CHAPTER 3

CONTENTS OF

THE FOLLOW-UP COOPERATION

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3-1 Outline of the Follow-up Programme

This follow-up programme was designed based on the result of the field survey conducted in each WD. The content of the rehabilitation plan of each WD is shown in the following.

3-2 Outline Design of the Cooperation Project in Abuyog WD

3-2-1 Rehabilitation Policies

3-2-1-1 Rehabilitation plan

Currently 'Small Water Districts Improvement Project' is going on under the technical cooperation project in Abuyog WD. And this project will develop the supplemental water source at Bito as of May 2011. Therefore policies on the rehabilitation of the WTP in Abuyog are as follows.

- ✓ Bito well will be drilled as supplemental water source.
- ✓ The water quality and quantity is presumed to be the same as the former Bito water source and water is to be sent directly to the water distribution tower.
- ✓ Iron, manganese, ammonium, taste and odor will be removed as stated in the basic plan.
- ✓ Capacity of the transmission pump will be reevaluated and be made to keep the maintenance and operation cost down.
- ✓ The facilities that have aged deterioration problems will be rehabilitated for the sustainable use.

3-2-1-2 Consistency with Long-term Plan

As of October 2010, there is no medium-and long-term plan under Technical Cooperation Project being made. Yet as mentioned above, new well will be developed near the former Bito (Supplementary Bito well), content of the rehabilitation work will be developed on the premise of using this well.

3-2-1-3 Policies on the Quantity of Treated Water

Current production of the WTP is approximately 500m^3/day as the demand remains relatively small for now. Because the supplementary well has the capacity of producing intake maximum of 800m^3/day, the current demand can be covered by the supplementary well alone. However, the water demand is expected to grow to 2,412m^3/day in the future and the capacity of 800m^3/day will no longer be able to meet the demand . The design water quantity will be

renovated to 2,412m^3/day to secure the capacity of the WTP based on the basic plan.

3-2-1-4 Policies on the Water Quality and Water Treatment

It is supposed that the supplementary water source will produce the same quality and quantity of water as the former Bito well. Depending on the the Bito well's water quality, the water can be sent to the WTP to be mixed with the Barayong well water for the treatment, instead of directly being supplied only with the chlorination treatment.

3-2-2 Basic Plan

From the result of the field survey, the rehabilitation work of the WTP is summarized in below. The measures for improving each facility are described in the following paragraphs. The measures for improving each facility are described in the following table.

Table 3-1 Summary of the Rehabilitation Work

Item	Work
Aeration Tower	Replacement of the door
Rapid mixing	Replacement of the equipment
Flocculator	Modification of baffle plates
Sedimentation Basin	Installation of inclined plates
Rapid Sand Filter	Modification of inlet trough
Surface wash pump	Reconnection of the surface-wash pipe
Sludge Drying Bed	Improvement and enlargement(one tank)
Coagulation injection pump	Replacement of the pump
Chlorination agitator	Renovation of No.2 control panel
Intermediate-Chlorination pump	Improvement of the injection pipe
Post- Chlorination pump	Replacement the pump
Stand-by Generator	Replacement of the equipment after examining the capacity
Transmission pump	Replacement of the pump after examining the capacity
Water quality analyzer	Procurement of turbidity and color potable water quality analyzer
Sand	Procurement of sand
National flag	Installation of the Philippine flag plate

3-2-2-1 Aeration Tower

There is no problem about dissolved oxygen and oxygen concentration in the aeration tower. However, entrance door is getting older and one door was already removed. Therefore, it will be replaced with an aluminum door.

Entrance door: Aluminum door 1unit

3-2-2-2 Rapid mixing

Rapid mixing will be replaced because it is out of order.

Rapid mixer: mixing diameter of impeller ϕ 300×2Ste、0.75kW×220V 1unit

3-2-2-3 Flocculator

The existing flocculator is vertical baffle type with the hydraulic mixing system, which uses the energy of flow itself. Currently the mean flow velocity of each basin is, from the 1st basin to 3rd basin, 0.13m/s, 0.06m/s, and 0.04m/s, respectively. The flow is slower than the design criteria of 0.15–0.30m/s, which means the mixing is less intensive. Thus the mean flow velocity shall be increased by adjusting the height of the baffle walls to narrow the flow openings of the underflow and overflow parts.

The dimension of the flow openings of the existing flocculator and modified one, mean flow velocity of each flow, G-value and GT value are shown below.

Table 3-2 Modification of the baffle flow and flow velocity

		Flow opening Dimension	Underflow Flow velocity	Overflow Flow velocity	Vertical-flow Flow velocity	G-value	GT-value
		m×m	m/s	m/s	m/s		
Existing	1st basin	1×0.25	0.112	0.112	0.112	19.0	39,303
	2nd basin	1×0.50	0.056	0.056	0.056		
	3rd basin	1×0.75	0.037	0.037	0.037		
Modified	1st basin	1×0.12	0.233	0.233	0.112	29.2	120,548
	2nd basin	1×0.15	0.187	0.187	0.056		
	3rd basin	1×0.20	0.140	0.140	0.037		
Design Criteria			0.15～0.30			10～75	23,000～ 210,000

To narrow the underflow opening, put the lumber block with the length of the opening dimension to the bottom and slide down the flush-boards, adding new flashboards made of lumber plate to the top. To narrow the overflow opening, put new flashboards adjusting the opening dimension.

＜1st basin＞

Flow opening area: 0.12m^2

Lumber block: □2.5cm×5cm × L12cm 38 units

Lumber plate: W13cm×L100cm×T3cm 38 units

＜2nd basin＞

Flow opening area: 0.15m^2

Lumber block: □2.5cm×5cm × L15cm 18 units

Lumber plate: W35cm×L100cm×T3cm 18 units

＜3rd basin＞

Flow opening area: 0.20m^2

Lumber block: □2.5cm×5cm × L20cm 12 units

Lumber plate: W55cm×L100cm×T3cm 12 units

3-2-2-4 Sedimentation Basin

The existing sedimentation basin is the horizontal flow sedimentation basin. The settling efficiency is not enough to remove small flocs which are carried over to the filter basin.

The surface loading of the existing facility is 25.8mm/min which meets the design criteria of 15–30 mm/min, and the Flow velocity is 105mm/min which satisfies the criteria of less than 400mm/min. However, the retention time is 2.1 hrs which is shorter than the criteria of 3–5 hrs that affects the settling efficiency. In order to improve the settling efficiency, inclined plate settlers shall be installed to the sedimentation basin. The surface loading can be decreased from 25.8 to 6.0 mm/min after installation of the inclined plate settlers, and thus the small size of flocs will be settled in the sedimentation basin without carryover. The specification of inclined plate settlers is as follows. The specification of inclined plate settlers is as follows

Inclined Plates: PVC plate, SUS rack

Rack dimension: W700×L2000×H1800 (18R×7C×2mL) 6units

W800×L2000×H1800 (18R×8C×2mL) 12units

The structure of the overflow trough does not affect the carryover of floc; the weir load is 302m^3/d/m, under the design criteria of 500m^3/d/m.

3-2-2-5 Rapid Sand Filter

The condition of filter sand is fine and the filtration rate is 127m/d satisfying the design criteria of 120–150m/d. However, concerning the inlet structure, due to the distance from the inlet trough to the water surface of the filter basin, the small flocs are broken where the inlet water falls into the basin. Therefore the inlet structure shall be improved by installing the inlet pipe

and weir plate to reduce the inlet flow velocity.

Inlet pipe: Φ150 Steel pipe w/flange, salinity-resist coating 2m	2units
Weir plate: W30cm×L90cm×T3cm, lumber plate	2units
Weir holding plate: W50cm×L150cm×T3cm×2, lumber plate	2units

The function of surface wash can not be done, because surface wash pipe and supply pipe was connected. Therefore, surface wash pipe will be installed again and connected to the current pipe.

Surface-wash pipe: Φ150	Lining steel pipe	25m
Gate valve: GV Φ150		1unit

3-2-2-6 Coagulant feeding facility

The current coagulant feeding facility adopts the method of injecting coagulant that is mixed and dissolved in dissolution tank to the receiving well by the quantum diaphragm pump . The injection pump will be replaced with the pump of the same specifications as the existing one is not in use due to oil leakage.
And plumbing around the pump will be replaced together with the pump.

Specification: quantum pump 1.0l/min×0.2MPa×0.2kW	1unit
Injection pipe: Φ15 PVC plumbing around the pump	1unit

3-2-2-7 Chlorination Facility

The chlorination facility consists of the chlorine mixing tanks, agitators, diaphragm injection pumps, and injection pipe. Chlorine is added at the sedimentation outlet trough for intermediate chlorination, and at the filter clearance well for post chlorination.

Currently, both intermediate chlorination and post chlorination is not conducted properly because of problems with the pump.
In the existing facility, the agitators and injection pumps are in good condition; however the injection pipe for intermediate chlorination needs to be modified by installing injection valves, so that the chlorine dosage will be uniform.

Specification：quantum pump 10.8l/min×0.3MPa×0.4kW	1unit
Injection pipe：Φ15 PVC 12m	1unit
Injection valve Φ15 PVC cock	4unit

The injection pump is out of order in post chlorination. Therefore, it will be replaced.

Specification: quantum pump	0.3l/min×1.0MPa×0.42W	1unit
Injection pipe: Φ15 PVC	plumbing around the pump	1unit

There are two chlorination mixings. Both of them can be available.However, the panel of No2 mixing shoul be repaired, because "RUN" switch of control panel can't be operated.

Chlorination control panel: Pepair of	No2 agitator RUN switch	1unit

3-2-2-8 Sludge Dring Bed

In the effluent standard at the time of basic design (enforcement in 1900), there was no necessity of effluent treatment because the amount of effluent was little. However, the clean water act was approved in 2004, it is required to keep the effluent standard even if the small amount of water. Therefore, enlargement is necessary because current capacity is less than the required capacity of current water quality.

The calculation of the sludge volume and required drying bed capacity is shown below. The sludge volume was recalculated according to the present water quality, and the required capacity of the drying bed is 105.8m^2 in case of efective depth. The sludge drying process takes 8days in one cycle, 7 days for drying and 1 day for desludging and sludge draining from the sedimentation tank. This WTP cann't provide the required demention. Therefore, existing drying bed 32m^2 will be utilized. And the walls will be modified 0.5m higher because current efective depth is only 0.5m. Altough the original plan of newly constructed sludge dring bed required about 74m^2 as of 1.0m efective depth; it was amended to 63m^2 as of 1.2m efective depth as the space acquision proved difficulty.

Drying bed structure: RC effective area 63m^2 (H 2.6m), bed sand, gravel
Sludge pipe: Φ150SP 60m, Φ80SP 30m, Φ80 Ball valve 6pc,
Drainage trough: RC tough 10m

Current sludge dring bed is as follow.

Dimension of bed: 4000 x 200 x 1000 x 4 Effective depth: 1000mm(500mm added)
Filling material: Gravel 2.5–5mm/5–15mm/15–25mm, sand 0.8mm–2.5mm

The calculation of the sludge volume and required capacity of the sludge drying bed is summarized below.

Table 3-3 Calculation of Sludge Volume and Drying Bed Capacity

Water Quality			Remarks
Water Quantity Q	m^3/d	2,412	
Color	CU	19	
PAC	mg/l	40	
Turbidity	NTU	3.2	
Fe	mg/l	2.4	
Sludge Mass & Volume			
SS from Color	kg/d	32.6	SS generated from color removal is 1.5mg/l per 1CU.*[1]
SS form PAC	kg/d	14.8	SS from PAC is 0.153mg/l per 1mg/l -PAC.
SS form Turbidity	kg/d	7.7	SS from turbidity removal is 1.0mg/l per 1NTU.
SS from Fe	kg/d	11.1	SS from iron removal is 1.91mg/l per1mg/l-Fe.
Total Sludge Mass	kg/d	66.1	
Total Sludge/day	m^3	13.2	As sludge concentration 5kg/m^3 (0.5%)*[2]
Sludge Drying Bed Capacity			
Required Capacity (for 8days)	m^2	105.8	As sludge concentration 5kg/m^3 (0.5%); H=1.15m
Current capacity	m^2	32	Existing bed 32m^2 (H=+0.5m)
Design Capacity	m^2	63	H=12m (New bed 75.6m^2 as aluculated H=1.0m)

*1: Color will be removed to 10 CU.

*2: From experiment

3-2-2-9 Transmission Pump

There are 2 large capacity pumps, which cover the maximum water demand at the peak hours currently installed at the facility. However, the current demand does not reach to the planned water supply and especially during the night the demand is very low. Thus the pumps shall be replaced to the smaller ones which can match the supply to the change of water demand. The pump operation will be more efficient by having two pumps operating during the peak hours and only one pump for low demand. And with this measure, it is possible to reduce electricity expense.

Specification: SUS submersible pump	1.3m^3/min×50m×18.5kW Φ80
Include lifting pipe	2 unit
Pluming around check valve	2unit

3-2-2-10 Stand-by Generator

Replacement of the transmission pumps under this programme will change the power requirement. The stand-by generator shall be replaced to one that supplys power for only the minimum amount required for the operation of the plant.

Generator for WTP: 220V 60Hz 90kVA silencer 1unit

3-2-2-11 Procurement of Other Equipment

The following equipment shall be procured under the Programme.

- ✓ Digital Turbidity/Color Meter: While the main parameter is color in this WTP, the water analysis device currently used is for multipurpose and requires complicate operation. Therefore a potable digital meter shall be provided to simplify the operation and to suite to the water quality management Filter Sand: Quality of raw water contains high hardness and surface wash has not been done adequately. Therefore, Filter sand form madball and it cann`t fulfill a function. Atltough WD exchange the sand at present, Mad ball will be break out. Therefore, a load of filter sand will be prepared.
- ✓ National Flag Plate: The Philippine flag plate was blown off in a typhoon and removed. Thus a new plate shall be installed.

Turbidity/color meter: Portable digital type	1unit
Filter sand: Silica sand 0.6–0.75mm	11.4m^3
National flag plate: Philippine flag plate	1unit

3-2-2-12 List of the Specifications of the Rehabilitation Work

The specifications of the rehabilitation work are listed below.

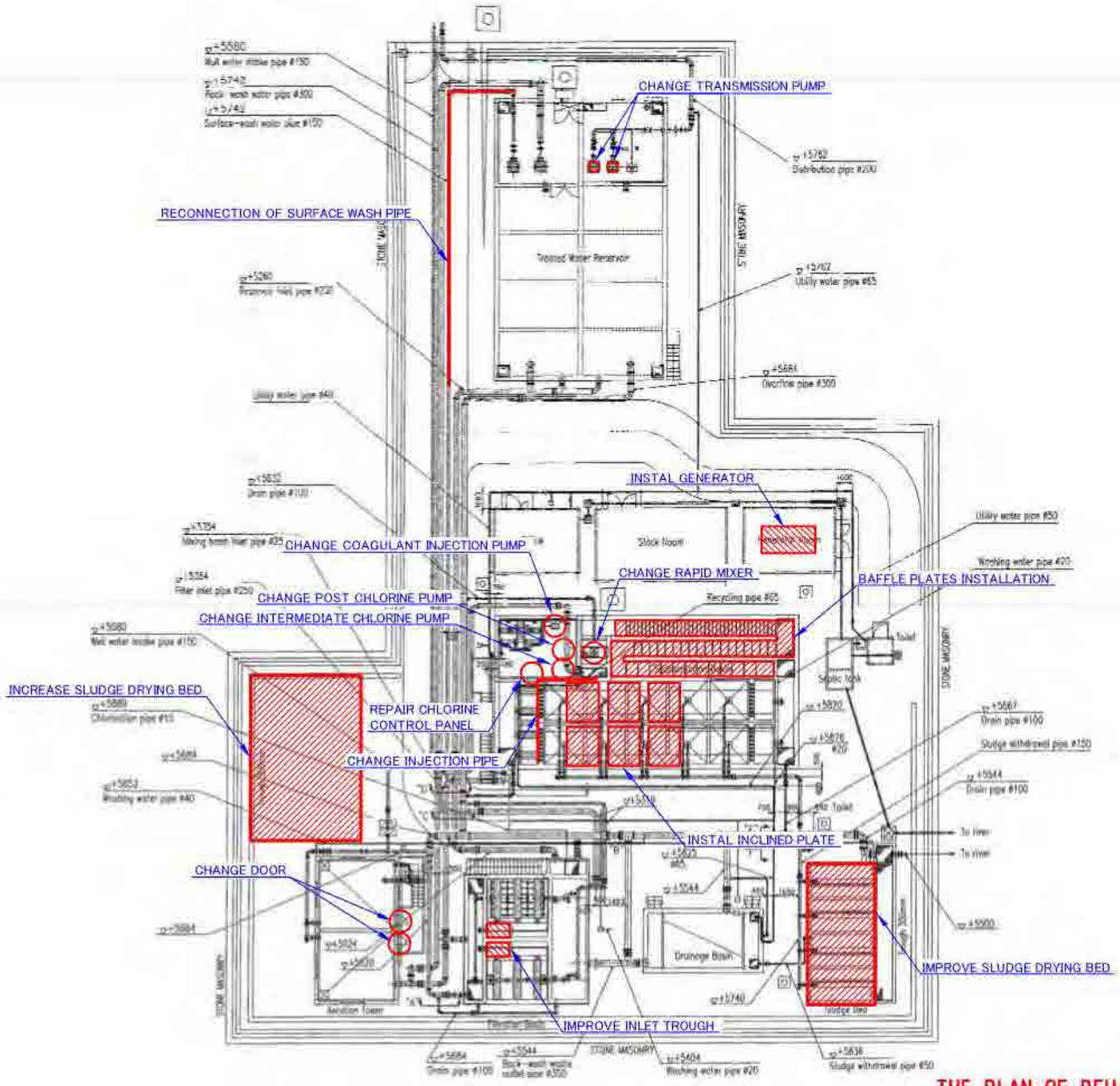
Table 3-4 Specifications of the Rehabilitation Work

Facility	Component	Item	Type*	Specifications	Unit	Q'ty
Aeration Tower	Entrance door	Replacement	C	Replacement of the door	unit	2
Flocculator	Baffle Plates submerged	Lumber installation	R	Lumber block □2.5cm×5cm – L12cm/15cm/20cm water-resist	m	15
	Baffle Plates overflow	Flashboard installation	R	Lumber plate W25cm×L100cm×T3cm water-resist	m.	84
Sedimentation Basin	Sedimentation Basin	Inclined plates	N	PVC inclined plates, stainless rack W700/800×L2000×H1800	unit	1
RapidSand Filter	Inlet trough	Inlet pipe	R	Φ150 SP w/flange salinity-resist coating ,	unit	2
	Surgace wash	Surface wash pipe	R	Φ150 Lining steel pipe 25m Φ150 Gate valve	unit	1
Coagulation facility	Coagulation injection	Injection pump	C	1.0l/min×0.2MPa×0.2kW	unit	1
Chlorination Facility	Intermediate Chlorination	Injection pump	C	10.8l/min×0.3MPa×0.4kW	pc.	1
		Injection pipe	C	Φ15 PVC	m	12
		Injection valve	N	PVC cock Φ15	pc.	4
	Post Chlorination	Injection pump	C	0.3l/min×1.0MPa×0.2kW Pluming aroud the pump	unit	1
	Control panel	No2 agitatar	C	Repair of Control panel	unit	1
Sludge Drying Bed	Current Drying Bed	Drying bed body	R	Raising of drying bed wall by 500mm	unit	1
		Gravel Sand	R	Gravel 10–20mm/25–35mm/40–60mm, Sand 4–6mm	unit	1
	Current Drying Bed	Drying bed	N	Rc dimension 63m^2 H=2.6m	unit	1
Transmission facility	Transmission pump	Transmission pump	C	1.3m^3/min×50m×18.5kW Φ80	pc.	2
Electrical Facility	Stan-by Generator	Generator	C	90kVA	pc.	1
Others	Water Analysis Device	Turbidity/color	N	Portable digital turbidity/color meter	unit	1
	Filter Sand	Filter sand	N	Silica sand: 0.6–0.75mm	m^3	11.4
	National Flag	Flag plates	C	Philippine flag plate	unit	1

(*) C: Change, N: New, R: Repair

3-2-3 Outline Design Drawings

The outline design drawings for the rehabilitation are attached below.



THE PLAN OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
ABUYOG WD	LAYOUT OF REHABILITATION WORK	FIG. 3-1
		SCALE NON

3-2-4 Priority of the Rehabilitation Work

As the budget for this Follow-up Programme is limited, probably not all the rehabilitation work can be covered by this Programme. It depends on the total cost for the rehabilitation. Therefore, all the rehabilitation work has been prioritized as listed below. The order of importance is as follows.

A: Item that is inevitable for proper treatment process

B: Item that is necessary for simple or low-cost operation

C: Item that is required for aesthetic aspect

Table 3-5 Priority of Rehabilitation Work

Facility	Component	Item	Order	Remarks
Aeration Tower	Entrance door	Replacement	B	It is necessary to replace, because it is deterioriationg.
Flocculator	Vertical Baffle Plate	Vertical baffle plate	A	Rehabilitation is essential for effective floc formation.
Sedimentation Basin	Sedimentation Basin	Inclined plates	B	Installation is necessary for effective floc settling. Without this, Filtration efficiency should be improved by more frequent backwashing.
RapidSand Filter	Inlet trough	Inlet pipe	A	Modification is important to prevent floc from breakage.
	Surface-wash	Surface-wash pipe	A	It is required to reconnect, because it can't be done surface-wash currently.
Coagulation facility	Coagulation injection	Injection pump	A	Replacement is necessary because of breakdown
Chlorination Facility	Intermediate Chlorination	Injection pump	A	Replacement is necessary because of flecuency breakdown and getting older.
		Injection pipe	A	Modification is required for even chlorination.
		Injection valve	A	
	Post Chlorination	Injection pump	A	Replacement is necessary due to breakdown
	Control panel	No2 agitatar	A	Repair is necessary due to inoperative when pushing the switch.
Sludge Drying Bed	Drying Bed	Bed sand	A	Modification is necessary for proper treatment. And current capacity of the bed is smaller comparing to the sludge volume.
		Structure	A	
Transmission facility	Transmission pump	Transmission pump	A	Replacement is important for efficient operation.
Electrical Facility	Stan-by Generator	Generator	B	Capacity of gererator is not so much problem. Because fuel consumption is depend on load of generator. Therefore, it is B.
Others	Water Analysis Device	Turbidity/color	B	Portable digital turbidity/color meter helps the WD simple water quality management. But visual check can substitute in some measure. Therefore, it is B.
	Filter Sand	Filter sand	A	Refill of filter sand is required, because the current sand is formulated mud ball and it is affected treatment.
	National Flag	Philippine flag plates	C	No effect on the treatment process. Therefore it is C.

3-2-5 Selected Rehabilitation Work for the Cooperation

3-2-5-1 Selected Rehabilitation Work for the cooperation

'Small Water Districts Improvement Project' is going on under the technical cooperation project in Abuyog WD. Therefore, the deep well will be developed near the Bito water source. The WTP will start the rehabilitation work after the water quality and quantity is examined and confirmed. Thus, this is not included in this follow-up programme.

3-2-5-2 Obligations of Recipient Country

In this project, is the Philippines are required to secure the land for the construction of the Sludge Drying Bed.

3-2-6 Operation and Maintenance budget

Annual budget of the WTP was projected based on the water quantity from 2011 to 2015 are as shown in Table.3-6. The table gives the figures of water supply quantity (A), expected annual expenditure (B), annual income (C), and revenues (D) in Abuyog.

The basic premises and assumptions are as follows:

- ✓ Current UFW is 35%. This situation is expected to last until 2015.
- ✓ Water transmission quantity is determined on the effective water supply of 2015 "Improvement Plan for Management and Services on The Water Supply System of Binmaley Water Distirict（NJS 2011）". Effective water supply of each year is based on this value and the result of 2009 which is prorated each year.
- ✓ In annual expenditure, constant cost, depreciation, interest and other deficits adopted the past results of Abuyog WD in 2009. This value is constant regardless of the water supply quantity.
- ✓ Variable expense (fuel cost, electricity cost, personnel cost, chemical cost, rest of variable cost) is prorated based on water supply quantity of 2009.
- ✓ Although labor cost is treated as fixed cost in other WD, it is treated as veriable expense in Abuyog WD, because its scale is small and transmission quantity was doubled by 2015.
- ✓ The more water usage, the higher unit cost in payment structure, therefore annual income is not prorated based on water supply quantity. However annual income forecast is prorated based on daily effective water supply and result of annual income to make the calculation simpler.

Table 3-6 Projected Annual Budget in Abuyog WD

Item	Unit	2011	2012	2013	2014	2015
Water transmission quantity	m^3/d	660	767	874	981	1,088
Effective water supply (A)	m^3/d	430	500	570	639	709
UFW rate	23%	35%	35%	35%	35%	35%
Income (C)	Peso	4,855,648	5,642,230	6,428,812	7,215,394	8,001,976
Expenditure	Peso					
Maintenance cost (fuel cost, electricity cost, chemical cost.etc)		686,415	797,609	908,804	1,019,999	1,131,193
Personnel cost		1,835,238	2,132,534	2,429,830	2,727,126	3,024,422
Constant cost (office electricity cost, conference cost etc.)		120,756	140,317	159,879	179,441	199,002
Variable cost （conference）		130,504	151,645	172,786	193,927	215,068
Depreciation cost		716,796	716,796	716,796	716,796	716,796
Depreciation		143,808	143,808	143,808	143,808	143,808
Unmeasured loss		547,353	547,353	547,353	547,353	547,353
Interest		212,810	212,810	212,810	212,810	212,810
Total expense (C)		4,393,680	4,842,873	5,292,066	5,741,259	6,190,452
Revenue (D)		461,968	799,357	1,136,746	1,474,134	1,811,523

According to the calculation above, the revenue and quantity of distributed water (number of connection) will increase each year. However, the condition for the prediction is the distribution of adecuate and quality water, and if these condiation is not met, revenue will not increase.

3-2-7 Concerned Issues

As of May 2011 'Small Water Districts Improvement Project' is going on under the technical cooperation project in Abuyog WD. And this project will develop the supplemental water source. Therefore the contents of rehabilitation of the WTP will be decided comprehensively with the water quality and quantity of the supplemental water sourece.

3-3 Outline Design of Facility Rehabilitation in Dingle-Pototan WD

3-3-1 Design Policies

3-3-1-1 Policies on the Rehabilitation

Policies on the rehabilitation of the Abangay WTP in Dingle-Pototan are as follows.

- ✓ Treatment process is the same as the initial design, i.e., removal of iron, manganese, color and turbidity.
- ✓ Downsize the capacity of the supply pumps and the operation cost.
- ✓ All the stolen cables will be replaced.

3-3-1-2 Consistency with Long-term Plan

Current water supply area in Dingle-Pototan WD is separated into Dingle City and Pototan City. The Abangay WTP supplies water to Pototan City. The future water supply plan in Pototan City is indicated in the "*Improvement Plan for Management and Services on The Water Supply System of Dingle-Pototan Water Distirict* (NJS 2010)" as shown in the table below. The current water supply in Pototan City is sourced from the Abangay deep well and Vita- Grande deep well, in total of 1,205m^3/d.

The maximum yield of each water source is 2,592m^3/d in Abangay and 1,188m^3/d (15L/s*22hrs) in Vita-Grande; the total production is 3,780m^3/d. This amount will be less than the daily maximum water supply after the year 2020, thus the additional water source should be developed in the future.

Table 3-7 Long-term Water Supply Plan in Pototan City

Item	Unit	Y 2015	Y 2020	Y 2030
Total Population	persons	75,790	81,390	93,855
Barangay	unit	10	16	37
Population above	Persons	19,603	26,618	77,314
Number of Service Connection	Points	1,877	3,198	6,718
Water Coverage	%	12	20	38
Population Served	Persons	9,385	15,990	35,468
Water Demand per capita	L/c/d	120	125	130
Daily Average Water Demand	m^3/d	1,126	1,997	4,610
Unaccounted for Water (UFW)	%	30	25	20
Daily Average Water Supply	m^3/d	1,608	2,662	5,767
Daily Maximum Water Supply	m^3/d	2,090	3,461	7,500

3-3-1-3 Policies on the Quantity of Treated Water

Though the shortage of water production from the existing water sources is expected after 2020, the concept of this Follow-up Program is to rehabilitate the existing facilities in order to secure the current WTP capacity. Therefore, the design water quantity is as initially designed 2,592m^3/d. However, the current yield of Abangai well is 15l/s, 1,296m^3/d for 24hr operation, it is necessary to confirm the exact capacity of the well by the pumping test.

3-3-1-4 Policies on the Water Quality and Water Treatment

As mentioned above, treatment process is the same as the initial design, i.e., removal of iron, manganese, color and turbidity.

3-3-2 Basic Plan

From the result of the field survey, the rehabilitation work of the WTP is summarized in below. The measures for improving each facility are described in the following table.

Table 3-8 Summary of the Rehabilitation Work

Item	Work
Deep well Pump	Replacement
Aeration Tower	Opening of maintenance manholes
Flocculator	Modification of baffle plates
Sedimentation Basin	Installation of inclined plates
Rapid Sand Filter	Modification of inlet trough
Sludge Drying Bed	Rehabilitation of drying bed
Chlorination Room	Change of entrance door
Intermediate-Chlorination	Improvement of injection pipe
Stand-by Generator	Replacement (for deep well and water treatment plant)
Supply Pump	Replacement

3-3-2-1 Deep Well Pump

The deep well pump currently installed has only half capacity of the planned pumping rate. With a low pumping rate, shortage of water supply for future demand is expected. Therefore the pump shall be replaced to a new pump with the designed capacity. Before installing the new pump, the Contractor shall conduct a pumping test in order to confirm the current yield of the well. In case the yield decreased from the design capacity, a pump with an appropriate capacity shall be selected. Also the riser pipe shall be extended to installthe pump to the proper position.

Pumping test: A. Step-drawdown test 2hrs×4steps
B. Continuous pumping test 24hrs
C. Recovery test 24hrs
Pump: Submersible motor pump 1.8m^3/min×80m×37kW 1unit
Riser pipe: Φ150 Steel pipe 57m

3-3-2-2 Aeration Tower

There is no problem about dissolved oxgen and oxygen concentration in the aeration tower. However, water leakage from the concrete joints of the wall was found and this shall be repaired. The joint part shall be demolished from interior, repaired with water-proof mortar and then water-proof painted. The exterior wall shall be also repainted.

Repair work: Chipping off, water-proof mortar & paint 1unit

3-3-2-3 Flocculator

The existing flocculator is vertical baffle type with the hydraulic mixing system, which uses the energy of flow itself. Currently the mean flow velocity of each basin, from the 1st basin to 3rd basin, is 0.12m/s, 0.06m/s, and 0.04m/s respectively. The flow is slower than the design criteria of 0.15-0.30m/s, which means the mixing is less intensive. Thus the mean flow velocity shall be increased by adjusting the height of the baffle walls to narrow the flow openings of the underflow and overflow parts. The dimension of the flow openings of the existing flocculator and modified one, mean flow velocity of each flow, G-value and GT value are shown below.

Table 3-9 Modification of the baffle flow and flow velocity

		Flow opening Dimension	Underflow Flow velocity	Overflow Flow velocity	Vertical-flow Flow velocity	G-value	GT-value
		m×m	m/s	m/s	m/s		
Existing	1st basin	1×0.25	0.12	0.12	0.12	20.4	42,110
	2nd basin	1×0.50	0.06	0.06	0.06		
	3rd basin	1×0.75	0.04	0.04	0.04		
Modified	1st basin	1×0.12	0.25	0.25	0.12	44.2	91,329
	2nd basin	1×0.15	0.2	0.2	0.06		
	3rd basin	1×0.20	0.15	0.15	0.04		
Design Criteria			0.15～0.30			10～75	23,000～210,000

To narrow the underflow opening, put the lumber block with the length of the opening dimension to the bottom and slide down the flush-boards, adding new flashboards made of lumber plate to the top. To narrow the overflow opening, put new flashboards adjusting the opening dimension.

＜1st basin＞
Flow opening area: 0.12m^2
Lumber block: □2.5cm×5cm × L12cm 38 units
Lumber plate: W13cm×L100cm×T3cm 38 units
＜2nd basin＞
Flow opening area: 0.15m^2
Lumber block: □2.5cm×5cm × L15cm 18 units
Lumber plate: W35cm×L100cm×T3cm 18 units
＜3rd basin＞
Flow opening area: 0.20m^2
Lumber block: □2.5cm×5cm × L20cm 12 units
Lumber plate: W55cm×L100cm×T3cm 12 units

3-3-2-4 Sedimentation Basin

The existing sedimentation basin is the horizontal flow sedimentation basin. The settling

efficiency is not enough to remove small flocs which are carried over to the filter basin.

The surface loading of the existing facility is 27.7mm/min which meets the design criteria of 15-30 mm/min, and the Flow velocity is 113mm/min which satisfies the criteria of less than 400mm/min. However, the retention time is 1.9 hrs which is shorter than the criteria of 3–5 hrs, that affects the settling efficiency. In order to improve the settling efficiency, inclined plate settlers shall be installed to the sedimentation basin. The surface loading can be decreased from 27.7 to 7.0 mm/min after installation of the inclined plate settlers, and thus the small size of flocs will be settled in the sedimentation basin without carryover. The specification of inclined plate settlers is as follows.

Inclined Plates: PVC plate, SUS rack
Rack dimension: W700×L2000×H1800 (18R×7C×2mL) 6units
W800×L2000×H1800 (18R×8C×2mL) 12units

The structure of the overflow trough does not affect the carryover of floc; the weir load is 324m^3/d/m, under the design criteria of 500m^3/d/m.

3-3-2-5 Rapid Sand Filter

The condition of filter sand is fine and the filtration rate is 136m/d satisfying the design criteria of 120–150m/d. However, concerning the inlet structure, due to the distance from the inlet trough to the water surface of the filter basin, the small flocs are broken where the inlet water falls into the basin. Therefore the inlet structure shall be improved by installing the inlet pipe and weir plate to reduce the inlet flow velocity.

Inlet pipe: Φ150 Steel pipe w/flange, salinity-resist coating 2m 2units
Weir plate: W30cm×L90cm×T3cm, lumber plate 2units
Weir holding plate: W50cm×L150cm×T3cm×2, lumber plate 2units

3-3-2-6 Chlorination Facility

The chlorination facility consists of the chlorine mixing tanks, agitators, diaphragm injection pumps, and injection pipe. Chlorine is added at the sedimentation outlet trough for intermediate chlorination, and at the filter clearance well for post chlorination. In the existing facility, the agitators and injection pumps are in good condition; however, the injection pipe for intermediate chlorination needs to be modified by installing injection valves, so that the chlorine dosage will be uniform.

Injection pipe: Φ15PVC 12m	1unit
Injection valve: PVC cock Φ15	4units

Additionally, the door of the chlorination room shall be changed due to corrosion.

Door: 900×2100 SUS frame, aluminum door coated 1unit

3-3-2-7 Sludge Drying Bed

In the effluent standard at the time of basic design (enforcement in 1900), there was no necessity of effluent treatment because the amount of effluent was little. However, the clean water act was approved in 2004, it is required to keep the effluent standard even if the small amount of water. Therefore, enlargement is necessary because current capacity is less than the required capacity of current water quality. The existing sludge drying bed is not functioning since there is no bed sand (consisting of filter sand, gravel base, and under-drain). In order to recover its function, filling of the bed sand, and installing the sand retaining walls and under-drain system is required.

Bed sand: Gravel 10–20mm/25–35mm/40–60mm, sand 4–6mm
Sand retaining structure: Wooden walls, wooden wedge, PVC net

The sludge volume was recalculated according to the present water quality, and the required capacity of the drying bed comes 30m^2 in the case of effective depth of 0.5m. The sludge drying process takes 7days in one cycle, 6days for drying and 1day for desludging and sludge draining from the sedimentation tank.Dimension of sludge drying bed is 18m^2 currently, therefore it is 12 m^2 short compared to required dimension 30m^2. In case that net depth change from 0.5m to 1.0m, required capacity comes to 15 m^2. The drying bed shall be extended by increasing the wall height by 0.5m because it can be treated at current capacity

Sludge drying bed dimension: W1500×L3000×H1000×4
Effective depth: 1000mm (height increased 500mm)

Table 3-10 Calculation of Sludge Volume and Drying Bed Capacity

Water Quality			Remarks
Water Quantity	m^3/d	2,592	
Color	CU	9.5	
PAC	mg/l	40	
Turbidity	NTU	1.6	
Fe	mg/l	1.1	
Sludge Mass & Volume			
SS from Color	kg/d	17.5	SS generated from color removal is 1.5mg/l per 1CU.*[1]
SS form PAC	kg/d	15.9	SS from PAC is 0.153mg/l per 1mg/l -PAC.
SS form Turbidity	kg/d	4.1	SS from turbidity removal is 1.0mg/l per 1NTU.
SS from Fe	kg/d	5.4	SS from iron removal is 1.91mg/l per1mg/l-Fe.
Total Sludge Mass	kg/d	42.9	
Total Sludge/day	m^3	4.29	As sludge concentration $10kg/m^3$ (1%)
Sludge Drying Bed Capacity			
Required Capacity (for 7days)	m^2	30	As sludge concentration $20kg/m^3$ (2%),the total sludge per day is half above ($2.15m^3/d$) *[2] Effective depth is 0.5m.
Existing Capacity	m^2	18	Effective depth is 0.5m
After increasing the effective depth from 0.5m to1.0m			
Required Capacity (for 7days) After Rehabilitation	m^2	15	As sludge concentration $20kg/m^3$ (2%); the total sludge per day is half above ($2.15m^3/d$) *[2] Effective depth is 1.0m.
Existing Capacity After Rehabilitation	m^2	18	Effective depth is 1.0m

*1: Color will be removed to 5 CU.

*2: The sludge concentration after 7 day retention time will be 20 kg/m^3, though the concentration of daily sludge is $10kg/m^3$.

3-3-2-8 Supply Pump

There are 2 large capacity pumps, which cover the maximum water demand at the peak hours currently installed at the facility. However, the current demand does not reach to the planned water supply and especially during the night the demand is very low. Thus the pumps shall be replaced to the smaller ones which can match the supply to the change of water demand. The pump operation will be more efficient by having two pumps operating during the peak hours and only one pump for low demand. And with this measure, it is possible to reduce electricity expense.

Pump: Vertical shaft pump $1.3m^3/min \times 45m \times 15kW$, Φ80 2units

3-3-2-9 Stand-by Generator

The power supply in this area is not sufficient and there are frequent power cuts. During the powercuts, generators need to be operated for several hours consuming a lot of fuel.

Replacement of the deep well pump and supply pump under this Programme will change the

power requirement. The stand-by generators for the well and water treatment plant shall be replaced accordingly. The capacity of the generator for the WTP shall cover only the minimum requirement for the operation of the plant.

Generator for well: 220V 60Hz 125kVA w/silencer	1unit
Generator for WTP: 220V 60Hz 60kVA w/silencer	1unit

3-3-2-10 Painting Work

Painting of the wall, handrail and door of each facility shall be done due to the request from the WD.

Painting area: Surface of all walls, handrails and doors	1unit

3-3-2-11 List of the Specifications of the Rehabilitation Work

The specifications of the rehabilitation work are listed below.

Table 3-11 Specifications of the Rehabilitation Work

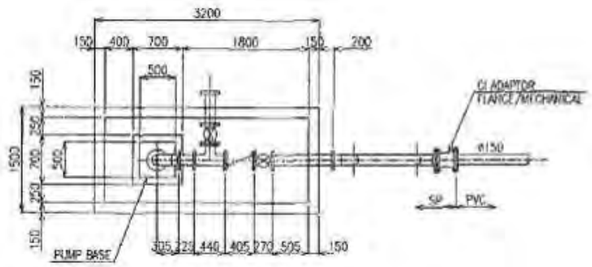
Facility	Component	Item	Type*	Specifications	Unit	Q'ty
Intake Facility	Deep Well	Pumping test	N	Step-drawdown2hr×4step, continuous, recovery test 24hr	unit	1
		Deep well pump	C	1.8m^3/min×80mH×37kW (*)	pc.	1
		Riser pipe	C	Φ150 SP	m	57
Aeration Tower	Aeration Tank	Water proof plastering	R	Chipping & repair, inside: water proof mortar, outside: paint	unit	1
Flocculator	Baffle Plates submerged	Lumber installation	R	Lumber block □2.5cm×5cm water-resist	m	15
	Baffle Plates overflow	Flashboard installation	R	Lumber plate W25cm×L100cm×T3cm water-resist	m.	84
Sedimentation Basin	Sedimentation Basin	Inclined plates	N	PVC inclined plates, stainless rack W700/800×L2000×H1800	unit	1
Rapid Sand Filter	Inlet trough	Inlet pipe	R	Φ150 SP w/flange salinity-resist coating	unit	2
Chlorination Facility	Chlorination room	Door	C	900×2100 SUS frame, alminum door coated	unit	1
	Intermediate Chlorination	Injection pipe	C	Φ15 PVC	m	12
		valve	N	PVC cock Φ15	pc.	4
Sludge Drying Bed	Drying Bed	Bed sand	R	Gravel 10–20mm/25–35mm/40–60mm, Sand 4–6mm	unit	1
		Structure	R	Raising of drying bed wall by 500mm	unit	1
Supply Facility	Supply Pump	Supply Pump	C	1.3m^3/min×45m×15kW Φ80	pc.	2
Electricity	Generator	Deep well	C	125kVA (*)	pc.	1
		Inside the WTP	C	60kVA	pc.	1
All Facilities		Painting	R	Surface of all walls, handrails and doors	unit	1

(*) C: Change, N: New, R: Repair

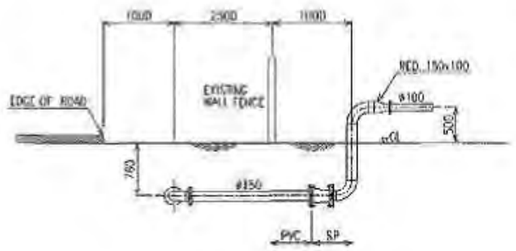
(*) Capacities of deep well pump and its stand-by generator shall be decided after the pumping test.

3-3-3 Outline Design Drawings

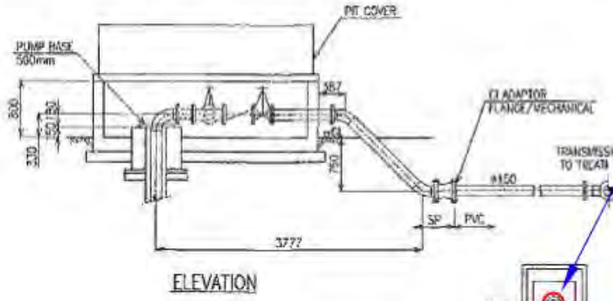
The outline design drawings for the rehabilitation are attached below.



