2.6.2 Design Fundamentals and Facility Specifications

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Table 2.6.2.1 Pump Station

(1) Design Fundamentals

ů vě	S NO		MOL LIRIODO	Invert Level		Water Level	eve		С, С	
		P/D	M/P	Inlet	Outlet	Inlet	Outlet	Actual Head	Present	Plan
	< 0	(M3/S)	(M3/S)	(W)	(W)	(M)	(W)	(W)	(W)	W
	12	1.484	1.774	-3,095	-0.650	-2.74	0.31	3.05	2.00	2.50
2	–7A	1.525	2:070	-2.801	0230	-1.73	1.31	200	2.88	3:00
3 4	4-4A	0.040	0.066	-2.794	1.380	-2.54	1.64	4.18	2.85	2.90
5 6-1	6-8A	0.187	0.766	-0.094	0.255	-1.81	0.55	2.36	9.98	2 50
6 6-1	6-12A	0.280	0.867	-3.999	0.530	-320	1.53	4 53	2 63	04 0
7 6-13A	13A	0.280	1.129	-1.731	0.500	06.0-	13		200	08.0
11 10	102A	0.236	0.236	-2.762	0.900	-2.30	1.37		5 83	0.20
12 305	305A	0.377	0.377	-2.975	0.500	-2.43	1.05	3.48	9.48	0 20

(2) Design Flow

			Preliminary Design	ry Design			M/P		
No	Sewer No.	<u>6</u>	Q2	03	04 04	6	8	SO	40
		(W3/m)	(M3/m)	(M3/m)	(M3/m)	(M3/m)	(M3/m)	(M3/m)	(M3/m)
	1-3A	18.02	20.89	29.66	89.04	21.74	25.35	35,48	106.44
~	1-7A	18.55	21.52	30.50	91.50	25.54	29.91	41.40	124.20
ဗ	4-4A	0.52	0.62	0.80	2.40	0.85	8	-	3 96
S	6-8A	2.40	2.83	3.74	11 22	9.83	11.80	15.8	45 GR
e	6-12A	3.60	4.31	5.60	16.80	11.13	13.35	17.34	202
7	6-13A	3.60	4.31	5.60	16.80	14 01	16.46	20.50	22.20
11	102A	3.03	3.63	4.72	14.16	3.03	3.63	3 6	14.18
12	305A	4.84	5.81	7.54	22.62	4 34	u a	2.2	00 00

a, ut Lany Ave. Q2 Daily Max. Q3 Hourly Max. Q4 3xHourly Max.

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					No. 6	No. of Units by Diameter	umeter			
No.	Sewer No.	Sewer No. Pump Type 150(mm)	150(mm)	200(mm)	250(mm)	250(mm) 300(mm) 350(mm) 400(mm)	350(mm)		450(mm)	600(mm)
-	1-3A	0						0		2
5	1-7A	0							2	2
n	4-4A	W	. 2							
s	6-8A	0				2		2		
G	6-12A	0				2		2		
2	6-13A	o					2		2	
1	102A	υ		,,	0					
12	305A	υ		,,	[]	5				
Note: C Common Type	nmon Type									

M Manhole type

			Pump Head				Î	HP by Diameter			
No.	Sewer No.	Actual Head	Loss	Total	200(mm)	250(mm)	300(mm)	350(mm)	400(mm)	450(mm)	- 600(m) -
		(W)	(W)	(W)	(kw/unit)	(kw/unit)	(kw/unit)	(kw/unit)	(kw/unit)	(kw/unit)	(kw/unit)
-	1-3A	3.05	1.50	4.55							45.00
~	1-7A	3.04	1.50	4.54						30	45.00
ю	4-4A	4.18	1.50	5.68							•
5	6-8A	2.36	1.50	3.86			7.50		15.00		
ŝ	6-12A	4.53	1.50	6.03			15.00		30.00		
7	6-13A	2.24	1.50	3.74				11.00		22	
11	102A	3.67	1.50	4.17	3.70	7.50				-	
12	305A	3,48	1.50	4.98	5.50		11.00				

			Preliminary Design (P/O)	esign (P/O)			Ч/М	4	
, Š	Pump Dia.	õ	02 02	03	04	δ	02 ·	8	
• .	(աա)	(tjun)	(tinu)	(unit)	(tinu)	(unit)	(unit)	(unit)	(unit)
	(m3/m)	18.02	20.89	29.66	89.04	21.74	25.35	35.48	106.44
-	400				1.00	2.00	2.00	2.00	5.00
	800	1.00	1.00	1.00	2.00				2.00
	(m3/m)	18.55	21.63	30.50	91.50	25.54	29.91	41,40	124.20
N	450				1.00	2.00	2.00	8.8	2.00
	800	1.00	1.00	1.00	2.00				2.00
	(m3/m)	0.51	0.62	0.80	2.40	0.85	1.20	8	3.961
ო	100								
	150	1	-	-	8	-			
	(m3/m)	2.401	2.88	3.74	11.22	9.834	11.796	15.20	45.96
S	300	+-			8	2	0	2	
	400								
	(m3/m)	3.595	4.312	506	16.8	11.131	13.351	17.34	52.02
G	300			-	2	0	01	8	0
	400								2
	(m3/m)	3.595	4.312	5.6	16.8	14.003	16.459	22.58	67.74
~	350	-			3	5	~	0	2
	450								0
	(m3/m)	3.03	3634	4.72	14.16	3.03	3.634	4.72	14.16
<del>.</del>	200	~	3	: 2	2	¢1	2	01	N
	250				N				2
4	(m3/m)	4.84	5.805	7.45	22.62	4.84	5.805	7.54	22.62
5	200	2	2	2	0	2	2	, <b>(</b> )	0

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Table 2.6.2.2 Inverted Siphon

•••••	~ <b>I</b>	Desigr	Design Flow	Ē	iniet		Siphon	5		40141 C	
No.	Contract Mar	<u>(</u>									มี
	ochel NO.	היה	W/P	Dia	Invert L.	Dia.	Velocity	Length	Loss	fuvert L	i M
		(W3/S)	(M3/S)	(MM)	(M)	(MM)	(S/W)	) (§	(94)	ΨΨ.	
									1.1.1	1141	
	0	1.48	1.88	1500	-1.33	-1.33 1,000x2line	1.39	7	44 U	10 01	20.
•	e *	000	1						5	5	
1	2	020	C1.1	1200	0.5	0.5 8000x2line	1.19	57	0.33	- 0	000
ო 	6-16	0.28	0. 1	1000		10.000					201
		}	2	202	10.14		1.19	£3	0.31	-0.6	0.28
4	7-3	0.14	0.14	500	-0.41	-0.41 300x2line	77.0	N.Y.Y	0000	U C	
								5	DC.0	- 1.00	-12/

TK

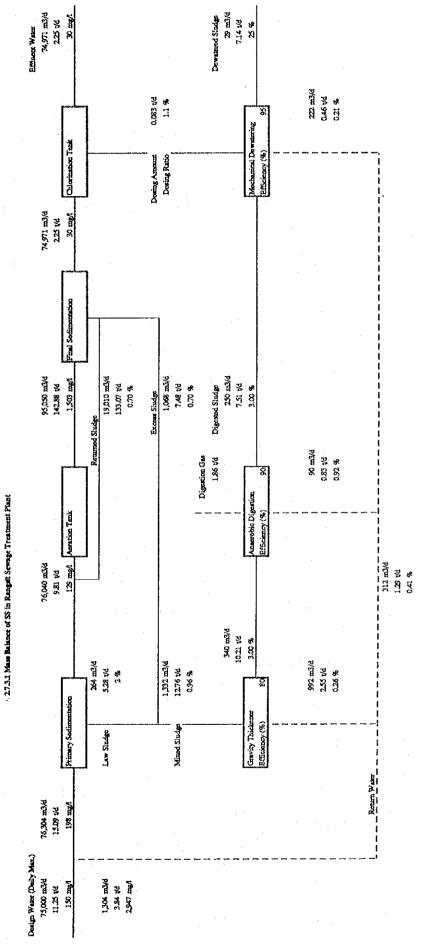
#### 2.6.2.3 Overflow Chamber

Overflow Chamber shall be installed under the public road. The conditions for selection of the location are as follows:

- (1) Junction of public roads
- (2) Junction of private and public roads (public road side) for connection of pipe from the housing estate.
- (3) Just downstream point in case that the train from private land is connected to the pipe under public road.
- (4) Except for the above conditions, it shall be installed with a maximum spacing of 500m.
- (5) Additional installation shall be done in case of the construction of new housing areas.

No.	Sewer No.	Quantity (M3/S)	Dia. (MM)	Slope  (1/1000)	Full (M/S)	How (M3/S)	Type   +
	   101	0.171	φ400	7.0	1.387	0.1742	B
2	102	0.065	ø300	5.0	0.967	0.0694	B
3	104	2,283	ø500	6.0	1.490	0.2925	B
4	1-1	0.436	\$600	5.5	1.611	0.4554	C
5	2-2	0.057	ø300	4.0	0.865	0.0612	B
6	301	0.107	ø400	3.0	0.908	0.1141	j c
7	302	0.196	ø400 -	9.0	1.572	0.1976	В
8	304	0.051	φ300	3.0	0.749	0.0530	В
9	305	0.023	ø300	2.0	0.612	0.0432	C
1.0	3-1	0.036	ø300	2.0	0.612	0.0432	C
11	3-2	0.041	ø300	2.0	0.612	0.0432	C
12	4-2	0.019	ø300	2.0	0.612	0.0432	C   C
13	5-1	0.015	φ300	2.0	0.612	0.0432	C
14	5-2	0.011	ø300	2.0	0.612	0.0432	i c
15	6-7	0.050	ø300	2.0	0.612	0.0432	C
16	701	0.042	ø300	2.0	0.612	0.0432	C
17	7-1	0.025	ø300	2.0	0.612	0.0432	C
18	702	0.052	ø300	3.0	0.749	0.0530	C
19	703	0.017	ø300	2.0	0.612	0.0432	C
20	7-4	0.002	ø300	2.0	0.612	0.0432	C
21	6-8	0.093	ø400	2.0	0.741	0.0931	C
22	6-9	0.007	ø300	2.0	0,612	0.0432	C
	 Total	1.799	T			1	

Table 2.6.3.(1) Number of overflow Chambers



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Shides Rang M/P Contributi E1993/11/1

### 2.7.3.2 Design of Facilities

Wastewater Treatment

(1) Inflow Pump Station

The inflow pump station of treatment plant consists of initial bar screen followed with the pump facilities.

1) Design Condition

	Dry Weather Flow	Wet Weather Flow
Design Flow (hourly max.)	33,300 m3/d = 23.1 m3/min.	100,000 m3/d = 69.4 m3/min.
Surface loading of grit chamber	1,800 m3/m2/day	3.600 m3/m2/day
Average velocity of grit chamber	0.3 m/sec	0.6 m/sec
Retention time	60 sec	30 sec

2) Proposed Inflow Pump Station

Grit Chamber	
Dry Weather Flow	1.6 m (w) x 0.7 m (h) x 11 m (l) x 1 unit
Wet Weather Flow	1.6 m (w) x 0.7 m (h) x 11 m (l) x 1 unit
Inflow Pump	
Dry Weather Flow	Ø 350 x 2 pumps
	(11.55 m3/min. x 2)
Wet Weather Flow	$\phi$ 350 x 2 pumps, 800 x 1 pump
	(11.55 m3/min. x 2 + 23.15 m3/min.x 1)

(2) Primary Sedimentation Basin for Wastewater

#### 1) Design Condition

Design Flow (Daily Max.)	25,700 m3/day
Surface Loading	35 m3/m2 day
Sedimentation Time	3.0 hr
Effective Depth	4.0 m
Overflow Loading of Weir	less than 250 m3/m/day
Reduction Efficiency	BOD : 30%
· · · · · · · · · · · · · · · · · · ·	SS : 35%
Influent Water Quality	BOD : 150 mg/l
	SS : 150 mg/l
Effluent Water Quality	BOD :105 mg/l
	SS : 97.5 mg/l

2) Proposed Sedimentation Basin Sedimentation Basin Surface Area

ǿ16.0 m x 4 units 804 m2

### (3) Storm Water Sedimentation Basin

1) Design Condition

T/ Design contaition		
Design Flow (Wet hourly max.	74,300 m3/day	
– dry daily max.)	(100,000 - 25,700)	
Surface Loading	70 m3/m2 day	
Sedimentation Time	0.5 hr	
Effective Depth	3.0 m	
Overflow Loading of Weir	less than 250 m3/m/day	

- 2) Proposed Storm water Sedimention Basin<br/>Sedimentation BasinØ18.5 m x 4 unitsSurface Area1,075 m2
- (4) Aeration Tank

Based on the discussion with PWD of an emergency condition, generator will not be instailed at the treatment plant from the economical view point. Hence, the diffused air aeration system is not proposed because of the easiness of diffuser clogging by the floccule while power failure. The mechanical aerator is proposed for this project.

1) Design Condition

Design Flow (daily max.)	25,700 m3/day
Aeration Time	6 hr
BOD-SS Loading	0.35 kg-BOD/kg-SS/day
Return sludge Ratio	25%
Returen Sludge Solid Concentration	7,000 mg/l
BOD Volumetric Loading	0.3 – 0.8 kg/m3/day
Sludge Age	2 – 4 days

- 2) Proposed Aeration Tank
  - Aeration Tank Aerator

15 m (w) x 75 m (l) x 3 m (d) x 2 units 22 kw x 2 units, 11 kw x 3 units

- (5) Secondary Sedimentation Basin
- 1) Design Condition

.,	
Design Flow (daily max.)	25,700 m3/day
Surface Loading	25 m3/m2day
Sedimentation Time	2.5 hr
Overflow Loading of Weir	less than 150 m3/m/day

2) Proposed Secondary Sedimentation Basin
 Sedimentation Basin
 \$\$\overline{0}\$ 18.5 m x 2.5 m (d) x 4 units
 Surface Area
 1,075 m2

(6) Disinfection Tank

Calcium hypochlorite is proposed to use the disinfection of treated water.

1) Design Condition

· ·	Dry Weather Flow	Wet Weather Flow
Disitn Flow	25,700 m3/day	100,000 m3/day
Contact Time	10 min.	10 min.

2) Proposed Disinfection Tank Tank Size

2 m (w) x 180 m (l) x 2 m (d) x 1 unit

#### Sludge Treatment

(1) Gravity Thickener

1) Design Condition

From the Mass Balance calculation in Fig. 7.###, design condition is shown below.

Primary Law Sludge Density	2%
Excess Sludge Density	0.7%
Thickened Sludge Density	3%
Solid Mass Loading	60 – 90 kg/m2/day
Effective Depth	4 m
Efficiency of Thickener	80 %

2) Proposed Gravity Thickener

Gravity Thickener Thickening Time ∮6 m x 4 m (d) x 2 unit 11.9 hr

(2) Anaerobic Digestion Tank

1) Design Condition	
Thickened Sludge Organic Material Ratio	60%
Digestion Ratio	50%
Efficiency of Digestion Tank	90%
Effective Depth	more than 4 m
Digestion Time	1st Tank 20 days
- 5	2nd Tank 10 days

### 2) Proposed Anaerobic Digestion Tank 1st digestion Tank

#### (3) Centrifugal Dewatering

1) Dewatering Condition

Operation Hour	6 days a week,
	6 hours a day
Digested Sludge Volume	86 m3/day,
	2.57 t/day
Digested Sludge Density	3%
Efficiency of Centrifugal Dewatering	95%
Dewatered Sludge Moisture Content	79%
Chemical Dosing Ratio	1.1%

2) Proposed Centrifugal Dewatering Capacity : Dewatered Sludge

8 m3/hr x 1 unit, 15 m3/hr x 1 unit 10 m3/day, 2.45 t/day (Moisture content = 79%) Design Calculation of Rangsit Wastewater Treatment Plant for MASTER PLAN

### (1) Design Discharge

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		m3/day	m3/min.	m3/sec.
Daily Average	(Qda)	62,500	43.4	0.723
Daily Maximum in Dry Weather	(Qdmd)	75,000	52.1	0.868
Hourly Maximum in Dry Weather	(Qhmd)	97,500	67.7	1.128
Hourly Maximum in Wet Weather	(Qhmw)	292,500	203.1	3.385

	Influent	Effluent
BOD ( mg/l )	175	20
SS ( mg/l )	150	30

### (2) Design Calculation

Grit Chamber ( Dry Weather )			1	
( bry weacher ) Design Flow Rate				
Hourly Maximum in Dry Weat	her Qhmd-	97,500 m	3/day	
ROULLY MAXIMUM IN DIY Weat		1.128 m		
		11100	.,	
Design Condition				
Surface Loading	Ls=	1,800 m	3/m2/day	
Average Velocity	Va=	0.3 m	/sec.	
Retention Time	Rs**	60 s	ec.	
Size				
Required Surface Area	A=Qhmd/Ls=	54.17 m	2	
Effective Depth	He=	0.7 m		
Required Width	Be≭	4.8 m		
Size of Structure				·
Width	B=	1.6	=	1.6 m
Length	L=A/Be=	11.28		11.0 m
Depth	H==	0.7		0.7 m
Numbers	n=	3	*	3 unit
Verification				
Surface Loading	Ls=Qhmd/B/L/n=	1,847 m	3/m2/day	
Average Velocity	Va=Qhmd/B/He=	0.336 m.	/sec.	
Retention Time	Rt=L/Va=	32.8 s	ec.	
Volume of Grit				
	Qhmd*0.00001*1.8 t/m3=	1.76 t	/day	
Screenings	Qhmd*0,00001=	0,98 m	3/day	

( Wet Weather )			
Design Flow Rate			
- Hourly Maximum in Wet Wea	ther Qhmw-Qhmd-	195,000 m3/day	
-Houly Maximum in Dry We		2.257 m3/sec.	:
-Roury Maximum in Dry ne	acher	2.207 107360.	
Design Condition			· .
Surface Loading	La	3,600 m3/m2/day	,
Average Velocity	Va¤	0.6 m/sec.	
Retention Time	Rs=	30 sec.	
		·	
Size	· · · ·		
Required Surface Area	A=Qhmw/Ls=	54.17 m2	
Effective Depth	He=	0.7 m	
Required Width	Be=	4.8 m	
Size of Structure			· · · · ·
Width	B=	1.6 =	1.6 m
Length	L≕A/Be=	11.28 🛥	11.0 m
Depth	Н=	0.7 ⊭	0.7 m
Numbers	. n**	3 78	3 units
		. *	
Verification			
Surface Loading	Ls=Qhmw/B/L/n=	3,693 m3/m2/day	,
Average Velocity	Va=Qhmw/B/He=	0.672 m/sec.	: •
Retention Time	Rt=L/Va≠	16.4 sec.	
Volume of Grit			
	Qhmw*0.00001*1.8 t/m3=	3.51 t/day	
Screenings	Qhmw*0.00001=	1.95 m3/day	

2) Inflow Pump

(Inflow Pump for Wastewater)

Hourly Maximum in Dry Weather

Qhmd= 67.7 m3/min.

	11.55 t	m3/min.	x	2 pumps	**	23.1	. m3/min.
(	Dia.=	350	mm,		V	2.01	m/s)
23.15 m3/min.		x	2 pumps	=	46.3	3_m3/min.	
. (	Dia.=	500	mm,		V=	1.97	m/s }
Total 65					69.4	m3/min.	

(Inflow Pump for Storm Water)

Hourly Maximum in Wet Weather

Qhmw= 203.1 m3/min.

_			. :					
		11.55 m	3/min.	х	2 pumps	1çt	23.1	m3/min.
	(	Dia.=	350	mm,		V=	2.01	m/s)
		23.15 m	3/min.	x	2 pumps	-	46.3	m3/min.
	(	Dia.=	500	nm,		V=	1.97	m/s)
		66.85 m	3/min.	x	2 pumps	<b>=</b>	133.7	m3/min.
L	(	Dia.=	800	mm,		V≔	2.23	m/s)
L			Total				203.1	m3/min.

	Design Flow Rate				
	Daily Maximum in Dry Weather	Qdmd-	75,000 m	13/day	
	•	. 101	3,125 m	13/hr	
	Design Condition				
	Surface Loading	Ŀs≖	35 m	3/m2/day	
	Settling Time	Ts∞	3.0 h	_	
	Effective Depth	He=	4.0 m		
	Size				
	Required Surface Area	An=Qdmd/Ls=	2,143 m		
	Required Tank Volume	V=Qdmd*Ts∞	9,375 m	13	
	Size of Structure				
	Diameter	D=	15.8	=	16.0 m
	Depth	H≈	4.0	=	4.0 m
	Numbers	n=	12		12 units
	Volume of Tank	. V=	9,646 m	3	
	Surface Area	As=	2,412 m		
		10	67316 M	L	
	Verification				
	Surface Loading	Ls≖	31.1 m	3/m2/day	
	Settling Time	TS=	3.1 h	r	
	Wier Loading	I.w=	124.4 m	3/m/day	
4)	Stormwater Sedimentation Tank				
	Design Flow Rate				
	= Hourly Maximum in Wet Weather	Qhmw-Qdmd=	217,500 m	3/day	
	-Daily Maximum in Dry Weather	=	9,063 m		
	Design Condition				. ·
	Surface Loading	Ls=	70 m	3/m2/day	
	Settling Time	Ts=	0.5 h		
	Effective Depth	He=	3.0 m	<b>.</b> .	
		110	5.0 m		
	Size				
	Required Surface Area	An=Qdmw/Ls=	3,107 m2		
	Required Tank Volume	Lw=Qdmw*Ts≕	4,531 m	3	
	Size of Structure				
	Diameter	D=	18.2	54	18.5 m
	Depth	Н=	3.0	=	3.0 m
	Numbers	n=	12	<b>52</b>	12 units
	Volume of Tank	(J	9,672 m3	3	
	Surface Area	V= As=	9,672 m3 3,224 m2		
		A9-	57223 102		
	Verification				
	Surface Loading	Ls=	67.5 m3	/m2/day	<u>.</u>
	Settling Time	Ts≈	1.1 hr		· ·
	Wier Loading	Lw≖	312.0 m3	l/m/day	

٢

Aeration Tank				
Design Wastewater Quality				
	Ci (BOD) :	122.5 mg		
	Ci (SS) :	98 mg	g/1	
Design Flow Rate				
Daily Maximum in Dry Weather	Qdmd-	75,000 mi	B/day	
Design Condition	01	6.0 h	•	
Aeration Time	Ta=		- ·	
BOD - SS Loading	Ls≖ Rs≖	25.0 %	g/kg/day	
Return Sludge Ratio		20.0 s 7,000 mg		
Return Sludge Solid Concentratio	5n - CL	7,000 mg	37 I	
Size				
MLSS				
· · · ·	s/100)/(1+Rs/100)=	1,478 mg	1/1	
Required Tank Volume			pr -	
V=Qdmd*C1 (BOD) / (BOD-	-SS Loading)*MLSS=	17,760 m.	3	· · ·
A-XUNG.OT (DOD)A (BOD				
Size of Structure				
Width	B≖	15.0		15.0 m
Length	L=Vn/H/n=	65.8	-	75.0 m
Depth	H=	3.0	<b>1</b> 27	3.0 m
Numbers	n=	6	-	6 units
				· .
Verification			~	
Cross Section	A=B*H-0.3^2≠	44.91 m		
Volume	V=A*L*n=	20,210 m	3	
BOD - SS Loading		0.01.1	n: 1.	
	Ls=Qdmd*Ci/V/MLSS=		g/kg/day	
Aeration Time	Ta=V/Qdmd*24=	6.47 h:	r	
BOD Volumetric Load	14 al (map) (11 /1 000	0.45 5	- 1-2 1-1-1-1	••
	d*Ci(BOD)/V/1,000=	0.45 KG	g/m3/day	
Sludge Age Sa=M	LSS*V/Qdmd/Ci(SS)=	4.08 da	avs .	:
			-1-	
Secondary Sedimentation Tank				
Design Flow Rate				
Daily Maximum in Dry Weather	Qdmd=	75,000 m	3/day	
-	mi	3,125 m	3/hr	
-				
Design Condition		;		
Surface Loading	Ls=		3/m2/day	
Settling Time	Ts=	2.5 h		- 
Effective Depth	He≖	2.5 m		
Size				
Required Surface Area	A=Qdmd/Ls≖	3,000 m	2	
Required Surface Area Required Tank Volume	Lw=Qdmd*Ts≃	7,813 m		
•				
Size of Structure				
Diameter	D=	18.2	25	18.5 m
Depth	H=	2.5	in .	2.5 m
	n=	12		12 units

	Volume of Tank	V=	8,060 m3	
	Surface Area	v- As∞	3,224 m2	
	Sullace Area	A3-	5,224 m2	
	Verification			
	Surface Loading	Ls≖	23.3 m3/m2/day	
•	Settling Time	Ts∞	2.6 hr	
	Wier Loading	Lw=	107.6 m3/m/day	
7)	Disinfection Tank			
	( Dry Weather )			
	Design Flow Rate			
	Daily Maximum in Dry Weather	Qdmd=	75,000 m3/day	
		=	3,125 m3/hr	
		174	52.1 m3/min.	
	· · · ·			
	Design Condition			
	Contact Time of Disinfecion Tank	Tc=	10 min.	
		Required Volume=	521 m3,	
	Size of Structure	5	2.0	0.0 -
	Width	B=	2.0 =	2.0 m
	Length	<b>L</b> ≖	43.4 =	180.0 m
	Depth	H=	2.0 =	2.0 m
	Numbers	n*	3 =	3 units
	Verification			
	Volume of Tank	V=	2,160 m3	
	Contact Time of Disinfecion Tank		41.5 min.	
	(Wet Weather )			
	Design Flow Rate			
	Hourly Maximum in Wet Weather	Qhmw=	292,500 m3/day	
	-	*	12,188 m3/hr	
		. =	203.1 m3/min.	
	Design Condition			
	Contact Time of Disinfecion Tank	Tc=	10 min.	
		Required Volume=	2,031 m3	
	Size of Structure Width	B=	2.0 =	2.0 m
	Length	. Г=	169.3 =	180.0 m
		H=	2.0 =	2.0 m
	Depth Numbers	H= N=	3 =	3 units
	nuilogi s	11=		U UNICO
	Verification			
	Volume of Tank	V=	2,160 m3	
	Contact Time of Disinfecion Tank	Tc≍		
	Conduct time of profitecton lank	10-	********	

8) Gravity Thickener

8)	Gravity Intekener			· · ·	
	Design Flow Rate				
	Daily Maximum in Dry	Weather	Qdmd=	75,000 m3/day	
	Row Sludge			264 m3/day	
			(	5.28 t-DS/day )	
	Excess Sludge		Υ.	1068 m3/day	
	Excess Studge		(	7.48 t-DS/day )	
		L-1 .6 0)	•		
	10	tal of Sludge		1,332 m3/day	
			( Ds1≖	12.76 t-DS/day )	•
	Design Condition			· · ·	
	Type : Gravity Thi	ckener			
	Solids Loading	LDs1-	60 to	90 kg/m2 day	
	Required Surface Are				
	_	- 	141.8 to	212.7 m2	
	Thickening Time		Tt=	12 hr	
	Required Volume		V=Dv1*Tt=	666.0 m3	
	Effective Depth		He=	4.0 m	
	-	aguitrad Surfa	ice Area = V/He =	166.5 m2 )	
	( 1	equired surra	ice Aled - V/ne -	100.5 mz )	
	Size of Structure			· .	
	Diameter		D=	5.9 🛥	6.0 m
	Depth	:	H≖	4.0 ==	4.0 m
	Numbers		n ==	6 =	6 unit#
	Effective Volume		V=	679.2 m3	
	Effective Surface Ar	~ ~	v- A=	169.8 m2	
	FILECTIVE SUITACE AL	ea	A	103.0 MZ	
	Travi fi patri an				
	Verification		*** 11		
	Solids Loading		LDs1'=	75.1 kg/m2 day	
	Thickening Time		Tt'≕	12.2 hr	
	Volume of Effluent		· · · ·		
	Efficiency of Thicke	ner	Et=	80 %	
	Solids Content		Ds1'=Ds1*Et=	10.21 t-DS/day	
	Moisture Content		Dw=	97 %	
	Effluent Volume				
		Dv1'=Ds	s1'*100/(100-Dw)=	340 m3/day	
	Thickened Sludge			-	
	Solids Content		Dst=Ds1-Ds1'=	2.55 t-DS/day	
	Moisture Content		Dw=	0.26 %	
	Volume of Thickened	Sludge	Dvt=Dv1-Dv1'=	992 m3/day	
01	Disastan				
9}	Digester			210	
	Design Sludge Volume		Dv2=Dv1'=	340 m3/day	
	Moisture Content		Dw≕	97 %	
	Solids Content		Ds2=Ds1'=	10.21 t-DS/day	•
	Primary Digester	V1-	- Dv2 * 20 days -	6,805 m3	
			. –		

Size of Primary Digester					
Diameter		D≔	17.0	224	17.0 m
Depth		He=	5.0	-	5.0 m
Numbers		• n==	6	==	6 units
We and Od an elad and		-		:	
Verification			00 0 1		
Digestion Time		Td=	20.0 d	ays	
Secondary Digester	V2= Dv2 *	10 days =	3,403 m	3	
Size of Secondary Digester					
Diameter		D=	12.0	384	12.0 m
Depth		He=	5.0	==	5.0 m
Numbers		n∞	6	=	6 units
Verification					
Digestion Time		Td≖	10.0 d	ays	
		·			
Volume of Effluent			÷		
Organic Matter Content		Co=	60 %		
Digestion Ratio		Rd=	50 %		
Efficiency of Digestion Ta	nk	De=	90 %	1.1	
Digestion Gas		Vg=	1.86 t		-
Solids Content	Ds2'=(D	s2-Vg)*De=	7.51 t	-DS/da	У
Moisture Content		Dw=	97 %		
Effluent Volume					
	Dv2'=Ds2'*100	/(100-Dw)=	250 m	3/day	
Digested Sludge					
Solids Content	Dsd=Ds	2-Ds2'-Vq=	0.83 t	-DS/da	v
Moisture Content			0.92 %	50, 44	1
Volume of Digested Sludge		Dvd=		3/day	
10) Dewatering					
Type : Centrifuge				~	
Design Sludge Volume		Dv3=Dv2'=	250 m	-	
Operation Day in A Week	i.	Td=	6 da	_	
Operation Hour in A Day Dewatered Sludge Volume	Drad - Drad + 7 -	Tt=		ours D(day	
Capacity of Dewatering Machin	Dvd=Dv3*7d e	ays/ouays≕	292 m3	Juay	
	city	Number		Tota	1
	8 m3/hr.x	2	=	16	m3/hr.
	15  m3/hr.x	2	-	30	m3/hr.
	20 mw/ mk I A	~	Vr ==	46	m3/hr.
			• =		

Operation Time

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Tt = Dvd/Vr = 6.3 hr.

