Appendix-4

WWTP

4.1 Design Concept of WWTP
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Appendix4.1 Design Concept of Pluit WWTP

1. Basic Design Condition

(1) Inflow Waste water Quantity

Inflow Rate based on Revised Master Plan are as follows.

Average Daily Flow Rate	**198,000**	**m^3/d**
Maximum Daily Flow Rate	**264,000**	**m^3/d**
Maximum Hourly Flow Ra	**400,000**	**m^3/d**

According to Pipe construction plan, phased inflow rate are determined as follows

	Final Phase		**Phase 1**	
Average Daily Flow Rate	**200,000**	**m^3/d**	**100,000**	**m^3/d**
Maximum Daily Flow Rate	**264,000**	**m^3/d**	**132,000**	**m^3/d**
Maximum Hourly Flow Ra	**350,000**	**m^3/d**	**175,000**	**m^3/d**

(2) Inflow Waste water Quality

The inflow wastewater qualities are determined by actual data in JAKARTA.

BOD	**120**	**mg/L**
TSS	**120**	**mg/L**
T-N	**40**	**mg/L**

(3) Effluent Quality

Effluent qualities are in accordance with Effluent Quality Standards established in INDONESIA.
Source: Quality standard of liquid waste (DKI Jakarta Governor decree No.122, 2005)

BOD	<50	mg/L
TSS	<50	mg/L
Ammonia	<10	mg/L

Target treated water qualities are set as follows

BOD	**<10**	**mg/L**
TSS	**<10**	**mg/L**
Ammonia	**<5**	**mg/L**

(4) Wastewater Treatment Process

As No 1 priority of the site constraints, we choose the Treatment Process.
As a result, to adopt the following treatment process.

MBR (Membrane Bioreactor) Process

(5) Sludge Treatment Process

Since adopting the MBR process, the thickening process is omitted.
Therefore only the Dewatering process is established.

Excess sludge ----- Dewatering ----- to Dump site

(6) Inlet Pipe

Dimension	Diameter	2,000	mm
Invert Elevation	About	PP - 27.74	M (GL - 27.92M)

(7) Discharge facility

Discharge Stream	to Pluit Flood Control Pond
Conduit Dimension	$1{,}500mm^{H}$ x $1{,}500mm^{W}$ x 2 Lines

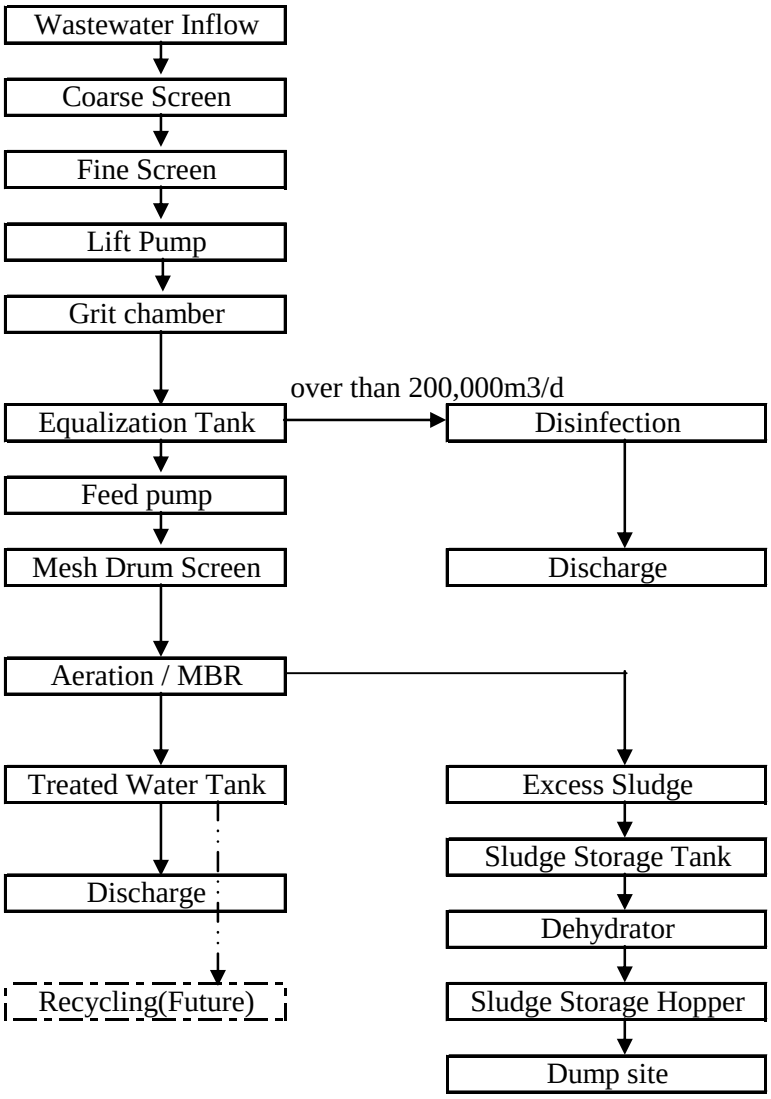
Highest Water Level at Discharge Point	PP + 1.00 M
Highest Water level in Existing Report *	PP + 0.50 M
Highest Water Level in Flood History of the Past	PP + 1.00 M (Adopted)

* Preparatory survey report on the project for urgent reconstruction of east pump station of Pluit in Jakarta, the Republic of Indonesia, JICA Yachiyo Engineering Co.,Ltd., 2010.6

(8) Site Ground Elevation

Ground Elevation	PP + 0.30 M

2. Process Flow Diagram



3. Design criteria for each facilities

(1) Coarse Screen

Opening	100	mm
Operation	Manual	

(2) Fine Screen

Opening	15	mm
Operation	Mechanical	

(3) Lift Pump

Type		Volute Type Mixed Flow Pump			
Capacity	(No.1-5)	Diamater	650	mm	61m^3/min
Pump Head	about	33.3	m	(assumed value)	

(4) Grit Chamber

Type	Aerated		
Surface Loading	1,411	$m^3/m^2/d$	(for Maximum Hourly)
Grit collector	Screw Type		
Grit lifter	Sand pump		

(5) Mesh Drum Screen

Opening	1	mm

(6) Equalization Tank

Retention Time	4	hr
Having a function of spillway and disinfection		

(7) Membrane Bioreactor Tank

Membrane placement	inside the MBR Tank	
MLSS in reactor Tank	9,000	mg/L
Design Flux	0.42	$m^3/m^2/d$
Excess Sludge Production Rate	72	%
BOD Removal Rate	0.12	kg-BOD/kg-SS/d
BOD Removal Rate per Unit Volume	1.44	kg-BOD/m^3/d
Nitrification Rate	0.025	kg-N/kg-SS/d
Nitrification Rate per Unit Volume	0.3	kg-N/m^3/d

(8) Oxygen Requirement

a) for BOD Removal

Required Unit Oxygen for BOD Removal	0.5	kg-O_2/kg-BOD

b) for Nitrification

Required Unit Oxygen for Nitrification	64/14	kg-O_2/kg-N

c) for Endogenous Respiration

Required Unit Oxygen for Endogenous Respiration	0.12	kg-O_2/kg-VSS
MLVSS/MLSS	0.75	

(9) Treated water Tank

a) for back wash

about	400	m^3

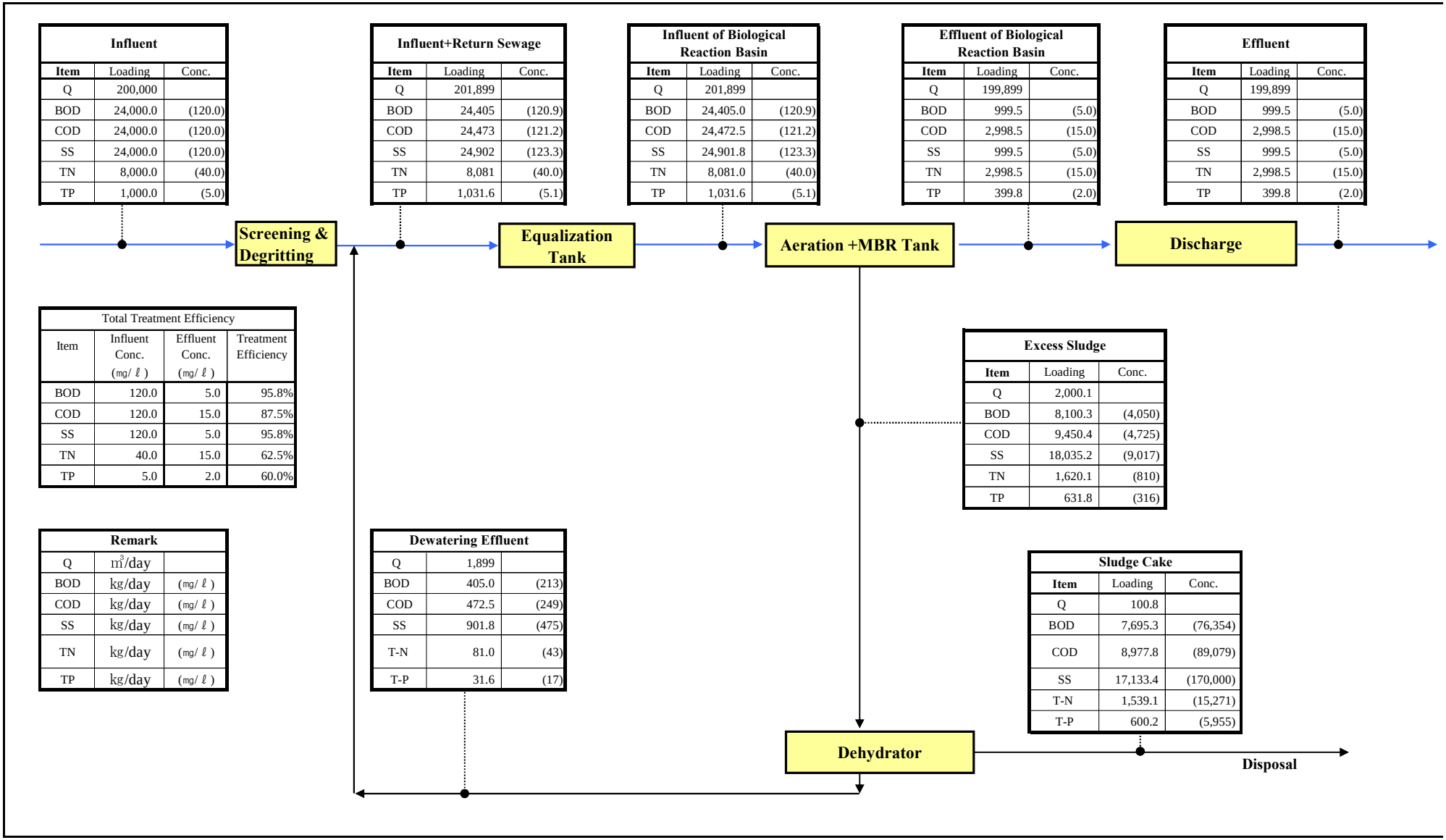
b) for recycling (in the future)

20,000m^3/d*8hr	6,700	m^3

(10) Dewatering Facility

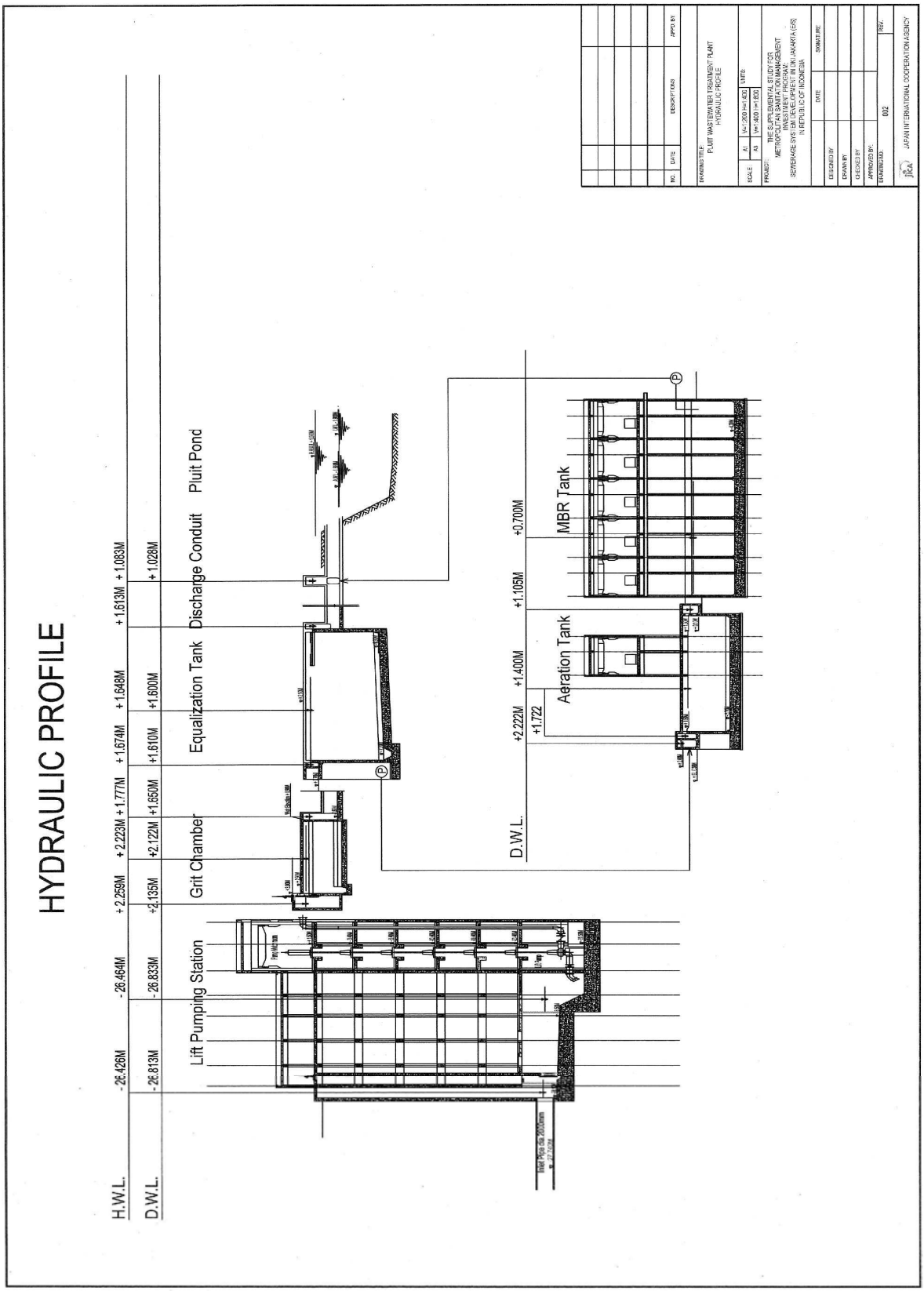
Dehydrator Type	Pressing Rotary Outer Cylinder-Type Screw Press	
Influent Sludge Concentration	0.9	%
Dewatered Sludge Concentration	83	%
Operation Time	23	hr

Appendix4.2 Mass Balance



Appendix4.3 Hydraulic Profile

Appendix4.3.1 Hydraulic Profile



Appendix4.3.2 Hydraulic Calculation

Point ［Discharge Conduit (1)］ ※Gravity flow

Formula:Manning

Content		Symbol	Case		
			QDM	QHM	Remarks
Flowrate	(m^3/d)	Q	200,000	350,000	
	(m^3/s)		2.315	4.051	
Number of pipes	(pipe)	n	2	2	
Flowrate/pipe	(m^3/s)	q	1.158	2.026	
Schematic Diagram			Box Culvert 2 serises Width 1.5 m Depth 1.5 m		
Length	(m)	L	35	n=0.014	
Invert Elevation	(M)	FH	-1.800		
Water Depth	(m)	H'	1.500	1.500	Ho-FH
Cross Section	(m^2)	A	2.25	2.25	
Wetted Perimeter	(m)	P	6.00	6.00	
Hydraulic Radius	(m)	R	0.375	0.375	A/P
Velocity	(m/s)	V	0.515	0.9	q/A
Hydraulic Gradient	(‰)	I	0.192	0.587	$(n*V/R^{2/3})^2$
Down stream WL	(M)	Ho	+1.000	+1.000	HHWL
HEAD LOSS Outflow	(m)		0.014	0.041	$1.0*(V^2/2g)*(Nm+1)$
HEAD LOSS Friction	(m)		0.007	0.021	I*L
HEAD LOSS Inflow	(m)		0.007	0.021	$0.5*(V^2/2g)*(Nm+1)$
HEAD LOSS Total	(m)	h	0.028	0.083	
Water Level	(M)	H	+1.028	+1.083	Ho+h

Point ［Discharge Conduit (2)］ ※Gravity flow

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	100,000	175,000	
	(m^3/s)		1.157	2.025	
Number of pipes	(pipe)	n	1	1	
Flowrate/pipe	(m^3/s)	q	1.157	2.025	
Schematic Diagram			Box Culvert 1 serises Width 1.5 m Depth 1.5 m		
Length	(m)	L	60.00	n=0.014	
Invert Elevation	(M)	FH	-1.800		
Water Depth	(m)	H'	1.500	1.500	Ho-FH
Cross Section	(m^2)	A	2.25	2.25	B*H'
Wetted Perimeter	(m)	P	6.00	6.00	2*H'+B
Hydraulic Radius	(m)	R	0.375	0.375	A/P
Velocity	(m^3/s)	V	0.514	0.9	p/A
Hydraulic Gradient	(‰)	I	0.191	0.587	$(n*V/R^{2/3})^2$
Down stream WL	(M)	Ho	+1.028	+1.083	
HEAD LOSS Outflow	(m)		0.013	0.041	$1.0*(V^2/2g)*1$
HEAD LOSS Friction	(m)		0.011	0.035	I*L
HEAD LOSS Refraction (90^o)	(m)		0.013	0.041	$0.99*(V^2/2g)*1$
HEAD LOSS Inflow	(m)		0.007	0.021	$0.5*(V^2/2g)*(Nm+1)$
HEAD LOSS Total	(m)	h	0.044	0.138	
Water Level	(M)	H	+1.072	+1.221	Ho+h

Point ［Discharge Channel (1)］　※Gravity flow

Formula:manning

Contents		Symbol	Case		
			QDm	QHm	
Flowrate	(m3/d)	Q	0	37,500	
	(m3/s)		0	0.434	
Number of pipes	(pipe)	n	1	1	
Flowrate/pipe	(m3/s)	q	0.000	0.434	
Schematic Diagram			Channel 1 serises Width 1.0 m Depth 2.0 m		
Length	(m)	L	68.00	n=0.014	
Invert Elevation	(m)	FH	-0.800		
Water Depth	(m)	H'	1.872	2.021	Ho-FH
Cross Section	(m2)	A	1.872	2.021	B*H'
Wetted Perimeter	(m)	P	4.74	5.04	2*H'+B
Hydraulic Radius	(m)	R	0.395	0.401	A/P
Velocity	(m3/s)	V	0	0.215	p/A
Hydraulic Gradient	(‰)	I	0.000	0.031	$(n*V/R^{2/3})^2$
Down stream WL	(m)	Ho	+1.072	+1.221	
HEAD LOSS Outflow	(m)		0.000	0.002	$1.0*(V^2/2g)*1$
HEAD LOSS Friction	(m)		0.000	0.002	I*L
HEAD LOSS					
HEAD LOSS Inflow	(m)		0.000	0.001	0.5*(V2/2g)*(Nm+1)
HEAD LOSS Total	(m)	h	0.000	0.005	
Water Level	(m)	H	+1.072	+1.226	Ho+h

Point ［Discharge Channel (2)］ ※Gravity flow

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	0	37,500	
	(m^3/s)		0	0.434	
Number of pipes	(pipe)	n	1	1	
Flowrate/pipe	(m^3/s)	q	0.000	0.434	
Schematic Diagram			Channel 1 serises Width 1.0 m Depth 2.0 m		
Length	(m)	L	34.00	n=0.014	
Invert Elevation	(M)	FH	-0.800	+2.500	
Water Depth	(m)	H'	1.872	2.026	Ho-FH
Cross Section	(m^2)	A	1.872	2.026	B*H'
Wetted Perimeter	(m)	P	4.74	5.05	2*H'+B
Hydraulic Radius	(m)	R	0.395	0.401	A/P
Velocity	(m^3/s)	V	0	0.214	p/A
Hydraulic Gradient	(‰)	I	0.000	0.030	$(n*V/R^{2/3})^2$
Down stream WL	(M)	Ho	+1.072	+1.226	
HEAD LOSS Outflow	(m)		0.000	0.002	$1.0*(V^2/2g)*1$
HEAD LOSS Friction	(m)		0.000	0.001	I*L
HEAD LOSS					
HEAD LOSS Inflow	(m)		0.000	0.001	$0.5*(V^2/2g)*(Nm+1)$
HEAD LOSS Total	(m)	h	0	0.004	
Water Level	(M)	H	+1.072	+1.230	Ho+h

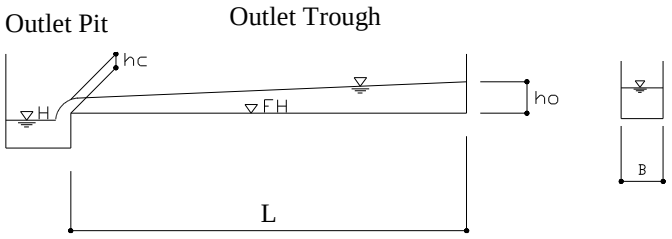
Point ［Discharge Channel (3)］ ※Gravity flow

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	0	18,750	
	(m^3/s)		0	0.217	
Number of pipes	(pipe)	n	1	1	
Flowrate/pipe	(m^3/s)	q	0.000	0.217	
Schematic Diagram			Channel 1 serises Width 1.0 m Depth 2.0 m		
Length	(m)	L	34.00	n=0.014	
Invert Elevation	(M)	FH	-0.800	+2.500	
Water Depth	(m)	H'	1.872	2.030	Ho-FH
Cross Section	(m^2)	A	1.872	2.03	B*H'
Wetted Perimeter	(m)	P	4.74	5.06	2*H'+B
Hydraulic Radius	(m)	R	0.395	0.401	A/P
Velocity	(m^3/s)	V	0	0.107	p/A
Hydraulic Gradient	(‰)	I	0.000	0.008	$(n*V/R^{2/3})^2$
Down stream WL	(M)	Ho	+1.072	+1.230	
HEAD LOSS Outflow	(m)		0.000	0.001	$1.0*(V^2/2g)*1$
HEAD LOSS Friction	(m)		0.000	0.000	I*L
HEAD LOSS					
HEAD LOSS Inflow	(m)		0.000	0.000	$0.5*(V^2/2g)*(Nm+1)$
HEAD LOSS Total	(m)	h	0	0.001	
Water Level	(M)	H	+1.072	+1.231	Ho+h

Point ［Equalization Tank］ Outflow Trough

Formula：Thomas Gump

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	0	37,500	
	(m^3/s)		0.000	0.434	
Number of tanks	(pipe)	n	8	8	
Flowrate/tank	(m^3/s)	q	0	0.05425	
Schematic Diagram					
Length	(m)	L	4.750	m	
Width	(m)	B	0.400		
Invert Elevation	(M)	FH	+1.400		
Critical depth	(m)	hc	0	0.123	$(q^2/9.8*B^2)^{1/3}$
Upper Water Depth	(m)	ho	0.000	0.213	$\sqrt{}3*hc$
Lower Water Level	(M)	Ho	+1.072	+1.226	
HEAD LOSS					
Water Level	(M)	H	+1.400	+1.613	FH+ho

Point ［Equalization Tank］ Inflow gate

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	50,000	87,500	
	(m^3/s)		0.579	1.013	
Number of tanks	(pipe)	n	8	8	
Flowrate/tank	(m^3/s)	q	0.072	0.127	
Schematic Diagram					
Gate Width	(M)	B	0.400	m	
Bottom Elevatior	(M)	FH	+1.100		
Water Depth	(m)	H'	0.500	0.548	Ho-FH
Cross Section	(m^2)	A	0.2	0.2192	B*H'
Velocity	(m^3/s)	V	0.362	0.578	q/A
Down stream WL	(M)	Ho	+1.600	+1.648	
HEAD LOSS					
	Outflow (m)		0.007	0.017	$1.0*(V^2/2g)*1$
	Inflow (m)		0.003	0.009	$0.5*(V^2/2g)*(Nm+1)$
	Total (m)	h	0.010	0.026	
Water Level	(M)	H	+1.610	+1.674	FH+h

Point ［Equalization Tank］ Distribution Channel (1)

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	25,000	30,649	
	(m^3/s)		0.289	0.355	
Number of pipes	(pipe)	n	1	1	
Flowrate/pipe	(m^3/s)	q	0.289	0.355	
Schematic Diagram			Channel 1 serises Width 1.5 Depth 2.0		
Length	(m)	L	34.00	n=0.014	
Invert Elevation	(M)	FH	+0.700	+4.000	
Water Depth	(m)	H'	0.910	0.974	Ho-FH
Cross Section	(m^2)	A	1.365	1.461	B*H'
Velocity	(m^3/s)	V	0.212	0.243	q/A
Down stream WL	(M)	Ho	+1.610	+1.674	
HEAD LOSS					
	Outflow (m)		0.002	0.003	1.0*(V^2/2g)*1
	Inflow (m)		0.001	0.002	0.5*(V^2/2g)*(Nm+1)
	Total (m)	h	0.003	0.005	
Water Level	(M)	H	+1.613	+1.679	FH+h

Point ［Equalization Tank］ Distribution Channel (2)

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	50,000	61,298	
	(m^3/s)		0.579	0.709	
Number of pipes	(pipe)	n	1	1	
Flowrate/pipe	(m^3/s)	q	0.579	0.709	
Schematic Diagram			Channel 1 serises Width 1.5 m Depth 2.0 m		
Length	(m)	L	34.00	n=0.014	
Invert Elevation	(M)	FH	+0.700		
Water Depth	(m)	H'	0.913	0.979	Ho-FH
Cross Section	(m^2)	A	1.3695	1.4685	B*H'
Wetted Perimeter	(m)	P	3.33	3.46	2*H'+B
Hydraulic Radius	(m)	R	0.412	0.425	A/P
Velocity	(m^3/s)	V	0.423	0.483	p/A
Hydraulic Gradient	(‰)	I	0.114	0.143	$(n*V/R^{2/3})^2$
Down stream WL	(M)	Ho	+1.613	+1.679	
HEAD LOSS					
	Friction (m)		0.004	0.005	I*L
	Inflow (m)		0.005	0.006	$0.5*(V^2/2g)*(Nm+1)$
	Total (m)	h	0.009	0.011	
Water Level	(M)	H	+1.622	+1.690	Ho+h

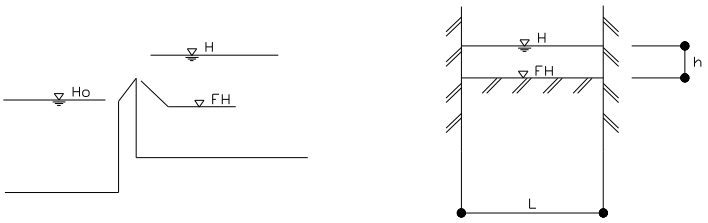
Point ［Equalization Tank from Grit chamber］ Connection conduit (1)

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	100,000	175,000	
	(m^3/s)		1.157	2.025	
Number of pipes	(pipe)	n	1	1	
Flowrate/pipe	(m^3/s)	q	1.157	2.025	
Schematic Diagram			Channel 1 serises Width 1.5 m Depth 1.5 m		
Length	(m)	L	42.00	n=0.014	
Invert Elevation	(M)	FH	-1.800	+1.500	
Water Depth	(m)	H'	1.500	1.500	Ho-FH
Cross Section	(m^2)	A	2.25	2.25	B*H'
Wetted Perimeter	(m)	P	6.00	6.00	2*H'+B
Hydraulic Radius	(m)	R	0.375	0.375	A/P
Velocity	(m^3/s)	V	0.514	0.9	p/A
Hydraulic Gradient	(‰)	I	0.191	0.587	$(n*V/R^{2/3})^2$
Down stream WL	(M)	Ho	+1.622	+1.690	
HEAD LOSS Outflow	(m)		0.013	0.041	$1.0*(V^2/2g)*(Nm+1)$
Friction	(m)		0.008	0.025	I*L
Inflow	(m)		0.007	0.021	$0.5*(V^2/2g)*(Nm+1)$
Total	(m)	h	0.028	0.087	
Water Level	(M)	H	+1.650	+1.777	Ho+h

Point ［Grit Chamber］ Outfall weir

Formula：Francis

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	200,000	350,000	
	(m^3/s)		2.315	4.051	
Number of pipes	(pipe)	n	4	4	
Flowrate/pipe	(m^3/s)	q	0.579	1.013	
Schematic Diagram					
Weir Width	(m)	B	3.00		
Weir Height	(M)	FH	+1.900	+5.200	
Lower Water Level	(M)	Ho	+1.650	+1.777	
WATER DEPTH	Complete Overflow (m)	h	0.222	0.323	(q/1.84*L)^(2/3)
Water Level	(M)	H	+2.122	+2.223	FH+h