PLAN

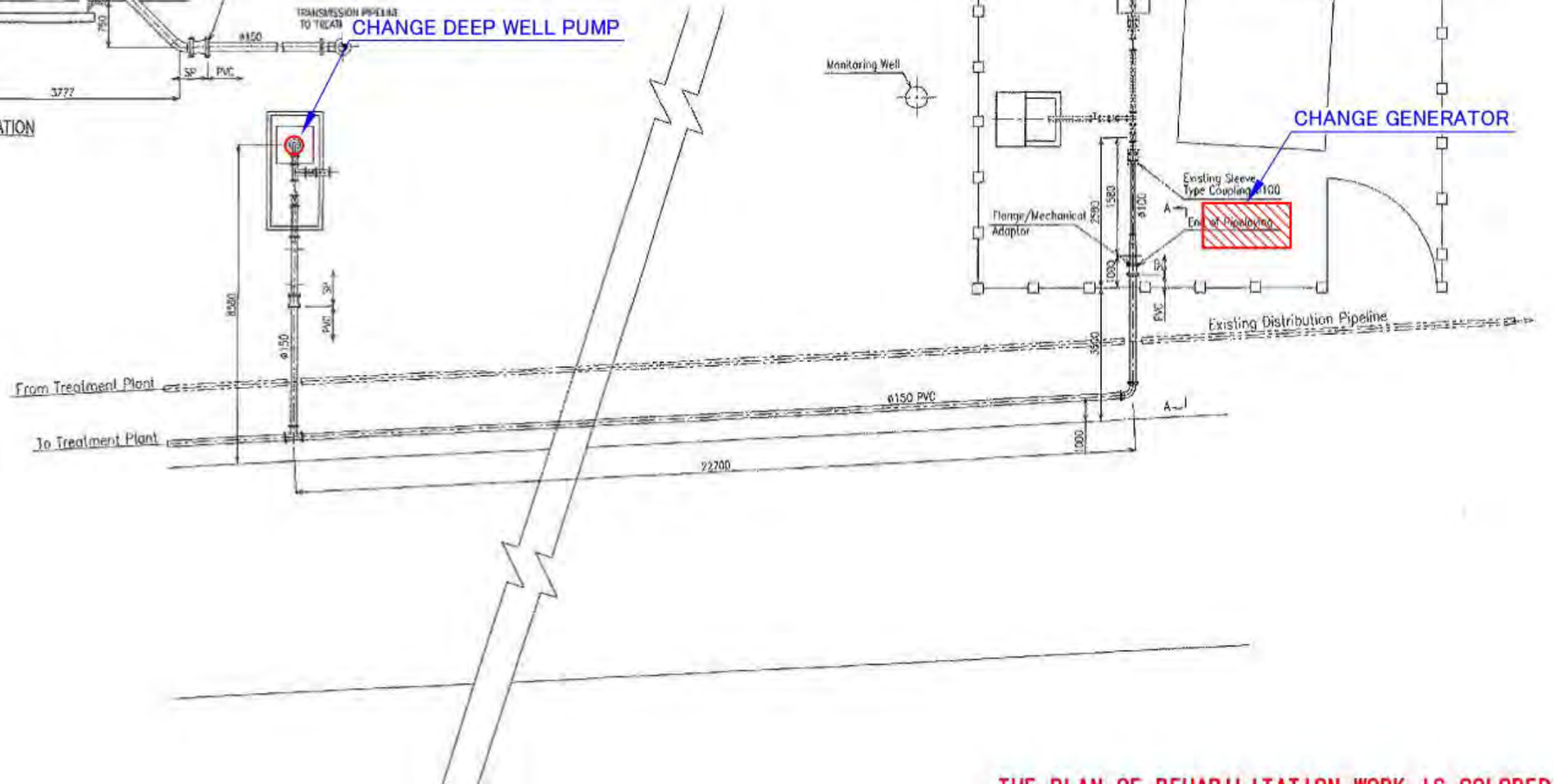


SECTION A–A



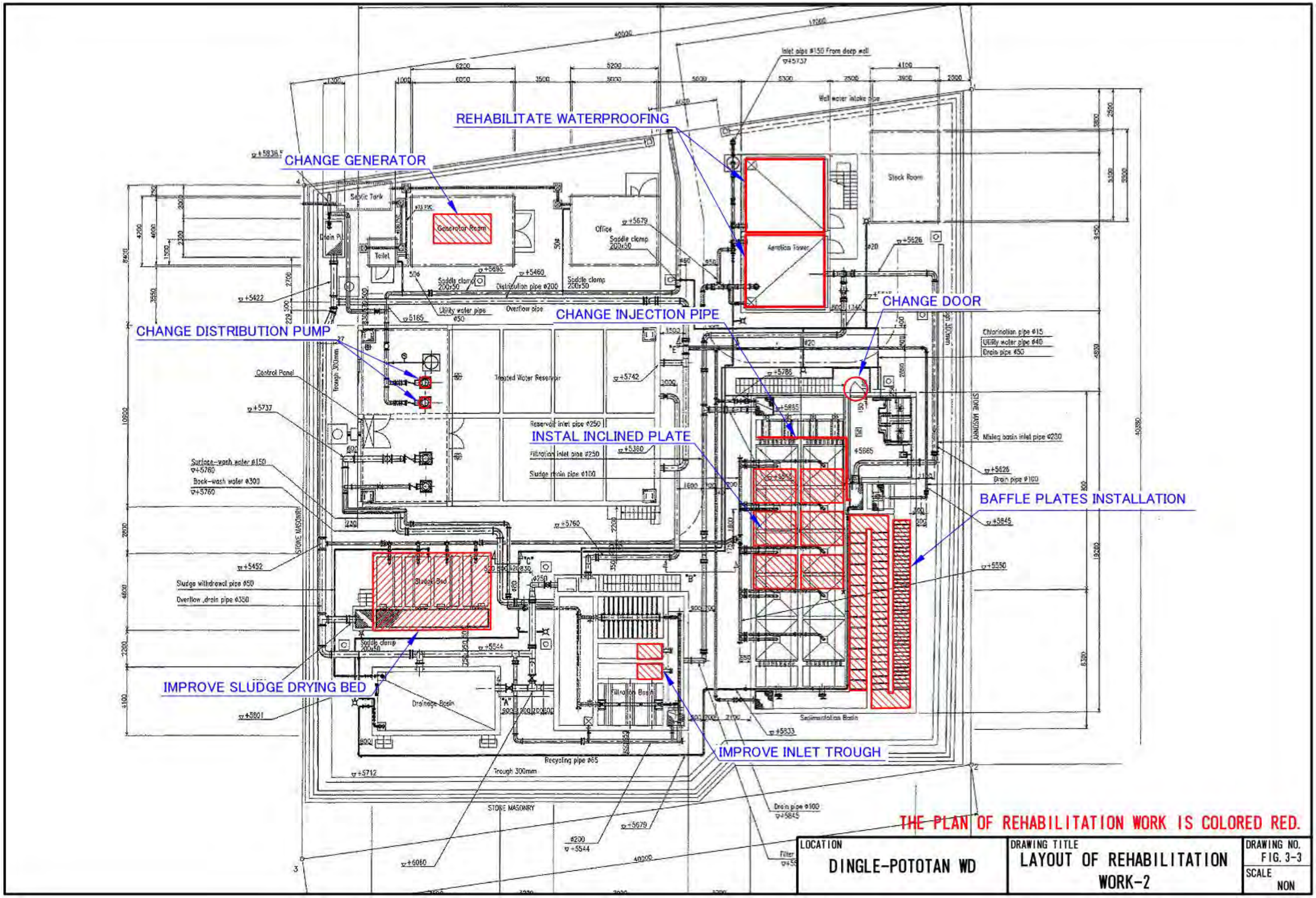
ELEVATION

CHANGE DEEP WELL PUMP



THE PLAN OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
DINGLE-POTOTAN WD	LAYOUT OF REHABILITATION WORK-1	FIG. 3-2
		SCALE NON


REHABILITATE WATERPROOFING
CHANGE GENERATOR
CHANGE DISTRIBUTION PUMP
CHANGE INJECTION PIPE
CHANGE DOOR
INSTAL INCLINED PLATE
BAFFLE PLATES INSTALLATION
IMPROVE SLUDGE DRYING BED
IMPROVE INLET TROUGH
Septic Tank
Generator Room
Toilet
Office
Stock Room
Aeration Tower
Treated Water Reservoir
Control Panel
Trough 300mm
Sludge Bed
Drainage Basin
Filtration Basin
Sedimentation Basin
Chlorination pipe ø15
Utility water pipe ø40
Drain pipe ø50
Inlet pipe ø150 From deep well
Well water intake pipe
Utility water pipe ø50
Overflow pipe
Distribution pipe ø200
Saddle clamp 200x50
Reservoir inlet pipe ø250
Filtration inlet pipe ø250
Sludge drain pipe ø100
Surface-wash water ø150
Back-wash water ø300
Sludge withdrawal pipe ø50
Overflow ,drain pipe ø350
Recycling pipe ø65
Drain pipe ø100
Mixing basin inlet pipe ø250
STONE MASONRY
THE PLAN OF REHABILITATION WORK IS COLORED RED.
LOCATION
DINGLE-POTOTAN WD
DRAWING TITLE
LAYOUT OF REHABILITATION WORK-2
DRAWING NO.
FIG. 3-3
SCALE
NON

3-3-4 Priority of the Rehabilitation Work

As the budget for this Follow-up Programme is limited, probably not all the rehabilitation work can be covered by this Programme. It depends on the total cost for the rehabilitation. Therefore, all the rehabilitation work has been prioritized as listed below. The order of importance is as follows.

A: Item that is inevitable for proper treatment process

B: Item that is necessary for simple or low-cost operation

C: Item that is required for aesthetic aspect

Table 3-12 Priority of Rehabilitation Work

Facility	Component	Item	Order	Remarks
Intake Facility	Deep Well	Pumping test	A	Pumping test is necessary for determination of current yield of the deep well.
		Deep well pump	A	Replacement is required to secure enough water volume.
		Riser pipe	A	Riser pipe is short because pump depth change.
Aeration Tower	Aeration Tank	Water proof plastering	C	The leakage may stop after operation continued.
Flocculator	Vertical Baffle Plate	Lumber block	A	Rehabilitation is essential for effective floc formation.
		Flashboard		
Sedimentation Basin	Sedimentation Basin	Inclined plate	B	Installation is necessary for effective floc settling. Without this, Filtration efficiency should be improved by more frequent backwashing.
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	Modification is important to prevent floc from breakage.
Chlorination Facility	Chlorination Room	Door	C	No effect on the treatment process.
	Intermediate Chlorination	Injection pipe	A	Modification is required for even chlorination.
		Injection valve		
Sludge Drying Bed	Drying Bed	Bed Sand	A	Modification is necessary for proper treatment.
		Structure	A	Current capacity of the bed is smaller comparing to the sludge volume.
Supply Facility	Supply Pump	Supply pump	A	Replacement is important for efficient operation.
Electrical Facility	Stand-by Generator(well)	Stand-by generator	B	Capacity of gererator is not so much problem. Because fuel consumption is depend on load of generator. Therefore, it is B.
	Stand-by Generator (on-site)	Stand-by generator	B	
All Facilities		Painting	C	No effect on the treatment process.

3-3-5 Selected Rehabilitation Work for the Cooperation

3-3-5-1 Selected Rehabilitation Work for the cooperation

As a result of the discussion with the WD and LWUA in SW mission regarding the priority order of the rehabilitation work, A will be included in the cooperation as these are necessary for the proper water treatment. For B and C, work to be implemented was selected as following

table shows, after taking the budget and overall result into consideration.

Table 3-13 Selected Rehabilitation Work for the Cooperation

Facility	Component	Item	Order	With or without	Reason for omitting
Intake Facility	Deep Well	Pumping test	A	○	
		Deep well pump	A	○	
		Riser pipe	A	○	
Aeration Tower	Aeration Tank	Water proof plastering	C	○	
Flocculator	Vertical Baffle Plate	Lumber block	A	○	
Sedimentation Basin	Sedimentation Basin	Inclined plate	B	×	It is not included due to high cost from a cost-effectiveness standpoint
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	○	
Chlorination Facility	Chlorination Room	Door	C	○	
	Intermediate Chlorination	Injection pipe	A	○	
		Injection valve	A	○	
Sludge Drying Bed	Drying Bed	Bed Sand	A	○	
		Structure	A	○	
Supply Facility	Supply Pump	Supply pump	A	○	
Electrical Facility	Stand-by Generator(well)	Stand-by generator	B	×	Capacity of gererator is not so much problem. Because fuel consumption is depend on load of generator. Therefore, generator will be used as it stands.
	Stand-by Generator (on-site)	Stand-by generator	B	×	
All Facilities		Painting	C	○	

3-3-5-2 Obligations of Recipient Country

In Dingle-Pototan WD, high rate of UFW from pipe leakage is a serious problem. Currently, renewal of the distribution pipe is carried out under the LWUA loan project. This plumbing work was expected to continue.

3-3-6 Operation and Maintenance budget

Annual budget of the WTP was projected based on the water quantity from 2011 to 2015 are as shown in Table.3-14. The table gives the figures of water supply quantity (A), expected annual expenditure (B), annual income (C), and revenues (D) in Dingle Pototan.

The basic premises and assumptions are as follows:

- ✓ Although current UFW is 62.1%, the value of LWUA standard which is 25%, will be applied because pipes will be renewed.
- ✓ This WTP will distribute the water for Pototan WD.
- ✓ Electrocity cost of the WTP depends on the water supply quantity, because

operation time of the distribution pump, deep well pump and the agitator, correspond to the quantity of distributed water. (Unit price of electricity 6Peso/kwh）

- ✓ Chemical cost is calculated by the amount of chlorine (injection rate 3mg/l [150peso/kg which effective chlorination is 70 %]) and PAC(Injection rate 40 mg/l [50peso/kg])
- ✓ Electricity cost and chemical cost of the Tingle is prorated based on the water supply quantity of 2009（3146.1m^3/day）and the total amount of the pumping and chemical cost (this is prorated based on the quantity of the designed water distribution 3)
- ✓ Expected annual expenditure is adopted from the performance in 2009 of annual salary, annual recurrent cost and annual interest payment. These are constant values regardless of quantity of distributed water.
- ✓ The more water usage, the higher unit cost in payment structure, therefore annual income is not proportional to the water distribution quantity. However annual income forecast is prorated based on the daily effective water supply and the result of annual income in 2009 so as to make the calculation simple.

Table 3-14 Projected annual Budget in Dingle Pototan WD

Item	Unit	2011	2012	2013	2014	2015
Water supply in Dingle	m^3/day	2,203	2,397	2,592	2,787	2,981
Water supply in Pototan	m^3/day	1,091	1,215	1,338	1,462	1,586
Total for water supply	m^3/day	3,293	3,612	3,930	4,249	4,567
Chemical cost in Pototan	Peso/day	4,118	4,585	5,053	5,520	5,988
Electricity cost in Pototan	Peso/day	5,639	6,013	6,386	6,760	7,133
Total recurrent cost in Pototan(B)	Peso/day	9,757	10,598	11,439	12,280	13,121
Annual recurrent cost (Pototan)	Peso/year	3,561,318	3,868,283	4,175,248	4,482,212	4,789,177
Annual salary payment (Dingle+Pototan)	Peso/year	3,004,988	3,004,988	3,004,988	3,004,988	3,004,988
Annual maintenance cost (Dingle+Pototan)	Peso/year	3,521,313	3,521,313	3,521,313	3,521,313	3,521,313
Annual Depreciation（Dingle＋Pototan）	Peso/year	900,999	900,999	900,999	900,999	900,999
Reccurent cost in Dingle	Peso/year	2,398,925	2,610,937	2,822,948	3,034,960	3,246,972
Annual expenditure (C)	Peso/year	13,387,543	13,906,519	14,425,496	14,944,472	15,463,449
Annual income in 2009 (Pototan)	Peso/year	3,199,304	3,199,304	3,199,304	3,199,304	3,199,304
Daily effective water supply in 2009 (Pototan)	m^3/day	455.9	455.9	455.9	455.9	455.9
Effective water supply in Pototan (UFW30%)	m^3/day	818	911	1,004	1,097	1,190
Expected income in Pototan	Peso/year	5,740,361	6,392,116	7,043,872	7,695,627	8,347,383
Effective water supply in Dingle (UFW30%)	m^3/day	1,542	1,678	1,814	1,951	2,087
Expected income in Dingle	Peso/year	10,820,575	11,776,873	12,733,171	13,689,469	14,645,766
Expected annual income (Dingle＋ Pototan)	Peso/year	16,560,936	18,168,989	19,777,042	21,385,096	22,993,149
Revenue (E)	Peso/year	3,173,393	4,262,470	5,351,547	6,440,624	7,529,700

According to the table above, there will be no deficit in each year. However, the repayment of the loan of the installation of pipes is not considered.

3-3-7 Concerned Issues

As of July 2011, after the rehabilitation work under this FU programme, operation of the WTP is expected to start after the completion of the pipe renewal implemented by the Dingle-Pototan WD. This pipe renewal work is directly managed by the WD; an engineer from the WD is superintending this pipe renewal, concurrently, in charge of daily operation and maintenance of the WTP and supervising of the WD office construction work as well. It is obvious the quality control of the pipe work is insufficient. Therefore the pressure test for confirming the pipe leakage and repair work for such leakage is essential. It is very important any defects shall be repaired before the WTP operation start.

3-4 Outline Design of Facility Rehabilitation in Pontevedra WD

3-4-1 Design Policies

3-4-1-1 Policies on the Rehabilitation

Policies on the rehabilitation of the Sublangon WTP in Pontevedra are as follows.

- ✓ Treatment process is the same as the initial design, i.e., removal of iron, manganese, color and turbidity, excluding salinity.
- ✓ Downsize the capacity of the supply pumps and the operation cost.
- ✓ Connect a new pipe connection to the existing 300m^3 to simplify the water supply control that is currently quite complicated.
- ✓ Replace the corroded pipes and valves.

3-4-1-2 Consistency with Long-term Plan

The future plan of water supply in Pontevedra WD is indicated in the "*Improvement Plan for Management and Services on The Water Supply System of Pontevedra Water Distirict* (NJS 2010)" as shown in the table below. The current water supply is approximately 1,700m^3/d.

As mentioned above, the maximum yield of each water source is 2,573m^3/d in Sublangon, 594m^3/d (7.5l/s*22hrs) in Yatiga, and 317m^3/d (4l/s*22hrs) in Hipona; the total production is 3,484m^3/d. This amount is less than the daily maximum water supply of the year 2020, thus the additional water source development will be inevitable in the future.

Table 3-15 Long-term Water Supply Plan in Pontevedra WD

Item	Unit	Y 2015	Y 2020	Y 2030
Total Population	persons	44,286	45,775	48,904
Barangay	unit	17	22	26
Population above	persons	37,382	43,041	48,904
Number of Service Connection	points	1,854	2,827	5,090
Water Coverage	%	20.9	30.9	52.0
Population Served	persons	9,266	14,131	25,436
Water Demand per capita	L/c/d	120	130	140
Daily Average Water Demand	m^3/d	1,250	2,054	3,984
Unaccounted for Water (UFW)	%	30	25	20
Daily Average Water Supply	m^3/d	1,786	2,737	4,986
Daily Maximum Water Supply	m^3/d	2,322	3,558	6,481

3-4-1-3 Policies on the Quantity of Treated Water

Though the shortage of water production from the existing water sources is expected before 2020, the concept of this Follow-up Programme is to rehabilitate the existing facilities in order to secure the current WTP capacity. Therefore, the design water quantity is as initially designed 2,573m^3/d.

3-4-1-4 Policies on the Water Quality and Water Treatment

It is supposed that the WTP will treat the water from new water source which is now under development. The raw water from the new deep well is expected to contain less salinity therefore the removal of salinity is not considered. Also, though the required capacity of the treatment facilities, such as the sludge drying bed, depends on the raw water quality, the rehabilitation design is tentatively based on the current water quality of the existing well because water quality of the new well is unknown yet.

3-4-2 Basic Plan

From the result of the field survey, the rehabilitation work of the WTP is summarized in below. The measures for improving each facility are described in the following paragraphs.

Table 3-16 Summary of the Rehabilitation Work

Item	Work
Aeration Tower	Opening of maintenance manholes
Flocculator	Modification of baffle plates
Sedimentation Basin	Change of sludge drain pipe, Installation of inclined plates
Rapid Sand Filter	Modification of inlet trough, Change of surface-wash pipe
Surface wash Pump	Replacement
Sludge Drying Bed	Rehabilitation of drying bed
Chlorination Room	Change of entrance door
Intermediate-Chlorination	Replacement of pump, Improvement of injection pipe
Post-Chlorination	Replacement of pump, Change of injection point
Stand-by Generator	Replacement
Transmission Pump	Replacement
Transmission Pipe	Installation of φ200 transmission pipe

3-4-2-1 Aeration Tower

During the operation, the door of the aeration tower is open. Concerning the oxidation process of iron, the dissolved oxygen is 6.5mg/l after aeration while the raw water contains only 1mg/l DO. Also, the concentration of oxygen in the tower was 20.6% ust after the aeration, which is nearly equal to the exterior oxygen concentration of 21%. Therefore, there is no problem of the aeration process.

However, inside of the treated water tank of the aeration tower is very dark because the maintenance manholes are opened at the diagonally opposite corner of the entrance door. Therefore, two maintenance manholes shall be opened close to the door, and one portable ladder shall be provided for the maintenance.

Maintenance manhole: 600×600	2units
Ladder: Aluminum, sliding stretch type 5m, portable	1unit

3-4-2-2 Flocculator

The existing flocculator is vertical baffle type with the hydraulic mixing system, which uses the energy of flow itself. Currently the mean flow velocity of each basin is, from the 1st basin to 3rd basin, 0.13m/s, 0.06m/s, and 0.04m/s, respectively. The flow is slower than the design criteria of 0.15–0.30m/s, which means the mixing is less intensive. Thus the mean flow velocity shall be increased by adjusting the height of the baffle walls to narrow the flow openings of the underflow and overflow parts.

The dimension of the flow openings of the existing flocculator and modified one, mean flow

velocity of each flow, G-value and GT value are shown below.

Table 3-17 Modification of the baffle flow and flow velocity

		Flow opening Dimension	Underflow Flow velocity	Overflow Flow velocity	Vertical-flow Flow velocity	G-value	GT-value
		m×m	m/s	m/s	m/s		
Existing	1st basin	1×0.25	0.125	0.125	0.125	21.7	42,952
	2nd basin	1×0.50	0.0626	0.0626	0.0626		
	3rd basin	1×0.75	0.0417	0.0417	0.0417		
Modified	1st basin	1×0.12	0.261	0.261	0.125	47.2	93,469
	2nd basin	1×0.15	0.210	0.210	0.0626		
	3rd basin	1×0.20	0.157	0.157	0.0417		
Design Criteria			0.15～0.30			10～75	23,000～ 210,000

To narrow the underflow opening, put the lumber block with the length of the opening dimension to the bottom and slide down the flashboards, adding new flashboards made of lumber plate to the top. To narrow the overflow opening, put new flashboards adjusting the opening dimension.

＜1st basin＞

Flow opening area: 0.12m^2

Lumber block: □2.5cm×5cm × L12cm 38 units

Lumber plate: W13cm×L100cm×T3cm 38 units

＜2nd basin＞

Flow opening area: 0.15m^2

Lumber block: □2.5cm×5cm × L15cm 18 units

Lumber plate: W35cm×L100cm×T3cm 18 units

＜3rd basin＞

Flow opening area: 0.20m^2

Lumber block: □2.5cm×5cm × L20cm 12 units

Lumber plate: W55cm×L100cm×T3cm 12 units

3-4-2-3 Sedimentation Basin

The existing sedimentation basin is the horizontal flow sedimentation basin. The settling efficiency is not enough to remove small flocs which are carried over to the filter basin. Also the sludge drain pipes are all corroded, and therefore the sludge drainage system is not functioning properly.

The surface loading of the existing facility is 25.5mm/min which meets the design criteria of 15–30 mm/min, and the Flow velocity is 110mm/min which satisfies the criteria of less than 400mm/min. However, the retention time is 2.1 hrs that is shorter than the criteria of 3–5 hrs,

which affects the settling efficiency. In order to improve the settling efficiency, inclined plate settlers shall be installed to the sedimentation basin. The surface loading can be decreased from 25.5 to 7.0 mm/min after installation of the inclined plate settlers, and thus the small size of flocs will be settled in the sedimentation basin without carryover. The specification of inclined plate settlers is as follows.

Inclined plates: PVC plate, SUS rack
Rack dimension: W700×L2000×H1800 (18R×7C×2mL) 6units
W800×L2000×H1800 (18R×8C×2mL) 12units

The structure of the overflow trough does not affect the carryover of floc; the weir load is 339m^3/d/m, under the design criteria of 500m^3/d/m.

Also, all sludge drain pipes which are corroded due to the high salinity shall be removed and sludge pumps shall be installed. Sludge pump will be installed to top of the sedimentation basin, and sludge underneath the water can be drawn out with the self-priming pump. The power source of the pump will be taken from the distribution panel newly installed in the chemical feeding room.

Sludge drainage will be operated every 7 days by running the sludge pumps to send the accumulated sludge to the sludge drying bed. The sludge pumping will take 5–10 min per each hopper.

Sludge pump: Suction pump, 240L/min×10mH×1.5kW, Φ50 2units
Handcart: 1units
Suction pipe : Φ 75 PVC L=90m
Discharge pipe: Φ 75 steel pipe L=25m
Electrical work: : Power distribution and wiring extension 1unit

Additionally, the corroded inlet valves shall be replaced to the stainless butterfly valves from the flange connection.

Inlet valve: Butterfly valve Φ250 salinity-resist coating, stainless 2units

3-4-2-4 Rapid Sand Filter

The condition of filter sand is fine and the filtration rate is 135.4m/d satisfying the design criteria of 120‑150m/d. However, concerning the inlet structure, with the distance from the inlet trough to the water surface of the filter basin, the small flocs are broken where the inlet water falls into the basin. Therefore the inlet structure shall be improved by installing the inlet

pipe and weir plate to reduce the inlet flow velocity.

Inlet pipe: Φ150 Steel pipe w/flange, salinity-resist coating 2m	2units
Weir plate : W30cm×L90cm×T3cm, lumber plate	2units
Weir holding plate: W50cm×L150cm×T3cm×2, lumber plate	2units

Currently, the backwash pump is detached due to its failure and the surface-wash pump is used as the backwash/surface-wash combined pump. However, its backwash capacity is very low, and thus the filter sand tends to be easily clogged because of insufficient washing. A new anti-corroive backwash pump shall be installed to recover the backwash capacity.

Backwash pump: Vertical shaft 6.4m^3/min×12mH×22kW Φ250	1unit

The surface-wash pipes are corroded, and those shall be replaced with the anti-corrosion pipes. The flow meter for the surface-wash pump is also malfunctioning and will be replaced.

Surface-wash pipe: Φ150main/Φ50branch/Φ25nozzle SP salinity-resist	1unit
Flow meter: Φ150 Turbine type w/accumulation	1unit

3-4-2-5 Chlorination Facility

The chlorination facility consists of the chlorine mixing tanks, agitators, diaphragm injection pumps, and injection pipe. Chlorine is added at the sedimentation outlet trough for intermediate chlorination, and at the filter clearance well for post chlorination.

Currently, both the intermediate and post chlorination pumps are defective thus chlorination process is not properly operated.
The injection pump for the intermediate chlorination shall be replaced because of the leakage from its diaphragm. Also, the injection pipe for intermediate chlorination needs to be modified by installing injection valves, so that the chlorine dosage will be uniform.

Intermediate Cl pump: diaphragm pump 1.7–2.0l/min×0.8MPa×0.2kW	1unit
Injection pipe: Φ15PVC 12m	1unit
Injection valve: PVC cock Φ15	4units

The injection pump for the post chlorination shall be replaced due to its failure. Additionally, the post chlorination injection point shall be changed from the filtered water tank to the transmission pipe. This is because with the current water demand the residual chlorine is decreased in the reservoir during the retention time.

Post Cl pump: diaphragm pump 0.25–0.3l/min×1.0MPa×0.2kW 1unit
Injection pipe: Φ15PVC 30m
Pipe protection trough: D150×W150 RC w/grating cover 20m
Connection box: L1000×W1000×D800, RC w/ steel cover, w/fittings 1unit

Additionally, the door of the chlorination room and the agitator support shall be changed due to corrosion.

Door: 900×2100 SUS frame 1unit
Agitator support: W500×L2100 lumber, water-resist paint 1unit

3-4-2-6 Sludge Drying Bed

In the effluent standard at the time of basic design (enforcement in 1900), there was no necessity of effluent treatment because the amount of effluent was little. However, the clean water act was approved in 2004, it is required to keep the effluent standard even if the small amount of water. The existing sludge drying bed is not functioning since there is no bed sand (consisting of filter sand, gravel base, and under-drain). In order to recover its function, filling of the bed sand, and installing the sand retaining walls and under-drain system are required.

Bed sand: Gravel 10–20mm/25–35mm/40–60mm, sand 4–6mm
Sand retaining structure: Wooden walls, wooden wedge, PVC net

The calculation of the sludge volume and required drying bed capacity is shown below. The sludge volume was recalculated according to the present water quality, and the required capacity of the drying bed is $24m^2$ in the case of effective depth of 0.5m. After installing the sand bed as explained above, the capacity of the existing drying bed will be $32m^3$ which is larger than the required capacity of$24m^3$ so no expansion will be done. The sludge drying process takes 7days in one cycle, 6days for drying and 1day for desludging and sludge draining from the sedimentation tank.

Table 3-18 Calculation of Sludge Volume and Drying Bed Capacity

Water Quality			Remarks
Water Quantity Q	m^3/d	2,708	
Color	CU	1.5	
PAC	mg/l	20	
Turbidity	NTU	1.6	
Fe	mg/l	4.2	
Sludge Mass & Volume			
SS from Color	kg/d	0.0	SS generated from color removal is 1.5mg/l per 1CU.*1
SS form PAC	kg/d	8.3	SS from PAC is 0.153mg/l per 1mg/l -PAC.
SS form Turbidity	kg/d	4.3	SS from turbidity removal is 1.0mg/l per 1NTU.
SS from Fe	kg/d	21.7	SS from iron removal is 1.91mg/l per1mg/l-Fe.
Total Sludge Mass	kg/d	34.3	
Total Sludge/day	m^3	3.43	As sludge concentration $10kg/m^3$ (1%) *
Sludge Drying Bed Capacity			
Required Capacity (for 7days)	m^2	24	As sludge concentration $20kg/m^3$ (2%); the total sludge per day is half above ($1.7m^3/d$) *2 Effective depth 0.5m
Existing Capacity	m^2	32	Effective depth 0.5m

*1: Color will be removed to 5 CU.

*2: The sludge concentration after 7 day retention time will be 20 kg/m^3, though the concentration of daily sludge is $10kg/m^3$.

3-4-2-7 Transmission and Supply Pump

There are 2 large capacity pumps, which cover the maximum water demand at the peak hours currently installed at the facility. However, the current demand of 1000 $m^{3/}$ day does not reach to the planned water supply, and especially the demand during the night is very low compared to the planned water supply. This can be solved by the installation of transmission pipes to the distribution tank. Water source contains salt, and corrosion of the facilities such as pipes progressed. Therefore there's a worry that the existing pump breaks down due to corrosion. As a preventative measure, an anti-corroive pump will be installed by the project as replacement by the WD's own expense is perceived difficult. The pump operation will be more efficient by having two pumps operating during the peak hours and only one pump for low demand. Additionally, the flow meter shall be replaced, which is broken.

Pump: Vertical shaft pump $1.34m^3/min \times 45m \times 22kW$, Φ100 2units
Flow meter: Φ200 turbine-type w/accumulation 1unit

The existing transmission pipe is connected to the reservoir and supply network, and also connected to the bypass pipe from another water source for dilution of the high salinity. A new pipeline shall be installed connecting the transmission pump and reservoir in order to simplify this complicated connection.

Transmission pipe: Φ200 SP epoxy-lining 80m

Φ200 PVC underground	470m
Gate valve: GV Φ200 salinity-resist coating	1unit

Also the level control valve of inlet pipe to the reservoir is removed, thus a new valve shall be installed.

Level control valve: Φ150 w/ball-tap	1unit
Inlet valve: GV Φ150	1unit

3-4-2-8 Stand-by Generator

Replacement of the transmission pumps under this programme will change the power requirement. The stand-by generator shall be replaced to one that supplys power for only the minimum amount required for the operation of the plant.

Generator for WTP: 220V 60Hz 90kVA w/silencer	1unit

3-4-2-9 Painting Work

Painting of the wall, handrail and door of each facility shall be done due to the request from the WD.

Painting area: Surface of all walls, handrails and doors	1unit

3-4-2-10 List of the Specifications of the Rehabilitation Work

The specifications of the rehabilitation work are listed below.

Table 3-19 Specifications of the Rehabilitation Work

Facility	Component	Item	Type*	Specifications	Unit	Q'ty
Aeration Tower	Aeration Tank	Manhole	R	□600×600 near entrance door	unit	2
		Ladder	N	Aluminum, sliding stretch type 5m, portable	pc.	1
Flocculator	Baffle Plates submerged	Lumber installation	R	Lumber block □2.5cm×5cm water-resist	m	15
	Baffle Plates overflow	Flashboard installation	R	Lumber plate W25cm×L100cm×T3cm water-resist	pc.	84
Sedimentation Basin	Inlet Pipe	Inlet valve	C	Butterfly valve Φ250 salinity-resist coat, SUS	pc.	2
	Sedimentation Basin	Inclined plates	N	PVC inclined plates, stainless rack W700/800×L2000×H1800	unit	1
	Sludge drain facility	Sludge pump	N	Suction pump 240l/min×10mH×1.5kW Φ50	unit	2
		Suction pipe	N	Φ75 PVC	m	90
		Discharge pipe	N	Φ75 Steel pipe	m	25
		Electrical work	N	Power distribution and wiring extension	unit	1
Rapid Sand Filter	Inlet trough	Inlet pipe	R	Φ150 SP w/flange salinity-resist coating, Weir	unit	2
	Backwash	Backwash Pump	C	6.4m^3/min×12mH×22kW Φ250×Φ200	pc.	1
	Surface-wash	Surface-wash pipe	C	Φ150/50/25 SP, salinity-resist coating	unit	1
		Flow meter	C	Φ150 turbine-type w/accumulation	pc.	1
Chlorination Facility	Chlorination room	Door	C	900×2100 SUS frame, alminum door coated	unit	1
	Agitator	Support	C	Lumber □15cm×10cm, water-resist painting	unit	1
	Intermediate Chlorination	Injection pump	C	1.7～2.0l/min×0.8MPa×0.2kW	pc.	1
		Injection pipe	C	Φ15 PVC	m	12
		valve	N	PVC cock Φ15	pc.	4
	Post Chlorination	Injection pump	C	0.25～0.3l/min×1.0MPa×0.2kW	pc.	1
		Injection pipe	C	Φ15 PVC	m	30
		Trough	N	RC D150×W150 w/grating cover	m	20
		Connection box	N	RC 1000×1000×800 w/steel cover	pc.	1
Sludge Drying Bed	Drying Bed	Bed sand	R	Gravel 10–20mm/25–35mm/40–60mm, Sand 4–6mm	unit	1
Transmission Facility	Transmission Pipe	Transmission pipe	N	Φ200 SP w/epoxy-lining, underground	m	80
			N	Φ200 PVC, underground	m	470
		Gate valve	N	GV Φ200 salinity-resist coating	pc.	1
		Flow meter	N	Φ200 turbine type w/accumulation salinity-resist coating	pc.	1
		Level Control valve	N	Level control valve Φ150 salinity-resist coating w/ball-tap	pc.	1
		Inlet valve	N	Φ150 salinity-resist coating	pc.	1
	Transmission Pump	Transmission Pump	C	1.34m^3/min×45m×18.5kW Φ200	pc.	2
Electricity	Generator	Generator	C	90kVA	pc.	1
All Facilities	Exterior	Painting	R	Surface of all walls, handrails and doors	unit	1

(*) C: Change, N: New, R: Repair

3-4-3 Outline Design Drawings

The design drawings for the rehabilitation are attached below.

TO RESERVOIR

INSTAL GENERATOR

IMPROVE SLUDGE DRYING BED

CHANGE INJECTION PIPE

INSTAL INCLINED PLATE

INSTAL INJECTION BOX

INSTAL TRANSMISSION PIPE

INSTAL SLUDGE DRAIN PIPE

CHANGE INLET VALVE

INSTAL INJECTION PIPE

CHANGE TRANSMISSION PUMP

CHANGE SURFACE WASH PIPE

CHANGE BACK WASH PUMP

CHANGE METER

BAFFLE PLATES INSTALLATION

CHANGE INJECTION PUMP

CHANGE DOOR

OPENING MAINTENANCE HOLE

CHANGE AGITATOR SUPPORT

IMPROVE INLET TROUGH

THE PLAN OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
PONTEVEDRA WD	LAYOUT OF REHABILITATION WORK	FIG. 3-4
		SCALE NON

3-4-4 Priority of the Rehabilitation Work

As the budget for this Follow-up Programme is limited, probably not all the rehabilitation work can be covered by this Programme. It depends on the total cost for the rehabilitation. Therefore, all the rehabilitation work has been prioritized as listed below. The order of importance is as follows.

A: Item that is inevitable for proper treatment process

B: Item that is necessary for simple or low-cost operation

C: Item that is required for aesthetic aspect

Table 3-20 Priority of Rehabilitation Work

Facility	Component	Item	Order	Remarks
Aeration Tower	Aeration Tank	Manhole	A	There are no steps to access inside from the existing manholes, also the inside is very dark because holes are far from the entrance.
		Ladder	A	
Flocculator	Vertical baffle plate	Flashboard	A	Rehabilitation is essential for effective floc formation.
Sedimentation Basin	Inlet Pipe	Inlet valve	A	Replacement is necessary due to serious corrosion.
	Sedimentation basin	Inclined plate	B	Installation is necessary for effective floc settling. Without this, Filtration efficiency should be improved by more frequent backwashing.
	Sludge Drain Pipe	Sludge pump	A	Due to serious corrosion of the pipe, sludge drain process is very difficult. Improvement of the sludge drain system is necessary.
		Suction hose	A	
		Discharge hose	A	
		Electrical work	A	
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	Modification is important to prevent floc from breakage.
	Backwash Facility	Backwash pump	A	Replacement is necessary due to breakdown.
	Surface-wash Facility	Surface-wash pipe	A	Replacement is necessary due to serious corrosion.
		Flow meter	A	It is necessary for measuring water flow.
Chlorination Facility	Chlorination Room	Door	C	No effect on the treatment process.
	Agitator	Agitator support	B	Corrosion is considerable but no effect on the operation for immediate days.
	Intermediate Chlorination	Injection pump	A	Replacement is necessary due to oil leakage.
		Injection pipe	A	Modification is required for even chlorination.
		Injection valve	A	
	Post Chlorination	Injection pump	A	Replacement is necessary due to breakdown.
		Injection pipe	A	Replacement is necessary for preventing the injection pipe from clogging.
		Trough for pipe	A	
		Connection box	A	
Sludge Drying Bed	Drying Bed	Bed Sand	A	Modification is necessary for proper treatment.
Transmission Facility	Transmission pipe	Transmission Pipe	B	Installation of new pipe is required for simple operation, though the water is distributed with the current operation anyway (priority B). However, replacement of the flow meter is A due to breakdown.
		Gate valve	B	
		Flow meter	A	
		Level control valve	B	
		Inlet valve	B	
	Transmission Pump	Transmission pump	A	It is necessary to replace to anti-corrosive pump due to the risk of rusting by salt.
Electrical Facility	Stand-by Generator	Stand-by generator	B	Capacity of gererator is not so much problem. Because fuel consumption is depend on load of generator. Therefore, it is B.
All Facilities		Painting	C	No effect on the treatment process.

3-4-5 Selected Rehabilitation Work for the Cooperation

3-4-5-1 Selected Rehabilitation Work for the cooperation

As a result of the discussion with the WD and LWUA in SW mission regarding the priority order of the rehabilitation work, A will be included in the cooperation as these are necessary for the proper water treatment. For B and C, work to be implemented was selected as following

table shows, after taking the budget and overall result into consideration.

Table 3-21 Selected Rehabilitation Work for the Cooperation

Facility	Component	Item	Order	with or without	Reason for omitting
Aeration Tower	Aeration Tank	Manhole	A	○	
		Ladder	A	○	
Flocculator	Vertical baffle plate	Flashboard	A	○	
Sedimentation Basin	Inlet Pipe	Inlet valve	A	○	
	Sedimentation basin	Inclined plate	B	×	It is not included due to high cost from a cost-effectiveness standpoint
	Sludge Drain Pipe	Sludge pump	A	○	
		Handcart	A	○	
		Drain hose	A	○	
		Electrical wiring	A	○	
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	○	
	Backwash Facility	Backwash pump	A	○	
	Surface-wash Facility	Surface-wash pipe	A	○	
		Flow meter	A	○	
Chlorination Facility	Chlorination Room	Door	C	○	
	Agitator	Agitator support	B	○	
	Intermediate Chlorination	Injection pump	A	○	
		Injection pipe	A	○	
		Injection valve	A	○	
	Post Chlorination	Injection pump	A	○	
		Injection pipe	A	○	
		Trough for pipe	A	○	
		Connection box	A	○	
Sludge Drying Bed	Drying Bed	Bed Sand	A	○	
Transmission Facility	Transmission pipe	Transmission Pipe	B	○	
		Gate valve	B	○	
		Flow meter	A	○	
		Level control valve	B	○	
		Inlet valve	B	○	
	Transmission Pump	Transmission pump	A	○	
Electrical Facility	Stand-by Generator	Stand-by generator	B	×	Capacity of gererator is not so much problem. Because fuel consumption is depend on load of generator. Therefore, generator will be used as it stands.
All Facilities		Painting	C	○	

3-4-5-2 Obligations of Recipient Country

The purpose of this the Follow-up programme is to supply quality water suitable for drinking by the rehabilitation of the WTP and development of the new water source. The WTP rehabilitation is implemented by the Japan side, and the water source development is carried out by the

Philippine side. Regarding the water source development project, the Pontevedra WD has applied for the LWUA loan, however, the budget allocation has been taking time and thus the work schedule is delayed. The water source development includes the following work:

- ✓ Deep well drilling
- ✓ Installation of a deep well pump
- ✓ Plumbing work (from the well to the WTP)
- ✓ Electrical work

3-4-6 Operation and Maintenance budget

Annual budget of the WTP was projected based on the water quantity from 2011 to 2015 as shown in the table below. The table gives the figures of daily electricity and chemical cost (B), expected annual expenditure (C), annual income (D), and revenues (E) for different water supply quantity (A).

For example of the Colum1, the daily water supply quantity in the Pontevedra WD is (A) 1,300m^3/d, the recurrent cost on the chemicals and electricity for this amount is (B) 3,570 peso/d. Annual expenditure for the water supply rate of 1,300m^3/d is expected (C) 7,799,213 peso/yr, and the annual income is expected (D) 8,646,729 peso/yr, which gives revenues of (E) 847,513 peso/yr.

The basic premises and assumptions are as follows:

- ✓ Water resources in Yatigan and Hipona are used preferentially, because treatment is not necessary. Water from Sublangon WTP covers the rest of the demand. The water supply from the Yatigan and Hipona deep wells are assumed the maximum capacity of 900m^3/d.
- ✓ Electricity cost of Yatigan and Hipona is for pump operation for 22 hours per day.
- ✓ Chemical cost of Yatigan and Hipona is only for chlorination and dosage of 1mg/l.
- ✓ Electricity cost of Sublangon WTP is for operation of deep well pump, transmission pump and agitator etc. The power consumption depends on the operation hours, which are relative to the water supply quantity.
- ✓ Chemical cost of Sublangon WTP is for chlorination (dosage 1mg/l) and coagulation using PAC (dosage 40mg/l).
- ✓ Annual expenditure is calculated based on the actual record of the Pontevedra WD in 2009. The annual salary, maintenance cost, annual depreciation, and repayment for the loan are assumed constant.
- ✓ Effective water supply quantity is estimated from the UFW of 50%, actual record of Dec 2009. For example of colum1, when the total water supply rate is 1,300m^3/d, the effective water supply is 650m^3/d.
- ✓ Annual income is calculated based on the actual record of 2009, the annual income of 7,090,315 peso/yr for the effective water supply of 533m^3/d. (E.g. with

the effective water supply of 650m3/d, the annual income is 650×7,090,315/533=8,646,726Peso.) And the water tariff is not considered which escalates the price depending on the water consumption.

Table 3-22 Projected Annual Budget in Pontevedra WD

Item		Unit	2011	2012	2013	2014	2015
Effective water supply quantity		m^3/d	850	950	1050	1150	1250
Unaccounted Water Ratio		%	50	50	50	50	50
Water Quantity	Yatigan+Hipona	m^3/d	900	900	900	900	900
	Sublangon	m^3/d	800	1000	1200	1400	1600
	Water Supply Quantity (A)	m^3/d	1700	1900	2100	2300	2500
Recurrent cost	Yatigan+Hipona electricity cost	Peso/d	1,485	1,485	1,485	1,485	1,485
	Yatigan+Hipona chemical cost	Peso/d	195	195	195	195	195
	Sublangon electricity cost	Peso/d	1,800	2,197	2,595	2,992	3,390
	Sublangon chemical cost	Peso/d	1,771	2,214	2,657	3,100	3,543
	Total Recurrent Cost (B)	Peso/d	5,251	6,092	6,932	7,773	8,613
Annual Expenditure	Annual recurrent cost	Peso/yr	1,916,717	2,223,473	2,530,229	2,836,985	3,143,741
	Annual salary	Peso/yr	1,941,792	1,941,792	1,941,792	1,941,792	1,941,792
	Maintenance cost	Peso/yr	2,417,355	2,417,355	2,417,355	2,417,355	2,417,355
	Depreciation cost	Peso/yr	549,177	549,177	549,177	549,177	549,177
	Loan repayment	Peso/yr	1,587,705	1,587,705	1,587,705	1,587,705	1,587,705
	Annual Expenditure (C)	Peso/yr	8,412,725	8,719,481	9,026,237	9,332,993	9,639,749
Annual Income	Annual income in 2009	Peso/yr	7,090,315	7,090,315	7,090,315	7,090,315	7,090,315
	Daily effective water supply in 2009	m^3/d	533	533	533	533	533
	Expected effective water supply (UFW 50%)	m^3/d	850	950	1050	1150	1250
	Annual Income (D)	Peso/yr	11,307,257	12,637,522	13,967,788	15,298,053	16,628,318
	Revenues (E)	Peso/yr	2,894,532	3,918,041	4,941,551	5,965,060	6,988,569

According to the table above, the balances for each water supply quantity are not deficit. However, the repayment for the loan on the new water source development is not counted in this calculation. Also, the annual income is estimated based on the water supply rate of 533 m^3/d with the current service connection of 987 households. Suppose the service connection is doubled, the effective water supply quantity will be around 1,050m^3/d then the annual revenues also will be double.

3-4-7 Concerned Issues

As mentioned above, the water source of the Sublangon WTP contains high concentrations of salt, which has been affecting the service connection. It is therefore very important to secure the alternative water source in order to supply water with low salinity to the user. The provisional location of the new deep well is 1.2km distant from the existing well in the WTP and thus expected to be low salinity. However, groundwater quality is very difficult to determine without

exploitation, and in case the well is saline more than the Philippine water quality standard, it should be canceled and another deep well need to be developed.

High rate of unaccounted for water (UFW) which makes a serious impact to the water service management is also a concern. However, the cause of the UFW is still unknown. It is crucial to investigate the cause of the UFW and take measures urgently, for improvement of the water service management.

3-5 Outline Design of Facility Rehabilitation in Binmaley WD

3-5-1 Design Polies

3-5-1-1 Policies on the Rehabilitation

Policies on of the rehabilitation of the WTP in Binmaley WD are as follows.

- ✓ Treatment process is the same as the initial design, i.e., removal of color.
- ✓ Broken or decayed facility will be rehabilitated.

3-5-1-2 Consistency with Long-term Plan

As the capacity of the two WTPs is insufficient for the current water demand, the present water service is additionally sourced by other untreated water. According to "*Improvement Plan for Management and Services on the Water Supply System of Binmaley Water District* (NJS, 2010)", compact WTP units are planned to be installed to comply with the national water quality standard in order. The future water supply plan in Binmaley is shown in the table below. Three more water sources are planned to be developed in 2015 to meet the water demand.

Table 3-23 Long-term Water Supply Plan in Binmaley WD

Item	Unit	2009	Stage-1 (2015)	Mid-Term (2020)	Long Term (2030)
Total Population	persons	78,810	87,150	94,770	112,060
Barangay	unit	32	32	32	33
Population above	persons	76,340	84,420	91,800	112,060
Number of Service Connection	points	8,107	9,762	11,496	15,324
Water Coverage	%	48,642	58,572	68,976	91,944
Population Served	persons	100	110	120	120
Water Demand per capita	L/c/d	4,865	6,444	8,276	11,032
Daily Average Water Demand	m^3/d	25%	20%	20%	20%
Unaccounted for Water (UFW)	%	6,087	8,059	10,347	13,794
Daily Average Water Supply	m^3/d	7,911	10,478	13,452	17,936
Daily Maximum Water Supply	m^3/d	62%	67%	73%	82%

3-5-1-3 Policies on the Quantity of Treated Water

As mentioned above, the water production of the WTPs cannot cover the current water demand

so other water sources without treatment are also used to supply water. No matter though new water sources are developed, the present WTPs still need to operate to treat water from the existing water sources. Therefore the water quantity for the WTPs rehabilitated under this programme is 1,555m^3/d in Caloocan and 1,728m^3/d in Fabia as the same amounts as initially designed.

3-5-1-4 Policies on the Water Quality and Water Treatment

The WTPs will treat the water removing color. As the result of jar test conducted during the field survey, feeding acid is more effective to remove color below the standard of 5 TCU, however, acid agents such as sulfuric acid, hydrochloric acid and nitric acid are strong medicines which are difficult to procure and handle. Therefore, feeding acid is not considered under this rehabilitation.

Feeding a large quantity of PAC is also effective for color and turbidity removal but its cost may affect the WTP management. Thus, optimum dosage of the coagulant is crucial for sustainable operation of the WTP.

3-5-2 Basic Plan in Caloocan WTP

From the result of the field survey, the rehabilitation work are listed in the following table. The measures for improving each facility are described in the following paragraphs.

Table 3-24 Summary of the Rehabilitation Work (Caloocan)

Item	Work
Aeration tower	Removal of exterior paint
Flocculator	Modification of baffle plates
Sedimentation basin	Installation of inclined plates, change of sludge drain pipes
Rapid sand filter	Modification of inlet trough
Recycle pump	Replacement of flow meter, replacement of recycle pump and pipes, electrical works for single phase outlet
Sludge drain pump	Replacement of submersible sludge drain pump
Sludge drying bed	Construction of drying bed
Pre/intermediate Cl pump	Repair of injection pipes
Post Cl pump	Replacement of injection pump
Distribution pump	Replacement of flow meter
Water analysis device	Supply of portable digital turbidity /color meter
Drainage pump	Supply of mobile drainage pump
Filter sand	Supply of filter sand
National flag	Supply of the Philippine flag plate

3-5-2-1 Aeration Tower

There is no problem of the aeration process concerning the dissolved oxygen after aeration and the concentrations of oxygen in the tower. Also the entrance door and opening have been replaced to aluminum ones by the WD.

