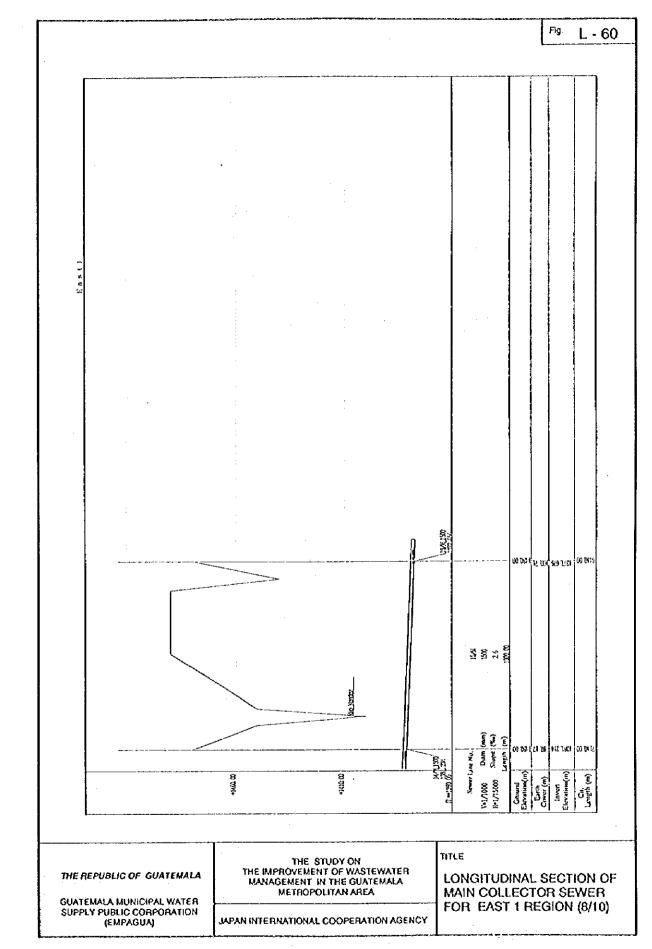
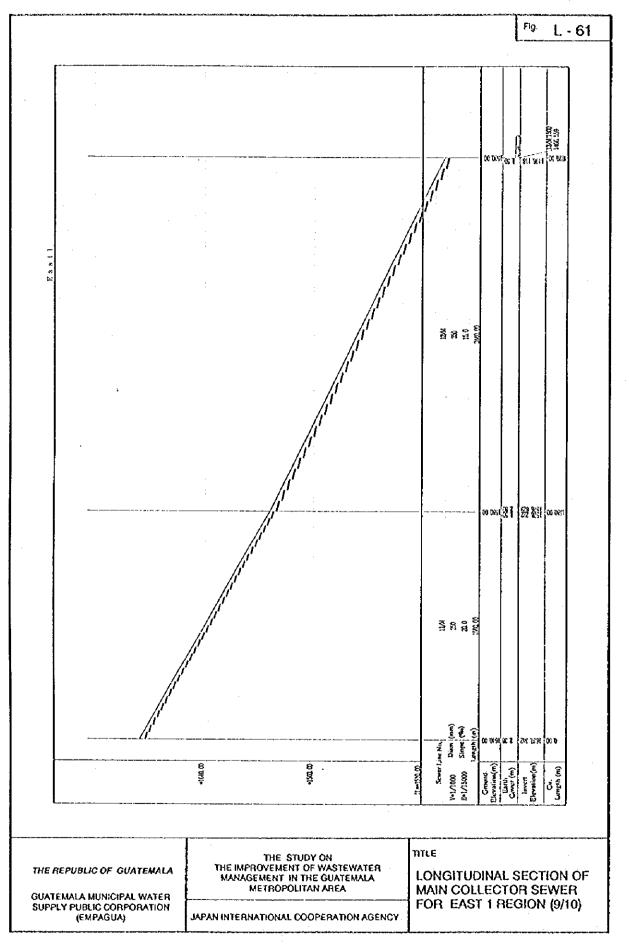


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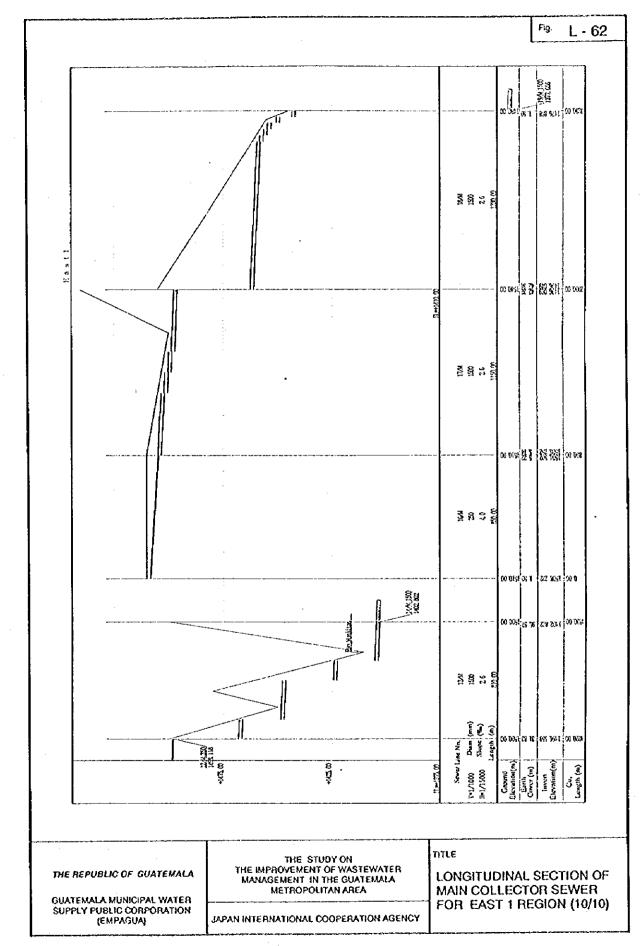


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SUPPORTING REPORT M

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TREATMENT PLANT DESIGN

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M1 INTRODUCTION

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This Supporting Report contains preliminary design calculations and layout plan of wastewater treatment plants (WWTPs) for Master Plan and Feasibility Study. Layout plans for Feasibility study namely Central Region WWTP and South 3 Region WWTP are based on topographical survey results, which are described in Supporting Report Q.

Table M-1, M-8 show outline of treatment facilities based on preliminary design calculations. Table M-2 to M-7 show the treatment process flow diagram and the design calculations to size the facilities at each treatment plant for Master Plan. Table M-9, M-10 show the same for Feasibility Study.

The preliminary proposed layout plan for each treatment plants are shown in Fig. M-1 to M-3 for Master Plan. At Master Plan stage, detailed topography of wastewater treatment plant sites are not known. Therefore the layout plans have been prepared based on the assumption that the WWTP site slope at a constant gradient and of rectangular shape. Fig. M-4, M-5 show proposed layout plan for Feasibility study.

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DESIGN CALCULATION FOR MASTER PLAN

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Ladie 191-1 Outline of Areatment Facilities	10 20	Learment Fich	Ser		Ì		ſ		ſ		Ī		
Facility		Central		North1		South I		South2		South3		East1	~
		Dintensions	No.	Dimensions	No.	Dimensions	No.	Dimensions	No.	Dimensions	No.	Dimensions	°Z Z
Primary Sedimentation Tank	ank	¢13.00m×h 11.89m	40	¢ 12. 50a × h 11. 45a	16	φ13.50m×h 12.33m	10	¢13.50m×h 12.33m	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	¢12.50m×h 11.46m	12	φ13.00m×h 11.89m	8
Trickling Filter (First Step)				φ 38.00m×h 2.00m	16	φ 41.00m×h 2.00m	2	Ф 40.00a X h 2.00a	00	¢ 38,00m×h 2,00m		φ 39.00m×h 2.00m	ន
Intermediate Claritier			70	¢12.50m×h 11.46m	16	¢13.50m×h 12.33m	01	¢13.50¤×h 12.33¤	~~	¢12.50¤×h 11.46¤	12	φ13.00¤×h 11.89¤	ន
Trickling Filter (Second Step)		1	1	с × 600	00	φ 41.00m×h 2.00m	2	¢ 40.00m×h 2.00m	4	é 38.00a×h 2.00a	Į	φ 39.00m×h 2.00m	2
Final Clanffer		8.00m×h 16.22m	ę	1.1	16		10		~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	φ17.50m×h 15.79m		¢18.00a×h 16.22a	8
Sludge Digester Tank		¢17.50m×h 9.75m	40	¢17.50¤×h 9.75≖	16	¢18.00m×h 10.00m	10	φ18.00m×h 10.00m	×	¢17.00m×h 9.50m	12	φ18.00m×h 10.00m	30
Sludge Drving Bed		¥ 40.00m × L100.00m	20	¥ 40.00m×L100.00m	÷	₩ 40.00m×L110.00m	ŝ	¥ 40.00m × L110.00m		₩ 40.00m×L 95.00m	9	¥ 40.00m×L105.00m	10
Design Flowrate Daily Average	m²/đ			83.000		64, 000		51.000		66, 000		121.000	
Daily Maximum	tt3∕d	261.000		97, 000		70.000		55, 000		72.000		131,000	
Hourly Maximum	m²/c	390. 000		144.000		103, 000		86, 000		107.000		196, 000	
Hourly Maximum Wet Weather	m²/đ	1, 087, 000											
Sludge Generation	٧d	90.0		49.8		24.3		19.3		25. 0		45.8	
Source : Study Team													

Table M-1 Outline of Treatment Facilities

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Design Calculation for Central Region Wastewater Treatment Plant (Master Plan)

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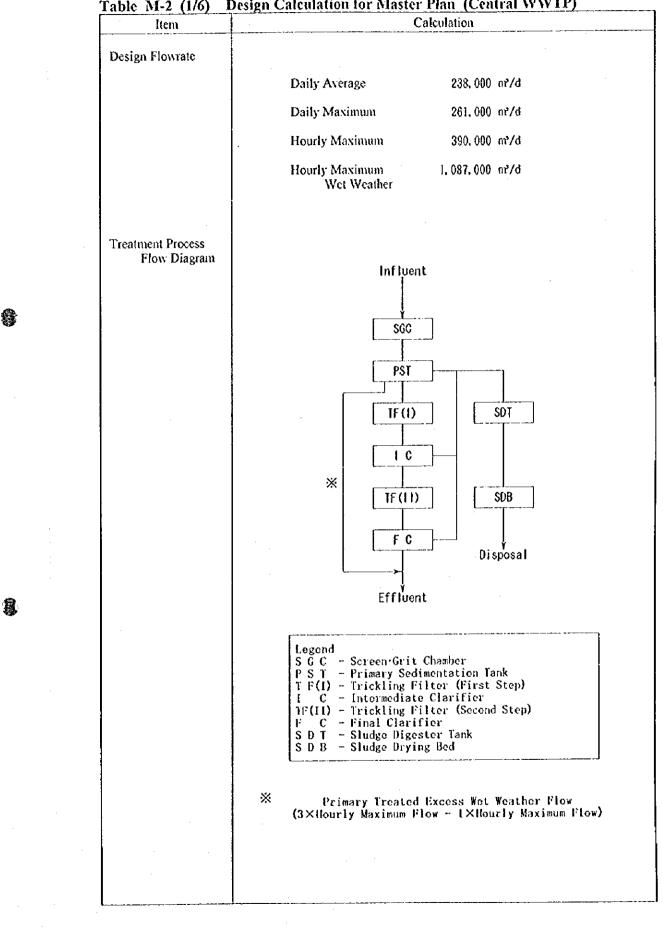


Table M-2 (1/6) Design Calculation for Master Plan (Central WWTP)