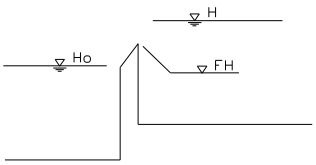
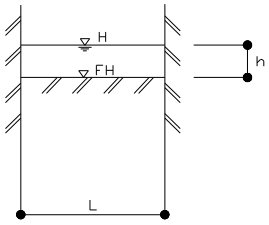
Point ［Grit Chamber］ Inflow Channel

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	200,000	350,000	
	(m^3/s)		2.315	4.051	
Number of pipes	(pipe)	n	4	4	
Flowrate/pipe	(m^3/s)	q	0.579	1.013	
Schematic Diagram			Channel 1 serises Width 1.0 m Depth 2.0 m		
Length	(m)	L	4.50	n=0.014	
Invert Elevation	(M)	FH	+0.700	+4.000	
Water Depth	(m)	H'	1.422	1.523	Ho-FH
Cross Section	(m^2)	A	1.422	1.523	B*H'
Wetted Perimeter	(m)	P	4.34	4.55	2*H'+B
Hydraulic Radius	(m)	R	0.327	0.335	A/P
Velocity	(m^3/s)	V	0.407	0.665	p/A
Hydraulic Gradient	(‰)	I	0.144	0.373	$(n*V/R^{2/3})^2$
Down stream WL	(M)	Ho	+2.122	+2.223	
HEAD LOSS Outflow	(m)		0.008	0.023	$1.0*(V^2/2g)*(Nm+1)$
Friction	(m)		0.001	0.002	I*L
Inflow	(m)		0.004	0.011	$0.5*(V^2/2g)*(Nm+1)$
Total	(m)	h	0.013	0.036	
Pump Discharge Well Water Level	(M)	H	+2.135	+2.259	Ho+h

Point ［MBR Tank］ Inflow Channel Inflow Weir

Formula：Francis

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	150,000		QDM= Q*(1+2)
	(m^3/s)		1.736	0.000	Return Sludge 2Q
Number of pipes	(pipe)	n	5	2	
Flowrate/pipe	(m^3/s)	q	0.347	0.000	
Schematic Diagram			 		
Weir Width	(m)	L	1.20		
Weir Height	(M)	FH	+0.800	+4.100	
Lower Water Level	(M)	Ho	+0.700	+0.700	
WATER DEPTH Complete Overflow	(m)	h	0.291	0.000	(q/1.84*L)^(2/3)
WATER DEPTH					
WATER DEPTH					
WATER DEPTH					
Water Level	(M)	H	+1.091	+0.800	FH+h
Base Level			+0.100		

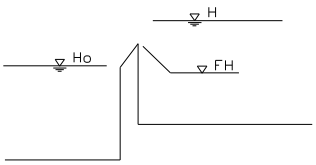
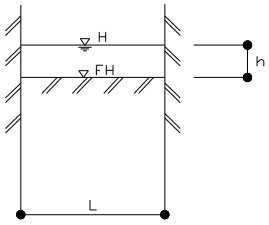
Point ［MBR Tank］ Inflow Channel

Formula:Manning

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	75,000	0	QDM=Q*(1*2)/2
	(m^3/s)		0.868	0.000	
Number of pipes	(pipe)	n	1	2	
Flowrate/pipe	(m^3/s)	q	0.868	0.000	
Schematic Diagram					
Channel Width	(m)	B	2.000		
Base Level	(M)	FH	+0.100	+3.400	
Length	(m)	L	44.50	n=0.014	
Water Depth	(m)	H'	0.991	0.700	Ho-FH
Cross Section	(m^2)	A	1.982	1.4	B*H'
Wetted Perimeter	(m)	P	3.982	3.4	2*H'+B
Hydraulic Radius	(m)	R	0.498	0.412	A/P
Velocity	(m^3/s)	V	0.438	0.000	p/A
Hydraulic Gradient	(‰)	I	0.095	0.000	$(n*V/R^{2/3})^2$
Lower point WL	(M)	Ho	+1.091	+0.800	
HEAD LOSS Refraction (90^o)	(m)		0.010	0.000	$0.99*(V^2/2g)*1$
HEAD LOSS Friction	(m)		0.004	0.000	I*L
HEAD LOSS					
HEAD LOSS					
HEAD LOSS Total	(m)	h	0.014	0	
Water Level	(M)	H	+1.105	+0.800	Ho+h

Point ［AerobicTank］ Discharge Weir

Formula：Francis

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	150,000		QDM= Q*(1+2)
	(m^3/s)		1.736	0.000	
Number of pipes	(pipe)	n	5	5	
Flowrate/pipe	(m^3/s)	q	0.347	0.000	
Schematic Diagram			 		
Weir Width	(m)	L	6.00		
Weir Height	(M)	FH	+1.300		
Lower Water Level	(M)	Ho	+1.105	+0.800	
WATER DEPTH: Complete Overflow	(m)	h	0.100	0.000	(q/1.84*L)^(2/3)
WATER DEPTH					
WATER DEPTH					
WATER DEPTH					
Water Level	(M)	H	+1.400	+1.300	FH+h
Base Level			-0.400		

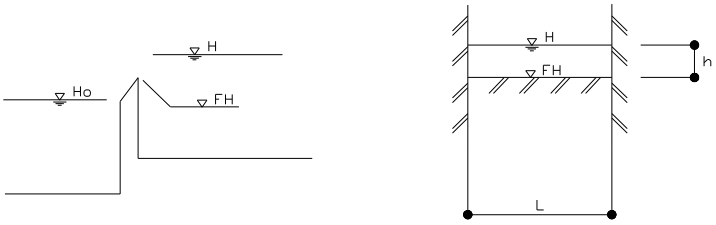
Point ［Ultra Fine Screen］

Formula：Thomas Gump

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	50,000	0	
	(m^3/s)		0.579	0	
Number of pipes	(pipe)	n	5	5	
Flowrate/pipe	(m^3/s)	q	0.116	0	
Schematic Diagram					
Lower Water Level	(M)	Ho	+1.722	+1.500	
HEAD LOSS Passing Loss	(M)		0.200		Maker Hearing
Water Level	(M)	H	+1.922	+1.500	FH+ho

Point ［Upstream of Screen］ Distribution Weir

Formula：Francis

Contents		Symbol	Case		
			QDM	QHM	
Flowrate	(m^3/d)	Q	50,000		
	(m^3/s)		0.579	0.000	
Number of pipes	(pipe)	n	5	5	
Flowrate/pipe	(m^3/s)	q	0.116	0.000	
Schematic Diagram					
Weir Width	(m)	L	0.60		
Weir Height	(M)	FH	+2.000		
Lower Water Level	(M)	Ho	+0.000	+1.400	
WATER DEPTH	Complete Overflow (m)	h	0.222	0.000	(q/1.84*L)^(2/3)
Water Level	(M)	H	+2.222	+2.000	FH+h
Base Level			+3.700		

Appendix4.4 Capacity Calculation

Lift pumping Station	Final Phase Calculation	Phase 1 Calculation
1. Lift Pumping Station		
1.1 Inlet Pipe		
1) Pipe Condition		
Design Flow Rate		
Average Daily Flow Rate	= 200,000 m^3/d = 2.315 m^3/s	= 100,000 m^3/d = 1.157 m^3/s
Maximum Daily Flow Rate	= 264,000 m^3/d = 3.056 m^3/s	= 132,000 m^3/d = 1.528 m^3/s
Maximum Hourly Flow Rate	= 350,000 m^3/d = 4.051 m^3/s	= 175,000 m^3/d = 2.025 m^3/s
Pipe Diameter	= 2,000 mm	= 2,000 mm
Pipe Gradient	= 1.2 permillage	= 1.2 permillage
Invert Level	= -27.740 M	= -27.740 M
Manning's "n" Value	= 0.013	= 0.013
Full Flow Rate	= 5.274 m^3/s	= 5.274 m^3/s
Full Flow Velocity	= 1.679 m/s	= 1.679 m/s
Water Depth		
Average Daily Flow Rate	= 0.927 m	= 0.636 m
Maximum Daily Flow Rate	= 1.093 m	= 0.737 m
Maximum Hourly Flow Rate	= 1.314 m	= 0.860 m
Water Level		
Average Daily Flow Rate	= -27.740 + 0.927 = -26.813 M	= -27.740 + 0.636 = -27.104 M
Maximum Daily Flow Rate	= -27.740 + 1.093 = -26.647 M	= -27.740 + 0.737 = -27.003 M
Maximum Hourly Flow Rate	= -27.740 + 1.314 = -26.426 M	= -27.740 + 0.860 = -26.880 M
2) Inlet Chamber		
Invert Elevation	= -28.100 M	= -28.100 M
Water Depth at Upstream of Inlet Gate		
Average Daily Flow Rate	= 1.287 m	= 0.996 m
Maximum Hourly Flow Rate	= 1.674 m	= 1.220 m
1.2 Inlet Gate		
Invert Elevation	= -28.100 M	= -28.100 M
Channel Inlet Width	= 1.0 m Gate Width → 1.4 m	= 1.0 m Gate Width → 1.4 m
Channel Inlet Height	= 2.0 m Gate Height → 3.1 m	= 2.0 m Gate Height → 3.1 m
Number of Gates	= 4 nos.	= 4 nos.
Passing Velocity		
Average Daily Flow Rate	= 2.315 /(1.00 x 1.287 x 4) = 0.450 m/s	= 1.157 /(1.00 x 0.996 x 4) = 0.290 m/s
Maximum Hourly Flow Rate	= 4.051 /(1.00 x 1.674 x 4) = 0.605 m/s	= 2.025 /(1.00 x 1.220 x 4) = 0.415 m/s

Lift pumping Station	Final Phase Calculation	Phase 1 Calculation
Headloss at Inlet Gate		
Average Daily Flow Rate	= 1.5 x 0.450 ^2 / 19.6 = 0.015 m	= 1.5 x 0.290 ^2 / 19.6 = 0.006 m
Maximum Hourly Flow Rate	= 1.5 x 0.605 ^2 / 19.6 = 0.028 m	= 1.5 x 0.415 ^2 / 19.6 = 0.013 m
Water Level at Downstream of Inlet Gate		
Average Daily Flow Rate	= -26.813 - 0.015 = -26.828 M	= -27.104 - 0.006 = -27.110 M
Maximum Hourly Flow Rate	= -26.426 - 0.028 = -26.454 M	= -26.880 - 0.013 = -26.893 M
1.3 Screen		
1) Coarse Screen		
Openning	= 100 mm	= 100 mm
Type	= Manual Rake	= Manual Rake
Bottom Elevation	= -28.150 M	= -28.150 M
Channel Width	= 2.500 m	= 2.500 m
Number of Screens	= 4 nos.	= 2 nos.
Approch Water Depth		
Average Daily Flow Rate	= -26.828 - -28.150 = 1.322 m	= -27.110 - -28.150 = 1.040 m
Maximum Hourly Flow Rate	= -26.454 - -28.150 = 1.696 m	= -26.893 - -28.150 = 1.257 m
Approch Velocity		
Average Daily Flow Rate	= 2.315 / (2.50 x 1.322 x 4) = 0.175 m/s	= 1.157 / (2.50 x 1.040 x 2) = 0.222 m/s
Maximum Hourly Flow Rate	= 4.051 / (2.50 x 1.696 x 4) = 0.239 m/s	= 2.025 / (2.50 x 1.257 x 2) = 0.322 m/s
Headloss at Coarse Screen	= neglect	= neglect
2) Fine Screen		
Openning	= 15 mm	= 15 mm
Type	= Mechanical Rake	= Mechanical Rake
Bottom Elevation	= -28.250 M	= -28.250 M
Channel Width	= 2.500 m	= 2.500 m
Number of Screens	= 4 nos.	= 2 nos.
Approch Water Depth		
Average Daily Flow Rate	= -26.828 - -28.250 = 1.422 m	= -27.110 - -28.250 = 1.140 m
Maximum Hourly Flow Rate	= -26.454 - -28.250 = 1.796 m	= -26.893 - -28.250 = 1.357 m
Approch Velocity		
Average Daily Flow Rate	= 2.315 / (2.50 x 1.422 x 4) = 0.163 m/s	= 1.157 / (2.50 x 1.140 x 2)= 0.203 m/s
Maximum Hourly Flow Rate	= 4.051 / (2.50 x 1.796 x 4) = 0.226 m/s	= 2.025 / (2.50 x 1.357 x 2)= 0.298 m/s
Headloss at Fine Screen		
Average Daily Flow Rate	= 2.34 x sin70 x (9/15)^(4/3) x 0.163 x 2)^2 / 19.6 = 0.005	= 2.34 x sin70 x (9/15)^(4/3) x 0.203 x 2)^2 / 19.6 = 0.008
Maximum Hourly Flow Rate	= 2.34 x sin70 x (9/15)^(4/3) x 0.226 x 2)^2 / 19.6 = 0.010	= 2.34 x sin70 x (9/15)^(4/3) x 0.298 x 2)^2 / 19.6 = 0.017
Water Level at Downstream of Fine Screen		
Average Daily Flow Rate	= -26.828 - 0.005 = -26.833 M	= -27.110 - 0.008 = -27.118 M
Maximum Hourly Flow Rate	= -26.454 - 0.010 = -26.464 M	= -26.893 - 0.017 = -26.910 M

Lift pumping Station	Final Phase Calculation	Phase 1 Calculation
1.4 Lift Pump		
Type	Vertical Shaft Volute Type Mixed Flow Pump	
Design Flow Rate		
Average Daily Flow Rate	= 200,000 m3/d = 139 m^3/min	= 100,000 m3/d = 69 m^3/min
Maximum Daily Flow Rate	= 264,000 m3/d = 183 m^3/min	= 132,000 m3/d = 92 m^3/min
Maximum Hourly Flow Rate	= 350,000 m3/d = 243 m^3/min	= 175,000 m3/d = 122 m^3/min
Pump Capacity		
Number of Pumps	= 4 nos	= 2 nos
Pump Capacity	= 243.0 / 4 = 61 m^3/min	= 122.0 / 2 = 61 m^3/min
Pump Diameter	= 146 × (61.0 / 3)^0.5 = 658 = 650 mm	= 146 × (61.0 / 3)^0.5 = 658 = 650 mm
Pump Head		
Discharge Water Level	= **2.300** M	= **2.300** M
Suction Water Level	= -29.000 M	= -29.000 M
Actual Pump Head	= 2.300 — -29.000 = 31.300 m	= 2.300 — -29.000 = 31.300 m
Others Headloss	= 2.000 m (assumed)	= 2.000 m (assumed)
Total Pump Head	= 31.300 + 2.000 = 33.300 m	= 31.300 + 2.000 = 33.300 m
Motor Output	$P=\frac{\rho \times g \times Q \times H}{60 \times 1000 \times \eta} \times (1+\alpha)$ ρ : Water Density 1,000 kg/m^3 g : Acceleration of Gravity 9.8 m/sec^2 Q : Flow Rate 61 m^3/min H : Pump Head 33.30 m η : Pump Efficiency 0.8 α : Surplus ratio 0.15 $= \frac{1,000 \times 9.8 \times 61.0 \times 33.3}{60 \times 1,000 \times 0.8} \times (1+0.15)$ = 476.9 → **480** kW	= Same as the left
Lift Pump Specification	Type Vertical Shaft Volute Type Mixed Flow Pump Diamater 650 mm Capacity 61 m^3/min Pump Head 33.30 m Motor Output 480 kW Numbers 5 nos. (Including 1 standby)	Type Vertical Shaft Volute Type Mixed Flow Pump Diamater 650 mm Capacity 61 m^3/min Pump Head 33.30 m Motor Output 480 kW Numbers 3 nos. (Including 1 standby)

Grit Chamber	Final Phase Calculation	Phase 1 Calculation
2. Grit Chamber		
2.1 Chamber		
Type	Aerated Grit Chamber	Aerated Grit Chamber
Design Flow Rate		
Average Daily Flow Rate	= 264,000 m^3/d	= 132,000 m^3/d
Maximum Hourly Flow Rate	= 350,000 m^3/d	= 175,000 m^3/d
Detention Time (For Maximum Hourly Flow Rate)	= 3 min	= 3 min
Required Volume	= 350,000 ÷ 1,440 × 3 = 730 m^3	= 175,000 ÷ 1,440 × 3 = 365 m^3
No. of Channel	= 4 channels	= 2 channels
Required Chamber Volume per each Basin	= 730 ÷ 4 = 183 m^3	= 365 ÷ 2 = 183 m^3
Depth	= 3.0 m	= 3.0 m
Width	= 4.0 m	= 4.0 m
Length	= 15.5 m	= 15.5 m
Actual Volume	= 4.0 mW × 3.0 mH × 15.5 mL = 186 m^3	= 4.0 mW × 3.0 mH × 15.5 mL = 186 m^3
2.2 Required Air		
Total Air Supply Required	= 15.5 m × 0.3 m^3/min/m = 4.7 m^3/min = 4.7 × 4 = 18.8 m^3/min	= 15.5 m × 0.3 m^3/min/m = 4.7 m^3/min = 4.7 × 2 = 9.4 m^3/min
Aeration Blower		
Number of Blowers	= 2 nos.	= 1 nos.
Blower Capacity	= 11 m^3/min	= 11 m^3/min
Discharge Pressure		
Diffuser Depth	= 3,000 mmAq	= 3,000 mmAq
Loss of Diffuser	= 750 mmAq	= 750 mmAq
Other Loss	= 500 mmAq	= 500 mmAq
Total Pressure	= 4,250 mmAq = 42 kpa	= 4,250 mmAq = 42 kpa
Blower Specification		
Type	= Turbo type blower	= Turbo type blower
Diameter	= 150 mm	= 150 mm
Capacity	= 11 m^3/min	= 11 m^3 m^3/min
Discharge Pressure	= 42 kpa	= 42 kpa
Motor Output	= 22 kW	= 22 kW
Number of Blowers	= 3 nos. (Including 1 standby)	= 2 nos. (Including 1 standby)

Grit Chamber	Final Phase Calculation	Phase 1 Calculation
2.3 Quantity of Grit at Peak Flow	Assume a value of 0.05m3/1000m3 at peak flow = 350,000 × 0.05 ÷ 1,000 = 17.5 m^3/d	Assume a value of 0.05m3/1000m3 at peak flow = 175,000 × 0.05 ÷ 1,000 = 8.8 m^3/d
Grit Collector		
Type	Screw Type Collector	Screw Type Collector
Number of Collectors	= 4 nos.	= 2 nos.
Required Capacity	= 17.5 ÷ 4 ÷ 24 = 0.20 m^3/hr	= 8.8 ÷ 2 ÷ 24 = 0.20 m^3/hr
Diameter of Screw	= 300 mm	= 300 mm
Diameter of Shaft	= 100 mm	= 100 mm

Equalization Tank	Final Phase Calculation	Phase 1 Calculation
3. Equalization Tank		
3.1 Equalization Tank Volume		
Retention Time	= 4 hour	= 4 hour
Required Volume	= 200,000 / 24 × 4 = 33,333 m^3	= 100,000 / 24 × 4 = 16,667 m^3
Number of Channels per Tank	= 4 channels/tank	= 4 channels/tank
Number of Tanks	= 8 tanks	= 4 tanks
Tank Volume (each)	= 33,333 / 8 = 4,167 m^3	= 16,667 / 4 = 4,167 m^3
Surface Loading	= 50 $m^3/m^2/d$	= 50 $m^3/m^2/d$
Required Surface Area	= 200,000 / 50 = 4,000 m^2	= 100,000 / 50 = 2,000 m^2
Tank Depth	= 33,333 / 4,000 = 8.30 m	= 16,667 / 2,000 = 8.30 m
Tank Size Width	= 19.0 m	= 19.0 m
Length	= 26.0 m	= 26.0 m
Depth	= 8.5 m	= 8.5 m
Actual Total Surface	= 19.0 × 26.0 × 8 = 3,952 m^2	= 19.0 × 26.0 × 4 = 1,976 m^2
Actual Total Volume	= 3,952 × 8.5 = 33,592 m^3	= 1,976 × 8.5 = 16,796 m^3
3.2 Constant Rate Pump	Install 6 Pumps per 2 tanks (Including 1 standby)	Install 6 Pumps per 2 tanks (Including 1 standby)
Pump Capacity	= 200,000 / 20 / 1,440 = 7.0 m^3/min	= 100,000 / 10 / 1,440 = 7.0 m^3/min
Pump Diameter	= 146 × √(7.0 / 2.5) = 244 mm = 250 mm	= 146 × √(7.0 / 3) = 223 mm = 250 mm
Pump Type	Nonclogging Pump	
Pump Head	Actual Pump Head = 10 m Piping Headloss = 4 m Total Pump Head = 14 m	
Motor Output	$P = \frac{\rho \times g \times Q \times H}{60 \times 1000 \times \eta} (1+\alpha)$ $= \frac{1,000 \times 9.8 \times 7.0 \times 14}{60.0 \times 1,000 \times 0.6} \times (1 + 0.2)$ = 32.0 → 37 kW	

Equalization Tank	Final Phase Calculation	Phase 1 Calculation
Pump Specification		
Type	= Nonclogging Pump	= Nonclogging Pump
Diameter	= 250 mm	= 250 mm
Capacity	= 7.0 m^3/min	= 7.0 m^3/min
Head	= 14 m	= 14 m
Motor Output	= 37 kW	= 37 kW
Numbers	= 24 nos. (Including 4 standby)	= 12 nos. (Including 2 standby)
3.3 Mixer for Antisettling		
Type	= Submersible propeller Mixer	= Submersible propeller Mixer
Propeller Diameter	= 500 mm	= 500 mm
Motor Output	= 5.5 kW	= 5.5 kW
Numbers	= 2 nos./channel × 4 × 8 = 64 nos.	= 2 nos./channel × 4 × 4 = 32 nos.

Disinfection Facility	Final Phase Calculation	Phase 1 Calculation
4. Disinfection Facility		
4.1 Disinfection Tank		
Disinfection Tank Volume		
Design Flow (maximum)	= 150,000 m^3/d	= 75,000 m^3/d
Retention Time	= 5 min	= 5 min
Required Tank Volume	= 150,000 / 1,440 × 5 = 521 m^3	= 75,000 / 1,440 × 5 = 260 m^3
Tank Size Width	= 1.20 m	= 1.20 m
Length	= 80.0 m	= 80.0 m
Depth	= 1.50 m	= 1.50 m
Numbers	= 4 tanks	= 2 tanks
Actual Tank Volume	= 576 m^3	= 288 m^3
4.2 Disinfection Chemicals	= Sodium hypochlorite	
Effective Chlorine Density (β)	= 10 %	
Specific Gravity	= 1.1 at 10% density	
Dosing Ratio (α)	= 10 mg/L	
Dosage Capacity		
Maximum Consumption q	= Q × α × 10^{-6} × (100 / β) × (1 / γ)	= Q × α × 10^{-6} × (100 / β) × (1 / γ)
	= 150,000 × 0.00001 × (100 / 10) × (1 / 1.1)	= 75,000 × 0.00001 × (100 / 10) × (1 / 1.1)
	= 13.64 m^3/d = 9.5 L/min	= 6.82 m^3/d = 4.7 L/min
Storage Tank	2 days storage, 1 tank/ train	
Required Tank Capacity	= 13.64 × 2 / 4 = 6.8 → 10 m^3	= 6.82 × 2 / 2 = 6.8 → 10 m^3
Number of Pumps	1pump and 1 stanby for 1 train	1pump and 1 stanby for 1 train
Required Pump Capacity	= 9.5 / 4 = 2.38 L/min	= 4.7 / 2 = 2.35 L/min

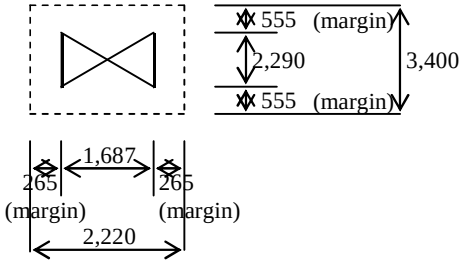
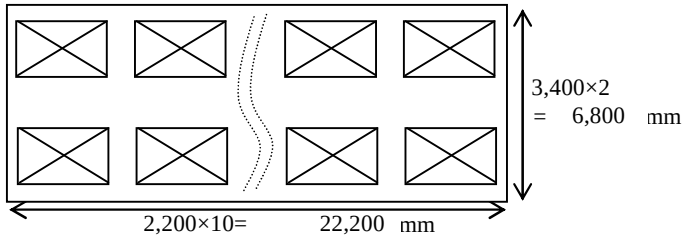
Aeration Tank and MBR Tank	Final Phase Calculation	Phase 1 Calculation
5. Aeration Tank & Membrane Bio-Reactor Facility		
5.1 Aeration Tank Volume		
1) BOD Removal in Aeration Tank		
Design Flow Rate	= 200,000 m^3/d	= 100,000 m^3/d
Influent BOD Concentration	= 120 mg/L	= 120 mg/L
Influent SS Concentration	= 120 mg/L	= 120 mg/L
BOD Load	= 200,000 × 120 / 1,000 = 24,000 kg/d	= 100,000 × 120 / 1,000 = 12,000 kg/d
BOD Removal Rate	= 0.14 kg-BOD/kg-SS/d (25 degrees C)	= 0.14 kg-BOD/kg-SS/d (25 degrees C)
MLSS in MBR Tank	= 9,000 mg/L	= 9,000 mg/L
BOD Removal Rate per Unit Volume	= 0.14 × 9,000 / 1,000 = 1.26 kg-BOD/m^3	= 0.14 × 9,000 / 1,000 = 1.26 kg-BOD/m^3
Required Aeration Tank Volume for BOD	= 24,000 / 1.26 = 19,048 m^3	= 12,000 / 1.26 = 9,524 m^3
2) Nitrification in Aeration Tank		
Design Flow Rate	= 200,000 m^3/d	= 100,000 m^3/d
Influent BOD Concentration	= 120 mg/L	= 120 mg/L
Influent SS Concentration	= 120 mg/L	= 120 mg/L
Influent T-N Concentration	= 40 mg/L	= 40 mg/L
MLSS in Aeration Tank	= 9,000 mg/L	= 9,000 mg/L
BOD Load	= 200,000 × 120 / 1,000 = 24,000 kg/d	= 100,000 × 120 / 1,000 = 12,000 kg/d
T-N Load	= 200,000 × 40 / 1,000 = 8,000 kg/d	= 100,000 × 40 / 1,000 = 4,000 kg/d
Excess Sludge Production Rate	= 100 %	= 100 %
Nitrogen Concentration in Sludge	= 6 %	= 6 %
Nitrogen in Excess Sludge	= 200,000 × 120 × 0.06 / 1,000 = 1,440 kg/d	= 100,000 × 120 × 0.06 / 1,000 = 720 kg/d
T-N Load for Nitrification	= 8,000 - 1,440 = 6,560 kg/d	= 4,000 - 720 = 3,280 kg/d
Nitrification Rate	= 0.037 kg-N/kg-SS/d (25 degrees C)	= 0.037 kg-N/kg-SS/d (25 degrees C)
MLSS in MBR Tank	= 9,000 mg/L	= 9,000 mg/L
Nitrification Rate per Unit Volume	= 0.037 × 9,000 / 1,000 = 0.33 kg-N/m^3	= 0.037 × 9,000 / 1,000 = 0.33 kg-N/m^3
Nitrification in MBR Tank	= 19,200 × 0.33 = 6,394 kg-N/d -OK-	= 7,550 × 0.33 = 2,514 kg-N/d
Channel Size of Aeration Tank		
Length	= 32.0 m	= 32.0 m
Width	= 6.0 m	= 6.0 m
Depth	= 5.0 m	= 5.0 m
Number of Channels	= 20 nos.	= 10 nos
Volume of each Channel	= 960 m^3	= 960 m^3
Total Volume of Aeration Tank	= 960 × 20 = 19,200 m^3 > 19,048 m^3 **O.K.**	= 960 × 10 = 9,600 m^3 > 9,524 m^3 **O.K.**

Aeration Tank and MBR Tank	Final Phase Calculation	Phase 1 Calculation
5.2 Required Air Volume for Aeration Tank		
1) Required Oxygen for BOD Removal		
Design Flow Rate	= 200,000 m^3/d	= 100,000 mg/L
Influent BOD Concentration	= 120 mg/L	= 120 mg/L
BOD Load	= 24,000 kg-BOD/d	= 12,000 kg-BOD/d
Required Unit Oxygen for BOD Removal	= 0.5 $kg\text{-}O_2/kg\text{-}BOD$	= 0.5 $kg\text{-}O_2/kg\text{-}BOD$
Required Oxygen for BOD Removal	= 24,000 × 0.5 = 12,000 $kg\text{-}O_2/d$	= 12,000 × 0.5 = 6,000 $kg\text{-}O_2/d$
2) Required Oxygen for Nitrification		
T-N Load for Nitrification	= 6,560 kg-N/d	= 3,280 kg-N/d
Required Unit Oxygen for Nitrification	= 64/14 $kg\text{-}O_2/kg\text{-}N$	= 64/14 $kg\text{-}O_2/kg\text{-}N$
Required Oxygen for Nitrification	= 6,560 × 64/14 = 29,989 $kg\text{-}O_2/d$	= 3,280 × 64/14 = 14,994 $kg\text{-}O_2/d$
3) Required Oxygen for Endogenous Respiration		
Aeration Tank Volume	= 19,200 m^3	= 9,600 m^3
MLSS in Tank	= 9,000 mg/L	= 9,000 mg/L
MLVSS/MLSS	= 0.75	= 0.75
Quantity of MLVSS	= 9,000 × 19,200 × 0.750 / 1,000	= 9,000 × 9,600 × 0.750 / 1,000
	= 129,600 kg/d	= 64,800 kg/d
Required Unit Oxygen for Endogenous Respiration	= 0.12 $kg\text{-}O_2/kg\text{-}VSS$	= 0.12 $kg\text{-}O_2/kg\text{-}VSS$
Required Oxygen for Endogenous Respiration	= 129,600 × 0.12 = 15,552 $kg\text{-}O_2/d$	= 64,800 × 0.12 = 7,776 $kg\text{-}O_2/d$
4) Total Required Oxygen for Biological Treatment(AOR)	= 12,000 + 29,989 + 15,552 = 57,541 $kg\text{-}O_2/d$	= 6,000 + 14,994 + 7,776 = 28,770 $kg\text{-}O_2/d$