## Design Calculation of Rangsit Wastewater Treatment Plant for PRELIMINARY ENGINEERING DESIGN

### (1) Design Discharge

		m3/day	m3/m1n.	m3/sec.
Daily Average	(Qda)	21,350	14.8	0.247
Daily Maximum in Dry Weather	(Qdmd)	25,700	17.8	0.297
Hourly Maximum in Dry Weather	(Qhmd)	33,300	23.1	0.385
Hourly Maximum in Wet Weather	(Qhmw)	100,000	69.4	1.15
		Influent	Effluent	
BOD ( mg/1 )		175	20	
SS ( mg/l )		150	30	

### (2) Design Calculation

Grit Chamber				
( Dry Weather )				
Design Flow Rate				
Hourly Maximum in Dry Weath	ner Qhmd=	33,300 m	3/day	
	34	0.385 m	3/sec.	
Design Condition				
Surface Loading	Ls≖	1,800 m.	3/m2/day	
Average Velocity	Va=	0.3 m,	/sec.	
Retention Time	Rs≖	60 s	ec.	
Size		1. A.		
Required Surface Area	A=Qhmd/Ls=	18.50 m	2.	
Effective Depth	He=	0.7 m	. ·	
Required Width	Be=	1.6 m		
Size of Structure		-		
Width	B=	1.6		1.6 m
Length	L=A/Be=	11.56		11.0 m
Depth	H=	0.7		0.7 m
Numbers	U res	1	<u>1:11</u>	1 unit
Verification				
Surface Loading	Ls=Qhmd/B/L/n=	1,892 m	3/m2/day	
Average Velocity	Va=Qhmd/B/He=	0.344 m		
Retention Time	Rt=L/Va=	32.0 s	ec.	
Volume of Grit			:	
	Qhmd*0.00001*1.8 t/m3=	0.60 t	/day	
Screenings		0.33 m	3/day	

( Wet Weather )				
Design Flow Rate				
- Hourly Maximum in Wet Weather	Qhmw-Qhmd=	66,700 m	n3/day	
-Houly Maximum in Dry Weather		0.772 m	n3/sec.	
Design Condition				
Surface Loading	Ls=	3,600 m	n3/m2/day	
Average Velocity	Va <b>×</b>	0.6 m	n/sec.	
Retention Time	Rs=	30 s	ec.	
Size				
Required Surface Area	A=Qhmw/Ls=	18.53 n	n2	
Effective Depth	He=	0.7 m	n	
Required Width	Be=	1.6 m	n	
Size of Structure				
Width	B=	1.6	-	1.6 m
Length	L=A/Be=	11.58		11.0 m
Depth	H≖	0.7		0.7 m
Numbers	n=	1	=	1 units
Verification				
Surface Loading	Ls=Qhmw/B/L/n=	3,790 m	n3/m2/day	
Average Velocity	Va=Qhmw/B/He=	0.689 n	/sec.	
Retention Time	Rt=L/Va≈	16.0 s	ec.	
Volume of Grit	· · · ·			
Qhmw*	0.00001*1.8 t/m3=	1.20 t	/day	
Screenings	Qhmw*0.00001=	0.67 m	n3/day	
Inflow Pump				
(Inflow Pump for Wastewater)				
Hourly Maximum in Dry Weather	Qhmd= 23.1 m	3/min.		
	11.55 m3/min. x	2 p	oumps ≖	23.1 m3/min
· · ·	(Dia.= 350 m	m, -	- V=	2.01 m/s)

(Inflow Pump for Storm Water) Hourly Maximum in Wet Weather

2)

Qhmw= 69.4 m3/min.

11.55 m3/mir	n. X	2 pumps ≕	23.	l m3/min.
(Dia.= 35	0 mm,	V=	2.01	m/s }
23.15 m3/mir	n. x	1 pumps =	23.1	5 m3/min.
( Dia.= 80	0 mm,	V=	0.77	m/s)
Tot	al		46.2	5 m3/min.

3)	Primary Sedimentation Tank				
	Design Flow Rate				
	Daily Maximum in Dry Weather	Qdmd=	25,700 m3/day		
			1,071 m3/hr		
	· ·				
	Design Condition				
	Surface Loading	L9=	35 m3/m2/day		
	Settling Time	Ts=	3.0 hr		
	Effective Depth	He=	4.0 m		
	Size				
	Required Surface Area	An=Qdmd/Ls=	734 m2		
	Required Tank Volume	V=Qdmd*Ts=	3,213 m3		
			i -		
	Size of Structure				
	Diameter	D∞	16.0 =	16.0 m	
	Depth	H=	4.0 ==	4.0 m	
	Numbers	Ų≈	4 =	4 units	
	Volume of Tank	V=	3,215 m3		
	Surface Area	As=	804 m2		
	Verification				
	Surface Loading	re=	32.0 m3/m2/day		
	Settling Time	Ts≃	3.0 hr		
	Wier Loading	Lw=	127.9 m3/m/day		
4)	Stormwater Sedimentation Tank				
	Design Flow Rate				~
	= Hourly Maximum in Wet Weather	Qhmw-Qdmd=	74,300 m3/day		
	-Daily Maximum in Dry Weather	***	3,096 m3/hr		
	Design Condition				
	Surface Loading	Ls⇔	70 m3/m2/day		
	Settling Time	Ts≖	0.5 hr		
	Effective Depth	He=	3.0 m		
	Size				
	Required Surface Area	An=Qdmw/Ls=	1,061 m2	· .	
	Required Tank Volume	Lw=Qdmw*Ts=	1,548 m3		
					· ·
	Size of Structure				
	Diameter	, D=	18.4 ==	18.5 m	
	Depth	H=	3.0 =	3.0 m	
	Numbers	n≂	4 ∞	4 units	
			. ' <b>e</b>		
	Volume of Tank	V=	3,224 m3		
	Surface Area	As=	1,075 m2		
	Verification				
	Surface Loading	Ls=	69.1 m3/m2/day		
	Settling Time	Ts≈	1.0 hr		
	Wier Loading	Lw=	319.8 m3/m/day		

5)	Aeration Tank	

A

- 57	Aeracion Tank			
	Design Wastewater Quality	· · · · · · · · · · · · · · · · · · ·		
		Ci (BOD) :	122.5 mg/1	
		Ci (SS) :	98 mg/1	
	Design Flow Rate			•
	Daily Maximum in Dry Weath	er Qdmdw	25,700 m3/day	
	<b>a</b>	going	nov too movad]	
	Design Condition			
	Aeration Time	Ta=	6.0 hr	
	BOD - SS Loading	Ls=	0.35  kg/kg/day	
	Return Sludge Ratio	Rs≖	25.0 %	
	Return Sludge Solid Concent		7,000 mg/1	
	Robarn Dradys Borra Concent		7,000 mg/1	
	Size			
	MLSS			
		+Cr*Rs/100)/(1+Rs/100)=	1,478 mg/l	
	Required Tank Volume	(1+R3/100)/ (1+R3/100/~	1,470 mg/1	-
		(BOD-SS Loading) *MLSS=	6 0062	
	v-gang-ot (BOD)/	" TPOP-22 TOSUTUG) VMPS2=	6,086 m3	
	Size of Structure			
	Width		15 0	
		B=	15.0 -	15.0 m
	Length	L=Vn/H/n=	67.6 🚥	75.0 m
	Depth	H⊨	3.0 =	3.0 m
	Numbers	n≃	2 📲	2 units
	Verification			
	Cross Section	A=B*H-0.3^2=	44.91 m2	
	Volume	V=A*L*n=	6,737 m3	
	BOD - SS Loading			
		Ls=Qdmd*C1/V/MLSS=	0.32 kg/kg/day	
	Aeration Time	Ta=V/Qdmd*24=	6.29 hr	
	BOD Volumetric Load			
		r=Qdmd*C1(BOD)/V/1,000=	0.47 kg/m3/day	
	Sludge Age			
		Sa=MLSS*V/Qdmd/C1(SS)=	3.97 days	
~				
6)	Secondary Sedimentation Tank			
	Design Flow Rate			
	Daily Maximum in Dry Weathe	r Qdmd=	25,700 m3/day	
		573	1,071 m3/hr	
	Design Condition	_		
	Surface Loading	Ls=	25 m3/m2/day	
	Settling Time	Ts=	2.5 hr	
	Effective Depth	He=	2.5 m	
	<b>A</b> 1			
	Size			
	Required Surface Area	A=Qdmd/Ls=	1,028 m2	
	Required Tank Volume	Lw=Qdmd*Ts=	2,677 m3	
	Size of Structure	·	r	• • - ·
	Diameter	D=	18.5 =	18.5 m
	Depth	H=	2.5 =	2.5 m
	Numbers	n=	4 =	4 units

Volume of Tank	v-	2,687 m3	
Surface Area	As-	1,075 m2	
Verification			
Surface Loading	T a_	22 0 2 / 2 /	· · ·
-	Ls=	23.9 m3/m2/day	
Settling Time	Ts≖	2.5 hr	
Wier Loading	Lw≕	110.6 m3/m/day	e e e
Disinfection Tank			
( Dry Weather )			
Design Flow Rate			
Daily Maximum in Dry Weather	Qdmd	25,700 m3/day	
•	<b>-</b>	1,071 m3/hr	
· ·	-	17.8 m3/min.	
Design Condition			
Contact Time of Disinfecion Tank	Tc≖	10 min.	
- -	and word Walnum	178 m3	
F	Required Volume=	178 103	
Size of Structure			
Width	<b>B</b> =	2.0 =	2.0 m
Length	L=	44.6 =	180.0 m
Depth	H≖	2.0 =	2.0 m
Numbers	n≖	1 =	l units
Verification			
Verification Volume of Tank		700 - 2	
Contact Time of Disinfecton Tank	V=	720 m3 40.3 min.	
contact time of Distification fails	Tc≖	4 <b>0.</b> 5 min.	
( Wet Weather )			
Design Flow Rate		4 · •	
Hourly Maximum in Wet Weather	Qhmw=	100,000 m3/day	
	. 23	4,167 m3/hr	
		69.4 m3/min.	
			. •
Design Condition			
Contact Time of Disinfecion Tank	Tc=	10 min.	
p	equired Volume=	694 m3	
T.	odarrow Aornug-	CIII FCO	
Size of Structure		· .	
Width	B=	2.0 **	2.0 m
Length	L=	173.6 =	180.0 m
Depth	H⇒	2.0 =	2.0 m
Numbers	<b>u</b> =	1 =	1 units
· · · · · · · · · · · · · · · · · · ·			н. — — — — — — — — — — — — — — — — — — —
Verification		·	
Volume of Tank	. V∞	720 m3	
Contact Time of Disinfecion Tank	Tc≓	10.4 min.	· ·

	8) (	Fravity Thickener						
		Design Flow Rate						
Alternative		Daily Maximum in	Dry Weather		<u>Qdmd</u> ≕	25,700 m3	/day	
		. <b>.</b>					-	
	I	Row Sludge				91 m.	8/day	
					(	1.81 t-	-DS/day )	
	1	Excess Sludge				367 m3	3/day	
4		-			(	2.57 t-	-DS/day )	
			Total of Sl	udge Volume	: Dv1≖	457 m3	/day	
				-	( Dsl∓	4.38 t-	-DS/day )	
		· · · · ·						
	I	Design Condition						
		Type : Gravity	Thickener					
		Solids Loading	LDs	1* 60	to	90 kg	g∕m2 day	
		Required Surface	Area					
		•	A=Ds1/LDs1	= 48.7	to	73.0 m2	2	
		Thickening Time			Tt≖	12 hi	<u>r</u>	
		Required Volume			V=Dv1*Tt=	228.5 m3	3	
		Effective Depth			He	4.0 m		
		- · · ·	( Required S	urface Area	= V/He =	57.1 m2	2)	
								1
	5	Size of Structure						
· · · ·		Diameter			D=	6.0	-	6.0 m
		Depth			H=	4.0	= .	4.0 m
		Numbers			n=	2	*	2 units
						006 4	<b>`</b>	
-		Effective Volume	_		V≕	226.4 m3		
		Effective Surface	e Area		A=	56.6 m2		
-		·						
	Ţ	Verification					(	
		Solids Loading			LDsl'=		g∕m2 day	
		Thickening Time			Tt'≖	11.9 hi	5	
		1-1						
	,	Volume of Effluent			Ph_	<i>9</i> 0 0		
		Efficiency of Thi	LCKENEI	De1	Et= '=Ds1*Et=	80 %	DE/day	
		Solids Content		DSI		3.30 L- 97 %	-DS/day	
· .		Moisture Content			Dw≓	516		
		Effluent Volume	D1	1 0-11+100/	(100) -	117 <b>ສ</b> ິ	/dag	
		n)/) [0])	DAT	'=Ds1'*100/	(100-Dw)=	117 113	sruay	
		Thickened Sludge			Ds1-Ds1'-	0.88 t-	Dg/day	
		Solids Content		DSC=		0.26%	-D3/uay	
		Moisture Content	-d Oludes	Deet -	Dw=	0.26 t 340 m3	/day	
		Volume of Thicker	nea Stuage	DVC=	Dv1-Dv1'=	540 103	Juay	
	9) T	Digester						
		Design Sludge Volume	2	1	Dv2≖Dv1'=	<b>117 m</b> 3	/dav	
	ı	Moisture Content	-		Dv2−0v1 = Dw≠	97 %	·1	
		Solids Content			Ds2=Ds1'=	3.50 t-	-DS/dav	
		SOLIDS CONCENE				510V E		
	1	Primary Digester		V1= Dv2 * 3	20 da <b>v</b> s =	2,336 m3	l .	
					->1-	_,,		

Size of Primary Digester					
Diameter		D=	17.3	<b>Best</b>	17.5 m
Depth	· ·	He=	5.0	-	5.0 m
Numbers		<b>n</b> =	2	T2	2 units
Verification					
Digestion Time		Td=	20.6 da	ауз	
Secondary Digester	V2≈ Dv2 *	10 days =	1,168 m	3	
Size of Secondary Digeste	r				
Diameter		D=	12.2	<b>a</b> r :	12.0 m
Depth		He=	5.0	-	5.0 m
Numbers		n=	2	**	2 units
Verification					
Digestion Time		Td=	9.7 da	ays	
Volume of Effluent					
Organic Matter Content		Co=	· 60 %		
Digestion Ratio		Rd≖	50 ቼ		. •
Efficiency of Digestic	on Tank	De≖	90 %		
Digestion Gas		Vg≖		-DS/day	
Solids Content	Ds2'= (Ds	2Vg) *De=	2.57 t-	-DS/day	
Moisture Content		Dw=	97 %		
Effluent Volume					
	Dv2'=Ds2'*100/	(100-Dw) =	86 m.	3/day	
Digested Sludge		·			
Solids Content	Dsd=Ds2	-Ds2'-Vg≖	0.29 t	-DS/day	:
Moisture Content		Dw=	0.94 %		
Volume of Digested Slu	ıdge	Dvd=	31 m	3/day	
Dewatering					
Type : Centrifuge					
Design Sludge Volume		Dv3=Dv2'=	86 m	3/day	
Operation Day in A Week		Td=	6 da	-	
Operation Hour in A Day		Tt≖	6 h	ours	
Dewatered Sludge Volume	Dvd=Dv3*7da	ys/6days=	100 m	3/day	
Capacity of Dewatering Ma	ichine				
	Capacity	Number		Tota	L · · ·
	8 m3/hr.x	1		8	m3/hr.
	15 m3/hr.x	1	. =	15	m3/hr.
			Vr =	23	m3/hr.
			-Dvd/Vr=		3 hr.

Calculation of Mechanical Surface Aerator of Rangsit Wastewater Treatment Plant for Master Plan

1. Design Condition a. Design Flow Daily Average : Qa 62,500 m3/day Daily Maximum : Om 75,000 m3/day b. Influent Quality (BOD) : Qb 122.5 mg/l BOD Removal Efficiency 83.7 % c. :ε d. Temperature : T 25 °C 2. Influent BOD : Bw kg/day  $Bw = \gamma \cdot Qb \cdot Qa \cdot 10^{-3}$  $\gamma = \text{Load Factor} = \text{Daily Maximum}(\text{Qm}) / \text{Daily Average}(\text{Qa})$ 9,188 kg/day Bw =3. Excluded BOD : Br kg/day  $Br = Bw \cdot \epsilon \cdot 10^{(-2)}$ 7,690 kg/day Br =4. Supplied Oxygen in Operation : Na kgO2/hr  $Na = Br \cdot n / 24$  $\eta$  = Required Oxygen for Exclusion of Unit BOD kg = 0.8 256.3 kgO2/hr Na = 5. Oxygen Transfer in Standard Condition : N kgO2 / hr  $N = Na/ \alpha \{(Csw-Cl)/Cs\}(1.024)^{(T-20)}$  $\alpha$ : Oxygen Transfer into Wastewater/Oxygen Transfer into Pure Water = 0.8  $Csw = \beta \cdot Css =$ 7.542 mg/l  $\beta$ : Oxygen Saturation in Wastewater / Oxygen Saturation in Pure Water = 0.9 Css : Oxygen Saturation in Pure Water in T C = 8.38 mg/l Cl: Dissolved Oxygen = 2.0 mg/l Cs: Oxygen Saturation in Pure Water in Standard Condition = 9.17 mg/l т: 25°C (1.024)^(T-20) : 1.126 596.9 kgO2/hr N =6. Supplied Oxygen per Motor Power of Aerator : Ns kgO2/kw/hr  $5 \sim 20 \text{ HP}$ 1.9 kgO2 / kw / hr  $25 \sim 50 \text{ HP}$ kgO2 / kw / hr 1.8  $60 \sim 150 \text{ HP}$ 1.7 kgO2/kw/hr 7. Required Power of Aerator : HP  $HP = N / (Ns \cdot Ef \cdot N0 \cdot 0.7457)$ Ef = Gear Reduction Factor  $5 \sim 20$  HP : Ef = 97.5 %  $25 \sim 150 \text{ HP}$  : Ef = 96.7 % N0 = Number of Aerator HP =432.1 kw = 72.0 kw/basin 11 kw х 3 units -----33 kw 22 kw 2 units х 44 kw 5 units/basin 77 kw/basin

Calculation of Mechanical Surface Aerator of Rangsit Wastewater Treatment Plant for Preliminary Engineering Design

1.	Do	sign Condition		
	a.	Design Flow		
		Daily Average	: Qa	21,350 m3/day
		Daily Maximum	: Qm	25,700 m3/day
	b.	Influent Quality (BOD)	: Qb	122.5 mg/l
	c.	BOD Removal Efficiency	: ε	83.7 %
	d.	Temperature	: T	25 °C

2. Influent BOD : Bw kg/day

 $\mathbf{Bw} = \gamma \cdot \mathbf{Qb} \cdot \mathbf{Qa} \cdot \mathbf{10^{(-3)}}$ 

 $\gamma$  = Load Factor = Daily Maximum(Qm) / Daily Average(Qa) Bw = 3,138 kg/day

3. Excluded BOD : Br kg/day

 $Br = Bw \cdot \varepsilon \cdot 10^{(-2)}$ Br = 2,627 kg/day

4. Supplied Oxygen in Operation : Na kgO2 / hr

 $Na = Br - \eta / 24$ 

 $\eta$  = Required Oxygen for Exclusion of Unit BOD kg = 0.8 Na = 87.6 kgO2/hr

5. Oxygen Transfer in Standard Condition : N kgO2 / hr

 $N = Na/\alpha \{(Csw-Cl)/Cs\}(1.024)^{(T-20)}$ 

 $\alpha$ : Oxygen Transfer into Wastewater/Oxygen Transfer into Pure Water = 0.8

- $Csw = \beta \cdot Css = 7.542 \text{ mg/l}$ 
  - $\beta$ : Oxygen Saturation in Wastewater / Oxygen Saturation in Pure Water = 0.9
- Css : Oxygen Saturation in Pure Water in T C = 8.38 mg/l
- Cl: Dissolved Oxygen = 2.0 mg/l

Cs: Oxygen Saturation in Pure Water in Standard Condition = 9.17 mg/l

Т: 25℃

(1.024)^(T-20) : 1.126

N = 204 kgO2 / hr

6. Supplied Oxygen per Motor Power of Aerator : Ns kgO2/kw/hr

$5 \sim 20 \text{ HP}$	•	1.9	kgO2 / kw / hr
$25\sim 50~\mathrm{HP}$	•	1.8	kgO2 / kw / hr
$60 \sim 150~\mathrm{HP}$	•	1.7	kgO2 / kw / hr

7. Required Power of Aerator : HP

 $HP = N / (Ns \cdot Ef \cdot N0 \cdot 0.7457)$ 

Ef = Gear Reduction Factor :  $5 \sim 20$  HP : Ef = 97.5 %

 $: 25 \sim 150 \text{ HP} : \text{Ef} = 96.7 \%$ 

N0 = Number of AeratorHP = 147.7 kw =

73.85 kw/basin

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	11	kw	x	3	units =	33	kw
L	22	kw	x	2	units =	44	kw
				5	units/basin	77	kw/basin

Hydraulic Calculation of Rangsit Treatment Plant

1. Design Condition

1) Design Wastewater Quantity

Preliminary Design	(m <sup>3</sup> /day)	(m <sup>3</sup> /min)	(m <sup>3</sup> /sec)
Daily Average	21,350	14.82	0.247
(Qdap)			
Daily Max.	25,700	17.85	0.298
(Qdmp)			
Hourly Max. (dry)	33,300	23.13	0.386
(Qhmdp)			
Hourly Max. (wet)	100,000	69.44	1.157
(Qhmwp)			ļ
Master Plan	(m <sup>3</sup> /day)	(m <sup>3</sup> /min)	(m <sup>3</sup> /sec)
Daily Average	62,500	43.40	0.723
(Qdam)			
Daily Max.	75,000	52.08	0.868
(Qdmm)			
Hourly Max. (dry)	97,500	67.71	1.129
(Qhmdm)			
Hourly Max. (wet)	292,500	203.13	3.386
(Qhmwm)			<u> </u>

2) Unit and Capacity of Treatment Facility

Unit of each treatment facility is as follows.

	U	nit
	Preliminary Design	Master Plan
Primary Sedimentation Tank	4	12
Aeration Tank	2	6
Final Sedimentation Tank	4	12
Disinfection Tank	1	1
Gravity Thickener	2	4
Digestion Tank (1st)	2	6
Digestion Tank (2nd)	2	6
Dewatering	1	1

### 3) Inlet Conduit

Conduit Size	1,600 mm x 1,600 mm
Gradient	0.1 %
Invert Elevation of Inlet Con-	duit MSL - 5.00 m

4) Design Grand Elevation

MSL + 2.5 m

5) Discharge

Discharge PointKhlong SonHWLMSL + 1.40Discharge ConduitSizeLength500 m

6) Formula for Hydraulic Calculation

Manning's Formula n = 0.013

2. Hydraulic Calculation

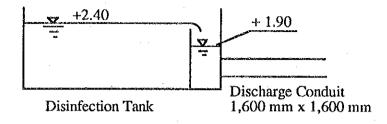
1).Water Level of Disinfection Tank Effluent Chamber (WL 1)

Design Water	$Qhmwm = 292,500 m3/day = 3.386 m^3/sec$
Velocity	V= 1.53 m/sec
Hydraulic Gradient	i= 0.09 %
Friction Loss	l=0.09 % x 500 m = 0.45 m

WL 1 = +1.40 + 0.45 = 1.85 say  $\pm 1.90$  m

2) Water Level of Disinfection Tank (WL 2)

Water Depth of Effluent Weir Width of Weir = 6.0 m $h = (Qhmwm / (1.84 \times 6.0))^{(2/3)} = 0.45 \text{ m}$ 



WL 2 = 1.90 + 0.45 = 2.35 say  $\pm 2.40$  m

3) Hydraulic Loss of Connection Pipe of D.T and F.S.T

Diameter $\emptyset$  500 mm x 6Length350 mDesign WaterQdmm =  $0.145 \text{ m}^3$ /secVelocityv = 0.745 m/secHydraulic Gradienti = 0.15 %Hydraulic Loss = 350 m x 0.15 % = 0.525 m

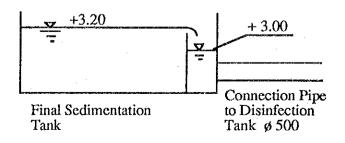
4) Water Level of Final Sedimentation Tank Effluent Chamber (WL 3)

WL 3 = +2.40 + 0.53 = +2.93 m say  $\pm 3.00$  m

5) Water Level of Final Sedimentation Tank (WL 4)

X

Water Depth of Effluent Triangle Weir Length of Weir = 55 m Design Water per unit weir long  $q = (Qdmm / 12) / 55 = 0.0013 \text{ m}^3 / \text{m} / \text{sec}$   $h = (q / 1.42)^{(2/5)} = 0.06 \text{ m}$ WL 4 = + 3.00 + 0.06 =+ 3.06 say + 3.20



6) Hydraulic Loss of Connection Pipe of F.S.T and Aeration Tank

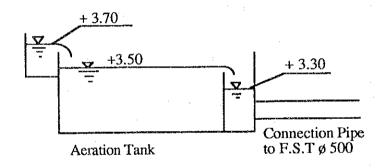
Diameter	ø 500 mm
Length	40 m
Design Water	$Qdmm / 6= 0.868 m^3 / sec / 6 = 0.145 m^3 / sec$
Velocity	v = 0.745  m / sec
Hydraulic Gradient	i = 0.15 %
Hydraulic Loss = 40	$m \ge 0.15 \% = 0.06 m$

7) Water Level of Aeration Tank Effluent Chamber (WL 5)

WL 
$$5 = +3.20 + 0.06 = +3.26$$
 say  $+3.30$  m

8) Water Level of Aeration Tank (WL 6)

Water Depth of Effluent Weir Width of Weir = 3 m  $h = (Odmm/6/(1.84 \times 3.0))^{(2/3)} = 0.088 \text{ m}$ 



WL 6 = +3.30 + 0.09 = +3.39 say +3.50 m

9) Water Level of Aeration Tank Influent Chamber (WL 7)

Water Depth of Influent Weir Width of Weir = 3.0 m  $h = (Qdmm / 6 / (1.84 \times 3)) \wedge (2/3) = 0.088 \text{ m}$ 

WL 7 = +3.50 + 0.09 = +3.59 say +3.70 m

10) Hydraulic Loss of Connection Pipe of A.T to P.S T

Diameter

ø 500 mm

Length40 mDesign Water $Qdmm / 6= 0.868 \text{ m}^3 / \sec / 6 = 0.145 \text{ m}^3 / \sec$ Velocity $v = 0.745 \text{ m} / \sec$ Hydraulic Gradienti = 0.15 %Hydraulic Loss = 40 m x 0.15 % = 0.06 m

