch and the pressure switch.	–	2	B	–
				Check the screws on the lever and the link of the position meter for tightness.	–	1	B	–
				Check tightness of screws on a limit switch.	–	1	B	–
				Check the coupling part of the pressure switch for oil leakage.	–	2	A	–
				Clean the oil filter of the oil pump.	–	1	–	–
				Tighten attachment bolts of main body.	–	2	B	–
			Motor	Measure insulation resistances.	–	1	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value	–	1	C	v
				Check the attachment bolts for tightness.	–	1	B	–
				Check the terminals for tightness and heat signs.	–	2	A	–
Final sedimentation	Return Sludge Pump	Centrifugal screw impeller pump	The main body	Check and record meters (discharge pressure, etc.)	–	156	A	–
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check the shaft seal for leakage.	–	156	A	–
				Appearance inspection (rust, leak, and damage)	–	156	A	–
				Disassemble and clean the strainer for the axis seals water.	–	4	–	–
				Measure and record vibration	–	2	C	f
				Check the body and the shaft of the check valve for damage, abrasion, and rust.	–	2	A	–
				Tighten attachment bolts of main body.	–	2	B	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Meth od	Tool
			Motor	Measure insulation resistances.	–	1	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value	–	156	A	–
				Check the attachment bolts of the motors for tightness.	–	1	B	–
				Check the terminals for tightness and heat signs.	–	2	A	–
			V belt	Check the belt for crack and discoloration.	–	156	A	–
				Adjust tension and centering of the belt.	–	4	B	–
				Check the pulley for damage and slack.	–	1	A	–
Final sedimentation	Sludge Scraper	Chain flight type	The main body	Check and record the meters.	–	242	A	–
				Check for abnormal noise, vibration, fever, and nasty smell	–	242	B	–
				Appearance inspection (rust, leak, and damage)	–	242	A	–
				Check the sprocket, the set pin, and the key for damage and tightness.	–	4	B	–
				Check the shear pin for damage, abrasion, and rust.	–	1	A	–
				Check the chain for slack, tension, and abrasion.	–	1	B	–
				Check the axis, the sprocket, the flight board and the shoe for damage and tightness .	–	1	A	–
				Check greased situations.	–	1	A	–
			Motor	Measure insulation resistances.	–	2	C	e
				Check for abnormal noise, vibration, fever, and nasty smell	–	156	B	–
				Check and record current value.	–	1	C	v
				Check the attachment bolts for tightness.	–	1	B	–
				Check the terminals for tightness and heat signs.	–	2	A	–

Facilities division	Equipment	Model	Object machinery	Maintenance Contents	Tolerance level	The number of times	Meth od	Tool
Final sedimentation	Sludge Scraper	Chain flight type	Cycloid reduction gears	Oil exchange	–	1	–	–
				Check volume of oil and oil leakage.	–	12	A	–
				Check the attachment bolts for tightness.	–	1	B	–
				Diagnosis of lubricating oil	–	1	C	–
				Check and clean inside the oil filter.	–	1	–	–
			Chain	Adjust tension and alignment of the drive chain.	–	4	B	–
				Check the sprocket wheel for damage and tightness.	–	1	A	–

9.13 Scope of Ground Maintenance Work

Scope of ground maintenance（Cleaning）

Place	Subject	Frequency	Tools	Duty description
Electrical room	Floors	Monthly	Vacuum cleaners and wax mops	Clean floors by vacuum cleaners and then mop the floors by wax mops. Moving shelves or the like is excluded.
Conduit and building	Steps (concrete floor)	Once every two month	Vacuum cleaners	Clean floors by vacuum cleaners.
Conduit（ able to be sprinkled/ concrete floor ）	Floors and handrails	Floor；12times/year Handrail；Once every three months	Scrapers, nylon brushes and floor clothes	Sprinkle water over floors and scrape it with scrapers. In case of sever dirt, use nylon brushes. As for handrails, wipe with dry floor clothes.
Ventilation mechanical room	Floors	Once every three months	Vacuum cleaners	Clean floors by vacuum cleaners.

Scope of ground maintenance（Weeding）

Place	Subject	Frequency	Tools	Duty description
Yard around the administration building	Lawn	Weeding 6times / year Sprinkle herbicide Twice a year	Mowers, pruning shears and etc. Sprinklers	Mowing（As for 0.3m margins of plantings or curbs, trim weeds b shears.） Sprinkle herbicide as required.（Herbicide should be prepared with a appropriate mix proportion according to an instruction manual）

Scope of ground maintenance（Pruning）

Place	Subject	Frequency	Tools	Duty description
Yard around the administration building	Trees	Once a year	Saws and pruning shears	Prune off branched by pruning shears and saws.

9.14 Ground Maintenance Schedule (Extracted)

Division	Work description	Frequency	20XX												Remarks
			1	2	3	4	5	6	7	8	9	10	11	12	
Cleaning															
Weeding															
Pruning															

9.15 Organization Chart of Safety and Health Committee

9.16 Schedule of Safety and Health Control

(1) Schedule of Safety and Health Control

Target		P : Plan			D : DO			C : CHECK			A : ACTION		
Subject	Detail	1	2	3	4	5	6	7	8	9	10	11	12
Three minute meeting	a) Three minute meeting before and after work.	Instruct the way of the meeting.			Make them do by themselves.			Check implemented result.			Let assignments to be improved known in common.		
	Assignments to be improved should be taken thoroughly.												
4S-activity	a) Improve working environment.	・Enforce monthly safety patrol.											
Educational training	a) Training of safety and health control.	・Training on personnel who are hired throughout the year and who changed the type of works. ・OJT											
	b) Training by personnel who own qualifications or careers	・Special lecture by qualified or careered personnel.											
	c) Intend to promote a sense of dangerous through ”hiyari-hatto”activity and KYT	・Monthly summarize “hiyari-hatto” activity. ・Fill a KYT sheet and hold a reflection meeting everyday.											
Committee	a) Hold a periodic meeting and activate it.	・Hold a periodic meeting（Base on PDCA cycle）								Asssignments to be reflected on annual plan of next year			
Health control	a) Health check by complexion and measurement.	・Encourage personnel who are to be rechecked to do self health care. ・Enforcer daily check by complexion and by asking body condition in order to secure personnel health and safety.											
	b) Health promotion activity	・Radio exercise at morning gatherings.											
Traffic safety	a) Prevent traffic accident by safety driving	・Instruction and confirmation on fastening seatbelt ・Instruction on driving within limit speed											
	b) Prevent traffic accident of commuters by revising KYmap.	・Prepare, revise, and utilize KY map. ・Correct dangerous driving manners.											

(2) Schedule of Safety and Health Subcommittee

Section and Explanation		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Safety	Confirmation of “hiyari-hatto” (hazard map)	P				D			C			A	
Machinery	Commodity of tools	P				D				C		A	
	Lecture on machinery		P			D		C		A			
Electricity	Lecture on electricity	P				D		C		A			
	KYT on electrical works		P				D			C		A	
Hygiene	Establish 4S policy	P				D			C			A	
	Preparation of first-aid kits	P		D			C			A			
Remarks													

9.17 Annual Schedule of Education and Training

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Technical Sewage treatment	Plan												
	Done												
Technical Electricity 1	Plan												
	Done												
Technical Machinery 1	Plan												
	Done												
Technical Machinery 2	Plan												
	Done												
Safety and health	Plan												
	Done												
Accident prevention training	Plan												
	Done												
Others 1	Plan												
	Done												
Others 2	Plan												
	Done												

9.18 Estimation of Utility Consumption（20XX）

Utility	Object	Annual quantity of procurement	unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Remarks
Electricity	Astana city sewage TP		kWh													
Chemical	For sludge treatment Coagulant	138,900	kg													
Fuel	Coal		t													
Others																
Electrical/mechanical consumable goods				←											→	
Water analysis consumable goods				←											→	
Other consumable goods				←											→	

Appendix 10

Survey Sheets of Household Expenditures and WTP

10.1 Jakarta WTP Survey Form

Questionnaire WTP Survey on Wastewater Management in JAKARTA City

Customer Name: Customer Code:

Residency Period: years Number of Family

Please check by (√) on Yes ( ) or No ( ) of Q-1 through Q-4. Your answer does not make any punishment to you, and is utilized for study purpose only.