Aeration Tank and MBR Tank		Final Phase Calculation	Phase 1 Calculation
5) Standard Oxygen Requirement (SOR)		$= \frac{AOR \times Csw \times r \times 760}{1.024^{\wedge}(T-20) \times \alpha \times (\beta \cdot Cs \cdot r - CA) \times P}$ C_{SW} ; Oxygen saturation concentration in clean water at 20 = 8.84 mg/L Ca ; Average DO = 1.5 mg/L Cs ; Oxygen saturation concentration in clean water at 25 = 8.39 mg/l T ; water temperature = 25 degees C r ; Coefficient of water depth $r = 1 + \frac{(H/2)}{10.332} = 1.23$ H ; Average depth of air diffuser = 4.80 m α ; 0.93 β ; 0.97 P ; 760	
	SOR	= 70,189 kg as O_2/d	= 35,095 kg as O_2/d
6) Required Air Volume (Gs)	Gs	$= \frac{SOR}{E_A \times \rho \times Ow} \times \frac{273 + T}{273}$ E_A ; Oxygen transfer efficiency (28 %) ρ ; Air density (1.293 kg/m^3N-Air) O_W ; Oxygen content in air (0.232 kg-O_2/m^3N-Air) T ; Water temperature = 25 degees C	
	Gs	$= \frac{70,189}{28 \times 1.293 \times 0.232} \times 100 \times \frac{273 + 25}{273}$	$= \frac{35,095}{28 \times 1.293 \times 0.232} \times 100 \times \frac{273 + 25}{273}$
		= 912,175 Nm^3/d = 633 Nm^3/min = 32 Nm^3/min/channel	= 456,094 Nm^3/d = 317 Nm^3/min = 32 Nm^3/min/channel

Aeration Tank and MBR Tank		Final Phase Calculation	Phase 1 Calculation
5.3 Aeration Blowers for Aeration Tank			
Required Air Volume per Channel		consider about 10% allowance = 32 × 1.1 = 35 Nm^3/min/channel	= 32 × 1.1 = 35 Nm3/min/ channel
Number of Actual Working Blowers per each Train	N	= 2 nos. / train	= 2 nos. / train
Blower Capacity	G	= 35 × 5 / 2 = 87.5 m^3/min → 90 m^3/min	= 35 × 5 / 2 = 87.5 m^3/min → 90 m^3/min
Discharge Pressure			
Diffuser Depth		= 4,800 mmAq	= 4,800 mmAq
Loss of Diffuser		= 1,100 mmAq	= 1,100 mmAq
Other Loss		= 1,000 mmAq	= 1,000 mmAq
Total Pressure		= 6,900 mmAq = 68 kpa	= 6,900 mmAq = 68 kpa
Blower Specification			
Type		Turbo Type Blower	Turbo Type Blower
Capacity		= 90 m^3/min	= 90 m^3/min
Discharge Pressure		= 68 kpa	= 68 kpa
Motor Output		= 150 kW	= 150 kW
Outlet Diameter		= 300 mm	= 300 mm
Number of Blowers		= 12 nos. (Including 4 standby)	= 6 nos. (Including 2 standby)

Aeration Tank and MBR Tank	Final Phase Calculation	Phase 1 Calculation
5.4 Air Diffuser for Aeration Tank		
Type	Fine Bubble Disk Membrane Type	Fine Bubble Disk Membrane Type
Air Flow Rate	= 120～150 L/min	= 120～150 L/min
Oxygen Transfer Efficiency	= 20 %	= 20 %
Total Oxygen Requirement	= 70,189 kg as O_2/d （SOR)	= 35,095 kg as O_2/d （SOR)
Oxygen Requirement per Channel	= 70,189 / 20 = 3,510 kg as O_2/d･tank	= 35,095 / 10 = 3,510 kg as O_2/d･tank
Total Air Requirement	= 633 Nm^3/min	= 317 Nm^3/min
Channel Size of Aeration Tank		
Length	= 32.0 m	= 32.0 m
Width	= 6.0 m	= 6.0 m
Depth	= 5.0 m	= 5.0 m
Number of Channels	= 20 nos.	= 10 nos.
Decision of Diffuser Number N	$= \frac{Gs}{\text{Air Flowrate per piece}} \times \frac{1}{OR} \times 1{,}000$	$= \frac{Gs}{\text{Air Flowrate per piece}} \times \frac{1}{OR} \times 1{,}000$
	$= \frac{633}{140} \times \frac{1}{0.5} \times 1{,}000$	$= \frac{317}{140} \times \frac{1}{0.5} \times 1{,}000$
	= 9,049 nos.	= 4,525 nos.
Per Channel	= 452 nos./channel	= 452 nos./channel

Aeration Tank and MBR Tank	Final Phase Calculation	Phase 1 Calculation
5.5 Membrane Bioreactor Tank(MBR Tank) Volume		
Design Flow Rate	= 200,000 m^3/d	= 100,000 m^3/d
Design Flux	= 0.42 $m^3/m^2/d$	= 0.42 $m^3/m^2/d$
Required Area of Membrane	= 200,000 / 0.42 = 476,190 m^2	= 100,000 / 0.42 = 238,095 m^2
Membrane Area per Skid	= 1,200 m^2/skid	= 1,200 m^2/skid
Required Number of Membrane Skids	= 476,190 / 1,200 = 397 → 400 nos.	= 238,095 / 1,200 = 199 → 200 nos.
Number of Channels	= 20 channels	= 10 channels
Number of Membrane Skids per Channel	= 400 / 20 = 20 skids	= 200 / 10 = 20 skids
Determined Size of Membrane Skid		
Length	= 2,290 mm	= 2,290 mm
Width	= 1,687 mm	= 1,687 mm
Depth	= 2,852 mm	= 2,852 mm
		
Determined Channel Size of Membrane Tank		
Length	= 22.2 m (2.20m x 10skids = 22.2m)	= 22.2 m (2.20m x 10skids = 22.2m)
Width	= 6.8 m (3.40m x 2Lines = 6.80m)	= 6.8 m (3.40m x 2Lines = 6.80m)
Depth	= 5.0 m	= 5.0 m
Number of Channels	= 20 nos.	= 10 nos.
Volume of each Channel	= 755 m^3	= 755 m^3
Total Volume of Membrane Tank	= 755 × 20 = 15,100 m^3	= 755 × 10 = 7,550 m^3
MLSS in Membrane Tank	= 9,000 mg/L	= 9,000 mg/L

Aeration Tank and MBR Tank		Final Phase Calculation	Phase 1 Calculation
5.6 Required Air Volume for Membrane Scrubbing			
Air Volume per Membrane Module		= 0.36 Nm^3/min/module	= 0.36 Nm^3/min/module
Number of Modules per Skid		= 20 module/ skid	= 20 module/ skid
Air Volume per Membrane Skid		= 7.2 Nm^3/min/skid	= 7.2 Nm^3/min/module
Number of Skids per Channel		= 20 skids/channel	= 20 skids/channel
Number of Channels		= 20 nos.	= 10 nos.
Total Number of Skids		= 400 skids	= 200 skids
Total Required Air Volume for Membrane		= 7.2 × 400 = **2,880 Nm^3/min**	= 7.2 × 200 = **1,440 Nm^3/min**
Required Air Volume per Channel		= 144 Nm^3/min/channel	= 144 Nm^3/min/channel
5.7 Aeration Blowers for MBR			
Required Air Volume per Channel		consider about 10% allowance = 144 × 1.1 = 158 Nm^3/min/channel	= 144 × 1.1 = 158 Nm^3/min/channel
Number of Actual Working Blowers	N	= 5 nos. / train	= 5 nos. / train
Blower Capacity	G	= 158 × 5 / 5 = 158 m^3/min → 160 m^3/min	= 158 × 5 / 5 = 158 m^3/min → 160 m^3/min
Discharge Pressure			
Diffuser Depth		= 4,800 mmAq	= 4,800 mmAq
Loss of Diffuser		= 750 mmAq	= 750 mmAq
Other Loss		= 1,000 mmAq	= 1,000 mmAq
Total Pressure		= 6,550 mmAq = 64 kpa	= 6,550 mmAq = 64 kpa
Blower Specification			
Type		= Turbo Type Blower	= Turbo Type Blower
Capacity		= 160 m^3/min	= 160 m^3/min
Discharge Pressure		= 64 kpa	= 64 kpa
Motor Output		= 188 kW	= 188 kW
Outlet Diameter		= 400 mm	= 400 mm
Number of Blowers		= 24 nos. (Including 4 standby)	= 12 nos. (Including 2 standby)

Aeration Tank and MBR Tank	Final Phase Calculation	Phase 1 Calculation
5.8 Circulation Pump		
Circulation sludge rate	= 200 %	= 200 %
Circulation sludge volume	= 400,000 m3 /day = 280 m3 /min	= 200,000 m3 /day = 140 m3 /min
Number of Actual Working Pumps	= 20 units / 4 trains	= 10 units / 2 trains
Pump Capacity	= 14.0 m^3/min	= 14.0 m^3/min
Pump Diameter	= 146 × √(14.0 / 3) = 315 mm	= 146 × √(14.0 / 3) = 315 mm
Pump Head	Actual Pump Head = 10 m Piping Headloss = 4 m Total Pump Head = 14 m	
Motor Output	$P = \frac{\rho \times g \times Q \times H}{60 \times 1000 \times \eta} (1+\alpha)$ $= \frac{1{,}000 \times 9.8 \times \#\#\# \times 14}{60.0 \times 1{,}000 \times 0.6} \times (1 + 0.2)$ = 64.0 kW	
Pump Specification		
Type	= Submergiable axial pump	= Submergiable axial pump
Diameter	= 315 mm	= 315 mm
Capacity	= 14 m^3/min	= 14 m^3/min
Discharge Pressure	= 14 m	= 14 m
Motor Output	= 64.0 kW	= 64.0 kW
Number of Pumps	= 28 nos. (Including 8 standby)	= 14 nos. (Including 4 standby)
5.9 Excess Sludge Pump		
Drawing Sludge Volume	= 2,000 m^3/d = 1.4 m^3/min	= 1,000 m^3/d = 0.7 m^3/min
Number of Actual Working Pumps	= 4 units / 4 trains	= 2 units / 2 trains
Pump Capacity	= 0.4 m^3/min	= 0.4 m^3/min
Pump Diameter	= 146 × √(0.4 / 3) = 50 mm	= 146 × √(0.4 / 3) = 50 mm
Pump Head	Actual Pump Head = 10 m Piping Headloss = 4 m Total Pump Head = 14 m	
Motor Output	$P = \frac{\rho \times g \times Q \times H}{60 \times 1000 \times \eta} (1+\alpha)$ $= \frac{1{,}000 \times 9.8 \times 0.4 \times 14}{60.0 \times 1{,}000 \times 0.6} \times (1 + 0.2)$ = 1.6 kW	

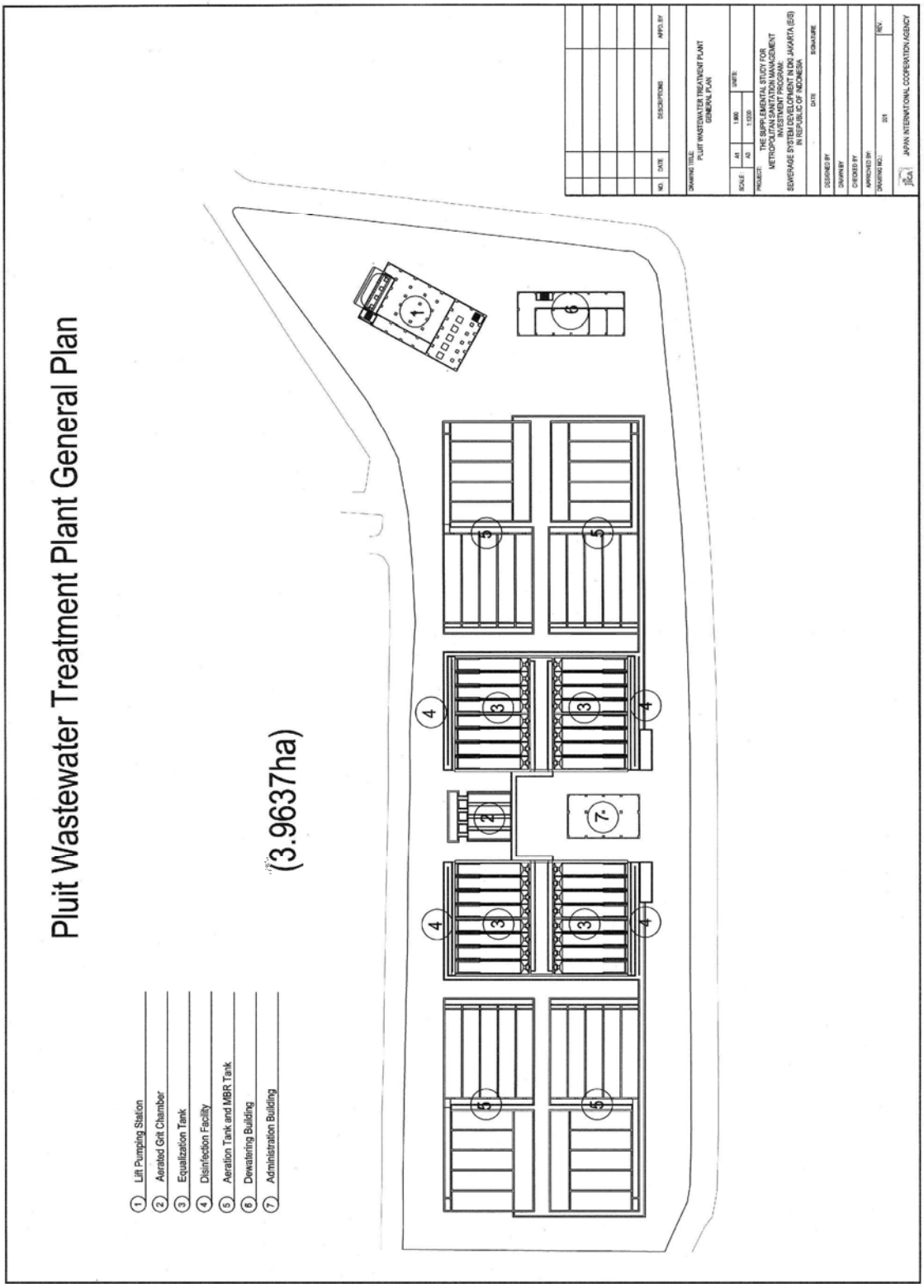
Aeration Tank and MBR Tank	Final Phase Calculation	Phase 1 Calculation
Type	= Non-clog Type Sludge Pump	= Non-clog Type Sludge Pump
Diameter	= 50 mm	= 50 mm
Capacity	= 0.4 m^3/min	= 0.4 m^3/min
Discharge Pressure	= 14 m	= 14 m
Motor Output	= 1.6 kW	= 1.6 kW
Number of Pumps	= 8 nos. (Including 4 standby)	= 4 nos. (Including 2 standby)

Dewatering Facility	Final Phase Calculation	Phase 1 Calculation
6. Dewatering Facility		
6.1 Design Condition		
Input Sludge Solids Quantity	= 18.0 t/d	= 9.0 t/d
Input Sludge Solids Concentration	= 0.9 %	= 0.9 %
Input Sludge Volume	= 2,004 m^3/d	= 1,002 m^3/d
Operation Time	= 23 hr/d	= 23 hr/d
Dehydrater Type	= Pressing Rotary Outer Cylinder-type Screw Press	= Pressing Rotary Outer Cylinder-type Screw Press
Screen Diameter	= 800 mm	= 800 mm
Filtration Rate	= 320 kg-DS/hr	= 320 kg-DS/hr
6.2 Required Number of Dehydraters	= 18.0352 / 0.32 / 23 = 2.5 = 3 nos.	= 9.01758 / 0.32 / 23 = 1.2 = 2 nos.
6.3 Dehydrater Specifications		
Type	= Pressing Rotary Outer Cylinder-type Screw Press	= Pressing Rotary Outer Cylinder-type Screw Press
Screen Diameter	= 800 mm	= 800 mm
Input Sludge Concentration	= 0.9 %	= 0.9 %
Filtration Rate	= 320 kg-DS/hr	= 320 kg-DS/hr
Operation Time	= 23 hr/d	= 23 hr/d
Dosage Type	= Organic Polymer (Cation)	= Organic Polymer (Cation)
Dosage Rate	= 1.7 %	= 1.7 %
Total Motor Power	= 2.2 kW/unit	= 2.2 kW/unit
Numbers of Dehydrator	= 5 nos. (Including 2 standby)	= 3 nos. (Including 1 standby)
6.4 Sludge Storage Tank		
Excess Sludge Volume	= 2,004 m^3/d	= 1,002 m^3/d
Retention Time	= 7.5 hr	= 7.5 hr
Required Tank Volume	= 626 m^3	= 313 m^3
Storage Tank Size		
Width	= 8 m	= 8 m
Length	= 8 m	= 8 m
Depth	= 5 m	= 5 m
Number	= 2 nos	= 1 nos
Total Volume	= 640 m^3	= 320 m^3

Dewatering Facility	Final Phase Calculation	Phase 1 Calculation
6.5 Sludge Feed Pump	1pump should be installed in each hydrator.	
Required Pump Capacity (Q)	= (D×100)/(C_0×10^3)×k Where, D: Dehydrate Capacity (kg-DS/hou 320 kg-DS/hr C_0: Solid Concentration = 0.9 % k: Coefficient = 0.5-1.!	
Q	= 320 × 100 / 0.9 / 1000 × 0.5-1.! = 17.8 - 53.3 m^3/hr = 0.30 - 0.89 m^3/min	= 320 × 100 / 0.9 / 1000 × 0.5-1.! = 17.8 - 53.3 m^3/hr
Pump Head		
Actual Pump Head	= 15 m	= 15 m
Others Headloss	= 5 m	= 5 m
Injection Pressure	= 5 m	= 5 m
Total Pump Head	= 25 m → 30 m	= 25 m → 30 m
Motor Output	$P = \frac{\rho \times g \times Q \times H}{60 \times 1000 \times \eta}(1+\alpha)$ $= \frac{1.05 \times 9.8 \times 0.9 \times 30}{60.0 \times 0.35 \times 0.95} \times (1 + 0.2)$ = 16.5 kW → 18.5 kW	
Pump Specification		
Type	= Progressing Cavity Pump	= Progressing Cavity Pump
Diameter	= 150 mm	= 150 mm
Capacity	= 17.8 - 53.3 m^3/hr	= 17.8 - 53.3 m^3/hr
Pump Head	= 30 m	= 30 m
Motor Output	= 18.5 kW	= 18.5 kW
Number of Pumps	= 5 nos. (Including 2 standby)	= 3 nos. (Including 1 standby)