11) Water Level of Primary Sedimentation Tank Effluent Chamber (WL 8)

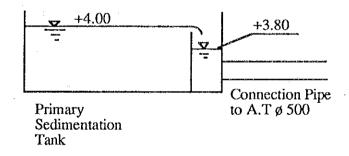
WL 8 = +3.70 + 0.06 = +3.76 say +3.80 m

12) Water Level of Primary Sedimentation Tank (WL 9)

Water Depth of Effluent Weir

Triangle Weir Width = 50 m Design Water per unit weir long  $q = (Qdmm / 12) / 50 = 0.00145 \text{ m}^3 / \text{m} / \text{sec}$  $h = (q / 1.42) \land (2/5) = 0.06 \text{ m}$ 

WL 9 = +3.80 + 0.06 = +3.86 say +4.00 m



13) Hydraulic Loss of Connection Pipe of P.S T to Distribution Tank

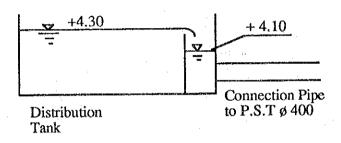
14) Water Level of Distribution Tank Effluent Chamber (WL 10)

### WL 10 = +4.00 + 0.04 = +4.04 say +4.10 m

15) Water Level of Distribution Tank (WL 11)

Water Depth of Effluent Weir Weir Width = 1.0 m  $h = (Qdmm / 12 / (1.84 \times 1.0)^{(2/3)} = 0.115 m$ 

WL 11 = +4.10 + 0.115 = +4.215 say  $\pm 4.30$  m



2.9.1.1 Unit Construction Cost of Wastewater Collection Facilities

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Unit Construction Cost of Interceptors Table 2.9.1.1 (1)-1

Diameter (mm)	300	400	500	600	800	1000	1200	1500
(1) Quantity								
Earth Covering Depth (m)		•	- A	<mark>ה. ה</mark>	1.5	1.5	1.5	•
Outer of Diameter (m)	0.40	0.52	0.64			1.22		1.80
Width of Excavation (m)	0	렵	2	e,	ŝ	ω.	0	4
Excavation Depth (m)	٩	님	e,	4	٢.	۰.	Ϋ́	5
Sheetpile Length (m)	1	2	4	ø	<b>-</b>	4.54	4.97	5.63
Volume of Pavement (m3)	0.35	Ϋ́.	4.	4	പ	9.	5	°0
Excavation (Backhoe m3)	0	4	ω.	2	<u></u>	്ഗ	5	0
Backfill (granular m3)	ഹ	٢.	ω,	<b>σ</b>	~	9	റ	ഹ
Backfill (original m3)	16.0	1.07	1.25	1.42	1.85	2.34	2.89	3.86
Backfill (selected soil m3)	Ч.	2		4.	9.	റ	Ċ1	ю.
Residual Soil (m3)	۰.	е.	ŝ		ഹ	-4	б.	Ч.
Pavement (m2)	9.	5	ω.	<u>ں</u>	4	4	9	٩,
Sheetpile Length (m)	1	Ч.	2	ო	ഗ	٢.	ω,	-
Sheetpile (kg)	t .	5.2	8.0	8.4	6.4	9.6	2.8	2-1
Bracing (kg)	1.	4	6	~	201	(M)	ហ	616
(2) Construction Cost (Baht/m)								
Unit Cost					÷			
Excavation (Backhoe) 60.0		4	71.	57	61.	e	07.	40.
(granular) 3	171.0		252.0	294.0	384.0		582.0	750.0
Backfill (original) 60.0	4.	64.	ۍ	ີ. ເກ		40.	73.	31.
Backfill (selected soil) 300.0		2	ე	6.	98.	19.	72.	40.
Residual Soil 30.0	~	0	ά	ч С	75.	с С	17.	54.
Pavement 400.0	40.	88.	36.	80.	76.	68.	,060.	,200.
Sheetpile (kg) 3.2	I	<u>.</u>	,649.	,810.	,156.	,486.	17.	23.
Bracing (kg) 5.1	1	,274.	51.	32	555.	03.	, 845 .	,141.
Pipe/Laying 1 1s	•	•	•	م	്റ	5	т. С	~
Dewatering/Others 1 1s	7.6	ະ. ເ	9.5	10.9	12.7	12	19.0	25.4
Total	1,329.9	6,335.7	6,830.2	7,302.2	8,408.3	9,765.0	11,036.6	13,608.6

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Unit Construction Cost of Interceptors

Table 2.9.1.1 (1)-2

Diameter (mm)	300	400	500	600	800	1000	1200	1500
(1) Quantity								
Earth Covering Depth (m)	2.0		2	2.0				
Outer of Diameter (m)	4.	ς,	Ŷ,	٢.	ი.	2	4	Υ
Width of Excavation (m)	0.	Ч.	2	<u>е</u>	ы С	ω.	0	94
Excavation Depth (m)	<u>ى</u>	ف	α.	ი,	2	in.	0	<u>``</u>
Sheetpile Length (m)	3.75	3.98	4.20	4.41	4.86	•	5	1 0
Volume of Pavement (m3)	m.	<u></u> .	4	4.	<u></u> .	0.64	0.72	0.84
Excavation (Backhoe m3)	ഗ	•	4	თ.		4		<u>`</u> ر
Backfill (granular m3)	υ.	٢.	8,	6	2	9	0	- C
	1.41	1.63	1.87	2.10	2.65	3.25	3.92	
Backfill (selected soil m3)		2	ς.	4	မ	σ.	2	°.
	0.	۳.	.6	æ,	្ល	-	o.	Ч
	9.	ſ.	ŝ	<u>م</u>	Ч	4	φ.	0
Sheetpile Length (m)	8.1	ი.	٩,	2.0		4	8.6	б
-	<b>0</b> .	5.2	8.0	4.	4.	9.6	ω.	2
Bracing (kg)	N I	446	461		0	ŝ	55	61
(2) Construction Cost (Baht/m)								
Unit Cost								
()	50.	78.	80	38. 38.	. 60	85°	69	· •
(granular)	171.0	ო	252.0	294.0	384.0	480.0	582.0	
Backfill (original) 60.0	4	-	12.	26.	50.0	95	321	8 6
(selected soil) 3	Н		ം റ	26.	86	5	72.	
Soil	2	0	с. С	ю.	75.	95.	17	5 - 4 4 
40	40.	88.	36.	80.	76.	68.	,060.	.200.
Sheetpile (kg) 3.2	2,880.0	6	in.	6	•	062.	93.	66
Bracing (kg) 5.1	152.	,274.	, 351.	,432.	, 555	03 -	,845.	,141.
Pipe/Laying 1 ls	253.0	•	•	ი ი	თ			~
Dewatering/Others 1 1s	7.6	8.0	9.5	10.9	12.7		19	25
Total	6,422.1	6,978.9	7,480.6	7,959.8	9,080.3	10,450.2	11,736.2	14,328.6

Unit Construction Cost of Interceptors Table 2.9.1.1 (1)-3

7.46 5.14 3.00 39.40 750.0 447.6 540.0 3.0 1.80 2.40 5.25 7.88 0.84 12.60 2.50 616 756.0 154.2 25-4 1,200.0 6,051.8 2,702.0 15,768.6 1,891.20 3,141.6 1500 3.0 1.45 2.05 81 81 592.2 372.0 9.87 358.2 7.22 5.97 1.24 3.90 36.10 558 582.0 117.0 19.0 0.72 1.94 2.65 1,732.80 1,060.0 5,545.0 2,845.8 1,643.0 13,134.2 1200 968.0 3.0 1.82 4.53 6.79 0.64 8.24 1.60 5.07 0.93 3.17 2.42 530 494.4 480.0 304.2 279.0 95.1 15.2 11,820.6 1.22 1,629.60 1,267.0 5,214.7 2,703.0 1000 404.4 198.0 75.0 876.0 779.0 12.7 1.59 4.24 6.36 0.56 4.24 0.66 2.50 2.19 31.80 0.99 6.74 1.28 384.0 254.4 1,526.40 501 4,884.5 10,423.1 2,555.1 800 207.0 о. С 0.75 1.35 3.94 5.91 0.47 5.32 0.98 3.45 0.42 1.95 29.55 294.0 126.0 780.0 319.2 509.0 10.9 9,273.8 477 56. I 1,418.40 4,538.9 2,432.7 600 1.84 28.50 282.6 252.0 186.6 99.0 439.0 48.0 736.0 1.24 3.80 5.70 0.43 4.71 0.84 0.33 1.60 9.5 .5 о. е 0.64 3.11 1,368.00 461 4,377.6 8,781.4 2,351.1 500 4.09 0.71 2.75 0.24 1.34 1.315.20 213.0 165.0 72.0 688.0 о. С 0.52 1.12 3.65 5.48 0.39 40.2 350.0 8. 5 245.4 8,265.3 446 4,208.6 2,274.6 400 1.60 144.6 32.7 640.0 253.0 7.6 3.0 1.00 3.50 5.25 0.35 0.17 4,032.0 2,152.2 0.40 3.50 0.57 2.41 422 210.0 171.0 51.0 1,260.00 7,694.1 300 60.0 300.0 60.0 300.0 30.0 400.0 5 N N N Unit Cost Ls Ls -1 H Backfill (selected soil m3) Construction Cost (Baht/m) Earth Covering Depth (m) Backfill (selected soil) (uuu) Width of Excavation (m) Volume of Pavement (m3) Excavation (Backhoe m3) Backfill (granular m3) Backfill (original m3) Outer of Diameter (m) Sheetpile Length (m) Excavation Depth (m) Sheetpile Length (m) Excavation (Backhoe) Diameter Backfill (granular) Backfill (original) Residual Soil (m3) Dewatering/Others Total Sheetpile (kg) Sheetpile (kg) Pavement (m2) Residual Soil Bracing (kg) Bracing (kg) Pipe/Laying Quantity Pavement 3 (7

(1)-4 Unit Construction Cost of Interceptors

Table 2.9.1.1

591.6 4.0 2.40 9.38 0.84 2.50 9.86 540.0 154.2 1.80 6.25 15.00 1.80 900.006 750.0 5:14 3.00 46.90 616 1,200.0 7,203.8 2,251.20 3,141.6 2,702.0 25.4 17,208.6 1500 481.2 4.0 582.0 372.0 1.45 2.05 5.81 8.72 0.72 117.0 11.92 1.94 8.02 1.24 3 90 2.65 43.60 558 19.0 2,092.80 715.2 1,060.0 6,697.0 1,643.0 14, 532.2 2,845.8 1200 1.22 603.6 480.0 413.4 279.0 4 5.53 8.29 64 64 968.0 1.82 10.06 1.60 6.89 0.93 3.17 2.42 41.45 530 95.1 1,989.60 6,366.7 2,703.0 1,267.0 15.2 13,191.0 1000 4.0 0.99 5.24 0.56 0.56 8.33 1.28 5.83 0.66 2.50 2.19 384.0 876.0 39.30 501 499.8 349.8 198.0 75.0 0.677 6,036.5 1,886.40 11,765.9 12.7 2,555.1 800 4.0 4.94 4.80 1.35 7.41 0.98 0.42 1.95 37.05 294.0 780.0 0.47 1.87 400.2 6.67 1,778.40 477 288.0 126.0 56 1 509.0 10.9 10,587.8 5,690.9 2,432.7 600 4.0 0.64 1.24 4.80 7.20 0.84 4.35 0.33 1.60 1.84 36.00 357.0 252.0 5.95 0.66 439.0 461 261.0 48.0 പ്പാ 1,728.00 736.0 5,529.6 2,351.1 10,082.2 500 0.52 1.12 4.65 6.98 0.39 0.24 1.72 34.90 213.0 232.2 350.0 8.5 4.0 5.21 3.87 1.34 1,675.20 446 312.6 72.0 688 . 0 0.71 40.2 5,360.6 9,551.7 2,274.6 400 1.60 33.75 4.0 0.40 1.00 4.50 6.75 0.35 4.50 3.41 0.17 1.09 204.6 51.0 32.7 640.0 422 270.0 171.0 1,620.00 253.0 5,184.0 7.6 2,152.2 8,966.1 300 60.0 300.0 60.0 300.0 30.0 400.0 Unit Cost 1 18 1 18 Backfill (selected soil m3) (2) Construction Cost (Baht/m) Earth Covering Depth. (m) (selected soil) Ē Width of Excavation (m) Volume of Pavement (m3) Excavation (Backhoe m3) Backfill (granular m3) Backfill (original m3) Outer of Diameter (m) Excavation Depth (m) Sheetpile Length (m) Sheetpile Length (m) Excavation (Backhoe) Diameter Backfill (original) Backfill (granular) Residual Soil (m3) Dewatering/Others Total Sheetpile (kg) Sheetpile (kg) (m2) Residual Soll Bracing (kg) Sracing (kg) Pipe/Laying Pavement Backfill Quantity Pavement Ĵ

2-40

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Unit Construction Cost of Interceptors

Table 2.9.1.1 (1)-5

2

1.80 2.40 7.25 10.88 750.0 735.6 540.0 5.0 12.26 1.80 154.2 17.40 5.14 3.00 54.40 616 1,044.0 25.4 1,200.0 8,355.8 3,141.6 2,702.0 18,648.6 2,611.20 1500 838.2 582.0 372.0 7,849.0 5.0 1.45 117.0 2.05 13.97 1.94 10.07 558 604.2 6.81 10.22 0.72 1.24 3.90 2.65 51.10 2,452.80 1,060.0 19.0 15,930.2 2,845.8 1,643.0 1200 9.79 2.42 48.95 522.6 0. 0 1.82 6.53 11.88 712.8 480.0 95.1 968.0 8.71 0.93 3.17 279.0 1.22 530 2,703.0 1,267.0 15.2 14,561.4 2,349.60 7,518.7 1000 7.42 0.66 2.50 2.19 46.80 198.0 75.0 5.0 0.90 9.79 0.78 0.78 0.78 0.78 876.0 9.92 1.28 384.0 445.2 501 595.2 779.0 2,246.40 7,188.5 13,108.7 2,555.1 12. 800 5.0 5.0 7.9 7.9 8.9 8.9 1.4 8.9 1.4 0.42 1.87 1.95 44.55 369.0 126.0 6.15 481.2 294.0 780.0 8.02 0.98 56.1 509.0 10.9 0.47 2,138.40 477 6,842.9 11,901.8 2,432.7 600 1.84 5.0 0.64 5.80 8.70 5.59 431.4 252.0 335.4 439.0 9.5 1.24 7.19 0.33 1.60 0.43 2,088.00 461 99.0 48.0 736.0 11,383.0 6,681.6 2,351.1 500 72.0 40.2 688.0 350.0 0 0 5.65 8.48 0.39 1.72 446 0.52 1.12 6.33 0.71 4.99 0.24 213.0 299.4 1.34 2,035.20 379.8 6,512.6 2,274.6 8.5 10,838.1 400 0.17 1.09 1.60 41.25 1,980.00 5.0 0.40 1.00 5.50 8.25 0.35 5.50 171.0 264.6 51.0 640.0 6,336.0 2,152.2 4.41 330.0 32.7 253.0 7.6 10,238.1 300 60.0 300.0 300.0 300.0 400.0 Unit Cost rs Ls Backfill (selected soil m3) (2) Construction Cost (Baht/m) Earth Covering Depth (m) Backfill (selected soil) Diameter (mm) Width of Excavation (m) Volume of Pavement (m3) Excavation (Backhoe m3) Backfill (granular m3) Backfill (original m3) Outer of Diameter (m) Excavation Depth (m) Sheetpile Length (m) Sheetpile Length (m) Excavation (Backhoe) Backfill (original) Backfill (granular) Residual Soil (m3) Dewatering/Others Total Sheetpile (kg) Sheetpile (kg) Pavement (m2) Residual Soil Bracing (kg) Bracing (kg) Pipe/Laying (1) Quantity Pavement

Туре	Manhole Hight	Construction Cost
		( Baht/Unit )
	2 m	11,480
NO.1	3 m	12,690
	4 m	13,890
	5 m	15,110
	2 m	14,680
NO.2	3 m	15,880
	4 m	17,080
	5 m	18,290
	2 m	18,070
NO.3	3 m	19,270
	4 m	20,470
	5 m	21,700
······································	2 m	24,420
NO.4	3 m	25,620
	4 m	26,820
	5 m	28,020
NO.5	4 m	35,660

# Table 2.9.1.1 (2) Unit Construction Cost of Manhole

Table 2.9.1.1 (3) Unit Costruction Cost of Overflow Chamber

Type of Overflow Chamber	Construction Cost ( Baht/Unit )
B	24,150
. C	18,700

# 2.9.1.2 Direct Construction Cost by Major Facilities

# Table 2.9.1.2 (1) Construction Cost of Interceptors

Diameter (mm)	Average Earth Covering Depth (m)	Length of Sewer (m)	Unit Construction Cost (Baht/m)	Construction Cost { x 1,000 Baht}
ø300	1.5	755	1,329.9	1,00
	2	320	6,422.1	2,05
	Sub-total	1,075		3,06
ø400	1.5	1,200	6,335.7	7,60
	2	350	6,978.9	2,44
	5	65	10,838.1	70
	Sub-total	1,615		10,75
ø500	2	1,210	7,480.6	9,052
	4	240		2,420
	Sub-total	1,450		11,47
ø600	1.5	550	7,302.2	4,01
	3	1,110	9,273.8	10,294
··· •·· •·· •·· •·· •· •· •· •· •· •· •·	Sub-total	1,660		14,31
ø800	1.5	770	8,408.3	6,47
	3	750	10,423.1	7,81
	4	840	11,765.9	9,88
	5	460	13,108.7	6,03
	Sub-total	2,820		30,20
ø1000	1.5	2,090	9,765.0	20,40
	3	1,620	11,820.6	19,15
· .	5	530	14,561.4	7,71
	Sub-total	4,240		47,27
ø1200	1.5	50	11,036.6	552
	2	1,440	11,736.2	16,901
	3	700	13,134.2	9,194
	4	423	14,532.2	6,148
· · ·	Sub-total	2,613		32,79
ø1500	1.5	920	13,608.6	12,520
	2	290	14,328.6	4,150
	5	580	18,648.6	10,817
	Sub-total	1,790		27,493
<b>1600</b>	4	1,690	19,804.1	33,469
	. 5	680	21,268.1	14,463
	Sub-total	2,370	·	47,932
	Total	19,633		225,300

### Table 2.9.1.2 (2)

### Construction Cost of Manhole

Type of Mahole	Manhole Hight (m)	Nos. of Manhole	Unit Construction Cost (Baht/unit)	Construction Cost ( x 1,000 Baht)
No.1	2	75	11,480	86
	3	39	12,690	49
	4	38	13,890	52
	5	24	15,110	36
	Sub-total	176		2,24
No.2	3	1	15,880	1
	4	21	17,080	35
	5	17	18,290	31
	Sub-total	39		68
No.3	3	21	19,270	40
	4	78	20,470	1,59
	5	21	21,700	45
	Sub-total	120		. 2,45
No.4	3	12	25,620	30
·	5	11	28,020	30
	Sub-total	23		61
	Total	358		6,00

# Table 2.9.1.2 (3) Cor

# Construction Cost of Overflow Chamber ( Rangsit )

Type of Overflow Chamber Ove	No. of erflow Chamber	Unit Construction Cost ( Baht/unit )	Construction Cost ( x 1,000 Baht )
		· · · · · ·	
В	6	24,150	145
с	16	18,700	299
Total	22		444

# Table 2.9.1.2 (4)-1 Construction Cost of Inverted Siphon

# 1 - 5 ( No.1 )

				Construction	on Cost (x 1	,000Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
Excavation	(m3)	2,244	60	135		13
Backfill (Granular)	(m3)	13.36	300	4		ų
Backfill (Soil)	(m3)	1,621	60	97		97
Sheet Pile	(kg)	83,798	3.2	268		268
Rubble Stone	(m3)	19.94	400	8		8
Piling	(piece)	157	1,900	298		298
Concrete	(m3)	361.59	4,658	1,684		1,684
Lean Concrete	(m3)	4.98	1,950	10		10
Reinforced Steel Bar	(kg)	32,540	12	390		3.90
Form Work	(m2)	629.96	300	189		189
Cover	(unit)	8	7,000	56		5€
Screen ( 1.9m x 2.85m )	(unit)	1			282	282

### 6 - 13 ( No.2 )

Item		Quantity	Unit Cost (Baht)	Construction Domestic Portion	on Cost (x 1 Foreign Portion	,000Baht) Total
Excavation	(m3)	2,129	60	128		128
Backfill (Granular)	(m3)	33,96	300	10		10
Backfill (Soil)	(m3)	1,920	60	115		-115
Sheet Pile	(kg)	86,880	3.2	278		278
Rubble Stone	(m3)	34.69	400	14		14
Piling	(piece)	128	1,900	243		243
Concrete	(m3)	264.18	4,658	1,231		1,231
Lean Concrete	(m3)	8.67	1,950	17		17
Reinforced Steel Bar	(kg)	23,780	12	285		285
Form Work	(m2)	680.37	300	204		204
Cover	(unit)	8	7,000	56		. 56
Screen ( 1.6m x 2.45m )	(unit)	1			238	238
		Total		2,581	238	2,819

# Table 2.9.1.2 (4)-2 Construction Cost of Inverted Siphon

6 -	16	{	No.3	)
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Item		Quantity	Unit Cost (Baht)	Constructi Domestic Portion	on Cost (x 1, Foreign Portion	000Baht) Total
Excavation	(m3)	1,572	60	94		94
Backfill (Granular)	(m3)	16.32	300	5	* .	5
Backfill (Soil)	(m3)	1,205	60	72		. 72
Sheet Pile	(kg)	57,216	3.2	183		183
Rubble Stone	(m3)	26.99	400	11		11
Piling	(piece)	100	1,900	190		190
Concrete	(m3)	204.54	4,658	953		953
Lean Concrete	(m3)	6.75	1,950	13		13
Reinforced Steel Bar	(kg)	18,140	12	218		218
Form Work	(m2)	539.18	300	162		162
Cover	(unit)	8	7,000	56		56
Screen ( 1.6m x 2.45m )	(unit)	1	· · ·		238	238
		Total		1,957	238	2,195

### 7 - 3 ( No.4 )

				Constructi	on Cost (x 1,	000Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
Excavation	(m3)	1,424	60	85	•	85
Backfill (Granular)	(m3)	9.327	300	3		3
Backfill (Soil)	(m3)	1,202	60	72		~ 72
Sheet Pile	(kg)	66,528	3.2	213		213
Rubble Stone	(m3)	20.32	400	8		8
Piling	(piece)	78	1,900	148		148
Concrete	(m3)	141.60	4,658	660	-	660
Lean Concrete	(m3)	5.08	1,950	10		10
Reinforced Steel Bar	(kg)	12,750	12	153		153
Form Work	(m2)	398.13	300	119		119
Cover	(unit)	. 8	7,000	56		56
Screen ( 0.9m x 1.65m )	(unit)	1_			133	133
		Total		1,527	133	1,660

Table 2.9.1.2 (5)-1 Construction Cost of Pump Station

No.1

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				Construct	on Cost (x1,00	0 Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
1) Civil and Architecture	Work		3,994-45-97-9-1-1	₩₽₽₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩₩		
Excavation	(m3)	2,345	60	141		14
Backfill (Granular)	(m3)	21,08	300	6		
Backfill (Soil)	(m3)	1,272	60	76		7
Sheet Pile	(kg)	88,512	3.2	283		28
Bracing	(kg)	1,134.77	5.2	6		
Rubble Stone	(m3)	34.14	400	14		1
Piling	(m)	133	3,800	505		50
Concrete	(m3)	1,134.77	4,658	5,286		5,28
Lean Concrete	(m3)	8.54	1,950	17		1
Reinforced Steel Bar	(kg)	54,200	12	650		65
Form Work	(m2)	1,249.7	300	375		37
Architecture	(LS)			175		17
	Sub-total o	f 1)		7,534		7,53
) Mechanical and Electric	cal Works					•
Screen (1.2m x 2.3m)	(unit)	2	178		356	35
Gate (1.2m x 1.2m)	(unit)	2	251		502	50
Pump (ø400mm x 22kw)	(unit)	1	1,905		1,905	1,90
Pump (ø600mm x 45kw)	(unit)	2	2,619		5,238	5,23
Piping and Valves	(LS)				1,429	1,42
Instrumentation	(LS)				2,143	2,14
Installation	(LS)				1,429	1,42
	Sub-total o	f 2)			13,001	13,00
	Total	····		7,534	13,001	20,53

No.2

				Construct	ion Cost (x1,00	00 Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
1) Civil and Architecture	e Work		· · ·			
Excavation	(m3)	2,345	60	141		141
Backfill (Granular)	(m3)	21.08	300	6		6
Backfill (Soil)	(m3)	1,272	60	76		76
Sheet Pile	(kg)	88,512	3.2	283		283
Bracing	(kg)	1,135	5.2	6		6
Rubble Stone	(m3)	34.14	400	14		14
Piling	(m)	133	3,800	505		505
Concrete	(m3)	1,134.77	4,658	5,286		5,286
Lean Concrete	(m3)	8.54	1,950	. 17		17
Reinforced Steel Bar	(kg)	54,200	12	650		650
Form Work	(m2)	1,249.7	300	375		375
Architecture	(LS)	•		175		175
	Sub-total of	5 1)		7,534		7,534
2) Mechanical and Electri	cal Works					
Screen (1.2m x 2.3m)	(unit)	2	178		356	356
Gate (1.2m x 1.2m)	(unit)	2	251		502	502
Pump (ø500mm x 30kw)	(unit)	1	2,413		2,413	2,413
Pump (ø600mm x 45kw)	(unit)	2	2,619		5,238	5,238
Piping and Valves	(LS)		•		1,530	1,530
Instrumentation	(LS)				2,295	2,295
Installation	(LS)				1,530	1,530
· · · · · · · · · · · · · · · · · · ·	Sub-total of	2)	5,461		13,865	13,865
	Total			7,534	13,865	21,399

### Table 2.9.1.2 (5)-2

2) Mechanical and Electrical Works

(unit)

(unit)

(unit)

(LS)

(LS)

(LS)

Sub-total of 2)

Total

Screen (1.0m x 2.4m)

Pump (ø300mm x 11kw)

Gate (1.Gm x 1.Om)