M-9

1. Frimary Schurchtstion Tark 3. Required Capacity Design Flowrate Overflow Rate Required Surface Area b)Dimensions c)Cleck Overflow Rate (D.M.) Retention Time (D.M.) Retention Time (D.M.) Sludge Generation Sludge Storage Volume V1 = $\frac{x \times h3}{3}$ (r2 2tr2 x r3tr3 2) = 397 n*/Tank (h1 = 4.55 m, r2 = 381 m r3 = 6.50 m) V2 = $\frac{x \times h3}{3}$ (r2 2tr2 x r3tr3 2) = 397 n*/Tank (h1 = 4.55 m, R = 13.00 m) V2 = $\frac{x \times h3}{3}$ (r2 2tr2 x r3tr3 2) = 397 n*/Tank (h1 = 4.55 m, R = 13.00 m) V2 = $\frac{x \times h3}{3}$ (r2 2tr2 x r3tr3 2) = 397 n*/Tank (h1 = 4.55 m, R = 13.00 m) V2 = $\frac{x \times h3}{3}$ (r2 2tr2 x r3tr3 2) = 397 n*/Tank (h1 = 4.55 m, R = 13.00 m) V2 = $\frac{x \times h3}{3}$ (r2 2tr2 x r3tr3 2) = 397 n*/Tank (h1 = 4.55 m, R = 13.00 m) V2 = $\frac{x \times h3}{3}$ (r2 2tr2 x r3tr3 2) = 397 n*/Tank (h1 = 4.55 m, R = 13.00 m) V = V + V2 = 596 n*/Tank (b1 = 1.50 m, R = 13.00 m) V = V + V2 = 596 n*/Tank	f	Calculation
Tark a)Required Capacity Design Flowrate Overflow Rate Retention Time 281,000 $n^{p}/d(0, N,), 1,087,090$ $n^{p}/d(0, N, N,$	Item	
a)Required Capacity Design Flowrate Overflow Rate Retention Time b)Dimensions c)Check Overflow Rate (D.M.) Retention Time (D.M.) Retention Time (H.M.W.W.F.) Sludge Generation b)Dimensions c)Sludge Storage Volume c)Single Storage V)Single Storage Single Storage Single Stor		
Design Flowrate Overflow Rate Retention Time 281,000 $m^2/n^2/d$ 1,037,000 n^2/d (I. X. V. F. C) Subscription Rate Retention Time 2.0 h (D. X.) 0.5 h (I. X. V. F. C) Dimensions Diameter Solo $= 3.220$ m² $= \frac{261,000}{50.0}$ $= 5.220$ m² b)Dimensions Diameter Nuber $= 13.00$ m $= \frac{261,000}{50.0}$ $= 18.89$ m c)Check Overflow Rate (D.M.) $= \frac{261,000}{5.309} = 49.2$ m²/m² d $= \frac{10.00}{5.309}$ $= \frac{261,000}{5.309} = 49.2$ m²/m² d Retention Time (D.M.) $= \frac{261,000}{5.309} = 49.2$ m²/m² d $= \frac{100}{5.309}$ $= \frac{23.840}{261.000} = 23.840$ Retention Time (H.M.W.W.F.) $= \frac{261,000}{1.087,000} = 42.2 n²/m² d = \frac{100}{1.087,000} = 10.00 m²/m² d Shudge GenerationVolume = 261,000 \times 154 \times 10^{-6} + 0.01 = 4.019 m² = 100 m²/Tank Sludge StorageVolume = \frac{\pi \times h3}{3} (r1^2 tr1 \times r2 tr2^2 2) = 100 m²/Tank = 100 m²/Tank C h1 = 4.65 m, r2 = 3.81 n, r3 = 6.50 m.) = \frac{\pi \times h4}{4} (r2^2 2 tr2 \times r3 tr3^2 2) = 397 m²/Tank (h = 4.65 m, r2 = 3.81 n, r3 = 6.50 m.) V 2 = \frac{\pi \times h4}{4} (r1 = 1.50 m, R = 13.00 m.) V = V + V 2 = 596 m²/Tank V = V + V 2 = 596 m²/Tank $		
Overflow Rate Retention Time 50.0 $n^{p}/r^{r}d^{-2}$ 0.5 h (II.X.F.V.F.) D.X. : baily Vaxinum Vet Feather Flow Required Surface Area = $\frac{261.000}{50.0}$ = 5.220 m² Diameter R = 13.00 m Depth D = 11.89 m Angle 0.5 h (II.X.F.V.F.) e)/Linearization Diameter R = 13.00 m Depth 0 1 poth D = 11.89 m Angle 0.60 * 1 e)/Linearization E $\frac{261.000}{5.309}$ = 49.2 m²/m² d e)/Linearization = $\frac{261.000}{5.309}$ = 49.2 m²/m² d e)/Linearization = $\frac{261.000}{5.309}$ = 49.2 m²/m² d e)/Linearization = $\frac{23.840}{261.000}$ × 24 = 2.2 h 1 e $\frac{23.840}{261.000}$ × 24 = 0.5 h 1 1 Retention Time (D.M.) = $\frac{28.40}{1.687.000}$ × 24 = 0.5 h 1 Studge Generation = 261.000 × 154 × 10 ² - 6 = 0.01 = 4.019 m² 100 m²/Tank Studge Storage Volume = $\frac{\pi \times h4}{3}$ (r1 ² +r1 × r2 ¹ +r2 ²) = 100 m²/Tank 100 m²/Tank		261,000 m²/d (Đ, X,). 1,087,000 m²/d (H, X, W, F,)
Retention Time2.0 h (D. X.)0.5 h (H. U. U. F. F.)D. M. : Daily MaximumD. S. h (H. U. U. F. F.)D. M. : Daily MaximumR. Y. F. F. Bourly Maximum Tet Feather FlowRequired Surface Area $= \frac{261.000}{50.0} = 5.220 \text{ m}^2$ b)DimensionsDiameter Depth D = 11.89 m Angle $\theta = 60^{\circ}$ Number 40 Tanks (h1 = 1.50 m, h2 = 10.39 m)c)Check $Occrflow Rate$ (D.M.)c)Check $= \frac{281.000}{5.309} = 49.2 \text{ m}^2/\text{m}^2 \text{d}$ Overflow Rate (D.M.) $= \frac{28.840}{261.000} \times 24 = 2.2 \text{ h}$ e.Check $= \frac{23.840}{261.000} \times 24 = 2.2 \text{ h}$ Greation Time (H.M.W.F.) $= \frac{23.840}{1.087.000} \times 24 = 0.5 \text{ h}$ Retention Time (H.M.W.W.F.) $= \frac{261,000 \times 154 \times 10^{\circ} 6 \div 0.01 = 4.019 \text{ m}^2}{1.097.000} = 100 \text{ m}^2/Tank$ Sludge Storage Volume $= \frac{\pi \times h3}{3}$ (r1 * 2 + r1 * r2 + r2 * 2) = 100 m^2/Tank (b 3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m.)Effective Volume $V1 = \frac{\pi \times h4}{3}$ (r1 * 2 + r2 * x * h3 * r2 = 139 m²/Tank (h1 = 1.50 m, R = 13.00 m.) $V2 = \frac{\pi \times h1}{4}$ (h1 = 1.50 m, R = 13.00 m.) $V2 = \frac{\pi \times h1}{4}$ (h1 = 1.50 m, R = 13.00 m.) $V = V + V2 = 596 m^2/Tank$		
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c)Check Overflow Rate (D.M.) Retention Time (D.M.) Retention Time (D.M.) Retention Time (D.M.) Retention Time (H.M.W.W.F.) Studge Generation Studge Generation = $\frac{23,840}{261,000} \times 24 = 2.2 h$ $\frac{23,840}{261,000} \times 24 = 2.2 h$ $\frac{11}{1}$ $\frac{1}{2$		(b1 - 1.50 m b2 - 10.30 m)
Overflow Rate (D.M.) Retention Time (D.M.) Retention Time (D.M.) Retention Time (H.M.W.W.F.) Sludge Generation Sludge Generation Sludge Storage Volume $\frac{\pi \times h3}{3} (r1^{-2}tr1 \times r2tr2^{-2}) = 100 \text{ m}^{2}/\text{fank}$ (b) $r2 = \frac{\pi \times h4}{3} (r2^{-2}tr2 \times r3^{2}r3^{-2}) = 397 \text{ n}^{2}/\text{fank}$ (b) $r2 = \frac{\pi \times h4}{4} (r2^{-2}tr2 \times r3^{2}r3^{-2}) = 397 \text{ n}^{2}/\text{fank}$ (c) $r1 = 1.50 \text{ m} \cdot r2 = 3.81 \text{ m} \cdot r3 = 6.50 \text{ m} \cdot r3$ V) $r = V + V 2 = 596 \text{ m}^{2}/\text{fank}$	c)Check	
Overflow Rate (D.M.) Retention Time (D.M.) Retention Time (D.M.) Retention Time (H.M.W.W.F.) Studge Generation Studge Generation $= \frac{23,840}{261,000} \times 24 = 2.2 h$ $= \frac{23,840}{1.087,000} \times 24 = 2.2 h$ $= \frac{23,840}{1.087,000} \times 24 = 0.5 h$ $= 261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 m^{2}$ $= 100 m^{2}/Tank$ (Solid Concentration 1%) Sludge Storage Volume $= \frac{\pi \times h3}{3} (r1^{-}2+r1 \times r2+r2^{-}2) = 100 m^{2}/Tank$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3} (r2^{-}2+r2 \times r3+r3^{-}2) = 397 n^{2}/Tank$ (h1 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) $V2 = \frac{\pi \times h1}{4} \times R^{-}2 = 199 m^{2}/Tank$ (h1 = 1.50 m, R = 13.00 m) $V = V1 + V2 = 596 m^{2}/fank$	U)CIRCIN	261, 000
Retention Time (D.M.) Retention Time (H.M.W.W.F.) Studge Generation Studge Storage Volume $= \frac{23.840}{261.000} \times 24 = 2.2 h$ $= \frac{23.840}{1.087.000} \times 24 = 0.5 h$ $= \frac{23.840}{1.087.000} \times 24 = 0.5 h$ $= 100 \text{ m}^{2}/\text{Tank}$ (Solid Concentration 1%) $= 100 \text{ m}^{2}/\text{Tank}$ (Solid Concentration 1%) $= \frac{\pi \times h3}{3} (r1^{-}2+r1 \times r2+r2^{-}2) = 100 \text{ m}^{2}/\text{Tank}$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3} (r2^{-}2+r2 \times r3+r3^{-}2) = 397 \text{ m}^{2}/\text{Tank}$ (h4 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) $V2 = \frac{\pi \times h1}{4} \times R^{-}2 = 199 \text{ m}^{2}/\text{Tank}$ (h1 = 1.50 m, R = 13.00 m) $V = V1 + V2 = 596 \text{ m}^{2}/\text{Tank}$	Overflow Rate	
Retention Time (D.M.) = $-\frac{261,000}{261,000} \times 24 = 2.2 h$ $till$ Retention Time (H.M.W.W.F.) = $\frac{23,840}{1,087,000} \times 24 = 0.5 h$ = 4.019 m^2 Studge Generation = $261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 \text{ m}^2$ = $100 \text{ m}^2/\text{Tank}$ Studge Storage Volume = $261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 \text{ m}^2$ = $100 \text{ m}^2/\text{Tank}$ Studge Storage Volume = $261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 \text{ m}^2$ = $100 \text{ m}^2/\text{Tank}$ Studge Storage Volume = $\frac{\pi \times h3}{3}$ $(r1^2 2 + r1 \times r2 + r2^2 2) = 100 \text{ m}^2/\text{Tank}$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) = $\frac{\pi \times h4}{3}$ $(r2^2 2 + r2 \times r3 + r3^2 2) = 397 \text{ m}^2/\text{Tank}$ (h1 = $4.65 m, r2 = 3.81 m, r3 = 6.50 m$) $V2 = \frac{\pi \times h1}{4} \times R^2 2 = 199 \text{ m}^2/\text{Tank}$ $V = V1 + V2 = 596 \text{ m}^2/\text{Tank}$	(D.M.)	5, 309
Retention Time (D.M.) = $-\frac{261,000}{261,000} \times 24 = 2.2 h$ $till$ Retention Time (H.M.W.W.F.) = $\frac{23,840}{1,087,000} \times 24 = 0.5 h$ = 4.019 m^2 Studge Generation = $261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 \text{ m}^2$ = $100 \text{ m}^2/\text{Tank}$ Studge Storage Volume = $261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 \text{ m}^2$ = $100 \text{ m}^2/\text{Tank}$ Studge Storage Volume = $261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 \text{ m}^2$ = $100 \text{ m}^2/\text{Tank}$ Studge Storage Volume = $\frac{\pi \times h3}{3}$ $(r1^2 2 + r1 \times r2 + r2^2 2) = 100 \text{ m}^2/\text{Tank}$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) = $\frac{\pi \times h4}{3}$ $(r2^2 2 + r2 \times r3 + r3^2 2) = 397 \text{ m}^2/\text{Tank}$ (h1 = $4.65 m, r2 = 3.81 m, r3 = 6.50 m$) $V2 = \frac{\pi \times h1}{4} \times R^2 2 = 199 \text{ m}^2/\text{Tank}$ $V = V1 + V2 = 596 \text{ m}^2/\text{Tank}$		
(D.M.) Retention Time (H.M.W.W.F.) Studge Generation $= \frac{23,840}{1,087,000} \times 24 = 0.5 h$ $= \frac{23,840}{1,087,000} \times 24 = 0.5 h$ (H.M.W.W.F.) Studge Generation $= 261,000 \times 154 \times 10^{-}6 \div 0.01 = 4.019 m^{2}$ $= 100 m^{2}/Tank$ (Solid Concentration 1%) Sludge Storage Volume $= \frac{\pi \times h3}{3} (r1^{-}2+r1 \times r2+r2^{-}2) = 100 m^{2}/Tank$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3} (r2^{-}2+r2 \times r3+r3^{-}2) = 397 n^{2}/Tank$ (h1 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) $V2 = \frac{\pi \times h1}{4} \times R^{-}2 = 199 m^{2}/Tank$ (h1 = 1.50 m, R = 13.00 m) $V = V1 + V2 = 596 m^{2}/Tank$		
Retention Time (H.M.W.W.F.) Sludge Generation $= \frac{23,840}{1,087,000} \times 24 = 0.5 h$ $= 261,000 \times 154 \times 10^{-6} \div 0.01 = 4.019 m^{9}$ $= 100 m^{9}/Tank$ (Solid Concentration 1%) (Solid Concentration 1%) $= \frac{\pi \times h3}{3} (r1^{-}2+r1 \times r2+r2^{-}2) = 100 m^{9}/Tank$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3} (r2^{-}2+r2 \times r3+r3^{-}2) = 397 m^{9}/Tank$ (h4 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) $V2 = \frac{\pi \times h1}{4} \times R^{-}2 = 199 m^{9}/Tank$ (h1 = 1.50 m, R = 13.00 m) $V = V1 + V2 = 596 m^{9}/Tank$	P	
Retention Time (H.M.W.W.F.) = $$	(D.M.)	
Retention Time (H.M.W.W.F.) = $$		23.840
(H.M.W.W.F.) Sludge Generation Sludge Generation $= 261,000 \times 154 \times 10^{-} - 6 \div 0.01 = 4.019 m^{2} = 100 m^{2}/Tank$ (Solid Concentration 1%) Sludge Storage Volume $= \frac{\pi \times h3}{3} (r1^{-}2+r1 \times r2+r2^{-}2) = 100 m^{2}/Fank$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3} (r2^{-}2+r2 \times r3+r3^{-}2) = 397 n^{2}/Tank$ (h1 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) $V2 = \frac{\pi \times h1}{4} \times R^{-}2 = 199 m^{2}/Tank$ (h1 = 1.50 m, R = 13.00 m) $V = V1 + V2 = 596 m^{2}/Fank$	Retention Time	
$= 100 \text{ m}^{3}/\text{Tank}$ (Solid Concentration 1%) Sludge Storage Volume $= \frac{\pi \times h3}{3} (r1^{2}+r1 \times r2+r2^{2}) = 100 \text{ m}^{3}/\text{Fank}$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3} (r2^{2}+r2 \times r3+r3^{2}) = 397 \text{ m}^{3}/\text{Tank}$ (h4 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) V2 = \frac{\pi \times h1}{4} \times R^{2} = 199 \text{ m}^{3}/\text{Tank} (h1 = 1.50 m, R = 13.00 m) V = V1 + V2 = 596 m^{3}/\text{fank}	1	
$= 100 \text{ m}^{3}/\text{Tank}$ (Solid Concentration 1%) Sludge Storage Volume $= \frac{\pi \times h3}{3} (r1^{2}+r1 \times r2+r2^{2}) = 100 \text{ m}^{3}/\text{Fank}$ (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3} (r2^{2}+r2 \times r3+r3^{2}) = 397 \text{ m}^{3}/\text{Tank}$ (h4 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) V2 = \frac{\pi \times h1}{4} \times R^{2} = 199 \text{ m}^{3}/\text{Tank} (h1 = 1.50 m, R = 13.00 m) V = V1 + V2 = 596 m^{3}/\text{fank}		
(Solid Concentration 1%) Sludge Storage Volume Effective Volume $\frac{\pi \times h3}{3} = (r1^2 tr1 \times r2 tr2^2) = 100 \text{ m}^3/\text{fank}$ $(h3 = 5.74 \text{ m}, r1 = 0.50 \text{ m}, r2 = 3.81 \text{ m})$ $V1 = \frac{\pi \times h4}{3} (r2^2 tr2 \times r3 tr3^2) = 397 \text{ n}^3/\text{fank}$ $(h4 = 4.65 \text{ m}, r2 = 3.81 \text{ m}, r3 = 6.50 \text{ m})$ $V2 = \frac{\pi \times h1}{4} \times R^2 2 = 199 \text{ m}^3/\text{fank}$ $(h1 = 1.50 \text{ m}, R = 13.00 \text{ m})$ $V = V1 + V2 = 596 \text{ m}^3/\text{fank}$	Sludge Generation	
Sludge Storage Volume $ \frac{\pi \times h3}{3} = \frac{\pi \times h3}{3} (r1^2 tr1 \times r2 tr2^2) = 100 \text{ m}^3/\text{Tank} $ Effective Volume $ V_1 = \frac{\pi \times h4}{3} (r2^2 tr2 \times r3 tr3^2) = 397 \text{ n}^3/\text{Tank} $ $ (h_1 = 4.65 \text{ m}, r_2 = 3.81 \text{ m}, r_3 = 6.50 \text{ m}) $ $ V_2 = \frac{\pi \times h1}{4} \times R^2 = 199 \text{ m}^3/\text{Tank} $ $ (h_1 = 1.50 \text{ m}, R = 13.00 \text{ m}) $ $ V = V_1 + V_2 = 596 \text{ m}^3/\text{Tank} $		
Sludge Storage Volume $= \frac{\pi + 1}{3} (r_1^2 + r_1^2 + r_2^2) = 100 \text{ m}^2/\text{fank}$ $(h_3 = 5.74 \text{ m}, r_1 = 0.50 \text{ m}, r_2 = 3.81 \text{ m})$ Effective Volume $V_1 = \frac{\pi + h_1^4}{3} (r_2^2 + r_2^2 + r_3^2 + r_3^2) = 397 \text{ n}^2/\text{Tank}$ $(h_1 = 4.65 \text{ m}, r_2 = 3.81 \text{ m}, r_3 = 6.50 \text{ m})$ $V_2 = \frac{\pi + h_1^2}{4} \times R^2 = 199 \text{ n}^2/\text{Tank}$ $(h_1 = 1.50 \text{ m}, R = 13.00 \text{ m})$ $V = V_1 + V_2 = 596 \text{ m}^2/\text{fank}$		(Solid concentration is)
Sludge Storage Volume $= \frac{\pi + 1}{3} (r_1^2 + r_1^2 + r_2^2) = 100 \text{ m}^2/\text{fank}$ $(h_3 = 5.74 \text{ m}, r_1 = 0.50 \text{ m}, r_2 = 3.81 \text{ m})$ Effective Volume $V_1 = \frac{\pi + h_1^4}{3} (r_2^2 + r_2^2 + r_3^2 + r_3^2) = 397 \text{ n}^2/\text{Tank}$ $(h_1 = 4.65 \text{ m}, r_2 = 3.81 \text{ m}, r_3 = 6.50 \text{ m})$ $V_2 = \frac{\pi + h_1^2}{4} \times R^2 = 199 \text{ n}^2/\text{Tank}$ $(h_1 = 1.50 \text{ m}, R = 13.00 \text{ m})$ $V = V_1 + V_2 = 596 \text{ m}^2/\text{fank}$		$\pi \times h3$
Volume 3 (h3 = 5.74 m, r1 = 0.50 m, r2 = 3.81 m) Effective Volume $V1 = \frac{\pi \times h4}{3}$ (r2 ² 2+r2×r3+r3 ² 2) == 397 nP/Tank (h4 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m) $V2 = \frac{\pi \times h1}{4}$ × R ² 2 = 199 nP/Tank (h1 = 1.50 m, R = 13.00 m) V = V1 + V2 = 596 m ² /Tank	Sludge Storage	
Effective Volume $V_{1} = \frac{\pi \times h4}{3} (r2^{2}+r2 \times r3 + r3^{2}) = 397 \text{ nP/Tank}$ $V_{1} = \frac{\pi \times h4}{3} (r2^{2}+r2 \times r3 + r3^{2}) = 397 \text{ nP/Tank}$ $(h_{1} = 4.65 \text{ m}, r2 = 3.81 \text{ m}, r3 = 6.50 \text{ m})$ $V_{2} = \frac{\pi \times h1}{4} \times R^{2} = 199 \text{ mP/Tank}$ $(h_{1} = 1.50 \text{ m}, R = 13.00 \text{ m})$ $V = V_{1} + V_{2} = 596 \text{ mP/Tank}$		
Effective Volume $V1 = \frac{1}{3} (r2^{2}r2 \times r3 + r3^{2}) = 397 \text{ nP/Tank}$ $(h1 = 4.65 \text{ m}, r2 = 3.81 \text{ m}, r3 = 6.50 \text{ m})$ $V2 = \frac{\pi \times h1}{4} \times R^{2} = 199 \text{ mP/Tank}$ $(h1 = 1.50 \text{ m}, R = 13.00 \text{ m})$ $V = V1 + V2 = 596 \text{ mP/Tank}$		(h3 = 5.74 m,rl = 0.50 m,r2 = 3.81 m)
Effective Volume $V1 = \frac{1}{3} (r2^{2}r2 \times r3 + r3^{2}) = 397 \text{ nP/Tank}$ $(h1 = 4.65 \text{ m}, r2 = 3.81 \text{ m}, r3 = 6.50 \text{ m})$ $V2 = \frac{\pi \times h1}{4} \times R^{2} = 199 \text{ mP/Tank}$ $(h1 = 1.50 \text{ m}, R = 13.00 \text{ m})$ $V = V1 + V2 = 596 \text{ mP/Tank}$		
$3 (h4 = 4.65 m, r2 = 3.81 m, r3 = 6.50 m)$ $V2 = \frac{\pi \times h1}{4} \times R^{2} = 199 m^{3}/Tank$ $(h1 = 1.50 m, R = 13.00 m)$ $V = V1 + V2 = 596 m^{3}/Tank$	E0	
$\frac{\pi \times h1}{4} \times R^{2} = 199 \text{ m}^{3}/\text{Tank}$ (h1 = 1.50 m. R = 13.00 m.) V = V1 + V2 = 596 m^{3}/\text{Tank}	Effective Volume	$v_1 = (r_2 + r_2 \times r_3 + r_3 + z) = 39f \text{ ary lank}$
$\frac{\pi \times h1}{4} \times R^{2} = 199 \text{ m}^{2}/\text{Tank}$ (h1 = 1.50 m. R = 13.00 m.) V = V1 + V2 = 596 m^{2}/\text{Tank}	1.	$[0, 1] = \frac{1}{2} + \frac{1}{$
$V2 = \frac{1}{4} \times R^2 = 199 m^2/Tank$ (hl = 1.50 m. R = 13.00 m.) $V = V1 + V2 = 596 m^2/Tank$		
$\frac{4}{(h] = 1.50 \text{ m} \cdot R = 13.00 \text{ m}}$ $V = V 1 + V 2 = 596 \text{ m}/fank$		$\pi \times b1$
$\frac{4}{(h] = 1.50 \text{ m} \cdot R = 13.00 \text{ m}}$ $V = V 1 + V 2 = 596 \text{ m}/fank$		$V2 = \times R^2 = 199 m^2/Tank$
$V = V 1 + V 2 = 596 \text{ m}^2/\text{fank}$		
		(h] = 1.50 m. R = 13.00 m)
		$V = V + V = 506 \text{ m}^2/(20k)$
$\Sigma V = V \times Number of Tanks = 596 \times 40 = 23,840 m2$		
		$\Sigma V = V \times \text{Number of Tanks} = 596 \times 40 = 23,840 \text{ m}^2$
	L]