The exterior wall paint of the aeration tower is peeling off thus all the paint shall be removed as requested by the WD.

Exterior wall: Removal of exterior paint 1unit

3-5-2-2 Flocculator

The existing flocculator is vertical baffle type with the hydraulic mixing system, which uses the energy of flow itself. Currently the mean flow velocity of each basin, from the 1st basin to 3rd basin, is 0.11m/s, 0.06m/s, and 0.04m/s respectively. The flow is slower than the design criteria of 0.15–0.30m/s, which means the mixing is less intensive. Thus the mean flow velocity shall be increased by adjusting the height of the baffle walls to narrow the flow openings of the underflow and overflow parts.

The dimension of the flow openings of the existing flocculator and modified one and mean flow velocity of each flow, G-value and GT value are shown below.

Table 3-25 Modification of the baffle flow and flow velocity

		Flow opening Dimension	Underflow Flow velocity	Overflow Flow velocity	Vertical-flow Flow velocity	G-value	GT-value
		m×m	m/s	m/s	m/s		
Existing	1st basin	0.8×0.20	0.11	0.11	0.11	18.5	41,466
	2nd basin	0.8×0.40	0.06	0.06	0.06		
	3rd basin	0.8×0.60	0.04	0.04	0.04		
Modified	1st basin	0.8×0.10	0.23	0.23	0.11	36.7	82,087
	2nd basin	0.8×0.15	0.15	0.15	0.06		
	3rd basin	0.8×0.20	0.11	0.11	0.04		
Design Criteria			0.15～0.30			10～75	23,000～ 210,000

To narrow the underflow opening, put the lumber block with the length of the opening dimension to the bottom and slide down the flush-boards, adding new flashboards made of lumber plate to the top. To narrow the overflow opening, put new flashboards adjusting the opening dimension.

＜1st basin＞
Flow opening area: 0.08m^2
Lumber block: □4cm×5cm × L10cm 40 units
Lumber plate: W10cm×L78cm×T4cm 47 units
＜2nd basin＞
Flow opening area: 0.12m^2
Lumber block: □4cm×5cm × L15cm 18 units
Lumber plate: W25cm×L78cm×T4cm 23 units
＜3rd basin＞
Flow opening area: 0.16m^2
Lumber block: □4cm×5cm × L20cm 12 units
Lumber plate: W20cm×L78cm×T4cm 29 units

3-5-2-3 Sedimentation Basin

The existing sedimentation basin is horizontal flow sedimentation basin. The settling efficiency is insufficient to remove small flocs that are carried over to the filter basin.

The surface loading of the existing facility is 27.0mm/min which meets the design criteria of 15–30 mm/min, and the Flow velocity is 84mm/min which satisfies the criteria of less than 400mm/min. However, the retention time is 2.0 hrs which is shorter than the criteria of 3–5 hrs that affects the settling efficiency. In order to improve the settling efficiency, inclined plate settlers shall be installed to the sedimentation basin. The surface loading can be decreased from 27.0 to 7.0 mm/min after installation of the inclined plate settlers, and thus the small size of flocs will be settled in the sedimentation basin without carryover. The specification of inclined

plate settlers is as follows.

Inclined Plates: PVC plate, SUS rack
Rack dimension: W900×L2000×H1800 (18R×9C×2mL) 4units
W1000×L2000×H1800 (18R×10C×2mL) 4units

The structure of the overflow trough does not affect the carryover of floc; the weir load is 258m^3/d/m, under the design criteria of 500m^3/d/m.

The sludge drain pipes are corroded due to long-time contact with the accumulated sludge at the bottom. The holes are closed with rubber sheet as a temporary measure but sludge cannot be drained completely under this condition. Therefore the corroded pipes shall be removed from the flange connection and replaced to the PVC pipes. The pipes installed through the concrete wall shall be repainted with water proof paint after scraping off the surface paint.

Sludge drain pipe: Φ100 PVC w/flange and bend	23m
Pipe support: SUS Pipe support	1unit
Pipe paint: Φ100 pipe paint scraping / waterproof painting	1unit

3-5-2-4 Rapid Sand Filter

The condition of filter sand is fine and the filtration rate is 124m/d satisfying the design criteria of 120 – 150m/d. However, concerning the inlet structure, due to the distance from the inlet trough to the water surface of the filter basin, the small flocs are broken where the inlet water falls into the basin. Therefore the inlet structure shall be improved by installing the inlet pipe and weir plate to reduce the inlet flow velocity.

Inlet pipe: Φ150 Steel pipe w/flange, salinity-resist coating 2.3m 2units
Weir plate : W30cm×L100cm×T3cm, lumber plate 2units
Weir holding plate: W50cm×L125cm×T3cm×2, lumber plate 2units

3-5-2-5 Chlorination Facility

The chlorination facility consists of the chlorine storage tank, diaphragm injection pumps, and injection pipe. Chlorine is added at the inlet of the rapid mixer for pre chlorination, at the sedimentation outlet trough for intermediate chlorination, and at the filter clearance well for post chlorination. Currently, the intermediate injection pump is used for pre chlorination to remove color, but post chlorination is not working due to the pump breakdown.

The intermediate chlorine injection pump is currently used for pre-chlorination but its flange bolts are corroded because of leakage chlorine solution. Thus the corroded bolts shall be

removed and replaced with the plastic ones. Also the gasket and pipe support shall be changed.

Injection pipe: M12 plastic bolt, Φ15gasket, SUS support 1 unit

The post chlorine injection pump shall be replaced due to its failure. Additionally, a part of the injection pipe was removed so the pipe and fittings shall be installed.

Post Cl pump: diaphragm pump 0.12l/min×1.0MPa×0.2kW 1unit
Injection pipe: Φ15PVC w/fittings 1 unit

3-5-2-6 Distribution Facility

The broken flow meter shall be replaced to a new one.

Flow meter: Φ150 Turbine type w/accumulation 1unit

3-5-2-7 Drainage Facility

The recycle pump initially installed has been removed due to its failure, and a single- phase submersible pump is installed by the WD for temporary use. Also the sludge drain pump is broken down, and the temporary recycle pump is used for drainage. The existing control panel is three phase, however the single phase pump is more locally available, so the single phase power is drawn from the distribution pump room with an extension cord. The socket is on the structure covered by a plastic sheet which is under risk of electric short.

Therefore new recycle pump and sludge drain pump shall be installed, and single phase outlet shall be provided from the existing control panel. In addition, the flow meter of the recycle pump shall be replaced due to breakdown.

Flow meter: Φ150 Turbine type w/accumulation 1unit
Recycle pump: Φ50 submersible 0.11m^3/min×10m×0.75kW 1unit
Sludge drain pump: Φ50submersible 0.1m^3/min×10m×0.75kW 1unit
Control panel: Single phase outlet

3-5-2-8 Sludge Drying Bed

In the effluent standard at the time of basic design (enforcement in 1900), there was no necessity of effluent treatment because the amount of effluent was little. However, the clean water act was approved in 2004, it is required to keep the effluent standard even if the small amount of water. Therefore, enlargement is necessary because current capacity is less than the required capacity of current water quality.

The existing sludge drying bed is not functioning after the bed sand was clogged and removed from the structure. It was caused by the sludge penetration into the sand layer. This can be avoided by removing and washing the bed sand surface when the rate of water penetration becomes slow. An additional sludge storage basin was constructed by the WD to receive the drained sludge; the structure is not for drying the sludge but for evaporation of the sludge moisture so the drying process requires for 3–4 weeks.

The sludge volume was recalculated according to the present water quality, and the required capacity of the drying bed is 90.4m^2 in the case of effective depth of 1.0m. The sludge drying process takes 8days in one cycle, 7days for drying and 1day for desludging and sludge draining from the sedimentation tank.

As the existing drying bed and the sludge storage tank constructed by the WD are not suitable to rehabilitate and use in aspect of workability and efficiency, a new drying bed shall be constructed under the Programme.

Drying bed structure: RC effective area 92m^2 (H 2.4m), bed sand
Sludge pipe: Φ150SP 60m, Φ80SP 36m, Φ80 Ball valve 8pc, Φ50SP 55m
Drainage trough: RC tough 55m

The calculation of the sludge volume and required capacity of the sludge drying bed is summarized below.

Table 3-26 Calculation of Sludge Volume and Drying Bed Capacity (Caloocan)

Water Quality			Remarks
Water Quantity Q	m^3/d	1,555	
Color	CU	31	
PAC	mg/l	30	
Turbidity	NTU	0.4	
Fe	mg/l	0	
Sludge Mass & Volume			
SS from Color	kg/d	49.0	SS generated from color removal is 1.5mg/l per 1CU.*1
SS form PAC	kg/d	7.1	SS from PAC is 0.153mg/l per 1mg/l -PAC.
SS form Turbidity	kg/d	0.6	SS from turbidity removal is 1.0mg/l per 1NTU.
SS from Fe	kg/d	0	SS from iron removal is 1.91mg/l per1mg/l-Fe.
Total Sludge Mass	kg/d	56.7	
Total Sludge/day	m^3	11.3	As sludge concentration 5kg/m^3 (0.5%)*2
Sludge Drying Bed Capacity			
Required Capacity (for 8days)	m^2	90.8	As sludge concentration 5kg/m^3 (0.5%)
Design Capacity	m^2	92	

*1: Color will be removed to 10 CU.

*2: from experiment

3-5-2-9 Procurement of Other Equipment

The following equipment shall be procured under the Programme:

- ✓ Digital Turbidity/Color Meter: While the main parameter is color in this WTP, the water analysis device currently used is for multipurpose and requires complicate operation. Therefore a potable digital meter shall be provided to simplify the operation and to suite to the water quality management.
- ✓ Drainage Pump: Since initially supplied drainage pump has been broken down, a new mobile pump shall be procured.
- ✓ Filter Sand: During the backwash process, the filter sand is washed away. Even the sand is returned to the filter, the amount has been reduced. The filter sand for filling two filter basins shall be provided as a stock.
- ✓ National Flag Plate: The Philippine flag plate was blown off in a typhoon and removed. Thus a new plate shall be installed.

Turbidity/color meter : Portable digital type	1unit
Drainage pump: 0.11m^3/min×10m×1kW, 1ph, mobile	1unit
Filter sand: Silica sand 0.6–0.75mm	7.5m^3
National flag plate: W660 x L1000 Philippine flag plate	1unit

3-5-2-10 List of the Specifications of the Rehabilitation Work

The specifications of the rehabilitation work are summarized as follows.

Table 3-27 Specifications of the Rehabilitation Work (Caloocan)

Facility	Component	Item	Type*	Specifications	Unit	Q'ty
Aeration Tower	Exterior wall	Removal of paint	R	Removal of exterior wall paint	unit	1
Flocculator	Baffle Plates submerged	Lumber installation	R	Lumber block □4cm×5cm water-resist	m	15
	Baffle Plates overflow	Flashboard installation	R	Lumber plate W10–25cm×L78cm×T4cm water-resist	pc.	99
Sedimentation Basin	Sedimentation Basin	Inclined plates	N	PVC inclined plates, stainless rack W900/1000×L2000×H1800	unit	1
		Sludge drain pipe	C	Φ100 PVC w/fittings , SUS support, waterproof painting	unit	1
Rapid Sand Filter	Inlet trough	Inlet pipe	R	Φ150 SP w/flange salinity-resist coating	unit	2
Chlorination Facility	Pre/Intermediate Chlorination	Injection pipe	C	Gasket Φ15 PVC, Pipe Bracket (plastic bolt).	unit	1
	Post Chlorination	Injection pump	C	0.12l/min×1.0MPa×0.2kW	pc.	1
		Injection pipe	C	Φ15 PVC Pipe Bracket (plastic bolt).	unit	1
Distribution Facility	Distribution Pump	Flow meter	C	Φ150 turbine-type w/accumulation	pc.	1
Drainage Facility	Recycle Pump	Flow meter	C	Φ50 turbine-type w/accumulation	pc.	1
		Recycle pump	C	0.11m^3/min×10m×0.75kW submersible, Φ50 pipe w/fittings	pc.	1
	Sludge drain pump	Sludge drain pump	C	0.1$m^{3/}$min×10m×0.75kW submersible	pc.	1
	Electricity	Control panel	R	Single phase outlet from control panel	pc.	1
Sludge Drying Bed	Drying Bed	Drying bed	N	Sludge drying bed (A=92m^2,H=2.4m) w/sand bed, under drain pipes, trough	unit	1
Others	Water Analysis Device	Turbidity/color	N	Portable digital turbidity/color meter	unit	1
	Drainage Pump	Drainage pump	C	0.11m^3/min×10m×1kW, 1phase, mobile pump	unit	1
	Filter Sand	Filter sand	N	Silica sand: 0.6–0.75mm	m^3	7.5
	National Flag	Flag plates	R	Philippine flag plate	unit	1

(*) C: Change, N: New, R: Repair

3-5-3 Basic Plan in Fabia WTP

From the result of the field survey, the rehabilitation works are listed in the following table. The measures for improving each facility are described as follows.

Table 3-28 Summary of the Rehabilitation Work (Fabia)

Item	Works
Aeration tower	Removal of exterior paint
Flocculator	Modification of baffle plates
Sedimentation basin	Installation of inclined plates, change of sludge drain pipes
Rapid sand filter	Modification of inlet trough
Recycle pump	electrical works for single phase outlet
Sludge Drain pump	Replacement of submersible sludge drain pump
Sludge drying bed	Construction of drying bed
Chlorination facility	Repair of Cl tank leakage, change of ventilation fan
Post Cl pump	Replacement of injection pump
Distribution pump	Replacement of flow meter and pressure gauge
Pressure tank	Replacement of pressure tank
Water analysis device	Supply of portable digital turbidity /color meter
Drainage pump	Supply of mobile drainage pump
Filter sand	Supply of filter sand
National flag	Supply of the Philippine/Japanese flag plate

3-5-3-1 Aeration Tower

There is no problem of the aeration process concerning the dissolved oxygen after aeration and the concentrations of oxygen in the tower. Also the entrance door and opening have been replaced to aluminum ones by the WD.

The exterior wall paint of the aeration tower is peeling off thus all the paint shall be removed as requested by the WD.

Exterior wall: Removal of exterior paint	1unit

3-5-3-2 Flocculator

The existing flocculator is vertical baffle type with the hydraulic mixing system, which uses the energy of flow itself. Currently the mean flow velocity of each basin, from the 1st basin to 3rd basin, is 0.13m/s, 0.06m/s, and 0.04m/s respectively. The flow is slower than the design criteria of 0.15–0.30m/s, which means the mixing is less intensive. Thus the mean flow velocity shall be increased by adjusting the height of the baffle walls to narrow the flow openings of the underflow and overflow parts.

The dimension of the flow openings of the existing flocculator and modified one and mean flow velocity of each flow, G-value and GT value are shown below.

Table 3-29 Modification of the baffle flow and flow velocity

		Flow opening Dimension	Underflow Flow velocity	Overflow Flow velocity	Vertical-flow Flow velocity	G-value	GT-value
		m×m	m/s	m/s	m/s		
Existing	1st basin	0.8×0.20	0.13	0.13	0.13	21.7	43,653
	2nd basin	0.8×0.40	0.06	0.06	0.06		
	3rd basin	0.8×0.60	0.04	0.04	0.04		
Modified	1st basin	0.8×0.10	0.25	0.25	0.13	36.7	82,087
	2nd basin	0.8×0.15	0.17	0.17	0.06		
	3rd basin	0.8×0.20	0.13	0.13	0.04		
Design Criteria			0.15～0.30			10～75	23,000～ 210,000

To narrow the underflow opening, put the lumber block with the length of the opening dimension to the bottom and slide down the flush-boards, adding new flashboards made of lumber plate to the top. To narrow the overflow opening, put new flashboards adjusting the opening dimension.

＜1st basin＞

Flow opening area: 0.08m^2

Lumber block: □4cm×5cm × L10cm 40 units

Lumber plate: W10cm×L78cm×T4cm 47 units

＜2nd basin＞

Flow opening area: 0.12m^2

Lumber block: □4cm×5cm × L15cm 18 units

Lumber plate: W25cm×L78cm×T4cm 23 units

＜3rd basin＞

Flow opening area: 0.16m^2

Lumber block: □4cm×5cm × L20cm 12 units

Lumber plate: W20cm×L78cm×T4cm 29 units

3-5-3-3 Sedimentation Basin

The existing sedimentation basin is horizontal flow sedimentation basin. The settling efficiency is not enough to remove small flocs that are carried over to the filter basin.

The surface loading of the existing facility is 30.0mm/min which meets the design criteria of 15–30 mm/min, and the Flow velocity is 94mm/min which satisfies the criteria of less than 400mm/min. However, the retention time is 1.8 hrs which is shorter than the criteria of 3–5 hrs,that affects the settling efficiency. In order to improve the settling efficiency, inclined plate settlers shall be installed to the sedimentation basin. The surface loading can be decreased from 30.0 to 7.0 mm/min after installation of the inclined plate settlers, and thus the small size of flocs will be settled in the sedimentation basin without carryover. The specification of inclined

plate settlers is as follows.

Inclined Plates: PVC plate, SUS rack
Rack dimension: W900×L2000×H1800 (18R×9C×2mL) 4units
W1000×L2000×H1800 (18R×10C×2mL) 4units

The structure of the overflow trough does not affect the carryover of floc; the weir load is 286m^3/d/m, under the design criteria of 500m^3/d/m.

The sludge drain pipes are corroded due to long-time contact with the accumulated sludge at the bottom. The holes are closed with rubber sheet as a temporary measure but sludge cannot be drained completely under this condition. Therefore the corroded pipes shall be removed from the flange connection and replaced to the PVC pipes. The pipes installed through the concrete wall shall be repainted with water proof paint after scraping off the surface paint.

Sludge drain pipe: Φ100 PVC w/flange and bend	23m
Pipe support: SUS Pipe support	1unit
Pipe paint: Φ100 pipe paint scraping / waterproof painting	1unit

3-5-3-4 Rapid Sand Filter

The condition of filter sand is fine and the filtration rate is 138m/d satisfying the design criteria of 120 – 150m/d. However, concerning the inlet structure, due to the distance from the inlet trough to the water surface of the filter basin, the small flocs are broken where the inlet water falls into the basin. Therefore the inlet structure shall be improved by installing the inlet pipe and weir plate to reduce the inlet flow velocity.

Inlet pipe: Φ150 Steel pipe w/flange, salinity-resist coating 2.3m	2units
Weir plate : W30cm×L100cm×T3cm, lumber plate	2units
Weir holding plate: W50cm×L125cm×T3cm×2, lumber plate	2units

3-5-3-5 Chlorination Facility

The chlorination facility consists of the chlorine storage tank, diaphragm injection pumps, and injection pipe. Chlorine is added at the inlet of the rapid mixer for pre chlorination, at the sedimentation outlet trough for intermediate chlorination, and at the filter clearance well for post chlorination. Currently, the intermediate injection pump is used for pre chlorination to remove color, but post chlorination is not working due to the pump breakdown.

The post chlorine injection pump shall be replaced due to its failure. Additionally, a part of the injection pipe was removed so the pipe and fittings shall be installed.

Post Cl pump: diaphragm pump 0.12l/min×1.0MPa×0.2kW	1unit
Injection pipe: Φ15PVC w/fittings	1 unit

The chlorine storage tank has leakage of chlorine solution. Its flange gasket shall be changed and the bolts shall be replaced with the plastic ones to stop the leakage.

Flange bolt: M12 plastic bolt	1 unit
Gasket: Φ15 gasket	1 unit

Additionally the ventilation fan of the chlorination room has been removed due to failures, thus it shall be replaced by new one.

Ventilation fan：Wall type	1unit

3-5-3-6 Distribution Facility

The broken flow meter and pressure gauge shall be replaced to new ones. The pressure tank has the traces of leakage so needs to be changed.

Flow meter: Φ150 Turbine type w/accumulation	1unit
Pressure gauge: Compound type, max range 1.0MPa	1unit
Pressure tank: Volume 130L	1unit

3-5-3-7 Drainage Facility

The existing sludge drain pump causes over-current and is not properly working, therefore it shall be replaced. Also single phase outlet shall be provided from the existing control panel for the future breakdown of pumps.

Sludge drain pump: Φ50submersible 0.1m^3/min×10m×0.75kW	1unit
Control panel: Single phase outlet	

3-5-3-8 Sludge Drying Bed

In the effluent standard at the time of basic design (enforcement in 1900), there was no necessity of effluent treatment because the amount of effluent was little. However, the clean water act was approved in 2004, it is required to keep the effluent standard even if the small amount of water. Therefore, enlargement is necessary because current capacity is less than the required capacity of current water quality.

The existing sludge drying bed is not functioning after the bed sand was clogged and removed from the structure. It was caused by the sludge penetration into the sand layer. This can be avoided by removing and washing the bed sand surface when the rate of water penetration becomes slow. An additional sludge storage basin was constructed by the WD to receive the drained sludge; the structure is not for drying the sludge but for evaporation of the sludge moisture so the drying process requires for 3–4 weeks.

The sludge volume was recalculated according to the present water quality, and the required capacity of the drying bed is 83.7m^2 in the case of effective depth of 1.0m. The sludge drying process takes 8days in one cycle, 7days for drying and 1day for desludging and sludge draining from the sedimentation tank.
As the existing drying bed and the sludge storage tank constructed by the WD are not suitable to rehabilitate and use in aspect of workability and efficiency, a new drying bed shall be constructed under the Programme.

Drying bed structure: RC effective area 92m^2 (H 2.4m), bed sand
Sludge pipe: Φ150SP 40m, Φ80SP 36m, Φ80 Ball valve 8pc, Φ50SP 30m
Drainage trough: RC tough 32m

The calculation of the sludge volume and required capacity of the sludge drying bed is summarized below.

Table 3-30 Calculation of Sludge Volume and Drying Bed Capacity (Caloocan)

Water Quality			Remarks
Water Quantity Q	m^3/d	1,728	
Color	CU	27	
PAC	mg/l	30	
Turbidity	NTU	0.2	
Fe	mg/l	0	
Sludge Mass & Volume			
SS from Color	kg/d	44.1	SS generated from color removal is 1.5mg/l per 1CU.*1
SS form PAC	kg/d	7.9	SS from PAC is 0.153mg/l per 1mg/l -PAC.
SS form Turbidity	kg/d	0.3	SS from turbidity removal is 1.0mg/l per 1NTU.
SS from Fe	kg/d	0	SS from iron removal is 1.91mg/l per1mg/l-Fe.
Total Sludge Mass	kg/d	52.3	
Total Sludge/day	m^3	10.5	As sludge concentration 5kg/m^3 (0.5%)*2
Sludge Drying Bed Capacity			
Required Capacity (for 8days)	m^2	83.7	As sludge concentration 5kg/m^3 (0.5%)
Design Capacity	m^2	92	

*1: Color will be removed to 10 CU.

*2: from experiment

3-5-3-9 Procurement of Other Equipment

The following equipment shall be procured under the Programme:

- ✓ Digital Turbidity/Color Meter: While the main parameter is color in this WTP, the water analysis device currently used is for multipurpose and requires complicate operation. Therefore a potable digital meter shall be provided to simplify the operation and to suite to the water quality management.
- ✓ Drainage Pump: Since initially supplied drainage pump has been broken down, a new mobile pump shall be procured.
- ✓ Filter Sand: During the backwash process, the filter sand is washed away. Even the sand is returned to the filter, the amount has been reduced. The filter sand for filling two filter basins shall be provided as a stock.
- ✓ National Flag Plate: The Philippine flag plate was blown off in a typhoon and removed. Thus a new plate shall be installed.

Turbidity/color meter : Portable digital type	1unit
Drainage pump: 0.11m3/min×10m×1kW, 1ph, mobile	1unit
Filter sand: Silica sand 0.6–0.75mm	7.5m^3
National flag plate: Japan Philippine flag plate 1unit	

3-5-3-10 List of the Specifications of the Rehabilitation Work

The specifications of the rehabilitation work are summarized as follows.

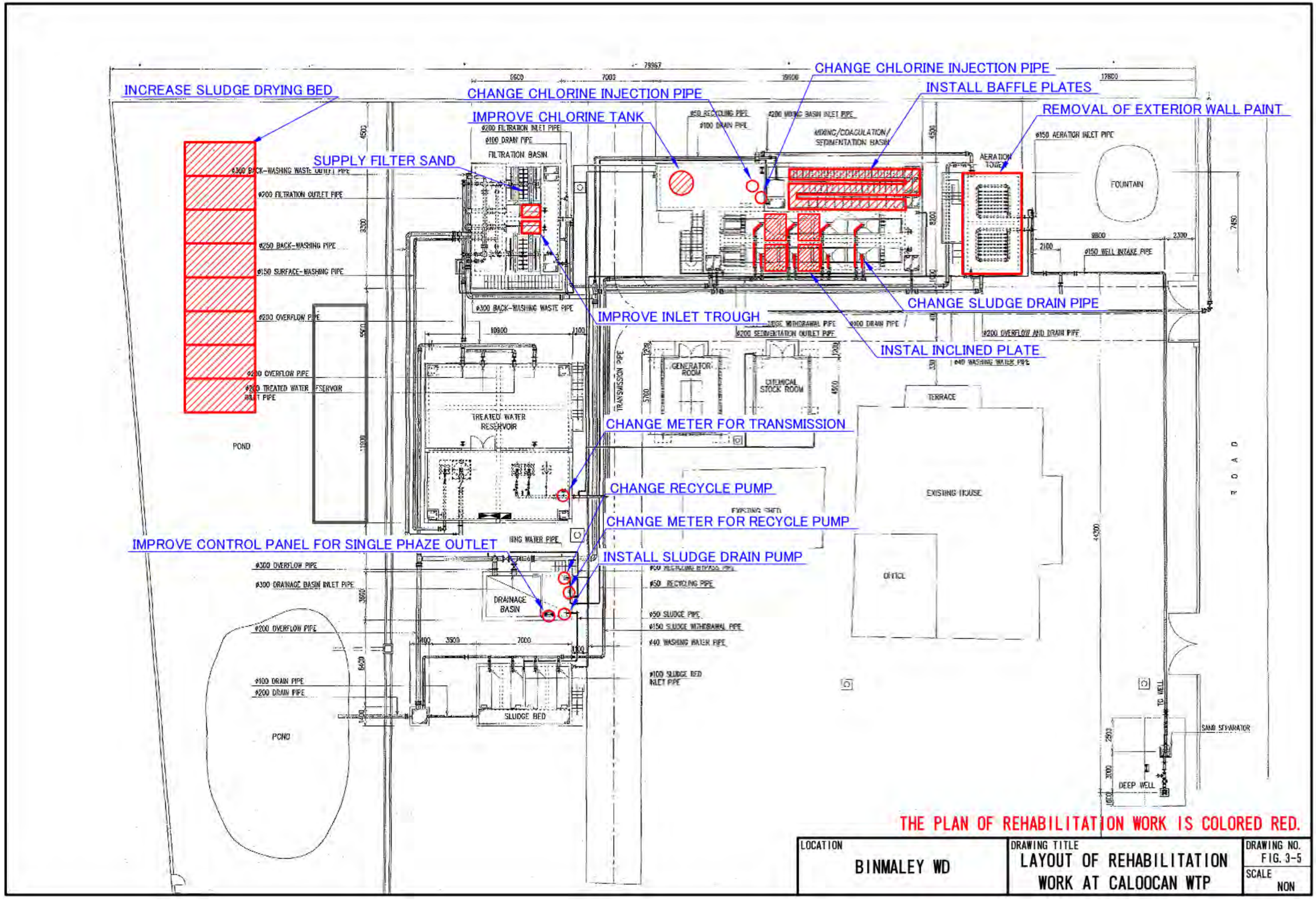
Table 3-31 Specifications of the Rehabilitation Work (Fabia)

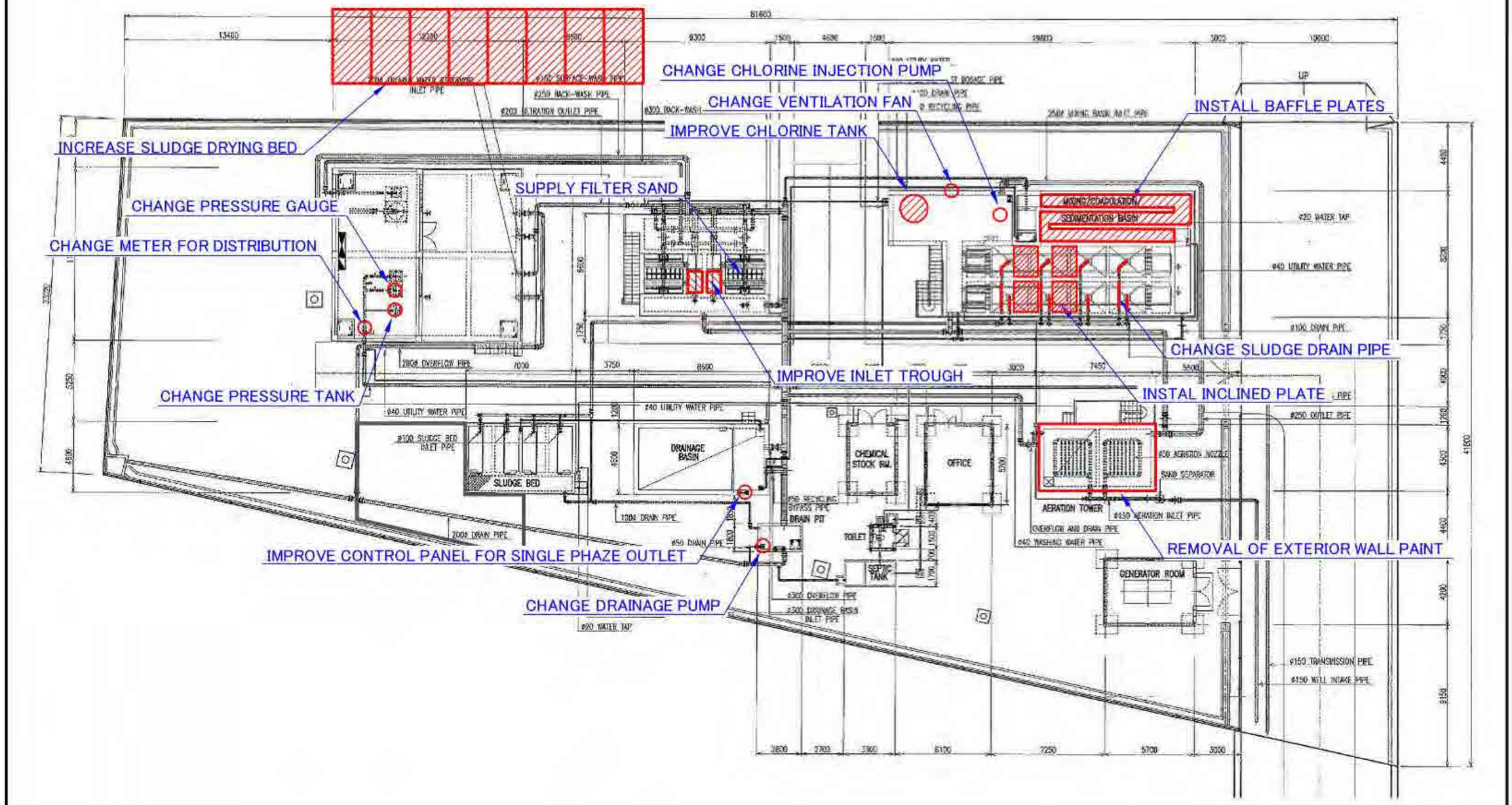
Facility	Component	Item	Type*	Specifications	Unit	Q'ty
Aeration Tower	Aeration Tank	Exterior wall	R	Removal of exterior wall paint	unit	1
Flocculator	Baffle Plates submerged	Lumber installation	R	Lumber block □4cm×5cm water-resist	m	15
	Baffle Plates overflow	Flashboard installation	R	Lumber plate W10-25cm×L78cm×T4cm water-resist	pc.	99
Sedimentation Basin	Sedimentation Basin	Inclined plates	N	PVC inclined plates, stainless rack W700/800×L2000×H1800	unit	1
		Sludge drain pipe	C	Φ100 PVC frange pipe bracket	unit	1
Rapid Sand Filter	Inlet trough	Inlet pipe	R	Φ150 SP w/flange salinity-resist coating overflow pipe	unit	2
Chlorination Facility	Post Chlorination	Injection pump	C	0.12l/min×1.0MPa×0.2kW	pc.	1
		Injection pipe	C	Φ15 PVC fittings	unit	1
	Cl Tank	Cl tank	R	Repair of leakage	unit	1
	Ventilation Fan	Ventilation fan	C	Wall-mounted type, wall frame space	pc.	1
Distribution Facility	Distribution Pump	Flow meter	C	Φ150 turbine-type w/accumulation	pc.	1
		Pressure gauge	C	Installtion of pressure gauge	pc.	1
	Pressure Tank	Pressure tank	C	Pressure tank	pc.	1
Drainage Facility	Sludge Drain Pump	Sludge drain pump	C	0.1m^3/min×10m×0.75kW submersible	pc.	1
	Electricity	Control panel	R	Single phase outlet from control panel	pc.	1
Sludge Drying Bed	Drying Bed	Drying bed	N	Sludge drying bed (A=92m^2,H=2.4m) w/sand bed, under drain pipes, trough	unit	1
Others	Water Analysis Device	Turbidity/color	N	Portable digital turbidity/color meter	unit	1
	Drainage Pump	Drainage pump	C	0.11m3/min×10m×1kW, 1phase, mobile pump	unit	1
	Filter Sand	Filter sand	N	Silica sand: 0.6–0.75mm	m^3	7.5
	National Flag	Flag plates	R	Installtion of Flag plates	unit	1

(*) C: Change, N: New, R: Repair

3-5-4 Outline Design Drawings

The design drawings for the rehabilitation are attached below.


INCREASE SLUDGE DRYING BED
SUPPLY FILTER SAND
IMPROVE CHLORINE TANK
CHANGE CHLORINE INJECTION PIPE
CHANGE CHLORINE INJECTION PIPE
INSTALL BAFFLE PLATES
REMOVAL OF EXTERIOR WALL PAINT
IMPROVE INLET TROUGH
CHANGE SLUDGE DRAIN PIPE
INSTAL INCLINED PLATE
CHANGE METER FOR TRANSMISSION
CHANGE RECYCLE PUMP
CHANGE METER FOR RECYCLE PUMP
IMPROVE CONTROL PANEL FOR SINGLE PHAZE OUTLET
INSTALL SLUDGE DRAIN PUMP
THE PLAN OF REHABILITATION WORK IS COLORED RED.
LOCATION
BINMALEY WD
DRAWING TITLE
LAYOUT OF REHABILITATION WORK AT CALOOCAN WTP
DRAWING NO.
FIG. 3-5
SCALE
NON



THE PLAN OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
BINMALEY WD	LAYOUT OF REHABILITATION WORK AT FABIA WTP	FIG. 3-6
		SCALE NON

3-5-5 Priority of the Rehabilitation Work

As the budget for this Follow-up Programme is limited, probably not all the rehabilitation work can be covered by this Programme. It depends on the total cost for the rehabilitation. Therefore, all the rehabilitation work has been prioritized as listed below. The order of importance is as follows.

A: Item that is inevitable for proper treatment process

B: Item that is necessary for simple or low-cost operation

C: Item that is required for aesthetic aspect

The priority and the reason are shown in the table below for Both of Caloocan WTP and Fabia WTP.

Table 3-32 Priority of Rehabilitation Work (Caloocan)

Facility	Component	Item	Order	Remarks
Aeration Tower	Exterior Wall	Exterior wall	C	There is no effect on the operation.
Flocculator	Vertical Baffle Plate	Vertical baffle plate	A	Rehabilitation is essential for effective floc formation.
Sedimentation Basin	Sedimentation basin	Inclined plate	B	Installation is necessary for effective floc settling. Without this, Filtration efficiency should be improved by more frequent backwashing.
	Sludge Drain Pipe	Sludge drain pipe	A	It is necessary to repair for sustainability though the corrosion is currently not serious.
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	Modification is important to prevent floc from breakage.
Chlorination Facility	Pre chlorination	Injection pipe	A	Repair is important to prevent the further corrosion
	Post chlorination	Injection pump	A	It is necessary because the existing pump is broken down.
		Injection pipe	A	Repair is important to prevent the further corrosion
Distribution Facility	Distribution Pump	Flow meter	A	It is indispensable to measure the water flow.
Drain Facility	Recycle Pump	Flow meter	A	It is indispensable to measure the water flow.
		Recycle pump	B	Temporary installed pump is working.
	Sludge Drain Pump	Sludge drain pump	A	It is indispensable to drain sludge.
	Electricity	Control panel	A	Single phase power supply is necessary for the future breakdown.
Sludge Drying Bed	Drying Bed	New structure	A	Current capacity of the bed is smaller comparing to the sludge volume.
Others	Water Analysis Device	Turbidity/color	B	Portable digital turbidity/color meter helps the WD simple water quality management. But visual check can substitute in some measure. Therefore, it is B.
	Drainage Pump	Drainage pump	B	Current pump procured by WD is working.
	Filter Sand	Filter sand	B	It is B, because filter sand is consumable good and it is better to be procured by WD.
	National Flag	Philippine flag plate	C	No effect on the treatment process. Therefore it is C.

Table 3-33 Priority of Rehabilitation Work (Fabia)

Facility	Component	Item	Order	Remarks
Aeration Tower	Exterior Wall	Exterior wall	C	There is no effect on the operation.
Flocculator	Vertical Baffle Plate	Vertical baffle plate	A	Rehabilitation is essential for effective floc formation.
Sedimentation Basin	Sedimentation basin	Inclined plate	B	Installation is necessary for effective floc settling. Without this, Filtration efficiency should be improved by more frequent backwashing.
	Sludge Drain Pipe	Sludge drain pipe	A	It is necessary to repair for sustainability though the corrosion is currently not serious.
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	Modification is important to prevent floc from breakage.
Chlorination Facility	Post chlorination	Injection pump	A	It is necessary because the existing pump is broken down.
		Injection pipe	A	Repair is important to prevent the further corrosion
	Cl Tank	Cl tank	A	Repair is important to prevent the further corrosion
	Ventilation Fan	Ventilation fan	A	Broken ventilation fan needs to be changed.
Distribution Facility	Distribution Pump	Flow meter	A	It is indispensable to measure the water flow.
		Pressure gauge	A	It is indispensable to measure the pump pressure.
	Pressure Tank	Pressure tank	B	For pressure control it is possible by using valve.
Drain Facility	Sludge Drain Pump	Sludge drain pump	A	It is indispensable to drain sludge.
	Electricity	Control panel	B	Single phase power supply is necessary for the future breakdown.
Sludge Drying Bed	Drying Bed	New structure	A	Current capacity of the bed is smaller comparing to the sludge volume.
Others	Water Analysis Device	Turbidity/color	B	Portable digital turbidity/color meter helps the WD simple water quality management. But visual check can substitute in some measure. Therefore, it is B.
	Drainage Pump	Drainage pump	B	Current pump procured by WD is working.
	Filter Sand	Filter sand	B	It is B, because filter sand is consumable good and it is better to be procured by WD.
	National Flag	Philippine/Japanese flag plate	C	No effect on the treatment process. Therefore it is C.

3-5-6 Selected Rehabilitation Work for the Cooperation

3-5-6-1 Selected Rehabilitation Work for the cooperation

As a result of the discussion with the WD and LWUA in SW mission regarding the priority order of the rehabilitation work, A will be included in the cooperation as these are necessary for the proper water treatment. For B and C, work to be implemented was selected as following table shows, after taking the budget and overall result into consideration.

Table 3-34 Selected Rehabilitation Work for the Cooperation (Caloocan)

Facility	Component	Item	Order	with or without	Reason for omitting
Aeration Tower	Aeration Tank	Remove of painting	C	○	
Flocculator	Vertical baffle plate	Flashboard	A	○	
Sedimentation Basin	Sedimentation basin	Inclined plate	B	×	It is not included, because of the high cost and low cost-effectiveness.
	Sludge Drain Pipe	Drain hose	A	○	
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	○	
Chlorination Facility	Intermediate chlorination	Injection pipe	A	○	
	Post chlorination	Injection pump	A	○	
		Injection pipe	A	○	
Distribution Facility	Distribution Facility	Flow meter	A	○	
Drain Facility	Recycle Facility	Flow meter	A	○	
		Recycle pump	B	×	It is not include, because there is a tentative facility.
	Sludge Drain Pump	Sludge drain pump	A	○	
	Electricity	Control panel	A	○	
Sludge Drying Bed	Drying Bed	Drying Bed	A	○	
Others	Water nalysis Device	Turbidity/color	B	×	Visual check can substitute in some measure.
	Drainage pump	Drainage pump	B	×	Current pump procured by WD is working.
	Filter Sand	Filter sand	B	×	Filter sand is consumable good and it is better to be procured by WD.
	National Flag	Philippine/Japanese flag plate	C	×	No effect on the treatment process.

Table 3-35 Selected Rehabilitation Work for the Cooperation (Fabia)

Facility	Component	Item	Order	with or without	Reason for omitting
Aeration Tower	Outside wall	Remove of painting	C	○	
Flocculator	Vertical baffle plate	Flashboard	A	○	
Sedimentation Basin	Sedimentation basin	Inclined plate	B	×	It is not included, because of the high cost and low cost-effectiveness.
	Sludge Drain Pipe	Drain hose	A	○	
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	○	
Chlorination Facility	Post chlorination	Injection pump	A	○	
		Injection pipe	A	○	
	Chlorination tank	Chlorination tank	A	○	
	Ventilation	Fan	A	○	
Distribution Facility	Distribution Facility	Flow meter	A	○	
	Pressure gauge	Pressure gauge	A	○	
	Pressure Adjustment	Pressure tank	B	○	
Drain Facility	Sludge Drain Pump	Sludge drain pump	A	○	
	Electricity	Control panel	B	×	Convert of control panel is not included, because sludge drain pump is replaced.
Sludge Drying Bed	Drying Bed	Drying Bed	A	○	
Others	Water analysis Device	Turbidity/color	B	×	Visual check can substitute in some measure.
	Drainage pump	Drainage pump	B	×	Current pump procured by WD is working.
	Filter Sand	Filter sand	B	×	Filter sand is consumable good and it is better to be procured by WD.
	National Flag	Philippine/Japanese flag plate	C	×	No effect on the treatment process.

3-5-6-2 Obligations of Recipient Country

Under this Follow-up programme, an additional sludge drying bed is constructed. Land allocation for this facility is required from the WD. And it is confirmed that the free area in the WTP is available for this purpose.

3-5-7 Operation and Maintenance budget

The UFW of this WD is lower (23%) because of the use of newer pipes and the proper leakage maintenance. There is no major concern in its management. Annual budget of the WTP was projected based on the water quantity from 2011 to 2015 as shown in Table-3-36. The table gives figures of expected annual expenditure (B), annual income (C), and revenues (D) for different water supply quantity (A).

The basic premises and assumptions are as follows:

- ✓ Current UFW is 23%. This situation is expected to last until 2015.
- ✓ Water transmission quantity is determined by the effective water supply of 2015.
- ✓ "Improvement Plan for Management and Services on The Water Supply System of Binmaley Water Distirict (NJS 2010)". Effective water supply of each year is based on this value and the result of 2009 which is prorated each year.
- ✓ In annual expenditure, constant cost, depreciation cost, interest and other deficit are adopted past results of Binmaley WD in 2009. This value is constant regardless of water supply quantity.
- ✓ Variable expense (fuel cost, electricity cost, chemical cost, plumbing cost, rest of variable cost) is prorated based on water supply quantity of of 2009.
- ✓ The more water usage, the higher unit cost in payment structure, therefore annual income is not prorated based on water supply quantity. However annual income forecast is prorated based on daily effective water supply and result of annual income in 2009 to make the calculation simpler.

Table 3-36 Projected Annual Budget in Binmaley WD

Item	Unit	2011	2012	2013	2014	2015
Water transmission quantity	m^3/d	6,903	7,261	7,620	7,978	8,336
Effective water supply quantity (A)	m^3/d	5,336	5,613	5,890	6,167	6,444
UFW rate		23%	23%	23%	23%	23%
Income (C)	Peso	41,442,821	43,594,606	45,746,390	47,898,175	50,049,960
Expenditure (B)	Peso	11,757,568	12,368,042	12,978,516	13,588,990	14,199,463
Maintenance cost (fuel cost, electricity cost, chemical cost.etc)		13,258,607	13,258,607	13,258,607	13,258,607	13,258,607
Personnel cost		293,646	293,646	293,646	293,646	293,646
Constant cost (office electricity cost, conference cost etc.)		4,143,969	4,143,969	4,413,969	4,143,969	4,143,969
Depreciation cost		8,947,241	8,947,241	8,947,241	8,947,241	8,947,241
Interest		38,401,031	39,011,504	39,621,978	40,232,452	40,842,926
Revenue (D)		3,041,790	4,583,101	6,124,412	7,665,723	9,207,034

Since this WD is comparatively-new and leakage control is excuted well, UFW rate is 23% of low level. There is no concern in terms of the management.

3-5-8 Concerned Issues

As mentioned above, the water service management of Binmaley WD is running well. Even though the colored water (20–30CU) is supplied from other water sources without treatment, not so many complaints have been made about the service. The water quality however needs to comply with the Philippine water quality standard, color value less than 5CU, fundamentally. In

the circumstances, appropriate operation of the WTPs should be determined with consideration of construction costs and the operation and maintenance process.

3-6 Outline Design of Facility Rehabilitation in Lingayen WD

3-6-1 Design Policies

3-6-1-1 Policies on the Rehabilitation

Policies on the rehabilitation of the WTPs in Lingayen WD are as follows.

- ✓ Treatment process is the same as the initial design, i.e., removal of color caused by humic substance.
- ✓ Broken or decayed facilities will be rehabilitated.
- ✓ Capacity of pump will be reconsidered to reduce the operation and maintenance cost.

3-6-1-2 Consistency with Long-term Plan

Current WTPs is not in operation and demand is beyond the facility's capacity.. According to "*Improvement Plan for Management and Services on the Water Supply System of Lingayen Water District* (NJS, 2010)", compact water treatment units are being installed to the water sources in order to comply with the national water quality standard as in Binmaley. The future water supply plan in Lingayen is shown in the table below.

Table 3-37 Long-term Water Supply Plan in Lingayen WD

Item	Unit	2009	Stage-1 (2015)	Mid-Term (2020)	Long Term (2030)
Total Population	persons	97,836	104,292	109,999	122,366
Barangay	unit	14	18	22	32
Population above	persons	61,285	76,092	90,879	122,366
Number of Service Connection	points	2,922	5,114	8,734	14,563
Population Served	persons	14,610	25,572	43,662	72,813
Water Demand per capita	L/c/d	120	120	130	145
Daily Average Water Demand	m^3/d	1,716	3,071	5,674	10,556
Unaccounted for Water (UFW)	%	50%	25%	20%	20%
Daily Average Water Supply	m^3/d	3,440	4,095	7,096	13,200
Daily Maximum Water Supply	m^3/d	4,474	5,323	9,225	17,160
Water Coverage	%	15%	25%	40%	60%

3-6-1-3 Policies on the Quantity of Treated Water

As mentioned above, the amount of water production of the WTPs does not cover the current water demand; therefore other water sources without treatment are also used to supply water.