Piping and Valves

Instrumentation

Installation

No.3

					ion Cost (x1,00	0 Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
1) Civil and Architecture Wo	ork				· · · · · · · · · · · · · · · · · · ·	
Excavation	(m3)	78.89	60	5		4
Backfill (Sand)	(m3)	60,35	300	18		1
Sheet Pile	(kg)	19,008	3.2	61		6
Bracing	(kg)	2,085	5.2	11		1
Rubble Stone	(m3)	0.67	400	0.3		.0,
Concrete	(m3)	6,28	4,658	29		2
Lean Concrete	(m3)	0.17	1,950	0.3		0.
Form Work	(m2)	74.5	300	22		2
S	ub-total o	f 1)		147		14
2) Mechanical and Electrical	Works					
Pump (ø150mm x 5.5kw)	(unit)	2	62		124	12
Piping and Valves	(LS)				25	2
Instrumentation	(LS)				37	3
Installation	(LS)				25	2
S	ub-total o	£2)			211	21
-						
	Total			147	211	35
10.5	Total	· · · · · · · · · · · · · · · · · · ·		147	211	351
	Total	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·		211 on Cost (x1,000	
	Total	Quantity	Unit Cost (Baht)		· · ·	
lo.5 Item		Quantity		Constructi Domestic	on Cost (x1,00) Foreign	) Baht)
lo.5 Item		Quantity 1,847		Constructi Domestic	on Cost (x1,00) Foreign	) Baht)
lo.5 Item L) Civil and Architecture Wo	ork		(Baht)	Constructi Domestic Portion	on Cost (x1,00) Foreign	) Baht) Total
Item Item I) Civil and Architecture Wo Excavation	ork (m3)	1,847	(Baht) 60	Constructi Domestic Portion 111	on Cost (x1,00) Foreign	) Baht) Total 11 1:
Item I) Civil and Architecture Wo Excavation Backfill (Granular)	rk (m3) (m3)	1,847 43.20	(Baht) 60 300	Constructi Domestic Portion 111 13	on Cost (x1,00) Foreign	) Baht) Total 11 1: 5
Item I) Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil)	rk (m3) (m3) (m3)	1,847 43.20 931	(Baht) 60 300 60	Constructi Domestic Portion 111 13 56	on Cost (x1,00) Foreign	) Baht) Total 11 1: 5: 29:
Item I) Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil) Sheet Pile	ork (m3) (m3) (m3) (kg)	1,847 43.20 931 92,160	(Baht) 60 300 60 3.2	Constructi Domestic Portion 111 13 56 295	on Cost (x1,00) Foreign	) Baht) Total 11 1: 5: 293
Item I) Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil) Sheet Pile Bracing	ork (m3) (m3) (m3) (kg) (kg)	1,847 43.20 931 92,160 820.58	(Baht) 60 300 60 3.2 5.2	Constructi Domestic Portion 111 13 56 295 4	on Cost (x1,00) Foreign	) Baht) Total 11 1: 5: 29: 1
To.5 Item Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil) Sheet Pile Bracing Rubble Stone	ork (m3) (m3) (m3) (kg) (kg) (kg) (m3)	1,847 43.20 931 92,160 820.58 25.37	(Baht) 60 300 60 3.2 5.2 400	Constructi Domestic Portion 111 13 56 295 4 10	on Cost (x1,00) Foreign	) Baht) Total 11 15 29 1 1 36
Item I) Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil) Sheet Pile Bracing Rubble Stone Piling	ork (m3) (m3) (m3) (kg) (kg) (m3) (m)	1,847 43.20 931 92,160 820.58 25.37 95	(Baht) 60 3.0 60 3.2 5.2 400 3,800	Constructi Domestic Portion 111 13 56 295 4 10 361	on Cost (x1,00) Foreign	) Baht) Total 11 1 5 29 1 36 3,72
To.5 Item Item Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil) Sheet Pile Bracing Rubble Stone Piling Concrete	ork (m3) (m3) (m3) (kg) (kg) (m3) (m) (m3)	1,847 43.20 931 92,160 820.58 25.37 95 799.94	(Baht) 60 3.0 60 3.2 5.2 400 3,800 4,658	Constructi Domestic Portion 111 13 56 295 4 10 361 3,726	on Cost (x1,00) Foreign	) Baht) Total 11 1 5 29 1 36 3,72 1
Item I) Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil) Sheet Pile Bracing Rubble Stone Piling Concrete Lean Concrete	ork (m3) (m3) (m3) (kg) (kg) (m3) (m3) (m3)	1,847 43.20 931 92,160 820.58 25.37 95 799.94 6.34	(Baht) 60 3.0 60 3.2 5.2 400 3,800 4,658 1,950	Constructi Domestic Portion 111 13 56 295 4 10 361 3,726 12	on Cost (x1,00) Foreign	) Baht) Total 11 1 5 29 1 1 36 3,72 1 2 46
Item I) Civil and Architecture Wo Excavation Backfill (Granular) Backfill (Soil) Sheet Pile Bracing Rubble Stone Piling Concrete Lean Concrete Reinforced Steel Bar	ork (m3) (m3) (m3) (kg) (kg) (m3) (m3) (m3) (kg)	1,847 43.20 931 92,160 820.58 25.37 95 799.94 6.34 38,350	(Baht) 60 300 60 3.2 5.2 400 3,800 4,658 1,950 12	Constructi Domestic Portion 111 13 56 295 4 10 361 3,726 12 460	on Cost (x1,00) Foreign	) Baht) Total

2

2

2

142

200

1,262

284

400

585

877

585

5,255

5,255

5,472

2,524

284

400

585

877

585

5,255

10,727

2,524

# Table 2.9.1.2 (5)-3 Construction Cost of Pump Station

No.6

				Const ruct i	on Cost (x1,00	0 Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
1) Civil and Architecture	Work					
Excavation	(m3)	2,105	60	126		126
Backfill (Granular)	(m3)	51.84	300	16		16
Backfill (Soil)	(m3)	1,012	60	61		61
Sheet Pile	(kg)	102,240	3.2	327		327
Bracing	(kg)	905.44	5.2	5		5
Rubble Stone	(m3)	26,54	400	11		11
Piling	(m)	102	3,800	388		388
Concrete	(m3)	905.44	4,658	4,218		4,218
Lean Concrete	(m3)	6.64	1,950	13		13
Reinforced Steel Bar	(kg)	44,220	12	531		531
Form Work	(m2)	1,123.5	300	337		337
Architecture	(LS)			122		122
	Sub-total o	f 1)		6,155		6,155
?) Mechanical and Electric	al Works					
Screen (1.0m x 2.4m)	(unit)	2	142		284	284
Gate (1.0m x 1.0m)	(unit)	2	200		400	400
Pump (ø300mm x 15kw)	(unit)	2	1,357		2,714	2,714
Piping and Valves	(LS)		·		623	623
Instrumentation	(LS)				934	934
Installation	(LS)				623	623
	Sub-total o	f 2) .			5,578	5,578
3 <b></b>	Total			6,155	5,578	11,733

No.7

				Construct	lon Cost (x1,00	0 Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
1) Civil and Architecture W	lork			· · · · · · · · · · · · · · · · · · ·		
Excavation	(m3)	2,345	60	141	•	14
Backfill (Granular)	(m3)	21.08	300	6		I
Backfill (Soil)	(m3)	1,272	60	76		7
Sheet Pile	(kg)	88,512	3.2	283		28
Bracing	(kg)	1,134.77	5.2	6		1
Rubble Stone	(m3)	34.14	400	14		1.
Piling	(m)	133	3,800	505		50
Concrete	(m3)	1,134.77	4,658	5,286		5,28
Lean Concrete	(m3)	8,54	1,950	17		1
Reinforced Steel Bar	-(kg)	54,200	12	650		65
Form Work	(m2)	1,249.7	300	375		37
Architecture	(LS) .			175		17
	Sub-total o	f 1)		7,534		7,534
?) Mechanical and Electrica	l Works					
Screen (1.2m x 2.3m)	(unit)	2	178		356	35
Gate (1.2m x 1.2m)	(unit)	2	251		502	50:
Pump (ø350mm x 15kw)	(unit)	2	1,667		3,334	3,334
Piping and Valves	(LS)				767	76
Instrumentation	(LS)				1,151	1,15
Installation	(LS)				767	76
	Sub~total o	f 2)			6,877	6,87
, , . , . , . ,	 Total			7,534	6,877	14,41

# Table 2.9.1.2 (5)-4 Construction Cost of Pump Station

No.11

•				Constructi	on Cost (x1,00	) Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
) Civil and Architecture	Work					
Excavation	(m3)	1,455	60	87		87
Backfill (Granular)	(m3)	22.71	300	7		7
Backfill (Soil)	(m3)	676	60	41		41
Sheet Pile	(kg)	82,944	3.2	265		265
Bracing	(kg)	542.48	5.2	3		3
Rubble Stone	(m3)	19.83	400	. 8		8
Piling	(m)	72	3,800	274		274
Concrete	(m3)	542.48	4,658	2,527	· · ·	2,527
Lean Concrete	(m3)	4.96	1,950	10		10
Reinforced Steel Bar	(kg)	31,430	12	377		37
Form Work	(m2)	811.5	300	243		243
Architecture				90		. 90
	Sub-total o	of 1)		3,932		3,932
2) Mechanical and Electri	cal Works					
Screen (0.8m x 1.8m)	(unit)	2	119		238	238
Gate (0.8m x 0.8m)	(unit)	2	167		334	. 334
Pump (g200mm x 5,5kw)	(unit)	2	809		1,618	1,618
Pump (ø350mm x 7.5kw)	(unit)	2	1,500		3,000	3,000
Piping and Valves	(LS)				924	924
Instrumentation	(LS)				1,385	1,385
Installation	(LS)				924	924
	Sub-total c	of 2)			8,423	8,423
	Total			3,932	8,423	12,35

				Constructi	on Cost (x1,000	Baht)
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
1) Civil and Architecture Wo	ork				•	
Excavation	(m3)	1,455	60	87		87
Backfill (Granular)	(m3)	22,71	300	7	1. A.	7
Backfill (Soil)	(m3)	676	60	41		41
Sheet Pile	(kq)	82,944	3.2	265		265
Bracing	(kg)	542.48	5.2	3		3
Rubble Stone	(m3)	19.83	400	8		8
Piling	(m)	72	3,800	274		274
Concrete	(m3)	542.48	4,658	2,527		2,527
Lean Concrete	(m3)	4.96	1,950	10		10
Reinforced Steel Bar	(kg)	31,430	12	377		377
Form Work	(m2)	811.5	300	243		243
Architecture	(1112)		•	90		90
	Sub-total o	f 1)		3,932		3,932
2) Mechanical and Electrica	l Works					
Screen (0.8m x 1.8m)	(unit)	2	119		238	238
Gate (0.8m x 0.8m)	(unit)	2	167		-334	334
Pump (ø200mm x 5,5kw)	(unit)	2	809		1,618	1,618
Pump (ø250mm x 7.5kw)	(unit)	2	1,071		2,142	2,142
Piping and Valves	(LS)				752	752
Instrumentation	(LS)				1,128	1,128
Installation	(LS)				752	752
5	Sub-total o	f 2)			6,964	6,964
	Total			3,932	6,964	10,896

\*

# Table 2.9.1.2 (6) Contruction Cost of Treatment Plant

		Constructio	n Cost (x 1,0	000 Baht)
	Item	Domestic Portion	Foreign Portion	Total
1. Civil and Architecture Facilities				
l-1 Grit Chamber	11.0 (L)m x 1.6 (W)m x 0.7 (H)m x 3units	5,965		5,96
	11.0 (L)m x 1.6 (W)m x 0.7 (H)m x 3units			
1-2 Primary Sedimentation Tank	16.0(D)m x 4.0(H)m x 4units	5,810		5,81
1-3 Stormwater Sedimentation Tank	18.5(D)m x 3.0(H)m x 4units	6,403		6,40
1-4 Aeration Tank	75.0(L)m x 15.0(W)m x 3.0(H)m x 2units	17,611		17,61
1-5 Secondary Sodimentation Tank	18.5 (D)m x 2.5 (H)m x 4units	6,046		6,040
1-6 Disinfection Tank	180.0(L)m x 2.0(W)m x 2.0(H)m x lunit	3,450		3,450
1-7 Thickener	6.0(D)m x 4.0(H)m x 2units	1,075		1,075
1-8 Digestion Tank	1st : 17.5(D)m x 5.0(H)m x 2units	5,310	-	5,31
	2nd : 12.0(D)m x 5.0(H)m x 2units	3,367		3,361
1-9 Dewatering Unit		800		800
1-10 Miscellaneous		5,700		5,700
Sub-total of 1		61,537		61,537
2-1 Grit Chamber			5,833	
				5.833
2-2 inflow Pump				
2-2 Inflow Pump 2-3 Primary Sedimentation Tank			12,619	12,619
2-3 Primary Sedimentation Tank			12,619 11,548	12,619 11,548
2-3 Primary Sedimentation Tank 2-4 Stormwater Sedimentation Tank			12,619 11,548 1,071	12,619 11,548 1,071
2-3 Primary Sedimentation Tank 2-4 Stormwater Sedimentation Tank 2-5 Aeration Tank			12,619 11,548 1,071 10,536	12,619 11,548 1,071 10,536
2-3 Primary Sedimentation Tank 2-4 Stormwater Sedimentation Tank 2-5 Aeration Tank 2-6 Secondary Sedimentation Tank			12,619 11,548 1,071 10,536 13,571	12,619 11,548 1,071 10,530 13,571
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> </ul>			12,619 11,548 1,071 10,536 13,571 2,024	12,619 11,548 1,071 10,536 13,571 2,024
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> </ul>			12,619 11,548 1,071 10,536 13,571 2,024 357	5,833 12,619 11,548 1,071 10,536 13,571 2,024 357 39,167
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> </ul>			12,619 11,548 1,071 10,536 13,571 2,024 357 39,167	12,619 11,548 1,073 10,536 13,571 2,024 357 39,167
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> </ul>	S		12,619 11,548 1,071 10,536 13,571 2,024 357	12,619 11,548 1,071 10,536 13,571 2,024 357 39,167 16,429
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> </ul>			12,619 11,548 1,071 10,536 13,571 2,024 357 39,167 16,429	12,619 11,546 1,071 10,530 13,571 2,024 357
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> </ul>			12,619 11,548 1,071 10,536 13,571 2,024 357 39,167 16,429 16,548 19,762	12,619 11,548 1,073 10,536 13,571 2,024 357 39,167 16,429 16,548 19,762
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> </ul>			12,619 11,548 1,071 10,536 13,571 2,024 357 39,167 16,429 16,548	12,619 11,546 1,071 10,536 13,571 2,024 357 39,167 16,429 16,548 19,762 24,286
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> <li>2-13 Transportation and Instalation</li> </ul>			12,619 11,548 1,071 10,536 13,571 2,024 357 39,167 16,429 16,548 19,762 24,286	12,619 11,548 1,073 10,530 13,571 2,024 357 39,167 16,429 16,548 19,762 24,286 2,260
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> <li>2-13 Transportation and Instalation</li> <li>2-14 Pump Station Monitoring Facilitie</li> </ul>		·	12,619 11,548 1,071 10,536 13,571 2,024 357 39,167 16,429 16,548 19,762 24,286 2,260	12,61 11,54 1,07 10,53 13,57 2,024 35 39,16 16,429 16,548 19,76 24,286 2,260 595
<ul> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> <li>2-13 Transportation and Instalation</li> <li>2-14 Pump Station Monitoring Facilitie</li> <li>2-15 Laboratory Equipment</li> </ul>	S		12,619 11,548 1,071 10,536 13,571 2,024 357 39,167 16,429 16,548 19,762 24,286 2,260 595	12,619 11,540 1,073 10,530 13,577 2,024 35 39,16 16,429 16,548

Assumption for Estimate of Interceptor Cleaning Cost

- 1) The Length of cleaning for one time is the distance of an average manhole interval (approximately 50m).
- 2) The nozzle moves forward and is pulled backward with jets three (3) times for one time cleaning.
- 3) It takes about ten (10) min. for the nozzle to move forward and backward,
- 4) The water (3 m3) of High Pressure Cleaner' tank is used for one time cleaning.
- 5) A cleaning team consists of "High Pressure Sewer Cleaner", "Vacuum Sludge Loader", "Water Wagon" and "Truck".
- 6) The Volume of a water wagon tank is 4 m3.
- 7) Required time for water feeding to a water wagon and discharging sludge is 1.5 hours (including traveling time).

From the above assumption,

The possible length of cleaning interceptor in a year,

In case that working hour is 8 hours, times of cleaning is the following.

8 hr. x 2 hr./time = 4 times

As the length of cleaning interceptor for one time is 50 m,

50 m/time x 4 times = 200 m/day

When actual Working hour in a year is 20 day/month x 12 months x 0.8 = 192 day/year, the possible length of cleaning interceptor in a year is the following.

200 m/day x 192 days = 38,400 m/year

Annual expenses for interceptor cleaning are,

(1) Labor Cost

Type of Vehicle	Classi -fication	Required No.	Working Day	Wage	Cost
1-1. High Pressure	Driver	1 person			
Sewer Cleaner	Operator	2 persons			
1-2. Vacuum Sludge	Driver	1 person			
Loader	Operator	2 persons			
1-3. Water Wagon	Driver	1 person			
1-4. Truck	Driver	1 person			
	Labor	4 persons			
	Driver	4 persons	192 days x	420 B/day =	322,560
Total	Operator	4 persons	192 days x	360 B/day⊨	276,480
	Labor	4 persons	192 days x	140 B/day=	107,520
······································	Annu	al Labor Cost (	Baht/Year )		706,560

### (2) Fuel Cost

×

3-1. High Pressure Sewer 201 / hr.	8 hr.	x	192 days =	30,720
-			x ( Vehicles )	3
				92,160
3-2. Water Wagon / Truck				
D E. Macci Magon / Ilack				
101 / hr.	3 hr.	x	192 days =	5,760
-	3 hr.	x	192 days = _x ( Vehicles )	5,760 <u>1</u>
	3 hr.	x	1	5,760 <u>1</u> 5,760
	3 hr.	х	1	1

(3) Spare Parts Cost

Type of Vehicle	Price	Working Life		Cost
1-1. High Pressure Sewer Cleaner	1,000,000 Baht	5 Years	=	200,000
1-2. Vacuum Sludge Loader	1,000,000 Baht	5 Years		200,000
1-3. Water Wagon	1,000,000 Baht	5 Years	=	200,000
1-4. Truck	700,000 Baht	10 Years	a.t	70,000
	Annual Vehicle C	Cost ( Baht/Year )		670,000
670,00	) { Vehicle Cost } x	3 %		20,100
	Spare Parts Co	st ( Baht/Year )		20,100
	Annual Cleaning	Cost ( Baht/Year )		824,580
Cle	aning Cost of Interce	ptor per Meter ( Bah	it/m )	21.5

3.6.1 Distribution of Population and Wastewater Quantity

# Table 3.6.1.1 Population Distribution

MJ. 012 EVENTS COMM CurrentDown Area Sewer stream (ha) 1/1 1/3 17. (101 - 105) 1/4 1/5 48.	S–	1 rea				-									-						
			б Ч	Kesidential-Area	-Area	Кe	Kesidenti	ential-Area		PublicLand	1	ndustrialArea	IArea.	<u>VacantArea</u>	rea		ServiceArea	rea		HODIEG	Ī
	••••	P.Dens, Design P. (p./ha) (person)	P. Area (ha)	a P.Dens () (p./ha)	ans   Design P. Da)   (person)		Area P.I (ha) (p	P.Dens De	Design P. (person)	Area (ha)	Design P. (person)	Aea Baile	Design P. (person)	Area (	Design P. (person)	Area (ha)	P.Dens (p./ha)	Design P. (person)	Aes (na)	P.Dens (p./ha)	Design P. (person)
		ł	{−	┢	+	-	╞	ł		1-	-	1		1							
- 10	17.2 20	200 3,440	40 45,	8	100 4.580		15.0	30	450	5.4	0	0.0	0	0.0	0	83.4	101.56	8.470	83.4	100. 90	8.415
			L		ļ																
	48.3 20	200 9,66	660 4	4.7	100 4	470	3.1	30	93	4.6	0	0.0	0	0.0	0	60.7	168.42	10.223	60.7	158.40	10.222
											-										
1/10 2:	22.0 20	200 4 400	00 25.	8	100 2.560	<u> </u>	16.4	30	492	0	0	0.0	0	0.0	0	64.0	116.44	7.452	64.0	116.60	7.462
-108)		[		-																	
/11 1/12 (	0.0	200	0 14	14.4	100 1.440	L	11.9	- 30-	357	0	0	0 0	0	0.0	0	25.3	68.33	1, 797	26.3	68.30	1, 796
													 			1					
2/2	7.9 20	200 1, 580		0.0	100	0	0.2	30	9	4.6	0	0.0	0	0.0	0	12.7	124.88	1, 586	12.7	65.70	834
				 				<u>.</u>													
2/5 (	0.0 21	200	0 73.	2	100 7, 320		19.8	30	294	0	0	0.0	0	0.0	ö	93.0	85.10	-7.914	93.0	85.10	7.914
-202)							-				·										
-	0.0	200	0	0.0 1	100	0	2.1	30	63	0	0	0.0	0	0.0	0	2.1	30.00	63	2.1	30.00	63
																		-			
3/5 (	0.0 2	200	0	0.0	100	0	0.0	30	0	0	0	0.0	0	0.0	0	0.0	00 0	0	0.0	0.00	0
	:											-									
3/7   . (	0.0 2	200	0 95	8	100 9,580		0.0	30	0	0	0	0.0	0	0.0	0	95.8	100.00	9, 580	95.8	100.00	9, 580
	-																				
Adopted 9	95.4	19 080	80 259.	9.5	25, 950		68.5		2.055	14.6	0	0.0	0	0.0	0	438.0		47.085	438.0		46, 237

·			γ <u> </u>	1	<b>r</b>	 		ſ	<u>,</u>	· · · ·	1	F	r	[	1	<u> </u>		1 I
	Remarks						- - - -		n				513 513 513					
	Earth Joyer	Έ	265		213	 120 354	35.4	455	109	1200		105	50.25	164		100	256	
	invert Level	X	0215		-0025	 0300	-2357 456	-2457	-2481	0130 -0156		0500	-3469	-0450		0610 0577	-1340	-
Semers	noitsval	×	155		254	 213	234 274	2514	254	254 199		199	134	76.1 76.1		134 134	194 219	
Designing of	мо]-ј	m <sup>1</sup> /360	0088		0088	 0045	0088	0151	0246	0246		0045	0132	0246		0045	0.529	
esigni	kticols/	2	010		070	 0.64	070	0.77	0.87	08.7		<b>9</b> 90	105	280		064	1.05	
	sqol2	26	180		130	 220	130	160	160	160		2,20	100	150		220	180	
	letemsi(	н Д	400		400	 300	400	500	600	600		300	400	600		300	800	
	Grand To Design I	m <sup>3</sup> /3ec	0.054		0053	0037	0.048	0107	0214	0240		032	0271	0,271		0016	0332	
Н. М	lstoT	m <sup>i</sup> /:ee	0.039		0.053	 		0.021	0113	0113			0113	0113			0113	
Other	Sewer	m²/sec	0039		0.053	 		0021										
	ngias0 ₩013	m'/sec	0015 0		0000	0037	0048	0,085	0101	0:127		0032	0158	0158		0,016	0219	
Wastewater Flow		<u> </u>	798 0		0	 1988 0	2543 0	4591 0	5389 0	6761 0		1685 0	8445 0	8446 0		842 0	11696 0	
stewati	Population Sewed Total	Person	198		0	 988	555	92048	. 0	372		686	7	0		842	42408 1	$\vdash$
Жа	Pop.	Peyha	100.9		00.9	 00.91	100.9	00.92	0.00	100.91		00.91	0.00	0.00		68.4	68.42	
	llstnis?	8																
с. В	d Area Total	гų				 								••••				
Run-off Stor	Arranged Area 7	ha ha			· · · · · · · · · · · · · · · · · · ·	 				·····								
Ru	hun-off itteo)	<b>†</b>				 												
	lstnis	m²/sec • ha																
bəta	17n9⊃noĆ 9⊪iT	1 =																
Length	Total	E	530		0	 750	1350	1365	1365	1875		15	1913	1913		15	2313	
	ករព្រះ១	E	530		°	 750	600	15	0	510		15	38	0		15	400	
Drainage Area	letoT	ha	130		000	 1970	2520	4550	5340	67.00		1670	8370	8370	·	500	10300	
Drain	Årea	e q	061		000	 1970	550	2030	000	1350		1670	00	000		200	1430	
	nsstream Novisiam		(VI-I)		(V-1)					(F-1)								
sı:	enes to	·on	1		101	102	103	(101)	(Y12-1)	1-2	·	105	(- -	WE-I		106	$\bigcirc$	

Table 3.6.1.2 (1) Hydraulic Calculation for Design of Sewers (Bang Bua Thong-North (1))

3-2

	-	Kenarks																	
	1	õ																	
	Jə.	163 VOJ	E	25.7 270	384		120 211	212		13.6	158 254	253		209	421 498	4 <u>9</u> 3 502	503 464	451 438	
	tre Iei		М	-1350	-1384		0410	-0560		-0140	-1053	-1153 -2458		0630	-2558	-2818	-2915	-3501	
Semers	noite	sval3	М	219	219		132	132		9.9	192	1 <u>9</u> 2 230		196	230 276	276	276 209	20.9	
Designing of 3	MO	'IJ	m <sup>3</sup> /300	0.529	0.529	·····	0045	0045		0151	0038	0151		0045	0246	0,246	0245	0337	
csign	viis	oləY	m/350	105	105					017	010	07.7		0.54	0.87	0.8.7	0.8.7	¥151	
	əde	PIS	સ્ટ	160	150		22.0	220		150	130	160		220	1:60	1,60	160	0143	
	nəfər	ns 10	я Я	800	800	:	300	300		500	400	500		300	600	600	600	1000	
	ol bn Ol bn		m'/se	0332	0462		0.42	0042		0033	0.083	0144		0043	0130	0130	2610	0.654	
М. Ч	lei	oT	m <sup>1</sup> /366	0113	0,113		0.027	0,027				0.027			0.027	0027	0.027	0140	
Other	er	es.	m³/365				0.027												
Flow	- MO - MO		m)/sec	0219	0349		0015	0015		0083	0.083	0117		0.043	0.153	0:163	0:165	0514	
ater Fl	Population	Total	Person	11696	18668		815	815		4460	4460	6270		2290	8723	8729	8792	27460	
Wastewater	V11s	Science Science Neur	. i	0 00	46972		70 815	00		104450	0 00	10 935		05230	10 169	00	00 63	00	
	*d0	8	se Peyha	<u> </u>	158.		65.	<u>ہ</u>		85. ]	0.0	85.1		85.10	85. ]		30. 0	<u></u>	
	8 Heir		m³/se																
Storm	nged Area	Tota	r F																
Run-off Storm	Arranged	Area	r Pa					,											
- <b>6</b> 2 -	,111, 111,	ມດງ ແກ່ຢູ	24				;									·			
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ated	ntn∋c ∋miT	ixog	5																
Length	181	<u> </u>	E	15 2328	710 3038		380 380	15 395		- 0	440 440	710 1150		310 310	170 1320	17 1337	160 1497	8205 03	
	ųιβυ		E				1240 34	1240		5240	5240 4	7650 7							
Drainage Area	leto	11 	a l	10320	14440			:			<u>.</u>			2630	10540	10540	10750	25190	
Į	163		гч Ч		1140		1240	ŝ		5240		1170		2690	500		510	8	
	sente oli rio							<u>.</u>		$ \ge $	$\sim$				_			¥8-1	
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**A** 

Mastemater         Tion         Other         M. M.         Mastemater         Flow           Mastemater         Flow         Other         M. M.         Mastemater         Flow         Other         M. M.           Mastemater         Flow         Other         M. M.         M. M.         M. M.         M. M.         M. M.           Mastemater         Flow         Other         Other         Other         Other         M. M.	
Possibility Possi Possibility Possibility Possibility Possibility	
Wastemater         Flow         Other         W         N         Model           Population         10	
Жазтениатет         Пона         Отнет         Ж ч         Пона         Отнет         Ж ч         Пона         Отало         Пона         Пона         Пона         Отало         Пона         Отало         Пона         Отало         Пона         Отало         Пона	
Wastemater Flow         Other N. N         Total Flow         Other N. N         Total Flow         Designing of Flow         Designift of Flow         Designift of Flow <td></td>	
Mastemater         Flow         Other         N. W         Sile	
Mastemater         Flow         Other         M. #         M           Per/ha         Per/ha         Other         M. #         M         M           Per/ha         Per/ha         District         District         District         M           Per/ha         Person         m/xee         m/xee         m/xee         m/xee         m/xee           116.6         5334         3324         0553         0553         10052         0563         100           116.6         5334         3324         0553         073         400         136           116.6         5334         3324         0553         073         400         136           116.6         5334         3324         073         400         136         136           0.0         0         0140         073         400         136         136           116.6         51014         34322         0554         0140         073         400         136           116.5         5331         333908         0535         0140         073         400         136           0.0         0         03020         05355         0544         0100         1	
Mastewater         Flow         Other         M M           Mastewater         Flow         Other         M M           Rephiz         Person         m/xee         m/xee         m/xee         m/xee           Rephiz         Person         m/xee         m/x	
Mastewater         Flow         Other         M #           Ref         Population         0 <td< td=""><td></td></td<>	
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Mastewater         Flow         Other           Postewater         Flow         Other           Postewater         Flow         Other           Person         m/xee         m/xee           Person         m/xee         m/xee           116.63324         3324         0052           116.63324         3324         0052           116.63324         33296         0535           0.00         0         34922         0554           0.00         0         34922         0554           0.00         0         34922         0554           0.00         0         34922         0554           0.00         0         34922         0554           0.00         0         34922         0554           0.00         0         34922         0554           0.00         0         0         0992           0.00         0         0         0992           0.00         0         0         0992	
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Run-off Storm	· · · · · · · · · · · · · · · · · · ·
11stnish 5	
Desterring to the second secon	   .
A         A         A         B	
Drainage         Area           Drainage         Area           ha         ha	
Drain Dr	
Downstream Sewers No.	<b> </b>
Line in the second seco	

Table 3.6.1.2 (3) Hydraulic Calculation for Design of Sewers (Bang Bua Thong-North (1))

3.6.2 Design Fundamentals and Facility Specifications

1

Table 3.6.2.1 Pump Station

(1) Design Fundamentals

		Design Flo	Flow	Invert Level	-evel	Water Level	level		G.L	
No.	Sewer No.	D/D	M/P	Inlet	Outlet	Inlet	Outlet	Actual Head	Present	Plan
		(M3/S)	(M3/S)	(W)	(M)	(M)	(W)	(W)	(W)	(M)
-	1-2A	0.101	0.214	-2.481	-0.800	-1.98	1.30	3,28	2.54	2.80
0	18A	0.588	0.727	-3.685	-0.320	-2.99	0.38	3.37	1.78	2.00

Mo	
Design Fl	
() Des	
9	

			P/D				M/P	0_	
No.	Sewer No.	δ	Q2	Q3	Q4	ē	02	CG CG	0 4
-		(M3/m)	(M3/m)						
	1–2A	1.30	1.56	2.02	6.06	2.74	3.30	4.28	12.84
3	18A	7.55	9.05	11.76	35.28	9.33	11.19	14.54	43.62

Note: Q1; Daily Ave.