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Table M-2 (2/6) Design Calculation for Master Plan (Central WWTP)

Item	Calculation
. Trickling Filter	
)First Step	
a)Required Capacity	
Design Flowrate	261,000 n²/d
BOD Loading	1.0 kg·BOD/m ¹ ·d
Influent BOD Load	$= 261,000 \times 182 \times 10^{-3} = 47,502 \text{ kg/d}$
	47, 502
Required Cross	$=$ $= 47,502 m^2$
-Sectional Area	1.0
b)Dimensions	Diserting 20.00 m
	Diameter 39.00 m Bed Depth 2.00 m
	Number 40 Tanks
c)Check	R an area and a second a
Cross-Sectional	$=$ $$ \times 39.00 ⁻ 2 \times 40 $=$ 47.784 m ²
Area	4
	47. 502
BOD Loading	= = 1.0 kg • BOD/ m' • d
	47, 784
	261, 000
Hydraulic Loading	
11) 414 4110 204 413	47, 784
	the second se
2)Intermediate Clarifier	Intermediate clarifier is the same size as primary sedimentation tank.
3)Second Step	
a)Required Capacity	
Design flowrate	261,000 m²/d 1.0 kg·BOD/m²·d
BOD Loading	$= 261,000 \times 91 \times 10^{2} - 3 = 23,751 \text{ kg/d}$
	23. 751
Required Cross	= = 23.751 m ²
-Sectional Area	1.0
b)Dimensions	Diameter 39.00 m
operation along	Bed Depth 2.00 m
	Number 20 Tanks
c)Check Cross-Sectional	$= \frac{\pi}{} \times 39.00^{2} \times 20 = 23.892 \text{ m}^{2}$
Area	4
7 11 00	
	23.751
BOD Loading	== = 1.0 kg • BOD/ n² • d 23, 892
	261.000
Hydraulic Loading	= = 10.9 m/d
	23, 892

Table M-2 (3/6) Design Calculation for Master Plan (Central WWTP)