Q-1

Do you know water pollution caused by untreated wastewater discharge derived from household and municipal activities? **Yes ( ) No ( )**

Q-2

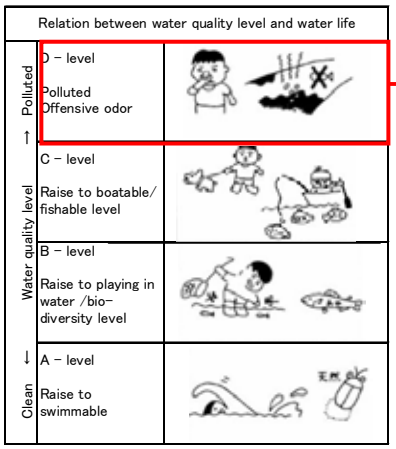
Do you know the role of sewerage system as follows?

Roles:	**to improve sanitation and public health**	**Yes ( )**	**No ( )**
	to mitigate storm water inundation	**Yes ( )**	**No ( )**
	to conserve water environment and water resource	**Yes ( )**	**No ( )**
	to create aesthetic urban view and amenity spot	**Yes ( )**	**No ( )**

How do you understand the sewerage roles? (ex. Public awareness promotion)

Do you have family conversation about natural environment, sanitation or water environment?

Please answer to Q-3 and Q-4 on the assumption that water environment is polluted and sewerage system would restore water environment as follows.



Present water environment: D-level

Polluted and offensive odor
Debris deposits
Unhygienic and caused habitual diarrhea

Untreated wastewater flows to river. Water environment around living area really becomes worse.

Following photographs show images of efficient sewerage facility development.

	
Public sanitation will be improved through prevention of stagnant water around living area, smooth discharge domestic wastewater to sewer system and so on.	Public water environment conservation and improvement will be achieved via wastewater treatment. People can enjoy water amenity environment.

Q-3

For sustainable public sanitation and water environment conservation/improvement, sewerage facilities shall be operated and maintained in proper condition, and expanded to the planned service area through stepwise development plan. In accordance with the beneficially-payment principle, operation and maintenance (O&M) cost of sewerage facilities shall be shared among beneficiaries in the service area as much as possible.

In line with the above said background, could you answer to the following question, and check by (√) on Yes ( ) or No ( ) for only one of **A-3**?

How much could you accept to pay for sewerage tariff??

□□,000 Rp./month (equivalent to cigarette boxes)

A-3 No ( ) Yes ( )

Reason of answer if "No"

Q-4

Could you give us more information based on your above mentioned willingness? Please answer to your willingness to pay, and check by (√) on Yes ( ) or No ( ) for only one of **A-4**.

If you answered "No" on Q-3, could you accept to pay for following sewerage tariff???

□□**,000 Rp./month** **Yes ( )** **No ( )**

If you answered "Yes" on Q-3, could you accept to pay for following sewerage tariff???

□□**,000 Rp./month** **Yes ( )** **No ( )**

Reason of answer if "No"

Satisfaction level/Complain/Requirement for Sewerage Service if any

Thank you very much!!

Reference to "_____"

10.2 Yogyakarta Household Expenditure Survey

Household Income/Expenditure Survey for YOGYAKARTA City

Survey Number _____ Date: _____

Customer Name: _____ Customer Code: _____

Do you know the role of sewerage system as follows:

Roles: to improve sanitation and public health	Yes ( )	No ( )
to mitigate storm water inundation	Yes ( )	No ( )
to conserve water environment and water resource	Yes ( )	No ( )
to create aesthetic urban view and amenity spot	Yes ( )	No ( )

Income/Expenditure Structure	Amount	Share(%)
1) Household background data (1) Family members (2) Occupation of householder (3) Monthly total income of household	Rp.	
2) Specification of expenditure	Rp.	(%)
(1) Basic foodstuffs		
(2) Housing and household operations		
(3) Fuels and transport		
(4) Public service(Electricity, water supply)		
(5) Non-consumables(house equipment)		
(6) Tobacco and other tasty things		
(7) Clothing and foot ware		
(8) Education		
(9) Health		
(10) Recreation and culture		
(11) Others		
Total		100%
3) How much could you accept to pay for sewerage charge? Please choose among (1) ~ (10) of 2) above.		

10.3 Vietnam Household Expenditure Survey

Household Income/Expenditure Survey

Do you know the role of sewerage system as follows Yes( ) No( )

Roles: to improve sanitation and public health
to mitigate storm water inundation
to conserve water environment and water resource
to create aesthetic urban view and amenity spot

Income/Expenditure Structure	Amount	Share(%)
1) Household background data (1) Family members (2) Occupation (3) Monthly income of house hold	(VND)	
2) Specification of expenditure (1) Basic foodstuffs (2) Housing and household operations (3) Fuels and transport (4) Public service(Electricity, water supply) (5) Non-consumables(house equipment) (6) Alcoholic beverages and tobacco (7) Clothing and foot ware (8) Education (9) Health (10) Recreation and culture (11) Others	(VND)	(%)
Total		100%
3) How much do you pay for sewerage charge? Please choose among (1) – (10) of 2) above.		

Procedure of Affordability Study (Vietnam)

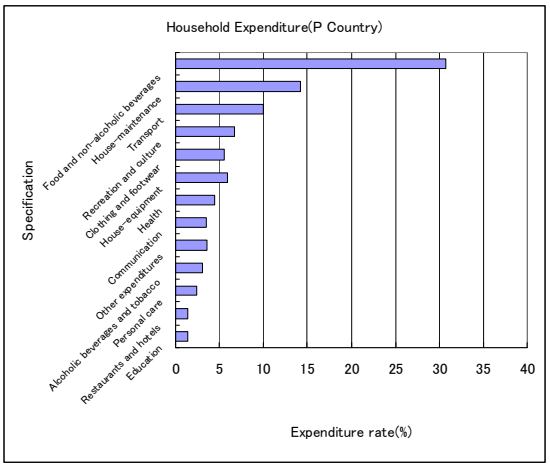
Role of "Affordability Study"

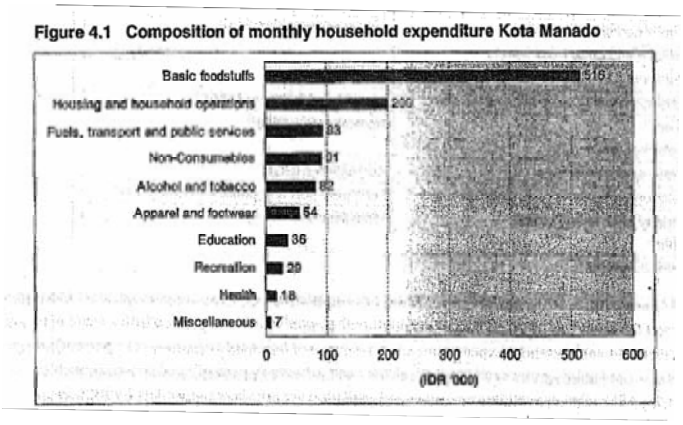
To survey the structure of household expenditure, and to evaluate the affordability of household for public service.