Q2; Daily Max.

Q4; 3xHourly Max. Q3; Hourly Max.

(3) Pump Specification

		3		No. of units by Dia.	ts by Dia.		
No.	Sewer No.	Sewer No.   Pump Type   150(mm)	150(mm)	200(mm)	300(mm)	400(mm)	R.M
-	1–2A	0	N	~			
N	1–8A	o			5	2	
Note: Common Type	non Type						

Manhole Type

	a		Pump Head	Head		H.P by Dia.	y Dia.		
No.	Sewer No. Actual	Actual Head	Loss	Total	150(mm)	200(mm)	300(mm)	400(mm)	R.M
		(M)	(M)	(M)	(KW/unit)	(KW/unit)	(KW/unit)	(KW/unit)	
<b>т</b> -	1-2A	3.28	1.50	4.78	3.70	5.50		- - -	
~	1-8A	3.37	1.50	4.87			11.00	18.50	

(5) Manner of Pump Operation

	0 4	(uniť)	12.84	2	2	43.62	2	2
-		n)					- 01	
0	g	(unit)	4.28	2		14.54	N	
M/P	02	(unit)	3.3	2		11.19	5	
	ą	(unit)	2.75	2		9.33	5	
	, 04	(unit)	6.06	7-	-	35.28		5
	g	(unit)	2.02			11.76		<b>F</b>
Q/d	02	(unit)	1.56	F		9.05		-
	ā	(unit)	1.3	<b>-</b>		7.55	1	
	Pump Dia.	(mm)	(m3/m)	150	200	(m3/m)	300	400
	No.			<b>r</b>			2	

Table 3.6.2.2 Inverted Siphon

	Design Flow	Flow	Inlet	ţ	-	Siphon	nor		Outlet	et
D/P	<u> </u>	M/P	Dia.	Invert L.	Dia.	Velocity	Length	Loss	Inver L.	W.L.
(N3/S)		(M3/S)	(MM)	(M)	(MM)	(M/S)	(M).	(M)	(W)	(M)
0.16		0.27	600	-0.16	-0.16 400x2 line	1.05	38	0.28	-0.45	-0.15

3-6

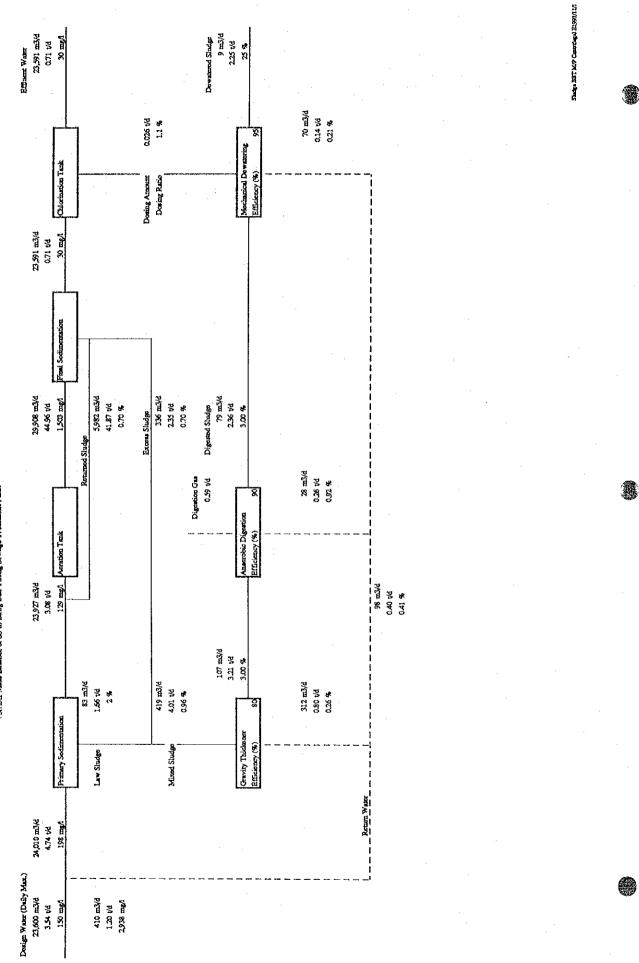
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### 3.6.2.3 Overflow Chamber

Number of overflow chambers is shown in table 3.6.2 (5) according to same conditions in Rang Sit project.

No.	Sewer No.	Quantity	Dia.	Slope	   Full	How	Туре
		(M3/S)	(MM)	(1/1000)	(M/S)	(M3/S)	
1	1-1	0.054	ø300	4.0	0.865	0.0612	C
2	102	0.037	ø300	2.0	0.612	0.0432	В
3	103	0.011	ø300	2.0	0.612	0.0432	C
4	104	0.059	ø300	4.0	0.865	0.0612	С
5	1-2	0.026	ø300	2.0	0.612	0.0432	Β.
б	105	0.032	\$300 ¢	2.0	0.612	0.0432	C
7	106	0.016	\$300 J	2.0	0.612	0.0432	С
8	1-4	0.045	ø300	2.5	0.684	0.0484	C
9	1-6	0.130	¢400	4.0	1.048	0.1317	C
10	2-1	0.042	ø300	2.0	0.612	0.0432	С
11	201	0.083	¢300	8.0	1.224	0.0865	С
12	2-3	0.019	ø300	2.0	0.612	0.0432	С
13	202	0.043	ø300	2.0	0.612	0.0432	C
14	2-4	0.003	¢300	2.0	0.612	0.0432	С
15	2-6	0.002	ø300	2.0	0.612	0.0432	С
16	107	0.062	d300	5.0	0.967	0.0684	С
17	108	0.011	ø300	2.0	0.612	0.0432	C
18	1-8	0.047	\$300 j	2.5	0.684	0.0484	С
19	1-9	0.019	ø300	2.0	0.612	0.0432	С
20	1-11	0.034	ø300	2.0	0.612	0.0432	Ċ
21	3-7	0.179	ø400	8.0	1.482	0.1863	В
	Total	0.954			F•	۱۲- ا	

Table 3.6.2.(1) Number of overflow Chambers



- 3.7.3.1 Mass Balance of SS in Rang Bua Thong Sewage Treatment Plant

## 3.7.3.2 Design of Facilities

### Wastewater Treatment

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(1) Inflow Pump Station

The inflow pump station of treatment plant consists of initial bar screen followed with the pump facilities.

### 1) Design Condition

	Dry Weather Flow	Wet Weather Flow
Design Flow (hourly max.)	14,200 m3/d = 9.86 m3/min.	42,600 m3/d = 29.58 m3/min.
Surface loading of grit chamber	1,800 m3/m2/day	3.600 m3/m2/day
Average velocity of grit chamber	0.3 m/sec	0.6 m/sec
Retention time	60 sec	30 sec

2) Proposed Inflow Pump Station

Grit Chamber	
Dry Weather Flow	1.0 m (w) x 0.4 m (h) x 9 m (l) x 1 unit
Wet Weather Flow	1.4 m (w) x 0.4 (h) x 9 (l) x 1 unit
Inflow Pump	
Dry Weather Flow	ø250 x 2 pumps
	(4.93 m3/min. x 2)
Wet Weather Flow	ø250 x 2 pumps, 450 x 1 pump
	(4.93 m3/min. x 2 + 21.35 m3/min. x 1)
Inflow Pump Dry Weather Flow	∮250 x 2 pumps (4.93 m3/min. x 2) ∮250 x 2 pumps, 450 x 1 pump

### (2) Primary Sedimentation Basin for Wastewater

### 1) Design Condition

Design Flow (Daily Max.)	10,900 m3/day
Surface Loading	35 m3/m2/day
Sedimentation Time	3,0 hr
Effective Depth	4.0 m
Overflow Loadign of Weir	less than 250 m3/m/day
Reduction Efficiency	BOD : 30%
	SS : 35%
Influent Water Quality	BOD : 150 mg/l
	SS : 150 mg/l
Effluent Water Quality	BOD :105 mg/l
	SS : 97.5 mg/l

2) Proposed Sedimentation Basin Sedimentation Basin Surface Area

ø15.0 m x 2 units 353 m2

(3) Storm Water Sedimentation Basin

### 1) Design Condition

17 Beelgn eenaden	
Design Flow (Wet hourly max.	31,700 m3/day
– dry daily max.)	(42,600 - 10,900)
Surface Loading	70 m3/m2 day
Sedimentation Time	0.5 hr
Effective Depth	3.0 m
Overflow Loading of Weir	less than 250 m3/m/day

- 2) Proposed Storm water Sedimention Basin
   Sedimentation Basin
   \$\overline{14.0 m x 3 units}\$
   Surface Area
   462 m2
- (4) Aeration Tank

Based on the discussion with PWD of the emergency condition, generator will not be installed at the treatment plant from the economical view point. Hence, the diffused air aeration system is not proposed because of the easiness of diffuser clogging by the floccule while power failure. The mechanical aerator is proposed for this project.

-+ 1	Dealara	Condition	
- 1 1	Design	Condition	

Design Flow (daily max.)	10,900 m3/day
Aeration Time	6 hr
BOD-SS Loading	0.35 kg-BOD/kg-SS/day
Return sludge Ratio	25%
Returen Sludge Solid Concentration	7,000 mg/l
BOD Volumetric Loading	0.3 0.8 kg/m3/day
Sludge Age	2 – 4 days

2) Proposed Aeration Tank

12 m (w) x 36 m (l) x 3 m (d) x 2 units 11 kw x 3 units

(5) Secondary Sedimentation Basin

1) Design Condition

Aeration Tank

Aerator

Design Flow (daily max.)	10,900 m3/day
Surface Loading	25 m3/m2day
Sedimentation Time	2.5 hr
Overflow Loading of Weir	less than 150 m3/m/day

2) Proposed Secondary Sedimentation Basin
 Sedimentation Basin
 Surface Area
 454 m2

### (6) Disinfection Tank

Calcium hypochlorite is proposed to use the disinfection of treated water.

### 1) Design Condition

	Dry Weather Flow	Wet Weather Flow
Disitn Flow		42,600 m3/dya
Contact Time of Disinfection Tank	8 min.	8 min.

### 2) Proposed Disinfection Tank

Tank Size

2 m (w) x 60 m (l) x 1.5 m (d) x 3 units

### **Sludge Treatment**

- (1) Gravity Thickener
- 1) Design Condition

From the Mass Balance calculation in Fig. 7.###, design condition is shown below.

Primary Law Sludge Density	2%
Excess Sludge Density	0.7%
Design Sludge Density	1.04%
Design Sludge Volume	193 m3/d. 1.85 t/d
Thickened Sludge Density	3%
Solid Mass Loading	60 – 90 kg/m2/day
Effective Depth	4 m
Efficiency of Thickener	80 %

2) Proposed Gravity Thickener Gravity Thickener Thickening Time

 $\phi 6 \text{ m x 4 m (d) x 1 unit (for 2001)}$ 14.1 hr

(2) Anaerobic Digestion Tank

1) Design Condition

Thickened Sludge Organic Material Ratio	60%
Digestion Ratio	50%
Efficiency of Digestion Tank	90%
Effective Depth	more than 4 m
Digestion Time	1st Tank 20 days
	2nd Tank 10 days

2) Proposed Anaerobic Digestion Tank 1st Digestion Tank

2nd Digestion Tank

(3) Centrifugal Dewatering

Operation Hour	6 days a week,	
	6 hours a day	
Digested Sludge Volume	36 m3/day,	
	1.09 t/day	
Digested Sludge Density	3%	
Efficiency of Centrifugal Dewatering	95%	
Dewatered Sludge Moisture Content	79%	
Chemical Dosing Ratio	1.1%	

2) Proposed Centrifugal Dewatering Capacity : Dewatered Sludge

7 m3/hr x 1 unit 4 m3/day, 1.04 t/day (Moisture content = 79%) Design Calculation of Bang Bua Thong Wastewater Treatment Plant for MASTER PLAN

### (1) Design Discharge

		m3/day	m3/min.	m3/sec.
Daily Average	(Qda)	19,700	13.7	0.228
Daily Maximum in Dry Weather	(Qdmd)	23,600	16.4	0.273
Hourly Maximum in Dry Weather	(Qhmd)	30,700	21.3	0.355
Hourly Maximum in Wet Weather	(Qhmw)	92,100	64.0	1.066
		Influent	Effluent	·
BOD ( mg/l )		150	20	
SS ( mg/l )		150	30	

### (2) Design Calculation

( Dry Weather )				
Design Flow Rate		-		
Hourly Maximum in Dry Weath	ner Qhmd≖	30,700 m3/	'day	
		0.355 m3/	sec.	
Design Condition			· · ·	
Surface Loading	Ls≖	1,800 m3/	/m2/day	
Average Velocity	Va <b></b> ⊷	0.3 m/s	sec.	
Retention Time	Rs=	60 sec		
Size				
Required Surface Area	A≕Qhmd/Ls=	17.06 m2	÷	
Effective Depth	He=	0.4 m		
Required Width	Be=	2.0 m		
Size of Structure				
Width	B=	1.0	₩	1.0 m
Length	L=A/Be=	8.53	<b></b>	9.0 m
Depth	H=	0.4	-	0.4 m
Numbers	n=	2		2 units
Verification				
Surface Loading	Ls=Qhmd/B/L/n=	1,706 m3/	/m2/day	
Average Velocity	Va=Qhmd/B/He=	0.444 m/s	sec.	
Retention Time	Rt=L/Va=	20.3 sec	e.	
Volume of Grit				
	Qhmd*0.00001*1.8 t/m3=	0.55 t/c	day	
Screenings	Qhmd*0.00001=	0.31 m3/	/day	

(Wet Weather )				
Design Flow Rate		61,400 m	2/day	
= Hourly Maximum in Wet Weat		0.711 m		
-Hourly Maximum in Dry We	ather	0.711 m	3/sec.	•
Design Condition				
Surface Loading	ls≓	3,600 m	3/m2/day	
Average Velocity	Va=	0.6 m	/sec.	
Retention Time	Rs=	30 s	ec.	
Size				
Required Surface Area	A=Ohmw/Ls=	17.06 m	2	
Effective Depth	Hem	0.4 m		
Required Width	Be=	2.8 m		
Size of Structure				
Width	B=	1.4	-	1.4 m
Length	L=A/Be=	6.09		9.0 m
Depth	H≈	0.4	==	0.4 m
Numbers	n=	2	25	2 units
Verification			· .	
Surface Loading	Ls=Qhmw/B/L/n=	2,437 m	3/m2/day	
Average Velocity	Va=Qhmw/B/He=	0.635 m	/sec.	
Retention Time	Rt L/Vam	14.2 s	ec.	
Volume of Grit				
	Qhmw*0.00001*1.8 t/m3=	1.11 t	/day	
Screenings	Qhmw*0.00001=	0.61 m	3/day	

2) Inflow Pump

(Inflow Pump for Wastewater) Hourly Maximum in Dry Weather

Qhmd≖ 21.30 m3/min.

4.93 m3/	min. x	2	pumps	-	9.86	m3/min.
( Dia.=	250	mai,		V=	1.68	m/s )
11.44 m3/	min. x	1	pumps		11.44	m3/min.
( Dia.≖	350	mm,		V=	1.99	m/s)
<u></u>	otal				21.30	m3/min.

(Inflow Pump for Storm Water) Hourly Maximum in Wet Weather

Qhmw= 64.00 m3/min.

4.93 m3/min.	x	2 pumps =	9.86 m3/min.
(Dia.= 250	mm,	v	= 1.68 m/s)
11.44 m3/min.	х	1 pumps =	11.44 m3/min.
(Dia.= .350	mm,	v	= 1.99 m/s)
21.35 m3/min.	х	2 pumps =	42.70 m3/min.
( Dia.= 450	mm,	v	= 2.25 m/s)
Total			64.00 m3/min.

				•	
3)	Primary Sedimentation Tank				
	Design Flow Rate		20 700 -2 (1		
	Daily Maximum in Dry Weather	Qdmd <del>≍</del>	30,700 m3/day 1,279 m3/hr		
			1,2/9 m3/nr		Vie
	Design Condition		· ·	<u>\</u>	
	Surface Loading	Ls=	35 m3/m2/d	av	
	Settling Time	Ts≖	3.0 hr	-1	
	Effective Depth	He=	4.0 m		
	Size				
	Required Surface Area	An=Qdmd/Ls≃	877 m2		
	Required Tank Volume	V=Qdmd*Ts=	3,838 m3		
	Size of Structure				
	Diameter	D=	16.7 🛥	15.0 m	
	Depth	Н=	4.0 =	4.0 m	
	Numbers	n=	4 ==	4 units	
	Volume of Tank	V=	2,826 m3		
	Surface Area	As=	707 m2		
	Verification	· _			
	Surface Loading	Ls≠ ‴	43.5 m3/m2/d	ау	
	Settling Time Wier Loading	Ts⇔	2.2 hr		
	witer hoading	ľw=	163 m3/m/da	Y	
4)	Stormwater Sedimentation Tank				4
	Design Flow Rate				
	= Hourly Maximum in Wet Weather	Qhmw-Qdmd=	68,500 m3/day		
	-Daily Maximum in Dry Weather	×	2,854 m3/hr		
	Design Condition				
	Surface Loading	Ls=	70 m3/m2/d	21/	
	Settling Time	lis- Ts≂	0.5 hr	цĂ	
	Effective Depth	He=	3.0 m		
	-				
	Size				
	Required Surface Area	An=Qdmw/Ls=	979 m2		
	Required Tank Volume	Lw=Qdmw*Ts=	1,427 m3		
	Size of Structure				
	Diameter	D==	14.4 =	14.0 m	
	Depth	D H≖	3.0 =	3.0 m	
	Numbers	Ω=	6 =	6 units	
			·		
	Volume of Tank	V=	2,769 m3		
	Surface Area	As≖	923 m2		
	Verification				
	Surface Loading	Ls∞	74.2 m3/m2/da	ау	
	Settling Time	Ts≖	1.0 hr		<i>i</i>
	Wier Loading	L₩≖	260 m3/m/day	t i i i i i i i i i i i i i i i i i i i	

5) Aeration Tank Design Wastewater Quality Ci (BOD) 105 mg/l : Ci (SS) : 98 mg/l Design Flow Rate Daily Maximum in Dry Weather 23,600 m3/day Odind= Design Condition Aeration Time Ta≖ 6.0 hr BOD - SS Loading 0.35 kg/kg/day Ls≖ Return Sludge Ratio Rs≖ 25.0 % Return Sludge Solid Concentration 7,000 mg/l Cr~ Size MLSS (Ci(SS)+Cr\*Rs/100)/(1+Rs/100) =1,478 mg/l Required Tank Volume V=Qdmd\*C1(BOD)/(BOD-SS Loading)\*MLSS= 4,790 m3 Size of Structure Width B= 12.0 12.0 m Length L'=Vn/H/n= 33.3 36.0 m Depth H≃ 3.0 3.0 m Numbers n# 4 Verification A=B\*H-0.3^2= Cross Section 35.91 m2 Volume V=A\*L'\*n= 5,171 m3 BOD - SS Loading Ls=Qdmd\*Ci/V/MLSS= 0.32 kg/kg/day Aeration Time Ta=V/Qdmd\*24=5.26 hr BOD Volumetric Load Lv=Qdmd\*Ci(BOD)/V/1,000= 0.48 kg/m3/day Sludge Age Sa=MLSS\*V/Qdmd/Ci(SS)= 3.32 days 6) Secondary Sedimentation Tank Design Flow Rate Daily Maximum in Dry Weather 23,600 m3/day Qdmd= 983 m3/hr ----

4 units

4 units

Design Condition Surface Loading 25 m3/m2/day Ls= 2.5 hr Settling Time Ts≖ Effective Depth He= 2.5 m Size Required Surface Area A=Qdmd/Ls= 944 m2 Required Tank Volume Lw=Qdmd\*Ts= 2,458 m3 Size of Structure Diameter 17.7 17.0 m D= Depth 2.5 2.5 щ Н≖

n=

4

Numbers

Volume of Tank	V=	2,269 m3		
Surface Area	As=	907 m2		
	10	SOV IIIE		
Verification				
Surface Loading	Ţa	26.0 m3/m2/day		
Settling Time	Ts=	2.3 hr		
Wier Loading	Lw=	111 m3/m/day		
) Disinfection Tank		· · ·		
( Dry Weather )				
Design Flow Rate				
Daily Maximum in Dry Weather	Qdmd=	23,600 m3/day		
	12	983 m3/hr		
		16.4 m3/min.		
Design Condition Contact Time of Disinfection Tank		0		
(Contact time of Distingetton tank	TC=	8 min.		
Concace cime of bischarge ripe is	Required Volume	131 m3		
	noquirou fortano	101 mo		
Size of Structure				
Width	Bm	2.0 =	2.0 m	
Length	L∍	14.6 =	60.0 m	
Depth	H=	1.5 -	1.5 m	
Numbers	n≖	3 <b>=</b>	3 units	
Verification	· · · · ·			
Volume of Tank	V=	540 m3	· .	
Contact Time of Disinfection Tank	Tc∞	32.9 min.		*
(Wet Weather )				
Design Flow Rate				
Hourly Maximum in Wet Weather	Qhmw-	92,100 m3/day		
	Kat.	3,838 m3/hr		
	<b>H</b>	64.0 m3/min.		
Design Condition				
Contact Time of Disinfection Tank	Tc=	8 min.		
		o mini	- '	
	Required Volume=	512 m3		
	-			
Size of Structure				
Width	B=	2.0 =	2.0 m	
Length	[.≂	56.9 -	60.0 m	
Depth	Here	1.5 =	1.5 m	
Numbers	n==	3 =	3 units	
: **				
Verification				
Volume of Tank	V=	540 m3		
Contact Time	Tc≖	8.4 min.	а.	

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**#** 

	Gravity Thickener			
ļ	Design Flow Rate			
	Daily Maximum in Dry Weathe	r Qdmd-	23,600 m3/day	
J	Row Sludge		83 m3/day	
		(	1.66 t-DS/day )	
1	Excess Sludge		336 m3/day	
		. (	2.35 t-DS/day )	
	Total o	f Sludge Volume : Dv1*	419 m3/day	
		( Ds1=	4.01 t-DS/day )	
I	Design Condition			
	Type : Gravity Thickener			
	2	Ds1= 60 to	90 kg/m2 day	
	Required Surface Area			
	A=Ds1/I	Ds1= 44.6 to	66.8 m2	
	Thickening Time	Tt=	12 hr	
	Required Volume	V=Dv1*Tt≖	209.5 m3	
	Effective Depth	He=	4.0 m	
	( Require	ed Surface Area = V/He =	52.4 m2 )	
5	Size of Structure			
	Diameter	D=	5.8 ×	6.0 m
	Depth	H est.	4.0 -	4.0 m
	Numbers	. n=	2	2 units
	Effective Volume	V=	226.4 m3	
	Effective Surface Area	A**	56.6 m2	
τ	Verification			
	Solids Loading	LDs1'=	70.8 kg/m2 day	
	Thickening Time	Tt'=	13.0 hr	
Ţ	Jolume of Effluent			
•	Efficiency of Thickener	Et=	80 %	
	Solids Content	Dsl'=Dsl*Et=	3.21 t-DS/day	
	Moisture Content	D31 -D31 EC-	97 %	
	Effluent Volume	51	51 0	
		Dv1'=Ds1'*100/(100-Dw)=	107 m3/day	
T	hickened Sludge			
	Solids Content	Dst=Ds1-Ds1'=	0.80 t-DS/day	
	Moisture Content	Dw=	0.26 %	
	Volume of Thickened Sludge	Dvt=Dv1-Dv1'=	312 m3/day	
9} D	digester			
D	esign Sludge Volume	Dv2=Dv1'=	107 m3/day	
	Moisture Content	Dw∞	97 %	
	Solids Content	Ds2=Ds1'=	3.21 t-DS/day	
	rimary Digester	V1≈ Dv2 * 20 days =	2,139 m3	
Р				
	ize of Primary Digester			
	ize of Primary Digester Diameter	. D=	11.7 -	12.0 m

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Numbers		n=	4	-	4 units
Verification			,		
Digestion Time		Td≖	21.2	days	
Secondary Digester	V2⇔ Dv2 *	10 days =	1,069	mЭ	
Size of Secondary Digester					
Diameter		D≖	8.3	-	8.5 m
Depth		He≖	5.0	<u>×</u> z	5.0 m
Numbers		n≠	4	2 <b>2</b>	4 units
Verification			-		
Digestion Time		Td=	10.6	days	
Volume of Effluent					
Organic Matter Content		Co=	60	8	
Digestion Ratio		Rd=	50	8	
Efficiency of Digestion Tank		De≖	90	ક	·
Digestion Gas		Vg=	0.59	t-DS/day	
Solids Content	Ds2'=(D	s2-Vg)*De=	2.36	t-DS/day	
Moisture Content		Dw=	97	ક	
Effluent Volume					
E	v2'=Ds2'*100	/(100-Dw)≖	79 :	m3/day	
Digested Sludge	4 N				
Solids Content	Dsd≍Ds	2-Ds2'-Vg=	0.26	t-DS/day	
Moisture Content		Dw=	0.92	20	
Volume of Digested Sludge		Dvd≖	28	m3/day	
10) Dewatering					
Type : Centrifuge				1	
Design Sludge Volume		Dv3=Dv2'=		m3/day	· · · · ·
Operation Day in A Week		Td≖		days	
Operation Hour in A Day		Tt≕		hours	
	Dvd=Dv3*7c	lays/6days=	92	m3/day	
Required Capacity of Dewatering					
Capac	ity	Number		Total	
	4 m3/hr.x	2		8	m3/hr.
	7 m3/hr.x	1		7	
			Vr =	15	m3/hr.
Operation Time		¶t≖	Dvd/Vr=	6.1	hr.

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Design Calculation fo Bang Bua Thong Wastewater Treatment Plant for PRELIMINARY ENGINEERING DESIGN

(1) Design Discharge

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		m3/day	m3/min.	m3/sec.
Daily Average	(Qda)	9,100	6.32	0.105
Daily Maximum in Dry Weather	(Qdmd)	11,000	7.64	0.123
Hourly Maximum in Dry Weather	(Qhmd)	14,300	9.93	0.160
Hourly Maximum in Wet Weather	(Qhmw)	42,900	29.79	0.49
		Influent	Effluent	
BOD ( mg/l )		150	20	
SS ( mg/l )		150	30	

(2) Design Calculation

1) Grit Chamber				
( Dry Weather )				
Design Flow Rate				
Hourly Maximum in Dry Wea	ther Qhmd=	14,300 m3	3/day	
· · · · · · · · · · · · · · · · · · ·		0.166 m3	/sec.	
Design Condition				
Surface Loading	Ls=	1,800 m3	8/m2/day	
Average Velocity	Va=	0.3 m/	sec.	
Retention Time	Rs=	60 se	ec.	
Size				
Required Surface Area	A=Qhmd/L9=	7.94 m2	2	
Effective Depth	He=	0.4 m		
Required Width	Be≖	1.0 m		
Size of Structure				
Width	B=	1.0		1.0 m
Length	L=A/Be=	7.94		9.0 m
Depth	H=	0.4	#	0.4 m
Numbers	U ==	1	-	1 units
Verification				
Surface Loading	Ls=Qhmd/B/L/n=	1,589 m3	/m2/day	
Average Velocity	Va=Qhmd/B/He=	0.414 m/	sec.	
Retention Time	Rt=L/Va=	21.8 se	c.	
Volume of Grit	-			
	Qhmd*0.00001*1.8 t/m3=	0.26 t/	day	
Screenings	Ohmd*0.00001=	0.14 m3	-	
			-	

Design Flow Rate	Qhmw-Qdmd≕	28,400 m3/day	
- Hourly Maximum in Wet Weather		0.329 m3/sec.	
-Hourly Maximum in Dry Weathe	r ==	0.329 m3/8ec.	
proton Condition			· ·
Design Condition Surface Loading	<b>L</b> 3₩	3,600 m3/m2/day	
Average Velocity	Va=	0.6 m/sec.	
Retention Time	Rs≖	30 sec.	
Recention lime	K9	30 360.	
Size			
Required Surface Area	A≃Qhmw/Ls=	7.89 m2	
Effective Depth	He=	0.4 m	
Required Width	Be≕	1.4 m	
Size of Structure			
Width	B=	1.4 =	1.4 m
Length	L⇒A/Be=	5.63 -	9.0 m
Depth	Н==	0.4 ≔	0.4 m
Numbers	n=	1 =	1 unit
Verification	i		
Surface Loading	Ls=Qhmw/B/L/n=	2,254 m3/m2/day	
Average Velocity	Va=Qhmw/B/He=	0.587 m/sec.	
Retention Time	Rt=L/Va≕	15.3 sec.	
Volume of Grit			
Qhm	v*0.00001*1.8 t/m3≖	0.51 t/day	
Screenings	Qhmw*0.00001=	0.28 m3/day	

(Inflow Pump for Wastewater)

Hourly Maximum in Dry Weather

Qhmd= 9.86 m3/min.