	Design Calculation for Master Plan (Central WWTP)
Item	Calculation
3. Final Clarifier a)Required Capacity	
Design Flowrate Overflow Rate Retention Time	261,000 m ³ /d 25.0 m ³ /n ³ ·d 3.0 h
Required Surface Area	$= \frac{261,000}{25.0} = 10.440 \text{ m}^2$ Effective Volume V1
b)Dimensions	Diameter $R = 18.00 \text{ m}$ Depth $D = 16.22 \text{ m}$ Angle $\theta = 60^{\circ}$ Number40 Tanks
C)Check	(h1 = 1.50 m, h2 = 14.72 m)
Overflow Rate	$= \frac{261,000}{10,179} = 25.6 \text{ m}/\text{m}/\text{m}^2 \cdot \text{d}$
Retention Time	$= \frac{66.280}{261,000} \times 24 = 6.1 \text{ h}$
Sludge Generation	$= 261,000 \times 70 \times 10^{-6} \div 0.01 = 1,827 \text{ m}^{2}$ = 46 m ² /Tank (Solid Concentration 1%)
Słudge Storage Volume	$\frac{\pi \times h3}{3} = \frac{1}{3} (rl^{2}+rl \times r2+r2^{2}) = 46 n^{3}/Tank$ (h3 = 4.25 m, rl = 0.50 m, r2 = 2.95 m)
Effective Volume	$\frac{\pi \times h4}{V1} = \frac{\pi \times h4}{3} (r2^2 tr2 \times r3 tr3^2) = 1.275 \text{ m}/Tank$ (h1 = 10.47 m, r2 = 2.95 m, r3 = 9.00 m)
	$V2 = \frac{\pi \times hI}{4} \times R^2 = 382 \text{ m}^2/Tank$
	(h] = 1.50 m , R = 18.00 m)
	$V = V1 + V2 = 1.657 \text{ m}^2/1 \text{ ank}$
	$\Sigma V = V \times Number of Tanks = 1,657 \times 40 = 66,280 m2$

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Table M-2 (4/6) Design Calculation for Master Plan (Central WWTP)

Item	Design Calculation for Master Plan (Central WWTP) Calculation
I.Sludge Digester Tank (Open Tank)	
a)Required Capacity Design Flowrate	238.000 m²/d (Daily Average)
Retention Time	47 days (Unheated Anaerobic Digestion)
Influent Solid Quantity	= Raw Sludge + Septage from Sanitation Facility
Quantity	$= 238,000 \times 280 \times 0.8 \times 10^{-6} + 0.84$
	$= 53.3 \div 0.84 = 54.1 \text{ t/d}$
Influent Sludge Volume	$= \frac{53.3}{0.06} + 12.0 = 900 \text{ m}^2/\text{d}$ (Raw Sludge Concentration 6%)
Required Volume	$= 900 \times 47 = 42,300 \text{ m}^3$
b)Dimensions	Diameter $R = 17.50$ m Depth $D = 9.75$ m Angle $\theta = 45^{\circ}$ Number 40 Tanks
	(h] = 1.50 m, h2 = 8.25 m)
	$V_{1} = \frac{\pi \times h2}{3} (r_{1}^{2}tr_{1} \times r_{2}tr_{1}^{2}) = 701 \text{ n}?/\text{Tank}$ $(h_{2} = 8.25 \text{ m}, r_{1} = 0.50 \text{ m}, r_{2} = 8.75 \text{ m})$
	$V2 = \frac{\pi \times h1}{\times R^2} \times R^2 = 361 \text{ nr}/Tank$
	$\frac{4}{(h1 = 1.50 m, R = 17.50 m)}$
	V = V I + V 2 = 1,062 mP/Tank
	$\Sigma V = V \times Number of Taoks = 1,062 \times 40 = 42,480 m2$
c)Check	
Retention Time	$= \frac{42,480}{990} = 47 \text{ days}$
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 Table M-2 (5/6)
 Design Calculation for Master Plan (Central WWTP)

Item	Calculation for Master Fran (Central W W1F)
5.Sludge Drying Bed	
a)Required Capacity	
Influent Solid Quantity	= Digested Solids
	$= 53.3 \times (1 - (0.65 \times 0.5)) = 36.0 \text{ t/d}$
	Volatile Solid Concentration of Raw Sludge : 65 % Volatile Solid Removal Rate : 50 %
Dried Sludge Quantity	$= \frac{36.0}{1-0.6} = 90.0 t/d$
	(Moisture Content of Dried Sludge: 60 %)
Solids Loading	160 kg-SS/m ² -yr.
Required Area	$=\frac{36.0 \times 365}{2}$ = 82, 125 m ²
b)Dimensions	0.16
	Vidth40.00 mLength100.00 mNumber20 tanks
c)Check	
Area	$= 40.00 \times 100.00 \times 20 = 80,000 \text{ m}^2$
Solids Loading	$= \frac{36.0}{80.000} \times 365 \times 10^{\circ}3 = 164.3 \text{ kg} \cdot \text{SS/m}^2 \cdot \text{yr}$

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Table M-2 (6/6) Design Calculation for Master Plan (Central WWTP)

Design Calculation for North 1 Region Wastewater Treatment Plant (Master Plan)

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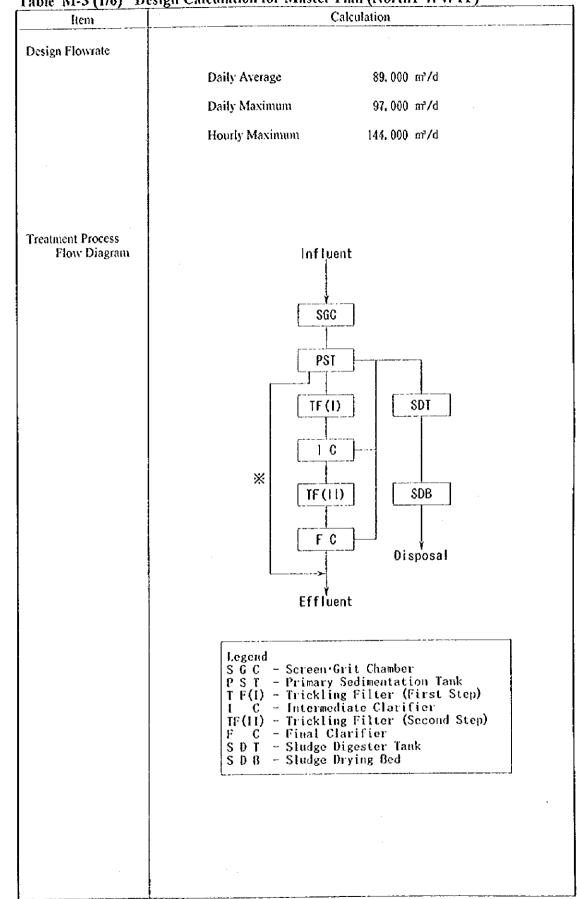


Table M-3 (1/6) Design Calculation for Master Plan (North1 WWTP)

Item	Calculation Calculation
1. Primary Sedimentation Tank	n
a)Required Capacity Design Flowrate Overflow Rate Retention Time	97,000 m³/d 50.0 m²/m²·d 2.0 h
Required Surface Area	$= \frac{97.000}{50.0} = 1.940 \text{ m}^2$
b)Dimensions	Diameter $R = 12.50$ mDepth $D = 11.46$ mAngle $0 = 60^{\circ}$ Number16 Tanks
c)Check Overflow Rate	$\left(\begin{array}{c} hl = 1.50 \text{ m}, h2 = 9.96 \text{ m} \right) \\ = \frac{97,000}{1.963} = 49.4 \text{ m}^3/\text{n}^2 \cdot \text{d} \\ \hline \theta \end{array}\right)$
Retention Time	$= \frac{8.528}{97,000} \times 24 = 2.1 \text{ h}$
Sludge Generation	$= 97.000 \times 154 \times 10^{-6} \div 0.01 = 1.494 \text{ m}^{3}$ = 93 nt/Tank (Solid Concentration 1%)
Sludge Storage Volume	$\frac{\pi \times h3}{3}$ (r1 ⁻ 2+r1 × r2+r2 ⁻ 2) = 93 m ² /fank 3 (h3 = 5.58 m, r) = 0.50 m, r2 = 3.72 m)
Effective Volume	$\frac{\pi \times h4}{3}$ (r2 ² tr2×r3tr3 ²) = 349 n²/fank (h4 = 4.38 m, r2 = 3.72 m, r3 = 6.25 m) $\pi \times h1$
	$V2 = \times R^2 = 184 m^2/Tank$ (h1 = 1.50 m , R = 12.50 m)
	$V = V + V 2 = 533 \text{ m}^2/\text{Tank}$ $\Sigma V = V \times \text{Number of Tanks} = 533 \times 16 = 8.528 \text{ m}^2$

Table M-3 (2/6)	Design Calculation	for Master	Plan (North1	WWTP)

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ltem	Calculation
2. Trickling Filter	
I)First Step	
a)Required Capacity	
Davies Flowrate	97.000 m²/d
Design Flowrate BOD Loading	1.0 kg+B0D/nf+d
Influent BOD Load	
Hangent DOD Load	- 510.000 × 102 × 10 0 - 11,001 kg/u
	17.654
Required Cross	= = 17,654 ar
-Sectional Area	1.0
b)Dimensions	
,	Diameter 38.00 m
	Bed Depth 2.00 m
	Number 16 Tanks
c)Check	$= \frac{\pi}{1000} \times 38.00^{\circ}2 \times 16 = 18,146$ of
Cross-Sectional	$= \times 30.00 \ z \times 10 = 10,140 \ m$
Area	4
	17. 654
BOD Loading	= = 1.0 kg • BOD/ m² • d
	18, 145
	97. 000
Hydraulic Loading	= = 5.3 m/d
	18. 146
Matamadiate Clarifier	Intermediate clarifier is the same size as primary sedimentation tank.
z)memeenate Charmer	intermediate clarifier is the same size us primery scormentation tonic
3)Second Step	
a)Required Capacity	
Design flowrate	97.000 m²/d
BOD Loading	I. 0 kg+BOD/m'+d
Influent BOD Load	$= 97,000 \times 91 \times 10^{-3} = 8,827 \text{ kg/d}$
	0.007
Designed Cares	8. 827
Required Cross -Sectional Area	= = 8.827 oř 1.0
-Sectional Alea	I. U
b)Dimensions	
ojizaacastons	Diameter 38.00 m
	Bed Depth 2.00 m
	Number 8 Fanks
c)Check	π
Cross-Sectional	= × 38.00°2 × 8 = 9,073 a²
Area	4
	0.003
PODIAN	$= \frac{8.827}{1-1-1} = 1.0 \text{ kg} \cdot 100/\text{ nf} \cdot d$
BOD Loading	$9.073 = 1.0 \text{ kg} \cdot 1007 \text{ bt} \cdot 0$
	7, VIU
	97.000
Hydraulic Loading	= = 10.7 m/d
	9.073
and the second	

Table M-3 (3/6) Design Calculation for Master Plan (North1 WWTP)

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f	esign Calculation for Master Plan (North1 WWTP)
Item	Calculation
3. Final Clarifier	
a)Required Capacity	
Design Flowrate	97.000 m²/d
Overflow Rate	25.0 m²/m²·d
Retention Time	3.0 h
	97.000
Required Surface	= = 3.880 m²
Area	25.0
b)Dimensions	Effective Volume
0)Dimensions	Diameter R = 17.50 m
	Depth D = 15.79 m
	Angle $\theta = 60^{\circ}$
	Number 16 Tanks Studge Storage Volume
	(h1 = 1.50 m, h2 = 14.29 m)
c)Check	
	97.000
Overflow Rate	$= \frac{1}{3.848} = 25.2 \text{ m}^3/\text{m}^2 \cdot \text{d} \frac{1}{3.848}$
	24. 528
Retention Time	=
	97. 000
Sludge Generation	$= 97,000 \times 70 \times 10^{-6} \div 0.01 = 679 \text{ m}^{2}$
	= 42 nr/Tank
	(Solid Concentration $ $ %) $\pi \times h3$
Sludge Storage	= (r1 ² ir1×r2ir2 ²) = 42 m ² /Tank
Volume	3
	(h3 = 4.09 m,r1 = 0.50 m,r2 = 2.86 m)
ĺ	
	$\pi \times h1$
Effective Volume	$V1 = (r2^2tr2 \times r3tr3^2) = 1,172$ nr/Tank
	3 (h4 = 10.20 m, r2 = 2.86 m, r3 = 8.75 m)
	χ Hz = 10.20 H + 12 = 2.00 H + 13 = 0.73 H /
1	$\pi \times h$
	$V2 = \times R^2 = 361 \text{ m}^2/\Gammaank$
	4 (hl = 1.50 m. R = 17.50 m)
	Z 917 - 31 OA W 2 TZ - 141 OA 90 A
	V = V1+V2 = 1,533 nP/Tank
	$\Sigma V = V \times \text{Number of Tanks} = 1,533 \times 16 = 24,528 \text{ m}^2$
	$2^{-1} - 1^{-1}$ A homoer of raises - 1, 333 A 10 - 24, 320 M ²
	<u> </u>

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Table M-3 (4/6) Design Calculation for Master Plan (North1 WWTP)