Considering the future demand, new water sources should be developed. Only underground

water can be used as water resources in Lingayen, however it has color. The present WTPs still need to be operated to treat water from the existing water sources. The produced water quantity of the WTPs, rehabilitated under this programme, is 2,434m^3/d as the same amount as the initial design. No.4 well, from which water was to be sourced initially, has less than a half of water quantity of planned value (28l/s) and No. 7 well is also in the same situation which amount is 10.5l/s. Therefore, No. 6 well located 1km east from WTPs will be used as a water source. Since conveyance pipelines were installed, the construction work is not necessary. Although the yield is 2,108m3/day, which does not meet the planned amount of initial design, it is not necessary to replace borehole pumps, because such lack of yield causes no problem. Current yield will be maintained.

3-6-1-4 Policies on the Water Quality and Water Treatment

The WTPs will remove color and turbidity from raw water. By the result of jar test during the field survey, feeding acid is more effective to remove color and to reduce its value below the standard value of 5 TCU, however, acid agents such as sulfuric acid, hydrochloric acid and nitric acid are strong medicines which are difficult to procure and handle. Therefore, feeding acid is not considered for this rehabilitation.

Feeding a large quantity of PAC is also effective for removing color and turbidity, but its cost may affect the WTP management adversely. Thus, optimum dosage of the coagulant is crucial for sustainable operation of the WTP.

3-6-2 Basic Plan

From the result of the field survey, the rehabilitation works are listed in the following table. The measures for improving each facility are described as follows.

Table 3-38 Summary of the Rehabilitation Work

Item	Work
Aeration tower	Replacement of door
Flocculator	Modification of baffle plates
Sedimentation basin	Installation of inclined plates, paint of sludge drain pipes
Rapid sand filter	Modification of inlet trough, Replacement of surface wash pipe
Recycle pump	Replacement of pressure gauge, electrical works for single phase outlet
Sludge drain pump	Replacement of pressure gauge
Drainage Facility	Construction of Drainage Facility
Sludge drying bed	Construction of drying bed, improvement of existing drying bed
Generator for emergency	Replacement of battery
Distribution pump	Replacement of pump (Reconsider capacity)
Water analysis device	Supply of portable digital turbidity /color meter
Drainage pump	Supply of mobile drainage pump
Filter sand	Supply of filter sand
National flag	Installation of the Philippine flag plate

3-6-2-1 Aeration Tower

There is no problem of the aeration process concerning the dissolved oxygen after aeration and the concentrations of oxygen in the tower. The entrance door shall be replaced since it is closed tightly by corrosion between doors.

Entrance door: Replacement of aluminium door 1unit

3-6-2-2 Flocculator

The existing flocculator is vertical baffle type with the hydraulic mixing system, which uses the energy of flow itself. Currently the mean flow velocity of each basin, from the 1st basin to 3rd basin, is 0.10m/s, 0.05m/s, and 0.03m/s respectively. The flow is slower than the design criteria of 0.15–0.30m/s, which means the mixing is less intensive. Thus the mean flow velocity shall be increased by adjusting the height of the baffle walls to narrow the flow openings of the underflow and overflow parts.

The dimension of the flow openings of the existing flocculator and modified one, and mean flow velocity of each flow, G-value and GT value are shown below.

Table 3-39 Modification of the baffle flow and flow velocity

		Flow opening Dimension	Underflow Flow velocity	Overflow Flow velocity	Vertical-flow Flow velocity	G-value	GT-value
		m×m	m/s	m/s	m/s		
Existing	1st basin	1.0×0.25	0.10	0.10	0.10	14.9	37,977
	2nd basin	1.0×0.50	0.05	0.05	0.05		
	3rd basin	1.0×0.75	0.03	0.03	0.03		
Modified	1st basin	1.0×0.12	0.20	0.20	0.10	34.7	76,888
	2nd basin	1.0×0.15	0.16	0.16	0.05		
	3rd basin	1.0×0.20	0.12	0.12	0.03		
Design Criteria			0.15～0.30			10～75	23,000～ 210,000

To narrow the underflow opening, put the lumber block with the length of the opening dimension to the bottom and slide down the flush-boards, adding new flush-boards made of lumber plate to the top. To narrow the overflow opening, put new flush-boards adjusting the opening dimension.

＜1st basin＞

Flow opening area: 0.12m^2

Lumber block: □4cm×5cm × L12cm 40 units

Lumber plate: W12cm×L98cm×T4cm 47 units

＜2nd basin＞

Flow opening area: 0.15m^2

Lumber block: □4cm×5cm × L15cm 18 units

Lumber plate: W35cm×L98cm×T4cm 23 units

＜3rd basin＞

Flow opening area: 0.20m^2

Lumber block: □4cm×5cm × L20cm 12 units

Lumber plate: W55cm×L98cm×T4cm 15 units

3-6-2-3 Sedimentation Basin

The existing sedimentation basin is horizontal flow sedimentation basin. The settling efficiency is insufficient to remove small flocs that are carried over to the filter basin.

The surface loading of the existing facility is 22.5mm/min which meets the design criteria of 15–30 mm/min, and the Flow velocity is 86mm/min which satisfies the criteria of less than 400mm/min. However, the retention time is 2.5 hrs which is shorter than the criteria of 3–5 hrs that affects the settling efficiency. In order to improve the settling efficiency, inclined plate settlers shall be installed to the sedimentation basin. The surface loading can be decreased from 27.0 to 6.0 mm/min after installation of the inclined plate settlers, and thus the small size of flocs will be settled in the sedimentation basin without carryover. The specification of inclined

plate settlers is as follows.

Inclined Plates: PVC plate, SUS rack Rack dimension: W700×L2000×H1800 (18R×7C×2mL) 6units W800×L2000×H1800 (18R×8C×2mL) 12units

The structure of the overflow trough does not affect the carryover of floc; the weir load is 350m^3/d/m, under the design criteria of 500m^3/d/m.

The sludge drain pipes shall be repainted with water proof paint after scraping off the surface paint.

Pipe Paint: Φ100 pipe paint scraping / waterproof painting 1unit

3-6-2-4 Rapid Sand Filter

The condition of filter sand is fine and the filtration rate is 111m/d satisfying the design criteria of 120 – 150m/d. However, concerning the inlet structure, due to the distance from the inlet trough to the water surface of the filter basin, the small flocs are broken where the inlet water falls into the basin. Therefore, the inlet structure shall be improved by installing the inlet pipe and weir plate to reduce the inlet flow velocity.

Inlet pipe: Φ150 Steel pipe w/flange, salinity-resist coating 2.3m 2units Weir plate : W30cm×L100cm×T3cm, lumber plate 2units Weir holding plate: W50cm×L125cm×T3cm×2, lumber plate 2units

Surface wash pipe shall be replaced with the corrosion resistant material.

Surface wash pipe : Φ50 branch pipe/Φ25 PVC 1unit

3-6-2-5 Distribution Facility

Existing distribution facility has two distribution pumps for corresponding to the peak time. However, current water demand does not meet the planned supply water amount and demand is especially low in the night. Therefore, pumps shall be changed to the flexible one to the water demand. Electricity can be saved by operating two pumps only at the peak time and by using only one pump at the time of low demand.

Pump : Vertical pump 1.2m^3/min x 50m x 18.5kw Φ80 (including lifting pipe Φ100) 2unit

3-6-2-6 Drainage Facility

Broken pressure gauge of recycle pump and sludge drain pump shall be replaced. Single phase outlet shall be provided from the existing control panel for the future breakdown of pumps.
The existing drainage to outside is blocked and it is drained to the private land. Therefore, open drainage (partially closed) shall be installed to the nearest existing drainage in order to manage drainage.

Pressure gauge for recycle pump 0.4MPa 1 unit
Pressure gauge for Sludge drain pump 0.4MPa 1 unit
Control panel: Single phase outlet
Drainage: Open drainage W 500 x D 400 …200m

3-6-2-7 Sludge Drying Bed

In the effluent standard at the time of basic design (enforcement in 1900), there was no necessity of effluent treatment because the amount of effluent was little. However, the clean water act was approved in 2004, it is required to keep the effluent standard even if the small amount of water. Therefore, enlargement is necessary because current capacity is less than the required capacity of current water quality.

As the result of recalculation based on the current water quality, required area of drying bed is 136.5m^2 in the case of effective depth of 1.15m. The operation takes 6 days, which is 5 days for the condensation to drying and 1 day for the drainage of sludge cake and inflow of sludge. Designed capacity to treat all sludge is 147m^2, and this space is insufficient. Therefore, existing drying bed 32m^2 will be utilized and required 115m^2 of drying bed shall be constructed.

Drying bed structure: RC effective area 115m^2 (H 2.55m), bed sand
Sludge pipe: Φ150 SP 30m, Φ80SP 45m, Φ80 Ball valve 10pc, Φ50SP 55m
Drainage trough: RC tough 40m

The existing sludge drying bed hight is insufficient. The wall will be modified 0.5m higher and sands and gravels shall be filled as with the construction of new sludge drying bed.

Dimension of bed: 4000 x 200 x 1150 x 4 Effective depth: 1150mm(500mm added)
Filling material: Sand Gravel 1 unit

The calculation of the sludge volume and required capacity of the sludge drying bed is summarized below.

Table 3-40 Calculation of Sludge Volume and Drying Bed Capacity

Water Quality			Remarks
Water Quantity Q	m^3/d	2,434	
Color	CU	39.5	
PAC	mg/l	60	
Turbidity	NTU	0.3	
Fe	mg/l	0	
Sludge Mass & Volume			
SS from Color	kg/d	107.7	SS generated from color removal is 1.5mg/l per 1CU.*1
SS form PAC	kg/d	22.3	SS from PAC is 0.153mg/l per 1mg/l -PAC.
SS form Turbidity	kg/d	0.7	SS from turbidity removal is 1.0mg/l per 1NTU.
SS from Fe	kg/d	0	SS from iron removal is 1.91mg/l per1mg/l-Fe.
Total Sludge Mass	kg/d	130.8	
Total Sludge/day	m^3	26.2	As sludge concentration 5kg/m^3 (0.5%)*2
Sludge Drying Bed Capacity			
Required Capacity (for 6days)	m^2	136.5	As sludge concentration 5kg/m^3 (0.5%); H=1.15m
Design Capacity	m^2	147	Existing bed 32m^2 (H=+0.5m), New bed 115m^2

*1: Color will be removed to 10 CU.

*2: from experiment

3-6-2-8 Electricity

Battery shall be replaced since it has been unused for a long period of time.

Battery : Battery	1unit

3-6-2-9 Procurement of Other Equipment

The following equipment shall be procured under the Programme:

- ✓ Digital Turbidity/Color Meter: While the main parameter is color in this WTP, the water analysis device currently used is for multipurpose and requires complicate operation. Therefore a potable digital meter shall be provided to simplify the operation and to suite to the water quality management
- ✓ Drainage Pump: Since the initially supplied drainage pump is broken, a new mobile pump shall be procured.
- ✓ Filter Sand: During the backwash process, the filter sand is washed away. Even the sand is returned to the filter, the amount has been reduced. The filter sand for filling two filter basins shall be provided as a stock.
- ✓ National Flag Plate: The Japanese flag plate was blown off by the typhoon and was removed. Thus a new plate shall be installed.

Turbidity/color meter : Portable digital type	1unit
Drainage pump: 0.11m^3/min×10m×1kW, 1ph, mobile	1unit
Filter sand: Silica sand 0.6–0.75mm	7.5m^3

National flag plate:	Japanese flag plate1unit

3-6-2-10 List of the Specifications of the Rehabilitation Work

The specifications of the rehabilitation work are summarized as follows.

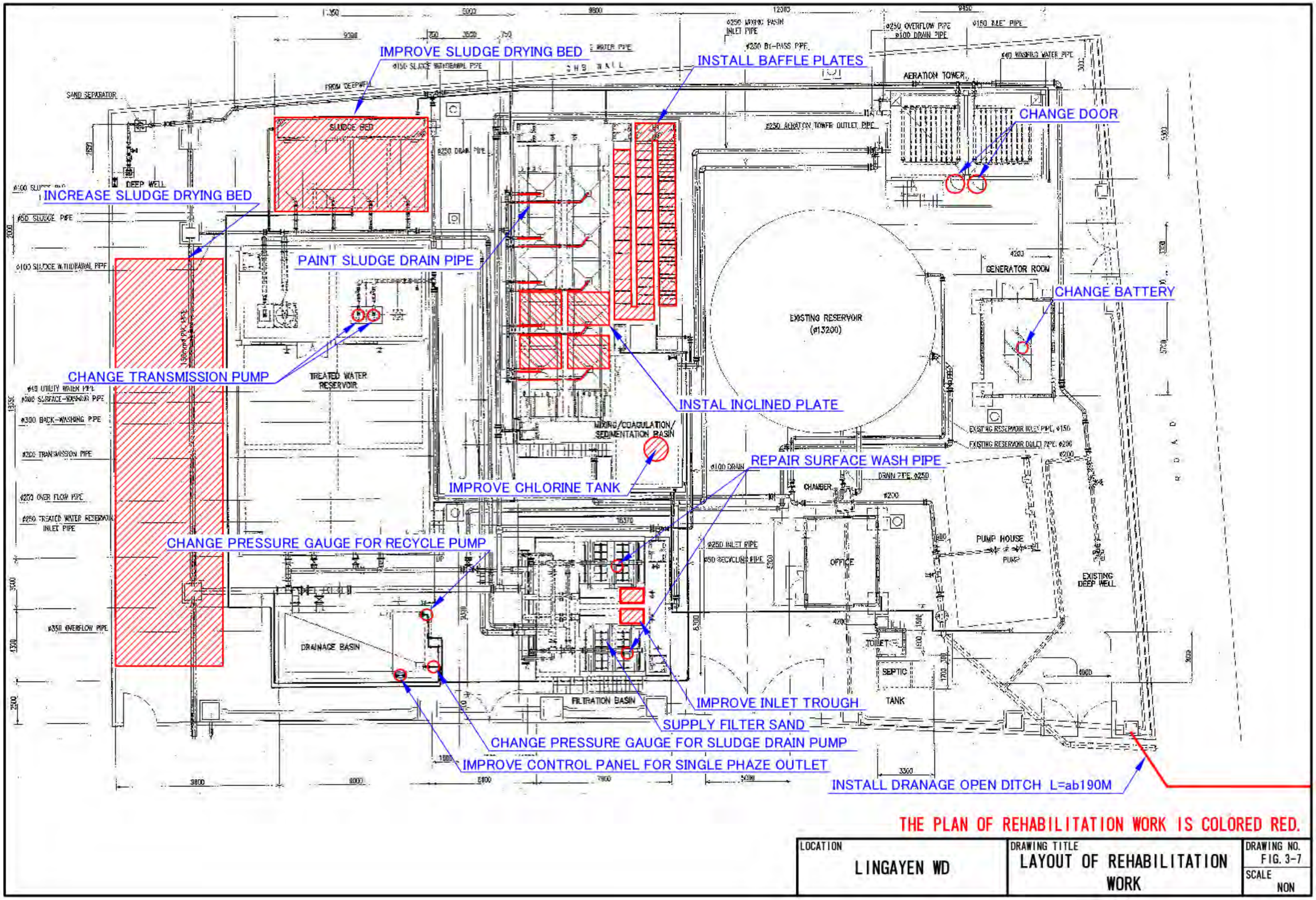
Table 3-41 Specifications of the Rehabilitation Work

Facility	Component	Item	Type*	Specifications	Unit	Q'ty
Aeration Tower	Aeration Tank	Replacement	R	Aluminum Door	unit	2
Flocculator	Baffle Plates submerged	Lumber installation	R	Lumber block □4cm×5cm L12cm/15cm/20cm water-resist	m	15
	Baffle Plates overflow	Flashboard installation	R	Lumber plate W12-35cm×L98cm×T4cm water-resist	pc.	99
Sedimentation Basin	Sedimentation Basin	Inclined plates	N	PVC inclined plates, stainless rack W700/800×L2000×H1800	unit	1
		Sludge drain pipe	R	Waterproof painting	unit	1
Rapid Sand Filter	Inlet trough	Inlet pipe	R	Φ150 SP w/flange salinity-resist coating, Weir	unit	2
	Surface wash	Surface wash pipe	R	Φ50 branch pipe Φ25 nozzle	unit	1
Distribution Facility	Distribution Pump	Distribution pump	C	1.2m3/min×50m×18.5kW Φ80	pc.	2
Drainage Facility	Recycle Pump Sludge drain pump	Recycle pump	C	Pressure gauge	pc	1
		Sludge drain pump	C	Pressure gauge	pc.	1
	Electricity	Control panel	R	Single phase outlet from control panel	pc.	1
	Drainage	Drainage	N	Drainage W 500 H400		
Sludge Drying Bed	Existing Drying Bed	Gravel Sand	R	Sand/Gravel		
	Drying Bed	Drying bed	N	Sludge drying bed (A=115m2)	unit	1
Generator	Generator	Battery	C	Battery	pc	1
Others	Water Analysis Device	Turbidity/color	N	Portable digital turbidity/color meter	unit	1
	Drainage Pump	Drainage pump	C	0.11m3/min×10m×1kW, 1phase, mobile pump	unit	1
	Filter Sand	Filter sand	N	Silica sand: 0.6–0.75mm	m3	7.5
	National Flag	Flag plates	R	Japanese flag plate	unit	1

(*) C: Change, N: New, R: Repair

3-6-3 Outline Design Drawings

The design drawings for the rehabilitation are attached below.


IMPROVE SLUDGE DRYING BED
INSTALL BAFFLE PLATES
CHANGE DOOR
INCREASE SLUDGE DRYING BED
PAINT SLUDGE DRAIN PIPE
CHANGE BATTERY
CHANGE TRANSMISSION PUMP
INSTAL INCLINED PLATE
REPAIR SURFACE WASH PIPE
IMPROVE CHLORINE TANK
CHANGE PRESSURE GAUGE FOR RECYCLE PUMP
IMPROVE INLET TROUGH
SUPPLY FILTER SAND
CHANGE PRESSURE GAUGE FOR SLUDGE DRAIN PUMP
IMPROVE CONTROL PANEL FOR SINGLE PHAZE OUTLET
INSTALL DRANAGE OPEN DITCH L=ab190M
SAND SEPARATOR
SLUDGE BED
DEEP WELL
AERATION TOWER
GENERATOR ROOM
EXISTING RESERVOIR (#13200)
TREATED WATER RESERVOIR
MIXING/COAGULATION/ SEDIMENTATION BASIN
CHAMBER
PUMP HOUSE
OFFICE
EXISTING DEEP WELL
TOILET
SEPTIC TANK
DRAINAGE BASIN
FILTRATION BASIN
THE PLAN OF REHABILITATION WORK IS COLORED RED.
LOCATION
LINGAYEN WD
DRAWING TITLE
LAYOUT OF REHABILITATION WORK
DRAWING NO.
FIG. 3-7
SCALE
NON

3-6-4 Priority of the Rehabilitation Works

As the budget for this Follow-up Programme is limited, probably not all the rehabilitation work can be covered by this Programme. It depends on the total cost for the rehabilitation. Therefore, all the rehabilitation work has been prioritized as listed below. The order of importance is as follows.

A: Item that is inevitable for proper treatment process

B: Item that is necessary for simple or low-cost operation

C: Item that is required for aesthetic aspect

Table 3-42 Priority of Rehabilitation Work

Facility	Component	Item	Order	Remarks
Aeration Tower	Entrance Door	Entrance Door	B	There is no problem with DO. It is necessary to replace due to rust.
Flocculator	Vertical Baffle Plate	Vertical baffle plate	A	Rehabilitation is essential for effective floc formation.
Sedimentation Basin	Sedimentation basin	Inclined plate	B	Installation is necessary for effective floc settling. Without this, Filtration efficiency should be improved by more frequent backwashing.
	Sludge Drain Pipe	Sludge drain pipe	A	It is necessary to repair for sustainability though the corrosion is currently not serious.
Rapid Sand Filter	Inlet Trough	Inlet pipe	A	Modification is important to prevent floc from breakage.
	Surface wash facility	Surface wash pipe	B	It is necessary to repair due to corrosion
	Sand filter	Sand	B	Refill of filter sand is required after reduction of sand.
Chlorination Facility	Chlorination tank	Leakage	A	To prevent corrosion of adjacent equipment
Distribution Facility	Distribution Pump	Distribution pump	A	It is necessary to economize maintenance cost
Drain Facility	Recycle Pump	Pressure gauge	A	It is indispensable to measure the pump pressure.
	Sludge Drain pump	Pressure gauge	A	It is indispensable to measure the pump pressure.
	Electricity	Control panel	A	Single phase power supply is necessary for the future breakdown.
	Drainage	Drainage	A	To drain outside.
Sludge Drying Bed	Existing Drying Bed	Sand and Gravel	A	Current capacity of the bed is smaller comparing to the sludge volume. It is necessary for sludge treatment
	Drying Bed	New structure	A	
Generator	Generator	Battery	B	Battery is not functioning. Replacement is necessary.
Others	Water Analysis Device	Turbidity/color	B	Portable digital turbidity/color meter helps the WD simple water quality management. But visual check can substitute in some measure. Therefore, it is B.
	Drainage Pump	Drainage pump	B	Current pump procured by WD is working.
	Filter Sand	Filter sand	B	It is B, because filter sand is consumable good and it is better to be procured by WD.
	National Flag	Japanese flag plate	C	No effect on the treatment process. Therefore it is C.

3-6-5 Selected Rehabilitation Work for the Cooperation

3-6-5-1 Selected Rehabilitation Work for the cooperation

As of October 2011, a distribution pipe renewal project is currently on going in Lingayen WD. WTP's rehabilitation will be implemented when the pipe renewal takes place in the area of Libson and Poblacion from WTP water distribution area. Therefore, the rehabilitation work is not included in this follow-up programme.

3-6-5-2 Obligations of Recipient Country

Under this Follow-up Programme, there is no direct contribution required from the Philippine side. However, unaccounted water rate in Lingayen is high and WTPs is not in operation. Under this Follow-up programme, the WD is assumed to replace the distribution pipelines. Although the WD applied for KfW loan to conduct this project and it is approved, it will take time for the completion of the project. Therefore, efficient schedule management is necessary by reducing time of registrative processes. Quality control should be scrunitised so as not to cause water leakage.

3-6-6 Operation and Maintenance budget

Annual budget of the WTP was projected based on the water quantity from 2011 to 2015 as shown in table below. The table gives the figures of expected annual expenditure(B), annual income (C), and revenues (D) for different water supply quantity (A).

The basic premises and assumptions are as follows:

- ✓ Current UFW is 51%. This UFW is assumed to decrease every year due to the implementation of pipe renewal.
- ✓ Loan payment for the plumbing work is not counted until 2015.
- ✓ Water transmission quantity is determined by the effective water supply of 2015, "Improvement Plan for Management and Services on the Water Supply System of Binmaley Water Distirict (NJS 2010)". Effective water supply of each year is based on this value and the result of 2009 which is prorated each year.
- ✓ In annual expenditure, constant cost, deprecion, interest and other deficitnt are adopted as the past results of Lingayen WD in 2009. This value is constant regardless of water supply quantity.
- ✓ Variable expense (fuel cost, electricity cost, chemical cost, plumbing cost, rest of variable cost) is prorated based on water supply quantity of of 2009.
- ✓ The more water usage, the higher unit cost in payment structure, therefore annual income is not prorate based on water supply quantity. However annual income forecast is prorated based on daily effective water supply and result of annual income to make the calculation simpler.

Table 3-43 Projected Annual Budget in Ringayen WD

Item	Unit	2011	2012	2013	2014	2015
Water transmission quantity	m^3/d	3,898	3,958	4,009	4,055	4,095
Effective water supply (A)	m^3/d	2,254	2,458	2,662	2,867	3071
UFW rate	23%	42%	38%	34%	29%	25%
Income (C)	Peso	19,508,448	19,805,164	20,063,488	20,290,419	20,491,351
Expenditure	Peso					
Maintenance cost (fuel cost, electricity cost, chemical cost.etc)		5,824,522	5,913,110	5,990,237	6,057,990	6,117,981
personnel cost		9,441,099	9,441,099	9,441,099	9,441,099	9,441,099
constant cost (office electricity cost, conference cost etc.)		311,056	311,056	311,056	311,056	311,056
depreciation cost		475,300	475,300	475,300	475,300	475,300
Other expenditure		2,858,531	2,858,531	2,858,531	2,858,531	2,858,531
Expenditure (B)		18,910,508	18,999,097	19,076,223	19,143,976	19,203,967
Revenue (D)		597,940	806,067	987,265	1,146,443	1,287,384

If they have to repay the loan for pipe renewal, this WD's management becomes more difficult. It will require the consideration of personnel cost.

3-6-7 Concerned Issues

Currently the colored water (20–30TCU) is supplied from water sources without treatment. The water production of the current WTPs will not cover the water demand even after the rehabilitation of distribution pipe. In general it is important to comply with the Philippine water quality standard and color value shall be less than 5 TCU, Yet in this circumstance, appropriate operation of the WTPs should be determined in consideration of construction cost and operation and maintenance process.

3-7 Outline Design of Facility Rehabilitation in Pagsanjan WD

3-7-1 Design Policies

3-7-1-1 Policies on the Rehabilitation

Policies on of the rehabilitation of the WTP in Pagsanjan WD are as follows.

- ✓ Treatment process is the same as the initial design, i.e., removal of iron.
- ✓ Broken or decayed facility will be rehabilitated for sustainability.

3-7-1-2 Consistency with Long-term Plan

There is no mid- and long-term plan by technical coorperation project at October 2011.

3-7-1-3 Water Quantity

A famous hamburger shop has been invited to open in Pagsanjan and a large shopping mall is also to be constructed. Therefore the water demand is expected to increase. To cope with the high water demand, it is essential to develop new water sources. For this reason, a new deep well is currently drilled. As mentioned above, there is no long-term plan, but the water production of the WTP is not sufficient for the future water demand. Even when new water sources are developed, the water supply from the WTP is still required to meet the demand. Therefore the water quantity for the WTP rehabilitated under this programme is 1,097m^3/d as the same amount as initially designed.

3-7-1-4 Policies on the Water Quality and Water Treatment

Iron will be removed through the WTP in the same process as the existing facility. Color is not considered for the rehabilitation of the WTP because after the treatment process color is removed and below the standard.

3-7-2 Basic Plan

From the result of the field survey, the rehabilitation works are listed in the following table. The measures to improve each facility are described below.

Table 3-44 Summary of the Rehabilitation Work

Item	Works
Intake Pump	Replacement of flow meter
Sand Separator	Replacement of sand separator
Aeration tower	Change of entrance door
Rapid sand filter	Repair of surface-wash pipes
Surface-wash pump	Replacement of flow meter
Sludge drain pump	Electrical works for single phase outlet
Chlorination facility	Supply of Cl tank, installation of windbreak fence, electrical works for single phase outlet
Intermediate Cl pump	Installation of pump, installation of injection pipe and trough
Post Cl pump	Installation of pump, installation of injection pipe and trough
Water analysis kit	Supply of water analysis kit (turbidity and color)
Filter sand	Supply of filter sand
National flag	Supply of the Philippine flag plate

3-7-2-1 Sand Separator

The initially installed sand separator was broken down with holes after 2 years and it was

replaced to another one, which also got holes after 1 year of use. It is not clear whether the cause is manufactural defect or due to raising the sand from the deep well. Currently the sand separator is removed and the raw water is sent to the aeration tower directly. After the intake pump was adjusted in right position, the sand raise has been reduced but the flow meter is not functioning. It is supposed that the sand affected the break down.

It is very important to measure the water flow for proper operation of the WTP and thus it is essential to remove the sand from the pumped water for sustainable use of the flow meter. There are two common types for sand separators, strainer type and cyclone separator type. As it is more suitable for this plant capacity, the cyclone separator shall be installed.

Sand separator: Cyclone separator type 46m^3/hr

3-7-2-2 Intake Facility

The broken flow meter shall be replaced to a new one.

Flow meter: Φ100 Turbine type w/accumulation	1unit

3-7-2-3 Aeration Tower

There is no problem of the aeration process concerning the dissolved oxygen after aeration and the concentrations of oxygen in the tower. However, the entrance door is hard to open due to corrosion, thus it shall be changed to the aluminum one.

Door: Aluminum door	1unit

3-7-2-4 Rapid Sand Filter

The condition of filter sand is fine and the filtration rate is 115m/d satisfying the design criteria of 120 – 150m/d. However, the surface-wash pipes are corroded so those shall be replaced. Also the flow meter for the surface-wash pump is broken down, which shall be replaced to the new one.

Surface-wash pipe: Φ25 SP nozzle	1unit
Flow meter: Φ150 Turbine type w/accumulation	1unit

3-7-2-5 Chlorination Facility

The existing chlorination facility uses the method of following: Chlorine is added at the inlet of the rapid mixer for pre chlorination, at the sedimentation outlet trough for intermediate

chlorination, and at the filter clearance well for post chlorination.. However, both the intermediate chlorination pump and post chlorination pump are removed after a breakdown, and an injection pump installed by the the WD is temporally operating only for intermediate chlorination. As the pump is single phase, an extension cord is connected to the pump room for power supply. Therefore, a new intermediate chlorination pump and post chlorination pump shall be installed.

Also a small chlorine storage tank shall be installed instead of the large storage tank which is currently out of use due to leakage of solution. Sodium hypo-chloride solution in 20 litter polyethylene tank is provided for substitution and no tank truck comes to substitute as initially designed. The smaller tank therefore is installed to improve safety and efficiency. The injection pipe laid underground is clogged and malfunction, therefore a new braided hose and protection trough shall be installed for easier maintenance.

Intermediate Cl pump: diaphragm pump 0.12/min×1.0MPa×0.2kW	1unit
Injection pipe: Φ15PVC braided hose w/ protection trough	1unit
Post Cl pump: diaphragm pump 0.12l/min×1.0MPa×0.2kW	1unit
Injection pipe: Φ15PVC braided hose w/ protection trough	1unit
Cl storage tank: 200L PE tank	1unit
Windbreak fence: pump security fence	1unit
Control panel: Single phase outlet	1uni

The chlorination pump is installed outside thus windbreak fence shall be installed surrounding the pump for protection from wind and rain which cause corrosion.

Additionally, single phase outlet shall be provided from the control panel of the chlorination equipment so that single phase injection pump can be used in case of a break-down.

3-7-2-6 Drainage Facility

The drainage facility is no need to rehabilitate except the pump control panel of the drainage basin. Single phase power source shall be provided from the control panel so that a single phase pump can be used in case of a break-down.

Control panel: Single phase outlet	1unit

3-7-2-7 Procurement of Other Equipment

The following equipment shall be procured under the Programme:

- ✓ Digital Turbidity/Color Meter: While the main parameter is color in this WTP, the water analysis device currently used is for multipurpose and requires complicate

operation. Therefore a potable digital meter shall be provided to simplify the operation and to suite to the water quality management.

- ✓ Filter Sand: During the backwash process, the filter sand is washed away. Even the sand is returned to the filter, the amount has been reduced. The filter sand for filling two filter basins shall be provided as a stock.
- ✓ National Flag Plate: The Philippine flag plate was blown off in a typhoon and removed. Thus a new plate shall be installed.

Turbidity/color meter : Portable digital type	1unit
Filter sand: Silica sand 0.6–0.75mm	5.7m^3
National flag plate: Philippine flag plate	1unit

3-7-2-8 List of the Specifications of the Rehabilitation Work

The specifications of the rehabilitation work are summarized as follows.

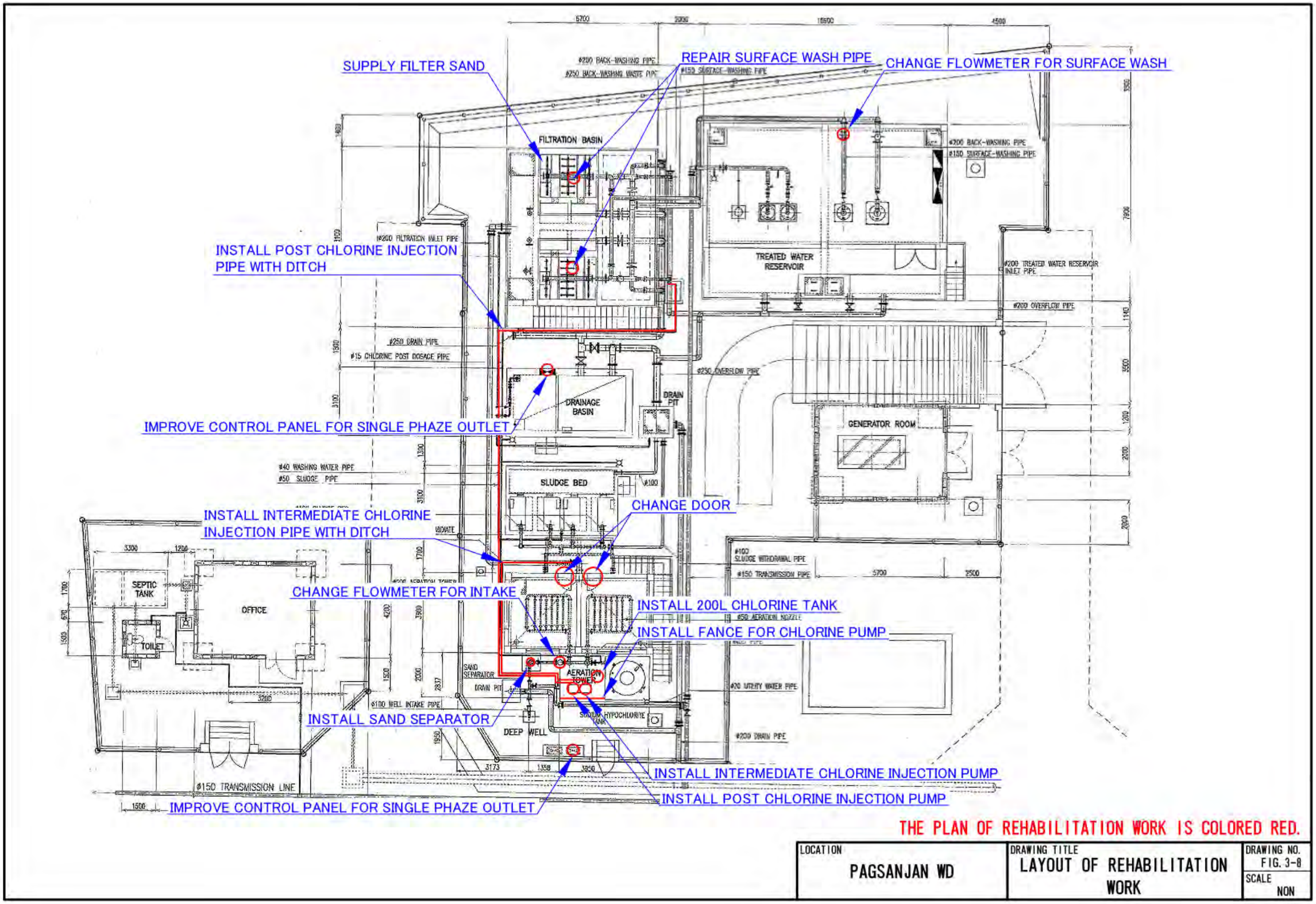
Table 3-45 Specifications of the Rehabilitation Work

Facility	Component	Item	Type*	Specifications	Unit	Q'ty
Sand Separator	Sand Separator	Sand separator	C	Centrifugal type 46m3/hr, w/fitting Φ80	pc.	1
Intake Facility	Intake Pump	Flow meter	C	Φ100 turbine-type w/accumulation	pc.	1
Aeration Tower	Aeration Tower	Entrance door	C	600×2100, aluminum door	unit	2
Rapid Sand Filter	Surface-wash Facility	Surface-wash pipe	R	surface wash nozzle Φ25	pc.	10
		Flow meter	C	Φ150 turbine-type w/accumulation	pc.	1
Chlorination Facility	Intermediate Chlorination	Injection pump	C	0.12l/min×1.0MPa×0.2kW	unit	1
		Injection pipe	C	Φ15 PVC fittings w/plastic bolt, RC trough D150×W150 w/grating cover, braided hose	unit	1
	Post Chlorination	Injection pump	C	0.12l/min×1.0MPa×0.2kW	unit	1
		Injection pipe	C	Φ15 PVC fittings w/plastic bolt, RC trough w/grating cover, braided hose	unit	1
	Chlorine Tank	Chlorine tank	N	200L PE tank	pc.	1
	Windbreak	Fence	N	galvanized corrugated sheets 3m×3m, t=0.8mm	unit	1
	Electricity	Control Panel	R	Single phase outlet from control panel	unit	1
Drain Facility	Electricity	Control Panel	R	Single phase outlet from control panel	unit	1
Others	Water Analysis Device	Turbidity/color	N	Portable digital turbidity/color meter	unit	1
	Filter Sand	Filter sand	N	Silica sand: 0.6–0.75mm	m^3	5.7
	National Flag	Flag plates	R	Japanese flag plate	unit	1

(*) C: Change, N: New, R: Repair

3-7-3 Outline Design Drawings

The design drawings for the rehabilitation are attached below.


SUPPLY FILTER SAND
REPAIR SURFACE WASH PIPE
CHANGE FLOWMETER FOR SURFACE WASH
INSTALL POST CHLORINE INJECTION PIPE WITH DITCH
IMPROVE CONTROL PANEL FOR SINGLE PHAZE OUTLET
INSTALL INTERMEDIATE CHLORINE INJECTION PIPE WITH DITCH
CHANGE DOOR
CHANGE FLOWMETER FOR INTAKE
INSTALL 200L CHLORINE TANK
INSTALL FANCE FOR CHLORINE PUMP
INSTALL SAND SEPARATOR
INSTALL INTERMEDIATE CHLORINE INJECTION PUMP
INSTALL POST CHLORINE INJECTION PUMP
IMPROVE CONTROL PANEL FOR SINGLE PHAZE OUTLET
FILTRATION BASIN
TREATED WATER RESERVOIR
DRAINAGE BASIN
DRAIN PIT
SLUDGE BED
GENERATOR ROOM
SEPTIC TANK
OFFICE
TOILET
AERATION TOWER
SAND SEPARATOR
DEEP WELL
SODIUM HYPOCHLORITE TANK
φ200 BACK-WASHING PIPE
φ150 SURFACE-WASHING PIPE
φ250 BACK-WASHING WASTE PIPE
φ200 FILTRATION INLET PIPE
φ250 DRAIN PIPE
φ15 CHLORINE POST DOSAGE PIPE
φ200 TREATED WATER RESERVOIR INLET PIPE
φ200 OVERFLOW PIPE
φ250 OVERFLOW PIPE
φ40 WASHING WATER PIPE
φ50 SLUDGE PIPE
φ100 SLUDGE WITHDRAWAL PIPE
φ150 TRANSMISSION PIPE
φ50 AERATION NOZZLE
φ20 UTILITY WATER PIPE
φ200 DRAIN PIPE
φ100 WELL INTAKE PIPE
φ150 TRANSMISSION LINE
THE PLAN OF REHABILITATION WORK IS COLORED RED.
LOCATION
PAGSANJAN WD
DRAWING TITLE
LAYOUT OF REHABILITATION WORK
DRAWING NO.
FIG. 3-8
SCALE
NON

3-7-4 Priority of the Rehabilitation Work

As the budget for this Follow-up Programme is limited, probably not all the rehabilitation work can be covered by this Programme. It depends on the total cost for the rehabilitation. Therefore, all the rehabilitation work has been prioritized as listed below. The order of importance is as follows.

A: Item that is inevitable for proper treatment process

B: Item that is necessary for simple or low-cost operation

C: Item that is required for aesthetic aspect

Table 3-46 Priority of Rehabilitation Work

Facility	Component	Item	Order	Remarks
Sand Separator	Sand Separator	Sand separator	A	It has been removed.
Intake Facility	Intake Pump	Flow meter	A	Pump capacity is not measured due to its break-down.
Aeration Tower	Aeration Tower	Entrance door	C	For inhaling the air, however, no problem with DO
Rapid Sand Filter	Surface-wash Facility	Surface-wash pipe	B	Repair is necessary due to corrosion.
		Flow meter	B	It is necessary to measure the flow.
Chlorination Facility	Intermediate Chlorination	Injection pump	A	Those facilities are broken-down and temporary operated by only intermediate chlorination. Proper chlorination is inevitable.
		Injection pipe	A	
	Post Chlorination	Injection pump	A	
		Injection pipe	A	
	Chlorine Tank	Chlorine tank	A	A PE tank of 200L will be provided for better handling of the chlorine solution.
	Windbreak	Fence	A	The chlorination pumps need to be protected from the wind and rain
	Electricity	Control Panel	A	Single phase power supply is necessary for the future breakdown.
Drain Facility	Electricity	Control Panel	A	Single phase power supply is necessary for the future breakdown.
Others	Water Analysis Device	Turbidity/color	B	Portable digital turbidity/color meter helps the WD simple water quality management. But visual check can substitute in some measure. Therefore, it is B.
	Filter Sand	Filter sand	B	It is B, because filter sand is consumable good and it is better to be procured by WD.
	National Flag	Japanese flag plates	C	No effect on the treatment process. Therefore it is C.

3-7-5 Selected Rehabilitation Work for the Cooperation

3-7-5-1 Selected Rehabilitation Work for the cooperation

As a result of the discussion with the WD and LWUA in SW mission regarding the priority order of the rehabilitation work, A will be included in the cooperation as these are necessary for the proper water treatment. For B and C, work to be implemented was selected as following table shows, after taking the budget and overall result into consideration.

Table 3-47 Selected Rehabilitation Work for the Cooperation

Facility	Component	Item	Order	with or without	Reason for omitting
Sand Separator	Sand Separator	Sand separator	A	○	
Intake Facility	Intake Pump	Flow meter	A	○	
Aeration Tower	Aeration Tower	Entrance door	C	×	It is no included because it is not effect WTP
Rapid Sand Filter	Surface-wash Facility	Surface-wash pipe	B	○	
		Flow meter	B	○	
Chlorination Facility	Intermediate Chlorination	Injection pump	A	○	
		Injection pipe	A	○	
	Post Chlorination	Injection pump	A	○	
		Injection pipe	A	○	
	Chlorine Tank	Chlorine tank	A	○	
	Windbreak	Fence	A	○	
	Electricity	Control Panel	A	○	
Drain Facility	Electricity	Control Panel	A	○	
Others	Water Analysis Device	Turbidity/color	B	×	Visual check can substitute in some measure.
	Filter Sand	Filter sand	B	×	Filter sand is consumable good and it is better to be procured by WD.
	National Flag	Philippine/Japanese flag plates	C	×	No effect on the treatment process.

3-7-5-2 Obligations of Recipient Country

Under this Follow-up Programme, there is no direct contribution required from the Philippine side. However, as mentioned above, development of new water sources and extension of distribution pipes are necessary for the increasing water demand.

3-7-6 Operation and Maintenance budget

Annual budget of the WTP was projected based on the water quantity from 2011-2015 as shown in below table. The table gives the figures of expected annual expenditure(B), annual income (C), and revenues (D) for different water supply quantity (A).

The basic premises and assumptions are as follows:

- ✓ Current UFW is 23%. This situation is expected to last until 2015.
- ✓ Water transmission quantity is determined on the effective water supply of 2015, “Improvement Plan for Management and Services on The Water Supply System of Binmaley Water Distirict（NJS 2010）”. Effective water supply of each year is based on this value and result of 2009 which is prorated each year.
- ✓ In annual expenditure, constant cost, depreciation cost, interest and other deficit adopted the past results of Pagsanjan WD in 2009. This value is constant regardless of the water supply quantity.
- ✓ Variable expense (fuel cost, electricity cost, chemical cost, plumbing cost, and rest of variable cost) is prorated based on the water supply quantity of 2009.

- ✓ The more water usage, the higher unit cost in payment structure, therfore annual income is not prorate based on water supply quantity. However annual income forecast is prorated based on daily effective water supply and result of annual income to make the calculation simpler.

Table 3-48 Projected Annual Budget in Pagsanjan WD

Item	Unit	2011	2012	2013	2014	2015
Water transmission quantity	m^3/d	7,749	8,497	9,244	9,992	10,740
Effective water supply (A)	m^3/d	4,649	5,098	5,547	5,995	6444
UFW rate		40%	40%	40%	40%	40%
Income (C)	Peso	34,785,023	38,141,879	41,498,736	44,855,592	48,212,448
Expenditure	Peso					
Maintenance cost (fuel cost, electricity cost, chemical cost.etc)		6,273,123	6,878,498	7,483,873	8,089,247	8,694,622
Personnel cost		13,258,607	13,258,607	13,258,607	13,258,607	13,258,607
Constant cost (office electricity cost, conference cost etc.)		4,205,868	4,205,868	4,205,868	4,205,868	4,205,868
Depreciation cost		1,919,245	1,919,245	1,919,245	1,919,245	1,919,245
Interest		1,366,368	1,366,368	1,366,368	1,366,368	1,366,368
Total expenditure (B)		27,023,211	27,628,586	28,233,961	28,839,336	29,444,710
Revenue (D)		7,761,812	10,513,293	13,264,775	16,016,256	18,767,738

This WD management is processed smoothly without any problem.

3-7-7 Concerned Issues

Although the residual chlorine is below standard at the WTP, the water users make complaint about the odor of chlorine. The chlorine concentrations increase at the end of the distribution pipe. In order to prevent the residual chlorine concentrations from rising, the water is drained at the end of the pipe periodically, which however generates the extra loss of water. The cause of the chlorine increase is unknown and thus no measure has been taken. Therefore, it is vital for the WD to find the source and take drastic measures to solve this problem.

3-8 Project Cost Estimation

Based on the above mentioned plan of cooperation, the cost of the rehabilitation work is estimated and the tender is excueted. The tender is divided into two lots due to the priorities and location of the WDs. The cost estimation of each lot is indicated below. Also some equipment are procured directly by JICA Philippine office, so the cost of procurement of equipment are also indicated below.

3-8-1 Cost estimation of Lot-1

The WDs of initially planned Lot-1 are Dingle-Pototan WD, Pontevedra WD and Abuyog WD. However, Abuyog WD was not included in Lot-1 as described in 3-2-5-1.

The cost estimation of Lot-1 is shown in the table below.