	4.93 m3/	min.	x	2 pumps =	E	9.86	m3/min.
(	Dia.=	250	mm,	v	/=	1.68	m/s)

(Inflow Pump for Storm Water) Hourly Maximum in Wet Weather

Qhmw= 29.58 m3/min.

4.93 n	n3/min.	x	2 pum		9.86	m3/min.
(Dia.=	250	mm,		V	1.68	m/s)
19.72 n	n3/min.	x	l pump	os ≕	19.72	m3/min.
( Dia.=	450	mm,		V≖	2.08	m/s)
	Total				29.58	m3/min.

	Primary Sedimentation Tank			
	Design Flow Rate	0 h	10 000 -2/2	
	Daily Maximum in Dry Weather	Qhmd×	10,900 m3/day 454 m3/hr	
	Design Condition			
	Surface Loading	Ls=	35 m3/m2/day	
	Settling Time	Ts=	3.0 hr	
	Effective Depth	He≓	4.0 m	
	Size			
	Required Surface Area	An=Qdmd/Ls=	311 m2	
	Required Tank Volume	V=Qdmd*Ts=	1,363 m3	
	Size of Structure			
	Diameter	D==	14.1 =	15.0 m
		H==	4.0 =	4.0 m
	Depth Numbers	n=	2 =	2 units
			_	
	Volume of Tank	V=	1,413 m3	
	Surface Area	As=	353 m2	
	Verification			
	Surface Loading	Ls≖	30.9 m3/m2/day	
	Settling Time	Ts=	3.1 hr	
	Wier Loading	Lw≖	116 m3/m/day	
~	Stormwater Sedimentation Tank			
4)	Design Flow Rate			
	Debign flow hato			
	Rourly Maximum in Wet Weather	Ohmw-Odmd-	31,700 m3/day	
	<ul> <li>Hourly Maximum in Wet Weather</li> <li>Daily Maximum in Dry Weather</li> </ul>	Qhmw-Qdmd <b>∞</b> ≕	31,700 m3/day 1,321 m3/hr	
	- Daily Maximum in Dry Weather			
	- Daily Maximum in Dry Weather Design Condition		1,321 m3/hr	
	- Daily Maximum in Dry Weather Design Condition Surface Loading		1,321 m3/hr 70 m3/m2/day	
	- Daily Maximum in Dry Weather Design Condition Surface Loading Settling Time		1,321 m3/hr 70 m3/m2/day	
	- Daily Maximum in Dry Weather Design Condition Surface Loading	== Ls** Ts=	1,321 m3/hr 70 m3/m2/day 0.5 hr	
	- Daily Maximum in Dry Weather Design Condition Surface Loading Settling Time	== Ls** Ts=	1,321 m3/hr 70 m3/m2/day 0.5 hr	
	- Daily Maximum in Dry Weather Design Condition Surface Loading Settling Time Effective Depth Size Required Surface Area	== Ls** Ts=	1,321 m3/hr 70 m3/m2/day 0.5 hr	
	- Daily Maximum in Dry Weather Design Condition Surface Loading Settling Time Effective Depth Size	== Ls≖ Ts= He≕	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m	
	- Daily Maximum in Dry Weather Design Condition Surface Loading Settling Time Effective Depth Size Required Surface Area	== Ls≖ Ts= He≕ An≕Qdmw/Ls=	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2	
	- Daily Maximum in Dry Weather Design Condition Surface Loading Settling Time Effective Depth Size Required Surface Area Required Tank Volume	== Ls≖ Ts= He≕ An≕Qdmw/Ls=	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2	14.0 m
	- Daily Maximum in Dry Weather Design Condition Surface Loading Settling Time Effective Depth Size Required Surface Area Required Tank Volume Size of Structure	= Ls≖ Ts= He≕ An≈Qdmw/Ls= Lw=Qdmw*Ts≕	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2 660 m3	14.0 m 3.0 m
	<ul> <li>Daily Maximum in Dry Weather</li> <li>Design Condition Surface Loading Settling Time Effective Depth</li> <li>Size Required Surface Area Required Tank Volume</li> <li>Size of Structure Diameter</li> </ul>	= Ls Ts= He He An=Qdmw/Ls= Lw=Qdmw*Ts= D=	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2 660 m3 13.9 =	3.0 m
	<ul> <li>Daily Maximum in Dry Weather</li> <li>Design Condition Surface Loading Settling Time Effective Depth</li> <li>Size Required Surface Area Required Tank Volume</li> <li>Size of Structure Diameter Depth</li> </ul>	== Ls== Ts== He== He== Lw=Qdmw*Ts== D= H==	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2 660 m3 13.9 = 3.0 =	3.0 m
	<ul> <li>Daily Maximum in Dry Weather</li> <li>Design Condition Surface Loading Settling Time Effective Depth</li> <li>Size Required Surface Area Required Tank Volume</li> <li>Size of Structure Diameter Depth Numbers</li> </ul>	= Ls** Ts= He≠ An≈Qdmw/Ls= Lw=Qdmw*Ts≠ D= H≈ n≠	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2 660 m3 13.9 = 3.0 = 3.0 = 3 =	3.0 m
	<ul> <li>Daily Maximum in Dry Weather</li> <li>Design Condition Surface Loading Settling Time Effective Depth</li> <li>Size Required Surface Area Required Tank Volume</li> <li>Size of Structure Diameter Depth Numbers</li> <li>Volume of Tank Surface Area</li> </ul>	= Ls Ts He He An≈Qdmw/Ls Lw=Qdmw*Ts D= H= n ≭	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2 660 m3 13.9 = 3.0 = 3 = 1,385 m3	3.0 m
	<ul> <li>Daily Maximum in Dry Weather</li> <li>Design Condition Surface Loading Settling Time Effective Depth</li> <li>Size Required Surface Area Required Tank Volume</li> <li>Size of Structure Diameter Depth Numbers</li> <li>Volume of Tank Surface Area</li> <li>Verification</li> </ul>	= Ls= Ts= He= He= Lw=Qdmw*Ts= D= H= n= N= N= As=	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2 660 m3 13.9 = 3.0 = 3 = 1,385 m3 462 m2	
	<ul> <li>Daily Maximum in Dry Weather</li> <li>Design Condition Surface Loading Settling Time Effective Depth</li> <li>Size Required Surface Area Required Tank Volume</li> <li>Size of Structure Diameter Depth Numbers</li> <li>Volume of Tank Surface Area</li> </ul>	= Ls Ts He He An≈Qdmw/Ls Lw=Qdmw*Ts D= H= n ≭	1,321 m3/hr 70 m3/m2/day 0.5 hr 3.0 m 453 m2 660 m3 13.9 = 3.0 = 3 = 1,385 m3	3.0 m

Aeration Tank Design Wastewater Quality			
Design wastewater Quality		105 11	•
	C1 (BOD) :	105 mg/1	
Design Flow Rate	C1 (SS) :	98 mg/1	
Daily Maximum in Dry Weath	er Qdmd=	10,900 m3/day	
sarry neuron in bij neuen		10,500 m5/day	
Design Condition			
Aeration Time	Таю	6.0 hr	
BOD - SS Loading	Ls=	0.35 kg/kg/day	
Return Sludge Ratio	Rs=	25.0 %	
Return Sludge Solid Concen	tration Cr*	7,000 mg/1	
			·
Size			
MLSS	·		
	3)+Cr*Rs/100)/(1+Rs/100)=	1,478 mg/l	
Required Tank Volume	D)/(BOD-SS Loading)*MLSS=	2,212 m3	
v-Zanaci (Bol	With the second se	2,212 MJ	
Size of Structure			
Width	B=	12.0 =	12.0 m
Length	L'=Vn/H/n=	30.7 -	36.0 m
Depth	· H=	3.0 =	3.0 m
Numbers	n=a	2 =	2 unita
Verification			
Cross Section	A=B*H-0.3^2≖	35.91 m2	
Volume	V=A*L'*n=	2,586 m3	
BOD - SS Loading		2,000 m3	
2	Ls=Qdmd*C1/V/MLSS=	0.30 kg/kg/day	
Aeration Time	Ta=V/Qdmd*24=	5.69 hr	
BOD Volumetric Load	• •		
	Lv=Qdmd*Ci(BOD)/V/1,000=	0.44 kg/m3/day	
Sludge Age	· · · · · · · · · · · · · · · · · · ·	н Н	
	Sa⇔MLSS*V/Qdmd/C1(SS)=	3.60 days	
Secondary Sedimentation Tank			
Design Flow Rate			
Daily Maximum in Dry Weathe	er Qdmd=	10,900 m3/day	
		454 m3/hr	
Design Condition			
Surface Loading	Ls=	25 m3/m2/day	
Settling Time	Ts=	2.5 hr	
Effective Depth	He=	2.5 m	
Size			
Required Surface Area	A=Qdmd/Ls=	436 m2	
Required Tank Volume	A=Qdmd/Ls≡ Lw=Qdmd*Ts=	436 m2 1,135 m3	
	gome vd=	-, me	-
Size of Structure			
Diameter	D	17.0 🛏	17.0 m
Depth	H=	2.5 =	2.5 m
Numbers	n=	2 🗯	2 units

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	Volume of Tank	V=	1,134 m3	
	Surface Area	As≖	454 m2	
	Verification			
	Surface Loading	Ls≖	24.0 m3/m2/day	
	Settling Time	Ts=	2.5 hr	
	Wier Loading	L₩≈	102 m3/m/day	
	uter podoruð	2.0		
7)	Disinfection Tank			
• • •	( Dry Weather )			
	Design Flow Rate			а.
	Daily Maximum in Dry Weather	Qdmd∽	10,900 m3/day	
	Parth Having In pri noronos	¥	454 m3/hr	
			7.6 m3/min.	
			/ O moy mins	
	Design Condition			
	Contact Time	Tc≠	8 min.	
			o min.	
	(Contact time of Discharge Pipe is	Required Volume=	61 m3	
		Keduited Aorame-	OI MJ	
	Size of Structure			
	Width	B=	2.0 ==	2.0 m
		L=	6.7 =	60.0 m
	Length	H=	1.5 =	1.5 m
	Depth	n=	3 =	3 units
	Numbers	11	J	2 011202
	Verification	V≖	540 m3	
	Volume of Tank Contact Time of Disinfection Tank	Tc=	71.3 min.	
	Contact Time of Distillection Tank	10-	71.5 min.	
	( Mat Manthon )			
•	( Wet Weather ) Design Flow Rate			
	Hourly Maximum in Wet Weather	Qhmw≠	42,600 m3/day	
	hourry maximum in met heather	₩ ₩	1,775 m3/hr	
		=	29.6 m3/min.	
		_	25.0 m57 min.	
	Deater Condition			
	Design Condition	Tc≓	8 min.	
	Contact Time	10-	o min.	
		Required Volume=	237 m3	
		vedniied Aoinme-	237 MJ	
	Size of Structure			
	Width	B=	2.0 =	2.0 m
		D⇒ L=	26.3 =	2.0 m
	Length	H= T=	1.5 =	1.5 m
	Depth	n= n=	3 =	3 units
	Numbers	II≖	<u>ـــر</u>	J UNALD
	Norification			
	Verification Volume of Tank	V=	540 m3	
		TC=	18.3 min.	
	Contact Time	10-	TOLO UPUL	

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8)	Gravity Thickener						
	Design Flow Rate						
	Daily Maximum in Dry Weather			Qdmd=	10,900	m3/day	
	Row Sludge					n3/day	
				(	0.77 1	t-DS/day )	· · ·
	Excess Sludge				155 1	n3/day	
			-	(	1.08	-DS/day )	
		Total of Sludge	e Volume	: Dv1=	193 r	n3/day	· · · · ·
				( Ds1-	1.85 t	:-DS/day )	
	Design Condition						
	Type : Gravity Thio	ckener					
	Solids Loading	LDs1≃	60	to	90 }	rg/m2 day	
	Required Surface Area	a					
		A=Ds1/LDs1=	20.6	to	30.8 n	n2	
	Thickening Time			Tt=	12 1		
	Required Volume		v=	Dv1*Tt≖	96.5 r		
	Effective Depth			He=	4.0 n		
		Required Surfa	ce Area =		24.1 n		
		Weddited putto	ice Area -	v/ne -	43.I I		
	Size of Structure						
	Diameter			D≖			<b>C A</b>
	Depth			1	-5.5		6.0 m
	Numbers			H=	4.0	-	4.0 m
	Numbers			n⇒	1	-	1 units
	Effective Volume			V=	113.2 m		
	Effective Surface Are				28.3 n		
	Effective Sufface Ale	a		À=	28.5 1	12	
					1.		
	Verification				·		
	Solids Loading			LDs1'≖		g/m2 day	
	Thickening Time			Tt'≕	14.1 h	r	
	Volume of Effluent						
	Efficiency of Thicker	her		Et≃	80 %	•	
	Solids Content		Dsl'≏	)sl*Et=	1.48 t	-DS/day	
	Moisture Content			Dw=	97 ቼ		
	Effluent Volume						
		Dv1'≍Ds	1'*100/(1	00-Dw) =	49 m	3/day	
	Thickened Sludge						
	Solids Content		Dst=Ds	l-Ds1'≖	0.37 t	-DS/day	4
	Moisture Content			Dw=	0.26 %		
	Volume of Thickened S	Sludge	Dvt=Dv	l-Dv1'≖	144 m	3/day	
9)	Digester			1. A. A. A.			
	Design Sludge Volume		Dv	?≖Dvl'=	49 m	3/day	
	Moisture Content		24	Dvi = Dw≕	97 %	-	
	Solids Content		Ds	2∝Dsl'=		-DS/day	
	Primary Digester	Dv2 * 20	days =	987 m	3		
	Size of Primary Digester	:			· .		
	Diameter			D=	11.2	24	12.0 m
	Depth	,		He=	5.0	#X	5.0 m

Numbers		n=-	2	#S	2 units
Verification					
Digestion Time		Td≖	22.9 d	ays	
Secondary Digester	V2≕ Dv2 v	* 10 days 🛥	493 m	3	
Size of Secondary Digester					
Diameter		D=	7.9	200	8.5 m
Depth		He=	5.0	-	5.0 m
Numbers		Ω <b>≕</b>	2		2 units
Verification					
Digestion Time		Td≂	11.5 d	ays	
Volume of Effluent					
Organic Matter Content		Co≃	60 %		
Digestion Ratio		Rd=	50 %		
Efficiency of Digestion Tank		De=	90 %		
Digestion Gas	•	Vg≠	0.27 t	-DS/da	y
Solids Content	Ds2'=(I	)s2-Vg)*De=	1.09 t		-
Moisture Content		D₩≕	97 %		
Effluent Volume		24	5, 0		
	v2'=Ds2'*100	)/(100-Dw) =	36 m	3/day	
Digested Sludge			A 44 4	56()	
Solids Content	DSC=DS	2-Ds2'-Vg=	0.12 t	-DS/da	У
Moisture Content		Dw=	0.93 %	2 ( -1	
Volume of Digested Sludge		Dvd=	13 m.	3/day	
10) Dewatering					
Type : Centrifuge					
Design Sludge Volume		Dv3=Dv2'=	36 m.	3/day	
Operation Day in A Week		Td=	6 da		
Operation Hour in A Day		Tt=		ours	
Dewatered Sludge Volume		lays/6days=	42 m3	3/day	
Required Capacity of Dewatering					
Capaci	lty	Number		Tota	1
	4 m3/hr.x	2	=	8	m3/hr.
			Vr =	8	m3/hr.
Operation Time		ባ <u>ነ</u> ተ =1	)vd/Vr=	5	3 hr.
-Formeron and		1 U - L		~•	

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Calculation for Mechanical Surface Aerator of Bang Bua Thong Wastewater Treatment Plant for Mater Plan

1. Design Condition					
a. Design Flow					
Daily Average	: Qa	19,700 1	•		
Daily Maximum	: Qm	23,600 1	•		
b. Influent Quality (BOD)	: Qb	105 1	•		
c. BOD Removal Efficiency	: €	81 9			
d. Temperature	: T	25 °	C		
2. Influent BOD : Bw kg/c $Bw = \gamma \cdot Qb \cdot Qa$ $\gamma = Load$ Bw = 2,482 H	• 10^(-3) Factor = D	Daily Maximum(Qn	1) / Daily Av	rerage(Qa)	
3. Excluded BOD : Br kg/	day				
$Br = Bw \cdot \epsilon \cdot 10^{4}$	-				
Br = 2,010 H	kg/day				
4. Supplied Oxygen in Operation	: Na	kgO2 / hr			
$Na = Br \cdot \eta / 24$					
		gen for Exclusion o	f Unit BOD I	kg = 0.8	
$\underline{Na} = 67 k$	gO2/hr				
$Csw = \beta$ $\beta : C$ Css : C Cl : Dissolved C Cs : Oxygen Sat $T : 25^{\circ}C$ $(1.024)^{(T-20)} :$	/Cs}(1.024 ansfer into • Css= Dxygen Sat Dxygen Sat Dxygen = 2	l)^(T-20) Wastewater/ Oxyg 7.542 m uration in Wastewa uration in Pure Wa	g/l tter / Oxygen ter in T $^{\circ}C =$		
6. Supplied Oxygen per Motor Pov	wer of Aera	ator . Ns kø	$\frac{1}{2}/\frac{1}{kw}$		
$5 \sim 20 \text{ HP}$ :		gO2/kw/hr			
$25 \sim 50 \text{ HP}$ :		gO2/kw/hr			
$60 \sim 150 \text{ HP}$ :	1.7 kg	gO2 / kw / hr			
7. Required Power of Aerator : $HP = N / (Ns \cdot Ef \cdot N)$ Ef = Gear Reaction N0 = Numb HP = 112.9	n Factor :	5 ~ 20 HP : Ef 25 ~ 150 HP : Ef	= 96.7 %		
11 1				· · · · · · · · · · · · · · · · · · ·	e e e e e e e e e e e e e e e e e e e
<u>11 kw x</u>	3	units =	33	kw	
	3	units/basin	33	kw/basin	•

Calculation for Mechanical Surface Aerator of Bang Bua Thong Wastewater Treatment Plant for Preliminary Engineering Deign

1. Design Condition a. Design Flow **Daily Average** : Oa 9,030 m3/day Daily Maximum : Om 10.900 m3/day b. Influent Quality (BOD) : Qb 105 mg/l c. BOD Removal Efficiency 81 % : ε d. Temperature : T 25 C 2. Influent BOD Bw kg/day :  $Bw = \gamma \cdot Ob \cdot Qa \cdot 10^{-3}$  $\gamma$  = Load Factor = Daily Maximum(Qm) / Daily Average(Qa) Bw =1,138 kg/day 3. Excluded BOD : Br kg/day.  $Br = Bw \cdot \epsilon \cdot 10^{-2}$ Br =922 kg/day 4. Supplied Oxygen in Operation : Na kgO2 / hr  $Na = Br \cdot \eta / 24$  $\eta$  = Required Oxygen for Exclusion of Unit BOD kg = 0.8 Na = 30.7 kgO2/hr 5. Oxygen Transfer in Standard Condition : N kgO2 / hr  $N = Na/\alpha \{(Csw-Cl)/Cs\}(1.024)^{(T-20)}$  $\alpha$ : Oxygen Transfer into Wastewater/Oxygen Transfer into Pure Water = 0.8  $Csw = \beta \cdot Css =$ 7.542 mg/l  $\beta$ : Oxygen Saturation in Wastewater / Oxygen Saturation in Pure Water = 0.9 Css: Oxygen Saturation in Pure Water in T C = 8.38 mg/l Cl : Dissolved Oxygen = 2.0 mg/lCs: Oxygen Saturation in Pure Water in Standard Condition = 9.17 mg/l т: 25°C (1.024)^(T-20) : 1.126 71.5 kgO2/hr N == 6. Supplied Oxygen per Motor Power of Aerator : Ns kgO2/kw/hr  $5 \sim 20 \text{ HP}$ kgO2/kw/hr 1.9  $25 \sim 50 \text{ HP}$ 1.8 kgO2/kw/hr  $60 \sim 150 \text{ HP}$ 1.7 kgO2/kw/hr 7. Required Power of Aerator HP  $HP = N / (Ns \cdot Ef \cdot N0 \cdot 0.7457)$ Ef = Gear Reuction Factor :  $5 \sim 20$  HP : Ef = 97.5 % :  $25 \sim 150 \text{ HP}$  : Ef = 96.7 % N0 = Number of Aerator HP =51.8 25.9 kw/basin kw =11 kw 3 units 33 X == kw 3 units/basin 33 kw/basin

Hydraulic Calculation of Bang Bua Thong Treatment Plant

1. Design Condition

1) Design Wastewater Quantity

		:	
Preliminary Design	(m <sup>3</sup> /day)	(m <sup>3</sup> /min)	(m <sup>3</sup> /sec)
Daily Average	9,030	6.27	0.105
(Qdap)			
Daily Max.	10,900	7.57	0.126
(Qdmp)			
Hourly Max. (dry)	14,200	9.86	0.164
(Qhmdp)		-	
Hourly Max. (wet)	42,600	29.58	0.493
(Qhmwp)			
Master Plan	(m <sup>3</sup> /day)	(m <sup>3</sup> /min)	(m <sup>3</sup> /sec)
Daily Average	19,700	13.68	0.228
(Qdam)			
Daily Max.	23,600	16.39	0.273
(Qdmm)			
Hourly Max. (dry)	30,700	21.32	0.355
(Qhmdm)			·
Hourly Max. (wet)	92,100	63.96	1.066
(Qhmwm)			

2) Unit and Capacity of Treatment Facility

Unit of each treatment facility is as follows.

	U	nit
	Preliminary Design	Master Plan
Primary Sedimentation Tank	2	4
Aeration Tank	2	4
Final Sedimentation Tank	2	4
Disinfection Tank	1	1
Gravity Thickener	1	2
Digestion Tank (1st)	2	4
Digestion Tank (2nd)	2	4
Dewatering	1	1

3) Inlet Pipe

Pipe Diameter	1,200 mm
Gradient	0.1 %
Invert Elevation of Inlet Pipe	MSL - 3.5 m
4) Design Grand Elevation	MSL + 2.3 m

5) Discharge

Discharge Point		Khlong Ban Kluai
HWL		MSL + 0.71
Discharge Pipe	Diameter	1,200 mm
	Length	260 m

6) Formula for Hydraulic Calculation

Manning's Formula n = 0.013

2. Hydraulic Calculation

1).Water Level of Disinfection Tank Effluent Chamber (WL 1)

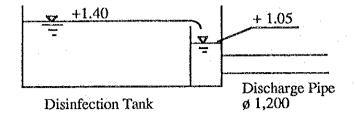
Design Water	$Qhmwm = 92,100 m3/day = 1.066 m^3/sec$
Velocity	V= $1.066/(1.2^{2} \times \pi/4) = 0.942$ m/sec
Hydraulic Gradient	i= 0.08 %
Friction Loss	l=0.08 % x 260 m = 0.208 m

WL 1 = +0.71 + 0.208 = 0.918 say +1.05 m

2) Water Level of Disinfection Tank (WL 2)

Water Depth of Effluent Weir

Widht of Weir = 4.0 mh = (Qhmwm / ( $1.84 \times 4.0$ ))^(2/3) = 0.28 m



WL 2 = 1.05 + 0.28 = 1.33 say  $\pm 1.40$  m

3) Hydraulic Loss of Connection Pipe of D.T and F.S.T

Diameter $\emptyset$  600 mmLenght170 mDesign WaterQdmm = 0.273 m³ / secVelocityv = 0.971 m / secHydraulic Gradienti = 0.2 %Hydraulic Loss = 170 m x 0.2 % = 0.34 m

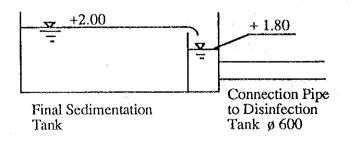
4) Water Level of Final Sedimentation Tank Effluent Chamber (WL 3)

WL 3 = +1.40 + 0.34 = +1.74 m say +1.80 m

5) Water Level of Final Sedimentation Tank (WL 4)

Water Depth of Effluent Triangle Weir

Length of Weir =  $\emptyset$  18.5 x  $\pi$  = 57 m Design Water per unit weir long q = (Qdmm / 4) / 57 = 0.0012 m<sup>3</sup> / m / sec h = (q / 1.42)^(2/5) = 0.06 m WL 4 = + 1.80 + 0.06 =+ 1.86 say + 2.00



6) Hydraulic Loss of Connection Pipe of F.S.T and aeration Tank

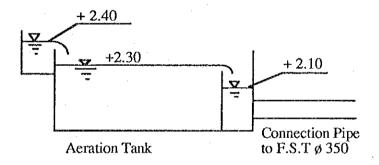
Diameter $\emptyset$  350 mmLenght20 mDesign WaterQdmm / 4= 0.273 m³ / sec / 4 = 0.068 m³ / secVelocityv = 0.711 m / secHydraulic Gradienti = 0.22 %Hydraulic Loss = 20 m x 0.22 % = 0.044 m

7) Water Level of Aeration Tank Effluent Chamber (WL 5)

WL 5 = +2.00 + 0.044 = +2.044 say +2.10 m

8) Water Level of Aeration Tank (WL 6)

Water Depth of Effluent Weir Width of Weir = 3 m  $h = (Qdmm/4/(1.84 \times 3.0))^{(2/3)} = 0.05 m$ 



WL 6 = +2.10 + 0.05 = +2.15 say +2.30 m

9) Water Level of Areration Tank Influent Chamber (WL 7)

Water Depth of Influent Weir Width of Weir = 3.0 mh = (Qdmm / 4 / (1.84 x 3)) ^ (2/3) = 0.05 m

WL 7 = +2.30 + 0.05 = +2.35 say +2.40 m

10) Hydraulic Loss of Connection Pipe of A.T to P.S T

Diameter

ø 350 mm

Lenght20 mDesign Water $Qdmm/4=0.273 m^3 / sec/4=0.068 m^3 / sec$ Velocityv = 0.711 m / secHydraulic Gradienti = 0.22 %Hydraulic Loss = 20 m x 0.22 % = 0.044 m

11) Water Level of Primary Sedimentation Tank Effluent Chamber (WL 8)

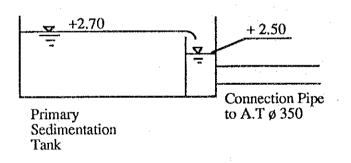
WL 8 = +2.40 + 0.044 = +2.44 say +2.50 m

12) Water Level of Primary Sedimentation Tank (WL 9)

Water Depth of Effluent Weir

Triangle Weir Width = 47 m Design Water per unit weir long  $q = (Qdmm / 4) / 47 = 0.0015 \text{ m}^3 / \text{m} / \text{sec}$  $h = (q / 1.42) \land (2/5) = 0.06 \text{ m}$ 

WL 9 = +2.50 + 0.06 = +2.56 say +2.70 m



13) Hydraulic Loss of Connection Pipe of P.S T to Distribution Tank

Diameter $\emptyset$  350 mmLenght20 mDesign WaterQdmm / 4= 0.273 m³ / sec / 4 = 0.068 m³ / secVelocityv = 0.711 m / secHydraulic Gradienti = 0.22 %Hydraulic Loss = 50 m x 0.22 % = 0.11 m

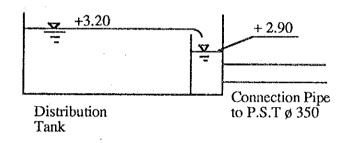
14) Water Level of Distribution Tank Effluent Chamber (WL 10)

# WL 10 = +2.70 + 0.11 = +2.81 say +2.90 m

### 15) Water Level of Distribution Tank (WL 11)

Water Depth of Effluent Weir Weir Width = 1.0 m h = (Qdmm / 4 / (1.84 x 1.0) ^ (2/3) = 0.111 m