Item	esign Calculation for Master Plan (North1 WWTP) Calculation	
I.Sludge Digester Tank (Open Tank) a)Required Capacity		
Design Flowrate	89.000 m²/d (Daily Average)	
Retention Time	47 days (Unheated Anaerobic Digestion)	
Influent Solid Quantity	= Raw Sludge + Septage from Sanitation Facility = 89,000 \times 280 \times 0.8 \times 10 ⁻⁶ + 1.25	
	= 19.9 + 1.25 = 21.2 t/d	
Influent Sludge Volume	=	
Required Volume	$= 349.9 \times 47 = 16.445 \text{ m}^{2}$	
b)Dimensions	Diameter $R = 17.50$ m Depth $D = 9.75$ m Angle $\theta = 45^{\circ}$ Number 16 Tanks	
	(h] = 1.50 m, h2 = 8.25 m)	
	$V_{1} = \frac{\pi \times h2}{3}$ (r1 ² tr1×r2tr1 ²) = 701 m²/Tank (h2 = 8.25 m, r1 = 0.50 m, r2 = 8.75 m)	
	$V2 = \frac{\pi \times h1}{4} \times R^2 = 361 \text{ m}^2/Tank$	
	(h1 = 1.50 m, R = 17.50 m)	
	$V = V I + V 2 = 1,062 m^2/fank$	
	$\Sigma V = V \times \text{Number of Tanks} = 1.062 \times 16 = 16.992 \text{ m}^3$	
c)Check		
Retention Time	$=\frac{16.992}{350}$ = 49 days	

Item	Catculation
5.Sludge Drying Bed	
a)Required Capacity	
Influent Solid Quantity	= Digested Solids
	$= 19.9 \times (1 - (0.65 \times 0.5)) = 19.9 t/d$
	Volatile Solid Concentration of Raw Sludge : 65 % Volatile Solid Removal Rate : 50 %
Dried Sludge Quantity	$= \frac{19.9}{1-0.6} = 49.8 t/d$
	(Noisture Content of Dried Sludge: 60 %)
Solids Loading	160 kg·SS/n²·yr.
Sonus Loading	
Required Area	$= \frac{19.9 \times 365}{0.16} = 45,397 \text{ m}^2$
b)Dimensions	Width 40.00 m Length 100.00 m Number 8 Tanks
c)Check	
Area	$= 40.00 \times 100.00 \times 8 = 32,000$ nr
A	19.9
Solids Loading	$= \times 365 \times 10^{\circ}3 = 227 \text{ kg} \cdot \text{SS/m}^{\circ} \cdot \text{yr}$ 32,000

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Table M-3 (6/6) Design Calculation for Master Plan (North1 WWTP)

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Design Calculation for South 1 Region Wastewater Treatment Plant (Master Plan)

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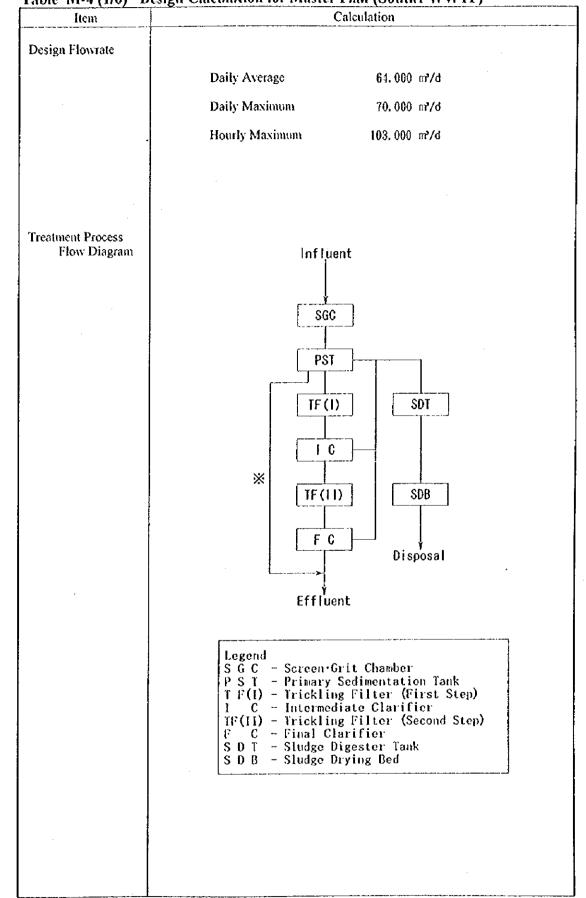


 Table M-4 (1/6) Design Calculation for Master Plan (South1 WWTP)

Item	Calculation		
1. Primary Sedimentatio			
Tank			
a)Required Capacity	70.000 m ² /d		
Design Flowrate Overflow Rate	50.0 m²/m²·d		
Retention Time	2.0 h		
	70.000		
Required Surface	70.000 = = 1.400 or		
Area			
b)Dimensions			
	Diameter $R = 13.50$ m V?		
	Depth $D = 12.33 \text{ m}$ Angle $\theta = 60^{\circ}$		
	Number 10 Tanks $V = 60$		
c)Check	(h1 = J.50 m, h2 = 10.83 m)		
0 0 D .	70,000		
Overflow Rate	70.000 = 48.9 m ² /n ² ·d		
	1,431		
Retention Time	$ = \frac{6.640}{.3} \times 24 = 2.3 h $		
	70,000		
Sludge Generation			
	$= 70,000 \times 154 \times 10^{-6} \div 0.01 = 1,078 \text{ m}^{2}$		
	= 108 m ² /fank (Solid Concentration 1%)		
Sludge Storage	$\pi \times h3$		
Volume	= (r1 ² tr1×r2tr2 ²) = 108 m ² /Tank		
	(h3 = 5.91 m, r1 = 0.50 m, r2 = 3.91 m)		
Effective Volume	$\kappa \times h1$		
	$V1 = - (r2^2 i r2 \times r3 i r3^2) = 449 \text{ m}^2/\text{Tank}$		
	з (h4 = 4.92 m, r2 = 3.91 м, r3 = 6.75 м)		
	$\pi \times hl$		
	$V2 = \times R^2 = 215 \text{ m}^2/\text{Tank}$		
	4 (h) = 1.50 m, R = 13.50 m)		
	$V = V I + V 2 = 661 m^2/Fank$		
	$\Sigma V = V \times Number of Tank = 664 \times 10 = 6,640 m^2$		

Table M-4 (2/6) D	Design Calculation for M	laster Plan (South1 WWTP)
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Item	Calculation
2. Trickling Filter	
I)First Step	
a)Required Capacity	
Design Flowrate	70.000 m²/d
BOD Loading	1.0 kg • BOD/ m ² • d
Influent BOD Load	$=$ 70,000 \times 182 \times 10 ⁻³ $=$ 12,740 kg/d
	12 740
Required Cross	$\frac{12.740}{12.740} = 12.740$ m ²
-Sectional Area	- 1.0
000000000000000000000000000000000000000	
b)Dimensions	
	Diameter 41.00 m Bed Depth 2.00 m
	Number 10 Tanks
	Politice 10 raine
c)Check	π
Cross-Sectional	$= \times 41.00^{\circ}2 \times 10 = 13.203$ nr
Area	4
	12, 740
BOD Loading	= = 1.0 kg • BOD/ nř•d
	13, 203
	70. 000
Hydraulic Loading	=
11/010000 2000000	13, 203
NT I CLARGE	Intermediate clarifier is the same size as primary sedimentation tank.
Z)intermediate Claritier	intermediate clatifier is the same size as primary second the term
3)Second Step	
a)Required Capacity	
Design flowrate	70.000 m³/d
BOD Loading	1.0 kg+BOD/m²•d
Influent BOD Load	$= 70.000 \times 91 \times 10^{-3} = 6.370 \text{ kg/d}$
D 10	6. 370 6. 270 ml
Required Cross -Sectional Area	= = 6.370 m²
-Sectional Area	1. 0
b)Dimensions	
	Diameter 41.00 m
	Bed Depth 2.00 m
	Number 5 Tanks
c)Check	π
Cross-Sectional	$= \times 41.00^{\circ}2 \times 5 = 6,601$ n ²
Arca	4
	6. 370
BOD Loading	$= = 1.0 \text{ kg} \cdot BOD/m^2 \cdot d$
DOD LOGUINE	6, 601
11. J 1: - 1	70.000 = 10.6 m/d
Hydraulic Loading	6, 601

Table M-4 (3/6) Design Calculation for Master Plan (South1 WWTP)

Item	Calculation for Master Plan (South1 WWTP)		
3. Final Clarifier			
a)Required Capacity			
Design Flowrate Overflow Rate Retention Time	70.000 m²/d 25.0 m²/m²•d 3.0 h		
Required Surface Area	$= \frac{70,000}{25.0} = 2,800 \text{ m}^2$		
b)Dimensions			
	Diameter $R = 18.50$ mDepth $D = 16.66$ mAngle $0 = 60^{\circ}$ Number10 Tanks		
	(h1 = 1.50 m, b2 = 15.16 m)		
c)Check Overflow Rate	$= \frac{70,000}{2,688} = 26.0 \text{ m}/\text{nr}\cdot\text{d} \qquad (3 - 12)$		
Retention Time	$= \frac{17.890}{70.000} \times 24 = 6.1 \text{ h}$		
Sludge Generation	$= 70,000 \times 70 \times 10^{-6} \div 0.01 = 490 \text{ m}^{2}$ $= 49 \text{ m}^{2}/\text{Tank}$		
Sludge Storage Volume	(Solid Concentration 1%) $\frac{\pi \times h3}{3} = \frac{1}{3}$ (r1 ² tr1×r2tr2 ²) = 49 m ² /Tank (h3 = 4.35 m, r1 = 0.50 m, r2 = 3.01 m)		
Effective Volume	$\pi \times h4$ VI = $\frac{\pi \times h4}{3}$ (r2 ⁻ 2+r2×r3+r3 ⁻ 2) = 1.386 m ³ /Tank (h1 = 10.81 m, r2 = 3.01 m, r3 = 9.25 m)		
	$\frac{\pi \times h}{V2} = -\frac{\pi \times h}{X} = 403 \text{ m}/\text{Tank}$		
	4 (h1 = 1.50 m, R = 18.50 m)		
	$V = V1 + V2 = 1.789 \text{ m}^2/\text{Tank}$		
	$\Sigma V = V \times \text{Number of Tanks} = 1.789 \times 10 = 17.890 \text{ n}^2$		

Table M-4 (4/6)	Design Calculatio	n for Master Plan	(South1 WWTP)

	esign Calculation for Master Plan (South1 WWTP) Calculation
Item 4.Sludge Digester Tank (Open Tank) a)Required Capacity Design Flowrate Retention Time Influent Solid Quantity Influent Sludge Volume Required Volume	Calculation 64.000 m ² /d (Daily Average) 47 days (Unheated Anaerobic Digestion) = Rax Sludge + Septage from Sanitation Facility = 64.000 × 280 × 0.8 × 10 ² -6 + 0.02 = 14.3 + 0.02 = 14.3 t/d = $\frac{14.3}{0.06}$ + 0.3 = 238.3 m ² /d (Rax Sludge Concentration 6%) = 238.3 × 47 = 11.200 m ²
b)Dimensions	Diameter $R = 18.00 \text{ m}$ Depth $D = 10.00 \text{ m}$ Angle $\theta = 45^{\circ}$ Number 10 Tanks (h] = 1.50 m, h2 = 8.50 m)
	$V_{1} = \frac{\pi \times h^{2}}{3} (r_{1}^{2} + r_{1}^{2} \times r_{2}^{2} + r_{1}^{2}) = 763 \text{ m}^{2}/\text{Tank}$ $(h_{2} = 8.50 \text{ m}, r_{1} = 0.50 \text{ m}, r_{2} = 9.00 \text{ m})$ $V_{2} = \frac{\pi \times h_{1}}{4} \times R^{2} = 382 \text{ m}^{2}/\text{Tank}$ $(h_{1} = 1.50 \text{ m}, R = 18.00 \text{ m})$ $V = V_{1} + V_{2} = 1,145 \text{ m}^{2}/\text{Tank}$ $\Sigma V = V \times \text{Number of Tanks} = 1.145 \times 10 = 11.450 \text{ m}^{2}$
c)Check Retention Time	$=\frac{11.450}{238}$ = 48 days

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Item 5.Sludge Drying Bed	Calcultion
a)Required Capacity	
Influent Solid	= Digested Solids
Quantity	$= 14.3 \times (1 - (0.65 \times 0.5)) = 9.7 t/d$
	Volatile Solid Concentration of Raw Sludge : 65 % Volatile Solid Removal Rate : 50 %
Dried Sludge Quantity	$= \frac{9.7}{0.4} = 24.3 \text{ t/d}$
	(Noisture Content of Dried Sludge: 60 %)
Solids Loading	160 kg·SS/a7·yr.
Required Area	$= \frac{9.7 \times 365}{0.16} = 22.128 \text{ m}^2$
b)Dimensions	Vidth 40.00 m Length 110.00 m Number 5 Tanks
c)Check	
Area	$= 40.00 \times 110.00 \times 5 = 22,000 \text{ m}^2$
Solids Loading	$= \frac{9.7}{22,000} \times 365 \times 10^{-3} = 160.9 \text{ kg}\cdot\text{SS/m}^{\circ}\cdot\text{yr}$