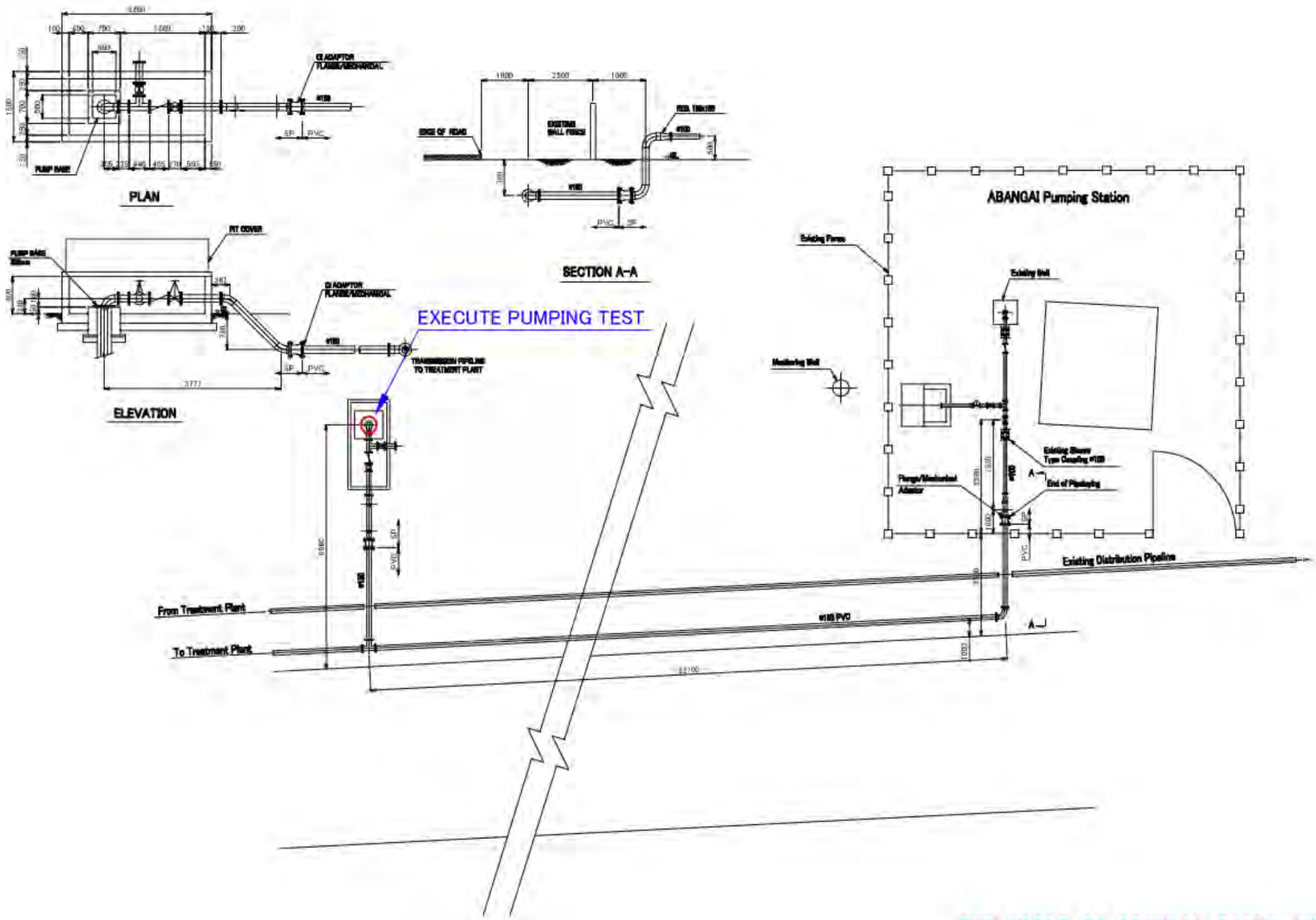
Table 3-49 Cost estimation of Lot-1

Item	Peso	Yen
Rehabilitation work of Dingle-Pototan WD	807,005.18	1,543,801
Rehabilitation work of Pontevedra WD	3,973,739.90	7,601,764
Overhead	863,267.70	1,651,431
Total	5,644,012.78	10,796,996

The rate of foreign exchange on Oct. 2010: Peso1 = ¥1.913

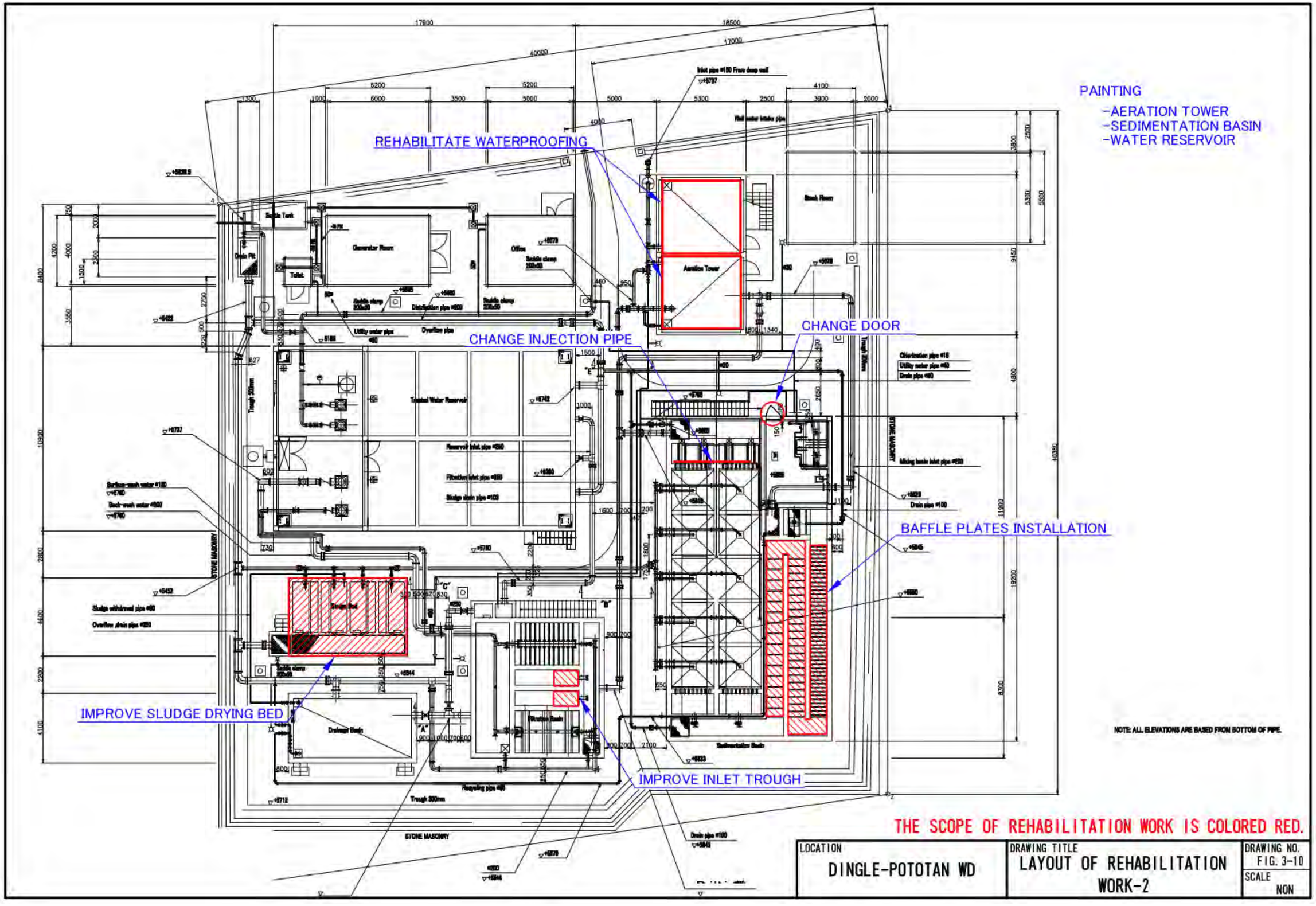
Regarding the direct construction cost of the rehabilitation work for Abuyog WD, it was estimated about 12,000,000 Peso (about 23 million yen) based on the table 3-5 Priority of Rehabilitation Work.

The design drawings for the rehabilitation work of each WD are attached below.



THE SCOPE OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
DINGLE-POTOTAN WD	LAYOUT OF REHABILITATION WORK-1	FIG. 3-9
		SCALE NON


PAINTING
-AERATION TOWER
-SEDIMENTATION BASIN
-WATER RESERVOIR
REHABILITATE WATERPROOFING
CHANGE INJECTION PIPE
CHANGE DOOR
BAFFLE PLATES INSTALLATION
IMPROVE SLUDGE DRYING BED
IMPROVE INLET TROUGH
Aeration Tower
Generator Room
Office
Toilet
Treated Water Reservoir
Drainage Bed
Drainage Basin
Vibration Basin
Sedimentation Basin
Trough 300mm
STONE MASONRY
NOTE: ALL ELEVATIONS ARE BASED FROM BOTTOM OF PIPE.
THE SCOPE OF REHABILITATION WORK IS COLORED RED.
LOCATION
DINGLE-POTOTAN WD
DRAWING TITLE
LAYOUT OF REHABILITATION WORK-2
DRAWING NO.
FIG. 3-10
SCALE
NON

TO RESERVOIR

IMPROVE SLUDGE DRYING BED

PAINTING
-AERATION TOWER
-SEDIMENTATION BASIN
-WATER RESERVOIR
-GENERATOR ROOM
-OFFICE, STOCK ROOM
-TOILET

CHANGE INJECTION PIPE

INSTAL TRANSMISSION PIPE

INSTAL SLUDGE DRAIN PIPE

CHANGE INLET VALVE

INSTAL INJECTION PIPE AND BOX

CHANGE SURFACE WASH PIPE

CHANGE INJECTION PUMP

CHANGE INJECTION PUMP

BAFFLE PLATES INSTALLATION

CHANGE METER

CHANGE DOOR

OPENING MAINTENANCE HOLE

CHANGE AGITATOR SUPPORT

IMPROVE INLET TROUGH

THE SCOPE OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
PONTEVEDRA WD	LAYOUT OF REHABILITATION WORK	FIG. 3-11
		SCALE NON

3-8-2 Cost estimation of Lot-2

The WDs of initially planned Lot-2 are Binmale WD, Pagsanjan WD and Lingayen WD. However, Lingayen WD was not included in Lot-1 as described in 3-6-5-2. Also the distribution pump of Dingle-Pototan WD and the back wash pump and transmission pump of Pontevedra WD were included in Lot-2 because it takes times to procure these items.

The cost estimation of Lot-2 is shown in the table below.

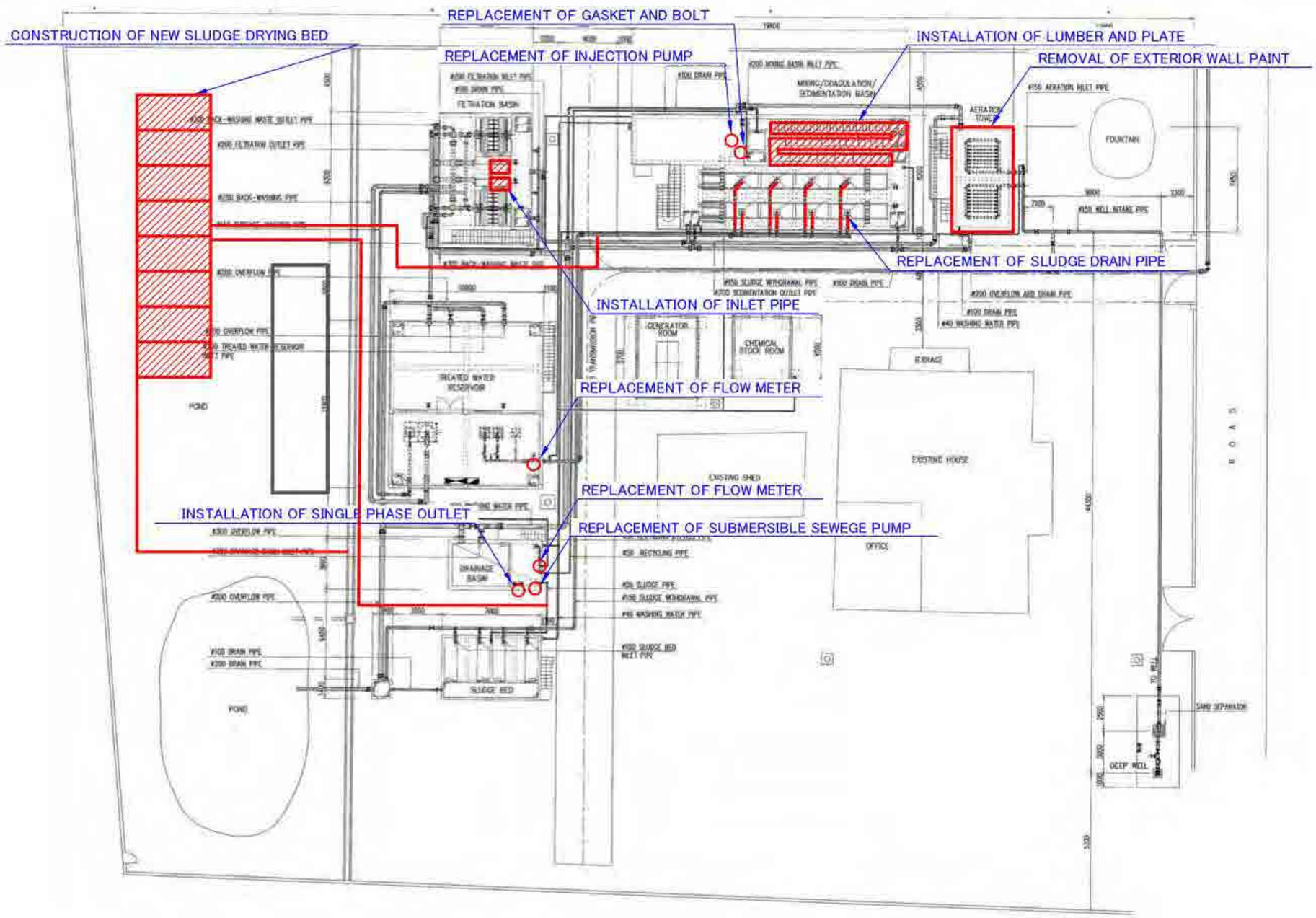
Table 3-50 Cost estimation of Lot-2

Item	Peso	Yen
Rehabilitation work of Caloocan WTP in Binmaley WD	3,774,067.43	7,121,665
Rehabilitation work of Fabia WTP in Binmaley WD	3,718,271.81	7,016,379
Rehabilitation work of Pagsanjan WD	1,036,826.24	1,956,491
Rehabilitation work of Dingle-Ptotan WD	1,176,462.92	2,219,986
Rehabilitation work of Pontevedra WD	5,247,607.50	9,902,235
Overhead	1,648,601.98	3,110,912
Total	16,601,837.88	31,327,668

The rate of foreign exchange on Jan. 2011: Peso1 = ¥1.887

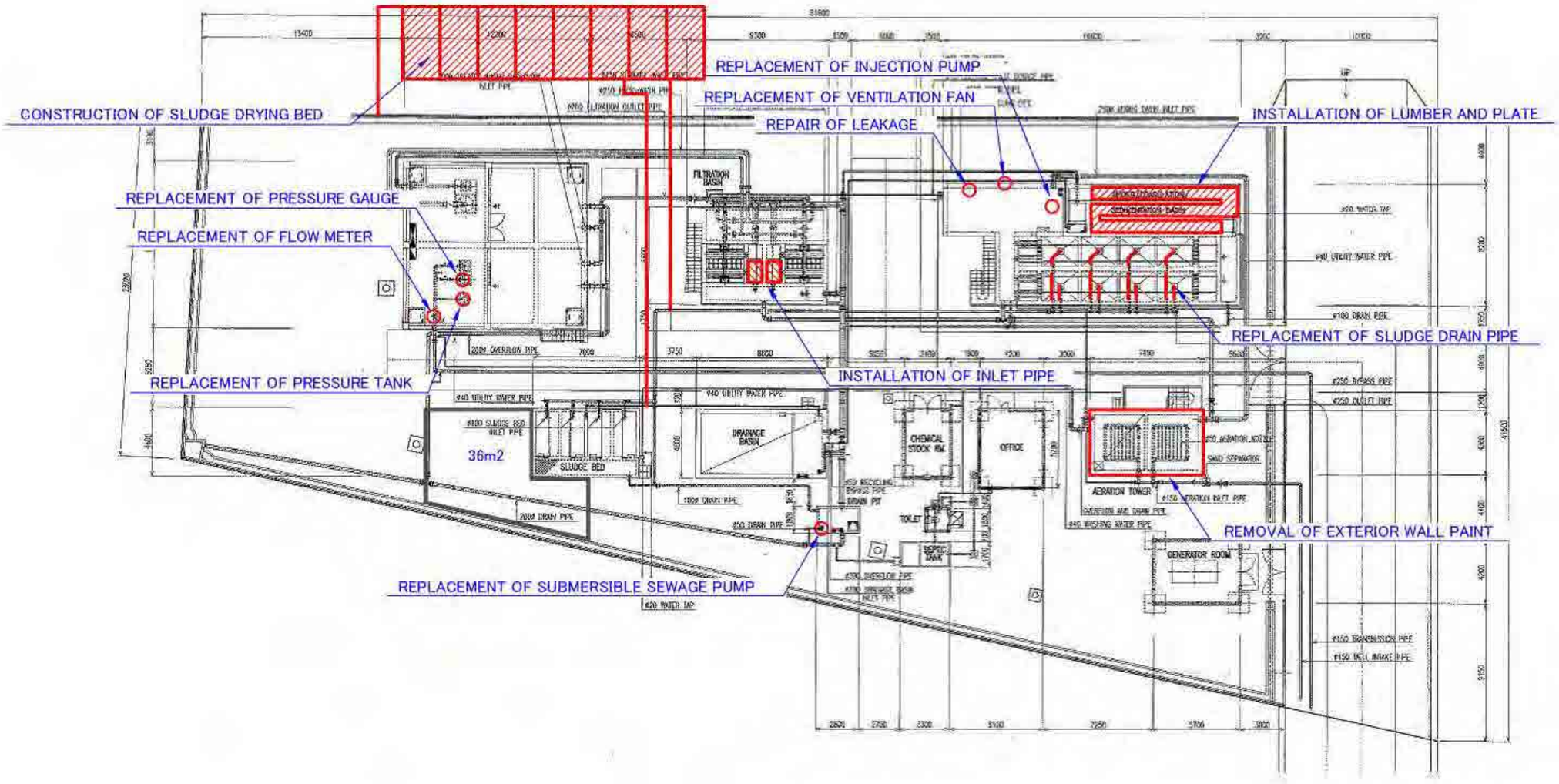
Regarding the direct construction cost of the rehabilitation work for Lingayen WD, it was estimated about 10,000,000 Peso (about 19 million yen) based on the table 3-42 Priority of Rehabilitation Work.

The design drawings for the rehabilitation work of each WD are attached below.



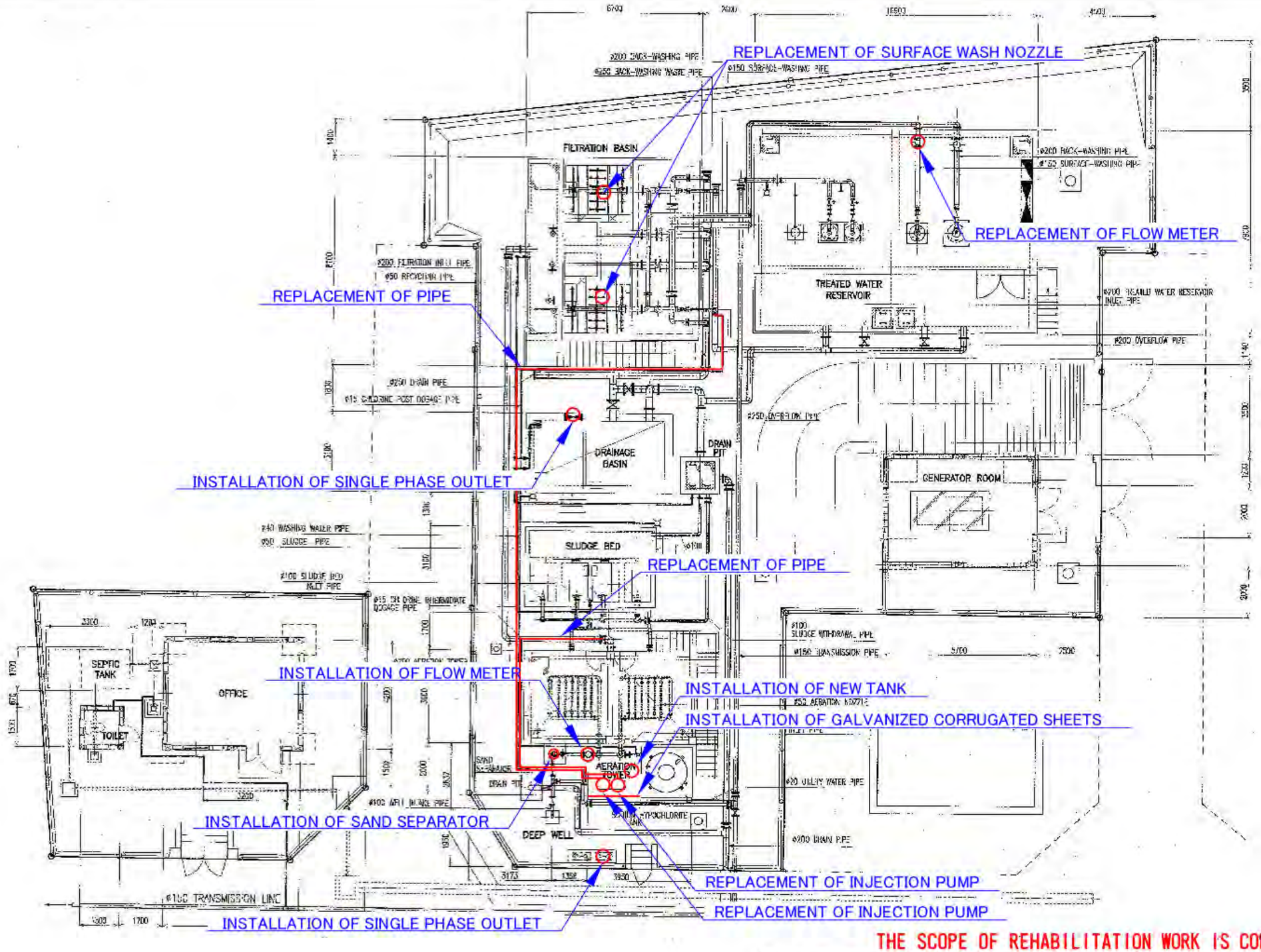
THE SCOPE OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
BINMALEY WD	LAYOUT OF REHABILITATION WORK AT CALOOCAN WTp	FIG. 3-12
		SCALE NON



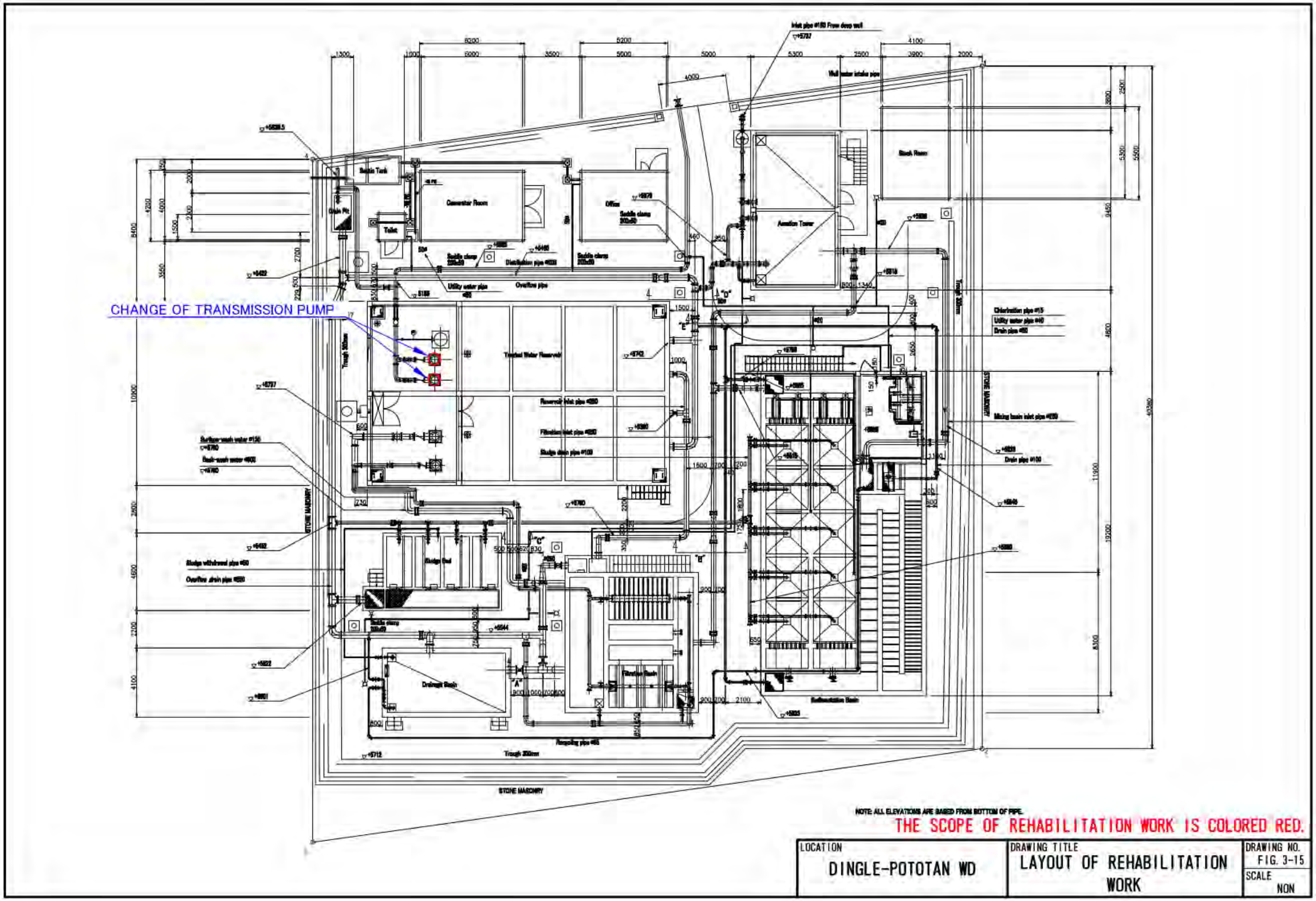
THE SCOPE OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
BINMALEY WD	LAYOUT OF REHABILITATION WORK AT FABIA WTP	FIG. 3-13
		SCALE NON



THE SCOPE OF REHABILITATION WORK IS COLORED RED.

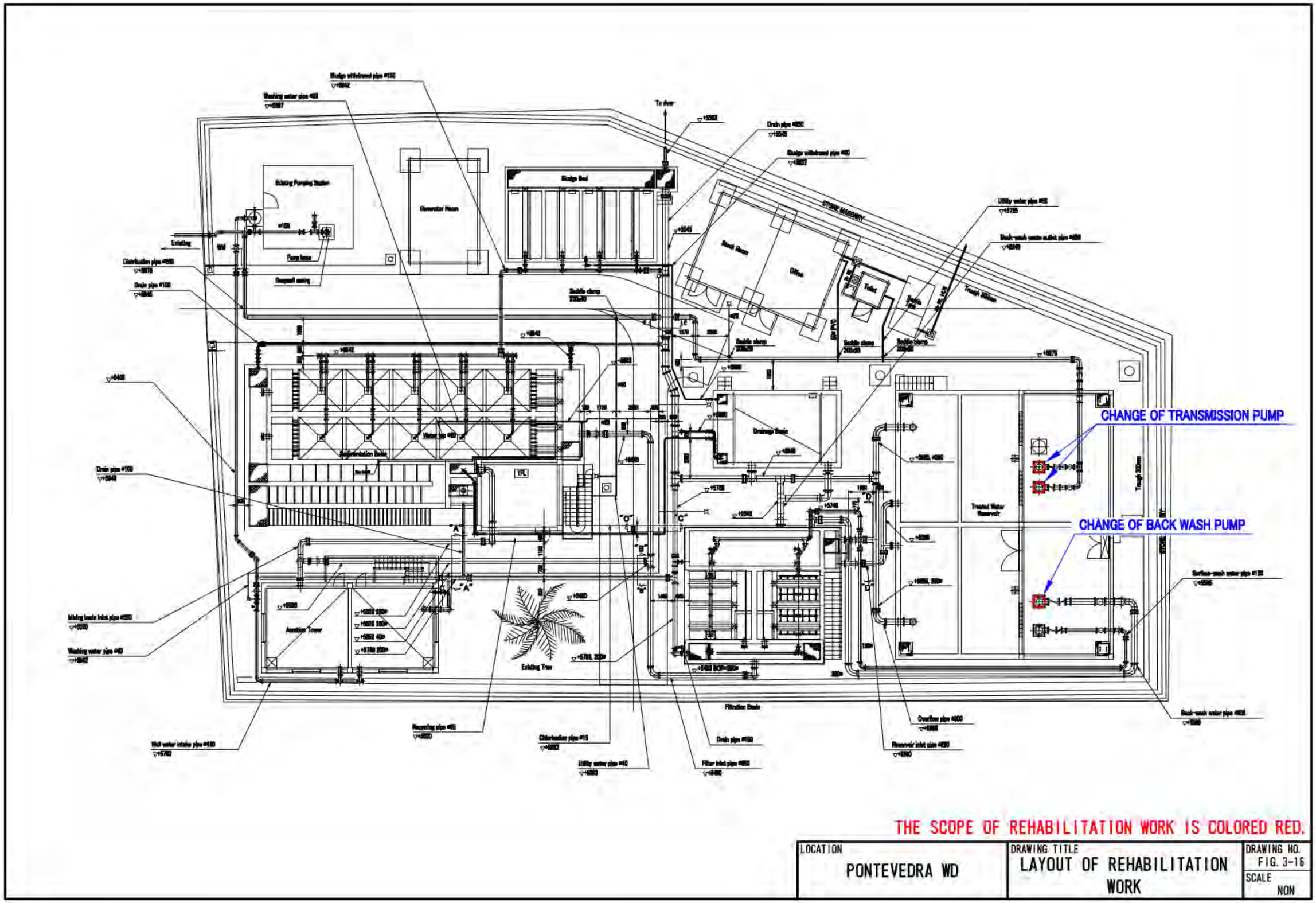
LOCATION	DRAWING TITLE	DRAWING NO.
PAGSANJAN WD	LAYOUT OF REHABILITATION WORK	FIG. 3-14
		SCALE NON



NOTE: ALL ELEVATIONS ARE BASED FROM BOTTOM OF PIPE.

THE SCOPE OF REHABILITATION WORK IS COLORED RED.

LOCATION	DRAWING TITLE	DRAWING NO.
DINGLE-POTOTAN WD	LAYOUT OF REHABILITATION WORK	FIG. 3-15
		SCALE NON


CHANGE OF TRANSMISSION PUMP
CHANGE OF BACK WASH PUMP
THE SCOPE OF REHABILITATION WORK IS COLORED RED.
LOCATION
PONTEVEDRA WD
DRAWING TITLE
LAYOUT OF REHABILITATION WORK
DRAWING NO.
FIG. 3-16
SCALE
NON

3-8-3 Cost estimation of procurement by JICA Philippine office

The deep well pump for Dingle-Ptotan WD was decided to be installed after finalization of the specification of the pump as the result of pumping test. Thus, only the pumping test was included in the Lot-1, and based on the result of the test, the JICA Philippine office procured the pump.

The following pump was selected by the result of the step-drawdown test, continuous pumpingtest and recovery test. Appropriate pumping rate was decided at 15 L/s.

Specification: Submersible deep well pump $0.9m^3$/min×55m×15kW 1unit

The cost estimation of installation of the submersible pump in deep well is shown in the table below.

Table 3-51 Cost estimation of procurement by JICA Philippine office

Item	Peso	Yen
Installation work of submersible deep well pump for Dingle-Pototan WD	689,000	1,289,808

The rate of foreign exchange on Mar. 2011: Peso1 = ¥1.872

CHAPTER 4

SUPERVISION AND PROJECT EFFECT

CHAPTER 4 SUPERVISION AND PROJECT EFFECT

4-1 Actual Performance of the Construction

4-1-1 Bidding and Contract stage

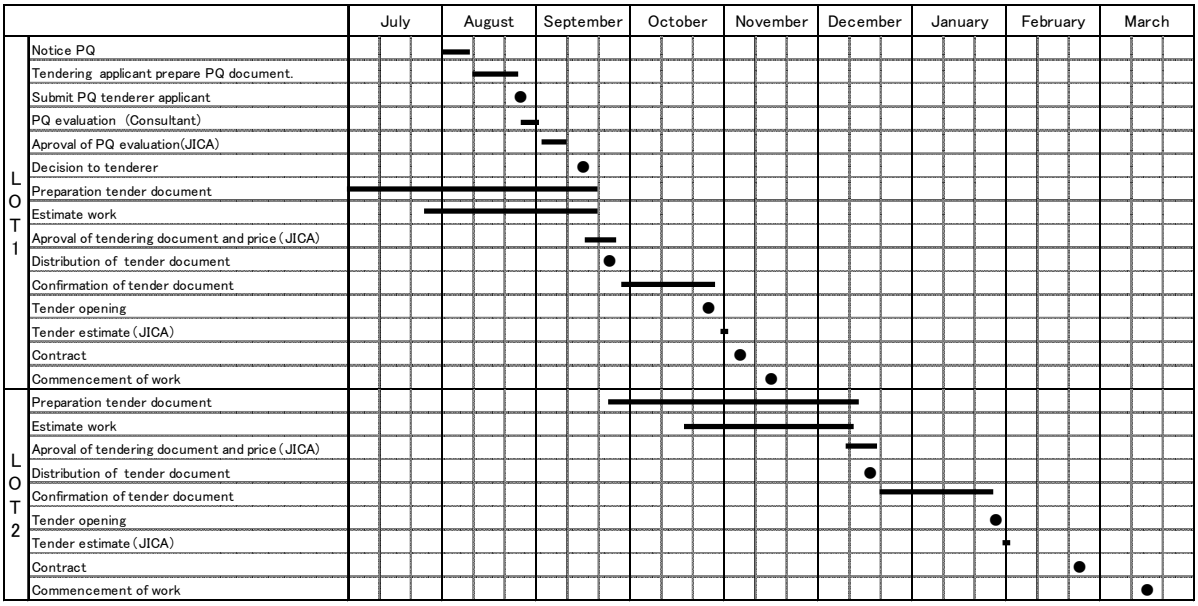
The general competitive bidding was selected as a standard procurement rule of JICA and Philippines for the bidding of Lot-1. Public notice of Prequalification was post on the website of JICA Philippine office. PQ screening standard is as follows:

- ✓ Company size (Rank B or higher in the Philippine standard)
- ✓ Financial situation (No deficit for the recent five years)
- ✓ Record of WPT constructions

Four companies submitted PQ documents and three companies became bidders through the screening.

PQ screening was not implemented for Lot-2. The bidding for Lot-2 was implemented as the designated competitive bidding. The participants in the bidding were those from Lot-1 bidding. Construction schedule from the PQ public notice to the commencement of the work is shown in the table below. The durations for preparation of the PQ documents and for confirmation of tender documents were set up referring to the Philippine standard. It took more than 3 months from the PQ public notification to the contract.

Table 4-1 Lot-1,2 Construction Schedule of the bidding and contract



4-1-2 Supervision of Rehabilitation Works

4-1-2-1 Supervision(S/V)

The supervision of the rehabilitation works was carried out from the signing of the Contract between JICA and the Contractor until the completion of the rehabilitation works. The progress, quality and safety aspect of the work was supervised and managed to assure that the works complied with the Specifications and Drawings of the Contract, the Law and Standards of the Philippines.

(1) Outline of the Construction

The Contract period of Lot-1was from 15 November 2010 to 2 March 2011, and Lot-2 was from 23 March 2011 to 23 July 2011. The Outline of the Contract is shown as below.

Table 4-2 Lot.1 Contract

Project Name	*F/U Programme on the Project for Improvement of Water Quality in the Republic of the Philippines* (Lot-1)		
Counterpart Agency	Local Water Utilities Administration (LWUA)		
Construction Site	Dingle-Pototan (ILOILO), Pontevedra (CAPIZ)		
Name of Engineer	Mr. Takao WATANABE		
Date of P/Q Publication	26 July 2010	Date of Tender	26 October 2010
Name of Contactor	Allado Construction Co., Ltd.		
Date of Contract	8 November 2010	Date of Verification	8 November 2010
Date of Commencement	15 November 2010	Date of Completion	2 March 2011

Table 4-3 Lot.2 Contract

Project Name	*F/U Programme on the Project for Improvement of Water Quality in the Republic of the Philippines* (Lot-2)		
Counterpart Agency	Local Water Utilities Administration (LWUA)		
Construction Site	Binmaley (PANGASINAN), Pagsanjan(LAGUNA), Dingle-Pototan (ILOILO), Pontevedra (CAPIZ)		
Name of Engineer	Mr. Takao WATANABE		
Date of P/Q Publication	21 October 2010	Date of Tender	31 January 2011
Name of Contactor	Allado Construction Co., Ltd.		
Date of Contract	21 February 2011	Date of Verification	21 February 2011
Date of Commencement	23 March 2011	Date of Completion	20 July 2011

The Contents of the rehabilitation works under the Contract is summarized in the following table.

Table 4-4 Summary of the Rehabilitation Works

	Facility	Item	Contents / Specifications	Quantity	
Dingle-Pototan	Intake Facility	Implement pumping test	The testing stage, serially, recuperation test	1	unit
Procurement		Submersible deep well pump	0.9m^3/min×55m× 15kW	1	pc.
	Aeration Tower	Interior exterior wall	Water proof mortar, water-resistant coating	180	m^2
	Flocculator	Remodel baffle	Add wooden baffle	1	unit
	Rapid Sand Filter	Improve inflow	Over flow weir Inlet pipe	1	unit
	Chlorination Facility	Improve injection pipe	PVCφ15, Protective ditch	1	unit
		Exchange door	Aluminum door SUS	1	unit
	Sludge Drying Bed	Repair Sludge Drain Bed	Add wall, Add Enlarge ,Sand	1	unit
	Exterior Walls	Painting	Mortar and iron painting	600	m^2
Lot-2	Transmission Facility	Install Transmission pump	Submersible pump	2	pc
Pontevedra	Aeration Tower	Install opening	□600×600	1	unit
	Flocculator	Remodel baffle plate	Add wooden baffle plate	1	unit
	Sedimentation Basin	Inlet valve	φ250SUS		
		Exchange sludge drain pipes	PVC φ75, Drain pump	1	unit
	Rapid Sand Filter	Improve inflow	Over flow weir Inlet pipe	1	unit
		Exchange surface wash pipe	SP φ150/φ50/ φ25, nozleφ25	1	unit
		Flow meter	φ150 turbine	1	pc
	Chlorination Facility	Intermediate-post chlorination	PVCφ15, protective weir	1	unit
		Exchange Door	Aluminum door SUS	1	unit
		Support of agitator	Wooden, water proof painting	1	unit
	Sludge Drying Bed	Install Bed Sand	Sand4-6/10-20/25-35/40-60mm	1	unit
	Transmission Facility	Install Transmission pipe	PVC φ200	1	unit
	Exterior Walls	Painting	Mortar and iron painting	806	m^2
Lot-2	Rapid Sand Filter	Install back wash pump	Plastics salinity tolerance	1	pc
Lot-2	Transmission Facility	Install Water Supply pump	Plastics salinity tolerance	2	pc
Pagsanjan	Intake Facility	Sand separator	46m^3/hr	1	pc
		Exchange flow meter	φ100	1	pc
	Rapid Sand Filter	Exchange surface wash pipe	Nozzle 25	1	unit
		Exchange flow meter	φ150 turbine	1	pc
	Chlorination Facility	Injection Pump	0.12l/min×1.0MPa× 0.2kW	2	pc
		Improve injection pipe	PVC φ15, protective weir	1	unit
		Cl tank	200lit PE	2	pc
		Protective barrier	Wavy ferrotype plate sheet	1	unit
		Single-phase supply	Two outlet	1	unit
	Drainage Facility	Single-phase supply	Two outlet	1	unit
Binmaley-Caloocan	Aeration Tower	Remove exterior painting	Remove current painting	195	m^2
	Flocculator	Remodel baffle	Add wooden baffle	1	unit
	Sedimentation Basin	Exchange sludge drain pipes	PVC φ100, Water proof painting	1	unit
	Rapid Sand Filter	Improve inflow	Over flow weir Inlet pipe	1	unit
	Chlorination Facility	Intermediate post chlorination pipe	PVC φ15, protective weir	1	unit
		Exchange post Chlorination Pump	0.12l/min×1.0MPa× 0.2kW	1	pc
	Drainage Facility	Exchange flow meter	φ150 turbine	1	pc
		Exchange Drainage pump	0.1l/min×10m× 0.75kW	1	pc
		Single-phase supply	two outlet	1	unit
	Sludge Drying Bed	Add Sludge Drying Bed	RC A=92m^2, H=2.4m	1	unit
	Transmission Facility	Exchange flow meter	φ150 turbine	1	pc
Binmaley-Fabia	Aeration Tower	Remove exterior painting	Remove current painting	195	m^2
	Flocculator	Remodel baffle	Add wooden baffle plate	1	unit
	Sedimentation Basin	Exchange sludge drain pipes	PVC φ100, Water proof painting	1	unit
	Rapid Sand Filter	Improve inflow	Over flow weir Inlet pipe	1	unit
	Chlorination Facility	Repair Cl tank	Repair the water leakage	1	unit
		Air fan	□37cm	1	pc
		Exchange Post Chlorination pump	0.12l/min×1.0MPa× 0.2kW	1	pc
	Drainage Facility	Exchange Drainage pump	0.1l/min×10m× 0.75kW	1	pc
	Sludge Drying Bed	Add Sludge Drying Bed	RC A=92m^2, H=2.4m	1	unit
	Transmission Facility	Flow meter	φ150 turbine	1	pc
		Pressure meter	1MPa	1	pc
		Exchange pressure Tank	130lit	1	pc

Procurement: Directly procured by the JICA Philippines office

(2) Construction Supervision Organization

The Supervision Office was based in Manila and the Engineer was basically stationed at the sites during the construction period. Also back-up system was established in Tokyo headquarter for solving problems and taking measures on important matters. The S/V Organogram is shown below.

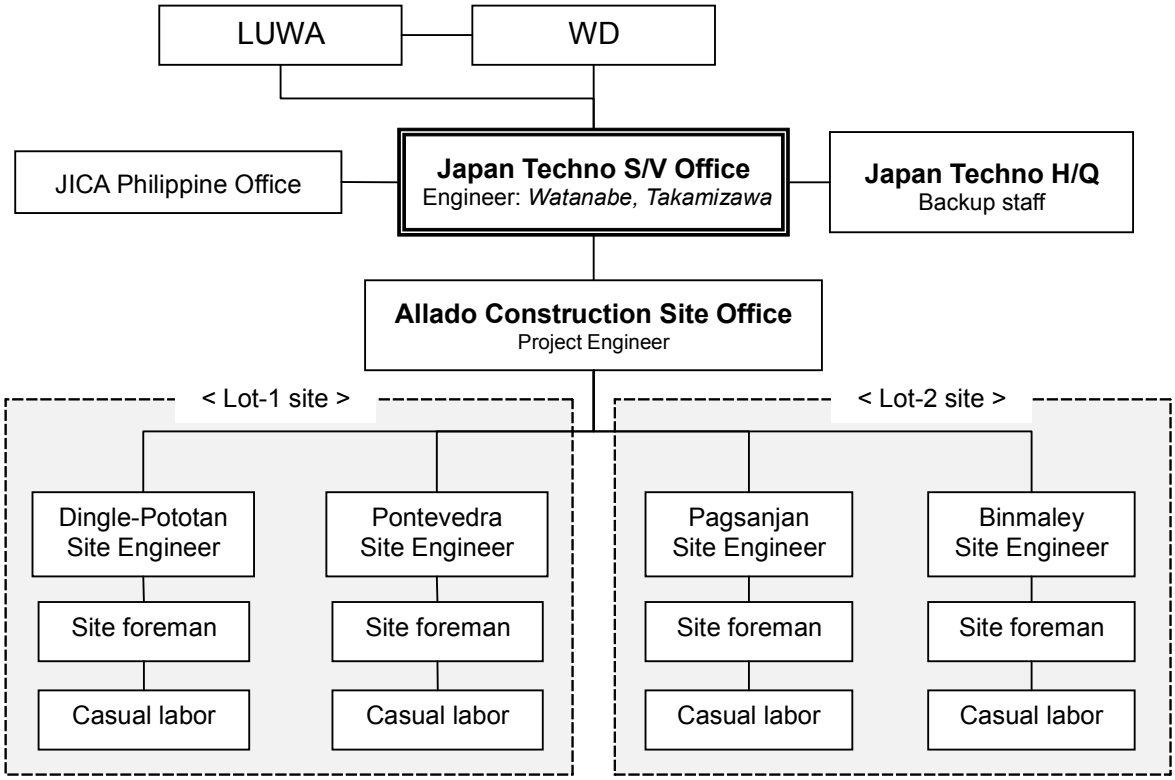


Figure 4-1 Supervision Organogram

(3) Reporting to the Client

Progress of the work was reported to the Client JICA Philippine Office periodically and the monthly reports were submitted by the Consultant. The completion inspection and handover of the facilities was arranged in consultation with the Client and parties concerned.

Regarding safety control, the Emergency response network containing the emergency response flow chart and contact details of the concerned parties was established and submitted to the JICA Philippine Office.

When a design change of the Sludge drying bed was requested by the Binmaley WD, it was reported to the JICA Philippine Office immediately and the official procedure of the design change took place with consent of the JICA headquarter (refer to 4-1-3).

4-1-2-2 Report on the Supervision Work

(1) Prior to the Commencement of the Construction

The Consultant checked the work schedule and gave advices to the Contractor for the appropriate construction method, work procedure, quality control and safety control. Also the Consultant compared the design drawings and shop drawings to confirm whether the rehabilitated facilities conform to the required quality, shape and performance.

Since other rehabilitation works were partial and not complicated, the work plan of only the Sludge drying bed was submitted by the Contractor. The commencement of works was approved by the Consultant after checking the work methods of the Sludge drying bed were appropriate and complying the requirement of the Contract.

The contractor's site organization was also examined to see if its human resources and supervision were appropriate. The setting of the temporary office, stock yard, workshop etc was also advised by the Consultant. Prior to the commencement, the emergency response flow and insurance were confirmed.

(2) During the Construction

The Consultant had supervised and instructed the Contractor as listed below:

1) Monitoring the work progress
- In order to ensure completion within the contract period, instructing the Contractor to produce a revised programme showing modifications to the original plan.
- Holding the monthly meetings and other periodical meetings for monitoring the work progress against the initial plan.
- Anticipating and responding to troubles which may cause delay in progress, taking preventive action and discussion for timely completion of the works.

2) Checking works' compliancy with the contract and the laws
- Ensuring the works to be complying with the drawings and specifications of the Contract and norms of the national standards.