Household Income Statistics

Study result of household expenditure shows basic foodstuffs to highest, housing and household operation to second highest in spite of income revels and countries. Low shares are education, recreation or health which shares 2 to 4 % of monthly expenditure.

Charge of basic public services are now recommended to affordable level through administrative approach.





Study scheme and procedure of survey

RDD（Random Digit Detecting） and face to face hearing

Survey area: Sewerage planned area in Hanoi and Ho Chi Minh

Sampling number: 30 recipients (15 samples in Hanoi and HCM each)

Five sample in each income level of high/middle/modest in each City.

VHLSS 2006 Statistics

1.8 Số lao động bình quân một hộ năm 2006 chia theo 5 nhóm thu nhập, thành thị nông thôn, giới tính, nhóm tuổi dân tộc của chủ hộ, trình độ học vấn của chủ hộ

Number of labourers per household in 2006 by income quintile, urban/rulral,sex, age group, ethenic of household head, educational level of household head

Đơn vị tính/Unit: Người/Person

	Chung *Total*	5 nhóm thu nhập/ *income quintile*				
		Nhóm *Quintile 1*	Nhóm *Quintile 2*	Nhóm *Quintile 3*	Nhóm *Quintile 4*	Nhóm/ *Quintile 5*
CẢ NƯỚC / *WHOLE COUNTRY*	**2,6**	**2,4**	**2,6**	**2,7**	**2,7**	**2,6**
Thành thị - Nông thôn/*Urban - Rural*						
Thành thị/ *Urban*	2,7	2,8	2,7	2,8	2,8	2,5
Nông thôn/ *Rural*	2,6	2,4	2,6	2,6	2,7	2,6
Giới tính chủ hộ/ *Sex of household head*						
Nam/ *Male*	2,8	2,6	2,7	2,8	2,8	2,7
Nữ/ *Female*	2,2	1,7	2,1	2,3	2,4	2,4
Nhóm tuổi/ *Age group*						
13-14	...	...	...	...	...	...
15-19	1,7	2,0	1,6	1,5	2,0	2,0
20-24	2,2	2,2	2,2	2,4	2,2	2,0
25-29	2,1	2,1	2,1	2,1	2,1	2,0
30-34	2,0	2,0	2,0	2,0	2,0	2,0
35-39	2,3	2,3	2,3	2,3	2,3	2,2
40-44	2,9	3,0	3,0	3,0	2,9	2,8
45-49	3,4	3,6	3,5	3,5	3,5	3,3
50-54	3,6	3,5	3,6	3,7	3,6	3,4
55-59	3,1	3,1	3,1	3,1	3,1	3,0
60-64	2,0	2,0	2,1	2,0	2,1	1,9
65+	1,5	1,1	1,5	1,6	1,7	1,7
Dân tộc của chủ hộ/ - *Ethnic of household head*						
Kinh	2,6	2,2	2,5	2,6	2,7	2,6
Tày	2,9	2,9	3,0	2,9	2,9	2,5
Thái	3,1	3,1	3,2	3,1	2,9	3,2
Hoa	3,2	3,9	2,8	3,2	3,6	2,9
Khơ me	2,8	2,6	2,8	3,0	2,8	3,0
Mường	3,0	2,9	3,1	3,0	2,9	2,9
Nùng	2,9	2,9	2,9	2,9	3,0	3,0
H'mông	3,1	3,2	3,1	2,4	1,7	2,4
Dao	2,8	2,8	2,8	2,8	3,0	3,2
Khác	2,8	2,9	2,7	2,9	2,9	2,4
Trình độ học vấn chủ hộ/ *Educational level of household head*						
Chưa học hết lớp 1 hoặc chưa bao giờ đến trường	2,1	2,1	2,1	2,2	2,3	2,1
Not finish grade 1 or never go to school	2,5	2,3	2,4	2,6	2,6	2,6
Không có bằng cấp/ *No Certificate*	2,7	2,5	2,6	2,7	2,8	2,8
Tốt nghiệp tiểu học/ *Primary*	2,8	2,7	2,8	2,8	2,8	2,8
Tốt nghiệp THCS/ *Lower secondary*	2,7	2,7	2,7	2,7	2,8	2,7
Tốt nghiệp THPT/ *Upper secondary*	2,6	2,6	2,8	2,5	2,6	2,6
Công nhân kỹ thuật/ *Technical worker*	2,6	2,3	2,7	2,6	2,6	2,5
Trung học chuyên nghiệp/ *Professional secondary*	2,5	2,7	2,8	2,6	2,5	2,5
Cao đẳng, đại học/ *College, university*	2,5	3,2	3,2	2,8	2,2	2,5
Cao đẳng/ College	2,5	2,5	2,7	2,4	2,8	2,5
Đại học/ University	2,2	...	...	...	2,0	2,2

55

5.1 Thu nhập bình quân nhân khẩu 1 tháng chia theo thành thị nông thôn, giới tính chủ hộ, vùng và 5 nhóm thu nhập

Monthly income per capita by urban rural, sex of household head, region and income quintile

(Giá hiện hành/ *At current prices)*

Đơn vị tính/ Unit: 1000 VNĐ

	2002	2004	2006
Cả nước/ *Whole country*	**356,1**	**484,4**	**636,5**
Thành thị - Nông thôn/*Urban - Rural*			
Thành thị/ *Urban*	622,1	815,4	1058,4
Nông thôn/ *Rural*	275,1	378,1	505,7
Vùng/*Region*			
Đồng bằng sông Hồng/ *Red River Delta*	353,1	488,2	653,3
Đông Bắc/ *North East*	268,8	379,9	511,2
Tây Bắc/ *North West*	197,0	265,7	372,5
BắcTrung Bộ/ *North Central Coast*	235,4	317,1	418,3
Duyên hải Nam Trung Bộ/ *South Central Coast*	305,8	414,9	550,7
Tây Nguyên/ *Central Highlands*	244,0	390,2	522,4
Đông Nam Bộ/ *South East*	619,7	833,0	1064,7
Đồng bằng sông Cửu Long/*Mekong River Delta*	371,3	471,1	627,6
Giới tính chủ hộ/*Sex of household head*			
Nam/ *Male*	332,6	455,4	596,8
Nữ/ *Female*	446,2	589,1	778,8
5 nhóm thu nhập/*Income quintile*			
Nhóm/*Quintile 1*	107,7	141,8	184,3
Nhóm/*Quintile 2*	178,3	240,7	318,9
Nhóm/*Quintile 3*	251,0	347,0	458,9
Nhóm/*Quintile 4*	370,5	514,2	678,6
Nhóm/*Quintile 5*	872,9	1182,3	1541,7

(*) Số đã được điều chỉnh so với số trong sách "Kết quả điều tra đời sống, kinh tế hộ gia đình năm 1999", năm 2000 - NXB Thống kê

(*) The adjusted figure compared to the figure in the book "Results of The Households' Living Standards and Economic Condition Survey in 1999", 2000 - Statistical Publishing House