WL 
$$11 = +2.90 + 0.111 = +3.011$$
 say  $+3.20$  m



3.9.1.1 Unit Construction Cost of Wastewater Collection Facilities

Unit Construction Cost of Interceptors Table 3.9.1.1 (1)-1

Diameter (mm)	300	400	500	600	800	1000	1200	1500
	- I		1	· }				
(1) Quantity								
Earth Covering Depth (m)	÷	•	•	•	•	•	•	
Outer of Diameter (m)	0.40	ŝ	9.	٢.	თ.	5	4	ω,
Width of Excavation (m)	$^{\circ}$	Ч.	2	ი.	ц Г	80	٥.	4.
Excavation Depth (m)	۰.	H	ς,	4	۲.	Ο.	с. С	٢.
Sheetpile Length (m)	1	3.23	3.45	3.66	4.11	4.54	4.97	
Volume of Pavement (m3)	0.35		4	4.	ς.	9.	٢.	0.84
Excavation (Backhoe m3)	°.	4	ω.	~	<u></u> м	ഹ	5	0
Backfill (granular m3)	0.57	0.71	0.84	0.98	1.28	1.60	1.94	2.50
Backfill (original m3)	ი.	٩,	2	<del>ا</del> ته •	εΩ,	ς,	ω.	ω,
Backfill (selected soil m3)	4	2	e,	4	9.	თ.	2	ц. 8
Residual Soil (m3)	•	en en	9.	α,	ŝ	Ц	<del>م</del>	-1
Pavement (m2)	9.	٢.	ω.	ი.	Ч.	4.	6.	°.
Sheetpile Length (m)	ı	6.1	4		ŝ	٢.	4.8	8.1
Sheetpile (kg)	ł	.2	8.0	8.4	6.4	9.6	°,	2
Bracing (kg)	1	5 5	9	r-	0	3	ទ ទ	ē1
(2) Construction Cost (Baht/m)								
Unit Cost								· · · · ·
Excavation (Backhoe) 60.0	0	44.	÷.	5	19	30.	07.	0
(granular) 3	. 171.	'n	52.	44 •	4	<b>.</b>	82.	50.
(original)	54.	64.	م	85.	11.	40.	73.	31.
ected soil) 3	51.	3	<u>.</u>	9	98.	.67	72.	40.
Residual Soil 30.0	32.		ω.	0	ς. Ω	ŝ	17	54.
Pavement 400.0	40.	88.	36.	80.	76.	68.	,090	200.
Sheetpile (kg) 3.2		2,480.6	2,649.6	2,810.9	156.	3,486.7	817	4,323.8
Bracing (kg) 5.1	1	,274.	,351.	,432.	, 555.	,703.	,845.	141.
Pipe/Laying 1 ls	253.0	350.0	439.0	509.0	779.0	5		10
Dewatering/Others I ls	•		•	0.	2.	15.2	19.0	
Total	1,329.9	6,335.7	6,830.2	7,302.2	8,408.3	9,765.0	11,036.6	13, 608.6

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Table 3.9.1.1 (1)-2

Unit Construction Cost of Interceptors

Diameter (mm)		300	400	500	600	800	1000	1200	1500
(1) Quantity		:	•						
Earth Covering Depth (m)			•	•		•	3	3	~
Outer of Diameter (m)	<u></u>	4	പ	9.	٢.	o,	2.	4	00
Width of Excavation (m)		°,	4	Ч.	'n.	'n.	<sup>o</sup>	٩,	4
Excavation Depth (m)		റ	φ,	ω,	σ.	2	ŝ	°°	2
Sheetpile Length (m)		3.75	3.98	4.20	4.41	4.86	5.29	5.72	6.38
Volume of Pavement (m3)	<sup>:</sup>	ς.	3	4	4	ŝ	s.	5	8
		u	d		Ø	r	5	α	Ç
		<u>,</u> ,	<u>р</u> (	r (	n e	• •	μ. ,		1 u > c
-		ກ່	~ '	0	ית		0	<i>n</i> (	ņ, (
(original		4	é,	8	H.	0	N.	ກ	<u>,</u>
Backfill (selected soil m3)	G)	Ļ	4	ς,	4	9.	ი.	1.2	φ,
Residual Soil (m3)		0	പ	9	œ.	S.	4	ი	Ą
Pavement (m2)		φ.	۲.	ω,	ο.	4	4.	9	°.
Sheetpile Length (m)		8.7	е. е	о. Т	2.0	4.3	6.4	ဖ	σ
Sheetpile (kg)		900.006	955.20	1,008.00	1,058.40	1,166.40	1,269.60		1,531.20
Bracing (kg)		$\sim$	<b>4</b> "	461	-	0	m	ഗ	H
(2) Construction Cost (Baht/m)									
Unit	it Cost		·						
Excavation (Backhoe)	60.0	50.	78.	08.	38.	. 60	85.	69.	12.
Backfill (granular)	300.0		ω.	~	4	4.	0	82.	50.
Backfill (original)	60.0	84.	97.	12.	26.	59.	იი	35.	03.
Backfill (selected soil)	300.0	4	3	<u></u> ,	26.	98.	79.	72.	40.
Residual Soil	30.0	32.7	40.2	48.0	56.1	75.0	95.1	117.0	154.2
Pavement	400.0	40.	88.	36.	80.	76.	68.	,060.	,200.
Sheetpile (kg)	3.2	5	,056.	,225.	,386.	3	,062.	99.	.66
Bracing (kg)	с. Г.	,152.	74.	51.	32.	, 555.	703.	,845.	,141.
Fipe/Laying	L LS	٠	•	•	თ	თ	*	т	2,702.0
Dewatering/Others	l ls	7.6	8.5	9.5	10.9	12.7	15.2	19.0	5.
Total		6,422.1	6,978.9	7,480.6	7,959.8	9,080.3	10,450 2	11,736.2	14,328.6
	4	4	1						

Unit Construction Cost of Interceptors Table 3.9.1.1 (1)-3

Diameter (mm)		300	400	500	600	800	1000	1200	1500
(1) Quantity									
Earth Covering Depth (m)		•	•	3.0		•	•	1	
Outer of Diameter (m)		4	ທີ	9.	٢,	റ	2	4	00
Width of Excavation (m)		0	H	2	с.	н.5	ω	°	4
Excavation Depth (m)		'n	ω.	ω.	ი	2	ŝ	00	
Sheetpile Length (m)		5.25	5.48		5.91	6.36	5	2	0
Volume of Pavement (m3)		ς,	<u></u> .	4	4	ŝ	0.64	0.72	0.84
Excavation (Backhoe m3)		<u>ں</u>	· •	5	_ ო	5	~	α	ú
Backfill (granular m3)		0.57	0.71	0.84	0.98	1.28	1.60	46 H	2 IC
Backfill (original m3)		4	٢.	ч.	4	2	0	ი 	1
Backfill (selected soil m3)		4	2	۳.	4	9.	പ്പ	2	.00
Residual Soil (m3)		0	ц.	9.	ω.	ц.	Ч	S.	-
Pavement (m2)		°.	٢.	α,	ი.		4	9	୍
Sheetpile Length (m)		2.	4	പ്	ი. ი	ч. 1	ი. ო	6.1	9
		0.0	5.2	8.0	4.	4	9	8	2
Bracing (kg)		2	446	Ś	~	501	53	55	•
(2) Construction Cost (Baht/m)									
Unit	Cost								
i	60.0	Ъ0.	45.	82.	19.	04.	46	6	. V. ư
(granular)	300.0	171.0	213.0	252.0	294.0	384.0	480.0	82.	
(original)	60.0	44.	65.	86.	07.	54.	04.	58	47.5
(selected soil) 3	300.0	ц	N	<u>ъ</u>	26.	98.	79.	72.	40.
Residual Soil	30.0	3	<b>.</b>	ω.	56.	75.	95.	17	54
	400.0	40.	88.	36.	80.	76.	68.	.060.	200
Sheetpile (kg)	3.2	,032.	•	, 377.	ω.	,884.	,214.	, 545	051.
Bracing (kg)	5.1	52.	,274.	51.	,432.	52	703	2,845.8	3,141.6
Pipe/Laying 1	ls		•	•	თ	·		ĉ	Ś
Dewatering/Others 1	ls	7.6	8.5	9.5	ц П	$\sim$	•	5	25.
Total		7,694.1	8,265.3	8,781.4	9,273.8	10,423.1	11,820.6	13, 134.2	15,768.6
			-	-					

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Table 3.9.1.1 (1)-4

Unit Construction Cost of Interceptors

g Depth (m) eter (m) vation (m) pth (m) pth (m) gth (m) eter (m) 1.00 1.12 vation (m) 4.50 4.65 6.98 6.39 4.65 6.98 6.75 6.98 6.75 6.98 6.75 6.98 6.75 6.98 0.39 0.39 0.35 0.39 0.39 0.24 (m3) 1.60 1.72 3.41 3.87 0.24 (m3) 1.60 1.72 9.17 0.24 (m3) 1.60 1.72 9.27 0.31 0.24 4.65 1.72 1.72 9.17 0.24 1.67 1.72 9.17 0.24 1.67 1.72 9.17 0.21 0.23 1.77 9.17 0.21 0.23 1.77 9.17 0.24 0.23 1.72 0.24 0.23 0.23 0.24 0.17 0.21 0.23 0.23 0.24 0.23 0.24 0.22 0.23 0.24 0.22 0.24 0.22 0.24 0.22 0.24 0.22 0.23 0.24 0.22 0.23 0.24 0.22 0.17 0.23 0.24 0.22 0.24 0.22 0.17 0.24 0.22 0.24 0.22 0.17 0.23 0.24 0.27 0.23 0.24 0.22 0.17 0.23 0.24 0.17 0.23 0.24 0.17 0.23 0.24 0.17 0.23 0.23 0.23 0.23 0.24 0.17 0.23 0.23 0.23 0.23 0.24 0.17 0.23 0.23 0.23 0.23 0.27 0.27 0.23 0.23 0.23 0.23 0.23 0.24 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.22 0.23 0.23 0.22 0.23 0.23 0.22 0.23 0.22 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.23 0.22 0.23 0.22 0.23 0.22 0.23 0.22	4 4 4 5 5 5 5 5 5 5 5 5 5 5 5 5			•		•
Earth Covering Depth (m) $4.0$ $4.0$ Outter of Diameter (m) $0.40$ $0.52$ Width of Excavation (m) $1.00$ $1.12$ Excavation Depth (m) $0.40$ $0.52$ Sheetpile Length (m) $4.50$ $4.65$ Sheetpile Length (m) $6.75$ $6.98$ Volume of Pavement (m3) $6.75$ $6.98$ Volume of Pavement (m3) $0.35$ $0.39$ Excavation (Backhoe m3) $0.35$ $0.39$ Excavation (Backhoe m3) $0.35$ $0.341$ Backfill (granular m3) $3.41$ $3.87$ Backfill (selected soil m3) $0.17$ $0.24$ Residual Soil (m3) $1.09$ $1.72$ Sheetpile Length (m) $1.60$ $1.72$ Sheetpile Length (m) $1.60$ $1.72$ Backfill (selected soil m3) $1.60$ $1.72$ Sheetpile Kg) $1.60$ $1.72$ Sheetpile Kg) $1.60$ $1.72$ Sheetpile Kg) $1.60$ $1.72$ Sheetpile Kg) $1.60$ $1.72$ Bracing (kg) $0.0$ $270.0$ Brackfill (granular) $300.0$ $270.0$ Backfill (original) $300.0$ $270.0$ Backfill (original) $300.0$ $270.0$ Backfill (selected soil) $300.0$ $270.0$	04470 004044 4					
Outer of Diameter (m)       0.40       0.52         Width of Excavation (m)       1.00       1.12         Excavation Depth (m)       4.50       4.65         Sheetpile Length (m)       6.75       6.98         Sheetpile Length (m)       6.75       6.98         Volume of Pavement (m3)       0.35       0.39         Volume of Pavement (m3)       0.35       0.39         Volume of Pavement (m3)       0.57       0.71         Backfill (granular m3)       0.57       0.71         Backfill (selected soil m3)       0.17       0.24         Backfill (selected soil m3)       1.09       1.72         Sheetpile Length (m)       1.60       1.72         Sheetpile Kg)       1.60       2.70.0         Brackfill (selected soil m3)       33.75       34.90         Backfill (selected soil m3)       1.60       1.72         Brackfill (selected soil m3)       1.60       2.70.0         Brackfill (selected soil m3)       2.70.0       312.6      <	0 - - - - - - - - - - - - -			4.0	. 4.0	
Width of Excavation (m)       1.00       1.12         Excavation Depth (m)       4.50       4.65         Sheetpile Length (m)       6.75       6.98         Sheetpile Length (m)       0.35       0.39         Volume of Pavement (m3)       0.35       0.39         Volume of Pavement (m3)       0.35       0.39         Volume of Pavement (m3)       0.57       0.71         Backfill (granular m3)       3.41       3.87         Backfill (selected soil m3)       0.17       0.24         Backfill (selected soil m3)       1.09       1.72         Backfill (selected soil m3)       1.09       1.72         Sheetpile Length (m)       1.60       1.72         Sheetpile (kg)       1.620.00       1.72         Sheetpile (kg)       1.620.00       1.72         Sheetpile (kg)       1.60       2.70.0         Stacting (kg)       270.0       312.6         Backfill (granular)       300.0       270.0         Backfill (selected soil)       300.0       270.0         Stackfill (selected soil)       300.0       270.0         Backfill (selected soil)       300.0       270.0	1470 104044 1990 1990 1990 1990 1990 1990 199	5	ማ	$\sim$	4	α
Excavation Depth (m)       4.50       4.65         Sheetpile Length (m)       6.75       6.98         Sheetpile Length (m)       6.75       6.98         Volume of Pavement (m3)       0.35       0.39         Volume of Pavement (m3)       0.57       0.39         Excavation (Backhoe m3)       4.50       5.21         Backfill (granular m3)       0.57       0.71         Backfill (selected soil m3)       3.41       3.87         Backfill (selected soil m3)       1.09       1.72         Pavement (m2)       1.60       1.72         Sheetpile Length (m)       1.60       1.72         Sheetpile Kg)       1.60       1.72         Sheetpile Kg)       1.60       1.72         Sheetpile Kg)       1.60       1.72         Sheetpile Kg)       1.60       1.72         Bracing (kg)       2.00       1.675.20         Bracing (kg)       1.660       2.60.0         Bracing (kg)       2.00       2.70.0         Bracing (kg)       2.00       2.70.0         Brackfill (original)       300.0       2.70.0         Backfill (original)       300.0       2.70.0         Backfill (original)       300.0	1470 3040444 	<u>_</u>	- In	00		4
Sheetpile Length (m)       6.75       6.98         Volume of Pavement (m3)       0.35       0.39         Excavation (Backhoe m3)       0.57       0.39         Excavation (Backhoe m3)       4.50       5.21         Backfill (granular m3)       0.57       0.71         Backfill (granular m3)       0.17       0.24         Backfill (selected soil m3)       3.41       3.87         Backfill (selected soil m3)       1.09       1.72         Pavement (m2)       1.60       1.72         Sheetpile Length (m)       1.60       1.72         Sheetpile (kg)       1.60       1.72         Sheetpile (kg)       1.60       1.72         Bracing (kg)       2.70.0       312.6         Bracing (kg)       270.0       312.6         Backfill (original)       300.0       270.0         Backfill (selected soil)       300.0       270.0         Backfill (selected soil)       300.0       270.0	20 004044 104 000000000000000000000000000	ຸ ດ	0		×α	: `
Volume of Pavement (m3)       0.35       0.39         Excavation (Backhoe m3)       4.50       5.21         Backfill (granular m3)       0.57       0.71         Backfill (granular m3)       0.17       0.24         Backfill (selected soil m3)       0.17       0.24         Residual Soil (m3)       1.09       1.72         Residual Soil (m3)       1.09       1.72         Residual Soil (m3)       1.60       1.72         Residual Soil (m3)       1.60       1.72         Residual Soil (m3)       1.60       1.72         Restidual Soil (m3)       1.60       1.72         Restidual Soil (m3)       1.60       1.72         Restidual Soil (m3)       1.60       1.72         Sheetpile (kg)       1.60       1.65         Sheetpile (kg)       1.66       232.6         Brackfill (selected soil)       300.0       270.0         Backfill (selected soil)       300.0       270.0         Backfill (selected soil)       300.0       72.0	0 004044 	4	00			۱ <b>۳</b>
Excavation (Backhoe m3)       4.50       5.21         Backfill (granular m3)       0.57       0.71         Backfill (original m3)       0.17       0.24         Backfill (selected soil m3)       3.41       3.87         Backfill (selected soil m3)       1.09       1.72         Backfill (selected soil m3)       1.09       1.72         Backfill (selected soil m3)       1.09       1.72         Residual Soil (m3)       1.60       1.72         Restidual Soil (m3)       1.60       1.72         Restorile Length (m)       1.60       1.72         Sheetpile (kg)       1.65       34.90         Sheetpile (kg)       1.60       1.72         Bracing (kg)       1.60       1.675.20         Bracing (kg)       1.60.0       1.675.20         Brackfill (selected soil)       300.0       270.0         Backfill (granular)       300.0       270.0       312.6         Backfill (selected soil)       300.0       271.0       213.0         Backfill (selected soil)       300.0       270.0       72.0	0.40440 0.00 0.00 0.00 0.00 0.00 0.00 0	0.47	0.56	0.64	0.72	0.84
Excavation (Backnoe m3)       4.50       5.21         Backfill (granular m3)       0.57       0.71         Backfill (granular m3)       3.41       3.87         Backfill (selected soil m3)       1.09       1.34         Backfill (selected soil m3)       1.09       1.72         Backfill (selected soil m3)       1.09       1.72         Residual Soil (m3)       1.09       1.72         Restidual Soil (m3)       1.60       1.72         Restile Length (m)       33.75       34.90         Sheetpile (kg)       1.620.00       1.675.20         Bracing (kg)       1.620.00       1.675.20         Bracing (kg)       1.60       2.32.6         Construction Cost (Baht/m)       270.0       312.6         Excavation (Backnoe)       60.0       270.0       312.6         Backfill (granular)       300.0       270.0       232.2         Backfill (selected soil)       300.0       204.6       232.2	чо4044 9 в ч ч б в с		•			
Backfill (granular m3)       0.57       0.71         Backfill (original m3)       3.41       3.87         Backfill (original m3)       3.41       3.87         Backfill (selected soil m3)       1.09       1.34         Backfill (selected soil m3)       1.09       1.72         Residual Soil (m3)       1.09       1.72         Restidual Soil (m3)       1.60       1.72         Restidual Soil (m2)       1.60       1.72         Restidual Soil (m3)       1.60       1.72         Restidual Soil (m3)       1.60       1.72         Sheetpile Length (m)       33.75       34.90         Sheetpile (kg)       1.620.00       1.675.20         Bracing (kg)       1.620.00       1.675.20         Bracing (kg)       1.620.00       1.675.20         Construction Cost (Baht/m)       2.60.00       2.62.2         Excavation (Backhoe)       60.0       270.0       312.6         Backfill (granular)       300.0       171.0       213.0         Backfill (selected soil)       300.0       51.0       72.0	040447 8.9.9.9.9.9.9.9.9.9.9.9.9.9.9.9.9.9.9.9	9	ო	0	ő	0
Backfill (original m3)       3.41       3.87         Backfill (selected soil m3)       0.17       0.24         Residual Soil (m3)       1.09       1.34         Restdual Soil (m3)       1.09       1.72         Restdual Soil (m3)       1.09       1.72         Restdual Soil (m3)       1.60       1.72         Restdual Soil (m3)       1.60       1.72         Restdual Soil (m2)       33.75       34.90         Sheetpile Length (m)       33.75       34.90         Sheetpile (kg)       1,620.00       1,72         Bracing (kg)       1,620.00       1,675.20       1,7         Bracing (kg)       1,620.00       1,675.20       1,7         Construction Cost (Baht/m)       422       446       1,7         Construction Cost (Baht/m)       1,60.0       270.0       312.6         Backfill (granular)       300.0       270.0       312.6         Backfill (original)       60.0       204.6       233.2         Backfill (selected soil)       300.0       51.0       72.0	40110 9.990 9.900	ი.	2	.6	ი.	Ω,
Backfill (selected soil m3)       0.17       0.24         Residual Soil (m3)       1.09       1.34         Pavement (m2)       1.60       1.72         Sheetpile Length (m)       33.75       34.90         Sheetpile Kg)       1,600       1.72         Sheetpile Kg)       1,600       1.72         Sheetpile Kg)       33.75       34.90         Sheetpile Kg)       1,620.00       1,72         Bracing (kg)       422       446         Construction Cost (Baht/m)       422       446         Construction Cost (Baht/m)       270.0       312.6         Brackfill (granular)       300.0       171.0       213.0         Backfill (selected soil)       300.0       51.0       72.0	9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	°.	ω.	α,	0	ω,
Residual Soil (m3)       1.09       1.34         Pavement (m2)       1.60       1.72         Sheetpile Length (m)       33.75       34.90         Sheetpile (kg)       33.75       34.90         Sheetpile (kg)       1,620.00       1,675.20         Sheetpile (kg)       422       446         Bracing (kg)       422       446         Construction Cost (Baht/m)       1,620.00       1,675.20         Excavation (Backhoe)       60.0       270.0       312.6         Backfill (granular)       300.0       171.0       213.0         Backfill (selected soil)       300.0       51.0       72.0	9 00 0 1 1 1 1	4.	9.	<del>م</del> .	2	ŝ
Pavement (m2)       1.60       1.72         Sheetpile Length (m)       33.75       34.90         Sheetpile (kg)       33.75       34.90         Sheetpile (kg)       1,620.00       1,675.20       1,7         Bracing (kg)       422       446       1,7         Construction Cost (Baht/m)       422       446       1,7         Excavation (Backhoe)       60.0       270.0       312.6         Backfill (granular)       300.0       171.0       213.0         Backfill (selected soil)       300.0       51.0       72.0	ы. 1. 1.	°,	Ω.	-	<u>م</u>	Ч
Sheetpile Length (m)       33.75       34.90         Sheetpile (kg)       1,620.00       1,675.20       1,7         Bracing (kg)       422       446       446         Construction Cost (Baht/m)       422       436       1,7         Excavation (Backhoe)       60.0       270.0       312.6         Backfill (granular)       300.0       171.0       213.0         Backfill (original)       60.0       204.6       232.2         Backfill (selected soil)       300.0       51.0       72.0	(	<u></u> .	Ч.	4	9	0
Sheetpile (kg)       1,620.00       1,675.20       1,7         Bracing (kg)       422       446       446         Construction Cost (Baht/m)       422       436       1         Construction Cost (Baht/m)       10000       270.0       312.6       1         Excavation (Backhoe)       60.0       270.0       312.6       171.0       213.0         Backfill (granular)       300.0       171.0       213.0       232.2       172.0         Backfill (selected soil)       300.0       51.0       72.0       72.0	ې. م	37.05	е. Э	4	3.6	<u>σ</u> ,
Bracing (kg)       422       446         Construction Cost (Baht/m)       122       446         Construction Cost (Baht/m)       1011       123         Excavation (Backhoe)       60.0       270.0       312.6         Backfill (granular)       300.0       171.0       213.0         Backfill (original)       60.0       204.6       232.2         Backfill (selected soil)       300.0       51.0       72.0	28.0	00		ഗ	2,092.80	1
Construction Cost (Baht/m) Excavation (Backhoe) Excavation (Backhoe) Backfill (granular) Backfill (original) Backfill (selected soil) 300.0 51.0 51.0 72.0	ω	477		53	ŝ	19
Unit Cost     Unit Cost       cn (Backhoe)     60.0     270.0     312.6       (granular)     300.0     171.0     213.0       (original)     60.0     204.6     232.2       (selected soil)     300.0     51.0     72.0						
on (Backhoe) 60.0 270.0 312.6 (granular) 300.0 171.0 213.0 (original) 60.0 204.6 232.2 (selected soil) 300.0 51.0 72.0						
(granular) 300.0 171.0 213.0 (original) 60.0 204.6 232.2 (selected soil) 300.0 51.0 72.0	57.	.00	66	03.	15.	00.
(original) 60.0 204.6 232.2 (selected soil) 300.0 51.0 72.0	252.	4.	47	6	82	50.
(selected soil) 300.0 51.0 72.0	261.	88.	49.	ы Б.	81.	91°
	.66	26.	98.	79.	72.	401
Soil 32.7 40.	8	56.	75.	ເກ ດ	17.	54.
40.0 688.0	36	80.	76.	68.	,060.	200.
e (kg) 3.2 5,184.0 5,360.6 5,	529.6	5,690.9	6,036.5	,366	6,697.0	7,203.8
1 2,152.2 2,274.6 2,	51.1	32.	55.	03.	,845.	141.
ls 253.0 350.0	439.0	509.0	0.677			- 2
1 ls 7.6 8.	•	0	3	15.2	19-0	25
Total 8,966.1 9,551.7 10,0	082.2 I	0,587.8	11,765.9	13, 191.0	14,532.2	17,208.