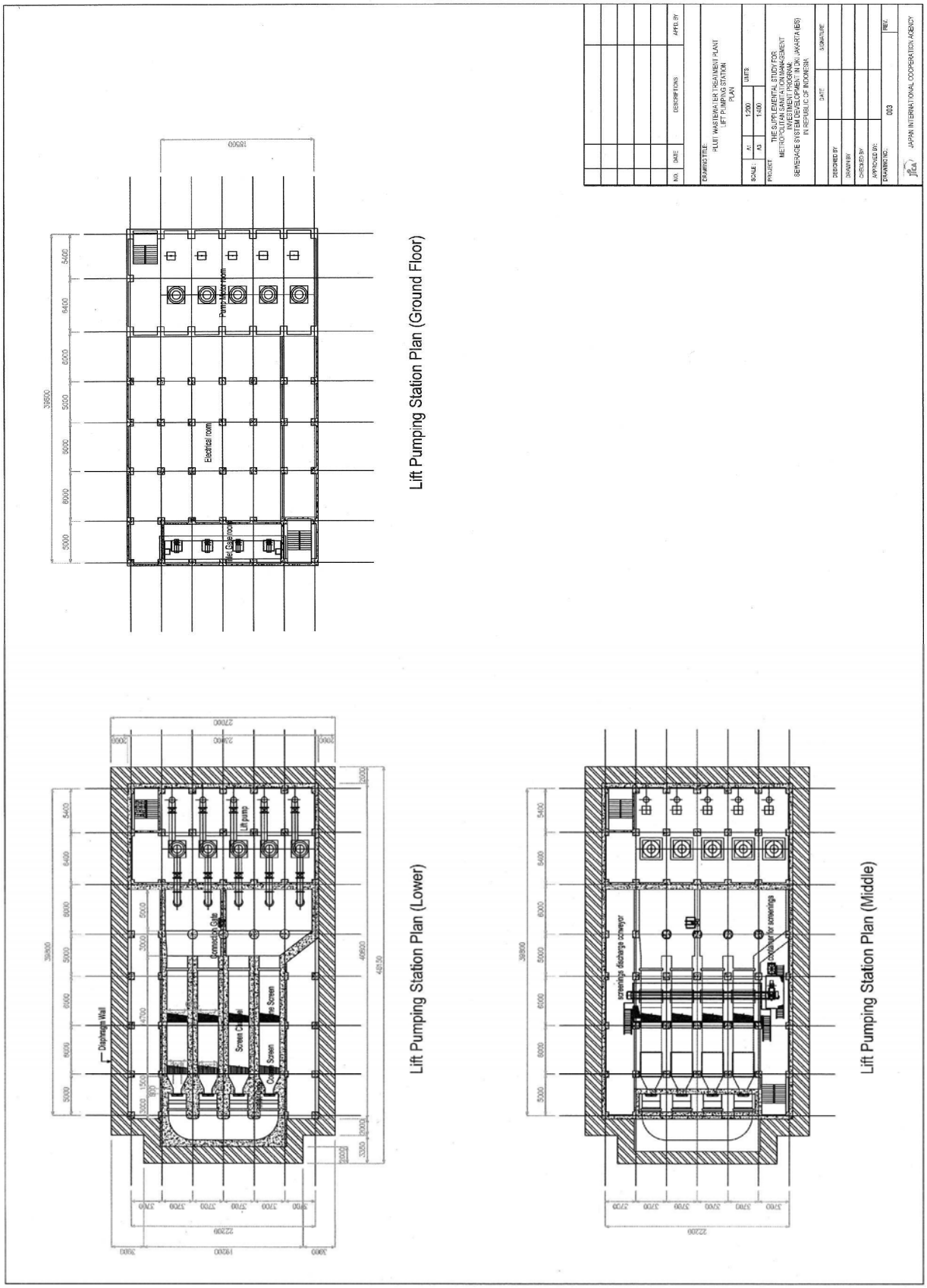
Appendix4.5 Drawings of Facilities

Appendix4.5.1 General Plan



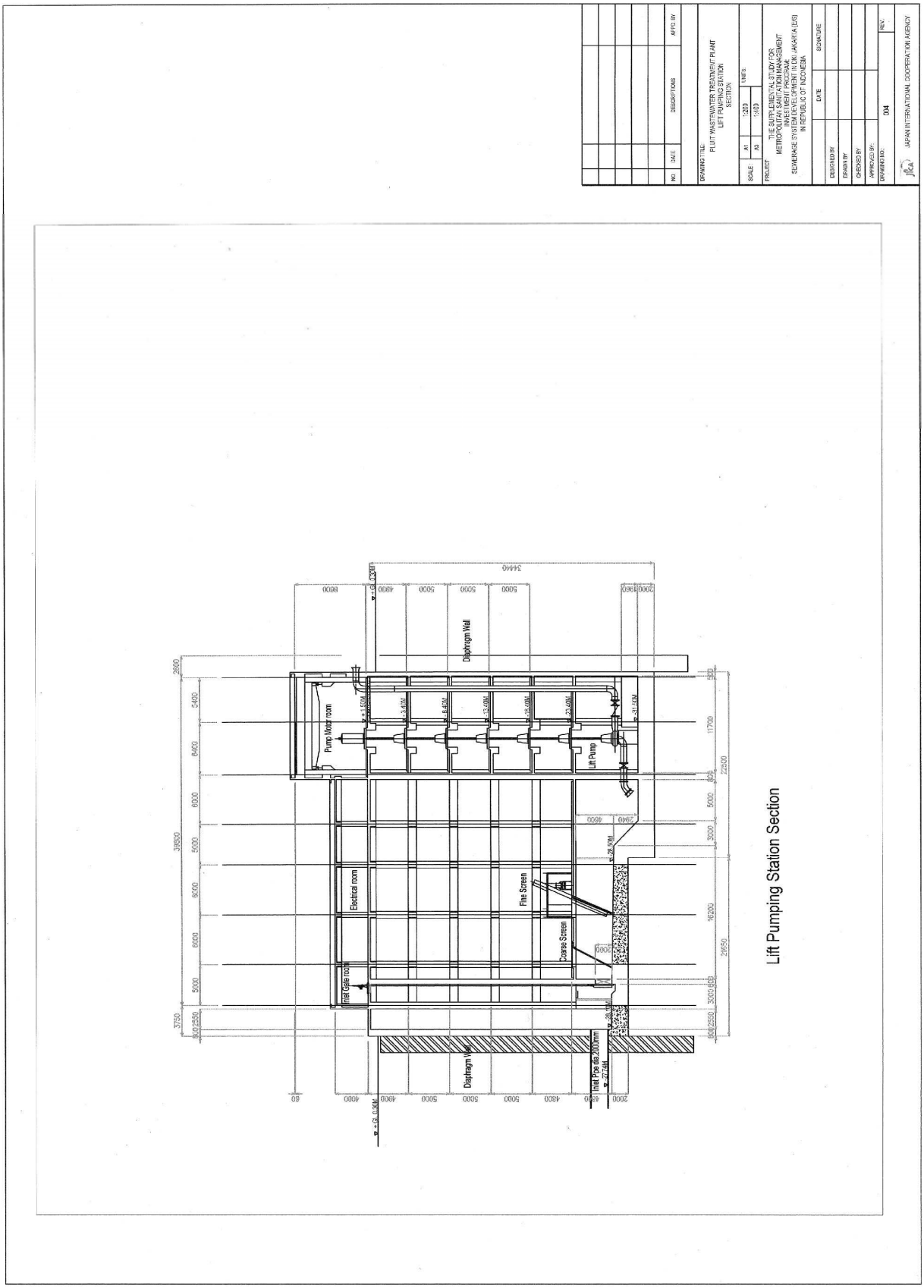
Appendix4.5.2 Lift Pumping Station

(1) Plan



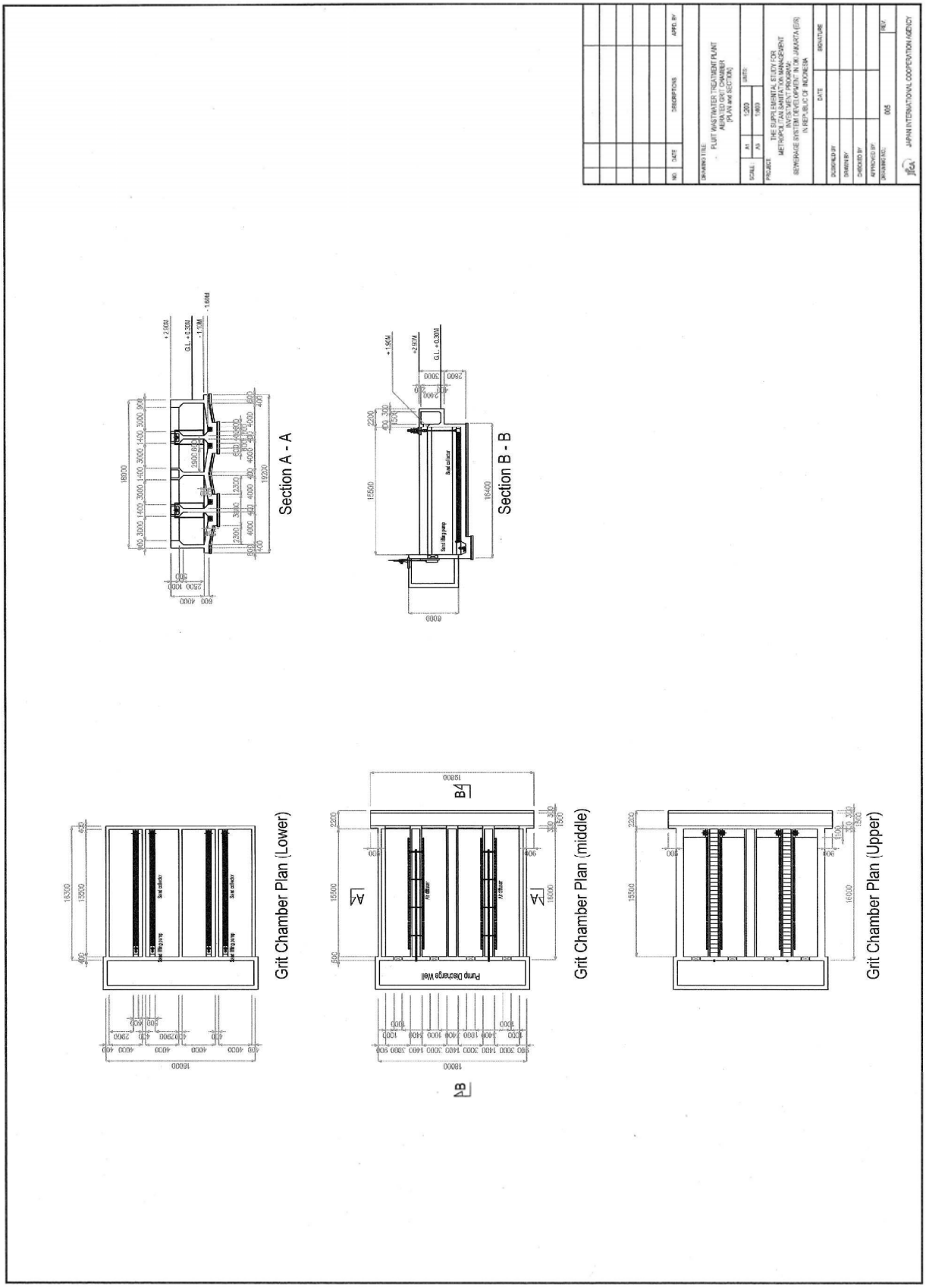
Appendix4.5.2 Lift Pumping Station

(2) Section



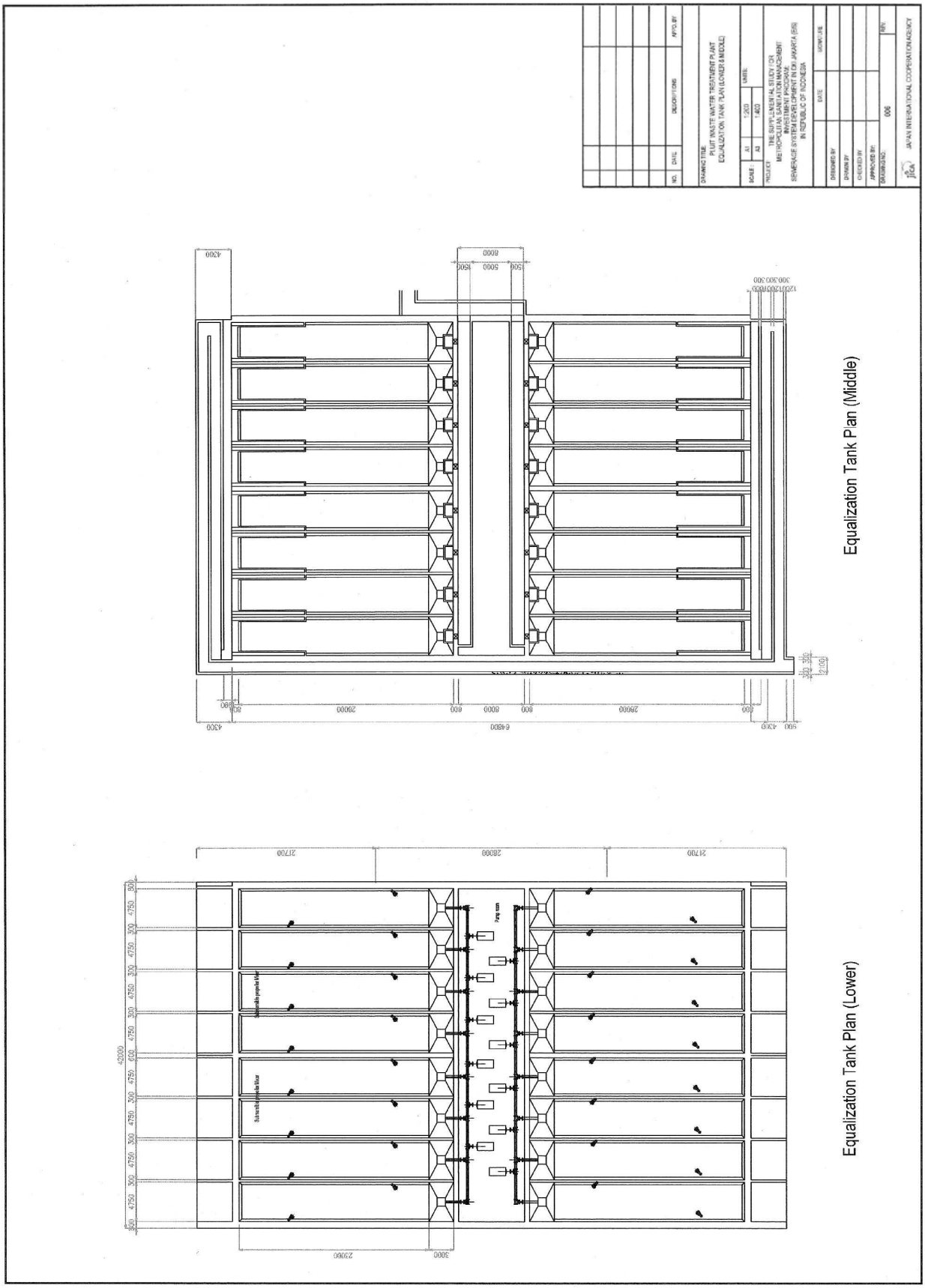
Appendix4.5.3 Grit Chamber

(1) Plan and Section



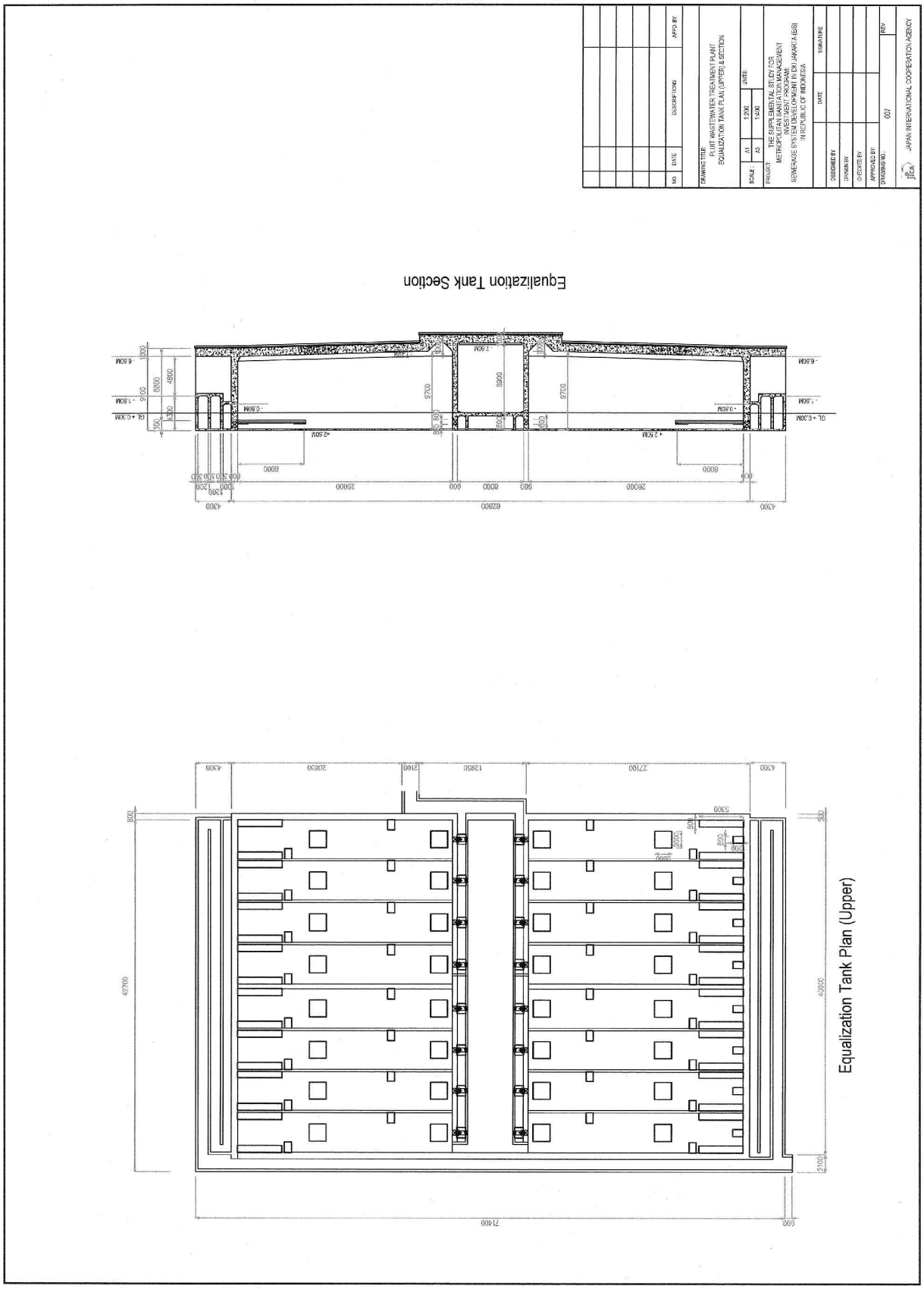
Appendix4.5.4 Equalization Tank and Disinfection Facility

(1) Plan (Lower and Middle)



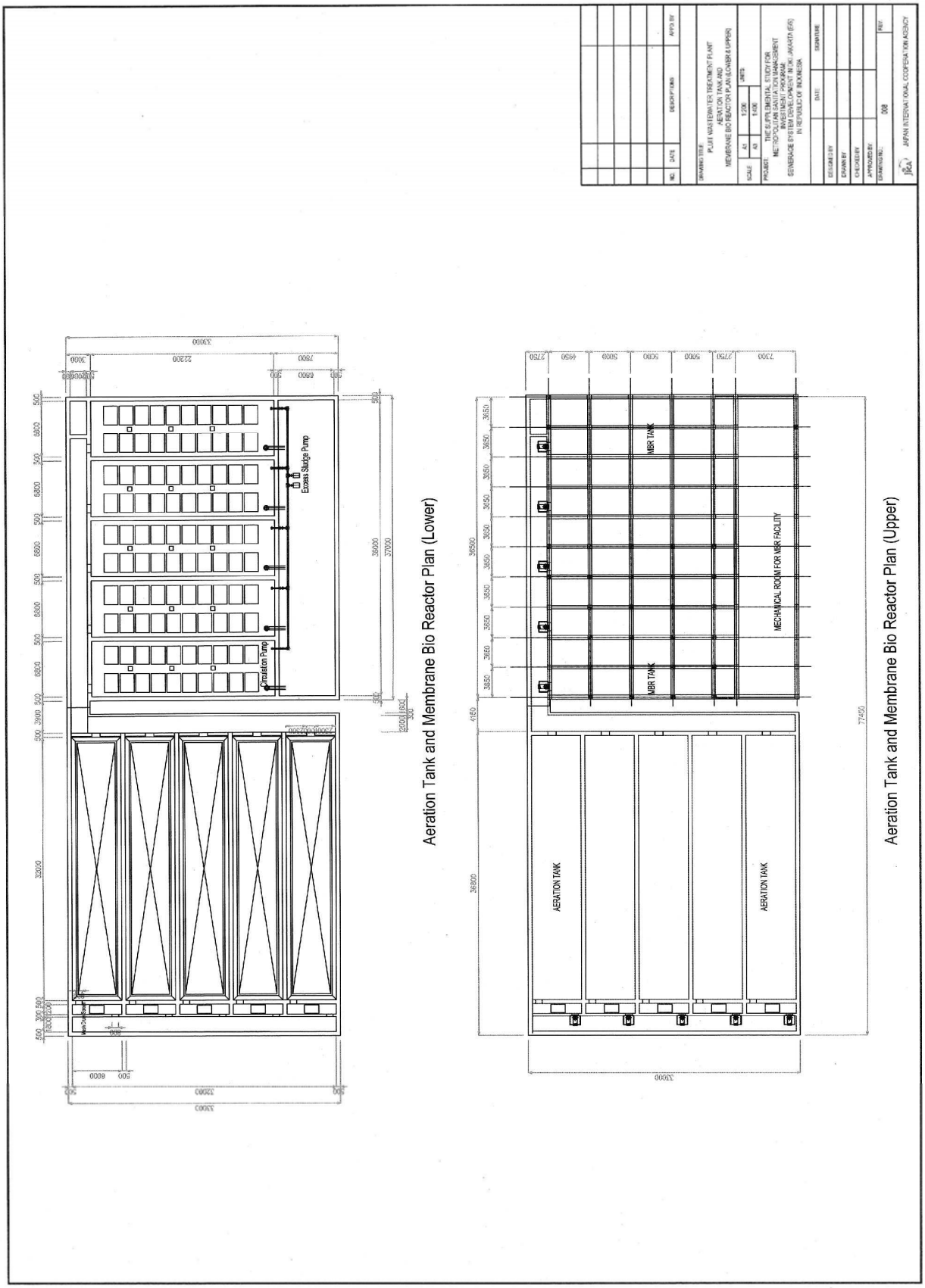
Appendix4.5.4 Equalization Tank and Disinfection Facility

(2) Plan (Top) and Section



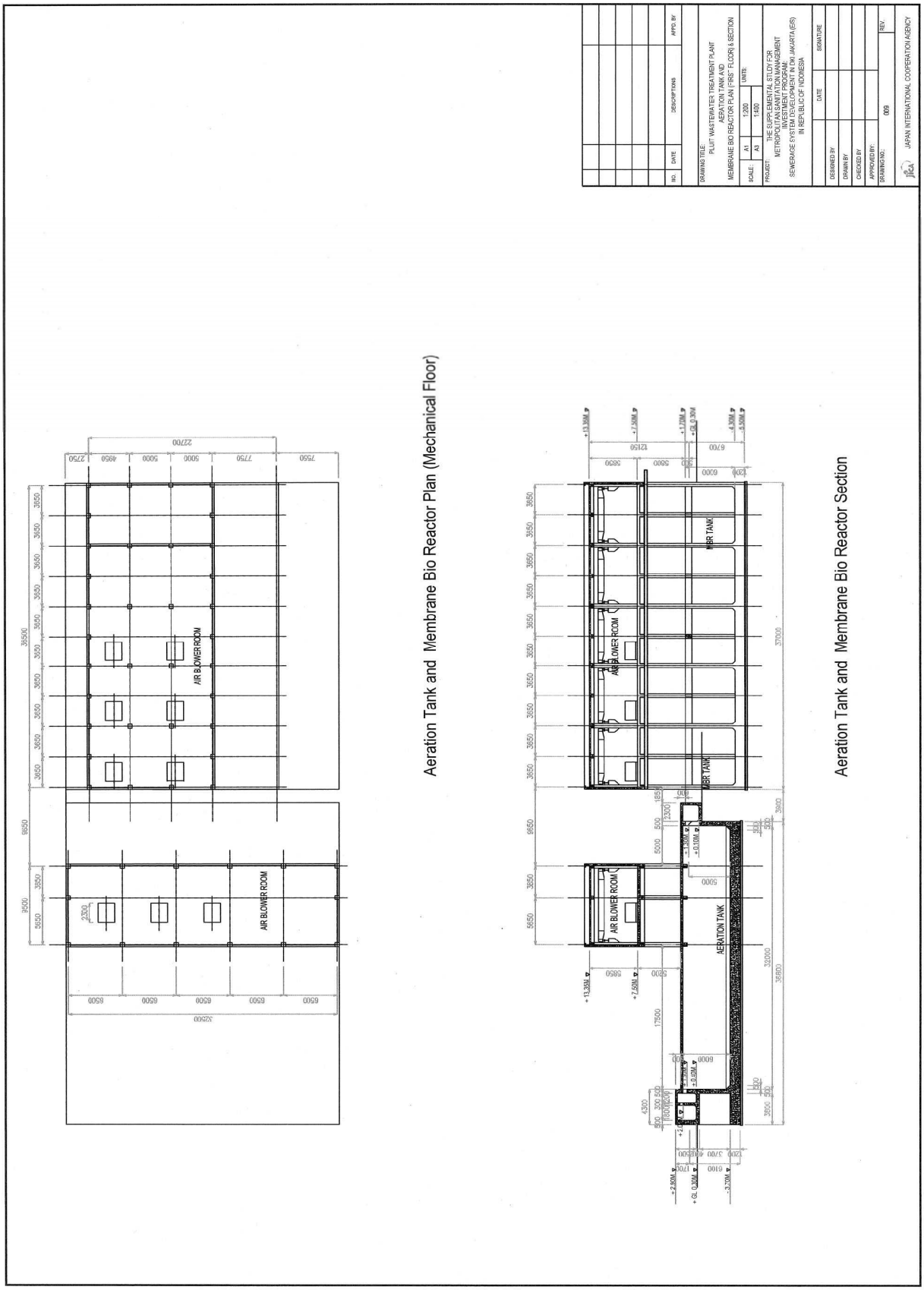
Appendix4.5.5 Aeration Tanks and MBR Tanks

(1) Plan (Lower and Upper)



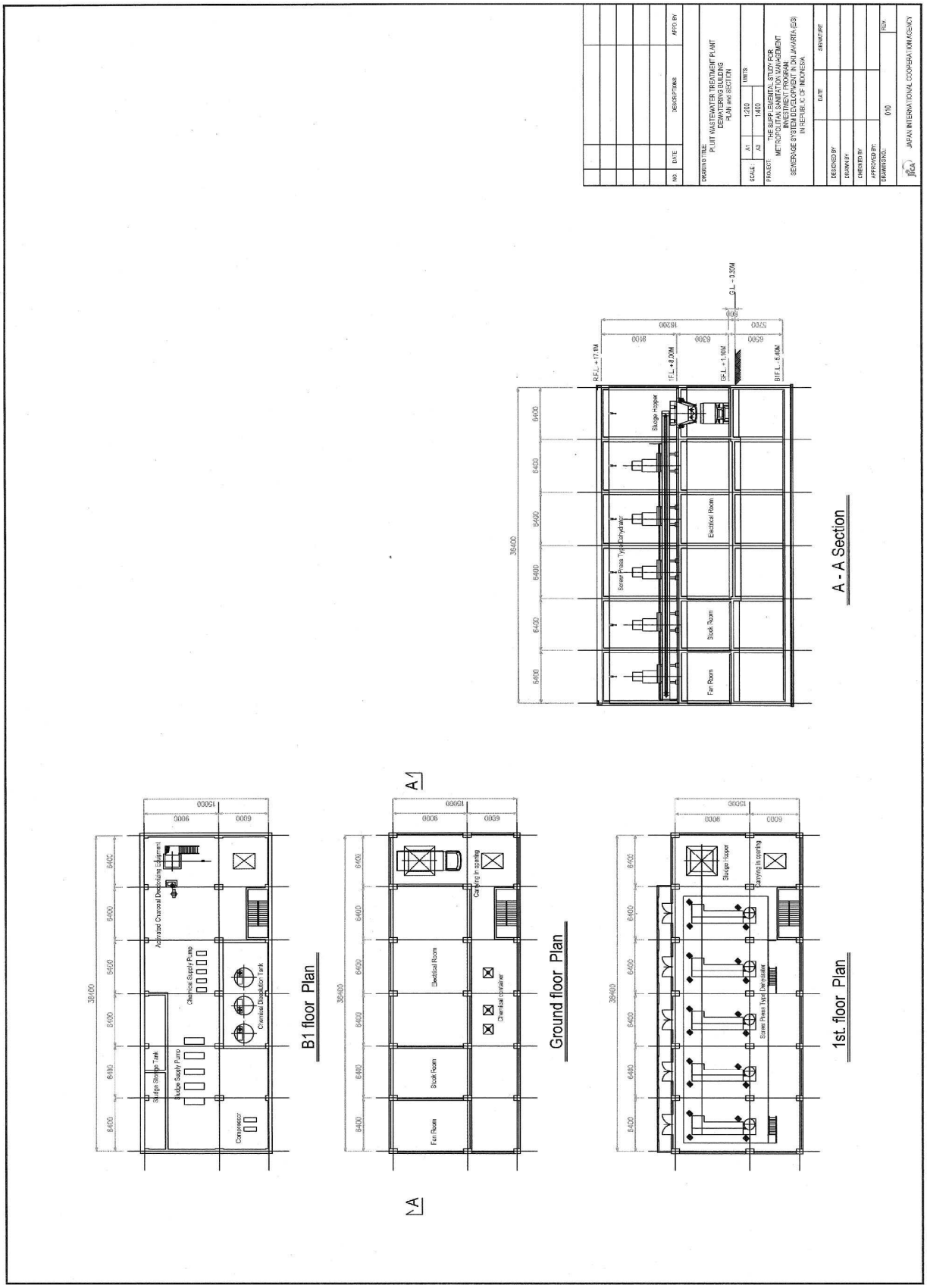
Appendix4.5.5 Aeration Tanks and MBR Tanks

(2) Plan (Mechanical Floor) and Section



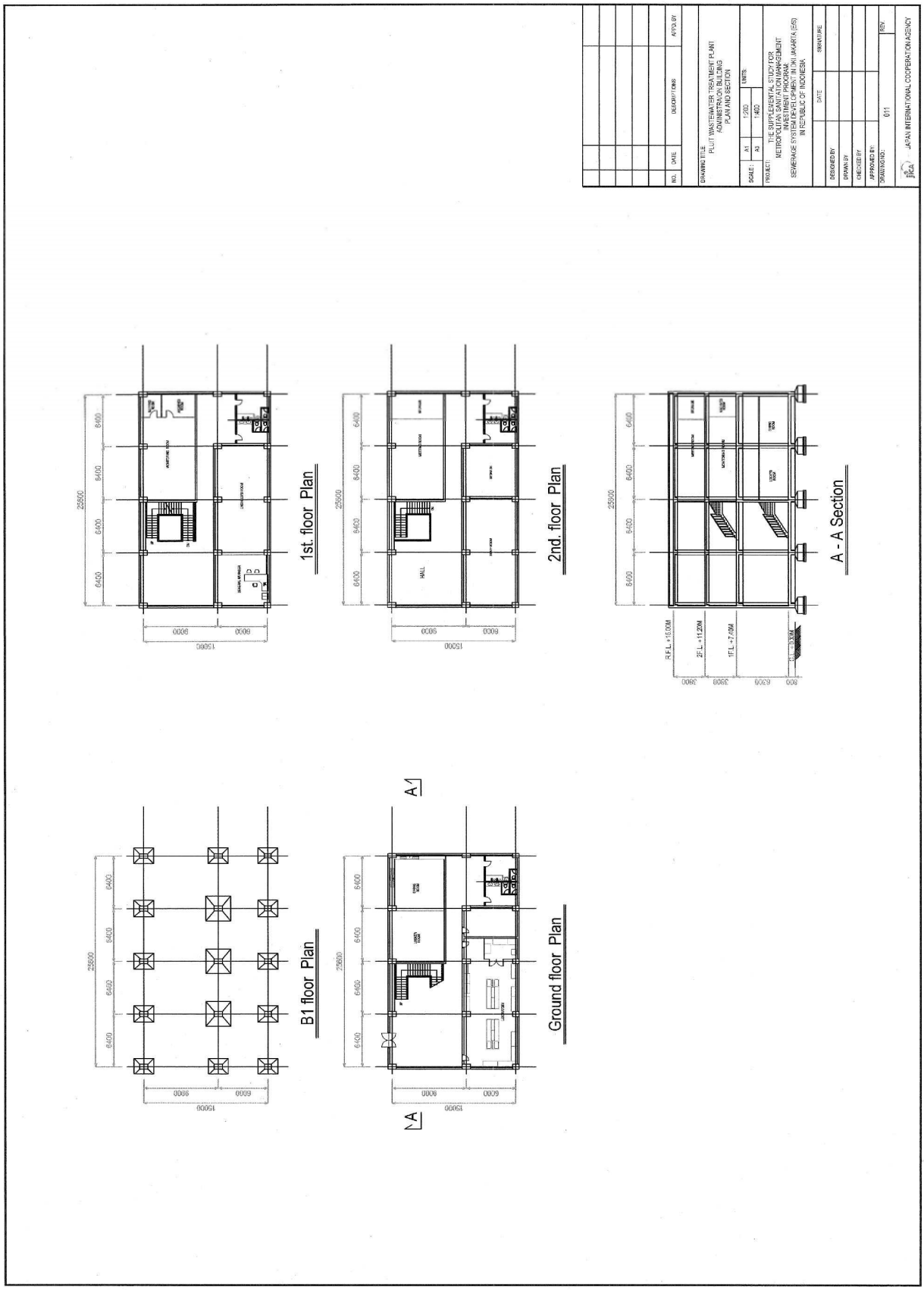
Appendix4.5.6 Dewatering Building

(1) Plan and Section



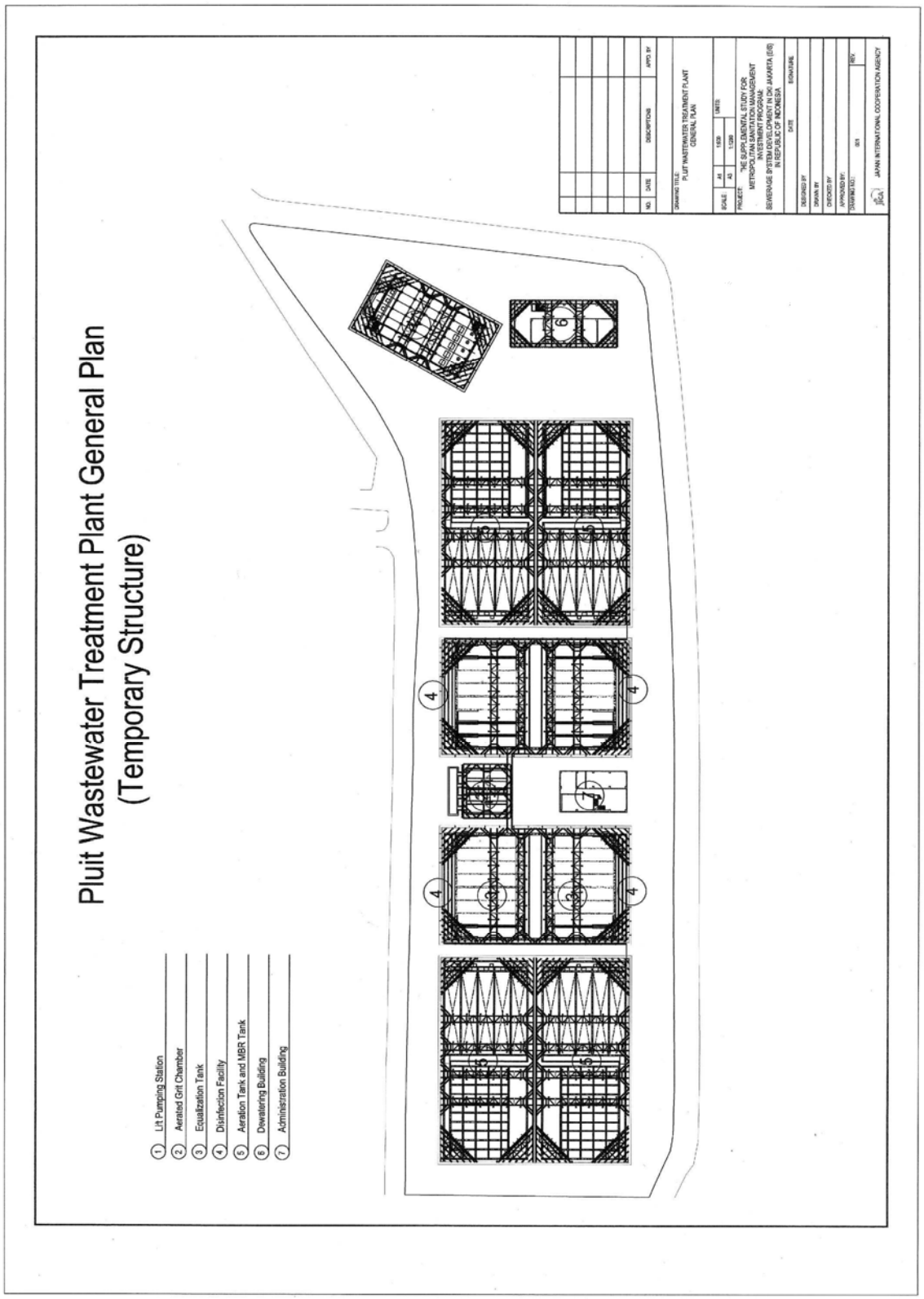
Appendix4.5.7 Administration Building

(1) Plan and Section



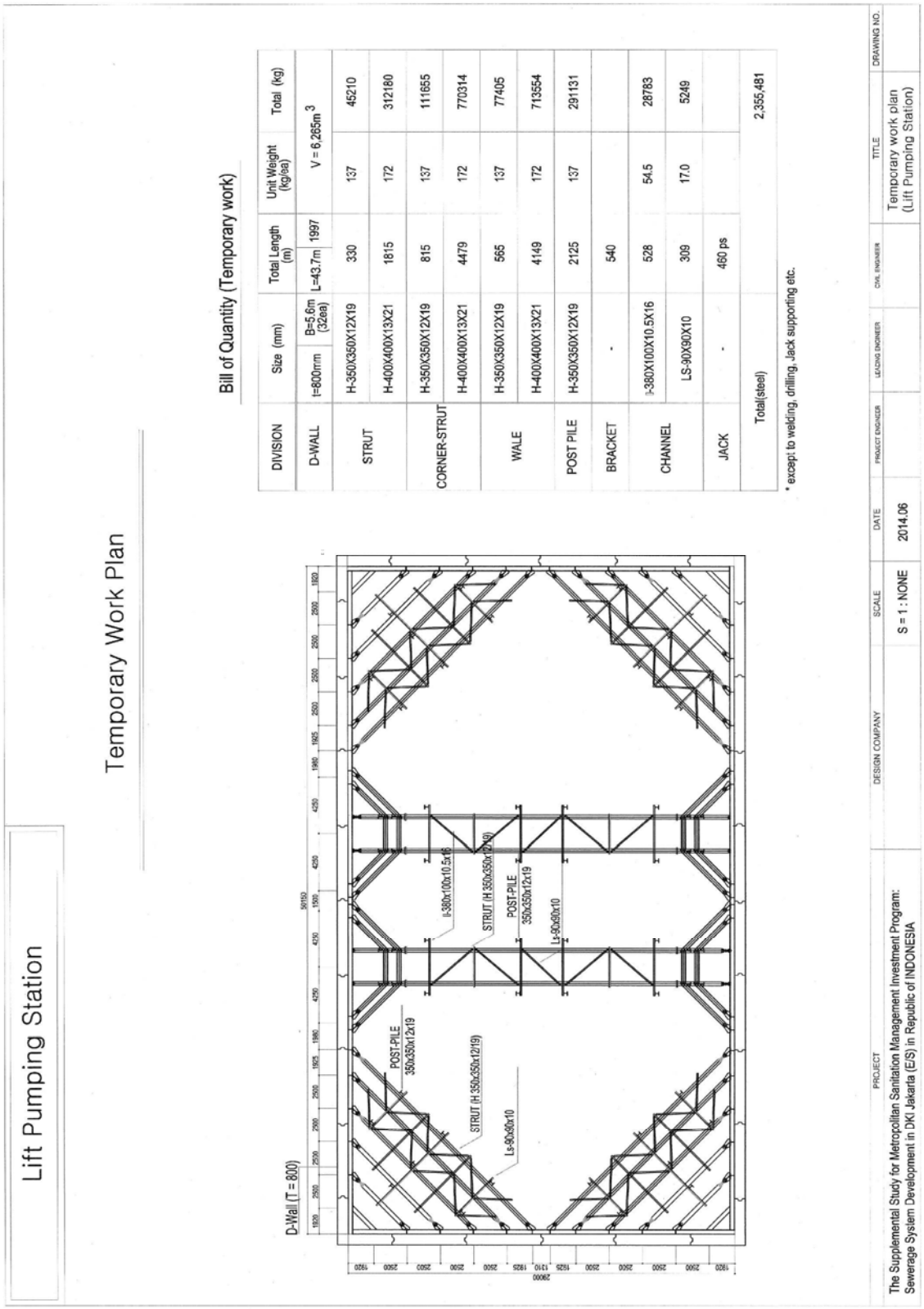
Appendix4.6 Drawings of Foundation Works and Temporary Works