Appendix 11

Sewerage Tariff Structure

11 Sewerage Tariff Structure

11.1 Summary of Tariff Structure

City	Metered water	Non-metered water	Domestic			Commercial			Remarks
			Flat rate	Progress	Progress Max/Min	Flat rate	Progress	Progress Max/Min	
Jakarta		○		○	1.76		○	1.6	HH : electricity class Commc : business type&star Comm/HH = 5 ~ 8
Yogyakarta		○	○	○	2	(○)	(×)	−	Employee&revenue
Bandung	○	○		○	Flow 3.1-3.5 Income 2.0		○	Flow 2.75/3.33 Income 1.1-1.3	flow rate & income
Denpasar, Bali		○		○	1.67	Commerc. (○)	Hotel (○)	Hotel -2	HH : access road Hotel: star
Surakarta (Solo)		○	○		1.5	○		1.5	HH&Comm: class&type
Banjarmasin		○	○		−	○		−	
Hanoi	○	○	○		−	○		−	
Ho Chi Minh	○			○	2.96	○		−	
Astana	○		○		−	○		−	HH equal to commercial
Manila	○	○		○	4.2		○	1.1-1.2	Comm/HH: 4.5
Maynilad	○	○		○	4.2		○	1.1-1.2	Comm/HH: 4.5

11.2 Sewerage Tariff of Indonesia

Attachment I to: The Greater Jakarta Governor Decree
No. 1470 of 2006
Dated 6th September 2006

WASTEWATER DISPOSAL SERVICE TARIFF
PD PAL JAYA (M^2 OF BUILDING ACREAGE PER MONTH)

No.	Customer Category Indonesian/ English	Tariff (Rp)	Connection Cost Unit	(Rp)	累進率 Progressive	累進率 rate	Original tariff Tariff (Rp)	Connection Cost Unit	(Rp)	累進率 Progressiv	改定率 Escaration
I	Rumah Tangga										
1	Rumah Tangga Tipe A /Type A (Electricity 450-900 VA)	90	Unit	10,000	1.00		72	Unit	10,000	1.00	1.25
2	Rumah Tangga Tipe B/ Type B (Electricity 900 -1,300	113	Unit	10,000	1.26		90	Unit	10,000	1.25	1.26
3	Rumah Tangga Tipe C/ Type C (Electricity 1,300 -2,200	135	Unit	10,000	1.50		108	Unit	10,000	1.50	1.25
4	Rumah Tangga Tipe D/ Type D (Electricity 2,200 VA～)	158	Unit	110,000	1.76		126	Unit	110,000	1.75	1.25
II	Niaga Kecil/ Small Scale Commerce										
1	Toko/ Shop	135	building acreage m^2	1,000	1.50	1.00	108	building acreage m^2	1,000	1.50	1.25
2	Kantor (Bangunan sampai dengan 3 lantai)/ Office (Building up to 3 floors)	135	building acreage m^2	1,000	1.50	1.00	108	building acreage m^2	1,000	1.50	1.25
3	Salon/Salon	158	building acreage m^2	1,000	1.76	1.17	126	building acreage m^2	1,000	1.75	1.25
4	Katering/ Catering	180	building acreage m^2	1,400	2.00	1.33	144	building acreage m^2	1,400	2.00	1.25
5	Restoran Kecil/Rumah Makan/ Small Restaurant	225	building acreage m^2	1,500	2.50	1.67	180	building acreage m^2	1,500	2.50	1.25
6	Losmen/Inn	225	building acreage m^2	1,500	2.50	1.67	180	building acreage m^2	1,500	2.50	1.25
7	Niaga Kecil Lainnya/Others	225	building acreage m^2	1,500	2.50	1.67	180	building acreage m^2	1,500	2.50	1.25
III	Niaga Besar /Large Scale Commerce										
1	Kantor Bangunan Tinggi /High Building Office	450	building acreage m^2	1,750	5.00	1.00	360	building acreage m^2	1,750	5.00	1.25
2	Kantor Bangunan Tinggi termasuk Restoran dan atau fitness/ High Building Office incl. Restaurant and/or fitness	495	building acreage m^2	1,925	5.50	1.10	396	building acreage m^2	1,925	5.50	1.25
3	Pusat Perbelanjaan/Mal/Supermarket/Show Room/ Shopping Center/Mall/Supermarket/Show Room	495	building acreage m^2	1,925	5.50	1.10	396	building acreage m^2	1,925	5.50	1.25
4	Hotel Bintang I, II, III/ Hotels of I, II, and III Stars	495	building acreage m^2	1,925	5.50	1.10	396	building acreage m^2	1,925	5.50	1.25
5	Apartemen/Kondominium/ Apartment/Condominium	675	building acreage m^2	2,625	7.50	1.50	540	building acreage m^2	2,625	7.50	1.25
6	Hotel Bintang IV/ Hotel of IV Star	675	building acreage m^2	2,625	7.50	1.50	540	building acreage m^2	2,625	7.50	1.25
7	Tempat Hiburan/Restoran Besar/Café／Entertainment Site/Large Restaurant/Café	720	building acreage m^2	2,800	8.00	1.60	576	building acreage m^2	2,800	8.00	1.25
8	Rumah Sakit Swasta/ Private Hospital	720	building acreage m^2	2,800	8.00	1.60	576	building acreage m^2	2,800	8.00	1.25
9	Hotel Bintang V/ Hotel of V Star	720	building acreage m^2	2,800	8.00	1.60	576	building acreage m^2	2,800	8.00	1.25
10	Niaga Besar Lainnya/ Others	720	building acreage m^2	2,800	8.00	1.60	576	building acreage m^2	2,800	8.00	1.25
IV	Sosial ・Social (Public)										
1	Tempat Ibadah/ Religious Service Site	50	building acreage m^2	550	0.56	1.00	40	building acreage m^2	550	0.56	1.25
2	Sekolah/ School	135	building acreage m^2	850	1.50	2.70	85	building acreage m^2	850	1.18	1.59
3	Puskesmas/ Community Health Centre (of sub-district level)	180	building acreage m^2	1,100	2.00	3.60	108	building acreage m^2	1,100	1.50	1.67
4	Instansi Pemerintah/ Government Institution	180	building acreage m^2	1,100	2.00	3.60	144	building acreage m^2	1,100	2.00	1.25
5	Lain-lain Lembaga/Instansi/ Other Institutions	180	building acreage m^2	1,100	2.00	3.60	144	building acreage m^2	1,100	2.00	1.25
6	Sekolah termasuk Asrama/ School including dormitory	180	building acreage m^2	1,100	2.00	3.60	144	building acreage m^2	1,100	2.00	1.25
7	Kolam Renang/ Swimming Pool	225	building acreage m^2	1,100	2.50	4.50	180	building acreage m^2	1,100	2.50	1.25
8	Rumah Sakit Swasta/ Private Hospital	270	building acreage m^2	1,500	3.00	5.40	216	building acreage m^2	1,500	3.00	1.25
9	Klinik/Balai Pengobatan/ Clinic	270	building acreage m^2	1,500	3.00	5.40	216	building acreage m^2	1,500	3.00	1.25
V	Industri/ Industry			V					V		
1	Industri Kecil/ Small Scale Industry	475	building acreage m^2	1,000	5.28	1.00	144	building acreage m^2	1,000	2.00	3.30
2	Industri Menengah/ Medium Scale Industry	675	building acreage m^2	4,200	7.50	1.42	432	building acreage m^2	4,200	6.00	1.56
3	Industri Besar/ Large Scale Industry	720	building acreage m^2	4,300	8.00	1.52	468	building acreage m^2	4,300	6.50	1.54

バンドン市水道料金／Bandung City

(m3)	Tariff Structure										
	Social		House hold					Commercial		Industry	
	1 A	1 B	2A1	2A2	2A3	2A4	2B	3A	3B	4A	4B
0-10	560	560	560	700	875	1,050	700	1,050	1,400	1,750	2,100
11-20	560	560	875	1,225	1,400	1,750	1,225	1,750	2,100	2,450	2,800
21-30	560	875	1,225	1,750	2,100	2,625	1,750	2,625	2,975	3,325	3,675
>30	560	1,225	1,750	2,450	2,975	3,500	2,450	3,500	3,850	4,375	4,725
Calculated charge 25m3 consumed	14,000		18,725	25,375	29,750	36,750	25,375	36,750	45,500	54,250	63,000
Wastewater 30% ×Q'ty	4,200		5,618	7,613	8,925	11,025	7,613	11,025	13,650	16,275	18,900
Administration	4,200		3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Meter cost	4,200		5,400	5,400	5,400	5,400	5,400	22,500	22,500	22,500	22,500
Total	26,600		32,743	41,388	47,075	56,175	41,388	73,275	84,650	96,025	107,400

Notes: 1. This tariff structure has been in effect from January 2001.
2. Most of the connections are unmetered except those in the NDMC area; hence, consumption is at best an estimate or is assessed on flat rates. The connection fee is Rs100 (US$2.08).
3. There are no specific sewerage charges in tariffs, but a 50% surcharge is collected ostensibly for sewerage.