3) Overseeing the documentation
- Confirming the work progress and accomplishment through the monthly reports and managing the Contractor's quality control.
- Managing the documentation such as approval, instruction, correspondence issued to the Contractor.

4) Supervising the site operation
- Visiting the site periodically and supervising the Contractor's site operation.

The following sections describe the work progress, quality and safety control during the construction period.

(3) Progress Management

Work progress in Lot-1 was behind initial schedule because the Contractor was unaccustomed, thus time for completion was extended. In Lot-2 the construction work went along smoothly and completed in the period of the Contract.

1) Lot-1: Work Progress

Regarding overall work progress, it was scheduled to complete the work in the middle of February 2011, however the completion was in the beginning of March 2011. This was because the installation of the sludge drain pipes took longer than expected until early March. Work in Dingle-Pototan was 3 weeks behind the initial schedule, and therefore the work in Pontevedra started late and completed 2 weeks behind the schedule.

A. Dingle-Pototan

In Dingle-Pototan, the work was completed 3 weeks later than initially planned. There are several reasons for the delay.

① Pumping Test

The Pumping test was scheduled in the beginning of December 2010 in the Contract, however, as the Contactor was inexperienced in the pumping test, the arrangement of the equipment and staff took time and the pumping test was conducted at the end of December 2010.

② Delay due to the rain

The weather was unfavorable with the heavy rain from the middle of December 2010 to the beginning of January 2011, which affected the concrete and paint works.

③ Request from WD

The Dingle-Pototan WD requested to the Contractor to stop some works during daytime because the WD office is located inside the WTP. Also during the Christmas season the WD requested to stop the entire works.

B. Pontevedra

The Work in Pontevedra was affected by the delay of the work in Dingle-Pototan, starting the work 2 weeks behind the schedule. Due to the additional reasons, the final completion of the work in Pontevedra was 4 weeks later than initially expected.

① Pipe laying discontinued

Laying of the transmission pipes from the WTP to reservoir was discontinued due to the claim from landowner. The GM of Pontevedra WD solved this problem but the work was stopped for a total of 10 days.

② Procurement delayed

The sludge drain pump was expected to be procured in Philippines but there was no stock in the country and it was procured from Japan. The process from order to delivery took about 1 month.

C. Allover the Lot-1

The Contractor's slow response to the arrangement resulted in delay of whole works. Early arrangement of the material procurement and appropriate allocation of the staff were instructed since the commencement of the works, however the Contractor's response was slow, which resulted in the delay of work progress.

① Work organization

The site engineer who was assigned to the site transfer as a replacement of the project manager remained in the site and the construction was carried out without actual project manager on site.

This site engineer did not have the authority for the decisions in the site, and every detail was consulted with headquarter. This caused delays of the operation. The Consultant instructed the Contractor to allocate the appropriate person as a project manager as soon as possible but an Engineer was not assigned to the site until the beginning of February 2011.

② Procurement of the pump

Procurement of the sludge drain pump affected the work progress. The contractor started the procurement process in the beginning of December 2010, however, the specification of the pump was not suitable for the Pontevedra water quality because it was not anti-salinity pump. The Consultant therefore recommended a suitable pump in the middle of December, but the procurement of this pump was not decided until the beginning of January.

2) Lot-2: Work Progress

The Lot-2 progress overall went along smoothly, and the rehabilitation works of the three WTPs were completed as scheduled. However the installation of pumps in Dingle- Pototan and Pontevedra delayed 2weeks behind the schedule due to the procurement and the customs procedure of the pumps.

A. Binmaley

Two WTPs namely Caloocan and Fabia were the target of the rehabilitation works in Binmaley. The major work was the construction of the sludge drying beds on each site. The work progress was almost on schedule in spite of the severe working conditions due to heat and typhoons. After the completion some deficiency was found and minor repair was instructed which was however finished during the contract period.

B. Pagsanjan

The rehabilitation works in Pagsanjan was rather small scale therefore all the works except the

sand separator installation were carried out in 2 weeks. The installation of the sand separator was also done in advance. There was no problem on the work progress.

C. Dingle-Pototan

In Dingle-Pototan the Lot-1 target site, the transmission pumps were installed during Lot-2. An additional work of enlarging the holes for the submersible pumps on the concrete slab was implemented. The arrangement of this work with the WD required a lot of time which resulted in work duration of 4 weeks from the initially scheduled 2 weeks. Also after the completion of the work, some comments on the control panel were made by the WD. On those comments, the Consultant responded that it was not included in the Contract therefore those will be addressed on another occasion.

D. Pontevedra

In Pontevedra the Lot-1 target site, only installation of the backwash pump and transmission pumps were carried out during Lot-2. Since those pumps were procured from Japan, determination of the specifications and pipe connections took time, and the customs procedure after import also delayed. Furthermore the installation and the test operation of the pumps needed schedule coordination with the WTP as it was under normal operation. The completion of the installation was delayed 3 weeks from the initial plan.

The Work schedule and actual accomplishment of the works for Lot-1 and Lot-2 are shown in the following pages.

Table 4-5 Lot-1 Work Progress Chart

	Construction work			Quantity	2010 November	2010 December	2011 January	2011 February	2011 March	Remark
	Preparation／removal and clearance		Unit	1						●(Completion)
1	Dingle\Pototan									●(Completion)
	Intake facility	Implement pumping test	Unit	1						●(Completion)
	Aeration Tower	Interior exterior wall water proof・painting	Unit	1						●(Completion)
	Flocculator	Remodel baffle plate	Unit	1						●(Completion)
	Rapid Sand Filter	Improve inflow	Unit	1						●(Completion)
	Cholorination Facility	Exchange door・Improve injection pipe	Unit	1						●(Completion)
	Sludge Drying Bed	Repair Sludge Drain Bed	Unit	1						●(Completion)
	Exterior Walls	Painting	Unit	1						●(Completion)
	Flow examination and test c		Unit	1						●(Completion)
2	Pontevedra									●(Completion)
	Aeration Tower	Exchange door・Install opening	Unit	1						●(Completion)
	Flocculator	Remodel baffle plate	Unit	1						●(Completion)
	Sedimentation asin	Exchange sludge drain pipes・Inlet valve	Unit	1						●(Completion)
	Rapid Sand Filter	Improve inflow ・Exchange sur	Unit	1						●(Completion)
	Cholorination Facility	Intermediate-post chlorination	Unit	1						●(Completion)
	Sludge Drying Bed	Install Bed Sand	Unit	1						●(Completion)
	Transmission Facility	Install Transmission pipe	Unit	1						●(Completion)
	Exterior Walls	Painting	Unit	1						●(Completion)
	Flow examination and test operation		Unit	1						●(Completion)

Inicial Plan　　Achievemer

Revised Plan　　● Completion

Table 4-6 Lot-2 Work Progress Chart

	Construction work			Qun atity	2011年 February	March	April	May	June	July	Remark
	Preparation／removal and clearance		Unit	1							●(Completion)
	Equipment procuration			1							
1	Pasanjan										
	Intake Facility	Flow meter･Exchange sand separator	Unit	1							●(Completion)
	Rapid Sand Filter池	Exchange surface wash pipe･Excahnge Flow meter	Unit	1							●(Completion)
	Chlorination Facility	Pump･Pluming･Tank･Protect Wall ･Single-phase supply	Unit	1							●(Completion)
	Waste water facility	Single-phase supply	Unit	1							●(Completion)
	Flow examination and test		Unit	1							●(Completion)
2	Binmaley-Caloocan										
	Aeration Tower	Remove exterior painting	Unit	1							●(Completion)
	Flocculator	Remodel baffle plate	Unit	1							●(Completion)
	Sedimentation Basin	Exchange sludge drain pipes	Unit	1							●(Completion)
	Rapid Sand Filter池	Improve inflow	Unit	1							●(Completion)
	Chlorination Facility	Intermediate-post chlorination pipe･ Exchange post Chlorination pump	Unit	1							●(Completion)
	Waste water facility	Flow meter･Exchange Drainage pump･ Single-phase supply	Unit	1							●(Completion)
	Sludge Drying Bed	Add Sludge Drying Bed	Unit	1							●(Completion)
	Trandmission Facility	Exchabge Flow meter	Unit	1							●(Completion)
	Flow examination and test		Unit	1							●(Completion)
3	Binmaley-Fabia										
	Aeration Tower	Remove exterior painting	Unit	1							●(Completion)
	Flocculator	Remodel baffle plate	Unit	1							●(Completion)
	Sedimentation Basin	Exchange sludge drain pipes	Unit	1							●(Completion)
	Rapid Sand Filter池	Improve inflow	Unit	1							●(Completion)
	Chlorination Facility	Repair Chlorination Tnak･Air fan･ Exchange post Chlorination pump	Unit	1							●(Completion)
	Waste water facility	Exchange Drainage pump	Unit	1							●(Completion)
	Sludge Drying Bed	Add Sludge Drying Bed	Unit	1							●(Completion)
	Trandmission Facility	Flow meter･Pressure meter･ Exchange pressure Tank	Unit	1							●(Completion)
	Flow examination and test		Unit	1							●(Completion)
4	Tingle-Poltan										
	Trandmission Facility	Install transmission pump	Unit	1							●(Completion)
5	Pomtevedra										
	Rapid Sand Filter池	Install back wash pump	Unit	1							●(Completion)
	Trandmission Facility	Install transmission pump	Unit	1							●(Completion)

Inicial Plan　Achievemer
Revised Pla　● Completion

(4) Quality Control

Quality, specification and quantity of all main materials and equipment were reviewed and approved in accordance with the set standard prior to the procurement. The quality of pumps, re-bars and ready-mixed concrete were reviewed through the quality test results or certificates issued by manufacturers.

When an issue affecting the work quality was found through the daily site supervision, instruction to improve the situation and take appropriate measures was given to the Contractor. Alternative methods to improve the quality of the work, if any were found, were also suggested to the Contractor.

Regarding the quality of the concrete used for the sludge drying bed, the slump tests on site and sampling for the compressive strength tests were carried out when concrete was casted. The compressive strength of each sample satisfied the requirement of the specifications of 3,000PSI (20.68MPa) for 28 days or 2,250 PSI (15.52 MPa) for 7 days. The result of the strength tests was summarized below.

Table 4-7 Result of the Compressive Strength Test

Facility	Site	Portion	Concrete placement day	Slump	Age	Compressive strength	
						(PSI)	(Mpa)
Sludge Drying Bed	Fabia	First Wall	6-May	70	7	3.857	26.59
Sludge Drying Bed	Caloocan	Basic Slab	14-May	70	28	3.132	21.59
Sludge Drying Bed	Fabia	Upper slab	21-May	85	14	2.647	18.25
Sludge Drying Bed	Caloocan	First Wall	27-May	110	7	2.401	16.55
Sludge Drying Bed	Caloocan	Upper slab	11-Jun	80	7	2.52	17.37

The quality control of the completed work was carried out by measurement of dimensions of the rehabilitated facilities and by inspecting photographs of the construction process.

(5) Safety Management

The safety and health control was satisfactory throughout the construction period without any accident or sickness of the workers. The Consultant arranged the working environment to be safer and conducted periodical safety patrol to motivate the Contractor's better safety and health practice.

The weather was especially unfavorable due to heat and the torrential rains during Lot-2 construction and special attention to the health maintenance of the construction workers was paid. Safety awareness of the workers was also raised by instructing them to utilize the safety

boots and helmets during the work.

(6) After the Completion

The Consultant supervised the restoration of the site and the preparation of the completion reports to be submitted to the client. Regarding the completion reports, the Consultants supported the Contractor on preparation of the as-built drawings and work photographs. For the restoration of the construction sites, the Consultant supervised the removal of the sign board and temporary structures, as well as cleanliness of the sites.

After the completion of the work, the Consultant conducted a facility inspection and instructed repair work where defects were found. The completion of the work was then approved after the repair work was carried out. The test operations of the rehabilitated WTPs were conducted for a required period to study the improvement made by the rehabilitation work. For the results of the test operation, refer to 4-2-1.

Implementation of the inspection at the end of the warranty period of one year will be discussed with JICA and the concerned agents for further detail.

4-1-3 Design Change

4-1-3-1 Contents of Design Changes

Design of the construction work has changed in the following two facilities.

- ✓ Binmaley WD Caloocan WTP (Lot.2): Change of Location and shape of new sludge drying bed
- ✓ Binmaley WD Fabia WTP (Lot.2): Location change of new sludge drying bed

The detail is shown in the figure below.

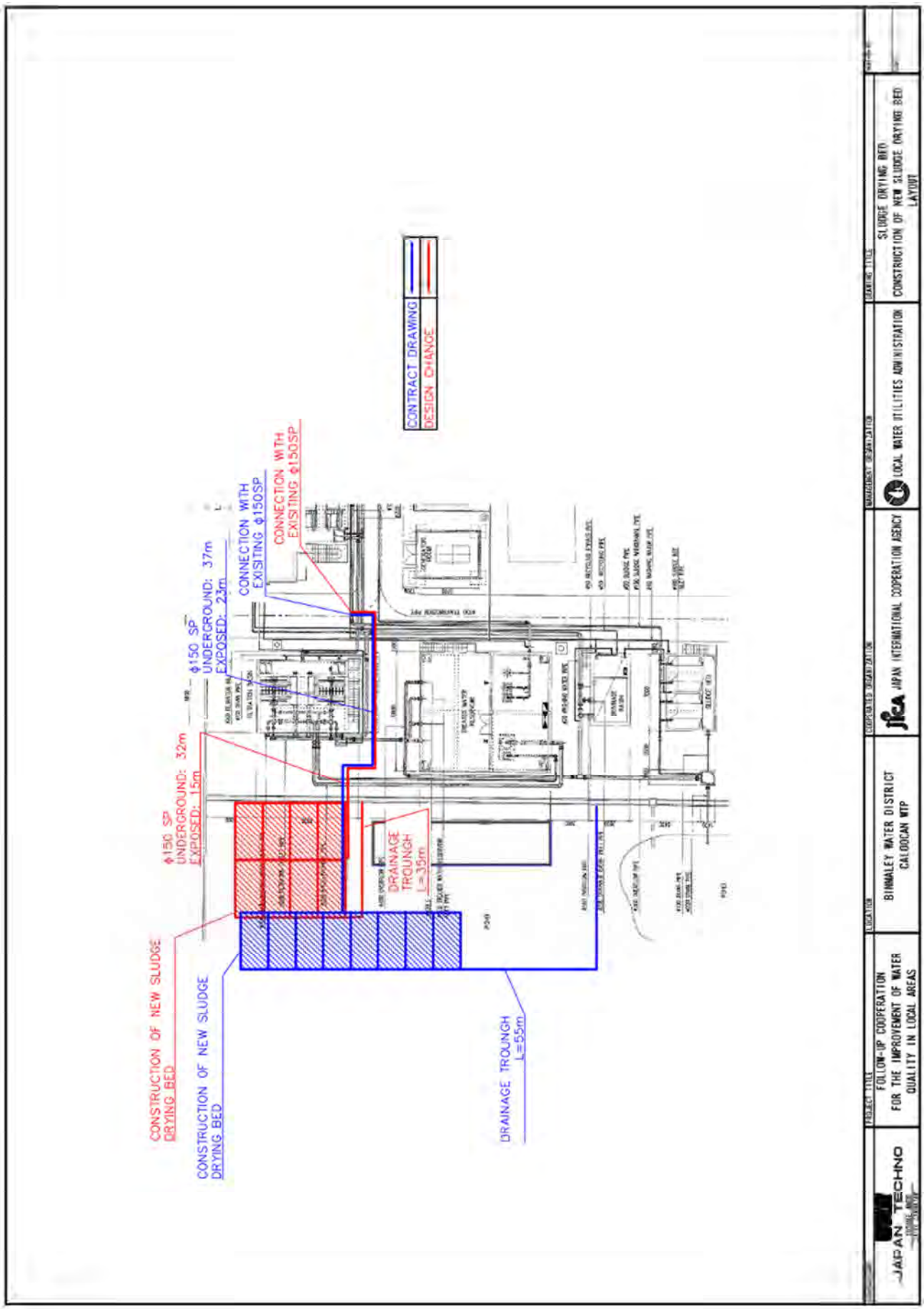


Figure 4-2 Drawing for the design change of Binmaley WD Caloocan WTP

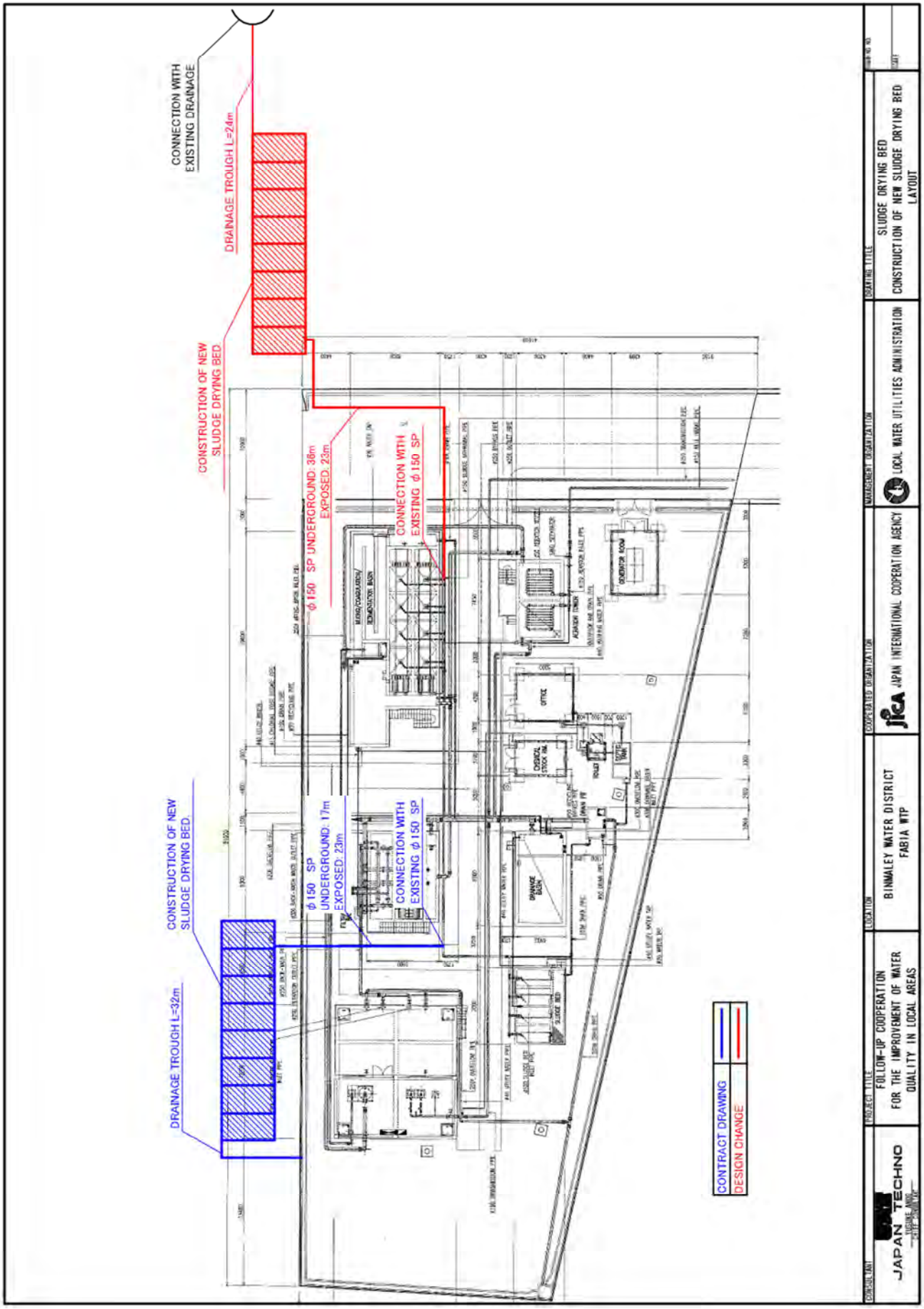


Figure 4-3 Drawing for the design change of Binmaley WD Fabia WTP

4-1-3-2 The reasons for the change

The reasons for changes are as follows.

(1) New sludge drying bed in Binmaley WD Caloocan WTP (Lot.2)

The location of installation was determined through discussion with Binmaley WD. However, in the final confirmation stage before the construction, the WD requested to change the location so that the space can be utilized effectively. To adjust the space for installation, the shape of structure shall be changed.

(2) New sludge drying bed in Binmaley WD Fabia WTP (Lot.2)

The location of construction was determined through discussion with the WD as it was done with Caloocan WTP. The WD requested to change the location so that the space can be utilized effectively. As no problem for the maintenance was found, the request was taken in.

4-1-3-3 Validation of the relevancy

These design changes above were validated as follows.

(1) New Sludge drying bed for Binmaley WD Caloocan WTP (Lot.2)

The problem of site acquisition will not be caused since the land belongs to Binmaley WD. To adjust to the land space, the shape of the sludge drying bed will be changed from rectangle to square. This change poses no problem for the maintenance and thus was appropriate.

(2) Sludge drying bed of Binmaley WD Fabia WTP (Lot.2)

Just as Caloocan WTP, the planned site is owned by Binmaley WD and the problem of land acquisition will not be caused. Sludge draining will not be a problem because the branch for the sludge drain pipe ϕ 150 can be connected to the pipe end of the existing pipe.
Since the ground is a little higher than in the plan, it is necessary to excavate for the drain of supernatant of the sludge drying bed. The discharged pipe can be connected to the drain of flow with opposite direction. These changes have no problem; therefore the design change was relevant.

4-1-3-4 Necessity for the budget correction

The increase in the cost with the design change, which is almost all accounted to the excavation cost of the sludge drying bed in Fabia WTP, is comparatively small. After a discussion with the contractor, the consensus is obtained over the contract amount to not to be changed since it is not necessary to purchase new equipment for the excavation. Therefore, the correction of the project budget is not necessary.

4-2 The Project Effect

4-2-1 Validation of the revitalization of WTP function

Improved WTP function is verified through this follow-up rehabilitation work.

4-2-1-1 Dingle-Pototan WD

Dingle-Pototan WD has not been operated since the hand over in 2004 and water was supplied to the town by existing simple treatment facility. In this follow-up project, WTP was done test operation to identify the facilities to be rehabilitated in end of October 2010. The main items of rehabilitation works were included in Lot-1, and it was completed in March 2011. And then the pipe renewal by the WD was almost completed, thus WTP was operated form April 2011. At this time the exchange work of distribution pumps was included in Lot-2, WD used the surface-wash pump instead of the distribution pump. However, the surface-wash pump was malfunctioned in May 2011, WD had to stop the operation of WTP temporally. And then in July 2011, the distribution pumps were exchanged by Lot-2, and also the submersible pump for deep well was installed by the project of JICA Philippines office. All of the rehabilitation works were completed and WTP have been fully operated from August 2011.

This follow up rehabilitation project made WTP functional and brought better water quality than that from simple treatment. The residence also commented that water quality was improved, and it showed that this follow up programme was effective.

The water quality of the simple treatment facility especially had a problem of color that does not meet the Philippine standard. Iron and Manganese were also dissolved in the water, so the water was oxidized in the pipe, which caused problems of turbidity and increased color. Treated water from the improved WTP of the project has color value of 3.0 which is within the standard, and Iron and Manganese were not detected, which means that all Iron and Manganese were removed through the treatment process.

Table 4-8 Improvement of the water quality (Dingle Pototan WD)

Items	PNSD	Raw water	Water from simple treatment	Water from Rehabilitation WTP
Turbidity (NTU)	5.0	0.7	0.5	0.0
Color (CU)	5.0	18.5	12.5	3.0
Iron (mg/l)	1.0	0.63	0.17	Undetected
Manganese (mg/l)	0.5	0.37	0.29	Undetected
Ammonia (mg/l)	-	3.3	2.6	0.32

Pink cell is the value which is higher than the PNSD.

As shown above, the rehabilitation work proved to impact positively the quality of water through the improvement of the water treatment function of the facilities. The result of the facility improvement is shown below.

Table 4-9 Validation of the improved function (Dingle Pototan WD)

Facilities	Contents	Before Rehabilitation	After Rehabilitation
Deep well pump	Replacement of the deep well pump and implementation of drawdown test	Capacity of the pump is 15l/s (up to existing simple treatment facilities)	Capacity of pump is 15l/s (to WTP) (The amount of water intake was 15l/s as a result of drawdown test, so water amount could not be increased.)
Aeration tower	Rehabilitation of water leakage	There are leakages from the concrete joint	Leakage repairing is completed
Flocculator	Improvement of vertical baffle plate	Insufficient mixing intensity due to low flow velocity.	Flow velocity is increased and froc is settled properly.
Rapid sand filter	Installation of inlet pipe	Flocs are broken due to the water inflow	Frocs are not broken as a result of installation of pipe.
Chlorination facility	Replacement of door in injection room	Maintenance work is impeded by the corrosion	Door was replaced to aluminum door, being used without any problem.
	Installation of pipe and valve for Cl injection	Intermediate chlorination injection is not done equally.	Valve is installed to each injection pipe and it enabled an equal injection.
Sludge Drying bed	Regrading/Gravel and Sand filling	The structure is not functioning to dry sludge.	Sludge is dried and drying bed is operated properly.
Distribution pump	Replacement of distribution pump	Distribution pump is broken so surface wash pump is utilized temporarily. Electricity cost is high due to its large capacity.	Submerged pump is replaced. It can respond flexibly to the water demand. So electricity expense is reduced.
Each Facilities	Repainting	Paint is peeled off and looks bad.	Repainting made its appearance better.

Before rehabilitation
Aeration Tower: Leakage from the concrete joint.

After rehabilitation:
Aeration tower: Leakage part was repaired and each facilities were painted.

Before rehabilitation
Rapid sand filter, inlet trough: Improvement is required to prevent flocs inflow to prevent the breakage.

After rehabilitation
Rapid sand filter: Inlet pipe was installed to prevent floc breakage

Before rehabilitation
Sludge drying bed: Installation of bed sand is required due to accommodate the change in Philippines effluent standard.

After rehabilitation
Sludge Drying bed: Gravel and sand are filled and re-graded. Tank volume is appropriate for the drying purpose.

Before rehabilitation
Chlorination room: The entrance door and its frame are corroded.

After rehabilitation:
Door of chlorination facility: Replaced to aluminum double door and it will not be corroded.

Before rehabilitation
Distribution pumps: They are not in use due to a breakdown. Pump No.1 is not in use because of the broken shaft. Pump No.2 has a problem with over-current; the motor has no problem, thus the pump could be defective.

After rehabilitation:
Distribution pumps: Replaced to submerged pump and water is distributed properly.

4-2-1-2 Pontevedra WD

Rusting and corrosion for each facility were advanced by salination of water source in Pontevedra and the maintenance was difficult. This follow-up rehabilitation work rehabilitated the facility and enabled proper and sustainable operation. The following table shows water quality before and after rehabilitation.

Water source still contains some salt and development of new water sources is required urgently.

Table 4-10 Improvement of the water quality (Pontevedra WD)

Items	PNSD	Raw water	Treated water before rehabilitation	Treated water after rehabilitation
Turbidity (NTU)	5.0	1.6	0.2	0.0
Color (CU)	5.0	1.5	0.5	0.0
Iron (mg/l)	1.0	7.0	0.1	Undetected
Manganese (mg/l)	0.5	2.0	0.3	< 0.5

Pink cell is the value which is higher than the PNSD.

The improvement of each facility for this project is shown table below.

Table 4-11 Validation of improved function (Pontevedra WD)

Facilities	Work	Before rehabilitation	After rehabilitation
Aeration tower	Installation of opening section for maintenance	Steps to the lower tank is not installed, therefore maintenance work is difficult.	Opening section for the maintenance and a slide extensible ladder were installed for the maintenance of the lower tank.
Flocculator	Improvement of vertical baffle plate	Flow velocity is slow and mixing intensity is not enough.	Flow velocity is increased and flocs are settled
Sedimentation basin	Replacement of inlet valve	Corrosion is ongoing and rust is swelling around valve. It makes difficult for opening and closing the valve.	Corrosive-resistant butterfly valve is installed and opening and closing are smooth.
	Installation of sludge drawing facility	Sludge drain pipe is corroded and has hole, so the maintenance work has difficulties with not being able to conduct one side operation.	Sludge drain pump and pipes are installed, so sludge is drained properly
Rapid sand filter	Installation of inlet pipe	Flocs are broken due to water fall from inlet.	Flocs are protected from breakage as inlet pipe is installed.
	Replacement of backwash pump	Backwash pump is broken and surface pump is used temporarily, but washing is not enough due to the lack of flow volume.	Back washing is done properly after the installation of corrosion resistant pumps.
	Replacement of surface washing pipe	Surface cannot be washed properly because there are some corrosion holes on the surface wash pipe.	Surface wash pipe were replaced to PVC, and the surface became able to be washed properly.
	Replacement of flow meter for surface wash	Flow meter is broken, therefore flow volume is not measureable.	Flow meter is replaced and flow volume can be measured properly.
Chlorination facility	Replacement of door in injection room	Corrosion poses the problem in maintenance work.	Door is replaced to aluminum and is used without any problem.
	Support platform for chlorination mixer	Rust is swelling in support platform and corrosion is promoting deterioration of the part.	Support platform was changed to wooden one, and durability was increased.
	Installation of intermediate chlorination injection pump and valve	Pump has leakage, and Chlorine is not injected equally.	Pump is renewed and valve is installed and so chlorine is injected equally.
	Replacement and installation of pump, pipes and box for post Cl injection	The pump is broken, and it is necessary to change the break point, however facility is incapable of responding to such changes.	The pump is renewed and injection can be done directly to the transmission pipe
Sludge drying bed	Gravel and sand filling	The structure is not functioning to dry sludge.	Sludge is dried properly and it is in the good condition
Transmission facility	Installation of transmission pipe	Current pipes are used for both transmission and distribution, therefore operation is complicated	Transmission pipes are installed and flow meter was replaced, so maintenance became simple.
	Replacement of transmission pump	The pump was wearing out with corrosion and there is a risk for sudden interruption.	The pump is renewed to the anti-corrosion one and the concern of rusting is resolved.
Each facility	Repainting	Paint is peeled off and looks bad.	Repainting removed the problem of the appearance.

Before rehabilitation
Hydraulic Flocculator: Adjustment of vertical baffles is required.

After Rehabilitation
Flocculator: flow velocity is increased by adjusting the vertical baffles.

Before rehabilitation
Sedimentation basin, sludge drain pipes: All pipes are corroded by high salinity of the raw water.

After rehabilitation
Sedimentation basin, sludge drain pipes: Sludge pump and distribution pipes are installed, and operated properly

Before rehabilitation
Rapid sand filter, surface-wash pipe: After drainage of water from the filter basin, settled flocs and sludge adhere to the surface-wash pipes.

After rehabilitation
Rapid sand filter
Surface wash pipes were replaced to PVC and the surface became able to be washed properly.

Before rehabilitation
Backwash pump: It has been removed since Oct 2009 because of a breakdown.

After rehabilitation
Backwash pump
Anti-corrosion pump is installed and backwash is done properly.

Before rehabilitation
Chlorination agitator support: It was covered by rust of the corrosion.

After rehabilitation
Chlorination agitator support
It was changed to wooden support, and durability is increased

Before rehabilitation
Pre/Intermediate chlorination, injection pump: Leakage from diaphragm of the pump occurred.

After rehabilitation
Intermediate chlorination, injection pump: Pump is renewed and valve is installed to each injection pipe and it enabled equal injection to each pipe.

Before rehabilitation
Post chlorination, injection pump: Not in use due to a breakdown.

After rehabilitation
Post chlorination pump: Pump is renewed and chlorine can be injected to transmission pipe directly.

Before rehabilitation
Transmission pipe: A bypass line is connected from another water source to dilute the saline water in the reservoir.

After rehabilitation
Transmission pipes were installed and flow meter was replaced, so maintenance became easier.

Before rehabilitation
Transmission and distribution pump
Pumps were wearing out with corrosion. There is the risk of sudden interruption.

After rehabilitation
Transmission and distribution pump
The pumps were replaced to the anti-corrosion ones and the concern of rusting was resolved.

Before rehabilitation
Sludge drying bed: Installation of bed sand is required due to accommodate the change in Philippines effluent standard..

After rehabilitation
Sludge Drying Bed
Gravel and sand are filled, and sludge drying bed is functioning properly.

4-2-1-3 Binmaley WD Caloocan WTP

Binmaley WD Caloocan WTP has the problem of water color, and some facilities are already broken down so the maintenance work was difficult. This follow-up rehabilitation work renewed such facilities and sustainable operation and maintenance of the facility was enabled.

The removal of color did not appear clearly about this rehabilitation work, because the repair item that influenced the water treatment processing was only increase of velocity of flocculation. However, the removal of color is checked that color was removed by the increase of dosing rate of coagulant, it can remove more by changing dosing rate.

Table 4-12 Improvement of the water quality (Binmaley WD Caloocan WTP)

Items	PNSD	Raw water	Treated water before rehabilitation	Treated water after rehabilitation
Turbidity (NTU)	5.0	0.4	0.0	0.0
Color (CU)	5.0	31.0	17.0	17.5

Pink cell is the value which is higher than the PNSD.

The improvement of each facility is shown below.

Table 4-13 Validation of improved function (Binmaley WD Caloocan WTP)

Facility	Work	Before rehabilitation	After rehabilitation
Aeration tower	Removal of paint	Paint is peeled and has the problem with appearance	After paint is removed, appearance became better.
Flocculator	Improvement of vertical inclined plate	Flow velocity is slow and mixing strength is not enough.	Flow velocity is increased and flocs are settled well.
Sedimentation basin	Replacement of sludge drain pipe	Sludge drain pipe is corroded and has hole, which make the maintenance difficult	Replaced corrosive part to PVC, so that sludge is drawn properly and there is no risk of corrosion.
Rapid filtration	Installation of inflow pipe	Flocs are broken by water fall from inlet and leaked.	Flocs are not broken because inlet pipe is installed.
Chlorination facility	Replacement of valve and pipe for intermediate chlorination injection	Some pipes are corroded by the leakage of chlorine solution.	Corroded pipes are replaced and the leakage is repaired by fastening.
	Replacement of post chlorination pump and pipe	They are removed due to breakdown.	The pump is renewed, and post chlorine injection can be done.
Distribution facility	Exchange of flow meter for distribution	Flow meter is broken so flow volume cannot be measured.	Flow meter is replaced, so flow volume can be measured.
Drainage facility	Replacement of flow meter for recycle	Flow meter is broken and flow volume cannot be measured.	Flow meter is replaced, and the flow volume can be measured.
	Replacement of drain pump	Since existing pump is broken, recycle pump is used temporarily, and maintenance work became complicated.	New pump is installed and operated as planned.
	Installation of single-phase supply	Installed pump by WD is operated with single phase supply, and existing control panel is for three phase panel, therefore cable is connected from next room. It meant that there is a risk of electrical leakage.	Single-phase supply is installed and so there is no risk of the electrical leak.
Sludge drying bed	Construction of sludge drying bed	Existing sludge drying bed is small and WD expanded sludge drying bed. However the structure is for evaporation, therefore it is not functioning well.	Construction of sludge drying bed which has required volume enabled the proper treatment for sludge.

Before rehabilitation
Aeration tower: Paint of exterior wall is peeled off. WD requested its removal.

After rehabilitation
Aeration tower:
Removal of paint is completed and appearance became better.

Before rehabilitation
Sedimentation basin: Hole on the sludge drain pipe has been repaired with rubber sheet.

After rehabilitation
Sedimentation basin: Corroded parts were replaced to PVC so as to drain properly and eliminate the risk of corrosion.

Before rehabilitation
Post chlorination pump: It has been removed due to breakdown.

After rehabilitation
Post Chlorination injection pump
Pump is renewed so post chlorination can be done.

Before rehabilitation
Drainage basin: The single phase socket is covered by a sheet for insulation.

After rehabilitation
Drainage basin: Outside consent for the single phase supply is installed, and the maintenance became easier.

Before rehabilitation
Sludge Storage basin: A sludge storage basin was constructed by WD for receiving the excess sludge. The structure is for evaporation, and not for drying, therefore it takes 3 to 4 weeks.

After rehabilitation
Sludge drying bed: Sludge is treated properly by the constructed sludge drying bed with the required volume.

4-2-1-4 Binmaley WD Fabia WTP

Binmaley WD Fabia WTP has the same color problem as Caloocan WTP, and some facilities are already broken down, therefore maintenance work was difficult. This follow-up rehabilitation work renewed those facilities and WTP now is able to operate properly and the maintenance work became easier.

The removal of color did not appear clearly about this rehabilitation work, because the repair item that influenced the water treatment processing was only increase of velocity of flocculation. However, the removal of color is checked that color was removed by the increase of dosing rate of coagulant, it can remove more by changing dosing rate.

Table 4-14 Improvement of the water quality (Binmaley WD Fabia WTP)

Items	PNSD	Raw water	Treated water before rehabilitation	Treated water after rehabilitation
Turbidity (NTU)	5.0	0.2	0.2	0.0
Color (CU)	5.0	24.0	20.5	19.0

Pink cell is the value which is higher than the PNSD.

The improvement of each facility is shown below.

Table 4-15 Validation of the Improved function

Facilities	Work	Before rehabilitation	After rehabilitation
Aeration tower	Paint Removal	Paint is peeled off and the appearance is not good.	Physical appearance is improved by the removal of paint.
Floccurator	Improvement of vertical baffle plate	Insufficient mixing intensity due to low flow velocity	Flow velocity is increased, and flocs are settled.
Sedimentation basin	Replacement of Sludge drain pipe	Sludge drain pipe have holes, therefore the maintenance work is not proper.	Part of corrosion is replaced to PVC, so adequate drain is enabled and there is no risk of corrosion.
Rapid sand filter	Installation of inlet pipe	Flocs are broken due to water fall	Flocs are not broken because inlet pipe is installed.
Chlorination facility	Replacement of pump and pipe for post chlorination injection	They cannot be used due to breakdown	Pump is replaced and post chlorination can be done.
	Rehabilitation of connection of Chlorine tank	There are leakages from the connecting part.	Leakage parts are repaired.
	Replacement of fan	Fan is broken and cannot be used.	Fan is replaced and ventilated properly.
Distribution facility	Replacement of flow meter for distribution.	Flow meter is broken, so flow volume cannot be measured.	Flow volume can be measured after the replacement of flow meter.
	Replacement for distribution pressure gauge	Pressure gauge is broken, and the pressure cannot be measured.	Water pressure can be measured by pressure gauge.
	Replacement of pressure tank	Pressure tank has hole so it is not possible to use.	Pressure tank is repaired and can be used properly.
Drainage	Replacement of drain pump	Drain pump is not working properly and excess current occurs in operation.	Pump is replaced and used properly.
Sludge drying bed	Construction of sludge drying bed	Existing sludge drying bed is small, and WD expanded the sludge drying bed, but it is not functioning because structure is just for evaporation.	Proper sludge treatment is enabled by the construction of the required area for drying bed.

Before rehabilitation
Sedimentation basin: Sludge drain pipe has holes due to corrosion.

After rehabilitation
Sedimentation basin: Corrosion parts were replaced to PVC, therefore there is no risk of corrosion

Before rehabilitation
Post chlorination pump: Diaphragm part is malfunction due to corrosion. Post chlorination is missing.

After rehabilitation:
Post chlorination pump
Pump is replaced and post chlorination can be done.

Before rehabilitation
Chlorination room: Ventilation fan has been removed due to breakdown.

After rehabilitation:
Chlorination room: Fan is replaced and the room is ventilated properly.

Before rehabilitation
Pressure tank: The trace of leakage is found. It needs to be replaced.

After rehabilitation
Pressure tank: Pressure tank is replaced and used properly

Before rehabilitation
Sludge Drying bed: An additional sludge storage basin was constructed by WD for receiving the excess sludge.

After rehabilitation
Sludge drying bed: Proper sludge treatment is practiced after the construction of required volume.

4-2-1-5 Pagsanjan WD

Pagsanjan WD has good operation and maintenance practice and there is no major problem. However, some facilities were broken, and maintenance work was difficult. This follow-up rehabilitation project renewed those broken facilities to enable sustainable operation of the facility.

The improvement of water quality was not confirmed, because the rehabilitation work was not included the repair item that affect the water treatment processing. Although turbidity is in the standard value, it rises from the value before rehabilitation. It is considered to be the cause chlorine dose at time of test operation was fewer than chlorine dose before rehabilitation. It is made to nearly 0 CU after treatment, because it can make the oxidization of iron by the proper amount of chlorine injection.

Table 4-16 Improvement of the water quality (Pagsanjan WD)

Items	PNSD	Raw water	Treated water before rehabilitation	Treated water after rehabilitation
Turbidity (NTU)	5.0	0	0.2	1.3
Color (CU)	5.0	3.0	5.0	3.5

Pink cell is the value which is higher than the PNSD.

The improvement of each facility is shown below.

Table 4-17 Validation of the improved function (Pagsanjan WD)

Facilities	Work	Before rehabilitation	After rehabilitation
Sand separator	Replacement of sand separator	Sand separator was broken and removed. Flow meter is also broken.	New sand separator is installed and sand separation is functioning.
Intake facility	Replacement of flow meter for intake	Flow meter is broken, and flow volume cannot be measured.	Flow meter is replaced and flow volume can be measured.
Rapid sand filter	Replacement of nozzle of surface wash pipe	Surface wash pipe nozzle have holes, therefore surface wash is not done properly	The nozzle was replaced and surface wash can be done.
	Replacement of flow meter for surface wash	Flow volume cannot be measured because flow meter is broken	Flow volume can be measured after the meter is replaced
Chlorination facility	Replacement of intermediate chlorination pump	Pumps are taken away due to corrosion, and injection pump is installed temporarily by WD, however there is a risk of electrical leak because single phase supply is taken out from the next distribution pumping room.	Pump is installed and intermediate chlorine injection became possible.
	Replacement of pump and pipe for post Cl injection		The pump is replaced and installed. Post chlorination became possible.
	Installation of chlorination tank	The existing chlorine tank is not used due to leakage. Small chlorine tank installed by the WD is used temporarily.	Small chlorine tank on the side of a new pump was installed and safety and efficiency are improved.
	Installation of fence to prevent weather	Chlorine injection pump was installed outside, and it broke down due to corrosion caused by the weather.	Fence around the pump was installed and the direct effect of weather can be avoided.
	Installation of single phase supply	Input of existing pump is for three phase supply, and pump which can be purchased at site is for single phase supply, so it was difficult to obtain its pump in the case of breakdown.	Pump installed is for single phase supply, so consent for single phase supply is also installed.
Drain facility	Installation of single phase supply	Drain facility: Input of existing pump is for three phase, however pump which can be purchased at site is only for single phase supply, therefore it was difficult to obtain it in the case of breakdown.	Electric point adaptable to the pumps for single phase supply is installed so the procurement of the spare parts became simpler.

Before rehabilitation
Sand separator: It was changed two times and finally removed because of holes.

After rehabilitation
Sand separator: New sand separator is installed, therefore sand can be removed from the water.

Before rehabilitation
Flow meter: Flow meter is broken and flow volume cannot be measured.

After rehabilitation
Flow meter: Flow meter is replaced and the flow volume can be measured.

Before rehabilitation
Chlorination pump: It is removed due to a breakdown, and injection pump installed by WD is utilized temporarily. However there is a high risk of electrical leakage because single phase supply is connected from the distribution pump room.

After rehabilitation
Chlorine injection pump: Pump is renewed and chlorination injection of each point is possible.

Before rehabilitation
Fence to prevent weather.
Chlorine injection pump was placed outside and exposed to the weather. The pump broke down due to corrosion in the end.

After rehabilitation
Fence to prevent the weather
The fence was installed around pump and direct effect of weather is avoided.

Before rehabilitation
Drain facility: Input of existing pump is for three phase, however pump which can be purchased at site is only for single phase supply, therefore it was difficult to obtain it in the case of breakdown.

After rehabilitation
Drain facility: The installation of single phase consent made procurement of spare parts easier in case of a breakdown of the drain facility.

4-2-2 Instruction for Primary operation

An operation and maintenance manual for each WD was prepared based on the commissioning of WTP and instruction on primary operation for the rehabilitation work is provided to the WD staff and operator of each WTP. Since WTP of Dingle pototan WD had never been operated, the instruction covered not only rehabilitation work but also operation for all WTP.

Table 4-18 Instruction for primary operation

WD	Students	Duration for instruction
Dingle pototan	5	Two day
Potevedra	3	One day
Binmaley	7	Half day
Pagsanjan	4	Half day

CHAPTER 5

RECOMMENDATIONS AND LESSONS LEARNED

CHAPTER 5 RECOMMENDATIONS AND LESSONS LEARNED

5-1 Recommendations for the Philippines Side

The agenda and recommendations of LWUA, which is the management organization of the WD for this project, and of each WD are shown in the table below. Each WD faces various difficulties. The common issues for all the WD in this project are the high unaccounted for water rate and as a result of this, high maintenance costs. Increase of the water supply rate is also an important matter to consider. These recommendations correspond to the each agenda and some of the recommendations have the necessity of an additional budget.

Table 5-1 Recommendations

	Agenda	Recommendations
LWUA	LWUA mainly provides technical support to WDs but also provides financial services like loans. However the loan probation processes take time and therefore it takes a long time until the lending process is implemented.	The process of credit services should speed up and the financial assistance should be implemented smoothly. Potevedra (New water resource development) and Lingayen (Rehabilitation of pipes) will especially need prompt action.
Abuyog	Although the hardness of raw water is high, since surface-wash is not performed, filtration sand forms mud ball. Moreover, since the operators have not performed appropriate water treatment processing because they does not understand water treatment processing enough.	As of May 2011, technical cooperation project will develop the supplemental water source to improve the water quality. Moreover, it is required to deepen an understanding to water treatment processing to operators by the technical guidance from LWUA and technical cooperation project.
Dingle-Pototan	The well's water sourcing capacity connected to the WTP is decreasing, so only about 60% of the total WTP water treatment capacity can be transmitted. The capacity of water intake in existing well is decreasing to the half amount.	Although current water production can meet the demand for this time, new water resource should be developed or water of existing well should be conducted to WPT for the compensation of lack of water for the future.

Pontevedra	The well that serves as the main water source for the WPT has the problem of salt, and current treatment process cannot remove it. Also it has high unaccounted water rate most likely caused by leakage but since those pipes were newly installed in 1991-1996, specific cause is unclear as for now.	Drilling new borehole is recommended to solve the problem of salt. The WD already applied the finance loan for this provision. About the unaccounted water, the accuracy of flow meter should be checked at first and if there is no problem, there must be some possibilities of leakage or stealing, this should be thoroughly investigated.
Binmaley	This city has big population growth and as a result,water supply rate is also ever-increasing. Yet even if new borehole is excavated, it will have the problem of color. Therefore certain treatment is necessary to obtain an adequate water quality.	One of the solution of the problem of color is the construction of a compact water treatment facility. It is necessary to obtain coagulant for that, therefore operation and maintenance cost will be increased.
Lingayen	It has high unaccounted water rate because the pipes installed are aging and wearing out. Because of this the WTP cannot be operated. The water quality of the well has the same problem of colors as Binmaley.	As a countermeasure for high unaccounted water rate, the pipe installation is proposed. WD already applied financial loan for this provision. A compact water treatment plantis considered to be constructed for new borehole as in Binmaley.
Pagsanjan	At the end of the distribution line from the WPT, residual chlorine concentration becomes higher than that in the treatment centre so that residents are complaining. The cause of this phenomenon is uncertain.	Finding the cause of chloride problem, including doing some experiment is the most important issue and the countermeasures should be reviewed after investigation.