Appendix4.6.1 General Plan



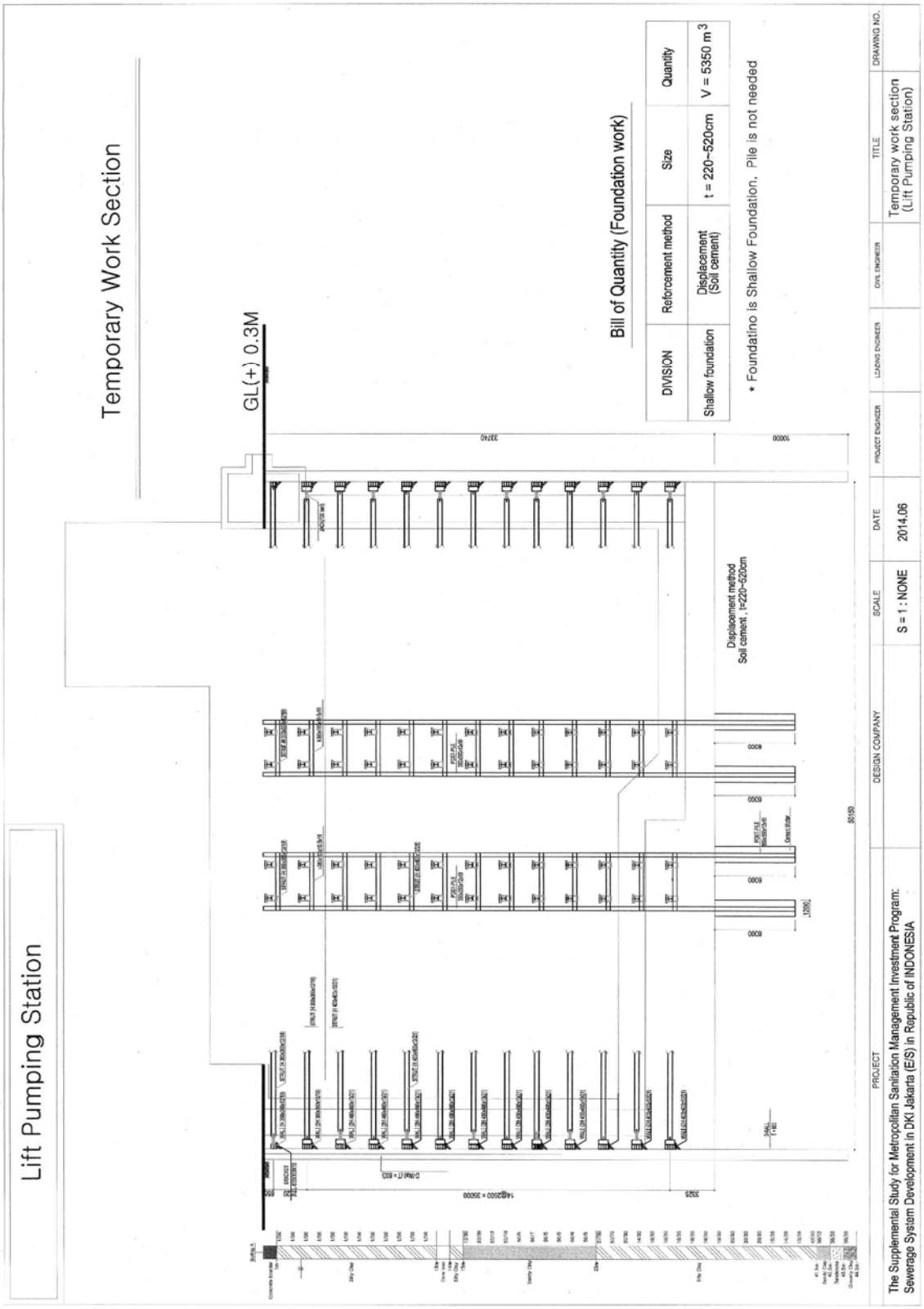
Appendix4.6.2 Lift Pumping Station

(1) Temporary Work Plan



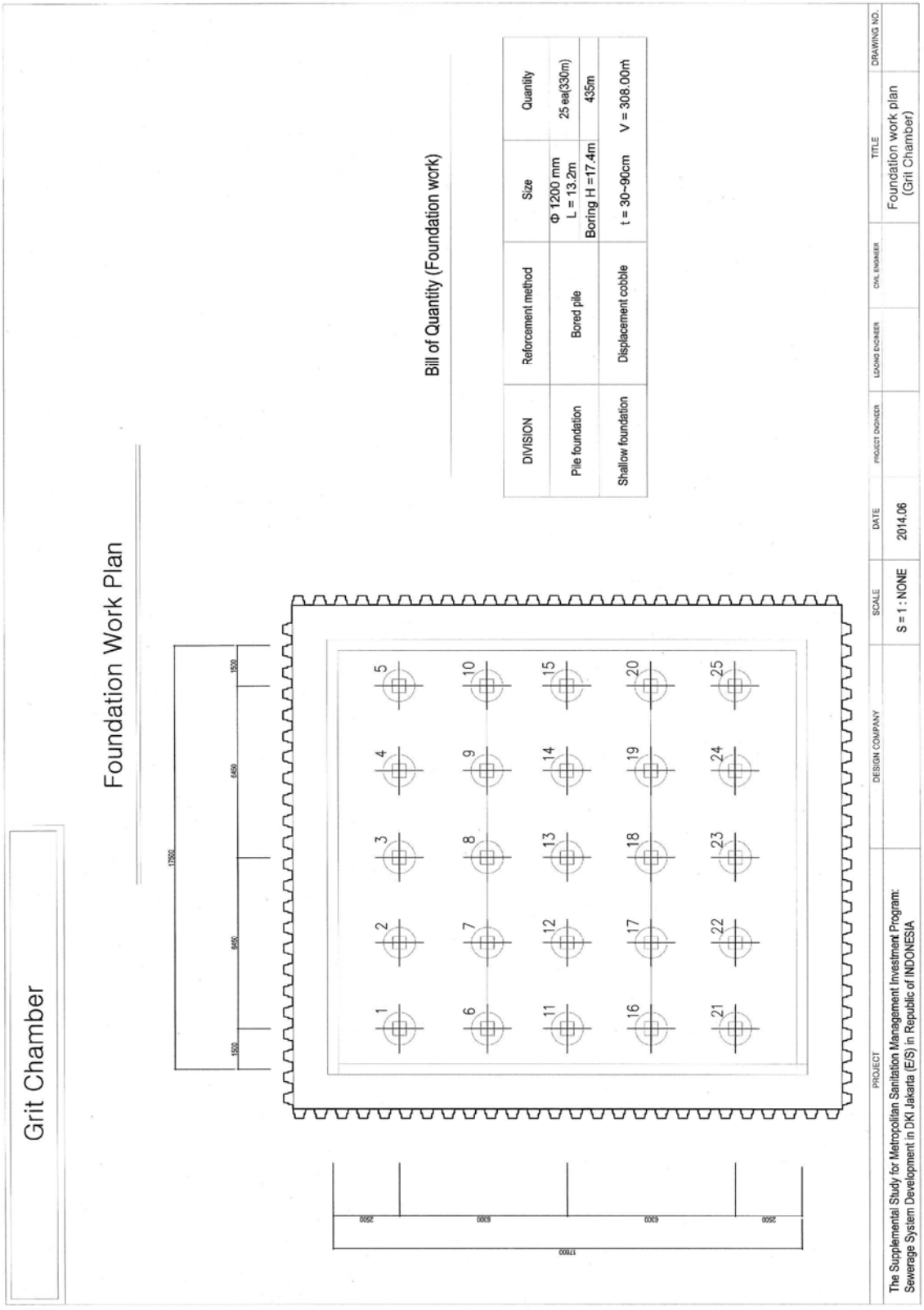
Appendix4.6.2 Lift Pumping Station

(2) Temporary Work Section



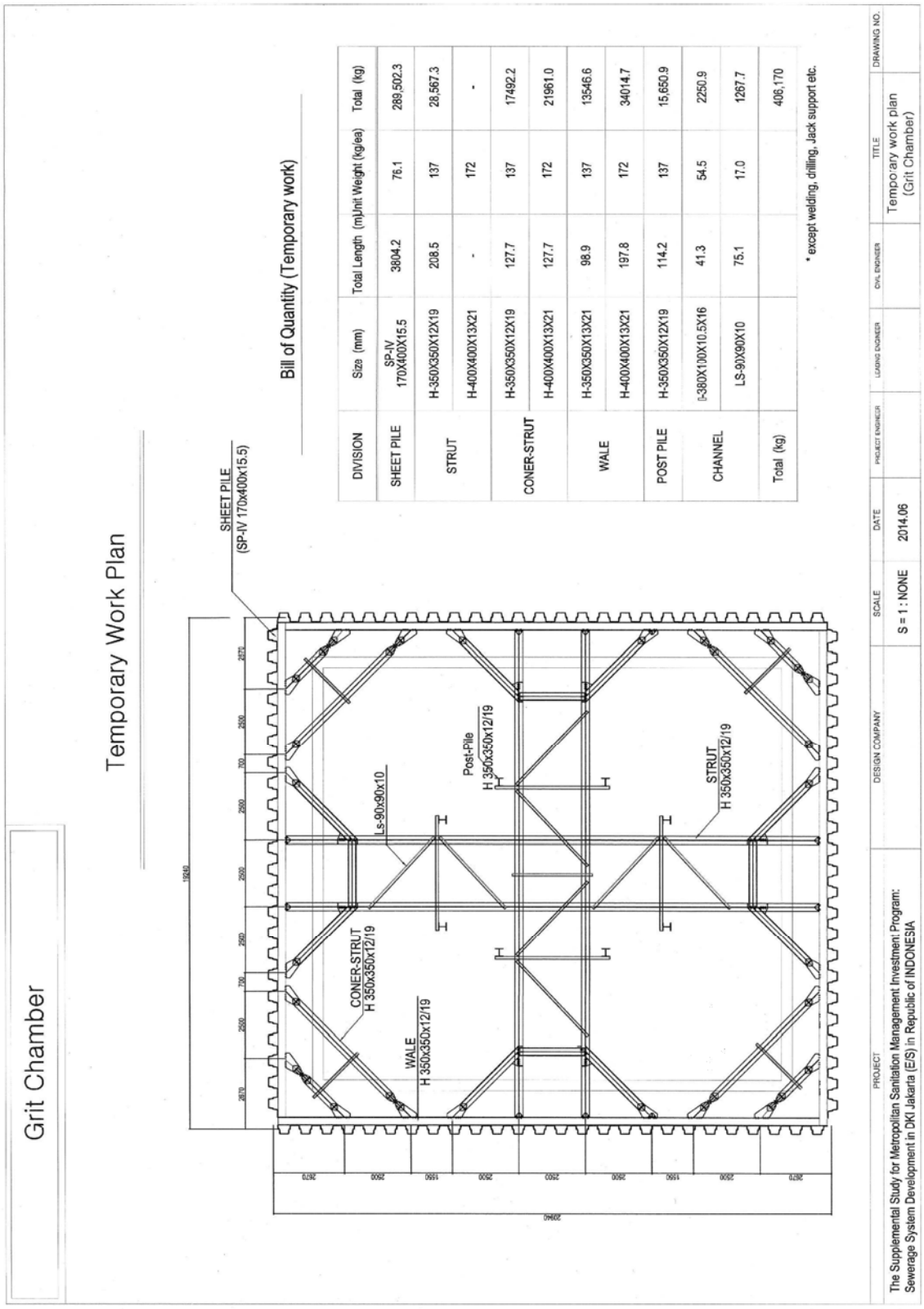
Appendix4.6.3 Grit Chamber Facility

(1) Foundation Work Plan



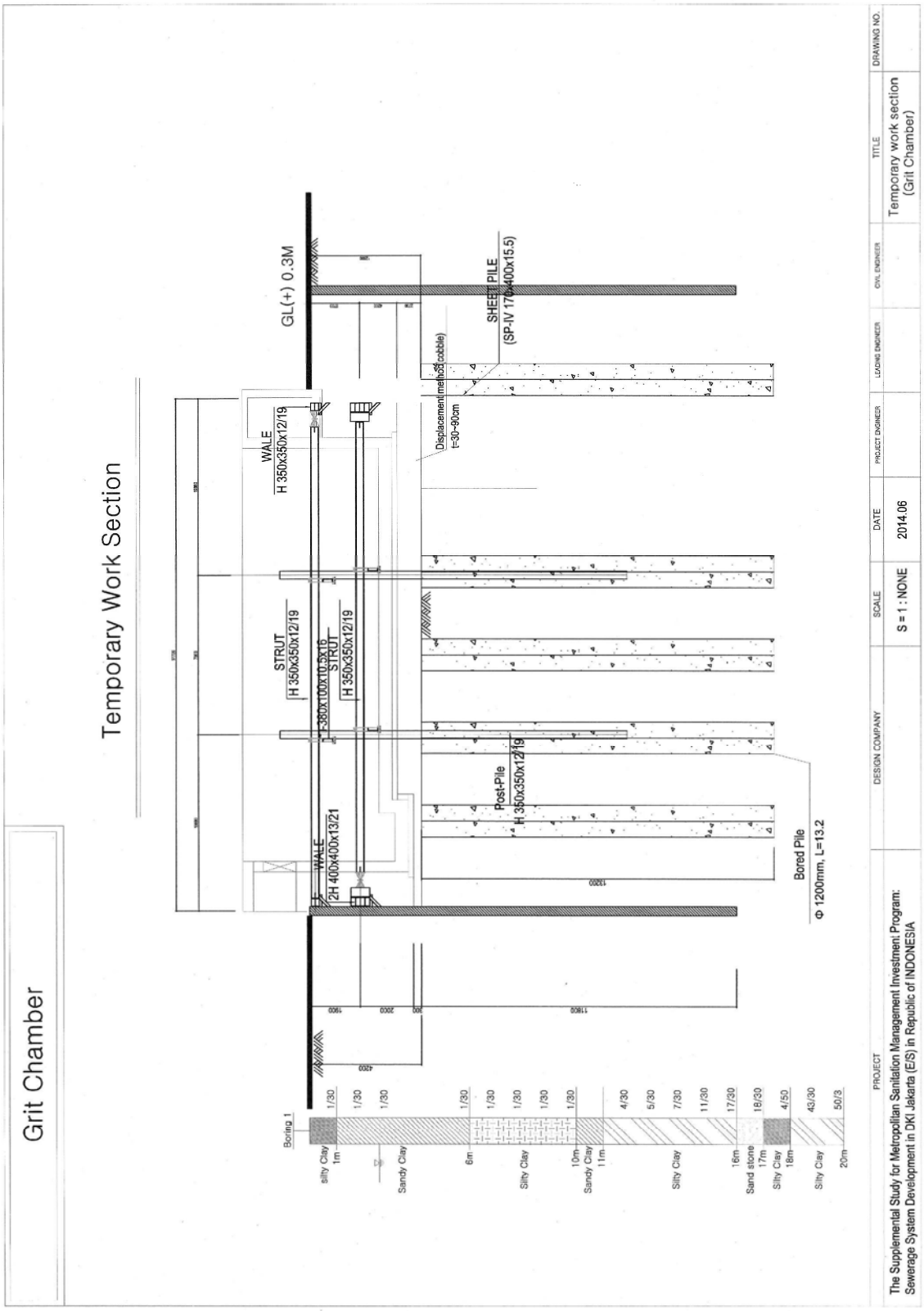
Appendix4.6.3 Grit Chamber Facility

(2) Temporary Work Plan



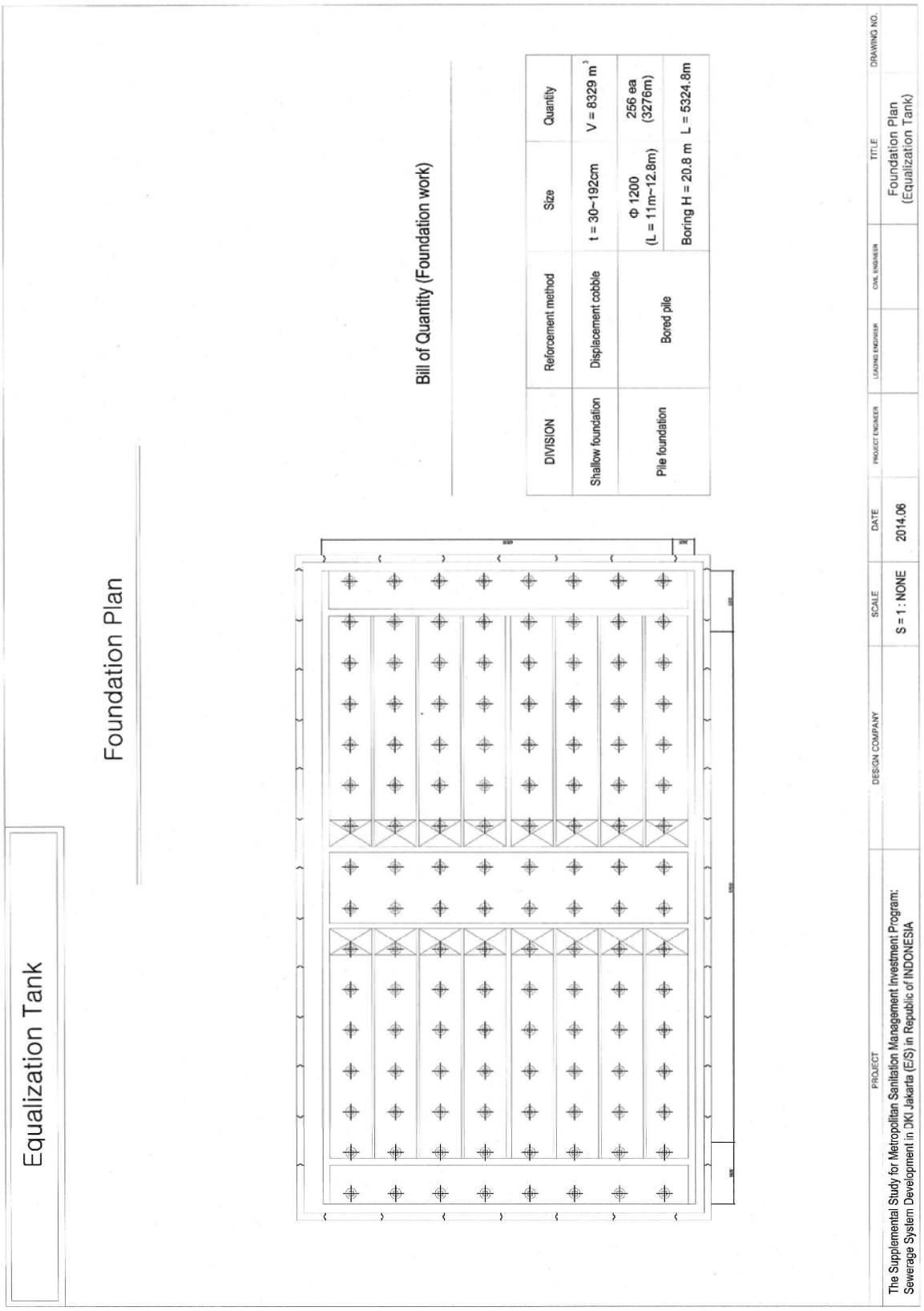
Appendix4.6.3 Grit Chamber

(3) Temporary Work Section



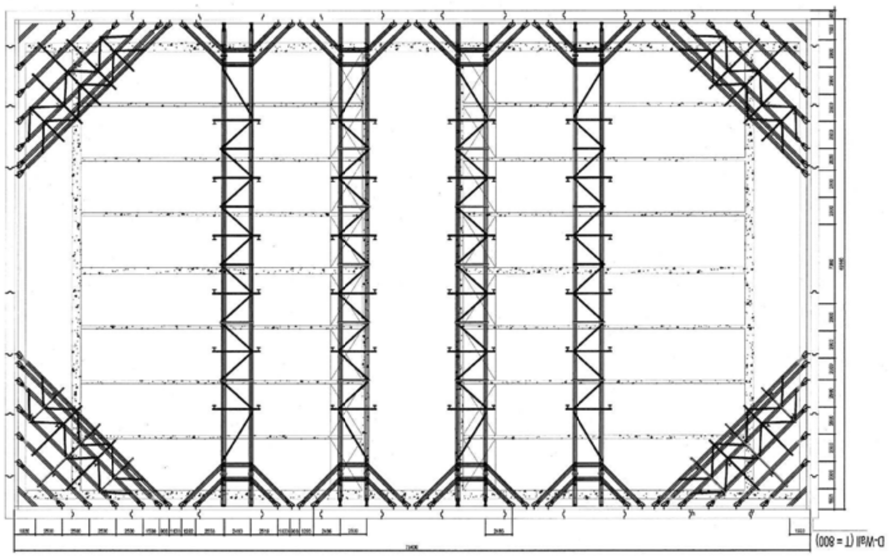
Appendix4.6.4 Equalization Tank and Disinfection Facility

(1) Foundation Work Plan



Equalization Tank

Temporary Work Plan



Bill of Quantity (Temporary work)

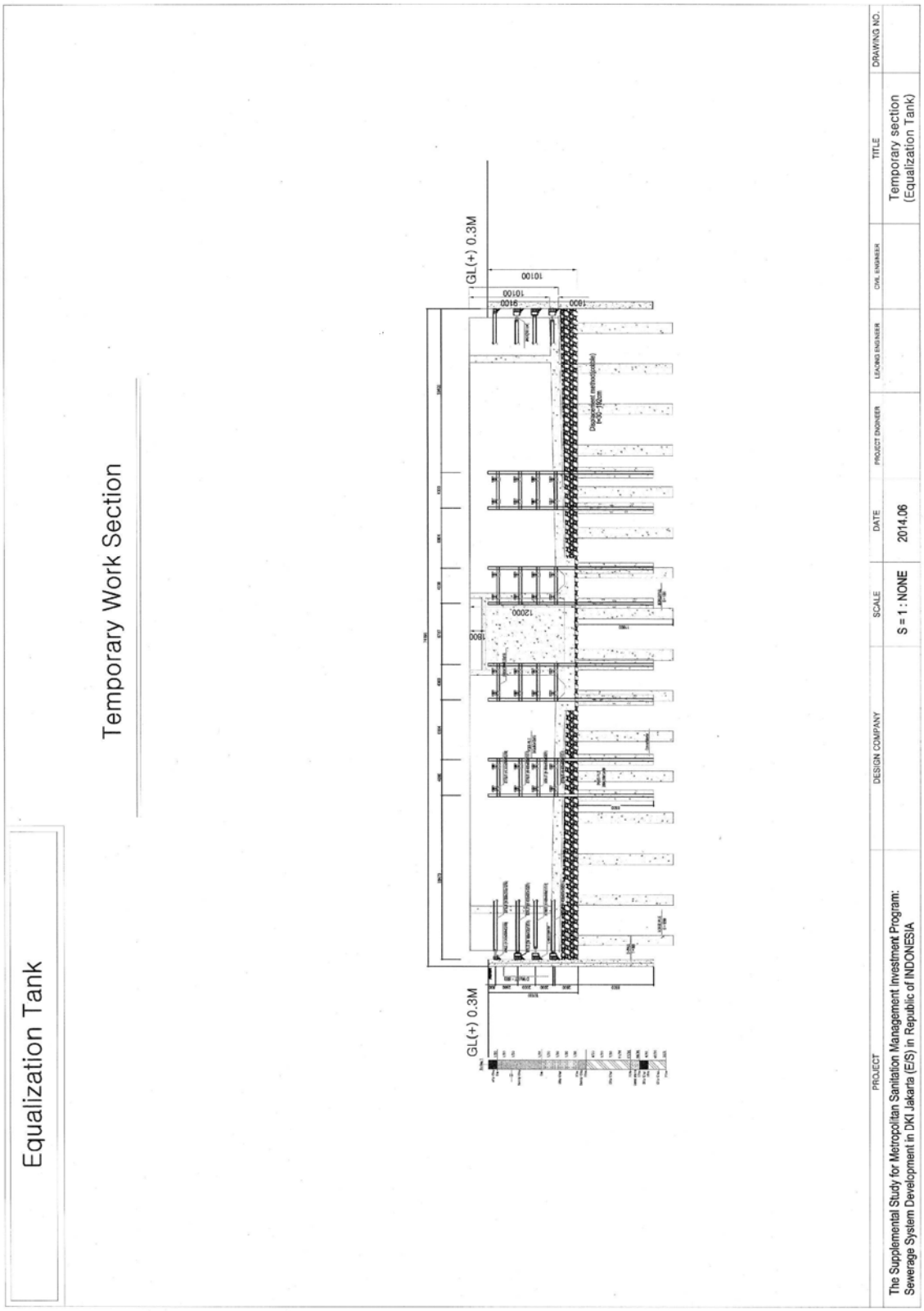
DIVISION	Size (mm)		Total Length (m)		Unit Weight (kg/m)	Total (kg)
D-WALL	t=800mm	B=5.6m (90ea)	L=18.6m	1746	V = 7,500 m³	
STRUT	H-350X350X12X19		1027		137	140735
	H-400X400X13X21		3082		172	530068
CONER-STRUT	H-350X350X12X19		1206		137	165162
	H-400X400X13X21		3589		172	617248
WALE	H-350X350X12X19		590		137	80830
	H-400X400X13X21		3520		172	605440
POST PILE	H-350X350X12X19		1177		137	161296
BRACKET	-		540			
CHANNEL	I-380X100X10.5X16		990		54.5	53955
	LS-90X90X10		1020		17.0	17334
JACK	-		460 ps			
Total(steel)						2,372,068

* except welding, drilling, Jack supporting etc.