Table M-4 (6/6) Design Calculation for Master Plan (South1 WWTP)

Design Calculation for South 2 Region Wastewater Treatment Plant (Master Plan)

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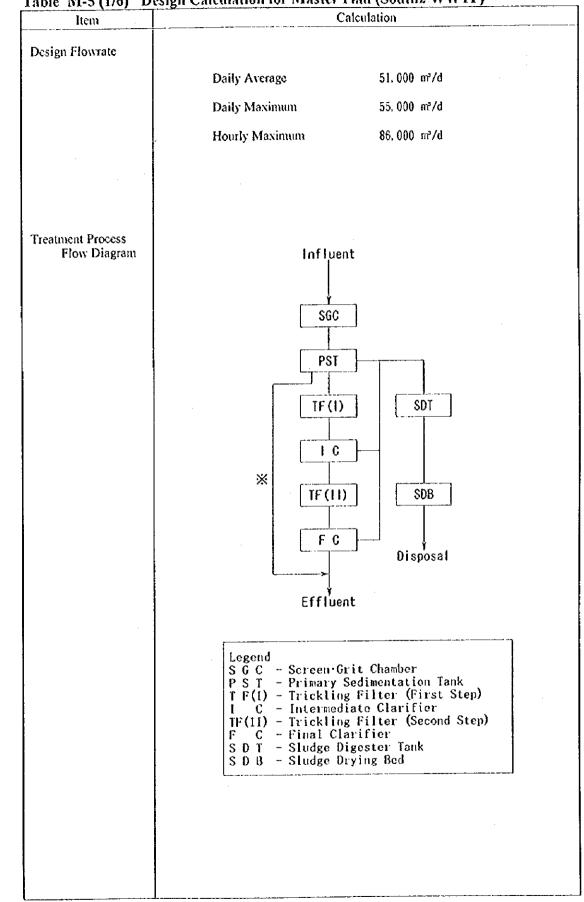


Table M-5 (1/6) Design Calculation for Master Plan (South2 WWTP)

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Item	Calculation
 Primary Sedimentatio Tank a)Required Capacity Design Flowrate Overflow Rate Retention Time 	n 55.000 m³/d 50.0 m³/n²∙d 2.0 h
Required Surface Area b)Dimensions	$= \frac{55,000}{50.0} = 1,100 \text{ m}^{2}$ Diameter R = 13.50 m
c)Check Overflow Rate	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
Retention Time	$= \frac{5,336}{55,000} \times 24 = 2.3 \text{ h}$
Sludge Generation Sludge Storage Volume	$= 55,000 \times 154 \times 10^{-6} \div 0.01 = 847 \text{ m}^{3}$ = 106 nP/Tank (Solid Concentration 1%) $\frac{\pi \times h3}{3} = \frac{106 \text{ nP}}{3} \text{ (rl}^{2}\text{rl} \times r2\text{tr}^{2}\text{2)} = 106 \text{ nP}}\text{ Tank}$ (h3 = 5.86 m , rl = 0.50 m , r2 = 3.88 m)
Effective Volume	$\frac{\pi \times h4}{3} (r2^{2}tr2 \times r3tr3^{2}) = 452 \text{ m}^{3}/\text{fank}$ $(h4 = 4.97 \text{ m}, r2 = 3.88 \text{ m}, r3 = 6.75 \text{ m})$ $V2 = \frac{\pi \times h1}{4} \times R^{2} = 215 \text{ m}^{3}/\text{fank}$ $(h1 = 1.50 \text{ m}, R = 13.50 \text{ m})$ $V = V1 + V2 = 667 \text{ m}^{3}/\text{fank}$ $\Sigma V = V \times \text{Number of fanks} = 667 \times 8 = 5.336 \text{ m}^{3}$

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Table M-5 (2/6) Design Calculation for Master Plan (South2 WWTP)

	esign Calculation for Master Plan (South2 WWTP)
Item	Calculation
2. Trickling Filter	
1)First Step a)Required Capacity	
a)Acquirea capacity	
Design Flowrate	55.000 m ³ /d
BOD Loading	1.0 kg+BOD/n7+d
Influent BOD Load	$= 55.000 \times 182 \times 10^{-3} = 10,010 \text{ kg/d}$
	10.010
Required Cross	= = 10, 010 m ²
-Sectional Area	1.0
b)Dimensions	Diancter 40.00 m
	Bed Depth 2.00 m
	Number 8 Tanks
c)Check Cross-Sectional	$\frac{\pi}{1}$ × 40.00 ² × 8 = 10.053 m ²
Area	4
DODI	10, 010
BOD Loading	= = 1.0 kg · BOD/ m ² · d 10.053
	10,000
	55. 000
Hydraulic Loading	= = 5.5 m/d
	10. 053
2)Intermediate Clarifier	Intermediate clarifier is the same size as primary sedimentation tank.
3)Second Step	
a)Required Capacity	
Design flowrate	55.000 nr/d
BOD Loading	1.0 kg-BOD/m ² ·d
Influent BOD Load	$= 55,000 \times 91 \times 10^{-3} = 5,005 \text{ kg/d}$
	5. 005
Required Cross	= = 5,005 m²
-Sectional Area	1.0
b)Dimensions	Diameter 40.00 m
	Bed Depth 2.00 m
	Number 4 Tanks
a Church	
c)Check Cross-Sectional	$\frac{\pi}{1} = \times 40.00^{\circ}2 \times 4 = 5.027$ m ²
Area	4
DOD Lastin	5.003 = 1.0 kg·BOD/m ² ·d
BOD Loading	$=$ $\frac{1}{5,027}$ = 1.0 kg 1007 m ² d
	55.000
Hydraulic Loading	= = 10.9 m/d 5.027
L	1

Table M-5 (3/6) Design Calculation for Master Plan (South2 WWTP)

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	esign Calculation for Master Plan (South2 WWTP)
Item	Calculation
3.Final Clarifier a)Required Capacity	
Design Flowrate Overflow Rate Retention Time	55.000 m²/d 25.0 m²/m²•d 3.0 h
Required Surface Area	$= \frac{55,000}{25.0} = 2,200 \text{ m}^2$
b)Dimensions	Diameter $R = 18.50$ m Depth $D = 16.66$ m Angle $\theta = 60^{\circ}$ Number 8 Tanks Sudge Straps Young
c)Check	(h1 = 1.50 m, h2 = 15.16 m) 55,000
Overflow Rate	$= \frac{33,000}{2,150} = 25.6 \text{ m}^3/\text{m}^2 \cdot \text{d}$
Retention Time	$= \frac{14,320}{55,000} \times 24 = 6.2 h$
Sludge Generation	= 55,000 × 70 × 10 ⁻ -6 ÷ 0.01 = 385 m ² = 48 m ² /Tank
Sludge Storage Volume	(Solid Concentration 1%) $\pi \times h3$ $= \frac{\pi \times h3}{3}$ (r1 ² +r1 × r2+r2 ²) = 48 m ³ /Tank (h3 = 4.32 m, r1 = 0.50 m, r2 = 2.99 m)
Effective Volume	$\pi \times h4$ V1 = $\frac{\pi \times h4}{3}$ (r2 ² tr2×r3tr3 ²) = 1.387 m ³ /Tank (h4 = 10.84 m , r2 = 2.99 m , r3 = 9.25 m)
	$V2 = \frac{\pi \times h1}{4} \times R^{2} = 403 \text{ m}^{3}/\text{tank}$ (h1 = 1.50 m, R = 18.50 m)
	$V = V1 + V2 = 1,790 \text{ m}^2/\text{Tank}$
	$\Sigma V = V \times \text{Number of Tanks} = 1.790 \times 8 = 14.320 \text{ m}^3$

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Table M-5 (4/6) Design Calculation for Master Plan (South2 WWTP)

Calculation
51.000 m²/d (Daily Average)
47 days (Unheated Anaerobic Digestion)
= Raw Sludge + Septage from Sanitation Facility
$= 51,000 \times 280 \times 0.8 \times 10^{-6} \pm 0.06$
= 11.4 + 0.06 = 11.5 t/d
$=$ $\frac{11.4}{10.9} = 190.9 \text{ m}^{2}/\text{d}$
0.06 (Raw Sludge Concentration 6%)
$= 190.9 \times 47 = 8,972 \text{ m}^2$
Diameter R = 18.00 m
$\begin{array}{c c} Drameter & R = 18.00 \text{ m} \\ \hline Depth & D = 10.00 \text{ m} \\ \end{array}$
Angle $\theta = 45$
Number 8 Tanks
(h1 = 1.50 m, h2 = 8.50 m)
$V_{1} = \frac{\pi \times h2}{3} (r_{1}^{2}r_{1} \times r_{2}r_{1}^{2}r_{2}) = 763 \text{ or}/Tank$ $(h_{2} = 8.50 \text{ m}, r_{1} = 0.50 \text{ m}, r_{2} = 9.00 \text{ m})$ $\pi \times h_{1}$
$V_2 = \times R^2 = 382 \text{ m}^2/\text{Tank}$
(h] = 1.50 m , R = 18.00 m) V = V 1 + V 2 = 1,145 m³/Tank
$\Sigma V = V \times \text{Number of Tanks} = 1,145 \times 8 = 9,160 \text{ and}$
$= \frac{9.160}{101} = 48 \text{ days}$
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Table M-5 (5/6) Design Calculation for Master Plan (South2 WWTP)

Item	Calculation for Master Plan (South2 WWTP) Calculation
S.Sludge Drying Bed	
a)Required Capacity Influent Solid Quantity	=Digested Solids
	= $11.4 \times (1 - (0.65 \times 0.5)) = 7.7 \text{ t/d}$ Volatile Solid Concentration of Raw Sludge : 65% Volatile Solid Removal Rate : 50%
Dried Sludge Quantity	$= \frac{7.7}{0.4} = 19.3 \text{ t/d}$
	(Moisture Content of Dried Sludge: 60 %)
Solids Loading	160 kg+SS/m²•yr.
Required Area	$= \frac{7.7 \times 365}{0.16} = 17,566 \text{ m}^3$
b)Dimensions	Vidth 40.00 m Length 110.00 m Number 4 Tanks
c)Check	
Area	$= 40.00 \times 110.00 \times 4 = 17.600 \text{ nr}$
Solids Loading	$= \frac{7.7}{17.600} \times 365 \times 10^{\circ}3 = 159.7 \text{ kg} \cdot \text{SS/nr} \cdot \text{yr}$

Table M-5 (6/6) Design Calculation for Master Plan (South2 WWTP)

Design Calculation for South 3 Region Wastewater Treatment Plant (Master Plan)

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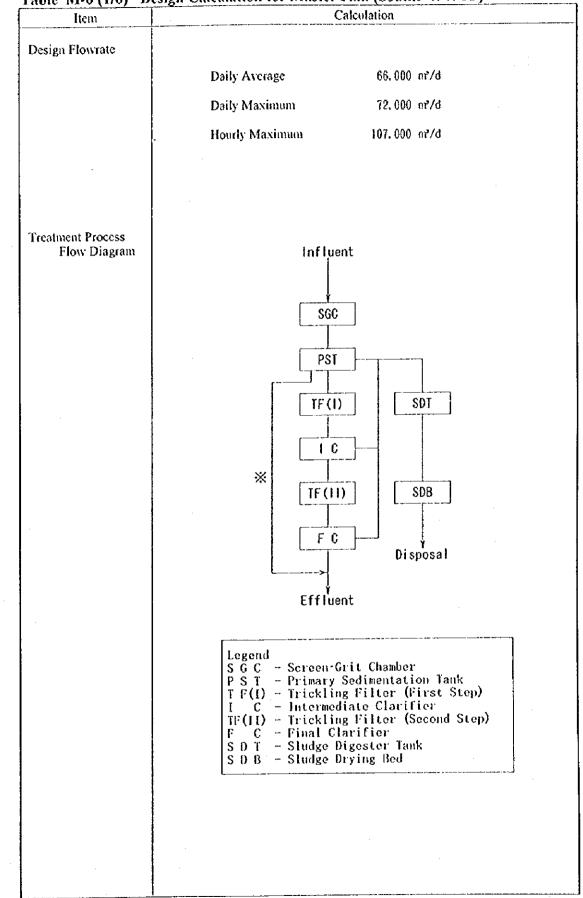


Table M-6 (1/6) Design Calculation for Master Plan (South3 WWTP)