5-2 Lessons Learned

This follow-up cooperation could improve the efficiency of the operation and maintenance of WTPs, and also could contribute to the sustainable management of WD. However, the background of this follow-up cooperation was required, there are following causes. For the sake of effective implementation of other projects, measures are shown as lessons.

Table 5-2 Lessons Learned

Cause	Lessons learnde
In Dingle-Pototan WD and Lingayen WD, the renewal of distribution pipe by their burden have not been proceeded, and they did not operate the WTPs because of high unaccounted for water.	About the matter of their burden, which will affect implementation of project and production of effect, it needs to consider feasibility based on their budget scale and expense/period required in survey stage. Also, the point that the implementing organization should do what by when, and it should mind in that case, will be clarified as possible. Furthermore, after agreement needs to influence positively according to progress.
The knowledge and technology of WD staff concerning operation and management of WTP were insufficient. Therefore, there were some cases that water treatment was not functioned properly.	The WTP of this project is rapid filtration method. This method has been established technically, but it is few adoption examples in Philippines. Therefore the implementation of soft component for its initial operation, but there was no chance to follow them after the start of operation. The capability of person for operation and maintenance is exactly grasped in the survey stage, and if only implementation of soft component is not enough to operate WTP, it is necessary to consider the establishment of system for appropriate operation and maintenance of WTP by cooperation with technical cooperation project etc. including technical guidance from LWUA.

APPENDICES

APPENDIX-1 MEMBER LIST OF THE STUDY TEAM

APPENDIX-1 Member List of the Study Team

(1) The First Survey of the Follow-up Cooperation Study Team

Assignment	Name	Affiliation
Team Leader	Mr. Hiroyuki Kinomoto	Deputy Director of Financing, Facilitation and Procurement Supervision Department, JICA
Programme coordinator	Ms. Haruko Kase	Southeast Asia Division 3, Southeast Asia 1 and Pacific Department, JICA
Technical Assistance Coordinator	Mr. Akio Endo	Water Resources Management Division 2, Global Environment Department, JICA
Study Planner	Mr. Takeshi Saheki	Grant Aid Project Management Division 3, Financing Facilitation and Procurement Supervision Department, JICA
Chief Consultant/ Water Supply Designer	Mr. Yusuke Ando	Japan Techno Co., Ltd.
Planning & Managment	Mr. Shoji Takamatsu	Japan Techno Co., Ltd.

(2) Scope of Work Mission Team for Lot.1

Assignment	Name	Affiliation
Team Leader	Mr. Kohei Sato	Grant Aid Project Management Division 3, Financing Facilitation and Procurement Supervision Department, JICA
Study Planner	Mr. Takanori Obayashi	Grant Aid Project Management Division 3, Financing Facilitation and Procurement Supervision Department, JICA
Chief Consultant/ Water Supply Designer	Mr. Yusuke Ando	Japan Techno Co., Ltd.

(3) Scope of Work Mission Team for Lot.2

Assignment	Name	Affiliation
Team Leader	Mr. Kazuhiko Ueno	Philippine Office, JICA
Study Planner	Mr. Takanori Obayashi	Grant Aid Project Management Division 3, Financing Facilitation and Procurement Supervision Department, JICA
Water Treatment/O&M /Cost Estimate1	Mr. Teruki Murakami	Japan Techno Co., Ltd.

(4) The Second and Later Survey of the Follow-up Cooperation Study Team

Assignment	Name	Affiliation
Chief Consultant/ Water Supply Designer	Mr. Yusuke Ando	Japan Techno Co., Ltd.
Water Treatment/O&M /Cost Estimate1	Mr. Teruki Murakami	Japan Techno Co., Ltd.
Construction Planning/Supervise	Ms. Kiyoko Takamizawa	Japan Techno Co., Ltd.

APPENDIX-2 STUDY SCHEDULE

APPENDIX-2 Study Schedule

(1)

No.	Date		Day	Team Leader	Programme Coordinator	Technical Assistance Coordinator	Study Planner	Chief Consultant/ Water Supply Designer	Planning & Management
				Mr. Hiroyuki Kinomoto	Ms. Haruko Kase	Mr. Akio Endo	Mr. Takeshi Saheki	Mr. Yusuke Ando	Mr. Shoji Takamatsu
1	4	11	Sun	Narita - Arrive at Manila					
2	4	12	Mon	Discussion with JICA, Courtesy call and Discussion with LWUA, Move to Iloilo					
3	4	13	Tue	Field survey and Discussion with Dingle-Pototan WD, Move to Manila and Move to Lingayen					
4	4	14	Wed	Field survey and Discussion with Lingayen WD, Field survey at Binmaley WD, Move to Manila					
5	4	15	Thu	Discussion with board of director of Dingle-Pototan WD, Discussion with LWUA					
6	4	16	Fri	Signing of M/M, Report to Embassy, Report to JICA					
7	4	17	Sat	Manila - Arrive at Narita					

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No.	Date		Day	Chief Consultant/ Water Supply Designer	Water Treatment/O&M /Cost Estimate1	Construction Planning/Supervise
				Mr. Yusuke Ando	Mr. Teruki Murakami	Ms. Kiyoko Takamizawa
1	5	31	Mon	Leave Tokyo, Arrive in Manila, Dingle-Pototan contract of electric		
2	6	1	Tue	Discussion of JICA, NJS, LWUA		
3	6	2	Wed	Purchase material, survey meeting		
4	6	3	Thu	Purchase material, survey meeting		
5	6	4	Fri	Purchase material, survey meeting		
6	6	5	Sat	Purchase material, survey meeting		
7	6	6	Sun	Data compling	Leave Tokyo, Arrive in Manila	
8	6	7	Mon	Discussion of JICA, LWUA Leave Tacloban	Discussion of JICA, LWUA Leave Tacloban	
9	6	8	Tue	Leave Abuyog, Site survey	Leave Abuyog, Site survey	
10	6	9	Wed	Water quality analisis, Jar test	Water quality analisis, Jar test	
11	6	10	Thu	Water quality analisis, Jar test	Water quality analisis, Jar test	
12	6	11	Fri	Arrive in Manila, Survey of price and Local contructor	Data compling	
13	6	12	Sat	Arrive in Tacloban	Data compling	
14	6	13	Sun	Operation implementation	Operation implementation	
15	6	14	Mon	Operation implementation	Operation implementation	
16	6	15	Tue	Operation implementation	Operation implementation	
17	6	16	Wed	Alternative water source survey	Alternative water source survey	
18	6	17	Thu	Data compling	Data compling	
19	6	18	Fri	Report to Abuyog WD	Report to Abuyog WD	
20	6	19	Sat	Data compling	Data compling	
21	6	20	Sun	Arrive in Manila	Arrive in Manila	
22	6	21	Mon	Prepare the report	Prepare the report	
23	6	22	Tue	Prepare the report	Prepare the report	
24	6	23	Wed	TV conference in JICA	TV conference in JICA	
25	6	24	Thu	Leave Roxas Visti Pontevedra	Leave Roxas Visti Pontevedra	
26	6	25	Fri	Site survey, Jar test	Site survey, Jar test	
27	6	26	Sat	Review the status of Dingle	Operation implementation	
28	6	27	Sun	Operation implementation	Operation implementation	
29	6	28	Mon	Operation implementation	Operation implementation	
30	6	29	Tue	JICA conference(PQ paper work)	Operation implementation	
31	6	30	Wed	Leave Roxas, Prepare the report	Prepare the report	
32	7	1	Thu	Report to Pontevedra WD, Leave at Iloilo	Report to Pontevedra WD, Leave at Iloilo	
33	7	2	Fri	Meeting with Dingle WD, Site survey	Meeting with Dingle WD, Site survey	
34	7	3	Sat	Data compling	Data compling	
35	7	4	Sun	Data compling	Data compling	

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No.	Date		Day	Chief Consultant/ Water Supply Designer	Water Treatment/O&M /Cost Estimate1	Construction Planning/Supervise
				Mr. Yusuke Ando	Mr. Teruki Murakami	Ms. Kiyoko Takamizawa
36	7	5	Mon	Data compling	Water quality analisis, Jar test	
37	7	6	Tue	Medical Leave	Operation implementation	
38	7	7	Wed	Medical Leave	Operation implementation	
39	7	8	Thu	Medical Leave	Operation implementation, Prepare the report	
40	7	9	Fri	Medical Leave	Report to Dingle WD	
41	7	10	Sat	Medical Leave	Move to Manila	
42	7	11	Sun	Medical Leave	Survey of prrice, Prepare the report	Arrive at Manila
43	7	12	Mon	Medical Leave	Survey of prrice, Prepare the report	Price survey, Prepare the report
44	7	13	Tue	Move to Manila	Survey of prrice, Prepare the report	Price survey, Prepare the report
45	7	14	Wed	Survey of prrice, Prepare the report	Survey of prrice, Prepare the report	Price survey, Prepare the report
46	7	15	Thu	Survey of prrice, Prepare the report	Survey of prrice, Prepare the report	Price survey, Prepare the report
47	7	16	Fri	, Survey of price and Local contructor	Price survey, Prepare the report	Leave Manila
48	7	17	Sat	Data compling Prepare the Tender Document	Data compling Prepare the Tender Document	
49	7	18	Sun	Data compling Prepare the Tender Document	Data compling Prepare the Tender Document	
50	7	19	Mon	Prepare the report	Prepare the report	
51	7	20	Tue	Move to Lloilo, Explain to Dingle WD about outline of construction	Prepare the report	
52	7	21	Wed	Explain to Dingle WD about outline of construction, Move to Manila	Prepare the report	
53	7	22	Thu	Report to JICA Philippin, Leave Manila, Arrive Tokyom	Report to JICA Philippin, Leave Manila, Arrive in Tokyo.	

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No.	Date		Day	Team Leader	Study Planner	Chief Consultant/ Water Supply Designer	Water Treatment/O&M /Cost Estimate1
				Mr. Kohei Sato	Mr. Takanori Obayashi	Mr. Yusuke Ando	Mr. Teruki Murakami
1	8	18	Wed			Leave Tokyo, Arrive in Manila. Meetin about estimate	
2	8	19	Thu			JICA conference, Prepare the	
3	8	20	Fri			Receive PQ document, Prepare the estimate.	
4	8	21	Sat			Estimate, Prepare tender document	
5	8	22	Sun			Estimate, Prepare tender document	
6	8	23	Mon			Estimate･Submit to JICA a tender document, Expalin tender document of Dingle-Poltan WD/LWUA tender document, Chec of PQ, Move to	
7	8	24	Tue			Explain tender document of pontevedra WD, Move to Mnila,	
8	8	25	Wed			Modification of estimate, Check of	
9	8	26	Thu			Modification of estimate, Check of	
10	8	27	Fri			Submit to JICA estimate, Check of	
11	8	28	Sat			Check of PQ	
12	8	29	Sun			Check of PQ	
13	8	30	Mon			Check of PQ	

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No.	Date		Day	Team Leader	Study Planner	Chief Consultant/ Water Supply Designer	Water Treatment/O&M /Cost Estimate1
				Mr. Kohei Sato	Mr. Takanori Obayashi	Mr. Yusuke Ando	Mr. Teruki Murakami
14	8	31	Tue			Submit the Check of PQ,	
15	9	1	Wed			Modification of Tender document	
16	9	2	Thu			Modification of Tender document	
17	9	3	Fri			Modification of Tender document	
18	9	4	Sat			Modification of Tender document	
19	9	5	Sun	Leave Tokyo, Arrive in Manila		Modification of Tender document	
20	9	6	Mon	Visit JICA, LWUA, SW conference			
21	9	7	Tue	Move to Iloilo, Meetin with Dingle-PototanWD, Pontevedra. Sign of Potevedra WD minutes			
22	9	8	Wed	Move to Manila, Sign of Dingle-Pototan WD minutes			
23	9	9	Thu	Minutes sign of Reprt to Japanese Embassy, JICA			
24	9	10	Fri	Leave Manila, Arrive at Tokyo		Modification of tender document (SWconference)	
25	9	11	Sat			Modification of Tender document	Leave Tokyo, Arrive at Manila
26	9	12	Sun			Modification of tender document (SWconference)	Modification of tender document (SWconference)
27	9	13	Mon			Modification of tender document (SWconference)	Modification of tender document (SWconference)
28	9	14	Tue			Submit planed tender document, Move to Pamgasinan.	Submit planed tender document, Move to Pamgasinan.
29	9	15	Wed			Site survey Kalcan in Binmaley WD	Site survey Kalcan in Binmaley WD
30	9	16	Thu			Site survey Kalcan in Binmaley WD, Kick off meeting.	Site survey Kalcan in Binmaley WD
31	9	17	Fri			Site survey Kalcan in Binmaley WD	Site survey Kalcan in Binmaley WD
32	9	18	Sat			Site survey Kalcan in Binmaley WD	Site survey Kalcan in Binmaley WD
33	9	19	Sun			Site survey Kalcan in Binmaley WD	Site survey Kalcan in Binmaley WD
34	9	20	Mon			Modification of Tender document	Modification of Tender document
35	9	21	Tue			Modification of Tender document	Modification of Tender document
36	9	22	Wed			Modification of Tender document	Modification of Tender document
37	9	23	Thu			Site survey in fabia in LingayenWD	Site survey in fabia in LingayenWD
38	9	24	Fri			Site survey in fabia in LingayenWD	Site survey in fabia in LingayenWD
39	9	25	Sat			Site survey in LingayenWD(night)	Site survey in LingayenWD(night)
40	9	26	Sun			Site survey in LingayenWD(night)	Site survey in LingayenWD(night)
41	9	27	Mon			Leave Tokyo, Arrive in Manila.	Site survey in fabia in LingayenWD
42	9	28	Tue			Prepare the report	Prepare the report
43	9	29	Wed			Binmaley WD,	Binmaley WD,
44	9	30	Thu			Move to pagsanjan	Move to pagsanjan
45	10	1	Fri			PadsanjanWDconference, Site	PadsanjanWDconference, Site
46	10	2	Sat			PadsanjanWDSite survey	PadsanjanWDSite survey
47	10	3	Sun			PadsanjanWDSite survey, Prepare	PadsanjanWDSite survey, Prepare
48	10	4	Mon			PadsanjanWDconference, Move to Manila	PadsanjanWDconference, Move to Manila
49	10	5	Tue			JICA conference (Lot 2 tender schedule)	JICA conference (Lot 2 tender schedule)
50	10	6	Wed			Move to Iloilo, Dingle-PototanWDtest operation ・training	Prepare the estimate
51	10	7	Thu			Dingle-PototanWDtest operation ・	Prepare the estimate
52	10	8	Fri			Dingle-PototanWDtest operation ・	Prepare the estimate
53	10	9	Sat			Dingle-PototanWDtest operation ・	Prepare the estimate
54	10	10	Sun			Move to Manila Data compiling	Data compiling
55	10	11	Mon			Leave Manila, Arrive at Tokyo	Move to Pangasinan, Binmaley WD, LingayenWDconference, Move to Manila
56	10	12	Tue				Move to pagsanjan, PadsanjanWDconference, Move to Manila
57	10	13	Wed				Move to Tacloban, Train tabout Water quality in AbuyogWD. Move
58	10	14	Thu				Leave Manila, Arrive at Tokyo

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No.	Date		Day	Chief Consultant/ Water Supply Designer
				Mr. Yusuke Ando
1	10	26	Tue	Leave Tokyo, Arrive at Manila, Lot1 Tender opening, Estimate contractar
2	10	27	Wed	Estimate contractar
3	10	28	Thu	Move to Iloilo, Dingle-PototanWDtest operation ・training,
4	10	29	Fri	Dingle-PototanWDtest operation ・training, Estimate contractar
5	10	30	Sat	Dingle-PototanWDtest operation ・training
6	10	31	Sun	Dingle-PototanWDtest operation ・training
7	11	1	Mon	Dingle-PototanWDtest operation ・training
8	11	2	Tue	Move to Manila, Move to Tacloban
9	11	3	Wed	Monitoring AbuyogWD, Move to Manila
10	11	4	Thu	Negotiate with contractor Lot1
11	11	5	Fri	Negotiate with contractor Lot2
12	11	6	Sat	Data compiling
13	11	7	Sun	Data compiling
14	11	8	Mon	Contract with Lot 1 contractar
15	11	9	Tue	Leave Manila, Arrive at Tokyo

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No.	Date		Day	Team Leader	Study Planner	Water Treatment/O&M /Cost Estimate1	Construction Planning/Supervise
				Mr. Kazuhiko Ueno	Mr. Takanori Obayashi	Mr. Teruki Murakami	Ms. Kiyoko Takamizawa
1	11	15	Mon			Leave Tokyo, Arrive at Manila, Visti JICA	
2	11	16	Tue			Move to Pangasinan, Binmaley WD, LingayenWDconference, Move to Manila	
3	11	17	Wed			Move to pagsanjan, PadsanjanWDconference, Move to Manila, SW conference before	
4	11	18	Thu			Move to Iloilo, Dingle-PototanWD site transfer	
5	11	19	Fri			PontevedraWD, Site transfer	
6	11	20	Sat			Move to Manila	
7	11	21	Sun		Leave Tokyo, Arrive at Manila	Data compiling	
8	11	22	Mon	Visti JICA, LWUAconference, Move to pagsanjan, PadsanjanWDconference, Move to Manila		Visti JICA, LWUAconference, Move to pagsanjan, PadsanjanWDconference, Move to	
9	11	23	Tue	Move to Pangasinan, Binmaley WDconference, LingayenWDconference		Move to Pangasinan, Binmaley WDconference,	
10	11	24	Wed	Move to Manila, LWUAminutesconference		Move to Manila, LWUA minutes conference	
11	11	25	Thu	Sign minutes, Report to JICA, Embassy		Modification of tender document	
12	11	26	Fri		Leave Manila, Arrive at Tokyo	Modification of tender document	
13	11	27	Sat			Modification of tender document	
14	11	28	Sun			Modification of tender document	
15	11	29	Mon			Modification of tender document	Arrive at Manila
16	11	30	Tue			JICA conference, Modification of tender document	JICA conference, Move to Iloilo
17	12	1	Wed			Modification of tender document	Dingle-PototanWDconstruction management
18	12	2	Thu			Modification of tender document	Dingle-PototanWDconstruction management, Move to Manila

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No.	Date		Day	Team Leader	Study Planner	Water Treatment/O&M /Cost Estimate1	Construction Planning/Supervise
				Mr. Kazuhiko Ueno	Mr. Takanori Obayashi	Mr. Teruki Murakami	Ms. Kiyoko Takamizawa
19	12	3	Fri			Submit tendering document, estimate	contractor conference （arrange pumping test）
20	12	4	Sat			Data compiling	Data compiling
21	12	5	Sun			Data compiling	Move to Iloilo
22	12	6	Mon			Modification of tender document	PontevedraWDconference
23	12	7	Tue			Modification of tender document	arrange pumping test
24	12	8	Wed			Modification of tender document	arrange pumping test
25	12	9	Thu			Modification of tender document	Dingle-PototanWDconstruction management
26	12	10	Fri			JICA conference, Modification of tender document	Dingle-PototanWDconstruction management
27	12	11	Sat			contractorconference	Move to Manila,
28	12	12	Sun			Data compiling	Report to JICA, Leave Manila
29	12	13	Mon			Modification of tender document	
30	12	14	Tue			Modification of tender document	
31	12	15	Wed			Submit FinalTendering document	
32	12	16	Thu			Report to JICA	
33	12	17	Fri			Leave Manila, Arrive at Tokyo	

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No.	Date		Day	Water Treatment/O&M /Cost Estimate1
				Mr. Teruki Murakami
1	1	27	Thu	Leave Tokyo, Arrive at Manila, Iloilo Move to
2	1	28	Fri	Dingle-PototanWDconference, Move to Dabao via Manila,
3	1	29	Sat	Move to Iloilo, Dingle-PototanWD, Confirm the situation in
4	1	30	Sun	Confirm the situation in Dingle-PototanWD
5	1	31	Mon	Move to Manila, Lot2Tender
6	2	1	Tue	Estimate contractar
7	2	2	Wed	Estimate contractar
8	2	3	Thu	Conference with JICA expert
9	2	4	Fri	JICA conference, Move to Tacloban
10	2	5	Sat	Move to AbuyogWD, New water source survey
11	2	6	Sun	Data compiling, Move to Manila
12	2	7	Mon	Move to Iloilo, Dingle-PototanWD Test operation
13	2	8	Tue	Test operation in Dingle-PototanWD
14	2	9	Wed	Test operation in Dingle-PototanWD
15	2	10	Thu	Water analysis in Dingle-PototanWD
16	2	11	Fri	Manual preparation
17	2	12	Sat	Manual preparation
18	2	13	Sun	Manual preparation
19	2	14	Mon	Instruct inicial operation in Dingle-PototanWD
20	2	15	Tue	Instruct inicial operation inDingle-PototanWD
21	2	16	Wed	Move to Manila, conference with JICA expert
22	2	17	Thu	PadsanjanWD site transfer
23	2	18	Fri	Binmaley WDsite transfer
24	2	19	Sat	Data compiling
25	2	20	Sun	Data compiling
26	2	21	Mon	Data compiling

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No.	Date		Day	Water Treatment/O&M /Cost Estimate1
				Mr. Teruki Murakami
27	2	22	Tue	Report to JICA, Leave Manila, Arrive at Tokyo

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No.	Date		Day	Water Treatment/O&M /Cost Estimate1
				Mr. Teruki Murakami
1	3	6	Sun	Leave Tokyo, Arrive at Manila
2	3	7	Mon	Move to Lohas, PontevedraWDの Confirm the situation
3	3	8	Tue	Test operation in PontevedraWD
4	3	9	Wed	Test operation in PontevedraWD
5	3	10	Thu	Test operation in PontevedraWD, Manual preparation
6	3	11	Fri	PontevedraWDInstruct inicial operation
7	3	12	Sat	Confirm the operation situation in Dingle-Pototan WD
8	3	13	Sun	Data compiling
9	3	14	Mon	Move to Manila, Data compiling
10	3	15	Tue	Report to JICA, Leave Manila, Arrive at Tokyo

(8)

No.	Date		Day	Chief Consultant/ Water Supply Designer	Construction Planning/Supervise
				Mr. Yusueke Ando	Ms. Kiyoko Takamizawa
1	3	28	Mon		Arrive at Manila
2	3	29	Tue		JICA conference, Meetin with contractor （Lot1completion documente)
3	3	30	Wed		Sign complete verification Dingle-PototanWD, PontevedraWD
4	3	31	Thu		Meeting with contractor（Complete Lot 工, Confirm the document of Lot2）
5	4	1	Fri		PadsanjanWDconference, construction management
6	4	2	Sat		supervision of works
7	4	3	Sun		Move to Manila
8	4	4	Mon		Binmaley WDconstruction management, LWUA conference
9	4	5	Tue		Meeting with contractor
10	4	6	Wed		Meeting with contractor
11	4	7	Thu		Report to JICA, contractor Meeting with
12	4	8	Fri	Leave Tokyo, Arrive at Manila, Move to Iloilo	Leave Manila
13	4	9	Sat	Dingle-PototanWDconstruction management	
14	4	10	Sun	Dingle-PototanWDconstruction management	
15	4	11	Mon	Confirm test operation, in Dingle-PototanWD PontevedraWD	
16	4	12	Tue	check Dingle-PototanWD, Move to Manila, Report to JICA	
17	4	13	Wed	Binmaley WDの Confirm the situation	
18	4	14	Thu	Leave Manila, Arrive at Tokyo	

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No.	Date		Day	Chief Consultant/ Water Supply Designer	Water Treatment/O&M /Cost Estimate1	Construction Planning/Supervise
				Mr. Yusuke Ando	Mr. Teruki Murakami	Ms. Kiyoko Takamizawa
1	5	29	Sun			Arrive at Manila
2	5	30	Mon			JICA, LWUAconference
3	5	31	Tue			Move to pagsanjan, Confirm Sand separate instalationr
4	6	1	Wed			Move to Pangasinan, Binmaley WDconstruction management
5	6	2	Thu			Binmaley WDconstruction
6	6	3	Fri			Move to Manila,
7	6	4	Sat			Move to pagsanjan, Sand separate instalationrconstruction management
8	6	5	Sun			Move to Pangasinan
9	6	6	Mon			Binmaley WDconstruction
10	6	7	Tue			Binmaley WDconstruction
11	6	8	Wed			JICA implementation status suvey in Binmaley WD.construction
12	6	9	Thu	Leave Tokyo, Arrive at Manila, Meetin wit contractor of pump （Well）		JICA implementation status suvey in Binmaley WD, construction managementﾚﾍ
13	6	10	Fri	JICA, LWUAconference		Move to Manila, JICA conference
14	6	11	Sat	Data compiling, Logisttics		Leave Manila
15	6	12	Sun	Move to Iloilo		
16	6	13	Mon	Dingle-PototanWDconference, Confirm the situation		
17	6	14	Tue	Prepare to Install well pump in Dingle-PototanWD, Logistics		
18	6	15	Wed	Install well pump in Dingle-PototanWDconference, construction management		
19	6	16	Thu	Meeting about installing well pump in Dingle-PototanWD		
20	6	17	Fri	Meeting about installi the supply pump in Dingle-PortanWD		
21	6	18	Sat	Install Water supply pump in Dingle-PototanWD		
22	6	19	Sun	Install Water supply pump in Dingle-PototanWD		
23	6	20	Mon	Construction management of supply water pump in Dingle-PototanWD		
24	6	21	Tue	Construction management of supply water pump in Dingle-PototanWD		
25	6	22	Wed	Construction management of supply water pump in Dingle-PototanWD		
26	6	23	Thu	Construction management of supply water pump in Dingle-PototanWD	Leave Tokyo, Arrive at Manila, JICA conference	
27	6	24	Fri	Construction management of supply water pump in Dingle-PototanWD	Move to pagsanjan, Test operation, Move to Manila	
28	6	25	Sat	Construction management of supply water pump in Dingle-PototanWD	MaintenanceManual preparation	
29	6	26	Sun	Construction management of supply water pump in Dingle-PototanWD	MaintenanceManual preparation	
30	6	27	Mon	Construction management of supply water pump in Dingle-PototanWD	Move to pagsanjan, Instruct inicial operation, Move to Manila	
31	6	28	Tue	Construction management of supply water pump in Dingle-PototanWD	Move to Binmaley, Prepare test operation	
32	6	29	Wed	Construction management of supply water pump in Dingle-PototanWD	Test operation in Coloocan WTP, Fabia WTP	
33	6	30	Thu	Construction management of supply water pump in Dingle-PototanWD	Move to Manila, Move to Iloilo	

(9)-2

No.	Date		Day	Chief Consultant/ Water Supply Designer	Water Treatment/O&M /Cost Estimate1	Construction Planning/Supervise
				Mr. Yusuke Ando	Mr. Teruki Murakami	Ms. Kiyoko Takamizawa
34	7	1	Fri	Construction management of supply water pump in Dingle-PototanWD, Operation conference in PontevedraWD Move to Manila	Construction management of supply water pump in Dingle-PototanWD	
35	7	2	Sat	Leave Manila, Arrive at Tokyo	Pump test operation in Dingle-PototanWD	
36	7	3	Sun		Construction management of supply water pump in Dingle-PototanWD	
37	7	4	Mon		Construction management of supply water pump in Dingle-PototanWD	
38	7	5	Tue		Construction management of supply water pump in Dingle-PototanWD	
39	7	6	Wed		Construction management of supply water pump in Dingle-PototanWD	
40	7	7	Thu		Construction management of supply water pump in Dingle-PototanWD	
41	7	8	Fri		Construction management of supply water pump in Dingle-PototanWD	
42	7	9	Sat		Supply pumpu test operation in PontevedraWD, Move to Manila	
43	7	10	Sun		Move to Binmaley, Prepare test operation	
44	7	11	Mon		Test operation of ColocanWTP, Fabia WTP	Arrive at Manila, Move to Roxas
45	7	12	Tue		Test operation of ColocanWTP, Fabia WTP	Back wash test operation in PontevedraWD
46	7	13	Wed		Test operation of ColocanWTP, Fabia WTP Preoare maintenance manual	Back wash test operation in PontevedraWD, Adjustment of supply water pump in Dingle-Pototan
47	7	14	Thu		Instruct inicial operation, Sing completion certification, Move to Manila	Back wash test operation in PontevedraWD Supply water pump test operation in Dingle-Pototan
48	7	15	Fri		Leave Manila, Arrive at Tokyo	Back wash test operation in PontevedraWD
49	7	16	Sat			Back wash test operation in PontevedraWD, Test operation
50	7	17	Sun			Adjustment of supply water pump in PDingle-Pototan
51	7	18	Mon			Test operation of supply water pump, back wash test in Pontevedra, Sign of competion
52	7	19	Tue			Sign of competion of Dingle-Pototancompletion Move to Manila
53	7	20	Wed			Report to JICA, Leave Manila

APPENDIX-3 LIST OF PARTIES CONCERNED IN THE RECIPIENT COUNTRY

APPENDIX-3 List of Parties Concerned in the Recipient Country

(1) The First Survey of the Follow-up Cooperation Study Team

1 JICA Philippines Office

Norio Matsuda	Resident Representative
Masafumi Nagaishi	Senior Representative
Makoto Iwase	Representative
Naoto Kuwae	Representative
Kessy A. Reyes	Program Officer
Aileen Ian Gay N. Ramos	Accounting and Procurement Officer
Abegail M. Castillo	Procurement Officer Accounting and Procurement Section

2 Local Water Utilities Administration :LWUA

Daniel L. Landingin	CESO Ⅲ/CEO Ⅱ Acting Administrator
Emmanuel B. Malicdem	Deputy Administrator
Alden A. Ganhinhin	Head Counterpart/Project Manager LWUA-JICA Projects
Kenji Kasamatsu	Project Director of SWDIP Coordinator for Water Program-Philippines

3 Water District :WD

Jose G. Hidalgo, Jr.	Lingayen WD Board Chairman
Goluvelito Gonzales	Lingayen WD General Manager
Lillian N. Asprer	Dingle-Pototan WD Board Chairwoman
Rose Marie S. Banarez	Dingle-Pototan WD Interim General Manager

4 Embassy of Japan in the Philippines

Shoko Ogawa	Second Secretary

(2) Scope of Work Mission Team for Lot.1

1 JICA Philippines Office

Norio Matsuda	Resident Representative
Masafumi Nagaishi	Senior Representative
Kenzo Iwakami	Senior Representative
Makoto Iwase	Representative
Naoto Kuwae	Representative
Kessy A. Reyes	Program Officer

2 Local Water Utilities Administration :LWUA

Daniel L. Landingin	CESO Ⅲ/CEO Ⅱ Acting Administrator
Emmanuel B. Malicdem	Deputy Administrator
Alden A. Ganhinhin	Head Counterpart/Project Manager LWUA-JICA Projects

3 Water District :WD

Lillian N. Asprer	Dingle-Pototan WD Board Chairwoman
Rose Marie S. Banarez	Dingle-Pototan WD Interim General Manager
Rufino Vicudo	Dingle-Pototan WD Technical Manager
Other Board Members	Dingle-Pototan WD
Gilbert B. Villanueva	Pontevedra WD Board Chairman
Leandro Antonio B. Capulso	Pontevedra WD General Manager

Other Board Members	Pontevedra WD

4 Embassy of Japan in the Philippines

Shoko Ogawa	Second Secretary

(3) Scope of Work Mission Team for Lot.2

1 JICA Philippines Office

Norio Matsuda	Resident Representative
Naoto Kuwae	Representative
Kessy A. Reyes	Program Officer

2 Local Water Utilities Administration :LWUA

Emmanuel B. Malicdem	Deputy Administrator
Alden A. Ganhinhin	Head Counterpart/Project Manager LWUA-JICA Projects
Jesus Diaz	KfW Loan Project

3 Water District :WD

Marifel Pabilinia	Pagsanjan WD Board Chairwoman
Alex C. Paguio	Pagsanjan WD General Manager
Ronaldo M. Velasco	Pagsanjan WD Operation Manager
Other Board Members	Pagsanjan WD
Ida F. Rosario	Binmaley WD Board Chairwoman
Mariao Gonzalo	Binmaley WD General Manager
Other Board Members	Binmaley WD
Jose G. Hidalgo, Jr.	Lingayen WD Board Chairman
Goluvelito Gonzales	Lingayen WD General Manager

4 Embassy of Japan in the Philippines

Takehiko Sakata	First Secretary

(4) The Second and Later Survey of the Follow-up Cooperation Study Team

1 JICA Philippines Office

Masafumi Nagaishi	Senior Representative
Masanori Kurisu	Senior Representative
Kazuhiko Ueno	Senior Representative
Makoto Iwase	Representative
Naoto Kuwae	Representative
Kessy A. Reyes	Program Officer
Aileen Ian Gay N. Ramos	Accounting and Procurement Officer
Abegail M. Castillo	Procurement Officer Accounting and Procurement Section

2 Local Water Utilities Administration :LWUA

Alden A. Ganhinhin	Head Counterpart/Project Manager LWUA-JICA Projects
Jessielen D. Catapang	Chemist
Kenji Kasamatsu	Project Director of SWDIP Coordinator for Water Program-Philippines

3 Water District :WD

Mariao Gonzalo	Binmaley WD General Manager

Goluvelito Gonzales	Lingayen WD General Manager
Alex C. Paguid	Pagsanjan WD General Manager
Leandro Antonio B. Capulso	Pontevedra WD General Manager
Rose Marie S. Banarez	Dingle-Pototan WD Interim General Manager
Meldy A Deueyra	Abuyog WD Acting General Manager

4 Technical Cooperation Project Team “Small Water Districts Improvement Project”

Masatoshi Momose	NJS Consultants Co., Ltd.
Nobuyuki Gonohe	NJS Consultants Co., Ltd.

APPENDIX-4 MINUTES OF DISCUSSIONS

MINUTES OF DISCUSSIONS
ON THE FOLLOW-UP COOPERATION
ON THE PROJECT OF IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
LOCAL WATER UTILITIES ADMINISTRATION
AND
THE WATER DISTRICTS

In response to a request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") decided to conduct a Follow-up Cooperation Study on the Project of Improvement of Water Quality in Local Areas.

JICA sent to the Philippines the Follow-up Cooperation Study Team (hereinafter referred to as "the Team") from 12th April 2010 to October, 2010.

The Team held discussions with Philippine officials concerned and conducted a field survey in Dingle-Pototan and Lingayen.

In the course of discussions and field survey, both parties confirmed the main items described on the attached sheets. The Team will proceed to further works and examine the contents of the Follow-up Cooperation.

Manila, 16th April, 2010

Hiroyuki Kinomoto	Daniel I. Landingin
Team Leader,	Acting Administrator,
Follow-up Cooperation Study Team,	Local Water Utilities Administration,
Japan International Cooperation Agency	Philippines

Lilian N. Asprer
Chairman,
Interim Board of Directors of
Dingle-Pototan Water District,
Philippines

Jose G. Hidalgo, Jr.
Chairman,
Board of Directors of Lingayen
Water District,
Philippines

Noted by

Gilbert B. Villanueva
Chairman,
Board of Directors of Pontevedra
Water District,
Philippines

Ida F. Rosario
Chairman,
Board of Directors of Binmaley
Water District,
Philippines

Imelda de Veyra
Chairman,
Board of Directors of Abuyog
Water District,
Philippines

Marifel Pabilonia
Chairman,
Board of Directors of Pagsanjan
Water District,
Philippines

ATTACHMENT

The Local Water Utilities Administration (hereinafter referred to as "LWUA"), the water districts and the Team shared the views on the issues to be solved in each Water Treatment Plant (hereinafter referred to as "WTP") which was constructed by Japanese Grant Aid.

The present conditions of the WTPs which are not in operation are as follows.

a) Dingle-Pototan: the replacement of the existing pipes will be completed by August 2010. The office of the water district was transferred inside of the WTP, therefore, the security of the electric cable has been improved.
b) Lingayen: the precondition to operate WTP is to decrease non revenue water. Although the application of the Loan for the replacement of existing pipes is already submitted by the water district, it has not been approved yet.

With regard to the Panitan WTP, present WTP is in use as stand-by of the Paslang WTP. The full operation of the WTP is scheduled from 2013, when the water demand exceeds the capacity of the Paslang WTP in Metro Roxas Water District. JICA strongly requested LWUA to discuss with Metro Roxas Water District to consider the possible measures for the earlier operation.

Apart from the issues mentioned above, LWUA and the Team recognized that there are further necessity to improve the water supply systems in the other 4 water districts which mentioned in the Minutes of Meeting signed on 4th June, 2009.

In order to ensure sustainable water supply, LWUA, the water districts and the Team agreed to take necessary measures described as follows.

I. THE MEASURES FOR THE IMPROVEMENT OF THE WATER SUPPLY

1. The measures to be taken by JICA

The team explained that JICA is considering following measures;

a) Rehabilitation of water treatment plants by the Grant Aid Follow-up Cooperation Project (hereinafter referred to as "the Project"). The components of the Project will be designed and estimated through the follow-up cooperation study (hereinafter referred to as "the Study"). The details of the Study are summarized in the article II. The general

conditions for the Grant Aid follow-up cooperation are also shown in Annex 2.

b) Technical assistance to formulate the Improvement Plans to improve the financial status of water districts (on-going).

c) The technical assistance in the operation and maintenance of the WTPs.

2. The measures to be taken by LWUA

a) To facilitate allocation of the necessary budget for Lingayen Water District to rehabilitate its water supply system. The rehabilitation is indispensable for the operation of the WTP to an early date.

b) As an incentive to operate the WTP, to consider the application of Lingayen Water District for the suspension of billing and payment of accumulated arrears on penalty and interest on the loan acquired by the water district for the payment of taxes related to the Grant Aid Project.

c) To allocate the budget for the development of the deep well nearby the WTP in Pontevedra Water District.

d) To provide technical assistance to water districts to assure proper operation and maintenance.

3. The measures to be taken by the water districts

a) The water districts where WTP is not in operation: Dingle-Pototan, Lingayen,

- The water districts agreed to operate the WTP at an early date, once the necessary conditions are met.
- In Dingle-Pototan Water District, the operation of the WTP is scheduled to be started on August 2010, upon completion of reconnection of the electric cable and pipe replacement. However, there is a possibility that the start of operation may be rescheduled if significant problems are found from the result of test operation of the WTP.
- To allocate necessary personnel and cost for the proper operation and maintenance of the WTP.
- In Lingayen water district, it is difficult to operate the WTP before the replacement of existing pipes. The major premise to conduct the pipe replacement is the approval of the Loan which is already applied with LWUA. Even if the loan is approved, the completion of the pipe replacement will take at least two years. Therefore, the water district promised to start the operation of WTP in advance to the completion of the replacement, by prioritizing the construction works in the areas to be served by the WTP and where old pipes mainly exist.

- To allocate necessary personnel and cost for the proper operation and maintenance of the WTP.

b) The water districts whose WTP is under operation but have some issues to be solved: Abuyog, Pontevedra, Binmaley, Pagsanjan

- The water districts will be responsible for operation and maintenance of the rehabilitated facilities.

To realize the sustainable operation of the water supply, all parties are agreed to implement the above measures, which are summarized in "the road map" attached as the Annex-1. LWUA and the water districts also understand that the measures to be undertaken by JICA will be finalized after the Study and the roadmap might be modified according to the Study results.

II. THE FOLLOW-UP STUDY ON THE REHIBLITATION OF WATER TREATMENT PLANTS

Regarding the Study which is mentioned in Articlel-1, all parties agreed to the following details.

1. Purpose

The purpose of the Study is to design and estimate the Grant Aid Follow-up Cooperation Project which aims to rehabilitate the WTPs constructed by the Japanese Grant Aid.

2. The period of the Study

From April to October 2010

3. Implementation schedule

The study will cover 6 water districts, which are divided into two lots. Lot 1 includes Dingle-Pototan Water District, Pontevedra Water District and Abuyog Water District. While succeeding lot 2 includes Lingayen Water District, Binmaley Water District and Pagsanjan Water District.

The details of the Project components will be finalized in accordance to the result of the Study and be authorized by the parties concerned in the form of the Scope of Works. The Scope of Works will be signed for lot 1 and lot 2 correspondingly, which is scheduled by July 2010 for lot1 and November 2010 for lot 2.

4. Contents of the Study

The main contents of the Study are as follows;

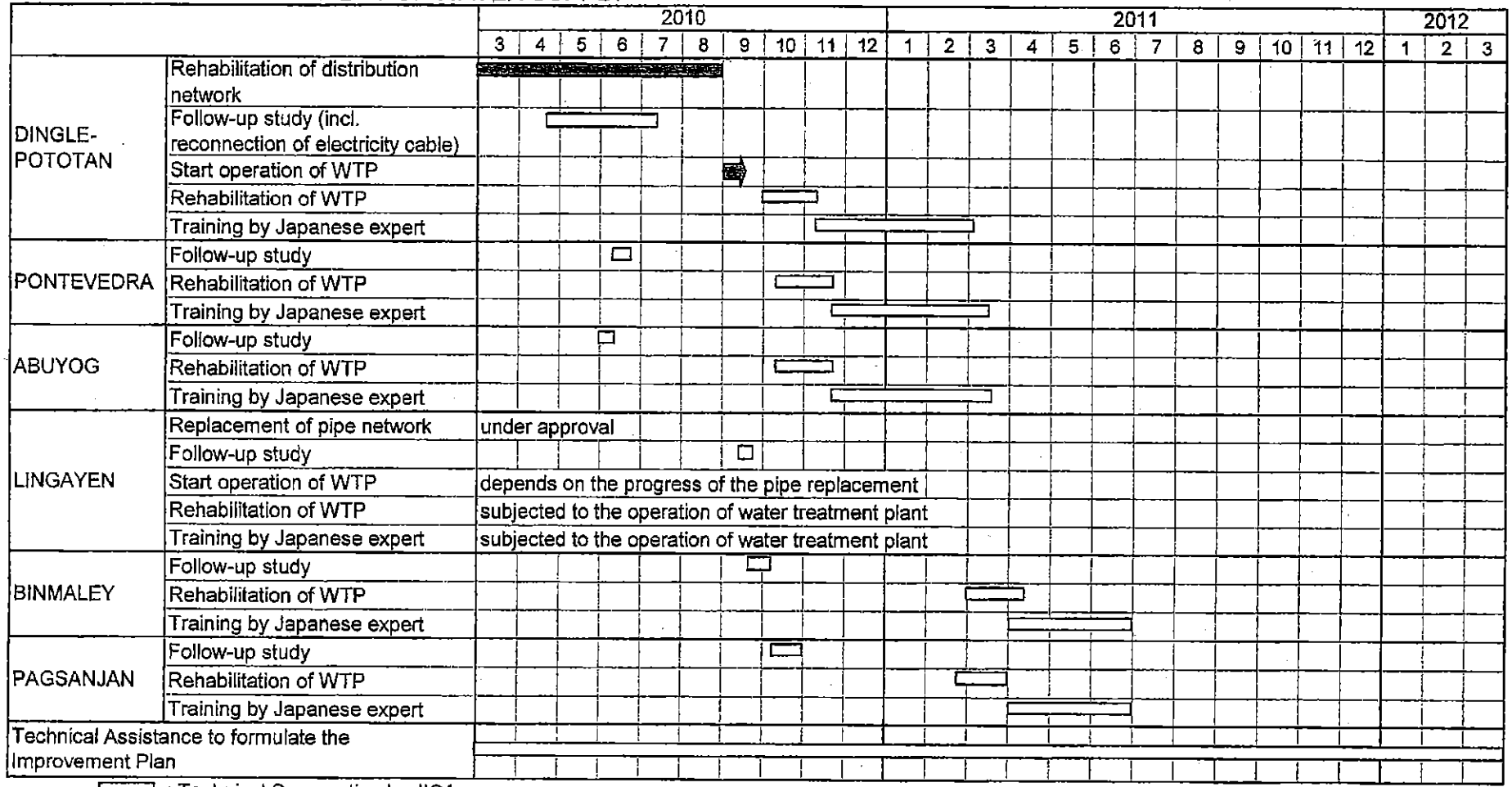
- water quality analysis,
- experiment to verify the treatment process,
- field survey to design the rehabilitation plan of the WTP, and
- cost estimation.

Annex-1 Roadmap for improvement of water supply in each water district.

Annex-2 The outline of the Grant Aid follow-up cooperation project

Annex 1

PROJECT FOR IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS IN PHILIPPINES
ROADMAP FOR IMPROVEMENT OF WATER SUPPLY



Annex 2

THE OUTLINE OF THE GRANT AID FOLLOW-UP COOPERATION PROJECT TO REHABILITATE THE WATER TREATMENT PLANTS

Regarding the Project mentioned in Articlel-1, all parties are agreed to the following conditions.

1. General conditions of the grant aid follow-up cooperation

a) The Project cannot modify the basic concept of the Original Project, thus it cannot include the facilities or equipment that were not covered in the past.
b) Request for the Grant Aid follow-up cooperation is allowed only once.
c) The components of the Project will be finalized according to the result of the Study.
d) The procurement for the Project will be done by the JICA Philippines Office.

2. The Undertakings by the Philippines' side

Once the Project is commenced, LWUA is responsible to take necessary measures described bellow in order to ensure the smooth implementation.

a) to provide necessary information to JICA. Information which may affect the basic concept of the Project is especially important, such as the change in schedule of the rehabilitation and the plan of new water development;
b) to ensure prompt unloading and customs clearance of the components and spare parts;
c) to ensure the refund of custom duties, internal taxes and other fiscal levies for the components purchased;
e) to accord Japanese nationals, who will be engaged for the Project, the necessary arrangement for their entry and stay in the Philippines, as well as to secure sufficient space, and to provide security information on the project site; and
d) to report the condition of the improved facilities to JICA Philippines Office six months after the completion of the construction.

MINUTES OF DISCUSSIONS
ON THE FOLLOW-UP COOPERATION
ON THE PROJECT FOR IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
LOCAL WATER UTILITIES ADMINISTRATION

In response to the official request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Mission Team (hereinafter referred to as "the Team") to the Philippines from September 5th to 11th, 2010 to discuss the Scope of Work for the Follow-up Cooperation (Lot 1) on the Project for Improvement of Water Quality in Local Areas (hereinafter referred as "the F/U Cooperation").

The Team held discussions with LWUA, Dingle-Pototan Water District (hereinafter referred to as "WD") and Pontevedra WD and reached an agreement on the Scope of Work as attached.

In the course of discussions between the Team and LWUA, both parties confirmed the main items described on the attachment.