PROJECT	DESIGN COMPANY	SCALE	DATE	PROJECT ENGINEER	LEADING ENGINEER	CIVIL ENGINEER	TITLE	DRAWING NO.
The Supplemental Study for Metropolitan Sanitation Management Investment Program: Sewerage System Development in DKI Jakarta (E/S) in Republic of INDONESIA		S = 1 : NONE	2014.06				Temporary Plan (Equalization Tank)	

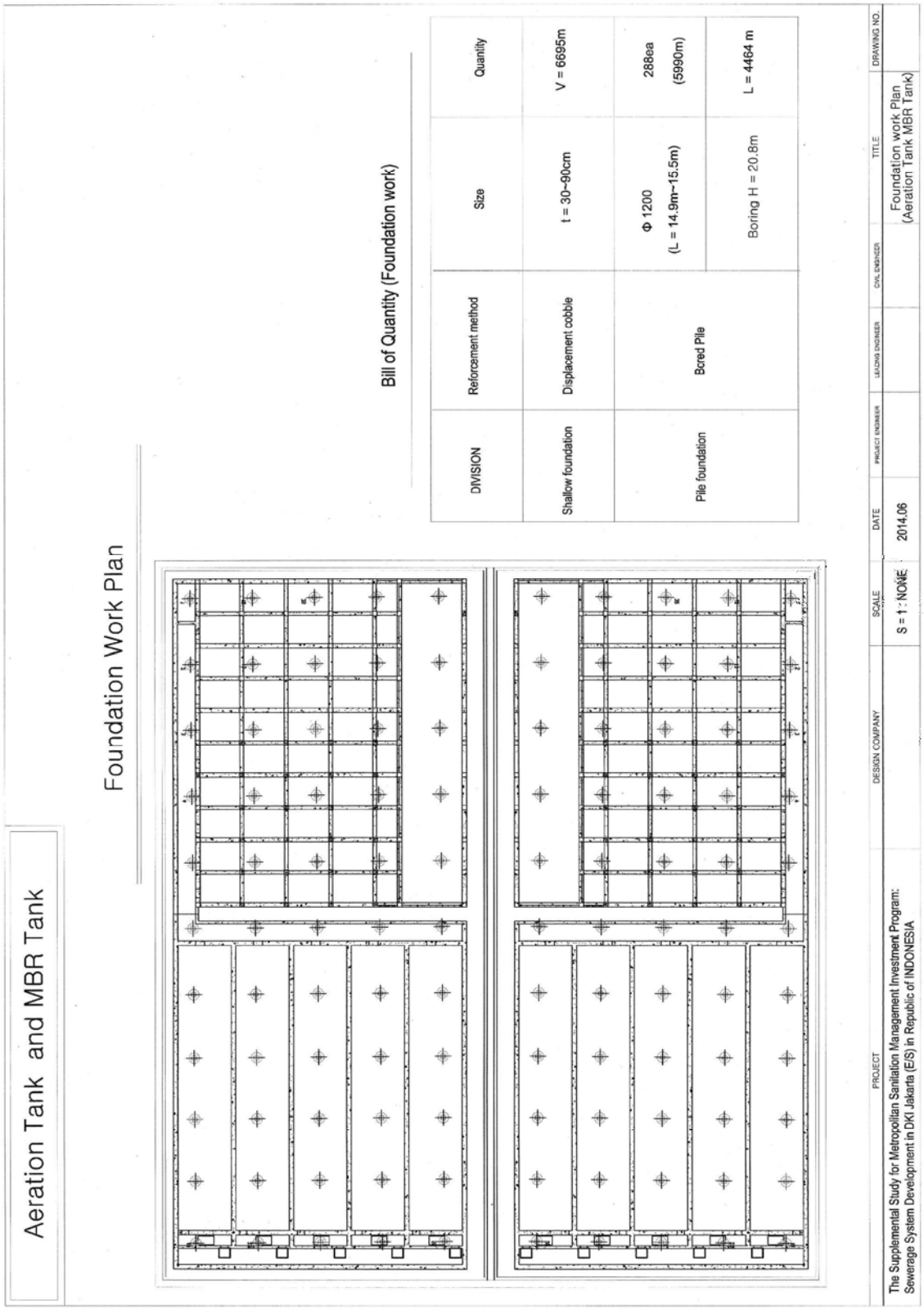
Appendix4.6.4 Equalization Tank and Disinfection Facility

(3) Temporary Work Section



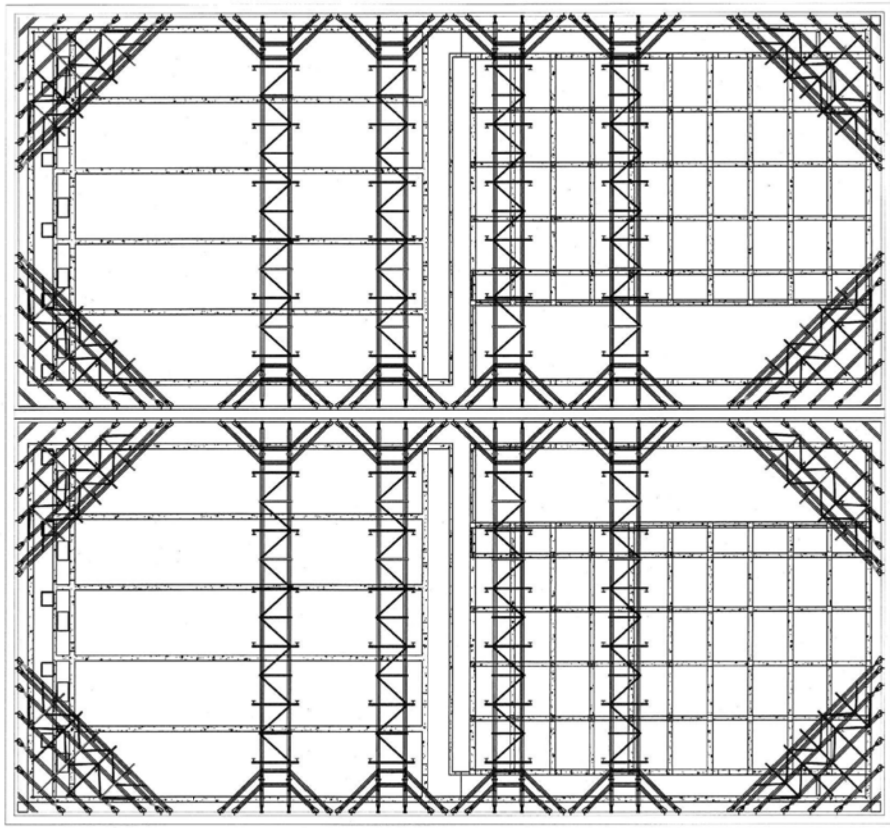
Appendix4.6.5 Aeration Tank and MBR Tank Facility

(1) Foundation Work Plan



Aeration Tank and MBR Tank

Temporary Work Plan



Bill of Quantity (Temporary work)

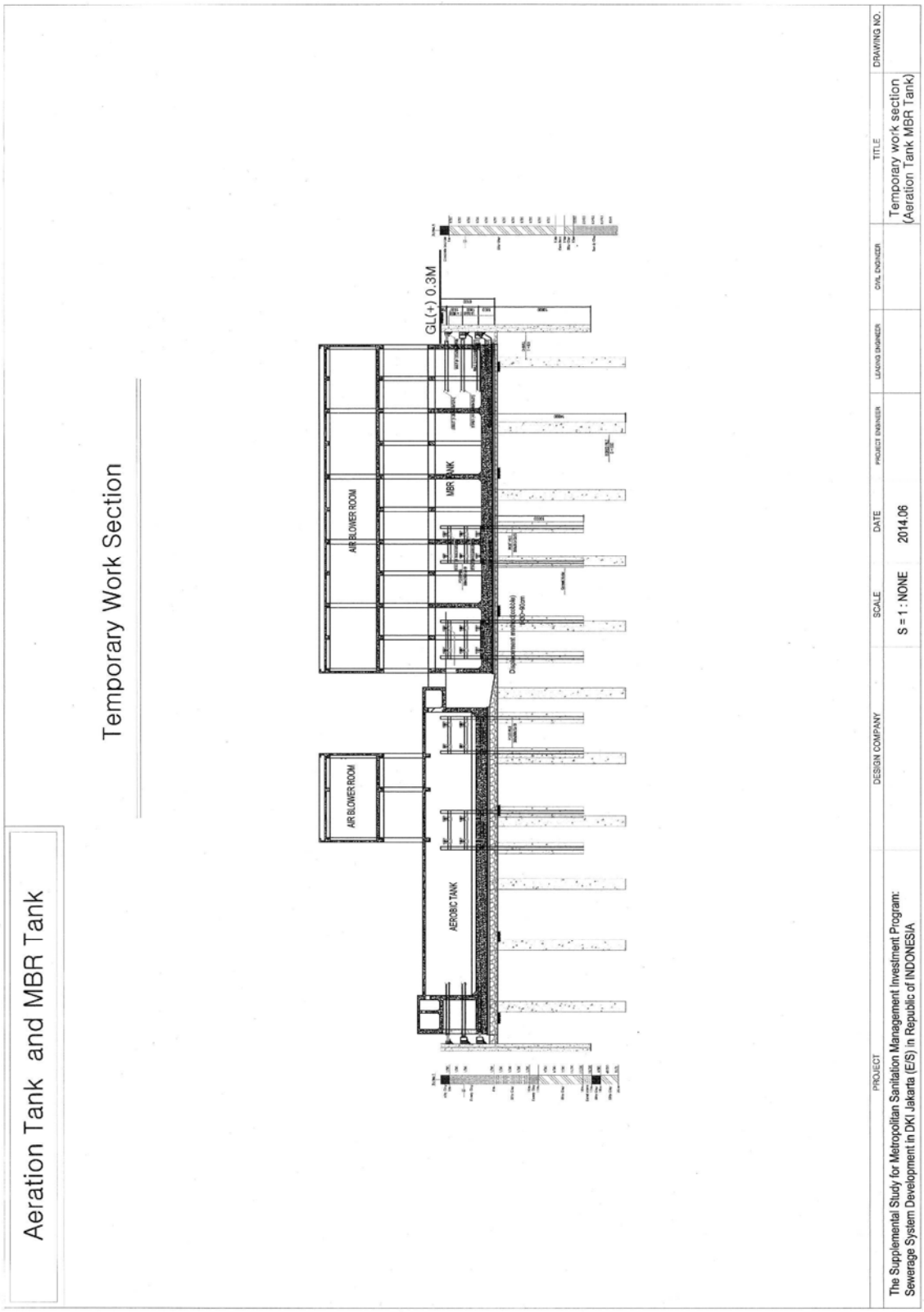
DIVISION	Size (mm)		Total Length (m)		Unit Weight (kg/m)	Total (kg)
D-WALL	t=800mm	B=5.6m (117ea)	L=16.1m	3189	V = 8,439 m³	
STRUT	H-350X350X12X19		1316		137	180356
	H-400X400X13X21		2633		172	452866
CORNER-STRUT	H-350X350X12X19		1822		137	249663
	H-400X400X13X21		3639		172	625928
WALE	H-350X350X12X19		1703		137	233344
	H-400X400X13X21		3394		172	583777
DIVISION	Size (mm)		Total Length (m)		Unit Weight (kg/m)	Total (kg)
POST PILE	H-350X350X12X19		4803		137	658028
BRACKET	-		780			
CHANNEL	Ⅱ-380X100X10.5X16		1115		54.5	60784
	LS-90X90X10		3880		17.0	65955
JACK	-		535			
Total(steel)						3,110,703

* except welding, drilling, Jack supporting etc.

PROJECT	DESIGN COMPANY	SCALE	DATE	PROJECT ENGINEER	LEADING ENGINEER	CIVIL ENGINEER	TITLE	DRAWING NO.
The Supplemental Study for Metropolitan Sanitation Management Investment Program: Sewerage System Development in DKI Jakarta (E/S) in Republic of INDONESIA		S = 1 : NONE	2014.06				Temporary work plan (Aeration Tank MBR Tank)	

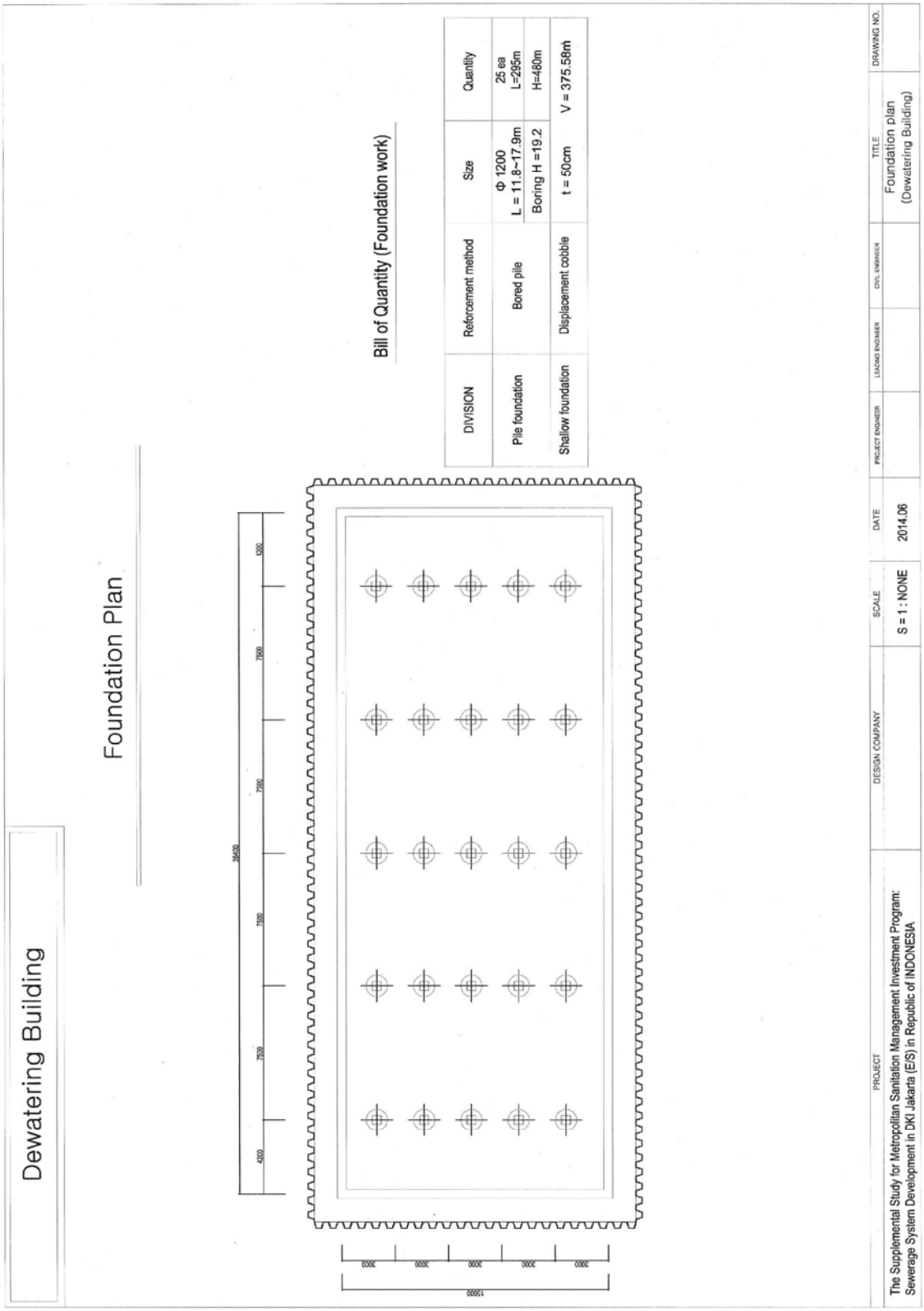
Appendix4.6.5 Aeration Tank and MBR Tank Facility

(3) Temporary Work Section



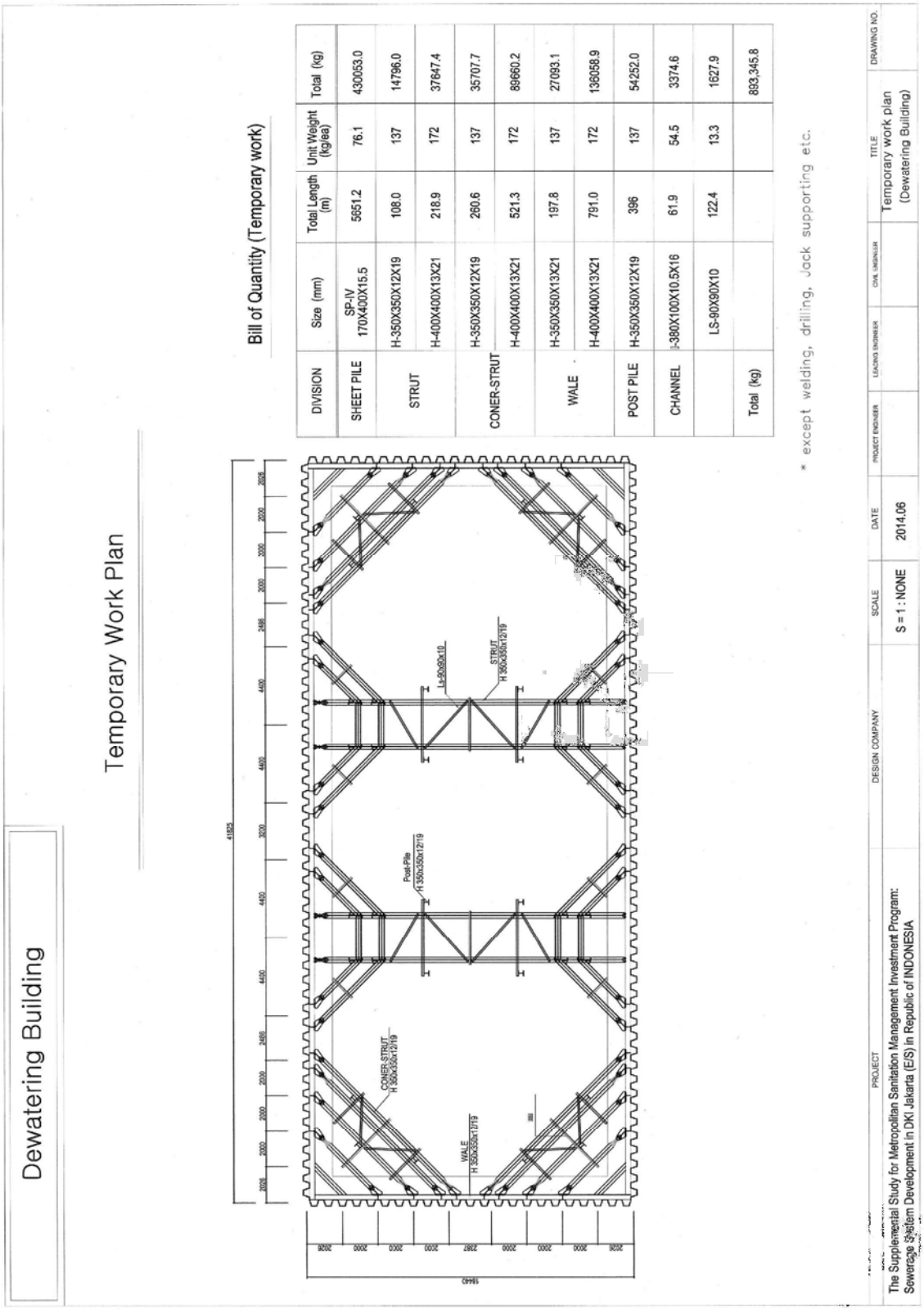
Appendix4.6.6 Dewatering Building

(1) Foundation Work Plan



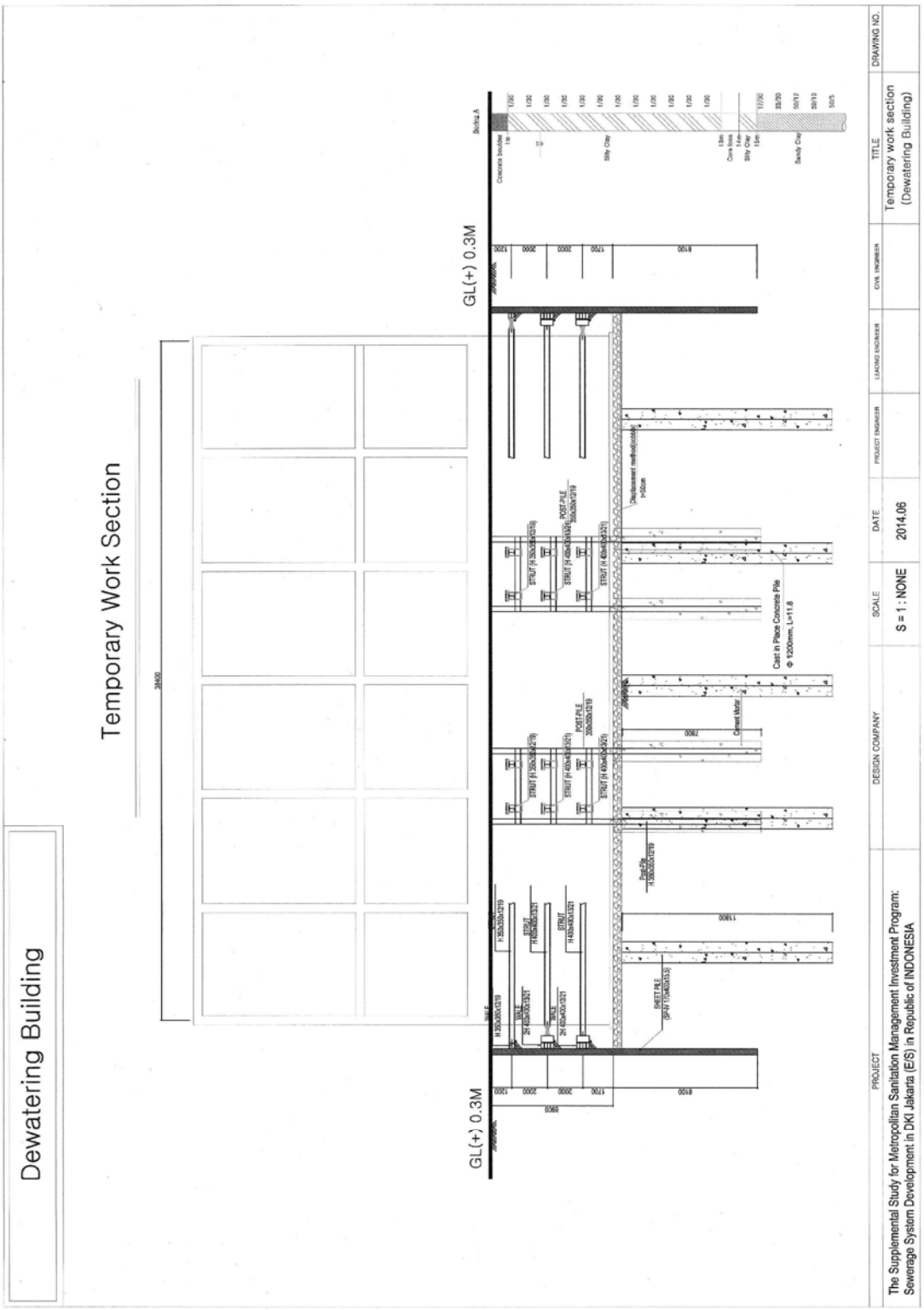
Appendix4.6.6 Dewatering Building

(1) Temporary Work Plan



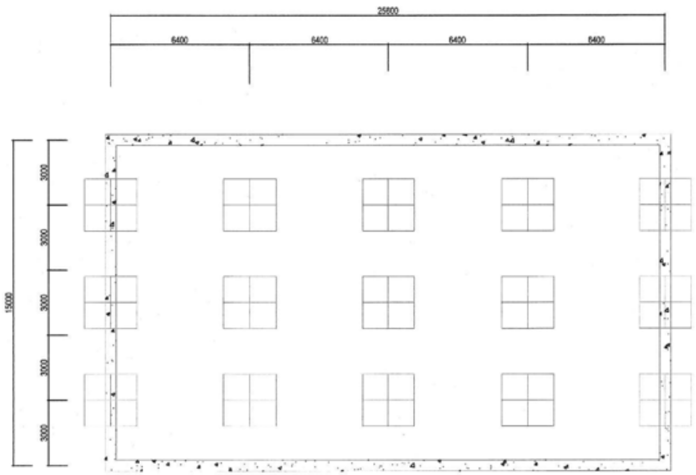
Appendix4.6.6 Dewatering Building

(1) Temporary Work Section



Administration Building

Temporary Work Plan



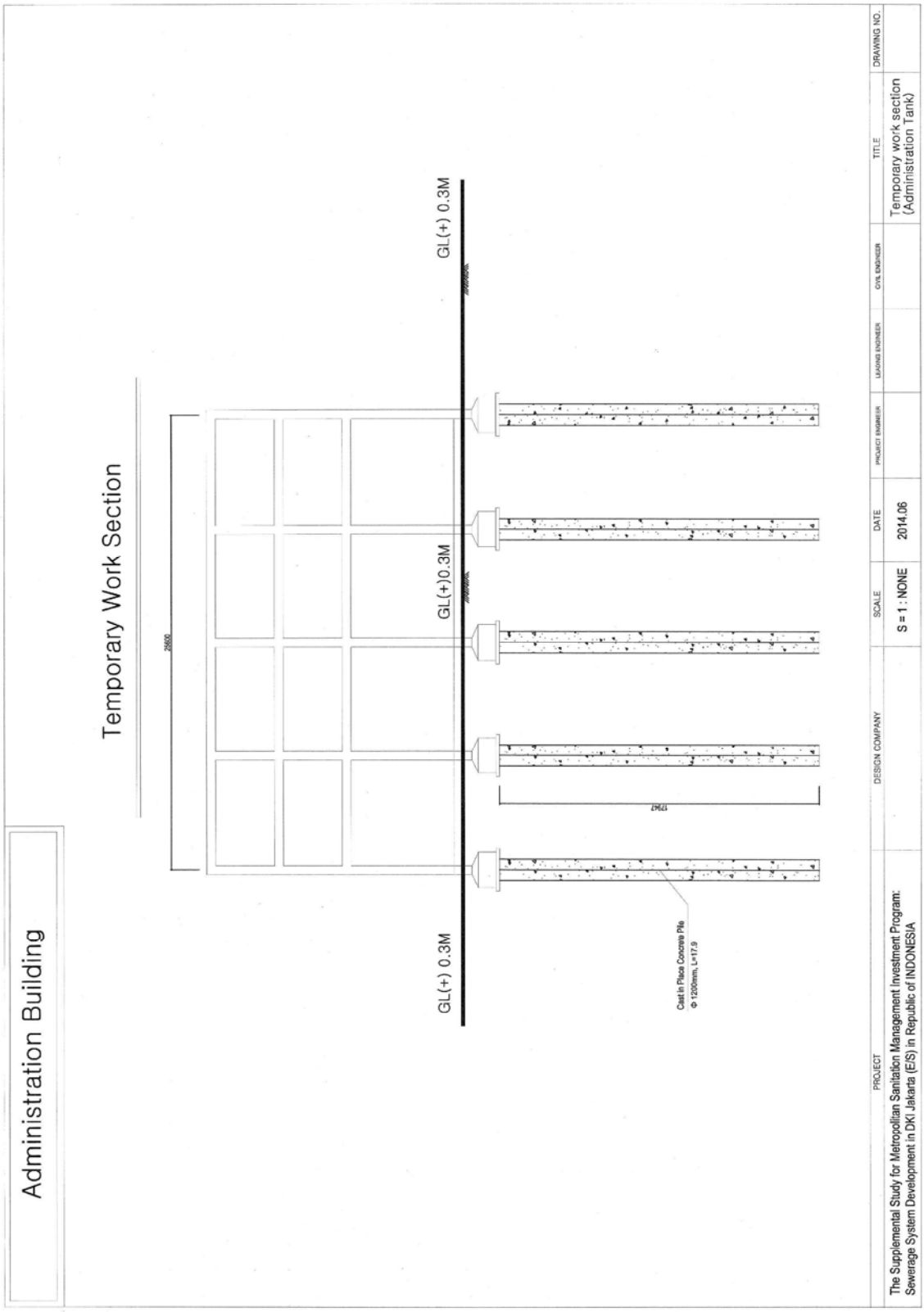
Bill of Quantity (Foundation work)

DIVISION	Reforcement method	Size	Quantity
Pile foundation	Bored pile	Φ 1200 L = 11.8~17.9m Boring H =20.2	15 ea L=268.5m H=303m

PROJECT	DESIGN COMPANY	SCALE	DATE	PROJECT ENGINEER	LEADING ENGINEER	CIVIL ENGINEER	TITLE	DRAWING NO.
The Supplemental Study for Metropolitan Sanitation Management Investment Program: Sewerage System Development in DKI Jakarta (E/S) in Republic of INDONESIA		S = 1 : NONE	2014.06				Temporary work plan (Administration Tank)	