Tarip Jasa Pengelolaan Air Kotor
PDAM Kota Surakarta Saat Ini

Type	Rp.
Rumah tangga I	5,000
Rumah tanggah I	7,500
Komersial I	20,000
Komersial II	30,000
Niaga I	50,000
Niaga II	100,000

Banjarmasin
Tarif Retribusi Air Limbah
Susuai dengan PERDA
No: 14 Thn 2006 seri"C"

No.	Golongan/Type	Rp.
1	Rumah Tangga	3,000
2	Sosial	3,000
3	Instansi Pemerintha	7,000
4	Niaga	6,000

Yogyakarta Amended 2009（left） Original（right）

YOGYAKARTA CITY REGULATION
NO. … OF 2008
Yogyakarta Sewerage Tariff DOMESTIC WASTEWATER RETRIBUTION

No.	Compulsory Retribution Category	Amount (Rp./month)	Permit and Administration Cost	Remark
I. Household				
1	H 1	3,000	10,000	Resident number of 1–5 persons, building acreage less than 100 m2
2	H 2	6,000	10,000	Resident number of 1–5 persons, building acreage less than 100 m3
3	H 3	9,000	10,000	Resident number of 6–10 persons
4	H 4	30,000	10,000	Resident number more than 10
II. Social				
1	S1	6,000	10,000	Religious Service Site, social institutions, museum
2	S2	9,000	10,000	Office with staff number of less than 25 persons, school with number of teachers and students of less than 180 persons
3	S3	21,000	10,000	Office with staff number ranging between 25 and 50 persons, school with number of teachers and students ranging from 180 to 240 persons
4	S4	37,000	10,000	Office with staff number of more than 50 persons, school with number of teachers and students of more than 240 persons
III. Company/Commercial				Including service business and goods production with the criteria below:
1	P1	9,000	10,000	Employing up to 10 persons and capital of less than Rp. 50,000,000
2	P2	28,000	10,000	Employing 11–50 persons and capital range of Rp. 50,000,000–
3	P3	60,000	10,000	Employing 50–100 persons and capital range of Rp. 100,000,000–Rp.500,000,000
4	P4	100,000	10,000	Employing 100–150 persons and capital range of Rp. 500,000,000–Rp.1,000,000,000
5	P5	125,000	10,000	Employing more than 150 persons and capital of more thanRp.1,000,000,000

Retribution Tariff for Wastewater and Rain Water Run-off Drai
and Permit Cost of Wastewater Canal

No.		Type of Compulsory Retribution	Amount (Rp./month)	Administration Cost (Rp)
I. Household				
1		K.1	500	500
2		K.2	1,000	500
3		K.3	2,000	500
4		K.4	4,000	500
5		K.5	8,000	500
II. Company				
	6	P.1	3,000	500
	7	P.2	6,000	500
	8	P.3	12,000	500

a. P.1 Company is the one that uses Current Capital of up to Rp. 25,000,(

b. P.2 Company is the one that uses Current Capital of more than Rp. 25

c. P.3 Company is the one that uses Current Capital of more than Rp. 50

Proposed Tariff for Service of DSDP/BLUPAL BALI
(Tariff effective from 2009)

No		Customer Classification		Rp/month	累進率 Progressive rate
A.		Pipeline			
I		Social	Social Foundation, Orphanage, School	10,000	
II	Household				
	1	Type A	Settlement where in front of the houses there are access roads of less than 7 m wide including drainage canal and 'berm' (embankment?)	15,000	1.00
	2	Type B	Settlement where in front of the houses there are access roads of 7–10 m wide including drainage canal and 'berm'	20,000	1.33
	3	Type C	Settlement where in front of the houses there are access roads of more than 10 m wide including drainage canal and 'berm'	25,000	1.67
III	Institution/Offices			70,000	
IV	Hotel				
	1	Starred	Tariff is computed based on per room basis	100,000	2.00
	2	Non Starred/motel	Tariff is computed based on per room basis	50,000	1.00
	3	Guest House/Inn		150,000	
V	Restaurant				
	1	Small scale	Having less than 50 seats	400,000	
	2	Medium scale	Having seats ranging from 50 to 100	500,000	
	3	Large scale	Having more than 100 seats	700,000	
VI	Commercial				
	1	Small scale	SIUP Kecil	45,000	1.00
	2	Medium scale	SIUP Sedang	100,000	2.22
	3	Large scale	SIUP Besar	150,000	3.33
VII	Public Facilities			40,000	
B	Non Pipeline				
	1	Septic tank suction service by truck per m3		150,000	
	2	Truck service to dispose domestic wastewater to Suwung IPAL per m3		25,000	

11.3 Sewerage Tariff of Vietnam

Hanoi Sewerage Charge

Water conservation tax：Water supply bill×10%

Sewerage charge：Water supply charge ×10%（Decree No. 88/2007/ND-CP、not-enacted）

Water supply tariff

Domestic is divided to three class, and industry and commercial are flat rate.

(Water supply tariff structure)

Category	Rate
Water Supply	
Domestic (unmetered)	VND30,000/account/month or
Domestic (metered user)	VND2,800/m3: up to 16m3
	VND3,500/m3: 17-20m3
	VND5,000/m3: 21-35m3
	VND7,500/m3: more than 36m3
Industry	VND4,500/m3
Commercial & Service	VND7,500/m3
State Agencies & Public Institutions	VND4,000/m3
Sewerage	
Environmental Protectin Fee	10% of Water Charge

Source： Consultant

Ho Chi Minh

Wastewater bill is charged to 10% of water supply bill, and wastewater tariff for domestic is equivalent to 300VND/m^3.

Water supply tariff for domestic is divided to three class, and office, industrial and commercial are flat RATE.

Table 2-3-8 Water supply tariff in Ho Chi Minh

	Domestic			Office	Industrial	Commercial
	4 m^3/month /person	> 4 – 6 m^3/month /person	> 6 m^3/month /person			
VND	2,700	5,400	8,000	6,000	4,500	8,000
USD	0.17	0.34	0.50	0.38	0.28	0.50

Source：Study team

11.4 Water Supply and Sewerage Tariff of Manila, Philippine

Manila Water (East Manila)

NOTICE TO MANILA WATER CUSTOMERS AND THE PUBLIC
WATER RATES FOR THE EAST ZONE

Effective 15 days after publication, Manila Water Company,Inc. will implement a **12.2% Consumer Price Index (CPI) Adjustment and a Foreign Currency Differential Adjustment (FCDA) OF 1.03%** of Basic Charge as recommended by MWSS Regulatory Office in its Resolution No. 09-002-CA dated 03 February 2009 and as approved/confirmed by the MWSS Board Resolution No. 2009-025 dated 03 February 2009.