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Item	Calculation
1. Primary Sedimentation	
Tank	
a)Required Capacity	
Design Flowrate	72,000 m²/d 50.0 m²/m²+d
Overflow Rate Retention Time	50.0 n ² /n ² ·d 2.0 h
Accontion Time	2.0
Required Surface	72, 000
Area	= = 1.440 m ²
	50.0
b)Dimensions	
	Diameter $R = 12.50$ m
	Depth $D = 11.46 \text{ m}$ 12
	Angle $O = 60$ Effective Valuese
	Number 12 Tanks
c)Check	(h1 = 1.50 m, h2 = 9.96 m)
UCHECK	
Overflow Rate	72.000
	= = 48.9 n²/m²·d
	1. 473
Retention Time	6. 408
Recention time	=
	72,000
Studge Generation	$= 72,000 \times 154 \times 10^{-6} \div 0.01 = 1.109 \text{ m}^3$
	$= 12,000 \times 134 \times 10^{-6} \div 0.01 - 1.109 \text{ m}$ = 92 n ³ /Tank
	(Solid Concentration 1%)
Sludge Storage	$\pi \times h3$
Volume	$= (r_1^2 + r_1 \times r_2 + r_2^2) = 92 \text{ m}/\text{Tank}$
	з (h3 = 5.56 м,r1 = 0.50 м,r2 = 3.71 м)
	(113 ~ J. J(11 , 11 - 0. J(10 , 12 - J. (1 10)
Effective Volume	$\pi \times h4$
	$V_1 = (r^2 2 + r^2 \times r^3 + r^3 \cdot 2) = 350 \text{ m}^2/Tank$
	3 (h4 = 4.40 m , r2 = 3.71 m , r3 = 6.25 m)
	$\pi \times h$]
	$V_2 = \times R_2 = 181 \text{ m}^2/\text{Iank}$
	4 (h) = 1.50 m, R = 12.50 m)
· · ·	τ τι ~ 1.30 M , IX ~ 12.30 W /
	$V = V I + V 2 = 534 m^2/Tank$
	$\Sigma V = V \times \text{Number of Tanks} = 534 \times 12 = 6,408 \text{ m}^3$
L	

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Table M-6 (2/6) Design Calculation for Master Plan (South3 WWTP)

Item	Calculation
2. Trickling Filter	
)First Step	
a)Required Capacity	
Design Flowrate	72, 000 nt/d
BOD Loading	1.0 kg·BOD/nr ² ·d
Influent BOD Load	
	13, 104
Required Cross	= = 13.104 m ²
-Sectional Area	1.0
b)Dimensions	
072	Diameter 33.00 m
	Bed Depth 2.00 m
	Number 12 Tanks
c)Check	π
Cross-Sectional	$=$ \xrightarrow{n} × 38.00 ² × 12 = 13.609 m ²
Area	4
	$= \frac{13.104}{1.0 \text{ kg} \cdot \text{BOD/m}^2 \cdot \text{d}}$
BOD Loading	13. 609
	10,000
	72, 000
Hydraulic Loading	= = 5.3 m/d
	13. 609
Montermediate Clarifier	Intermediate clarifier is the same size as primary sedimentation tank.
3)Second Step	
a)Required Capacity	
Design flowrate	72, 000 m²/đ
BOD Loading	1.0 kg·BOD/nr·d
	$= 72,000 \times 91 \times 10^{-3} = 6,552 \text{ kg/d}$
D 10.0	6, 552
Required Cross -Sectional Area	= == 6.552 n²
-Sectional Area	1.0
b)Dimensions	
	Diameter 38.00 m
	Bed Depth 2.00 m
	Number 6 Tanks
c)Check	π
Cross-Sectional	$= \times 38.00^{\circ}2 \times 6 = 6,805$ m ²
Area	4
	e 550
BOD Loading	6.552 = 1.0 kg · BOD/ m ² · d
DOD Loading	6.805
	72.000
Hydraulic Loading	= = 10.6 m/d
	6. 805

 Table M-6 (3/6)
 Design Calculation for Master Plan (South3 WWTP)

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Item	Calculation for Master Plan (South3 WW LP) Calculation
3.Final Clarifier	
a)Required Capacity	
Design Flowrate Overflow Rate Retention Time	72,000 n²/d 25.0 n²/n²+d 3.0 h
Required Surface Area	$= \frac{72.000}{25.0} = 2.880 \text{ m}^2$
b)Dimensions	Diameter $R = 17.50$ m Depth $D = 15.79$ m Angle $0 = 60$ ' Number 12 Tanks
c)Check	(h1 = 1.50 m, h2 = 14.29 m) 72,000
Overflow Rate	$= \frac{12,000}{2,886} = 24.9 \text{ m}^3/\text{m}^2 \cdot \text{d}$
Retention Time	$= \frac{18,396}{72,000} \times 24 = 6.1 \text{ h}$
Sludge Generation	= 42 m²/Tank
Sludge Storage Volume	(Solid Concentration 1%) $= \frac{\pi \times h3}{3}$ (r1 ² frl×r2fr2 ²) = 42 m ³ /Tank (h3 = 4.09 m, r1 = 0.50 m, r2 = 2.86 m)
Effective Volume	$V_{1} = \frac{\pi \times h_{1}}{3} (r2^{2} r2 \times r3 r3^{2}) = 1,172 \text{ nr}/Tank$ $(h_{1} = 10.20 \text{ m}, r2 = 2.86 \text{ m}, r3 = 8.75 \text{ m})$
	$V2 = \frac{\pi \times hI}{4} \times R^2 = 361 \text{ m}^2/\text{Tank}$
	(h] ~ }.50 m , R = 17.50 m)
	V = V1 + V2 = 1,533 m/Tank
	$\Sigma V = V \times \text{Number of Tanks} = 1,533 \times 12 = 18.396 \text{ m}^3$

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 Table M-6 (4/6)
 Design Calculation for Master Plan (South3 WWTP)

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r	esign Calculation for Master Plan (South3 WWTP)
Item	Calculation
 4.Sludge Digester Tank (Open Tank) a)Required Capacity Design Flowrate 	66.000 m²/d (Daily Average)
Retention Time	47 days (Unheated Anaerobic Digestion)
Influent Solid Quantity	= Raw Sludge + Septage from Sanitation Facility
	$= 66,000 \times 280 \times 0.8 \times 10^{-6} + 0.02$
	$= 14.8 \pm 0.02 = 14.8 \text{ t/d}$
Influent Sludge Volume	14.8 =
Required Volume	$= 247.3 \times 47 = 11.623$ n ²
b)Dimensions	Diameter $R = 17.00 \text{ m}$ Depth $D = 9.50 \text{ m}$ Angle $0 = 45^{\circ}$ Number 12 Tanks ($h1 = 1.50 \text{ m}, h2 = 8.00 \text{ m}$)
c)Check	$V_{1} = \frac{\pi \times h2}{3} (r_{1}^{2} 2 r_{1}^{2} \times r_{2}^{2} r_{1}^{2}) = 643 \text{ m}^{2}/\text{Tank}$ $(h_{2} = 8.00 \text{ m}, r_{1} = 0.50 \text{ m}, r_{2} = 8.50 \text{ m})$ $V_{2} = \frac{\pi \times h1}{4} \times R^{2} = 340 \text{ m}^{2}/\text{Tank}$ $(h_{1} = 1.50 \text{ m}, R = 17.00 \text{ m})$ $V = V_{1} + V_{2} = 983 \text{ m}^{2}/\text{Tank}$ $\Sigma V = V \times \text{Number of Tanks} = 983 \times 12 = 11.796 \text{ m}^{2}$
C)Check	11.700
Retention Time	$=\frac{11.796}{247}$ = 48 days

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 Table M-6 (5/6)
 Design Calculation for Master Plan (South3 WWTP)

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Item 5.Sludge Drying Bed	Calculation
a)Required Capacity	
Influent Solid Quantity	= Digested Solids
	$= 14.8 \times (1 - (0.65 \times 0.5)) = 10.0 \text{ t/d}$
	Volatile Solid Concentration of Raw Sludge : 65 % Volatile Solid Removal Rate : 50 %
Dried Studge Quantity	$= \frac{10.0}{0.4} = 25.0 \text{ t/d}$
	(Moisture Content of Dried Sludge: 60 %)
Solids Loading	160 kg+SS/m ² +yr.
Required Area	$= \frac{10.0 \times 365}{0.16} = 22.813 \text{ m}^2$
b)Dimensions	Vidth 40.00 m Length 95.00 m Number 6 Tanks
c)Check	
Area	$= 40.00 \times 95.00 \times 6 = 22.800 \text{ m}^2$
Solids Loading	$= \frac{10.0}{22,800} \times 365 \times 10^{-3} = 160.1 \text{ kg} \cdot \text{SS/m}^2 \cdot \text{yr}$

Table M-6 (6/6) Design Calculation for Master Plan (South3 WWTP)

Design Calculation for East 1 Region Wastewater Treatment Plant (Master Plan)

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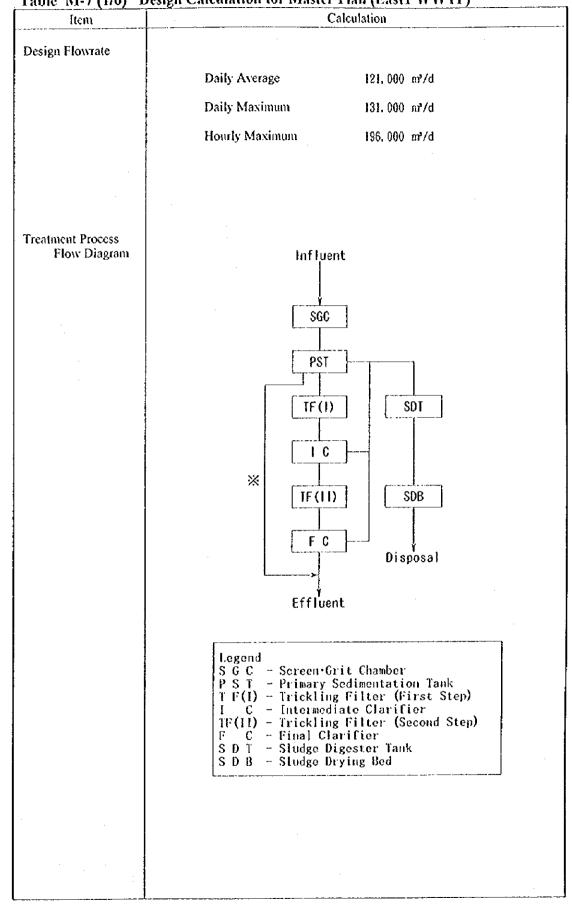


Table M-7 (1/6) Design Calculation for Master Plan (East1 WWTP)

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Item	Calculation
I. Primary Sedimentation	
Tank a)Required Capacity Design Flowrate Overflow Rate	131.000 m²/d 50.0 m²/m²+d
Retention Time Required Surface	2.0 h 131.000
Area b)Dimensions	= = 2,620 m ²
	Diameter $R = 13.00 \text{ m}$ Depth $D = 11.89 \text{ m}$ Angle $\theta = 60^{\circ}$ Number 20 Tanks
c)Check Overflow Rate	(h1 = 1.50 m, h2 = 10.39 m) 131,000
	$= = 49.3 \text{ m}^2/\text{m}^2 \cdot \text{d}$
Retention Time	$= \frac{11.920}{131.000} \times 24 = 2.2 \text{ h}$
Sludge Generation	$= 131,000 \times 154 \times 10^{-6} \div 0.01 = 2.017 \text{ an}^{2}$ = 101 m ² /Tank (Solid Concentration 1%)
Sludge Storage Volume	$\frac{\pi \times h3}{3} = \frac{\pi \times h3}{3}$ (r] ² tr1×r2tr2 ² 2) = 101 m ² /Tank (h3 = 5.75 m, r1 = 0.50 m, r2 = 3.82 m)
Effective Volume	$\frac{\pi \times h4}{3}$ (r2 ² 2+r2×r3+r3 ² 2) = 397 m ² /Tank (h4 = 4.61 m, r2 = 3.82 m, r3 = 6.50 m)
	$V_2 = \frac{\pi \times h_1}{4} \times R^2 = 199 \text{ m}^2/\text{Tank}$
	(hl = 1.50 m, R = 13.00 m) V = V1 + V2 = 596 m ³ /Tank
	$\Sigma V = V \times Number of Tanks = 596 \times 20 = 11,920 m2$

Table M-7 (2/6) Design Calculation for Master Plan (East1 WWTP)

Item	Calculation
2. Trickling Filter	
1)First Step	
a)Required Capacity	
Design Flowrate	131,000 m²/d
80D Loading	1.0 kg·BOD/m²·d
Influent BOD Load	$=$ 131,000 \times 182 \times 10 ⁻³ $=$ 23,842 kg/d
	23. 842
Required Cross	= = 23, 842 m ²
-Sectional Area	1.0
b)Dimensions	Diameter 39.00 m
	Bed Depth 2.00 m
	Number 20 Tanks
c)Check Cross-Sectional	$= \frac{\pi}{} \times 39.00^{\circ}2 \times 20 = 23.892$ n ²
Area	4
DODLAS	$= \frac{23,842}{$
BOD Loading	23, 892
	131.000
Hydraulic Loading	= = 5.5 m/d 23.892
4 .	
2)Intermediate Clarifier	Intermediate clarifier is the same size as primary sedimentation tank.
3)Second Step a)Required Capacity	
ancequired Capacity	
Design flowrate	131.000 n ² /d
BOD Loading	1.0 kg+BOD/m?+d
Influent BOD Load	$= 131.000 \times 91 \times 10^{-3} = 11.921 \text{ kg/d}$
	11, 921
Required Cross	= = 11, 921 m [*]
-Sectional Area	1.0
b)Dimensions	
	Diameter 39.00 m
	Bed Depth 2.00 m
	Number 10 Tanks
c)Check	π
Cross-Sectional	$= \frac{\pi}{1000} \times 39.00^{\circ}2 \times 10 = 11.946 \text{ m}^{\circ}$
Area	4
	11 001
BOD Loading	$= \frac{11.921}{1.0 \text{ kg} \cdot \text{BOD/ n}^2 \cdot \text{d}}$
DOD Loading	11.946
the face the face of the	= 131,000 = 11.0 m/d
Hydraulic Loading	