Appendix4.6.7 Administration Building

(1) Temporary Work Section



Appendix4.7 Construction Cost

Appendix4.7.1. Civil & Building Works

(1) Lift Pump Station

Item		Description	Unit	Q'ty	Unit Price		Sub-Total Price		Total	
					F/C (USD)	L/C (IDR)	F/C (USD)	L/C (IDR)	IDR	Equivalent to USD
1.Soil Work										
1)	Excavation	H=33.74m	m^3	49,070	0	66,411	0	3,258,804,945	3,258,804,945	283,374
2)	Backfill	Imported, Excavation × 10%	m^3	4,907	0	111,750	0	548,354,797	548,354,797	47,683
3)	Disposal	within 5km	m^3	49,070	0	29,769	0	1,460,750,109	1,460,750,109	127,022
2. Foundation Work										
	Displacement	Soil Cement(t=220-520cm)	m^3	5,350	0	113,495	0	607,195,843	607,195,843	52,800
3. Concrete Work			m^3	9,291	0	5,117,742	0	47,548,736,434	47,548,736,434	4,134,673
4. Temporary Work										
1)	Diaphragm Wall									
a.	Guide Wall									
	Excavation		m^3	190	0	10,162	0	1,930,685	1,930,685	168
	Con'c		m^3	127	0	741,475	0	94,167,312	94,167,312	8,188
	Form		m^2	761	0	275,750	0	209,845,522	209,845,522	18,247
	Re-bar	re-use	ton	17	0	9,027,500	0	153,467,500	153,467,500	13,345
	Backfill		m^3	63	0	31,475	0	1,982,950	1,982,950	172
	Re-Excavation		m^3	63	0	10,162	0	640,175	640,175	56
	Con'c Waste	re-use	ton	304	0	1,107,000	0	336,528,051	336,528,051	29,263
	Re-Backfill		m^3	190	0	31,475	0	5,980,326	5,980,326	520
b.	Cap Beam									
	Con'c		m^3	127	0	741,475	0	94,167,312	94,167,312	8,188
	Form		m^2	318	0	275,750	0	87,688,405	87,688,405	7,625
	Re-bar		ton	7	0	9,027,500	0	63,192,500	63,192,500	5,495
c.	Deaphragm wall	depth=43.7m, t=0.8								
	Installation	material	m^3	6,265	0	3,325,750	0	20,835,825,003	20,835,825,003	1,811,811
	Con'c	material	m^3	6,265	0	680,000	0	4,260,200,000	4,260,200,000	370,452
	Re-bar		ton	940	0	6,800,000	0	6,392,000,000	6,392,000,000	555,826
2)	H-section steel Pipe	400×400×13×21	ton	2,356	0	17,968,000	0	42,332,607,647	42,332,607,647	3,681,096
3)	Post pile									
a.	Pile	Φ1200	m	264	0	18,936,377	0	4,999,203,449	4,999,203,449	434,713
b.	Con'c		m^3	358	0	680,000	0	243,440,000	243,440,000	21,169
c.	Sand		m^3	1,678	0	213,000	0	357,414,000	357,414,000	31,079
5. Bulding Work			m^2	880	0	10,752,500	0	9,462,200,000	9,462,200,000	822,800
6. Other Works(Miscellaneous works)			LS	1	0	5,701,184,690	0	5,701,184,690	5,701,184,690	495,750
	10% of Concrete & Building work									
Total								149,057,507,653	149,057,507,653	12,961,517

(2) Grit Chamber

Item		Description	Unit	Q'ty	Unit Price		Sub-Total Price		Total	
					F/C (USD)	L/C (IDR)	F/C (USD)	L/C (IDR)	IDR	Equivalent to USD
1.Soil Work										
1)	Excavation	H=4.2m	m^3	1,692	0	16,545	0	27,994,563	27,994,563	2,434
2)	Backfill	Imported, Excavation × 10%	m^3	169	0	111,750	0	18,885,666	18,885,666	1,642
3)	Disposal	within 5km	m^3	1,692	0	29,769	0	50,368,640	50,368,640	4,380
2. Foundation Work										
1)	Bored File									
a.	Pile	Φ1200	m	330	0	18,935,000	0	6,248,549,901	6,248,549,901	543,352
b.	Con'c		m^3	373	0	680,000	0	253,640,000	253,640,000	22,056
c.	Re-bar		ton	56	0	6,800,000	0	380,800,000	380,800,000	33,113
d.	Sand		m^3	119	0	212,500	0	25,287,500	25,287,500	2,199
2)	Displacement	Aggregate	m^3	336	0	113,495	0	38,134,169	38,134,169	3,316
3. Concrete Work			m^3	1,050	0	8,733,367	0	9,169,305,755	9,169,305,755	797,331
4. Temporary Work										
1)	Sheet Pile		ton	290	0	14,372,001	0	4,167,880,261	4,167,880,261	362,424
2)	Post File									
a.	Pile	Φ1200	m	95	0	2,840,000	0	1,798,955,787	1,798,955,787	156,431
b.	Con'c		m^3	0	0	680,000	0	0	0	0
c.	Sand		m^3	108	0	213,000	0	23,004,000	23,004,000	2,000
3)	H-section steel Pipe	400×400×13×21	ton	135	0	17,968,000	0	2,425,679,980	2,425,679,980	210,929
5. Other Works(Miscellaneous works)			LS	1	0	916,930,576	0	916,930,576	916,930,576	79,730
	10% of Concrete work									
Total								25,545,416,797	25,545,416,797	2,221,338

(3) Equalization Tank

Item		Description	Unit	Q'ty	Unit Price		Sub-Total Price		Total	
					F/C (USD)	L/C (IDR)	F/C (USD)	L/C (IDR)	IDR	Equivalent to USD
1.Soil Work										
1)	Excavation	H=10.1m	m^3	70,338	0	16,545	0	1,163,759,795	1,163,759,795	101,197
2)	Backfill	Imported, Excavation × 10%	m^3	7,034	0	111,750	0	786,045,983	786,045,983	68,352
3)	Disposal	within 5km	m^3	70,338	0	29,769	0	2,093,870,821	2,093,870,821	182,076
2. Foundation Work										
1)	Bored File									
a.	Pile	Φ1200	m	3,277	0	18,935,000	0	62,049,994,017	62,049,994,017	5,395,652
b.	Con'c		m^3	3,704	0	680,000	0	2,518,720,000	2,518,720,000	219,019
c.	Re-bar		ton	556	0	6,800,000	0	3,780,800,000	3,780,800,000	328,765
d.	Sand		m^3	2,315	0	212,500	0	491,937,500	491,937,500	42,777
2)	Displacement	0	m^3	9,700	0	113,495	0	1,100,897,135	1,100,897,135	95,730
3. Concrete Work			m^3	19,033	0	5,517,052	0	105,007,750,912	105,007,750,912	9,131,109
4. Temporary Work										
1)	Diaphragm Wall									
a.	Guide Wall									
	Excavation		m^3	580	0	10,162	0	5,893,670	5,893,670	512
	Con'c		m^3	387	0	741,475	0	286,950,786	286,950,786	24,952
	Form		m^2	2,322	0	275,750	0	640,290,803	640,290,803	55,677
	Re-bar	re-use	ton	53	0	9,027,500	0	478,457,500	478,457,500	41,605
	Backfill		m^3	193	0	31,475	0	6,074,752	6,074,752	528
	Re-Excavation		m^3	193	0	10,162	0	1,961,170	1,961,170	171
	Con'c Waste	re-use	ton	928	0	1,107,000	0	1,027,296,155	1,027,296,155	89,330
	Re-Backfill		m^3	580	0	31,475	0	18,255,732	18,255,732	1,587
b.	Cap Beam			0						
	Con'c		m^3	387	0	741,475	0	286,950,786	286,950,786	24,952
	Form		m^2	968	0	275,750	0	266,925,710	266,925,710	23,211
	Re-bar		ton	21	0	9,027,500	0	189,577,500	189,577,500	16,485
c.	Deaphragm wall	depth=43.7m, t=0.8		0						
	Installation	material	m^3	7,500	0	3,325,750	0	24,943,126,500	24,943,126,500	2,168,968
	Con'c	Φ1200	m^3	7,500	0	680,000	0	5,100,000,000	5,100,000,000	443,478
	Re-bar		ton	1,125	0	6,800,000	0	7,650,000,000	7,650,000,000	665,217
2)	Post File									
a.	Pile	Φ1200	m	1,904	0	18,936,377	0	36,054,861,237	36,054,861,237	3,135,205
b.	Con'c		m^3	2,583	0	680,000	0	1,756,440,000	1756440000	152,734
c.	Sand		m^3	2,557	0	213,000	0	544,641,000	544,641,000	47,360
3)	H-section steel Pipe	400×400×13×21	ton	2,732	0	17,968,000	0	49,088,575,590	49,088,575,590	4,268,572
5. Other Works(Miscellaneous works)			LS	1	0	10,500,775,091	0	10,500,775,091	10,500,775,091	913,111
	10% of Concrete work									
Total								317,840,830,144	317,840,830,144	27,638,333

(4) Aeration & MBR Tanks

Item		Description	Unit	Q'ty	Unit Price		Sub-Total Price		Total	
					F/C (USD)	L/C (IDR)	F/C (USD)	L/C (IDR)	IDR	Equivalent to USD
1.Soil Work										
1)	Excavation	H=6.4m	m^3	80,361	0	16,545	0	1,329,592,835	1,329,592,835	115,617
2)	Backfill	Imported, Excavation × 10%	m^3	8,036	0	111,750	0	898,018,982	898,018,982	78,089
3)	Disposal	within 5km	m^3	80,361	0	29,769	0	2,392,242,501	2,392,242,501	208,021
2. Foundation Work										
1)	Bored File									
a.	Pile	Φ1200	m	4,464	0	18,935,000	0	84,525,838,661	84,525,838,661	7,350,073
b.	Con'c		m^3	5,046	0	680,000	0	3,431,280,000	3,431,280,000	298,372
c.	Re-bar		ton	757	0	6,800,000	0	5,147,600,000	5,147,600,000	447,617
d.	Sand		m^3	1,725	0	212,500	0	366,562,500	366,562,500	31,875
2)	Displacement	0	m^3	12,820	0	113,495	0	1,455,000,131	1,455,000,131	126,522
3. Concrete Work										
1)	Aeration Tanks		m^3	15,429	0	5,400,154	0	83,321,045,096	83,321,045,096	7,245,308
2)	MBR Tanks		m^3	10,722	0	6,444,962	0	69,100,158,068	69,100,158,068	6,008,709
4. Temporary Work										
1)	Diaphragm Wall									
a.	Guide Wall									
	Excavation		m^3	763	0	10,162	0	7,753,225	7,753,225	674
	Con'c		m^3	509	0	741,475	0	377,410,724	377,410,724	32,818
	Form		m^2	3,056	0	275,750	0	842,691,083	842,691,083	73,277
	Re-bar	re-use	ton	70	0	9,027,500	0	631,925,000	631,925,000	54,950
	Backfill		m^3	254	0	31,475	0	7,994,752	7,994,752	695
	Re-Excavation		m^3	254	0	10,162	0	2,581,021	2,581,021	224
	Con'c Waste	re-use	ton	1,222	0	1,107,000	0	1,352,754,204	1,352,754,204	117,631
	Re-Backfill		m^3	763	0	31,475	0	24,015,730	24,015,730	2,088
b.	Cap Beam									
	Con'c		m^3	509	0	741,475	0	377,410,724	377,410,724	32,818
	Form		m^2	1,274	0	275,750	0	351,305,118	351,305,118	30,548
	Re-bar		ton	27	0	9,027,500	0	243,742,500	243,742,500	21,195
c.	Deaphragm wall	Φ1200								
	Installation	material	m^3	8,439	0	3,325,750	0	28,066,005,938	28,066,005,938	2,440,522
	Con'c	material	m^3	8,439	0	680,000	0	5,738,520,000	5,738,520,000	499,002
	Re-bar		ton	1,266	0	6,800,000	0	8,608,800,000	8,608,800,000	748,591
2)	Post File									
a.	Pile	Φ1200	m	2,173	0	18,936,377	0	41,148,746,569	41,148,746,569	3,578,152
b.	Con'c		m^3	2,947	0	680,000	0	2,003,960,000	2003960000	174,257
c.	Sand		m^3	1,621	0	213,000	0	345,273,000	345,273,000	30,024
3)	H-section steel Pipe	400×400×13×21	ton	3,459	0	17,968,000	0	62,151,311,481	62,151,311,481	5,404,462
4. Bulding Work										
1)	Aeration Tanks		m^3	1,240	0	7,820,000	0	9,696,800,000	9,696,800,000	843,200
2)	MBR Tanks		m^3	3,310	0	7,820,000	0	25,884,200,000	25,884,200,000	2,250,800
5. Other Works(Miscellaneous works)			LS	1	0	18,800,220,316	0	18,800,220,316	18,800,220,316	1,634,802
	10% of Concrete work and Building work									
Total								458,630,760,158	458,630,760,158	39,880,936

(5) Dewatering Buildings

Item		Description	Unit	Q'ty	Unit Price		Sub-Total Price		Total	
					F/C (USD)	L/C (IDR)	F/C (USD)	L/C (IDR)	IDR	Equivalent to USD
1.Soil Work										
1)	Excavation	H=7.4m	m^3	5,707	0	16,545	0	94,423,742	94,423,742	8,211
2)	Backfill	Imported, Excavation × 10%	m^3	571	0	111,750	0	63,808,965	63,808,965	5,549
3)	Disposal	within 5km	m^3	5,707	0	29,769	0	169,889,971	169,889,971	14,773
2. Foundation Work										
1)	Bored File									
a.	Pile	Φ1200	m	295	0	18,935,000	0	5,585,824,912	5,585,824,912	485,724
b.	Con'c		m^3	333	0	680,000	0	226,440,000	226,440,000	19,690
c.	Re-bar		ton	50	0	6,800,000	0	340,000,000	340,000,000	29,565
d.	Sand		m^3	209	0	212,500	0	44,412,500	44,412,500	3,862
2)	Displacement	0	m^3	376	0	113,495	0	42,673,951	42,673,951	3,711
3. Temporary Work										
1)	Sheet Pile	SP-IV 170*400*15.5	ton	430	0	14,372,001	0	6,179,960,387	6,179,960,387	537,388
2)	Post File									
a.	Pile	Φ1200	m	156	0	18,936,377	0	2,954,074,765	2,954,074,765	256,876
b.	Con'c		m^3	212	0	680,000	0	144,160,000	144160000	12,536
c.	Sand		m^3	167	0	213,000	0	35,571,000	35,571,000	3,093
3)	H-section steel Pipe	400×400×13×21	ton	401	0	17,968,000	0	7,205,167,940	7,205,167,940	626,536
4. Bulding Work			m^2	1,740	0	10,752,500	0	18,709,350,000	18,709,350,000	1,626,900
5. Other Works(Miscellaneous works)			LS	1	0	1,870,935,000	0	1,870,935,000	1,870,935,000	162,690
	10% of Concrete work and Building work									
Total								43,666,693,132	43,666,693,132	3,797,104

(6) Administration Buildings

Item		Description	Unit	Q'ty	Unit Price		Sub-Total Price		Total	
					F/C (USD)	L/C (IDR)	F/C (USD)	L/C (IDR)	IDR	Equivalent to USD
1. Foundation Work										
a.	Pile	Φ1200	m	269	0	18,935,000	0	5,093,514,919	5,093,514,919	442,914
b.	Con'c		m^3	304	0	680,000	0	206,720,000	206,720,000	17,976
c.	Re-bar		ton	46	0	6,800,000	0	312,800,000	312,800,000	27,200
d.	Sand		m^3	39	0	212,500	0	8,287,500	8,287,500	721
	0									
2. Bulding Work			m^2	1,140	0	13,196,250	0	15,043,725,000	15,043,725,000	1,308,150
5. Other Works(Miscellaneous works)			LS	1	0	1,504,372,500	0	1,504,372,500	1,504,372,500	130,815
	10% of Concrete work and Building work									
Total								22,169,419,919	22,169,419,919	1,927,776

Appendix4.7.2. Machinery & Electricity Facilities

(1) Lift Pumping Station

No.	Equipment	Brief Spec.	Motor Output (kW)	Quantity: Unit	Quantity: Phase I	Quantity: Phase II	Quantity: Total	Unit Price: FC (USD)	Unit Price: LC (Rp)	Unit Price: LC (USD)	Cost Phase I: FC (USD)	Cost Phase I: LC (USD)	Cost Phase I: Total (USD)	Cost Phase II: FC (USD)	Cost Phase II: LC (USD)	Cost Phase II: Total (USD)	Cost Total: FC (USD)	Cost Total: LC (USD)	Cost Total: Total (USD)	Cost Total: Total (Rp)	Remarks
1.1	Inflow Gate	Electrical motor operation cast iron sluice gate 1.4mW x 3.1mH	3.7	set	4	0	4	25,000	57,500,000	5,000	100,000	20,000	120,000	0	0	0	100,000	20,000	120,000	1,380,000,000	
1.2	Coarse screen	Flat bar screen (manual raking) Spacing 100mm (2.5mW x 4.6mH, 65 deg installation)	-	set	2	2	4	15,000	57,500,000	5,000	30,000	10,000	40,000	30,000	10,000	40,000	60,000	20,000	80,000	920,000,000	
1.3	Fine screen	Single rake automatic Screen Spacing 15mm (2.5mW x 4.6mH, 70 deg installation)	2.2	set	2	2	4	110,000	80,500,000	7,000	220,000	14,000	234,000	220,000	14,000	234,000	440,000	28,000	468,000	5,382,000,000	
1.4	Lift pump	Vertical shaft Volute type mixed flow pump 650mm x 61.0m3/min x 33.3mH	480	set	3	2	5	660,000	345,000,000	30,000	1,980,000	90,000	2,070,000	1,320,000	60,000	1,380,000	3,300,000	150,000	3,450,000	39,675,000,000	Including 1 standby at each Phase
1.5	Flow meter	Ultrasonic type Diameter 650mm	-	set	3	2	5	12,000	55,200,000	4,800	36,000	14,400	50,400	24,000	9,600	33,600	60,000	24,000	84,000	966,000,000	
1.6	Hoist	Electric motor operation hoist Lifting capacity : 10 ton	5.0 (Hoisting) 0.85 (Travelling)	set	1	0	1	18,000	55,200,000	4,800	18,000	4,800	22,800	0	0	0	18,000	4,800	22,800	262,200,000	
1.7	Pump up well connection gate	Manual operation cast iron sluice gate 1.5 mW x 1.5 mH	-	set	1	0	1	138,000	55,200,000	4,800	138,000	4,800	142,800	0	0	0	138,000	4,800	142,800	1,642,200,000	
1.8	Miscellaneous	with piping	-	set	1	1	2	48,000	138,000,000	12,000	48,000	12,000	60,000	48,000	12,000	60,000	96,000	24,000	120,000	1,380,000,000	
Sub Total											2,570,000	170,000	2,740,000	1,642,000	105,600	1,747,600	4,212,000	275,600	**4,487,600**	**51,607,400,000**	

(2) Grit Chamber

No.	Equipment	Brief Spec.	Motor Output (kW)	Quantity				Unit Price			Cost										Remarks
											Phase I			Phase II			Total				
				Unit	Phase I	Phase II	Total	FC	LC		FC	LC	Total	FC	LC	Total	FC	LC	Total		
								(USD)	(Rp)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	
3.1	Inflow weir gate	Manual operation cast iron weir type gate 0.6 mW x 0.6 mH	-	set	16	16	32	8,330	23,920,000	2,080	133,280	33,280	166,560	133,280	33,280	166,560	266,560	66,560	333,120	3,830,880,000	
3.2	Constant rate pump	Nonclogging pump 250mm x 7.0 m3/min x 14m	37	set	12	12	24	55,000	44,275,000	3,850	660,000	46,200	706,200	660,000	46,200	706,200	1,320,000	92,400	1,412,400	16,242,600,000	Phase1 including 2 standbys Final phase including 4 standbys
3.3	Mixer for antisettling	Submersible propeller type Propeller diameter 500mm	5.5	set	32	32	64	21,600	27,600,000	2,400	691,200	76,800	768,000	691,200	76,800	768,000	1,382,400	153,600	1,536,000	17,664,000,000	
3.4	Ultra fine screen	Motorized step screen Spacing 5mm	0.4	set	10	10	20	63,960	13,800,000	1,200	639,600	12,000	651,600	639,600	12,000	651,600	1,279,200	24,000	1,303,200	14,986,800,000	For reducing the burden of drum screen in aeration tank
3.5	Miscellaneous	with piping	-	set	1	1	2	24,330	5,520,000	480	24,330	480	24,810	24,330	480	24,810	48,660	960	49,620	570,630,000	
Sub Total											2,148,410	168,760	2,317,170	2,148,410	168,760	2,317,170	4,296,820	337,520	**4,634,340**	**53,294,910,000**	

(3) Equalization Tanks

No.	Equipment	Brief Spec.	Motor Output (kW)	Quantity Unit	Quantity Phase I	Quantity Phase II	Quantity Total	Unit Price FC (USD)	Unit Price LC (Rp)	Unit Price LC (USD)	Cost Phase I FC (USD)	Cost Phase I LC (USD)	Cost Phase I Total (USD)	Cost Phase II FC (USD)	Cost Phase II LC (USD)	Cost Phase II Total (USD)	Cost Total FC (USD)	Cost Total LC (USD)	Cost Total Total (USD)	Cost Total Total (Rp)	Remarks
3.1	Inflow weir gate	Manual operation cast iron weir type gate 0.6 mW x 0.6 mH	-	set	16	16	32	8,330	23,920,000	2,080	133,280	33,280	166,560	133,280	33,280	166,560	266,560	66,560	333,120	3,830,880,000	
3.2	Constant rate pump	Nonclogging pump 250mm x 7.0 m3/min x 14m	37	set	12	12	24	55,000	44,275,000	3,850	660,000	46,200	706,200	660,000	46,200	706,200	1,320,000	92,400	1,412,400	16,242,600,000	Phase1 including 2 standbys Final phase including 4 standbys
3.3	Mixer for antisettling	Submersible propeller type Propeller diameter 500mm	5.5	set	32	32	64	21,600	27,600,000	2,400	691,200	76,800	768,000	691,200	76,800	768,000	1,382,400	153,600	1,536,000	17,664,000,000	
3.4	Ultra fine screen	Motorized step screen Spacing 5mm	0.4	set	10	10	20	63,960	13,800,000	1,200	639,600	12,000	651,600	639,600	12,000	651,600	1,279,200	24,000	1,303,200	14,986,800,000	For reducing the burden of drum screen in aeration tank
3.5	Miscellaneous	with piping	-	set	1	1	2	24,330	5,520,000	480	24,330	480	24,810	24,330	480	24,810	48,660	960	49,620	570,630,000	
Sub Total											2,148,410	168,760	2,317,170	2,148,410	168,760	2,317,170	4,296,820	337,520	**4,634,340**	**53,294,910,000**	

(4) Disinfection Facility

No.	Equipment	Brief Spec.	Motor Output (kW)	Quantity				Unit Price			Cost										Remarks
											Phase I			Phase II			Total				
				Unit	Phase I	Phase II	Total	FC	LC		FC	LC	Total	FC	LC	Total	FC	LC	Total		
								(USD)	(Rp)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(Rp)	
4.1	Sodium hypochlorite storage tank	Fiberglass plastic construction Cylindrical tank 10m3	-	set	2	2	4	14,400	33,120,000	2,880	28,800	5,760	34,560	28,800	5,760	34,560	57,600	11,520	69,120	794,880,000	
4.2	Sodium hypochlorite dosing pump	Diaphragm pump 2.5L/min	0.4	set	3	3	6	4,440	6,210,000	540	13,320	1,620	14,940	13,320	1,620	14,940	26,640	3,240	29,880	343,620,000	Phase1 including 1 standbys Final phase including 2standbys
4.3	Miscellaneous	with piping	-	set	1	1	2	2,880	4,140,000	360	2,880	360	3,240	2,880	360	3,240	5,760	720	6,480	74,520,000	
Sub Total											45,000	7,740	52,740	45,000	7,740	52,740	90,000	15,480	**105,480**	**1,213,020,000**	

(5) Aeration & MBR Tanks

No.	Equipment	Brief Spec.	Motor Output (kW)	Quantity				Unit Price			Cost										Remarks
											Phase I			Phase II			Total				
				Unit	Phase I	Phase II	Total	FC	LC		FC	LC	Total	FC	LC	Total	FC	LC	Total		
								(USD)	(Rp)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(Rp)	
5.1	Mesh screen	Mesh Drum Screen Spacing 1mm Capacity 2,084m3/h or more	9	set	4	4	8	250,000	57,500,000	5,000	1,000,000	20,000	1,020,000	1,000,000	20,000	1,020,000	2,000,000	40,000	2,040,000	23,460,000,000	
5.2	Air diffuser for aeration tank	Fine Bubble Disk Membrane Type Air Flow Rate 120～150 L/min Oxygen Transfer Efficiency 20%	-	ea	4700	4700	9400	70	575,000	50	329,000	235,000	564,000	329,000	235,000	564,000	658,000	470,000	1,128,000	12,972,000,000	Including 1 standby at each phase
5.3	Blower for aeration tank	Turbo type Blower 90m3/min x 68kpa	150	set	6	6	12	300,000	34,500,000	3,000	1,800,000	18,000	1,818,000	1,800,000	18,000	1,818,000	3,600,000	36,000	3,636,000	41,814,000,000	Including 2 standbys at each phase
5.4	Membrane unit	Hollow fiber membrane Membrane area 1,200m2/unit	-	set	200	200	400	108,000	55,200,000	4,800	21,600,000	960,000	22,560,000	21,600,000	960,000	22,560,000	43,200,000	1,920,000	45,120,000	518,880,000,000	
5.5	Membrane filtration pump	Centrifugal pump 10.6m3/min x 10m	22	set	12	12	24	96,000	5,980,000	520	1,152,000	6,240	1,158,240	1,152,000	6,240	1,158,240	2,304,000	12,480	2,316,480	26,639,520,000	Including 2 standbys at each phase Including air-water separator, vacuum pumps
5.6	NaOCl pump for maintenance cleaning	Diaphragm pump 4.2L/min	0.2	set	8	8	16	4,800	6,210,000	540	38,400	4,320	42,720	38,400	4,320	42,720	76,800	8,640	85,440	982,560,000	Including 4 standbys at each phase
5.7	NaOCl pump for recovering cleaning	Diaphragm pump 25.2L/min	1.5	set	8	8	16	6,000	6,900,000	600	48,000	4,800	52,800	48,000	4,800	52,800	96,000	9,600	105,600	1,214,400,000	Including 4 standbys at each phase
5.8	Dilution water pump	Centrifugal pump 1.2m3/min	3.7	set	8	8	16	9,600	13,800,000	1,200	76,800	9,600	86,400	76,800	9,600	86,400	153,600	19,200	172,800	1,987,200,000	Including 4 standbys at each phase
5.9	Blower for membrane scrubbing	Turbo type Blower 132m^3/min x 64kpa	150	set	12	12	24	345,600	20,700,000	1,800	4,147,200	21,600	4,168,800	4,147,200	21,600	4,168,800	8,294,400	43,200	8,337,600	95,882,400,000	Including 2 standbys at each phase
5.10	Circulation pump	Submergible Axial Pump 13.9m^3/min	11	set	14	14	28	108,000	16,560,000	1,440	1,512,000	20,160	1,532,160	1,512,000	20,160	1,532,160	3,024,000	40,320	3,064,320	35,239,680,000	Including 4 standbys at each phase
5.11	Excess sludge pump	Non-clog type Sludge Pump 1.0m3/min Discharge pressure 12m	11	set	4	4	8	16,800	4,140,000	360	67,200	1,440	68,640	67,200	1,440	68,640	134,400	2,880	137,280	1,578,720,000	Including 2 standbys at each phase
5.12	Miscellaneous	with piping	-	set	1	1	2	87,600	358,800,000	31,200	87,600	31,200	118,800	87,600	31,200	118,800	175,200	62,400	237,600	2,732,400,000	
Sub Total											31,858,200	1,332,360	33,190,560	31,858,200	1,332,360	33,190,560	63,716,400	2,664,720	**66,381,120**	**763,382,880,000**	

(6) Dewatering & Deodorization Facility

No.	Equipment	Brief Spec.	Motor Output (kW)	Quantity				Unit Price			Cost										Remarks
											Phase I			Phase II			Total				
				Unit	Phase I	Phase II	Total	FC	LC		FC	LC	Total	FC	LC	Total	FC	LC	Total		
								(USD)	(Rp)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(Rp)	
6.1	Excess sludge mixer	Vertical shaft paddle mixer	11	set	2	0	2	43,200	11,040,000	960	86,400	1,920	88,320	0	0	0	86,400	1,920	88,320	1,015,680,000	including 1 standby
6.2	Excess sludge feed pump	Progressive cavity pump 125mm x 4.3 - 35m3/h	11	set	3	2	5	22,320	17,940,000	1,560	66,960	4,680	71,640	44,640	3,120	47,760	111,600	7,800	119,400	1,373,100,000	including 1 standby
6.3	Dehydrator	Pressing Rotary Outer Cylinder -type Screw Press (ISGK-0805) Screen diameter 800 mm	2.2	set	3	2	5	1,462,722	51,060,000	4,440	4,388,165	13,320	4,401,485	2,925,444	8,880	2,934,324	7,313,609	22,200	7,335,809	84,361,803,500	including 1 standby
6.4	Deodorization equipment	Bio-deodorization system	453	set	1	0	1	1,800,000	5,520,000,000	480,000	1,800,000	480,000	2,280,000	0	0	0	1,800,000	480,000	2,280,000	26,220,000,000	
6.5	Miscellaneous	with piping	-	set	1	1	2	6,000	13,800,000	1,200	6,000	1,200	7,200	6,000	1,200	7,200	12,000	2,400	14,400	165,600,000	
Sub Total											6,347,525	501,120	6,848,645	2,976,084	13,200	2,989,284	9,323,609	514,320	**9,837,929**	**113,136,183,500**	