Manila Water Company, the East Zone concessionaire, covers the following areas:

Manila (San Andres and Sta. Ana only; **Quezon City** (east of San Juan River, West Avenue, EDSA, Congressional and Mindanao Ave., Districts of Tandang Sora, Pasong Tamo and Matandang Balara), **Makati City** (east of South Super Highway), **Mandaluyong City, San Juan, Marikina City, Pasig City, Pateros, Taguig, - all in Metro Manila; Rizal Province.**

MANILA WATER COMPANY, INC.
WATER RATES FOR THE EAST ZONE

Manila Water

1.A Water Charge (peso per cubic meter

RESIDENTIAL		Old Rate	New Rate
First	10 cu.m.	69.16 /Conn.	77.60 /Conn.
Next	10 cu.m.	8.44 /Cu.m.	9.47 /Cu.m.
Next	20 cu.m.	16.00 /Cu.m.	17.95 /Cu.m.
Next	20 cu.m.	21.07 /Cu.m.	23.64 /Cu.m.
Next	20 cu.m.	24.02 /Cu.m.	27.02 /Cu.m.
Next	20 cu.m.	25.78 /Cu.m.	28.93 /Cu.m.
Next	50 cu.m.	26.93 /Cu.m.	30.22 /Cu.m.
Next	50 cu.m.	28.09 /Cu.m.	31.52 /Cu.m.
Over	200 cu.m.	29.25 /Cu.m.	32.82 /Cu.m.

SEMI-BUSINESS		Old Rate	New Rate
First	10 cu.m.	118.09 /Conn.	77.60 /Conn.*
Next	10 cu.m.	14.13 /Cu.m.	15.85 /Cu.m.
Next	20 cu.m.	17.42 /Cu.m.	19.55 /Cu.m.
Next	20 cu.m.	22.13 /Cu.m.	24.83 /Cu.m.
Next	20 cu.m.	25.75 /Cu.m.	28.93 /Cu.m.
Next	20 cu.m.	26.93 /Cu.m.	30.22 /Cu.m.
Next	50 cu.m.	28.09 /Cu.m.	31.52 /Cu.m.
Next	50 cu.m.	29.25 /Cu.m.	32.82 /Cu.m.
Over	200 cu.m.	30.49 /Cu.m.	34.21 /Cu.m.

BUSINESS GROUP I			
First	10 cu.m.	314.33 /Conn.	352.68 /Conn.
Next	90 cu.m.	31.47 /Cu.m.	35.31 /Cu.m.
Next	100 cu.m.	31.65 /Cu.m.	35.51 /Cu.m.
Next	100 cu.m.	31.74 /Cu.m.	35.61 /Cu.m.
Next	100 cu.m.	31.82 /Cu.m.	35.70 /Cu.m.
Next	100 cu.m.	32.00 /Cu.m.	35.90 /Cu.m.
Next	100 cu.m.	32.09 /Cu.m.	36.00 /Cu.m.
Next	100 cu.m.	32.18 /Cu.m.	36.11 /Cu.m.
Next	100 cu.m.	32.36 /Cu.m.	36.31 /Cu.m.
Next	100 cu.m.	32.45 /Cu.m.	36.41 /Cu.m.
Next	100 cu.m.	32.54 /Cu.m.	36.51 /Cu.m.
Next	200 cu.m.	32.71 /Cu.m.	36.70 /Cu.m.
Next	200 cu.m.	32.80 /Cu.m.	36.80 /Cu.m.
Next	200 cu.m.	32.88 /Cu.m.	36.90 /Cu.m.
Next	200 cu.m.	33.07 /Cu.m.	37.10 /Cu.m.
Next	200 cu.m.	33.16 /Cu.m.	37.21 /Cu.m.
Next	500 cu.m.	33.25 /Cu.m.	37.31 /Cu.m.
Next	500 cu.m.	33.42 /Cu.m.	37.50 /Cu.m.
Next	500 cu.m.	33.51 /Cu.m.	37.60 /Cu.m.
Next	500 cu.m.	33.60 /Cu.m.	37.70 /Cu.m.
Next	500 cu.m.	33.78 /Cu.m.	37.90 /Cu.m.
Next	500 cu.m.	33.87 /Cu.m.	38.00 /Cu.m.
Next	500 cu.m.	33.96 /Cu.m.	38.10 /Cu.m.
Next	500 cu.m.	34.14 /Cu.m.	38.31 /Cu.m.
Next	500 cu.m.	34.22 /Cu.m.	38.39 /Cu.m.
Next	500 cu.m.	34.31 /Cu.m.	38.50 /Cu.m.
Next	500 cu.m.	34.40 /Cu.m.	38.60 /Cu.m.
Next	500 cu.m.	34.58 /Cu.m.	38.80 /Cu.m.
Next	500 cu.m.	34.67 /Cu.m.	38.90 /Cu.m.
Next	500 cu.m.	34.76 /Cu.m.	39.00 /Cu.m.
Next	500 cu.m.	34.94 /Cu.m.	39.20 /Cu.m.
Next	500 cu.m.	35.02 /Cu.m.	39.29 /Cu.m.
Over	10000 cu.m.	35.11 /Cu.m.	39.39 /Cu.m.

BUSINESS GROUP II			
First	10 cu.m.	340.11 /Conn.	381.60 /Conn.
Next	90 cu.m.	34.22 /Cu.m.	38.39 /Cu.m.
Next	100 cu.m.	34.40 /Cu.m.	38.60 /Cu.m.
Next	100 cu.m.	34.67 /Cu.m.	38.90 /Cu.m.
Next	100 cu.m.	34.94 /Cu.m.	39.20 /Cu.m.
Next	100 cu.m.	35.11 /Cu.m.	39.39 /Cu.m.
Next	100 cu.m.	35.38 /Cu.m.	39.70 /Cu.m.
Next	100 cu.m.	35.65 /Cu.m.	40.00 /Cu.m.
Next	100 cu.m.	35.82 /Cu.m.	40.19 /Cu.m.
Next	100 cu.m.	36.09 /Cu.m.	40.49 /Cu.m.
Next	100 cu.m.	35.36 /Cu.m.	40.80 /Cu.m.
Next	200 cu.m.	36.54 /Cu.m.	41.00 /Cu.m.
Next	200 cu.m.	36.80 /Cu.m.	41.29 /Cu.m.
Next	200 cu.m.	36.98 /Cu.m.	41.49 /Cu.m.
Next	200 cu.m.	37.25 /Cu.m.	41.79 /Cu.m.
Next	200 cu.m.	37.51 /Cu.m.	42.09 /Cu.m.
Next	500 cu.m.	37.69 /Cu.m.	42.29 /Cu.m.
Next	500 cu.m.	37.96 /Cu.m.	42.59 /Cu.m.
Next	500 cu.m.	38.22 /Cu.m.	42.88 /Cu.m.
Next	500 cu.m.	38.40 /Cu.m.	43.08 /Cu.m.
Next	500 cu.m.	38.67 /Cu.m.	43.39 /Cu.m.
Next	500 cu.m.	38.94 /Cu.m.	43.69 /Cu.m.
Next	500 cu.m.	39.11 /Cu.m.	43.88 /Cu.m.
Next	500 cu.m.	39.38 /Cu.m.	44.18 /Cu.m.
Next	500 cu.m.	39.65 /Conn.	44.49 /Conn.
Next	500 cu.m.	39.82 /Cu.m.	44.68 /Cu.m.
Next	500 cu.m.	40.09 /Cu.m.	44.98 /Cu.m.
Next	500 cu.m.	40.27 /Cu.m.	45.18 /Cu.m.
Next	500 cu.m.	40.54 /Cu.m.	45.49 /Cu.m.
Next	500 cu.m.	40.80 /Cu.m.	45.78 /Cu.m.
Next	500 cu.m.	40.98 /Cu.m.	45.98 /Cu.m.
Next	500 cu.m.	41.25 /Cu.m.	46.28 /Cu.m.
Over	10000 cu.m.	41.51 /Cu.m.	46.57 /Cu.m.