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Unit Construction Cost of Interceptors Table 3.9.1.1 (1)-5

Diameter (mm)       300       400         vering Depth (m)       5.0       5.0         vering Depth (m)       0.40       0.40         Diameter (m)       1.00       1.100         Excavation (m)       0.35       8.6         on Depth (m)       8.25       8.6         on Length (m)       0.35       0.35         on (Backhoe m3)       0.35       0.17         on (Backhoe m3)       0.17       0.17         on (Backhoe m3)       0.17       0.17         on (Backhoe)       1.0980.00       2,035.5         e (kg)       1.980.00       2,035.5         e (kg)       1.980.00       2,035.5         on (Backhoe)       60.0       1.13         on (Backhoe)       60.0       2,035.5         on (Backhoe)       60.0       2,13         on (Backhoe)       60.0       2,13         on (Backhoe)       60.0       2,13         on (Backhoe)       60.0       2,13         on (Backhoe)       60.0       2,10         on (Backhoe)       60.0       2,13         on (Backhoe)       60.0       2,13         on (Bacular)       300.0       2,12    <							
Quantity5.0Quantity0.40Cuter of Diameter (m)0.40Width of Excavation (m)1.00Excavation Depth (m)0.40Excavation Depth (m)0.35Sheetpile Length (m)0.35Volume of Pavement (m3)8.25Sheetpill (granular m3)8.25Backfill (granular m3)0.57Backfill (selected soil m3)0.17Backfill (selected soil m3)0.17Pavement (m2)1.09Pavement (m2)1.09Sheetpile Length (m)0.17Backfill (selected soil m3)0.17Pavement (m2)1.09Pavement (m2)1.09Sheetpile (kg)1.980.00Sheetpile (kg)1.980.00Backfill (selected soil m3)1.980.00Sheetpile (kg)1.980.00Backfill (selected soil m3)1.990.00Backfill (selected soil m3)2.035.2Backfill (selected soil m3)2.000.0Backfill (selected soil m3)2.000.0Backfill (selected soil m3)2.000.0Backfill (selected soil)300.0Backfill (selected soil)300.0	0	500	600	800	1000	1200	1500
Earth Covering Depth (m) $5.0$ $5.0$ $5.0$ Outer of Diameter (m) $0.40$ $0.5$ Width of Excavation (m) $1.100$ $1.11$ Excavation Depth (m) $5.50$ $5.6$ Sheetpile Length (m) $8.25$ $8.4$ Sheetpile Length (m) $0.35$ $0.3$ Sheetpile Length (m) $0.57$ $0.7$ Excavation (Backhoe m3) $0.57$ $0.7$ Backfill (granular m3) $0.57$ $0.7$ Backfill (original m3) $0.17$ $0.27$ $0.7$ Residual Soil (m3) $1.09$ $1.7$ Residual Soil (m3) $1.09$ $1.7$ Sheetpile (kg) $1.7$ Sheetpile (kg) $1.71.0$ $2.035.2$ Bracing (kg) $1.71.0$ Excavation (Backhoe) $60.0$ $171.0$ $213$ . Backfill (original) $300.0$ $264.6$ $299$ .							
Outer of Diameter (m)       0.40       0.55         Width of Excavation Depth (m)       5.50       5.6         Excavation Depth (m)       5.50       5.6         Sheetpile Length (m)       0.35       0.3         Volume of Favement (m3)       0.35       0.3         Volume of Favement (m3)       0.57       0.35         Excavation (Backhoe m3)       0.57       0.3         Backfill (granular m3)       0.17       0.27         Backfill (selected soil m3)       0.17       0.2         Backfill (selected soil m3)       0.17       0.2         Pavement (m2)       1.980.00       1.73         Parement (m2)       1.980.00       2.035.2         Backfill (selected soil m3)       1.980.00       2.035.2         Sheetpile Length (m)       1.980.00       2.035.2         Backfill (selected soil m3)       1.980.00       2.035.2         Bracing (kg)       1.980.00       2.035.2         Bracing (kg)       1.980.00       2.035.2         Backfill (selected soil m3)       300.0       2.035.2         Backfill (selected soil m3)       300.0       2.035.2         Backfill (selected soil m3)       300.0       2.171.0         Backfill (selected soil	•	•		S	ഹ	n	ທ
Width of Excavation (m)       1.00       1.1         Excavation Depth (m)       5.50       5.6         Sheetpile Length (m)       8.25       8.4         Sheetpile Length (m)       0.35       0.3         Volume of Pavement (m3)       0.35       0.3         Volume of Pavement (m3)       8.25       8.4         Excavation (Backhoe m3)       0.35       0.3         Backfill (granular m3)       0.57       0.3         Backfill (selected soil m3)       0.17       0.2         Backfill (selected soil m3)       1.09       1.3         Backfill (selected soil m3)       0.17       0.2         Pavement (m2)       1.09       1.60       1.7         Pavement (m2)       1.60       1.7         Sheetpile Length (m)       1.60       2.035.2         Sheetpile Kg)       1.60       2.035.2         Brackfill (granular)       1.60       2.035.2         Brackfill (granular)       330.0       2.035.2         Backfill (granular)       300.0       264.6         Backfill (granular)       300.0       24.6         Backfill (granular)       300.0       217.0	'n	9	5	ი	0	4	°,
Excavation Depth (m)       5.50       5.6         Sheetpile Length (m)       8.25       8.4         Sheetpile Length (m)       8.25       0.35         Volume of Pavement (m3)       0.35       0.35         Excavation (Backhoe m3)       8.25       8.4         Backfill (granular m3)       0.57       0.37         Backfill (selected soil m3)       0.17       0.27         Backfill (selected soil m3)       0.17       0.2         Backfill (selected soil m3)       1.09       1.3         Pavement (m2)       1.09       1.60       1.7         Pavement (m2)       1.60       1.7         Sheetpile Length (m)       1.980.00       2.035.2         Sheetpile Length (m)       1.980.00       2.035.2         Construction Cost (Baht/m)       1.980.00       2.035.2         Backfill (granular)       300.0       264.6       299.         Backfill (original)       300.0       264.6       299.	Ч.	4	ო.	ທຸ	°.	٩,	4
Backfill (granular m3)       8.25       8.4         Volume of Pavement (m3)       0.35       0.35         Excavation (Backhoe m3)       0.57       0.57         Backfill (granular m3)       0.57       0.57         Backfill (selected soil m3)       0.17       0.2         Backfill (selected soil m3)       0.17       0.2         Backfill (selected soil m3)       0.17       0.2         Backfill (selected soil m3)       1.09       1.3         Pavement (m2)       1.09       1.60         Pavement (m2)       1.60       1.7         Sheetpile Length (m)       1.60       1.7         Sheetpile Kq)       41.25       42.4         Sheetpile Kq)       1.60       1.7         Sheetpile Kq)       1.60       2.035.2         Brackfill (granular)       300.0       264.6         Backfill (granular)       300.0       264.6         Backfill (original)       300.0       264.6	9	ω.	ი.	4	ŝ	°,	2
Directive       0.35       0.35       0.35         Volume of Pavement (m3)       5.50       6.3         Excavation (Backhoe m3)       5.50       6.3         Backfill (granular m3)       0.57       0.7         Backfill (granular m3)       0.17       0.7         Backfill (granular m3)       0.17       0.2         Backfill (granular m3)       0.17       0.2         Backfill (granular m3)       1.09       1.7         Backfill (selected soil m3)       1.09       1.7         Backfill (selected soil m3)       1.09       1.7         Pavement (m2)       1.980.00       2.035.2         Sheetpile [e (kg)       1.980.00       2.035.2         Sheetpile (kg)       1.980.00       2.035.2         Bracing (kg)       1.980.00       2.035.2         Brackfill (granular)       300.0       171.0         Backfill (original)       300.0       264.6         Backfill (original)       300.0       244.6         Backfill (original)       300.0       264.6	4	5	თ.	. ო	$\sim$	2	10.88
Excavation (Backhoe m3)       5.50       6.3         Backfill (granular m3)       0.57       0.7         Backfill (granular m3)       0.17       0.7         Backfill (granular m3)       0.17       0.17         Backfill (granular m3)       0.17       0.2         Backfill (granular m3)       0.17       0.2         Backfill (selected soil m3)       1.09       1.3         Residual Soil (m3)       1.09       1.7         Residual Soil (m3)       1.09       1.7         Sheetpile Length (m)       1.60       1.7         Sheetpile Kg)       41.25       42.4         Sheetpile Kg)       1,980.00       2,035.2         Bracing (kg)       1,980.00       2,035.2         Bracing (kg)       1,980.00       2,035.2         Backfill (granular)       300.0       171.0       213.         Backfill (original)       300.0       264.6       299.	<u></u> м	0.43	0.47	ហ	9	٢.	÷
Excavation (Backhoe m3)       5.50       6.3         Backfill (granular m3)       0.57       0.7         Backfill (granular m3)       0.17       0.2         Backfill (granular m3)       1.09       1.3         Backfill (granular m3)       1.09       1.3         Residual Soil (m3)       1.09       1.3         Sheetpile Length (m)       1.60       1.7         Sheetpile Length (m)       1,980.00       2,035.2         Sheetpile (kg)       41.25       42.4         Stacing (kg)       1,980.00       2,035.2         Brackfill (granular)       300.0       330.0         Backfill (granular)       50.0       264.6         Backfill (original)       50.0       264.6         Backfill (selected soil)       300.0       264.6	(	•	Ċ	Ċ	0 1	0 (*	5
Backfill (granular m3)       0.57       0.7         Backfill (original m3)       4.41       4.9         Backfill (selected soil m3)       0.17       0.2         Backfill (selected soil m3)       1.09       1.3         Backfill (selected soil m3)       0.17       0.2         Residual Soil (m3)       1.09       1.3         Pavement (m2)       1.60       1.7         Sheetpile Length (m)       1.60       1.7         Sheetpile (kg)       41.25       42.4         Sheetpile (kg)       41.25       42.4         Sheetpile (kg)       1,980.00       2,035.2         Sheetpile (kg)       1,980.00       2,035.2         Stacting (kg)       1,980.00       2,035.2         Stacting (kg)       1,980.00       2,035.2         Backfill (granular)       300.0       171.0       213.         Backfill (original)       300.0       264.6       299.	ņ i	-	<u>э</u> (	'n d	٥ ч •	n d	ни • • с
Backfill (original m3)       4.41       4.9         Backfill (selected soil m3)       0.17       0.2         Residual Soil (m3)       0.17       0.2         Residual Soil (m3)       1.09       1.3         Residual Soil (m3)       1.09       1.3         Residual Soil (m3)       1.09       1.3         Sheetpile Length (m)       1.60       1.7         Sheetpile (kg)       41.25       42.4         Sheetpile (kg)       422       44         Construction Cost (Baht/m)       422       44         Construction Cost (Baht/m)       50.0       330.0         Backfill (granular)       300.0       264.6       299.         Backfill (original)       50.0       264.6       299.	Ľ.	Ω,	υ.	N	<u>ء</u>	ה א ה ה	2 4
Backfill (selected soil m3)       0.17       0.2         Residual Soil (m3)       1.09       1.3         Residual Soil (m3)       1.09       1.3         Sheetpile Length (m)       1.60       1.7         Sheetpile Length (m)       41.25       42.4         Sheetpile (kg)       41.25       42.4         Sheetpile (kg)       1,980.00       2,035.2         Bracing (kg)       422       44         Construction Cost (Baht/m)       422       43         Excavation (Backhoe)       60.0       330.0       379.         Backfill (Granular)       300.0       171.0       213.         Backfill (original)       50.0       264.6       299.	ი	ŝ	H	4	5	°.	N
Residual Soil (m3)       1.09       1.3         Pavement (m2)       1.60       1.7         Sheetpile Length (m)       41.25       42.4         Sheetpile (kg)       41.25       42.4         Sheetpile (kg)       41.25       42.4         Sheetpile (kg)       422       44         Construction Cost (Baht/m)       422       43         Excavation (Backhoe)       60.0       330.0       379.         Backfill (granular)       300.0       171.0       213.         Backfill (original)       50.0       51.0       72.	2	e,	4	Q.	σ	$\sim$	1.80
Pavement (m2)       1.60       1.7         Sheetpile Length (m)       41.25       42.4         Sheetpile (kg)       41.25       42.4         Sheetpile (kg)       1,980.00       2,035.2         Stacing (kg)       422       44         Construction Cost (Baht/m)       422       43         Excavation (Backhoe)       60.0       330.0       379.         Backfill (granular)       300.0       264.6       299.         Backfill (selected soil)       300.0       51.0       72.	ω.	ω.	ω.	പ്	Ч	ሳ	"
Sheetpile Length (m)       41.25       42.4         Sheetpile (kg)       1,980.00       2,035.2         Sheetpile (kg)       422       44         Sheetpile (kg)       422       44         Sheetpile (kg)       1,980.00       2,035.2         Sheetpile (kg)       1,980.00       2,035.2         Sheetpile (kg)       1011       422         Construction Cost (Baht/m)       50.0       330.0         Excavation (Backhoe)       60.0       330.0         Backfill (granular)       300.0       171.0       213.         Backfill (original)       50.0       264.6       299.	٢.	ω.	°.	Ļ	4	°.	0
Backfill (selected soil)       1,980.00       2,035.2         44       422       44         Bracing (kg)       422       44         Construction Cost (Baht/m)       422       44         Construction Cost (Baht/m)       330.0       379.         Excavation (Backhoe)       60.0       330.0       379.         Backfill (granular)       300.0       264.6       299.         Backfill (selected soil)       300.0       51.0       72.	2 4	ິ	4.5	°,	ς,	H H	4.
Stackport42244Bracing (kg)42244Construction Cost (Baht/m)330.0379.Excavation (Backhoe)60.0330.0379.Backfill (granular)300.0171.0213.Backfill (original)60.0264.6299.Backfill (selected soil)300.051.072.	35.2	Ó	2,138.40	4	2,349.60	2,452.80	ч
Construction Cost (Baht/m) Excavation (Backhoe) Unit Cost Backfill (granular) 300.0 171.0 213. Backfill (original) 60.0 264.6 299. Backfill (selected soil) 300.0 51.0 72.	446	4	47	501	$^{\circ}$	ഗ	616
Construction Cost (Baht/m) Excavation (Backhoe) Unit Cost Backfill (granular) 300.0 379.0 379.0 Backfill (original) 500.0 264.6 299. Backfill (selected soil) 300.0 51.0 72.0							
Unit Cost       330.0       379.         (Backhoe)       60.0       330.0       379.         granular)       300.0       171.0       213.         original)       60.0       264.6       299.         selected soil)       300.0       51.0       72.			-				
(Backhoe)       60.0       330.0       379.         granular)       300.0       171.0       213.         original)       60.0       264.6       299.         selected soil)       300.0       51.0       72.						•	
granular) 300.0 171.0 213. original) 60.0 264.6 299. selected soil) 300.0 51.0 72.	79.	31.	81.	95.	12.	38.	44.
(original) 60.0 264.6 299. (selected soil) 300.0 51.0 72.	13.	2	94.	84.	80.	82	50.
(selected soil) 300.0 51.0 72.	. 66	35.	<u></u> ,	ີ ທີ	~	04.	ມີ ເມ
	~	б	26.	98.	79.	12.	40
2.7 40.	$\dot{\circ}$	48.0	56.1	75.0	95.1	117.0	154
400.0 640.0 688.	88.	36.	80.	76.	68.	0.60	,200.
e (kg) 3.2 6,336.0 6,512.	,512.6	· •	2	ω.	8	6 <del>4</del>	55.
5.1 2,152.2 2,274.	.274.6	,351.	,432.	, 555.	,703.	845.	,141.
.0 35	50	439.0	509.0	779.0	1,267.0	1,643.0	2,702.0
Others 1 1s 7.6 8.	•	9.5	<u>.</u>	~	ഗ	<b>5</b>	ທ່
Total 10,238.1 10,838.1	0,838.1 1	1,383.0	11,901.8	13,108.7	14,561.4	15, 930.2	18,648.6

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Туре ,	Manhole Hight	Construction Cost ( Baht/Unit )
<u></u>	2 m	11,480
NO.1	3 m	12,690
	4 m	13,890
	5 m	15,110
	2 m	14,680
NO.2	3 m	15,880
	4 m	17,080
	5 m	18,290
	2 m	18,070
NO.3	3 m	19,270
	4 m	20,470
	5 m	21,700
	2 m	24,420
NO.4	3 m	25,620
	<b>4</b> m	26,820
	5 m	28,020
NO.5	4 m	35,660

Table 3.9.1.1 (2) Unit Construction Cost of Manhole

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Table 3.9.1.1 (3) Unit Construction Cost of Overflow Chamber

Type of Overflow Chamber	Construction Cost
	( Baht/Unit )
В	24,150
С	18,700

# 3.9.1.2 Direct Construciton Cost by Major Facilities

Table 3.9.1.2 (1) Construction Cost of Interceptors

Diameter (mm)	Average Earth Covering Depth (m)	Length of Interceptor (m)	Unit Construction Cost (Baht/m)	Construction Cost ( x 1,000 Baht)
ø300	1.5	720	1,329.9	958
	2	765	6,422.1	4,913
	Sub-total	1,485		5,871
ø400	1.5	560	6,335.7	3,548
-	2	1,390	6,978.9	9,701
	4	600	9,551.7	5,732
·	Sub-total	2,550		18,981
ø500	3	15	8,781.4	132
0000	5	710		8,082
	Sub-total	725		8,214
ø600	1.5	510	7,302.2	3,725
2000	5	347	11,901.8	4,130
	Sub-total	857		7,855
ø800	. 2	870	9,080.3	7,900
	3	725	10,423.1	7,557
	Sub-total	1,595		15,457
ø1000	1.5	650	9,765.0	6,348
	2	250	10,450.2	2,613
	3	- 30	11,820.6	355
	4.	250	13,191.0	3,298
	5	60	14,561.4	874
	Sub-total	1,240	) 	13,488
ø1200	4	50	14,532.2	727
	Sub-total	50	)	. 727
	Total	8,502	2	70,593

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#### Table 3.9.1.2 (2) Construction Cost of Manhole

Type of Mahole	Manhole Hight (m)	Nos. of Manhole	Unit Construction Cost (Baht/unit)	Construction Cost ( x 1,000 Baht)
No.1	2	71	11,480	81
	3	56	12,690	71
	4	28	13,890	38
	Sub-total	155		1,91
No.2	3	13	15,880	20
	4	13	17,080	223
······	Sub-total	26		43
No.3	3	13	19,270	25
	4	9	20,470	18
·	Sub-total	22		43
No.5	4	1	35,660	3
·	Sub-total	1		3
	Total	. 204		2,81

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Table 3.9.1.2 (3) Construction Cost of Overflow Chamber ( Bang Bua Thong )

Type of Overflow Chamber	No. of Overflow Chamber	 Unit Construction Cost ( Baht/unit )	Construction Cost ( x 1,000 Baht )
В	3	24,150	72
с	18	18,700	. 337
Total	21		409

### Table 3.9.1.2 (4)

# Construction Cost of Inverted Siphon

				Construction	on Cost (x 1,	000Baht)	
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total	
Excavation	(m3)	978	60	59		59	
Backfill (Granular)	(m3)	10.58	300	3		3	
Backfill (Soil)	(m3)	793	60	48	•	.48	
Sheet Pile	(kg)	52,800	3.2	169		169	
Rubble Stone	(m3)	40.13	400	16		16	
Piling	(piece)	64	1,900	122		122	
Concrete	(m3)	92.03	4,658	429		429	
Lean Concrete	(m3)	10.03	1,950	20		20	
Reinforced Steel Bar	(kg)	8,280	12	99		99	
Form Work	(m2)	386.16	300	116		116	
Cover	(unit)	. 8	7,000	56		5€	
Screen ( 1.1m x 1.65m )	(unit)	1			164	164	
		Total		1,137	164	1,301	

Table 3.9.1.2 (5) Construction Cost of Pump Station

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No.1

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				Constructi	on Cost (x1,00	0 Baht)
Itom	:	Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total
1) Civil and Architecture W	ork					
Excavation	(m3)	1,455	60	87		87
Backfill (Granular)	(m3)	22.71	300	7		7
Backfill (Soil)	(m3)	676	60	41		41
Sheet Pile	(kg)	82,944	3.2	265		265
Bracing	(kg)	542.48	5.2	3		3
Rubble Stone	(m3)	19,83	400	8		8
Piling	(m)	72	3,800	274		274
Concrete	(m3)	542,48	4,658	2,527		2,527
Lean Concrete	(m3)	4.96	1,950	. 10		. 10
Reinforced Steel Bar	(kg)	31,430	12	377		377
Form Work	(m2)	811.5	300	243		243
Architecture				90		90
S	Sub-total o	f 1)		3,932		3,932
2) Mechanical and Electrica	1 Works					
Screen (0.8m x 1.8m)	(unit)	. 2	119		238	238
Gate (0.8m x 0.8m)	(unit)	2	167		334	334
Pump (ø150mm x 5.5kw)	(unit)	1	97		97	97
Pump (ø200mm x 5,5kw)	(unit)	. 1	809		809	809
Piping and Valves	(LS)				181	181
Instrumentation	(LS)				272	272
Installation	(LS)				181	181
Ś	Sub-total o	f 2)			2,112	2,112
**************************************	Total			3,932	2,112	6,044

No.2

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				Construct	Construction Cost (x1,000 Baht)			
Item		Quantity	Unit Cost (Baht)	Domestic Portion	Foreign Portion	Total		
1) Civil and Architecture Wo	ork					<u>,</u>		
Excavation	(m3)	1,847	60	111	•	111		
Backfill (Granular)	(m3)	43.20	300	13		13		
Backfill (Soil)	(m3)	931	60	56		5€		
Sheet Pile	(kg)	92,160	3.2	295		295		
Bracing	(kg)	821	5.2	4		4		
Rubble Stone	(m3)	25.37	400	10		10		
Piling	(m)	95	3,800	361		361		
Concrete	(m3)	799,94	4,658	3,726		3,726		
Lean Concrete	(m3)	6.34	1,950	12		12		
Reinforced Steel Bar	(kg)	38,350	12	460		460		
Form Work	(m2)	1,006.9	300	302		302		
Architecture				122		122		
S	ub-total o	£ 1)		5,472		5,472		
2) Mechanical and Electrical	Works							
Screen (1.0m x 2.4m)	(unit)	2	142		284	284		
Gate (1.0m x 1.0m)	(unit)	2	200		400	400		
Pump (ø300mm x 11kw)	(unit)	1	1,262		1,262	1,262		
Pump (ø400mm x 18.5kw)	(unit)	2	1,905		3,810	3,810		
Piping and Valves	(LS)				1,014	1,014		
Instrumentation	(LS)				1,522	1,522		
Installation	(LS)				1,014	1,014		
S	ub-total of	E 2)			9,306	9,306		
	Total			5,472	9,306	14,778		

Table 3.9.1.2 (6) Construction Cost of Treatment Plant

		Constructio	n Cost (x 1,0	)00 Baht)
	Item	Domestic Portion	Foreign Portion	Total
Civil and Architecture Facilities				
1-1 Grit Chamber	9.0 (L)m x 1.0 (W)m x 0.4 (H)m x 2units 9.0 (L)m x 1.4 (W)m x 0.4 (H)m x 2units	3,192		3,19
1-2 Primary Sedimentation Tank	15.0(D)m x 4.0(H)m x 2units	2,738		2,73
1-3 Stormwater Sedimentation Tank	14.0(D)m x 3.0(H)m x 3units	3,263		3,26
1-4 Aeration Tank	36.0(L)m x 12.0(W)m x 3.0(H)m x 2units	7,917		7,91
1-5 Secondary Sedimentation Tank	17.0(D)m x 2.5(H)m x 2units	2,754		2,75
1-6 Disinfection Tank	60.0(L)m x 2.0(W)m x 1.5(H)m x 3units	1,477		1,47
1-7 Thickener	6.0(D)m x 4.0(H)m x lunits	1,787		1,78
1-8 Digestion Tank	1st : 12.0(D)m x 5.0(H)m x 2units	2,877		2,87
•	2nd : 8.5(D)m x 5.0(H)m x 2units	1,843		1,84
1-9 Dewatering Unit		210		21
1-10 Miscellaneous		2,850		2,85
Sub-total of 1.		30,908		30,90
2-1 Grit Chamber	* ·		1,667	1,00
2-1 Grit Chamber 2-2 Inflow Pump			5,119	
				5,11 5,00
2-2 Inflow Pump	· · · · · · · · · · · · · · · · · · ·		5,119 5,000 595	5,11 5,00 59
2-2 Inflow Pump 2-3 Primary Sedimentation Tank			5,119 5,000 595 4,524	5,11 5,00 59 4,52
2-2 Inflow Pump 2-3 Primary Sedimentation Tank 2-4 Stormwater Sedimentation Tank			5,119 5,000 595	5,11 5,00 59 4,52 5,95
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> </ul>			5,119 5,000 595 4,524 5,952 1,548	5,11 5,00 59 4,52 5,95 1,54
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> </ul>			5,119 5,000 595 4,524 5,952 1,548 357	1,66 5,11 5,00 4,52 5,95 1,54 35
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> </ul>			5,119 5,000 595 4,524 5,952 1,548 357 20,000	5,11 5,00 59 4,52 5,95 1,54 35 20,00
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> </ul>			5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> </ul>	· · ·		5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143 7,500	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14 7,50
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> </ul>	5		5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143 7,500 8,929	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14 7,50 8,92
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> </ul>	5		5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143 7,500 8,929 10,833	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14 7,50 8,92 10,83
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> <li>2-13 Transportation and Instalation</li> <li>2-14 Pump Station Monitoring Facilitie</li> </ul>			5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143 7,500 8,929 10,833 1,315	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14 7,50 8,92 10,83 1,31
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> <li>2-13 Transportation Monitoring Facilitie</li> <li>2-15 Laboratory Equipment</li> </ul>			5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143 7,500 8,929 10,833 1,315 595	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14 7,50 8,92 10,83 1,31 59
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> <li>2-13 Transportation and Instalation</li> <li>2-14 Pump Station Monitoring Facilitie</li> </ul>			5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143 7,500 8,929 10,833 1,315 595 8,571	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14 7,50 8,92 10,83 1,31 59 8,57
<ul> <li>2-2 Inflow Pump</li> <li>2-3 Primary Sedimentation Tank</li> <li>2-4 Stormwater Sedimentation Tank</li> <li>2-5 Aeration Tank</li> <li>2-6 Secondary Sedimentation Tank</li> <li>2-7 Disinfection Tank</li> <li>2-8 Thickener</li> <li>2-9 Digestion Tank</li> <li>2-10 Dewatering Unit</li> <li>2-11 Piping Materials, Valves and Gate</li> <li>2-12 Control Panel and Instrumentation</li> <li>2-13 Transportation Monitoring Facilitie</li> <li>2-15 Laboratory Equipment</li> </ul>	S		5,119 5,000 595 4,524 5,952 1,548 357 20,000 7,143 7,500 8,929 10,833 1,315 595	5,11 5,00 59 4,52 5,95 1,54 35 20,00 7,14 7,50 8,92 10,83 1,31

Assumption for Estimate of Interceptor Cleaning Cost

- 1) The Length of cleaning for one time is the distance of an average manhole interval (approximately 50m).
- 2) The nozzle moves forward and is pulled backward with jets three (3) times for one time cleaning.
- 3) It takes about ten (10) min. for the nozzle to move forward and backward.
- 4) The water (3 m3) of High Pressure Cleaner' tank is used for one time cleaning.
- 5) A cleaning team consists of "High Pressure Sewer Cleaner", "Vacuum Sludge Loader", "Water Wagon" and "Truck".
- 6) The Volume of a water wagon tank is 4 m3.
- 7) Required time for water feeding to a water wagon and discharging sludge is 1.5 hours (including traveling time).

From the above assumption,

The possible length of cleaning interceptor in a year,

In case that working hour is 8 hours, times of cleaning is the following.

8 hr. x 2 hr./time = 4 times

As the length of cleaning interceptor for one time is 50 m,

50 m/time x 4 times = 200 m/day

When actual Working hour in a year is 20 day/month x 12 months x 0.8 = 192 day/year,

the possible length of cleaning interceptor in a year is the following.

200 m/day x 192 days = 38,400 m/year

Annual expenses for interceptor cleaning are,

(1)	Labor Cos	È.		:	1. s. s.

			· · · · · · · · · · · · · · · · · · ·		····
Type of Vehicle	Classi -fication	Required No.	Working Day	Wage	Cost
1-1. High Pressure	Driver	1 person	· · · · · ·		
Sewer Cleaner	Operator	2 persons			
1-2. Vacuum Sludge	Driver	1 person	· · ·		
Loader	Operator	2 persons	· · ·		
1-3. Water Wagon	Driver	1 person			
l-4. Truck	Driver	1 person			
	Labor	4 persons			1
	Driver	4 persons	192 days x	420 B/day =	322,560
Total	Operator	4 persons	192 days x	360 B/day≖	276,480
	Labor	4 persons	192 days x	140 B/day=	107,520
· · · · · · · · · · · · · · · · · · ·	Annua	al Labor Cost ( )	Baht/Year )	······································	706,560

(2) Fuel Cost

3-1. High Pressure Sewer	Cleaner	: / Va	cuum	Sludge	Loader		
201 / hr.	x		8	hr.	х	192 days =	30,720
						x ( Vehicles )	3
				·			92,160
3-2. Water Wagon / Truck		÷					
10 l / hr.	x		3	hr.	x	192 days =	5,760
				•		x (Vehicles)	1
• •				· .			5,760
				• •			
	Annual 1	Fuel C	ost (	Baht/Ye	ar )		97,920

(3) Spare Parts Cost

Type of Vehicle	Price	Working Life		Cost
1-1. High Pressure Sewer Cleaner	1,000,000 Baht	5 Years	<b>R</b> 2	200,000
1-2. Vacuum Sludge Loader	1,000,000 Baht	5 Years	-	200,000
1-3. Water Wagon	1,000,000 Baht	5 Years	715	200,000
1-4. Truck	700,000 Baht	10 Years	25	70,000
	Annual Vehicle C	ost ( Baht/Year )		670,000
670,000 (Vehicle Cost ) x 3%				20,100
	Spare Parts Co	st ( Baht/Year )		20,100
Annual Cleaning Cost ( Baht/Year )				824,580
Clea	aning Cost of Interce	ptor per Meter ( Bal	nt/m )	21.5

3.14.1 Private Health and Sanitation Benefits

Data used in this study were gathered from the Central Region Survey on Income and Employment, National Institute of Health, Public Health Office.

Data on medical cost, illness cost were obtained from public helath office. Labor force particiaption, average monthly household income, average size of household, average wage rate were collected from Central REgion Survey Data. Morbidity rate for the wastewater-borne diseases were obtained from National Institute of Health.

Health Cost =  $(MC_A + MC_B) \cdot (0.14) \cdot (PS) = 11.34$  million Baht in 1991

- where,  $MC_A = medical cost = (EAP) \cdot (MR) \cdot (MC_1 + MC_2) = 232.6$  Baht in 1991  $MC_B = illness cost = (EAP) \cdot (MR) \cdot (W) \cdot (D) = 99.43$  Baht in 1991 0.14 = 14% of the water-borne diseases attributable to the sever-
  - 0.14 = 14% of the water-borne diseases attributable to the sewerage project on the basis of diarrhea by cause in isolation (NIH Study 1978)
  - PS = In 1991, total population in the study area was 244,691, compared with 369,991 in the sewerage area in 2011.
  - EAP = economically active population of 13 years old and over in the labor force in the Central Region was 76.6%.
  - POP = population in the study area of eight municipalities, 248,710 in 1991 and 397,200 in 2011 respectively.
  - MR = morbidity rate for the water-borne disease, 2,984 per 100,000 population (National Institute of Health Study of 1987)
  - MC<sub>1</sub> = medical cost of treatment and care per person per hospital day was 560 Baht on the average, 7,840 Baht for an average of two weeks.
  - MC<sub>2</sub> = medical cost of treatment and care per person per consultation was 280 Baht on the average, 2,352 Baht for 2.1 consultation per person for an average of 4 days.
  - W = Average monthly household income with the average size of household, 3.1 persons was 6,060 in Central Region, 1990. The average working days per month is 25 days, the average daily household income is 242 Baht per day.
  - D = days lost due to illness (hospitalization and out-patient consultation days), 18 days.

The annual health cost is estimated at 8.67 million Baht in 1991, and 12.9 million Baht in 2026 in the study area of eight sewerage projects.