(7) Electrical Facility & Control System

No.	Equipment	Brief Spec.	Motor Output (kW)	Quantity				Unit Price			Cost										Remarks
											Phase I			Phase II			Total				
				Unit	Phase I	Phase II	Total	FC	LC		FC	LC	Total	FC	LC	Total	FC	LC	Total		
								(USD)	(Rp)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(USD)	(Rp)	
7.1	GIS, Transformer	20kV/380V 50Hz 3,000kVA	-	set	2	2	4	1,560,000	5,520,000,000	480,000	3,120,000	960,000	4,080,000	3,120,000	960,000	4,080,000	6,240,000	1,920,000	8,160,000	93,840,000,000	
7.2	Generator	380V 50Hz 3,300kVA Emergency Diesel Generation	-	set	1	0	1	1,485,600	690,000,000	60,000	1,485,600	60,000	1,545,600	0	0	0	1,485,600	60,000	1,545,600	17,774,400,000	
7.3	Monitoring and control system		10	set	0.6	0.4	1	3,000,000	13,800,000,000	1,200,000	1,800,000	720,000	2,520,000	1,200,000	480,000	1,680,000	3,000,000	1,200,000	4,200,000	48,300,000,000	AIO:500 Points DIO:1,800 Points
7.4	Miscellaneous	with Electrical wiring and so on	-	set	0.6	0.4	1	600,000	2,760,000,000	240,000	360,000	144,000	504,000	240,000	96,000	336,000	600,000	240,000	840,000	9,660,000,000	
Sub Total											6,765,600	1,884,000	8,649,600	4,560,000	1,536,000	6,096,000	11,325,600	3,420,000	**14,745,600**	**169,574,400,000**	

Appendix4.8 Replacement Cost

Appendix4.8.1 Replacement Cost in Case1 (Year 1st to 10th)

Items	1st year		2nd year		3rd year		4th year		5th year		6th year		7th year		8th year		9th year		10th year		Sub-total	
	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)
1. Lift Pumping Facility																						
1.1 Inflow Gate																					0.0	0.0
1.2 Coarse screen																					0.0	0.0
1.3 Fine screen																					0.0	0.0
1.4 Lift pump																					0.0	0.0
1.5 Flow meter																					0.0	0.0
1.6 Hoist																					0.0	0.0
1.7 Pump up well connection gate																					0.0	0.0
1.8 Miscellaneous																			552.0	138.0	552.0	138.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	552.0	138.0	552.0	138.0
2. Grit Chamber Facility																						
2.1 Grit collector																					0.0	0.0
2.2 Grit lifting pump																					0.0	0.0
2.3 Air blower																					0.0	0.0
2.4 Miscellaneous																	132.5	19.3			132.5	19.3
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	132.5	19.3	0.0	0.0	132.5	19.3
3. Equalization Tank Facility																						
3.1 Constant rate pump																					0.0	0.0
3.2 Mixer for antisettling																					0.0	0.0
3.3 Ultra fine screen																					0.0	0.0
3.4 Miscellaneous																					0.0	0.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. Disinfection Facility																						
4.1 Sodium hypochlorite storage tank									662.4	132.5									662.4	132.5	1,324.8	265.0
4.2 Sodium hypochlorite dosing pump									306.4	37.3									306.4	37.3	612.7	74.5
4.3 Miscellaneous											16.6	4.1							66.2	8.3	82.8	12.4
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	968.8	169.7	16.6	4.1	0.0	0.0	0.0	0.0	0.0	0.0	1,035.0	178.0	2,020.3	351.9
5. Aeration Tank & Membrane Bioreactor Facility																						
5.1 Mesh screen																					0.0	0.0
5.2 Air diffuser for aeration tank																			7,567.0	5,405.0	7,567.0	5,405.0
5.3 Blower for aeration tank																					0.0	0.0
5.4 Membrane unit															248,400.0	2,760.0	248,400.0	2,760.0			496,800.0	5,520.0
5.5 Membrane filtration pump																					0.0	0.0
5.6 NaOCl pump for maintenance cleaning											883.2	99.4									883.2	99.4
5.7 NaOCl pump for recovering cleaning											1,104.0	110.4									1,104.0	110.4
5.8 Dilution water pump																					0.0	0.0
5.9 Blower for membrane scrubbing																					0.0	0.0
5.10 Circulation pump																					0.0	0.0
5.11 Excess sludge pump																					0.0	0.0
5.1 Miscellaneous											604.4	143.5							604.4	143.5	1,208.9	287.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2,591.6	353.3	0.0	0.0	248,400.0	2,760.0	248,400.0	2,760.0	8,171.4	5,548.5	507,563.1	11,421.8
6. Dewatering & Deodorization Facility																						
6.1 Excess sludge mixer																					0.0	0.0
6.2 Excess sludge feed pump																					0.0	0.0
6.3 Dehydrator																					0.0	0.0
6.4 Deodorization equipment																					0.0	0.0
6.5 Miscellaneous																			138.0	27.6	138.0	27.6
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.0	27.6	138.0	27.6
7. Electrical Facility & Control System																						
7.1 GIS, Transformer																					0.0	0.0
7.2 Generator																					0.0	0.0
7.3 Monitoring and control system															6,900.0	2,760.0					6,900.0	2,760.0
7.4 Miscellaneous																					0.0	0.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6,900.0	2,760.0	0.0	0.0	0.0	0.0	6,900.0	2,760.0
Total(1-7)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	968.8	169.7	2,608.2	357.4	0.0	0.0	255,300.0	5,520.0	248,532.5	2,779.3	9,896.4	5,892.1	517,305.9	14,718.6
8. Site Overhead																						
5 % of sum of total 1 to 7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.4	8.5	130.4	17.9	0.0	0.0	12,765.0	276.0	12,426.6	139.0	494.8	294.6	25,865.3	735.9
9. General Overhead																						
10% of net replacement cost(sum of 1 to 8)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	101.7	17.8	273.9	37.5	0.0	0.0	26,806.5	579.6	26,095.9	291.8	1,039.1	618.7	54,317.1	1,545.5
10. Total replacement cost																						
the sum of 1 to 9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,118.9	196.0	3,012.5	412.8	0.0	0.0	294,871.5	6,375.6	287,055.0	3,210.1	11,430.4	6,805.4	597,488.3	17,000.0

Appendix4.8 Replacement Cost

Appendix4.8.1 Replacement Cost in Case1 (Year 11th to 20th and Total)

Items	11th year		12th year		13th year		14th year		15th year		16th year		17th year		18th year		19th year		20th year		Sub-total		Total			
	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	**FC (Mil. Rp.)**	**LC (Mil.Rp.)**	**FC+LC (Mil. Rp.)**	**FC+LC (Equiv. to USD)**
1. Lift Pumping Facility																										
1.1 Inflow Gate																					0.0	0.0	0.0	0.0	0.0	0
1.2 Coarse screen																	690.0	230.0			690.0	230.0	690.0	230.0	920.0	80,000
1.3 Fine screen																	2,530.0	161.0	2,530.0	161.0	5,060.0	322.0	5,060.0	322.0	5,382.0	468,000
1.4 Lift pump																			37,950.0	1,725.0	37,950.0	1,725.0	37,950.0	1,725.0	39,675.0	3,450,000
1.5 Flow meter					690.0	276.0															690.0	276.0	690.0	276.0	966.0	84,000
1.6 Hoist																					0.0	0.0	0.0	0.0	0.0	0
1.7 Pump up well connection gate																					0.0	0.0	0.0	0.0	0.0	0
1.8 Miscellaneous																	1,104.0	276.0			1,104.0	276.0	1,656.0	414.0	2,070.0	180,000
Sub-total	0.0	0.0	0.0	0.0	690.0	276.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4,324.0	667.0	40,480.0	1,886.0	45,494.0	2,829.0	46,046.0	2,967.0	49,013.0	4,262,000
2. Grit Chamber Facility																										
2.1 Grit collector																	2,967.0	118.7	2,967.0	118.7	5,934.0	237.4	5,934.0	237.4	6,171.4	536,640
2.2 Grit lifting pump																	469.2	30.4	469.2	30.4	938.4	60.7	938.4	60.7	999.1	86,880
2.3 Air blower																			1,490.4	60.0	1,490.4	60.0	1,490.4	60.0	1,550.4	134,820
2.4 Miscellaneous																	132.5	19.3			132.5	19.3	265.0	38.6	303.6	26,400
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,568.7	168.4	4,926.6	209.1	8,495.3	377.4	8,627.8	396.8	9,024.5	784,740
3. Equalization Tank Facility																										
3.1 Constant rate pump																	7,590.0	531.3	7,590.0	531.3	15,180.0	1,062.6	15,180.0	1,062.6	16,242.6	1,412,400
3.2 Mixer for antisettling											7,948.8	883.2	7,948.8	883.2							15,897.6	1,766.4	15,897.6	1,766.4	17,664.0	1,536,000
3.3 Ultra fine screen															7,355.4	138.0	7,355.4	138.0			14,710.8	276.0	14,710.8	276.0	14,986.8	1,303,200
3.4 Miscellaneous									559.6	11.0											559.6	11.0	559.6	11.0	570.6	49,620
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	559.6	11.0	7,948.8	883.2	7,948.8	883.2	7,355.4	138.0	14,945.4	669.3	7,590.0	531.3	46,348.0	3,116.0	46,348.0	3,116.0	49,464.0	4,301,220
4. Disinfection Facility																										
4.1 Sodium hypochlorite storage tank									662.4	132.5									662.4	132.5	1,324.8	265.0	2,649.6	529.9	3,179.5	276,480
4.2 Sodium hypochlorite dosing pump									306.4	37.3									306.4	37.3	612.7	74.5	1,225.4	149.0	1,374.5	119,520
4.3 Miscellaneous											16.6	2.1							66.2	8.3	82.8	10.4	165.6	22.8	188.4	16,380
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	968.8	169.7	16.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	1,035.0	178.0	2,020.3	349.8	4,040.6	701.7	4,742.4	412,380.0
5. Aeration Tank & Membrane Bioreactor Facility																										
5.1 Mesh screen																	11,500.0	230.0	11,500.0	230.0	23,000.0	460.0	23,000.0	460.0	23,460.0	2,040,000
5.2 Air diffuser for aeration tank																			7,567.0	5,405.0	7,567.0	5,405.0	15,134.0	10,810.0	25,944.0	2,256,000
5.3 Blower for aeration tank																	20,700.0	207.0	20,700.0	207.0	41,400.0	414.0	41,400.0	414.0	41,814.0	3,636,000
5.4 Membrane unit											248,400.0	2,760.0	248,400.0	2,760.0							496,800.0	5,520.0	993,600.0	11,040.0	1,004,640.0	87,360,000
5.5 Membrane filtration pump									26,496.0	143.5											26,496.0	143.5	26,496.0	143.5	26,639.5	2,316,480
5.6 NaOCl pump for maintenance cleaning	883.2	99.4									883.2	99.4							883.2	99.4	2,649.6	298.1	3,532.8	397.4	3,930.2	341,760
5.7 NaOCl pump for recovering cleaning	1,104.0	110.4									1,104.0	110.4							1,104.0	110.4	3,312.0	331.2	4,416.0	441.6	4,857.6	422,400
5.8 Dilution water pump																	1,766.4	220.8			1,766.4	220.8	1,766.4	220.8	1,987.2	172,800
5.9 Blower for membrane scrubbing																	95,385.6	496.8			95,385.6	496.8	95,385.6	496.8	95,882.4	8,337,600
5.10 Circulation pump															34,776.0	463.7					34,776.0	463.7	34,776.0	463.7	35,239.7	3,064,320
5.11 Excess sludge pump																			1,545.6	33.1	1,545.6	33.1	1,545.6	33.1	1,578.7	137,280
5.1 Miscellaneous	604.4	143.5					604.4	143.5					604.4	143.5					604.4	143.5	2,417.8	574.1	3,626.6	861.1	4,487.8	390,240
Sub-total	2,591.6	353.3	0.0	0.0	0.0	0.0	604.4	143.5	26,496.0	143.5	250,387.2	2,969.8	249,004.4	2,903.5	34,776.0	463.7	129,352.0	1,154.6	43,904.2	6,228.4	737,116.0	14,360.3	1,244,679.0	25,782.1	1,270,461.1	110,474,880
6. Dewatering & Deodorization Facility																										
6.1 Excess sludge mixer									993.6	22.1											993.6	22.1	993.6	22.1	1,015.7	88,320
6.2 Excess sludge feed pump											1,283.4	89.7									1,283.4	89.7	1,283.4	89.7	1,373.1	119,400
6.3 Dehydrator																	42,053.3	127.7	42,053.3	127.7	84,106.5	255.3	84,106.5	255.3	84,361.8	7,335,809
6.4 Deodorization equipment									20,700.0	5,520.0											20,700.0	5,520.0	20,700.0	5,520.0	26,220.0	2,280,000
6.5 Miscellaneous																			103.5	27.6	103.5	27.6	241.5	55.2	296.7	25,800
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21,693.6	5,542.1	1,283.4	89.7	0.0	0.0	0.0	0.0	42,053.3	127.7	42,156.8	155.3	107,187.0	5,914.7	107,325.0	5,942.3	113,267.3	9,849,329.0
7. Electrical Facility & Control System																										
7.1 GIS, Transformer																					0.0	0.0	0.0	0.0	0.0	0
7.2 Generator																			17,084.4	690.0	17,084.4	690.0	17,084.4	690.0	17,774.4	1,545,600
7.3 Monitoring and control system									10,350.0	4,140.0											10,350.0	4,140.0	17,250.0	6,900.0	24,150.0	2,100,000
7.4 Miscellaneous									3,450.0	1,380.0											3,450.0	1,380.0	3,450.0	1,380.0	4,830.0	420,000
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13,800.0	5,520.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17,084.4	690.0	30,884.4	6,210.0	37,784.4	8,970.0	46,754.4	4,065,600
Total(1-7)	2,591.6	353.3	0.0	0.0	690.0	276.0	604.4	143.5	63,518.0	11,386.4	259,636.0	3,944.7	256,953.2	3,786.7	42,131.4	601.7	194,243.3	2,786.9	157,177.0	9,878.0	977,545.0	33,157.3	**1,494,850.8**	**47,875.9**	**1,542,726.7**	**134,150,149**
8. Site Overhead																										
5 % of sum of total 1 to 7	129.6	17.7	0.0	0.0	34.5	13.8	30.2	7.2	3,175.9	569.3	12,981.8	197.2	12,847.7	189.3	2,106.6	30.1	9,712.2	139.3	7,858.8	493.9	48,877.2	1,657.9	74,742.5	2,393.8	77,136.3	6,707,507
9. General Overhead																										
10% of net replacement cost(sum of 1 to 8)	272.1	37.1	0.0	0.0	72.5	29.0	63.5	15.1	6,669.4	1,195.6	27,261.8	414.2	26,980.1	397.6	4,423.8	63.2	20,395.5	292.6	16,503.6	1,037.2	102,642.2	3,481.5	156,959.3	5,027.0	161,986.3	14,085,766
10. Total replacement cost																										
the sum of 1 to 9	2,993.3	408.0	0.0	0.0	797.0	318.8	698.1	165.8	73,363.2	13,151.3	299,879.5	4,556.2	296,781.0	4,373.7	48,661.8	694.9	224,351.0	3,218.9	181,539.4	11,409.1	1,129,064.4	38,296.6	**1,726,552.7**	**55,296.6**	**1,781,849.4**	**154,943,422**

Appendix4.8 Replacement Cost

Appendix4.8.2 Replacement Cost in Case2 (Year 1st to 10th)

Items	1st year		2nd year		3rd year		4th year		5th year		6th year		7th year		8th year		9th year		10th year		Sub-total	
	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)
1. Lift Pumping Facility																						
1.1 Inflow Gate																					0.0	0.0
1.2 Coarse screen																					0.0	0.0
1.3 Fine screen																					0.0	0.0
1.4 Lift pump																					0.0	0.0
1.5 Flow meter																					0.0	0.0
1.6 Hoist																					0.0	0.0
1.7 Pump up well connection gate																					0.0	0.0
1.8 Miscellaneous																			331.2	82.8	331.2	82.8
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	331.2	82.8	331.2	82.8
2. Grit Chamber Facility																						
2.1 Grit collector																					0.0	0.0
2.2 Grit lifting pump																					0.0	0.0
2.3 Air blower																					0.0	0.0
2.4 Miscellaneous																	79.5	11.6			79.5	11.6
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	79.5	11.6	0.0	0.0	79.5	11.6
3. Equalization Tank Facility																						
3.1 Constant rate pump																					0.0	0.0
3.2 Mixer for antisettling																					0.0	0.0
3.3 Ultra fine screen																					0.0	0.0
3.4 Miscellaneous																					0.0	0.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4. Disinfection Facility																						
4.1 Sodium hypochlorite storage tank									331.2	66.2									331.2	66.2	662.4	132.5
4.2 Sodium hypochlorite dosing pump									153.2	18.6									153.2	18.6	306.4	37.3
4.3 Miscellaneous											16.6	2.1							16.6	2.1	33.1	4.1
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	484.4	84.9	16.6	2.1	0.0	0.0	0.0	0.0	0.0	0.0	500.9	86.9	1,001.9	173.9
5. Aeration Tank & Membrane Bioreactor Facility																						
5.1 Mesh screen																					0.0	0.0
5.2 Air diffuser for aeration tank																			3,783.5	2,702.5	3,783.5	2,702.5
5.3 Blower for aeration tank																					0.0	0.0
5.4 Membrane unit															248,400.0	2,760.0					248,400.0	2,760.0
5.5 Membrane filtration pump																					0.0	0.0
5.6 NaOCl pump for maintenance cleaning															441.6	49.7					441.6	49.7
5.7 NaOCl pump for recovering cleaning																					0.0	0.0
5.8 Dilution water pump																					0.0	0.0
5.9 Blower for membrane scrubbing																					0.0	0.0
5.10 Circulation pump																					0.0	0.0
5.11 Excess sludge pump																					0.0	0.0
5.1 Miscellaneous											201.5	71.8							201.5	71.8	403.0	143.5
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	201.5	71.8	0.0	0.0	248,841.6	2,809.7	0.0	0.0	3,985.0	2,774.3	253,028.1	5,655.7
6. Dewatering & Deodorization Facility																						
6.1 Excess sludge mixer																					0.0	0.0
6.2 Excess sludge feed pump																					0.0	0.0
6.3 Dehydrator																					0.0	0.0
6.4 Deodorization equipment																					0.0	0.0
6.5 Miscellaneous																			138.0	27.6	138.0	27.6
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.0	27.6	138.0	27.6
7. Electrical Facility & Control System																						
7.1 GIS, Transformer																					0.0	0.0
7.2 Generator																					0.0	0.0
7.3 Monitoring and control system															6,900.0	2,760.0					6,900.0	2,760.0
7.4 Miscellaneous																					0.0	0.0
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6,900.0	2,760.0	0.0	0.0	0.0	0.0	6,900.0	2,760.0
Total(1-7)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	484.4	84.9	218.0	73.8	0.0	0.0	255,741.6	5,569.7	79.5	11.6	4,955.1	2,971.6	261,478.6	8,711.6
8. Site Overhead																						
5 % of sum of total 1 to 7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.2	4.2	10.9	3.7	0.0	0.0	12,787.1	278.5	4.0	0.6	247.8	148.6	13,073.9	435.6
9. General Overhead																						
10% of net replacement cost(sum of 1 to 8)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.9	8.9	22.9	7.8	0.0	0.0	26,852.9	584.8	8.3	1.2	520.3	312.0	27,455.3	914.7
10. Total replacement cost																						
the sum of 1 to 9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	559.5	98.0	251.8	85.3	0.0	0.0	295,381.5	6,433.0	91.8	13.4	5,723.2	3,432.2	302,007.8	10,061.9

Appendix4.8 Replacement Cost

Appendix4.8.2 Replacement Cost in Case2 (Year 11th to 20th and Total)

Items	11th year		12th year		13th year		14th year		15th year		16th year		17th year		18th year		19th year		20th year		Sub-total		Total			
	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	FC (Mil. Rp.)	LC (Mil.Rp.)	**FC (Mil. Rp.)**	**LC (Mil.Rp.)**	**FC+LC (Mil. Rp.)**	**FC+LC (Equiv. to USD)**
1. Lift Pumping Facility																										
1.1 Inflow Gate																					0.0	0.0	0.0	0.0	0.0	0
1.2 Coarse screen																	345.0	115.0			345.0	115.0	345.0	115.0	460.0	40,000
1.3 Fine screen																	2,530.0	161.0			2,530.0	161.0	2,530.0	161.0	2,691.0	234,000
1.4 Lift pump																			22,770.0	1,035.0	22,770.0	1,035.0	22,770.0	1,035.0	23,805.0	2,070,000
1.5 Flow meter					414.0	165.6													414.0	165.6	828.0	331.2	828.0	331.2	1,159.2	100,800
1.6 Hoist																					0.0	0.0	0.0	0.0	0.0	0
1.7 Pump up well connection gate																					0.0	0.0	0.0	0.0	0.0	0
1.8 Miscellaneous																	552.0	138.0			552.0	138.0	883.2	220.8	1,104.0	96,000
Sub-total	0.0	0.0	0.0	0.0	414.0	165.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,427.0	414.0	23,184.0	1,200.6	27,025.0	1,780.2	27,356.2	1,863.0	29,219.2	2,540,800
2. Grit Chamber Facility																										
2.1 Grit collector																	2,967.0	118.7			2,967.0	118.7	2,967.0	118.7	3,085.7	268,320
2.2 Grit lifting pump																	469.2	30.4			469.2	30.4	469.2	30.4	499.6	43,440
2.3 Air blower																			993.6	60.0	993.6	60.0	993.6	60.0	1,053.6	91,620
2.4 Miscellaneous																	106.0	15.5			106.0	15.5	185.5	27.0	212.5	18,480
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,542.2	164.5	993.6	60.0	4,535.8	224.5	4,615.3	236.1	4,851.4	421,860
3. Equalization Tank Facility																										
3.1 Constant rate pump																			7,590.0	531.3	7,590.0	531.3	7,590.0	531.3	8,121.3	706,200
3.2 Mixer for antisettling											7,948.8	883.2							7,948.8	883.2	15,897.6	1,766.4	15,897.6	1,766.4	17,664.0	1,536,000
3.3 Ultra fine screen																	7,355.4	138.0			7,355.4	138.0	7,355.4	138.0	7,493.4	651,600
3.4 Miscellaneous									447.7	8.8											447.7	8.8	447.7	8.8	456.5	39,696
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	447.7	8.8	7,948.8	883.2	0.0	0.0	0.0	0.0	7,355.4	138.0	15,538.8	1,414.5	31,290.7	2,444.5	31,290.7	2,444.5	33,735.2	2,933,496
4. Disinfection Facility																										
4.1 Sodium hypochlorite storage tank			331.2	66.2					331.2	66.2			331.2	66.2					331.2	66.2	1,324.8	265.0	1,987.2	397.4	2,384.6	207,360
4.2 Sodium hypochlorite dosing pump			153.2	18.6					153.2	18.6			153.2	18.6					153.2	18.6	612.7	74.5	919.1	111.8	1,030.9	89,640
4.3 Miscellaneous											16.6	2.1							66.2	8.3	82.8	10.4	115.9	14.5	130.4	11,340
Sub-total	0.0	0.0	484.4	84.9	0.0	0.0	0.0	0.0	484.4	84.9	16.6	2.1	484.4	84.9	0.0	0.0	0.0	0.0	550.6	93.2	2,020.3	349.8	3,022.2	523.7	3,545.9	308,340.0
5. Aeration Tank & Membrane Bioreactor Facility																										
5.1 Mesh screen																			11,500.0	230.0	11,500.0	230.0	11,500.0	230.0	11,730.0	1,020,000
5.2 Air diffuser for aeration tank															3,783.5	2,702.5			3,783.5	2,702.5	7,567.0	5,405.0	11,350.5	8,107.5	19,458.0	1,692,000
5.3 Blower for aeration tank																			20,700.0	103.5	20,700.0	103.5	20,700.0	103.5	20,803.5	1,809,000
5.4 Membrane unit									248,400.0	2,760.0	248,400.0	2,760.0									496,800.0	5,520.0	745,200.0	8,280.0	753,480.0	65,520,000
5.5 Membrane filtration pump									13,248.0	71.8											13,248.0	71.8	13,248.0	71.8	13,319.8	1,158,240
5.6 NaOCl pump for maintenance cleaning											883.2	99.4							294.4	33.1	1,177.6	132.5	1,619.2	182.2	1,801.4	156,640
5.7 NaOCl pump for recovering cleaning											552.0	55.2									552.0	55.2	552.0	55.2	607.2	52,800
5.8 Dilution water pump																	883.2	110.4			883.2	110.4	883.2	110.4	993.6	86,400
5.9 Blower for membrane scrubbing																	47,692.8	248.4			47,692.8	248.4	47,692.8	248.4	47,941.2	4,168,800
5.10 Circulation pump															17,388.0	231.8					17,388.0	231.8	17,388.0	231.8	17,619.8	1,532,160
5.11 Excess sludge pump																			772.8	16.6	772.8	16.6	772.8	16.6	789.4	68,640
5.1 Miscellaneous											604.4	143.5							604.4	143.5	1,208.9	287.0	1,611.8	430.6	2,042.4	177,600
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	261,648.0	2,831.8	250,439.6	3,058.1	0.0	0.0	21,171.5	2,934.3	48,576.0	358.8	37,655.1	3,229.2	619,490.3	12,412.2	872,518.3	18,067.9	890,586.2	77,442,280
6. Dewatering & Deodorization Facility																										
6.1 Excess sludge mixer					496.8	11.0													496.8	11.0	993.6	22.1	993.6	22.1	1,015.7	88,320
6.2 Excess sludge feed pump											641.7	44.9									641.7	44.9	641.7	44.9	686.6	59,700
6.3 Dehydrator																			42,053.3	127.7	42,053.3	127.7	42,053.3	127.7	42,180.9	3,667,905
6.4 Deodorization equipment					20,700.0	5,520.0															20,700.0	5,520.0	20,700.0	5,520.0	26,220.0	2,280,000
6.5 Miscellaneous																			103.5	27.6	103.5	27.6	241.5	55.2	296.7	25,800
Sub-total	0.0	0.0	0.0	0.0	21,196.8	5,531.0	0.0	0.0	0.0	0.0	641.7	44.9	0.0	0.0	0.0	0.0	0.0	0.0	42,653.6	166.3	64,492.1	5,742.2	64,630.1	5,769.8	70,399.8	6,121,724.5
7. Electrical Facility & Control System																										
7.1 GIS, Transformer																					0.0	0.0	0.0	0.0	0.0	0
7.2 Generator																			17,084.4	690.0	17,084.4	690.0	17,084.4	690.0	17,774.4	1,545,600
7.3 Monitoring and control system									10,350.0	4,140.0											10,350.0	4,140.0	17,250.0	6,900.0	24,150.0	2,100,000
7.4 Miscellaneous									3,450.0	1,380.0											3,450.0	1,380.0	3,450.0	1,380.0	4,830.0	420,000
Sub-total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13,800.0	5,520.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17,084.4	690.0	30,884.4	6,210.0	37,784.4	8,970.0	46,754.4	4,065,600
Total(1-7)	0.0	0.0	484.4	84.9	21,610.8	5,696.6	0.0	0.0	276,380.1	8,445.5	259,046.7	3,988.2	484.4	84.9	21,171.5	2,934.3	62,900.6	1,075.3	137,660.1	6,853.8	779,738.5	29,163.4	**1,041,217.1**	**37,875.0**	**1,079,092.2**	**93,834,101**
8. Site Overhead																										
5 % of sum of total 1 to 7	0.0	0.0	24.2	4.2	1,080.5	284.8	0.0	0.0	13,819.0	422.3	12,952.3	199.4	24.2	4.2	1,058.6	146.7	3,145.0	53.8	6,883.0	342.7	38,986.9	1,458.2	52,060.9	1,893.8	53,954.6	4,691,705
9. General Overhead																										
10% of net replacement cost(sum of 1 to 8)	0.0	0.0	50.9	8.9	2,269.1	598.1	0.0	0.0	29,019.9	886.8	27,199.9	418.8	50.9	8.9	2,223.0	308.1	6,604.6	112.9	14,454.3	719.6	81,872.5	3,062.2	109,327.8	3,976.9	113,304.7	9,852,581
10. Total replacement cost																										
the sum of 1 to 9	0.0	0.0	559.5	98.0	24,960.5	6,579.6	0.0	0.0	319,219.0	9,754.5	299,198.9	4,606.4	559.5	98.0	24,453.1	3,389.2	72,650.2	1,242.0	158,997.4	7,916.1	900,598.0	33,683.8	**1,202,605.8**	**43,745.6**	**1,246,351.4**	**108,378,386**