** Based on IRR-2008-03 dated 31 March 2008 and confirmed by MWSS BOT Res. No. 2008-064 dated 24 April 2008, the first 10 cubic meter of water consumed in Semi-Business customers shall be billed at Residential Rate.*

B. Foreign Currency Differential Adjustment (FCDA)
A percentage of the Basic Charge reviewed & adjusted quarterly depending on the fluctuation of the FOREX

2. A. Environmental Charge (EC)
12% of Water Charge

B. Sewerage Charge (SC)
40% of the Water Charge for Residential and Semi Business
45% of the Water Charge for Business Group I & II customers

3. Maintenance Service Charge

Meter Size	Amount (Peso/conn.)
1/2" or 13mm	1.50
1/4" or 20mm	2.00
1 or 25mm	3.00

Meter Size	Amount (Peso/conn.)
1 1/4" or 40mm	4.00
2" or 50mm	6.00
3" or 75mm	10.00

Meter Size	Amount (Peso/conn.)
4" or 100mm	20.00
6" or 150mm	35.00
8" or 200mm	50.00

4. Value Added Tax (VAT) 12% for the Charges 1, 2, and 3

THE MONTHLY BILL IS THE SUM OF 1,2,3, AND 4.

Approved by:

MANUEL P. QUEZON
MWSS RO Chief Regulator
02/08/09

DIOSDADO JOSE M. ALLADO
MWSS Administrator

ANTONINO T. AQUINO
MWCI President

For further inquiries you may call Manila Water Company Hotline at 1627 or visit www.manilawater.com

Manila Water

WHAT EAST CONCESSION CUSTOMERS SHOULD KNOW

We will implement a REDUCTION in the previously-approved water rates.

- Full implementation of previously-approved water rates was deferred pending the review of tariff mitigation measures.
- Water rate increase at this time is limited to inflation adjustment and recovery of forex losses.

Because we care about our customers, we made sure that the new water rates are as reasonable as possible.

- **Low-income households consuming 10 cubic meters a month or less will be exempt from the water rate increase.**

MONTHLY CONSUMPTION	RATE ADJUSTMENT	AFFECTED CUSTOMERS
10 cubic meters or less	NO INCREASE	1.5 million
15 cubic meters	P17 / month	over 3 million
30 cubic meters	P49 / month	

We will continue to invest in service improvement programs for our customers.

- **Reliability** – to ensure availability of water when you need it, and even in times of emergency.
- **Expansion** – to provide water to additional 200,000 people per year.
- **Environmental Protection** – to secure future water supply today, and reduce pollution of rivers through sewerage and septic tank desludging programs.

We are committed to outdo our performance in the past 11 years and deliver better services to our customers.

- Reduced system losses from 63% in 1997 to less than 20%.
- Increased 24-hour water availability from 63% of the population to 99%.
- Increased volume of water delivered to customers from 440 million liters per day to more than 1,000 million liters per day.
- Provided efficient and affordable water supply to 1.5 million poor people via the 'Tubig Para Sa Barangay' (TPSB) program.
- Increased sewer coverage from 3% in 1997 to 16%.
- Provided septic tank desludging services to more than 400,000 households.

For further inquiries, please call our Customer Care Hotline 1627 or log on to www.manilawater.com.

Maynilad (West Manila)

NOTICE TO MAYNILAD WATER CUSTOMERS AND THE PUBLIC
NEW WATER RATES FOR THE WEST ZONE

Effective 01 January 2008, Maynilad Water Services, Inc. will implement a tariff adjustment to cover the 2.6% Consumer Price Index, the Special Transitory Mechanism(STM) of 8.99% of the Basic Charge and the Foreign Currency Differential Adjustment (FCDA) of -1.85% of the Basic Charge as recommended by the Metropolitan Waterworks and Sewerage System (MWSS) Regulatory Office under Resolution No. 07-026-CA dated 12 December 2007, and approved & confirmed by the MWSS Board of Trustees under Resolution No. 2007-274 dated 14 December 2007.

The MWSI presently serves the West Zone which consists of the following areas: the cities of Manila (all but portions of San Andres & Sta Ana), Quezon City (west of San Juan River, West Ave., EDSA, Congressional & Mindanao Ave..; the northern part starting from Districts of the Holy Spirit & Batasan Hills), Makati (west of South Super Hi-way), Caloocan, Pasay, Parañaque, Las Piñas, Muntinlupa and Valenzuela, and the towns of Navotas and Malabon - all in Metro Manila; Cavite City, towns of Bacoor, Imus, Kawit, Noveleta and Rosario - all in Cavite province.

The new schedule of water tariff for all MWSI customers effective 01 January 2008 is as follows:

1. WATER CHARGES

A1. BASIC CHARGE

		Effective Until Dec. 31, 2007	Effective on Jan. 1, 2008
RESIDENTIAL			
First	10 cu.m.	P 75.65 /conn.	P 77.62 /conn.
Next	10 cu.m.	9.24 /cu.m.	9.48 /cu.m.
Next	20 cu.m.	17.56 /cu.m.	18.02 /cu.m.
Next	20 cu.m.	23.07 /cu.m.	23.67 /cu.m.
Next	20 cu.m.	26.95 /cu.m.	27.65 /cu.m.
Next	20 cu.m.	28.17 /cu.m.	28.90 /cu.m.
Next	50 cu.m.	29.46 /cu.m.	30.23 /cu.m.
Next	50 cu.m.	30.78 /cu.m.	31.58 /cu.m.
Over	200 cu.m.	32.08 /cu.m.	32.91 /cu.m.
BUSINESS GROUP I			
First	10 cu.m.	P 343.82 /conn.	P 352.76 /conn.
Next	90 cu.m.	34.54 /cu.m.	35.44 /cu.m.
Next	100 cu.m.	34.64 /cu.m.	35.54 /cu.m.
Next	100 cu.m.	34.74 /cu.m.	35.64 /cu.m.
Next	100 cu.m.	34.86 /cu.m.	35.77 /cu.m.
Next	100 cu.m.	34.97 /cu.m.	35.88 /cu.m.
Next	100 cu.m.	35.15 /cu.m.	36.06 /cu.m.
Next	100 cu.m.	35.29 /cu.m.	36.21 /cu.m.
Next	100 cu.m.	35.40 /cu.m.	36.32 /cu.m.
Next	100 cu.m.	35.53 /cu.m.	36.45 /cu.m.
Next	100 cu.m.	35.62 /cu.m.	36.55 /cu.m.
Next	200 cu.m.	35.80 /cu.m.	36.73 /cu.m.
Next	200 cu.m.	35.91 /cu.m.	36.84 /cu.m.
Next	200 cu.m.	36.07 /cu.m.	37.01 /cu.m.
Next	200 cu.m.	36.18 /cu.m.	37.12 /cu.m.
Next	200 cu.m.	36.28 /cu.m.	37.22 /cu.m.
Next	500 cu.m.	36.38 /cu.m.	37.33 /cu.m.
Next	500 cu.m.	36.58 /cu.m.	37.53 /cu.m.
Next	500 cu.m.	36.70 /cu.m.	37.65 /cu.m.
Next	500 cu.m.	36.83 /cu.m.	37.79 /cu.m.
Next	500 cu.m.	36.89 /cu.m.	37.85 /cu.m.
Next	500 cu.m.	37.05 /cu.m.	38.01 /cu.m.
Next	500 cu.m.	37.21 /cu.m.	38.18 /cu.m.
Next	500 cu.m.	37.30 /cu.m.	38.27 /cu.m.
Next	500 cu.m.	37.44 /cu.m.	38.41 /cu.m.
Next	500 cu.m.	37.58 /cu.m.	38.56 /cu.m.
Next	500 cu.m.	37.68 /cu.m.	38.66 /cu.m.
Next	500 cu.m.	37.83 /cu.m.	38.81 /cu.m.
Next	500 cu.m.	37.96 /cu.m.	38.95 /cu.m.
Next	500 cu.m.	38.09 /cu.m.	39.08 /cu.m.
Next	500 cu.m.	38.23 /cu.m.	39.22 /cu.m.
Next	500 cu.m.	38.34 /cu.m.	39.34 /cu.m.
Over	10000 cu.m.	38.48 /cu.m.	39.48 /cu.m.