Manila, 9th September, 2010

Kohei Sato
Team Leader,
Scope of Work Mission for the Follow-up Cooperation,
Japan International Cooperation Agency

Daniel I. Landingin, CESOIII/CEO III
Administrator,
Local Water Utilities Administration
Philippines

ATTACHMENT

1. Scope of Work

LWUA endorsed the Scope of Work (hereinafter referred to as "S/W") for the F/U Cooperation for Dingle-Pototan WD and Pontevedra WD. (Appendix Ⅰ and Ⅱ)

2. Undertakings by JICA

The major undertakings by JICA are as follows:

- to select a local contractor through tender procedures;
- to execute the rehabilitation of the WTP as is mentioned in the S/W; and
- to secure supervision of the rehabilitation of the WTP by Japanese consultant.

3. Undertakings by LWUA

The major undertakings by LWUA are as follows:

(1) Dingle-Pototan

- to allocate necessary budget to complete the rehabilitation of distribution pipe by the end of December, 2010;
- to support partial operation of the WTP from the middle of October, 2010; and
- to support the allocation of necessary personnel and budget for the proper operation and maintenance of the WTP.

(2) Pontevedra

- to facilitate the allocation of necessary budget to develop alternative water source by the completion of the rehabilitation of the WTP;
- to provide technical assistance to reduce Un-accounted for Water rate; and
- to support the allocation of necessary personnel and budget for the proper operation and maintenance of the WTP.

4. Others

(1) Lingayen

- While JICA will conduct a survey for Lingayen WD in the end of September, 2010, LWUA will secure necessary budget to rehabilitate distribution pipe by the beginning of the F/U Cooperation for Lot 2.

(2) Abuyog

- JICA and LWUA reached a consensus that it is indispensable to develop new water source with a better water quality before rehabilitation of the WTP, in lieu of the present one which has chemical elements that make operation of the WTP beyond the financial capability of the Abuyog WD.
- Both parties agreed to take measures to allocate necessary budget for the water source development at an early date.

(3) Roadmap for Improvement of Water Supply

As attached Appendix Ⅲ.

Appendix Ⅰ: S/W for the F/U Cooperation for Dingle-Pototan WD
Appendix Ⅱ: S/W for the F/U Cooperation for Pontevedra WD
Appendix Ⅲ: Roadmap for Improvement of Water Supply

SCOPE OF WORK
FOR
THE FOLLOW-UP COOPERATION
ON
THE PROJECT OF IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
AGREED UPON BETWEEN
DINGLE-POTOTAN WATER DISTRICT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

In response to the official request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Mission Team (hereinafter referred to as "the Team") to the Philippines from September 5th to 11th, 2010 to discuss the Scope of Work for the Follow-up Cooperation (Lot 1) on the Project of Improvement of Water Quality in Local Areas (hereinafter referred as "the F/U Cooperation").

This document sets forth the scope of the F/U Cooperation on Dingle-Pototan Water District (hereinafter referred to as "the WD") and the undertakings to be taken by the authorities concerned, based on the discussion held between the Team and the WD.

Manila, 8th September, 2010

Kohei Sato Team Leader, Scope of Work Mission for the Follow-up Cooperation, Japan International Cooperation Agency	Lillian N. Asprer Chairperson, Interim Board of Directors of Dingle-Pototan Water District, Philippines

1. Introduction

In response to the official request from the Philippines, JICA conducted the study on the F/U Cooperation for Dingle-Pototan WD from July 2nd to 9th, 2010. Based upon the results of the study, the Team held discussion with the WD and reached an agreement on the Scope of Work and the undertakings to be taken by the authorities concerned.

2. Scope of Work

The Scope of Work for the F/U Cooperation on the WD shall be repair and replacement of the facilities in the Water Treatment Plant (hereinafter referred to as "the WTP") indicated in Appendix 1.

3. Tentative Work Schedule

The F/U Cooperation will be carried out in accordance with the tentative schedule indicated in Appendix 2.

4. Major Undertakings by JICA

The major undertakings by JICA are as follows:

- to select a local contractor through tender procedures;
- to execute the rehabilitation of the WTP as is mentioned in Article 2 above; and
- to secure supervision of the rehabilitation of the WTP by Japanese consultant.

5. Major Undertakings by Dingle-Pototan WD

The major undertakings by the WD are as follows:

- to complete the rehabilitation of distribution pipe by the end of December, 2010;
- to start partial operation of the WTP from the middle of October, 2010; and
- to allocate necessary personnel and budget for the proper operation and maintenance of the WTP.

6. Mutual Consultation

JICA and the Philippines shall consult with each other on any matters that may arise from or connected with the work prior to actual responses.

Appendix 1 List of facilities to be covered by the cooperation
Appendix 2 Tentative work schedule

Appendix 1

List of facilities to be covered by the Follow-up Cooperation [Dingle-Pototan]

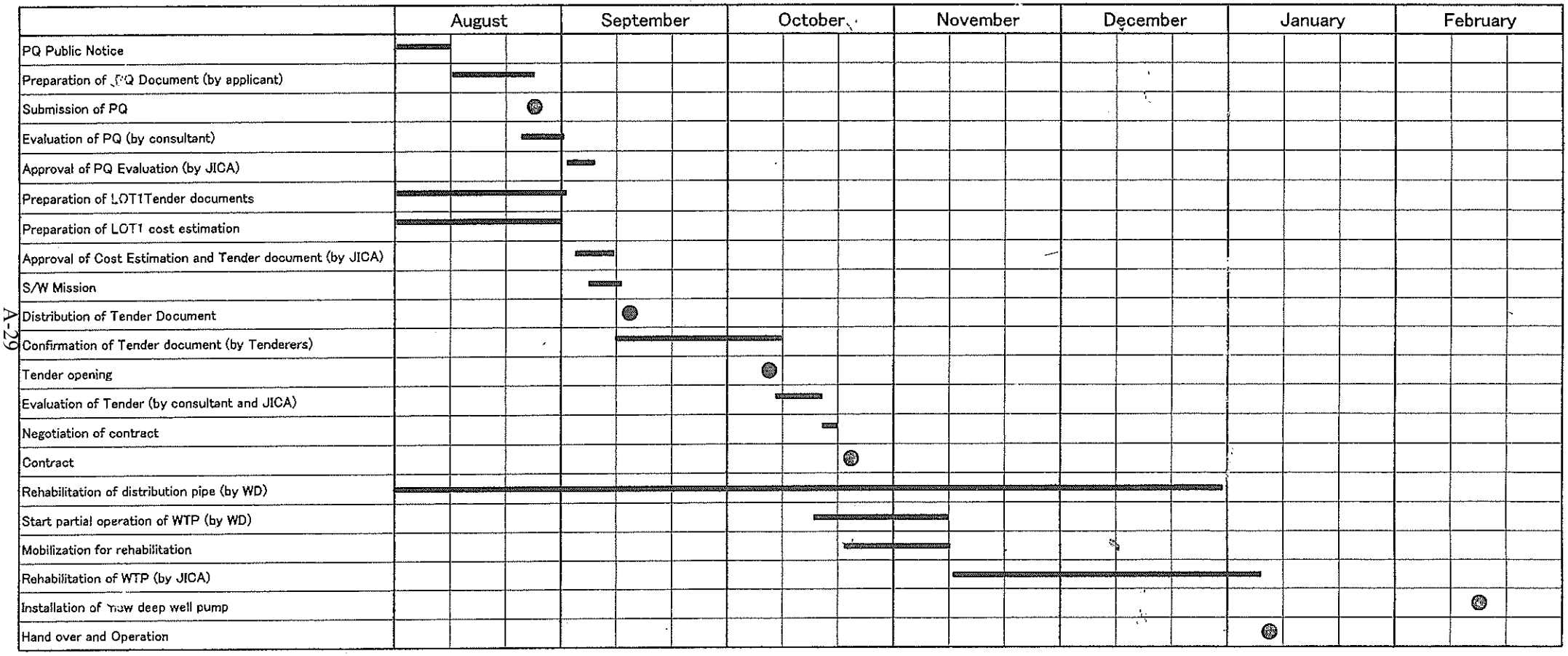
Facility	Component	Item	Category	Specifications	Unit	Q'ty
Intake Facility	Deep Well	Pumping Test	New	Step-drawdown 4hr x 3, continuous12hr, recovery 6hr	unit	1
		Deep well pump	Change	1.8m3/min x 80mH x 37kW (*)	pc.	1
		Riser pipe	Change	Φ150 SP	m	57
Aeration Tank	Aeration Tank	Water proof plastering	Repair	Demolish & repair, inside:water resist mortar,outside: paint	unit	1
Floccurator	Baffle Plates/submerged	Lumber installation	Repair	Lumber block 2.5cm x 5cm water-resist	m	15
	Baffle Plates/overflow	Plate installation	Repair	Lumber plate W25cm x L100cm x T3cm water-resist	m	84
Rapid Sand Filter	Inlet Trough	Inlet pipe installation	Repair	Φ150 SP w/flange salinity-resist coating, 2m	pc.	2
		Weir plate	New	Lumber plate W30cm x L90cm x T3cm water-resist	pc.	2
		Weir holding plate	New	Lumber plate W50cm x L150cm x T3cm water-resist	pc.	4
Chlorination Facility	Chlorination Room	Door	Change	900 x 2100 SUS frame, alminum door coated	unit	1
	Intermediate-Chlorination	Injection pipe	Change	Φ15 PVC	m	12
		Injection valve	New	PVC cock Φ15	pc.	4
Sludge Drying Bed	Drying Bed	Drying bed structure	Repair	Existing wall hightening (500mm)	unit	1
		Sand & gravel filling	Repair	Gravel 10-20mm/25-35mm/40-60mm, sand 4-6mm	unit	1
Transmission Facility	Transmission Pump	Transmission pump	Change	1.3m3/min x 35m x 15kW Φ200	pc.	2
All Facility	Painting	Painting	Repair	Wall (497.32m2), Door (21.52m2), Handrail (79.05m2)	pc.	1

(*) Capacity of the deep well pump shall be decided according to the pumping test result.

All pump are three phase and 60Hz.

Appendix 2

Tentative Schedule of the Follow-up Cooperation for Dingle-Pototan WD



SCOPE OF WORK
FOR
THE FOLLOW-UP COOPERATION
ON
THE PROJECT OF IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
AGREED UPON BETWEEN
PONTEVEDRA WATER DISTRICT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

In response to the official request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Mission Team (hereinafter referred to as "the Team") to the Philippines from September 5th to 11th, 2010 to discuss the Scope of Work for the Follow-up Cooperation (Lot 1) on the Project of Improvement of Water Quality in Local Areas (hereinafter referred as "the F/U Cooperation").

This document sets forth the scope of the F/U Cooperation on Pontevedra Water District (hereinafter referred to as "the WD") and the undertakings to be taken by the authorities concerned, based on the discussion held between the Team and the WD.

Pontevedra, 7th September, 2010

Kohei Sato
Team Leader,
Scope of Work Mission for the Follow-up Cooperation,
Japan International Cooperation Agency

Gilbert B. Villanueva
Chairman,
Board of Directors of Pontevedra Water District,
Philippines

1. Introduction

In response to the official request from the Philippines, JICA conducted the study on the F/U Cooperation for Pontevedra WD from June 24th to July 1st, 2010. Based upon the results of the study, the Team held discussion with the WD and reached an agreement on the Scope of Work and the undertakings to be taken by the authorities concerned.

2. Scope of Work

The Scope of Work for the F/U Cooperation on the WD shall be repair and replacement of the facilities in the Water Treatment Plant (hereinafter referred to as "the WTP") indicated in Appendix 1.

3. Tentative Work Schedule

The F/U Cooperation will be carried out in accordance with the tentative schedule indicated in Appendix 2.

4. Major Undertakings by JICA

The major undertakings by JICA are as follows:

- to select a local contractor through tender procedures;
- to execute the rehabilitation of the WTP as is mentioned in Article 2 above; and
- to secure supervision of the rehabilitation of the WTP by Japanese consultant.

5. Major Undertakings by Pontevedra WD

The major undertakings by the WD are as follows:

- to develop alternative water source by the completion of the rehabilitation of the WTP;
- to take necessary measures to reduce high Un-accounted For Water rate; and
- to allocate necessary personnel and budget for the proper operation and maintenance of the WTP.

6. Mutual Consultation

JICA and the Philippines shall consult with each other on any matters that may arise from or connected with the work prior to actual responses.

Appendix 1 List of facilities to be covered by the cooperation
Appendix 2 Tentative work schedule

Appendix 1

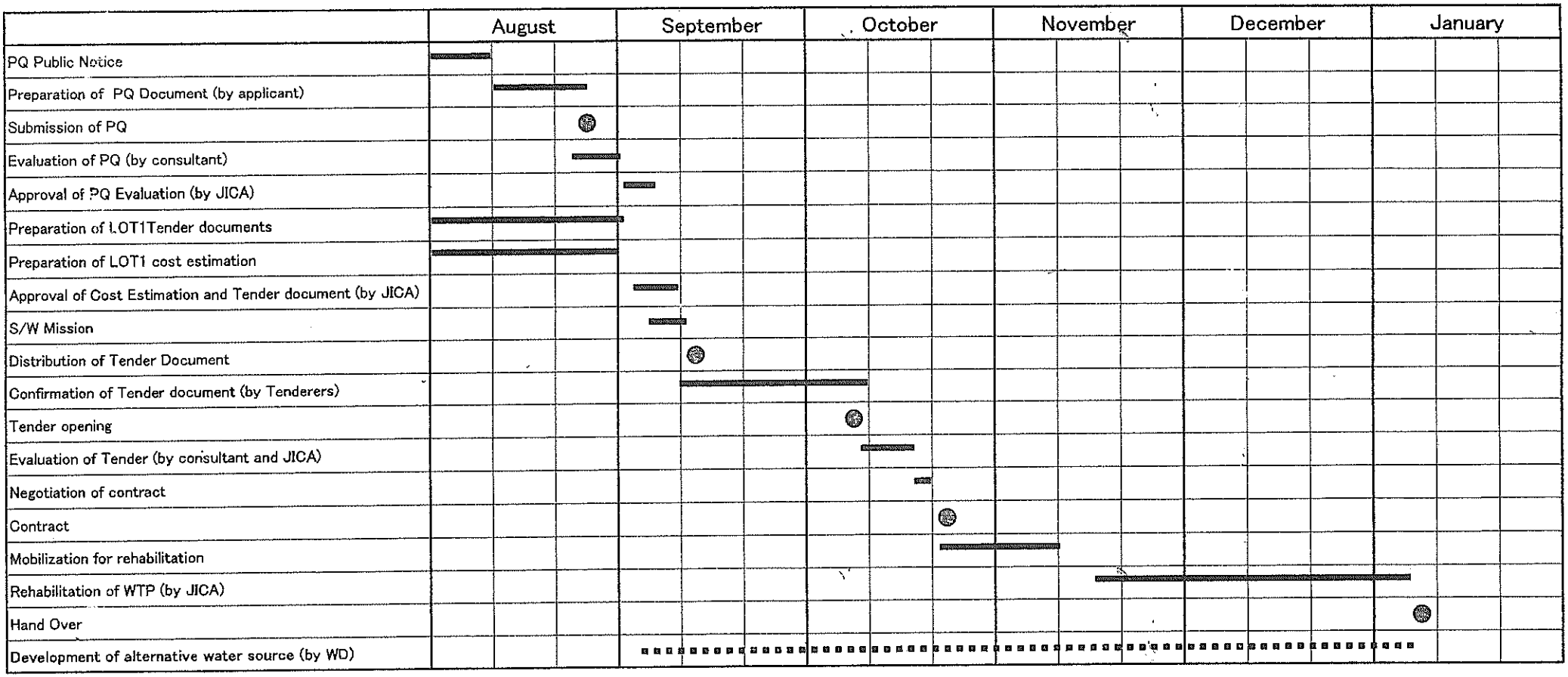
List of facilities to be covered by the Follow-up Cooperation [Pontevedra]

Facility	Component	Item	Category	Specifications	Unit	Q'ty
Aeration Tower	Aeration Tank	Opening of manhole	Repair	600 x 600 near entrance door	unit	2
		Ladder	New	Aluminum, sliding stretch type 5m, portable	pc.	1
Floccurator	Baffle Plates/submerged	Lumber installation	Repair	Lumber block 2.5cm x 5cm water-resist	m	15
	Baffle Plates/overflow	Plate installation	Repair	Lumber plate W25cm x L100cm x T3cm water-resist	pc.	84
Sedimentation Basin	Inlet Pipe	Inlet valve	Change	Butterfly valve Φ250 salinity-resist coating, stainless	pc.	2
	Sludge Drain Equipment	Sludge drain pump	New	Self-priming pump	pc.	3
		Push cart	New	For pump mount	pc.	1
		Rail	New	L-section steel L-30 x 30 x 5	m	30
		Hose for suction side	New	Blade hose Φ80 with fitting L=5m	unit	2
		Hose for delivery side	New	Fire Hydrant hose Φ80 with fitting L=20m	unit	2
		Pipe for fitting	New	Connection for hose	pc.	1
		Electrical work	New	Outlet, Motor Breaker, Extension cable	unit	1
Rapid Sand Filter	Inlet Trough	Inlet pipe installation	Repair	Φ150 SP w/flange salinity-resist coating, 2m	pc.	2
		Weir plate	New	Lumber plate W30cm x L90cm x T3cm water-resist	pc.	2
		Weir holding plate	New	Lumber plate W50cm x L150cm x T3cm water-resist	pc.	4
	Back Wash System	Back wash pump	Change	6.4m3/min x 12mH x 30kW Φ250	pc.	1
	Surface Wash System	Surface wash pipe	Change	Φ150/50/25 SP, salinity-resist coating	unit	1
		Flow meter	Change	Φ150 turbine-type w/accumulation	pc.	1
Chlorination Facility	Chlorination Room	Door	Change	900 x 2100 SUS frame, alminum door coated	unit	1
	Agitator	Agitator support	Change	Lumber □15cm x 10cm, water-resist painting	m	6
	Intermediate-Chlorination	Injection pump	Change	1.7～2.0l/min x 0.8MPa x 0.2kW	pc.	1
		Injection pipe	Change	Φ15 PVC	m	12
		Injection valve	New	PVC cock Φ15	pc.	4
	Post-Chlorination	Injection pump	Change	0.25～0.3l/min x 1.0MPa x 0.2kW	pc.	1
		Injection pipe	Change	Φ15 PVC	m	30
		Trough for injection pipe	New	RC D150 x W150 w/grating cover	m	20
		Connection box w/fittings	New	RC 1000 x 1000 x 800 w/steel cover, Φ15 PVC valves & fitt	unit	1
Sludge Drying Bed	Drying Bed	Sand & gravel filling	Repair	Gravel 10-20mm/25-35mm/40-60mm, sand 4-6mm	unit	1
Transmission Facility	Transmission Pipe	Transmission pipe	New	Φ200 SP w/epoxy-lining, underground	m	80
		Transmission pipe	New	Φ200 PVC, underground	m	470
		Gate valve	New	GV Φ200 salinity-resist coating	pc.	1
		Flow meter	New	Φ200 turbine type w/accumulation salinity-resist coating	pc.	1
		Level Control valve	New	Level control valve Φ150 salinity-resist coating w/ball-tap	pc.	1
		Inlet valve	New	GV Φ150 salinity-resist coating	pc.	1
	Transmission Pump	Transmission pump	Change	1.34m3/min x 45mH x 18.5kW Φ200	pc.	2
All Facility	Painting	Painting	Repair	Wall (680.83m2), Door (44.08m2), Handrail (79.05m2)	pc.	1

All pump are three phase and 60Hz.

Appendix 2

Tentative Schedule of the Follow-up Cooperation for Pontevedra WD



Appendix III

PROJECT FOR IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS IN PHILIPPINES
ROADMAP FOR IMPROVEMENT OF WATER SUPPLY

Project Site		To Do	2010										2011												2012		
			3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Lot 1	DINGLE-POTOTAN	Rehabilitation of distribution network																									
		Follow-up study (incl. reconnection of electricity cable)																									
		Start partial operation of WTP																									
		Rehabilitation of WTP																									
		Training by Japanese expert																									
	PONTEVEDRA	Follow-up study																									
		Rehabilitation of WTP																									
		Training by Japanese expert																									
	ABUYOG	Follow-up study																									
		Rehabilitation of WTP	depends on the progress of water source development																								
		Training by Japanese expert	subjected to the operation of water treatment plant																								
Lot 2	BINMALEY	Follow-up study																									
		Rehabilitation of WTP																									
		Training by Japanese expert																									
	PAGSANJAN	Follow-up study																									
		Rehabilitation of WTP																									
		Training by Japanese expert																									
	LINGAYEN	Replacement of pipe network	under approval																								
		Follow-up study																									
		Start operation of WTP	depends on the progress of the pipe replacement																								
		Rehabilitation of WTP	subjected to the operation of water treatment plant																								
		Training by Japanese expert	subjected to the operation of water treatment plant																								
Technical Assistance to formulate the Improvement Plan																											

: Technical Cooperation by JICA
: Follow-up Cooperation by JICA
: Undertaking by LWUA and WD

MINUTES OF DISCUSSIONS
ON THE FOLLOW-UP COOPERATION
ON THE PROJECT FOR IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
LOCAL WATER UTILITIES ADMINISTRATION

In response to the official request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Mission Team (hereinafter referred to as "the Team") to the Philippines from November 22nd to 26th, 2010 to discuss the Scope of Work for the Follow-up Cooperation (Lot 2) and other related issues on the Project for Improvement of Water Quality in Local Areas.

The Team held discussions with Pagsanjan Water District (hereinafter referred to as "WD") and Binmaley WD and reached to an agreement on the Scope of Work as attached. The Team also had a discussion with Lingayen WD and shared a prospective schedule of the F/U cooperation for the WD.

In the course of discussions between the Team and the Local Water Utilities Administration (hereinafter referred to as "LWUA"), both parties confirmed the main items described on the attachment.

Manila, 25th November, 2010

Kazuhiko Ueno
Senior Representative,
Philippines Office
Japan International Cooperation Agency

Emmanuel B. Malicdem
Deputy Administrator,
Local Water Utilities Administration
Philippines

ATTACHMENT

1. Scope of Work for the F/U Cooperation (Lot2)

(1) LWUA endorsed the Scope of Work (hereinafter referred to as "S/W") of the F/U Cooperation for Pagsanjan WD and Binmaley WD that are attached as Appendix Ⅰ and Ⅱ.

(2) The major undertakings by JICA for the F/U Cooperation are as follows:
- to select a local contractor through tender procedures;
- to execute the rehabilitation of the WTP as is mentioned in the S/W; and
- to secure supervision of the rehabilitation of the WTP by Japanese consultant.

(3) The major undertaking by LWUA for the F/U Cooperation is to support the allocation of necessary personnel and budget for the proper operation and maintenance of the WTP.

2. Prospective schedule of the F/U Cooperation for Lingayen WD

(1) Both parties confirmed that the rehabilitation of the water treatment plant (hereinafter referred to as "WTP") in Lingayen WD, which was originally planned in the Lot 2 Cooperation, needs to be postponed due to the delay of the pipeline replacement.

(2) LWUA basically endorsed the prospective schedule agreed between Lingayen WD and JICA except that it estimated the detail design take longer than three months, and promised to advance entire process of the KfW Loan Project so that the rehabilitation and operation of the WTP in Lingayen WD can start at an early date.

3. Progress of the undertakings for Dingle-Pototan WD and Pontevedra WD

(1) Both parties confirmed that the WTP in Dingle-Pototan WD has been partially operated, although it is needed to complete the transfer of service connections for full-time operation. LWUA committed to preferentially release the remaining fund necessary for the transfer of service connections for Dingle-Pototan WD.

(2) LWUA also promised to assist the Pontevedra WD to advance the water source development in the KfW Loan Project.

4. Water source development in Abuyog WD

(1) Both parties reconfirmed that the rehabilitation of the WTP in Abuyog WD, which was originally planned in the Lot 1 Cooperation, needs to be postponed until new water source with a better quality is developed as agreed in the Minutes of Discussions on 9th September, 2010.

(2) JICA set forth a plan of conducting a survey on water source development in Abuyog WD, and LWUA agreed to support such undertaking by providing available data and technical advice relevant to the survey.

5. Training for WD by JICA expert

(1) In response to the dispatch of JICA expert from January 2010, LWUA promised to allocate a counterpart as a contact person and to help identifying specific training needs of respective WD.

(2) LWUA mentioned that the training should be intended mainly for Dingle-Pototan WD and Pontevedra WD in terms of current situation of WTP management.

6. Roadmap for Improvement of Water Supply

Both parties concurred on the updated roadmap for Improvement of Water Supply which is attached as Appendix Ⅳ.

Appendix Ⅰ: S/W for the F/U Cooperation for Pagsanjan WD
Appendix Ⅱ: S/W for the F/U Cooperation for Binmaley WD
Appendix Ⅲ: M/D between JICA and Lingayen WD
Appendix Ⅳ: Roadmap for Improvement of Water Supply

SCOPE OF WORK
FOR
THE FOLLOW-UP COOPERATION
ON
THE PROJECT OF IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
AGREED UPON BETWEEN
PAGSANJAN WATER DISTRICT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

In response to a request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") conducted the "Study for the Follow-up Cooperation (Lot 2) on the Project of Improvement of Water Quality in Local Areas" (hereinafter referred to as "Study").

Based on the results of the Study and the discussion between the Philippines and JICA, this document sets forth the Scope of Work for the sole cooperation on the Pagsanjan WD and the undertakings to be taken by the authorities concerned.

Pagsanjan, 22nd November, 2010

Kazuhiko Ueno
Senior Representative,
Philippines Office
Japan International Cooperation Agency

Marifel Pabilonia
Chairman,
Board of Directors
Pagsanjan Water District,
Philippines

1. Introduction

In response to a request from the Philippines, JICA conducted the Study on the Pagsanjan WD from October 1st to 4th, 2010. Based on the results of the Study, this document sets forth the Scope of Work for the sole cooperation on the Pagsanjan WD and the undertakings to be taken by the authorities concerned.

2. Scope of Work

The Scope of Work for the cooperation on the Pagsanjan WD shall include repair and replacement of the facilities indicated in Appendix 1.

3. Tentative Work Schedule

The Follow-up Cooperation will be carried out in accordance with the tentative schedule indicated in Appendix 2.

4. Major Undertakings by JICA

The major undertakings by JICA are as follows:

- to select a local contractor through tender procedures;
- to execute the repair and replacement as is mentioned in Article 2 above; and
- to secure construction supervision by Japanese consultant.

5. Major Undertakings by Pagsanjan WD

The major undertakings by WD are as follows:

- to allocate necessary personnel and budget for the proper operation and maintenance of the water treatment plant; and
- to take necessary measures to adjust impurities (such as color, turbidity and residual chlorine) that exceeds the standards at the faucet in order to enhance customer satisfaction, which will be technically advised through the technical cooperation by JICA.

6. Mutual Consultation

JICA and the Philippines shall consult with each other on any matters that may arise from or connected with the work prior to actual responses.

Appendix 1 List of facilities to be covered by the cooperation
Appendix 2 Tentative work schedule

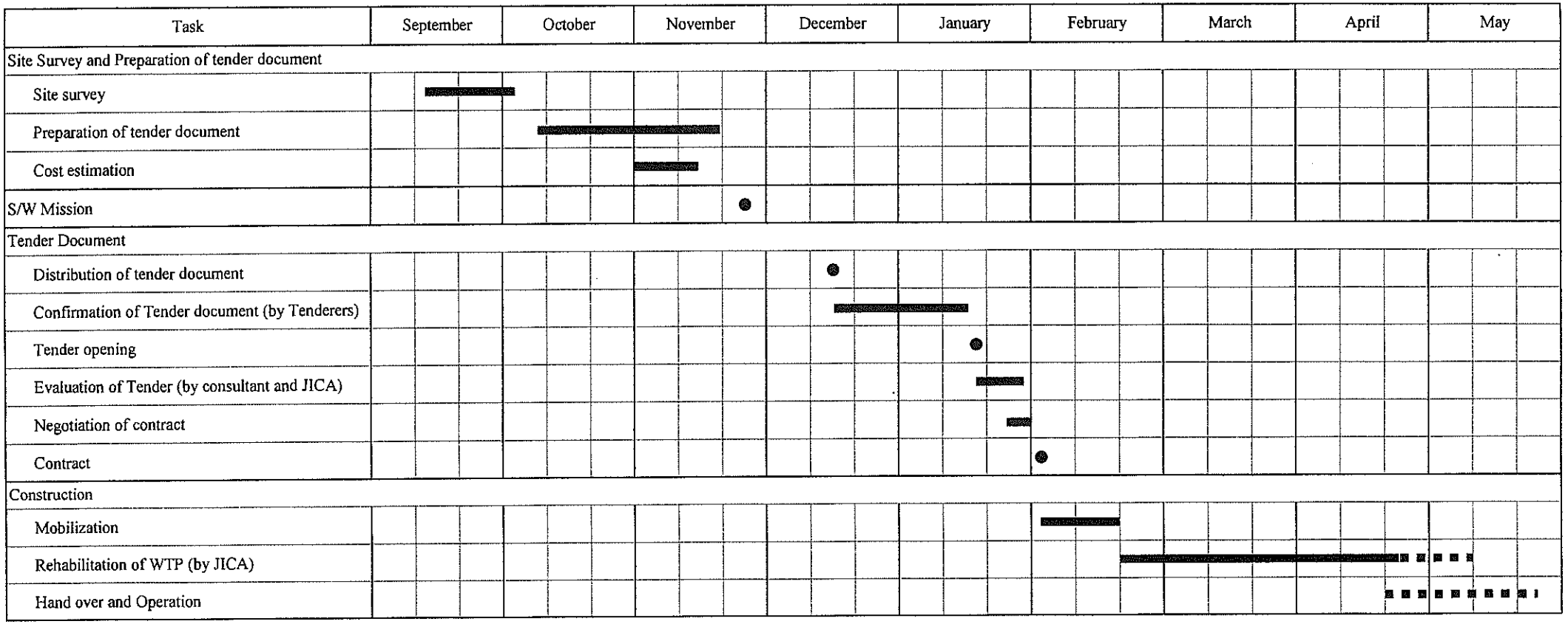
List of facilities to be covered by the Follow-up Cooperation

Appendix 1

Pagsanjan WD

Facility	Component	Item	Category	Specifications	Unit	Q'ty
Sand separator	Sand separator		Change	Install sand separator (Centrifugal type, flow range 46m3/hr), with fitting for existing pipe Φ80	pc.	1
Intake Facility	Conveyance pipe	Flow meter	Change	Φ100 turbine type w/accumulation	pc.	1
Rapid Sand Filter	Surface Wash System	Surface wash pipe	Repair	Change surface wash nozzle Φ25	pc.	10
		Flow meter	Change	Φ150 turbine type w/accumulation	pc.	1
Chlorination Facility	Intermediate-Chlorinatio	Injection pump and pipe	Change	0.12l/min×1.0MPa×0.2kW, Φ15 PVC braided hose with canal	unit	1
	Post-Chlorination	Injection pump and pipe	Change	0.12l/min×1.0MPa×0.2kW, Φ15 PVC braided hose with canal	unit	1
	Chlorination Tank	Tank	New	Install 200L PE tank (Polyethylen Tank for chlorine solution)	pc.	1
	Protection of Pump	Fence	New	Install galvanized corrugated sheets (3m x 3m, t = 0.8mm)	unit	1
	Electrical Equipment	Control panel	Repair	Electrical work for single phase outlet from control panel	unit	1
Dranage Facility	Electrical Equipment	Control panel	Repair	Electrical work for single phase outlet from control panel	unit	1

Tentative Schedule of the Follow-up Cooperation for Pagsanjan WD



SCOPE OF WORK
FOR
THE FOLLOW-UP COOPERATION
ON
THE PROJECT OF IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
AGREED UPON BETWEEN
BINMALEY WATER DISTRICT
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

In response to a request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") conducted the "Study for the Follow-up Cooperation (Lot 2) on the Project of Improvement of Water Quality in Local Areas" (hereinafter referred to as "Study").

Based on the results of the Study and the discussion between the Philippines and JICA, this document sets forth the Scope of Work for the sole cooperation on the Binmaley WD and the undertakings to be taken by the authorities concerned.

Binmaley, 23rd November, 2010

Kazuhiko Ueno
Senior Representative,
Philippines Office,
Japan International Cooperation Agency

Ida F. Rosario
Chairman,
Board of Directors
Binmaley Water District,
Philippines

1. Introduction

In response to a request from the Philippines, JICA conducted the Study on the Binmaley WD from September 15th to 19th, 2010. Based on the results of the Study, this document sets forth the Scope of Work for the sole cooperation on the Binmaley WD and the undertakings to be taken by the authorities concerned.

2. Scope of Work

The Scope of Work for the cooperation on the Binmaley WD shall include repair and replacement of the facilities indicated in Appendix 1 and 2.

3. Tentative Work Schedule

The Follow-up Cooperation will be carried out in accordance with the tentative schedule indicated in Appendix 3.

4. Major Undertakings by JICA

The major undertakings by JICA are as follows:

- to select a local contractor through tender procedures;
- to execute repair and replacement as is mentioned in Article 2 above; and
- to secure construction supervision by Japanese consultant.

5. Major Undertakings by Binmaley WD

The major undertakings by WD are as follows:

- to allocate necessary personnel and budget for the proper operation and maintenance of the water treatment plant; and
- to secure land for construction of additional sludge drying bed.

6. Mutual Consultation

JICA and the Philippines shall consult with each other on any matters that may arise from or connected with the work prior to actual responses.

Appendix 1 List of facilities for Caloocan to be covered by the cooperation
Appendix 2 List of facilities for Fabia to be covered by the cooperation
Appendix 3 Tentative work schedule

Appendix 1

List of facilities to be covered by the Follow-up Cooperation

Binmaley WD (Caloocan)

Facility	Component	Item	Category	Specifications	Unit	Q'ty
Aeration Tower	Exterior wall paint	Removal of paint	Repair	Removal of exterior wall paint	unit	1
Floccurator	Baffle Plates	Lumber installation	Repair	Lumber block and lumber plate	unit	1
Sedimentation Basin	Sludge Drain Pipe	Sludge Drain Pipe	Change	Φ100 PVC with flange and bend	unit	1
Rapid Sand Filter	Inlet Trough	Inlet pipe installation	Repair	Φ150 SP w/flange water-resist coating, 2.3m with weir plate	unit	2
Chlorination Facility	Pre-Chlorination	Injection pipe	Change	Change gasket and bolt	unit	1
	Post-Chlorination	Injection pump and pipe	Change	0.12l/min×1.0MPa×0.2kW, Φ15 PVC L=2m and flange	unit	1
Transmission Facility	Transmission Pipe	Flow meter	Change	Φ150 turbine type w/accumulation	pc.	1
Dranage Facility	Recycle Equipment	Flow meter	Change	Φ50 turbine type w/accumulation	pc.	1
	Sludge Drain Equipment	Sludge drain pump	Change	Submersible sewage pump 0.1m3/min×10m×0.75kW Φ50	pc.	1
	Electrical Equipment	Control panel	Repair	Electrical work for single phase outlet from control panel	unit	1
Sludge Drying Bed	Drying Bed	Drying bed	New	Sludge drying bed (H=2.4m) with gravel, sand and handrail	unit	1

Appendix 2

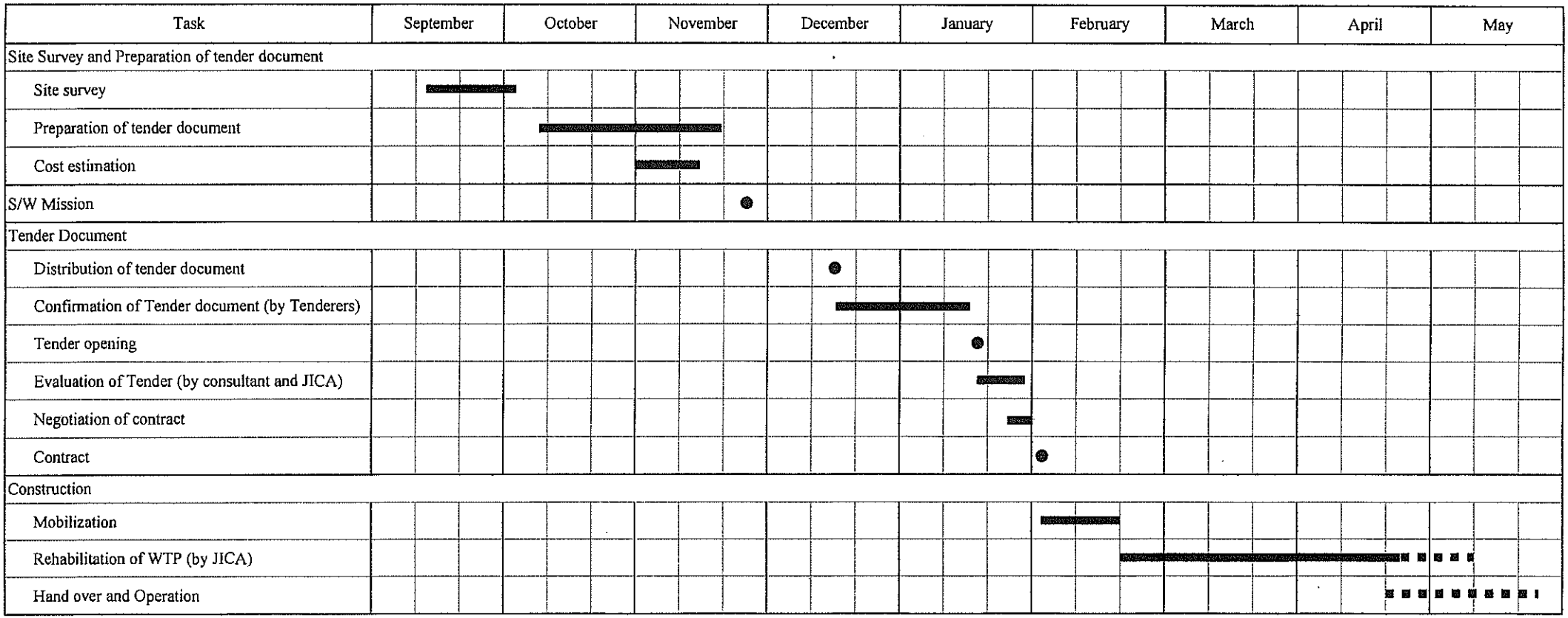
List of facilities to be covered by the Follow-up Cooperation

Binmaley WD (Fabia)

Facility	Component	Item	Category	Specifications	Unit	Q'ty
Aeration Tower	Exterior wall paint	Removal of paint	Repair	Removal of exterior wall paint	unit	1
Floccurator	Baffle Plates	Lumber installation	Repair	Lumber block and lumber plate	unit	1
Sedimentation Basin	Sludge Drain Pipe	Sludge Drain Pipe	Change	Φ100 PVC with flange and bend	unit	1
Rapid Sand Filter	Inlet Trough	Inlet pipe installation	Repair	Φ150 SP w/flange water-resist coating, 2.3m with weir plate	unit	2
Chlorination Facility	Post-Chlorination	Injection pump and pipe	Change	0.12l/min×1.0MPa×0.2kW, Φ15 PVC L=2m and flange	unit	1
	Chlorination Tank	Leakage	Repair	Change gasket and bolt	unit	1
	Ventilation Fan	Fan	Repair	Install new ventilation fan (wall-mounted type, wall frame space □37cm)	pc.	1
Transmission Facility	Transmission Pipe	Flow meter	Change	Φ150 turbine type w/accumulation	pc.	1
		Pressure gauge	Change	Install pressure gauge (compound type, max range 1.0MPa)	pc.	1
		Pressure tank	Change	Install pressure tank (volume:130L, efficiency:450L)	pc.	1
Dranage Facility	Dranage Equipment	Dranage pump	Change	Submersible sewage pump 0.1m3/min×10m×0.75kW Φ50	pc.	1
Sludge Drying Bed	Drying Bed	Drying bed	New	Sludge drying bed (H=2.4m) with gravel, sand and handrail	unit	1

Appendix 3

Tentative Schedule of the Follow-up Cooperation for Binmaley WD



MINUTES OF DISCUSSIONS
ON THE FOLLOW-UP COOPERATION
ON THE PROJECT FOR IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
LINGAYEN WATER DISTRICT

In response to the official request from the Government of the Republic of Philippines (hereinafter referred to as "the Philippines"), the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Mission Team (hereinafter referred to as "the Team") to the Philippines from 22nd to 26th November, 2010 to discuss the Scope of Work for the Follow-up Cooperation (Lot 2) on the Project for Improvement of Water Quality in Local Areas (hereinafter referred as "the F/U Cooperation") and to confirm prospective schedule for operation of the water treatment plant in Lingayen Water District (hereinafter referred to as "WD").

In the course of discussions between the Team and Lingayen WD, both parties confirmed the main items described on the attachment.

Lingayen, 23rd November, 2010

Kazuhiko Ueno
Senior Representative,
Philippines Office,
Japan International Cooperation Agency

Jose G. Hidalgo, Jr.
Chairman,
Board of Directors
Lingayen Water District,
Philippines

ATTACHMENT

1. The discussion between Lingayen WD and the Team was held based on the following common understandings:

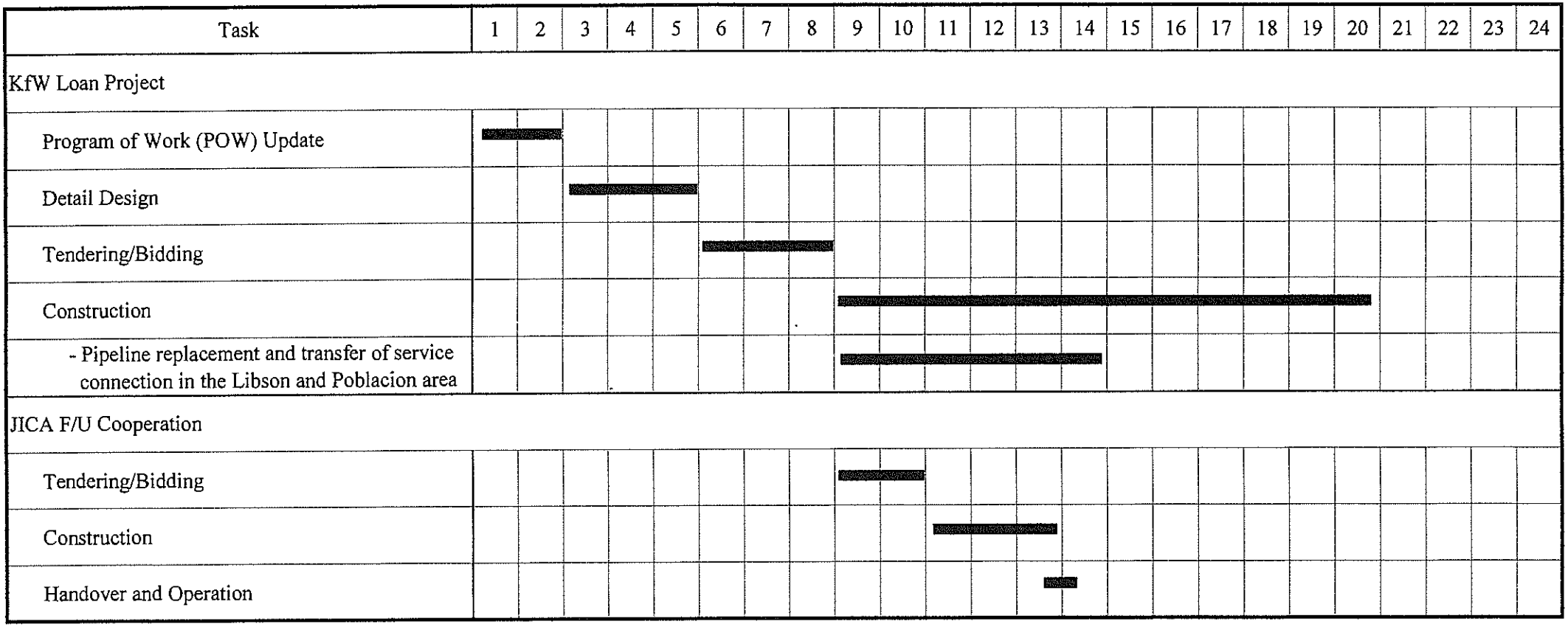
1) Although the study for the F/U Cooperation for Lingayen WD has already been conducted, rehabilitation and operation of the water treatment plant (hereinafter referred to as "WTP") needs to be postponed due to the delay of the pipeline replacement;
2) The WD would start operation of the WTP in advance to the completion of all the pipeline replacement by prioritizing the construction works in the areas to be served by the WTP, which was agreed upon in the Minutes of Meeting signed on 16th April, 2010; and
3) It has been decided that the WD would obtain financial support for the pipeline replacement from KfW Provincial Towns Water Supply Program Ⅲ (hereinafter referred to as "KfW Loan Project");

2. Regarding the KfW Loan project, both parties confirmed main obligations of the WD such as sercuring Environmental Compliance Certificate and Regional Development Council endorsement for the project to proceed. The WD promised to apply immediately in order to secure those requirements.

3. The parties also shared a prospective schedule of the KfW Loan Project and thereafter the F/U Cooperation by JICA as indicated in the Appendix. The WD promised again to prioritize the pipeline replacement in Libsong and Poblacion, the areas where the WTP covers.

Appendix: Prospective schedule of the KfW Loan Project and the F/U Cooperation for Lingayen WD

Prospective Schedule of the KfW Loan Project and the JICA Follow-up Cooperation for Lingayen WD



Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
KfW Loan Project																								
Program of Work (POW) Update																								
Detail Design																								
Tendering/Bidding																								
Construction																								
- Pipeline replacement and transfer of service connection in the Libson and Poblacion area																								
JICA F/U Cooperation																								
Tendering/Bidding																								
Construction																								
Handover and Operation																								

Appendix Ⅳ

PROJECT FOR IMPROVEMENT OF WATER QUALITY IN LOCAL AREAS IN PHILIPPINES
ROADMAP FOR IMPROVEMENT OF WATER SUPPLY

Project Site		To Do	2010										2011												2012											
			3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Lot 1	DINGLE-POTOTAN	Rehabilitation of distribution network																																		
		Follow-up study (incl. reconnection of electricity cable)																																		
		Start partial operation of WTP																																		
		Rehabilitation of WTP																																		
		Training by Japanese expert																																		
	PONTEVEDRA	Follow-up study																																		
		Rehabilitation of WTP																																		
		Training by Japanese expert																																		
Lot 2	BINMALEY	Follow-up study																																		
		Rehabilitation of WTP																																		
		Training by Japanese expert																																		
	PAGSANJAN	Follow-up study																																		
		Rehabilitation of WTP																																		
		Training by Japanese expert																																		
Phase 2	LINGAYEN	Replacement of pipe network											POW Review			Detail Design					Tendering			Construction (Libson & Poblacion)					Construction (Other areas)						
		Follow-up study																																		
		Rehabilitation of WTP																					Tendering			Rehabilitation			Handover and Operation						
	ABUYOG	Follow-up study																																		
		Water source development															Study																			
		Rehabilitation of WTP	depends on the progress of water source development																																	
Technical Assistance to formulate the Improvement Plan																																				

: Technical Cooperation by JICA
: Follow-up Cooperation by JICA
: Undertaking by LWUA and WD