		Effective Until Dec. 31, 2007	Effective on Jan. 1, 2008
SEMI-BUSINESS			
First	10 cu.m.	P 127.08 /conn.	P 130.38 /conn.
Next	10 cu.m.	15.51 /cu.m.	15.91 /cu.m.
Next	20 cu.m.	19.11 /cu.m.	19.61 /cu.m.
Next	20 cu.m.	24.23 /cu.m.	24.86 /cu.m.
Next	20 cu.m.	28.17 /cu.m.	28.90 /cu.m.
Next	20 cu.m.	29.49 /cu.m.	30.26 /cu.m.
Next	50 cu.m.	30.78 /cu.m.	31.58 /cu.m.
Next	50 cu.m.	32.08 /cu.m.	32.91 /cu.m.
Over	200 cu.m.	33.35 /cu.m.	34.22 /cu.m.
BUSINESS GROUP II			
First	10 cu.m.	P 372.04 /conn.	P 381.71 /conn.
Next	90 cu.m.	37.44 /cu.m.	38.41 /cu.m.
Next	100 cu.m.	37.68 /cu.m.	38.66 /cu.m.
Next	100 cu.m.	37.96 /cu.m.	38.95 /cu.m.
Next	100 cu.m.	38.23 /cu.m.	39.22 /cu.m.
Next	100 cu.m.	38.48 /cu.m.	39.48 /cu.m.
Next	100 cu.m.	38.74 /cu.m.	39.75 /cu.m.
Next	100 cu.m.	39.00 /cu.m.	40.01 /cu.m.
Next	100 cu.m.	39.23 /cu.m.	40.25 /cu.m.
Next	100 cu.m.	39.51 /cu.m.	40.54 /cu.m.
Next	100 cu.m.	39.75 /cu.m.	40.78 /cu.m.
Next	200 cu.m.	40.01 /cu.m.	41.05 /cu.m.
Next	200 cu.m.	40.25 /cu.m.	41.30 /cu.m.
Next	200 cu.m.	40.55 /cu.m.	41.60 /cu.m.
Next	200 cu.m.	40.76 /cu.m.	41.82 /cu.m.
Next	200 cu.m.	41.04 /cu.m.	42.11 /cu.m.
Next	500 cu.m.	41.30 /cu.m.	42.37 /cu.m.
Next	500 cu.m.	41.53 /cu.m.	42.61 /cu.m.
Next	500 cu.m.	41.78 /cu.m.	42.87 /cu.m.
Next	500 cu.m.	42.08 /cu.m.	43.17 /cu.m.
Next	500 cu.m.	42.30 /cu.m.	43.40 /cu.m.
Next	500 cu.m.	42.59 /cu.m.	43.70 /cu.m.
Next	500 cu.m.	42.83 /cu.m.	43.94 /cu.m.
Next	500 cu.m.	43.06 /cu.m.	44.18 /cu.m.
Next	500 cu.m.	43.34 /cu.m.	44.47 /cu.m.
Next	500 cu.m.	43.62 /cu.m.	44.75 /cu.m.
Next	500 cu.m.	43.84 /cu.m.	44.98 /cu.m.
Next	500 cu.m.	44.15 /cu.m.	45.30 /cu.m.
Next	500 cu.m.	44.36 /cu.m.	45.51 /cu.m.
Next	500 cu.m.	44.65 /cu.m.	45.81 /cu.m.
Next	500 cu.m.	44.88 /cu.m.	46.05 /cu.m.
Next	500 cu.m.	45.16 /cu.m.	46.33 /cu.m.
Over	10000 cu.m.	45.39 /cu.m.	46.57 /cu.m.

A2. CERA - P1.00 per cubic meter of water consumption

B. Foreign Currency Differential Adjustment (FCDA) - negative 1.85% of the basic charge subject to quarterly review and adjustment

C. Special Transitory Mechanism (STM) - 8.99% of the basic charge

2. A. ENVIRONMENTAL CHARGE (EC) - 10% of Water Charge **B. SEWERAGE CHARGE (SC)** - 50% of Water Charge For all customers connected to MWSI sewerlines

3. MAINTENANCE SERVICE CHARGE (MSC)

METER SIZE	AMOUNT (per conn.)	METER SIZE	AMOUNT (per conn.)	METER SIZE	AMOUNT (per conn.)
1/2" or 13mm	P 1.5	1 1/4" or 40mm	P 4	4" or 50mm	P 20
3/4" or 20mm	2	2" or 50mm	6	6" or 150mm	35
1" or 25mm	3	3" or 75mm	10	8" or 200mm	50

4. VALUE-ADDED TAX (VAT)- 12% of the Charges 1, 2 and 3

THE MONTHLY BILL IS THE SUM OF 1, 2, 3 and 4.

Approved by:

ALBERTO C. AGRA	**LORENZO H. JAMORA**	**ROGELIO L. SINGSON**
Chief Regulator, MWSS-RO	MWSS Administrator	President, MWSI

11.5 Water Supply and Sewerage Tariff of Singapore

Water Tariff

PUB, Singapore's national water agency.
Managing the country's water supply, water catchment and used water in an integrated way.

Tariff Category	Consumption Block (m^3 per month)	Tariff($/$m^3$) [before GST]	Water Conservation Tax (% of tariff) [before GST]
Domestic	0 to 40	1.17	30
	Above 40	1.4	45
Non-Domestic	All units	1.17	30
Shipping	All units	1.92	30

Tariff Category	Consumption Block (m^3 per month)	Waterborne Fee ($/$m^3$) [before GST]	Waterborne Fee ($/$m^3$)* [after GST]	Sanitary Appliance Fee [before GST]	Sanitary Appliance Fee * [after GST]
Domestic	All units	0.2803	0.3	$2.8037/- per chargeable fitting per	$3.00/- per chargeable fitting per
Non-Domestic	All units	0.5607	0.6		
Shipping	All units	-	-	-	-

Industrial Water Tariffs (inclusive of GST)

Tariff Category	Consumption Block (m^3 per month)	Tariff (cents/m^3)	WCT (% of tariff)	WBF (cents/m^3)
Industrial	All units	43	-	-

Water Conservation Tax

Tax levied by the Government to reinforce the water conservation message.

Sanitary Appliance Fee and Waterborne Fees

Statutory charges payable to the Public Utilities Board (PUB) under the Sewerage and Drainage (Sanitary Appliances and Water Charges) Regulations to offset the cost of treating used water and for the operation and maintenance of the public sewerage system.

Tariffs/Fees
Charges are given in Singapore currency.

GST
Goods and Servces Tax (currently at 7%).

* Inclusive of GST, rounded to the nearest cent. The consumer is advised to refer to the invoice should they wish to make a claim for input tax.