Table M-7 (3/6) Design Calculation for Master Plan (East WWTP)

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Table MI-7 (4/6) 1 Item	Design Calculation for Master Plan (East1 WWTP) Calculation
3. Final Clarifier a)Required Capacity	Contrainton
Design Flowrate Overflow Rate Retention Time	131,000 m²/d 25.0 m²/n²·d 3.0 h
Required Surface Area	$= \frac{131,000}{25.0} = 5.240 \text{ nm}$ Effective Volume V_1 t_1
b)Dimensions	Diameter $R = 18.00$ mDcpth $D = 16.22$ mAngle $\theta = 60^{\circ}$ Number20 Tanks
c)Check	(h1 = 1.50 m, h2 = 14.72 m) 131.000
Overflow Rate	$= \frac{151,000}{5,089} = 25.7 \text{ m}^2/\text{m}^2 \cdot \text{d}$
Retention Time	$= \frac{33,140}{131,000} \times 24 = 6.1 h$
Sludge Generation	$= 131.000 \times 70 \times 10^{2} - 6 \div 0.01 = 917 \text{ m}^{2}$ = 46 m ² /Tank (Solid Concentration 1%)
Sludge Storage Volume	$=\frac{\pi \times h3}{3}$ (r1 ² fr1 × r2 fr2 ²) = 46 m ³ /Tank (h3 = 4.25 m, r1 = 0.50 m, r2 = 2.95 m)
Effective Volume	$\frac{\pi \times h4}{V1} = \frac{\pi \times h4}{(r2^2 + r2 \times r3 + r3^2)} = 1.275 \text{ m}^3/\text{Tank}$ (h4 = 10.47 m . r2 = 2.95 m . r3 = 9.00 m)
	$V2 = \frac{\pi \times h}{4} \times R^2 = 382 \text{ m}^3/\text{Tank}$
	(h1 = 1.50 m, R = 18.00 m) V = V1+V2 = 1.657 m ² /Tank
	$\Sigma V = V \times Number of Tanks = 1,657 \times 20 = 33,140 m^2$

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Design Calculation for Master 1	

	Design Calculation for Master Plan (East1 WWTP)
Item	Calculation
4.Slodge Digester Tank (Open Tank)	
a)Required Capacity	
Design Flowrate	121,000 m²/d (Daily Average)
Retention Time	47 days (Unheated Anacrobic Digestion)
Influent Solid Quantity	= Raw Sludge + Septage from Sanitation Facility
	$= 121.000 \times 280 \times 0.8 \times 10^{-6} + 0.46$
	$= 27.1 \pm 0.46 = 27.6 t/d$
Influent Sludge	$= \frac{27.1}{+6.6} = 458.6 \text{ m}^3/\text{d}$
Volume	0.06 (Raw Sludge Concentration 6%)
Required Volume	$= 458.6 \times 47 = 21,554 \text{ m}^3$
b)Dimensions	
OfDiricusions	Diameter $R = 18.00$ m
	Depth D = 10.00 m
	Angle $\theta = 45$
	Number 20 Tanks
	(hl = 1.50 m, h2 = 8.50 m)
	· · ·
	$V1 = \frac{\pi \times h2}{(r1^2 tr1 \times r2 tr1^2)} = 763 \text{ m}^2/Tank$
	3 (h2 = 8.50 л.r) = 0.50 л.r2 = 9.00 л.)
	$\frac{\pi \times h1}{\sqrt{2} = \times R^2} = 382 \text{ nr}/Tank$
	$\sqrt{2} = \frac{1}{\sqrt{2}} \times (\sqrt{2} = 332 \text{ m/rank})$ (hl = 1.50 m, R = 18.00 m)
	V = V 1 + V 2 = 1,145 m/Tank
	$\Sigma V = V \times Number of Tanks = 1.145 \times 20 = 22,900 ar$
c)Check	
	22. 900
Retention Time	= = 50 days

Table M-7 (5/6) Design Calculation for Master Plan (East1 WWTP)

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Table M1-7 (6/6) 1 Item	Design Calculation for Master Plan (East1 WWTP) Calculation
5.Sludge Drying Bed	
a)Required Capacity	
Influent Solid Quantity	= Digested Solids
	$= 27.1 \times (1 - (0.65 \times 0.5)) = 18.3 \text{ t/d}$
	Volatile Solid Concentration of Raw Sludge : 65 % Volatile Solid Removal Rate : 50 %
Dried Sludge Quantity	$= \frac{18.3}{0.4} = 45.8 t/d$
	(Moisture Content of Dried Sludge: 60 %)
Solids Loading	160 kg·SS/m²·yr.
Required Area	$= \frac{18.3 \times 365}{0.16} = 41,747 \text{ m}^2$
b)Dimensions	Vidth 40.00 m Length 105.00 m Number 10 Tanks
c)Check	
Arca	$= 40.00 \times 105.00 \times 10 = 42,000 \text{ m}^2$
Solids Loading	$= \frac{18.3}{42,000} \times 365 \times 10^{\circ}3 = 159 \text{ kg} \cdot \text{SS/ar} \cdot \text{yr}$

Table M-7 (6/6) Design Calculation for Master Plan (East1 WWTP)

DESIGN CALCULATION FOR FIRST STAGE PROJECT

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Table M-8 Outline of Treatment Facilities for the First Stage Project (Alternative 1 and Alternative 2)

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Note : BA....Bottom Arca, SA....Surface Arca Source: Study Team

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Design Calculation for Central Region Wastewater Treatment Plant (First Stage)

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а. Б. ΑP First Stage Disposal 179.000 m²/d 196.000 n?/d 293.000 nt/d 879.000 m/d SDB Effluent Influent l S S PST Hourly Maximum Wet Weather Hourly Maximum Daily Maximum Daily Avenue Table M-9 (1/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP) с ч Primary Troated Excess Wet Weather Flow (3.XMaximum Hourly Flow - 1.XMaximum Hourly Flow) ۲ Legend P G C - Screen-Grit Chambor P S T - Primery Solimentation Tank T F(1) - Trickling Filter (First Step) T C - Intermediate Clarifier T F(1) - Trickling Filter (Second Step) F C - Final Clarifier S D - Sludge Digester Tank S D - Sludge Digester Tank A P - Amaerobia Pond F P - Facultative Pond Disposal \$08 238,000 m/d 261.000 m²/d 390,000 m¹/d 1.037.000 m²/d Ultimate SoT TF(11) Effuent Inf luent 0 1 SGC TF(1) PS1 Hourly Maximum Wet Weather Hourly Maximum Daily Maximum Daily Average * X Treatment Process Flow Diagram Design Flowrate ltem

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m'/d (H. N. W. F. F.) һ < Ш, Ж, Ү, Р, Р,) h3 = 5.74 m.r1 = 0.50 m.r2 = 3.54 m.L2 *20.00 m) ■ 198.000 × 154 × 10⁻⁻6 ÷ 0.01 = 3.018 m²
■ 201 m²/Tank 196.000 mr/d (0. M.). 875.000 mr/d (1 50.0 mr/mr-d 2.0 h (0. M.) 0.5 h (11.) 2.0 Daily Maximum Wet Weather Flow M. M. F : Hourly Maximum Yet Weather Flow $(\pi \times r3^2 2+ R \times L2) \times Number of Tanks = 4, 178 m²$ First Stage (hi = 1.50 n.h2 = 8.50 n.L2 = 20.00 n) *π*×h3 (r1²+r1×r2+r2²2) = 87.5 m² × h3 × L2 = 463.8 m² (Solid Concentration 1%) •• 46.9 m/m*•d 87.5 + 463.8 = 551 m/Tank × 24 = 1.9 h $\times 24 = 0.4 h$ $\begin{array}{c} R = 10.00 \text{ m} \\ D = 10.00 \text{ m} \\ 0 = 10.00 \text{ m} \\ 0 = 62.1 \text{ m} \\ 15 \text{ Tanks} \end{array}$ E - 3.920 15. 735 379. 000 $(r1+r2) \times 2$ 196. 000 196.000 15, 735 196, 000 4.178 50.0 Diameter Length Depth Angle Number ~ 3 Chesture Whitena I, 087, 000 m/d (II, M. Y. Y. F.) ь (II. М. Ч. Ч. Р.) h3 * 5.74 m.r1 * 0.50 m.r2 = 3.54 m.L2 * 20.00 m) $= 261,000 \times 154 \times 10^{-6} \div 0.01 = 4,019 m^{2}$ $= 201 m^{2}/Tank$ 261,000 m²/d (D.M.), 1,027,000 m²/d (50.0 m²/m²-d 2.0 h (D.M.) 2.0 h (D.M.) 1.0 - Daily Maximum Vet Veather Flow N.M.Y.E.F Houriv Maximum Vet Veather Flow (*x* × r3² + R×L2) × Number of Tanks = 5,571 m² Ultimate (hi • 1.50 m, h2 • 8.50 m, L2 + 20.00 m) *π*×h3 (r1²+r1×r2+r2²2) = 87.5 m × h3 × L2 = 403.8 m (Solid Concentration 1%) - 46.8 m/m*-d 87.5 + 463.8 = 551 m/Tank × 24 = 1.9 h R 10.00 m L1 30.00 m D 10.00 m D 10.00 m 20 10.00 m 20 Tanks = 5.220 m² 1.037.000 (rl+r2)×2 261.000 20.980 261.000 261.000 20.980 50.0 5. 571 Diameter Length Depth Angle Number 2 ß 1. Primary Sedimantation Tank a)Required Capacity Design Flowrate Overflow Rate Retention Time Sludge Generation Required Surface Area Retention Time (D.M.) Retention Time (H.M.W.W.F.) Studge Stornge Volume Overflow Rate (D.M.) Surface Area b)Dimensions <u>بال</u> e)Check

Table M-9 (2110) Design Calculation for First Stage Project (Afternative 1 : Central WWTP)

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Table M-9 (3/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP)

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Tendeno Volume $\frac{x \times M_1}{2}$ $(x^2) \cdot (x^2) \cdot (x^2$	lícin	Ultimate	First Stage
.2 -20.00 m) 18 mr/Tank 5 	Effective Volume	<i>π</i> ×th _i 3 (r2 ² 2+r2×r3+r3 ² 2) = 159.6 m ⁴	$\frac{\pi \times hi}{3} (r2^2 2^{+} r3^{+} 3^{-} 2) = 159.6 \text{ or}$
.2 = 20.00 m) 18 m/Tank) = 20.380 m ⁴		$\frac{(r^2+r^2)\times 2}{2} \times h^1 \times L^2 = 471.4 \text{ m}$	
2 -20.00 m) 18 m/Tank) = 20.380 m ²		Vie 159.6 + 471.4 = 53; mt/Tunk	VI = 159.6 + 471.4 = 631 m/Tank
18 mr/Tank 5 == 20.380 ar ⁴			< h4 = 2.75 m, r2 = 3.54 m, r2 = 5.00 m, L2 = 20.00 m > -
20.380 m²		$V_{2^{\infty}} = \frac{\pi \times h_1}{2^{\infty}} \times R^2 + R \times I_2 \times h_1 = 418 \text{ m}/7 \text{Link}$	$V2 = \frac{\pi \times hl}{\pi \times h} \times R^2 2 + R \times L2 \times hl = 418 \text{ or}/Tank$
= 20.380 m²		<pre>< hl = 1.50 m . R = 10.00 m . L2 = 20.00 m)</pre>	(hi = 1.50 m, R = 10.00 m, L2 - 20.00 m)
= 20. 380 m²		V = V + V2 = 631 + 418 = 1.049 at 7 Tank	V = V1 + V2 = G31 + 418 = 1.049 mT/Tank
			$\Sigma V = V \times Number of Tanks = 1.049 \times 15 = 15.735 mf$

First Stage 2) Intermediate Clarifier Interzediate clarifier is the same size as primary section tank. Ultimate 261.000 mt/d 1.0 kg-000/mt-d 261.000 × 182 × 10⁻³ = 47.562 kg/d 261.000 π/2 1.0 kg-B0D/π+d = 261.000 × 91 × 10⁻-3 = 23.751 kg/d $= 19.50^{\circ}2 \times \pi \times 40 = 47.784 \text{ m}^{\circ}$ = 19.50 2 × π × 20 = 23.892 m — = 1.0 kg-800/ar-d = 1.0 kg-B0D/m'-d $\frac{23.751}{1.0} = 23.751 \, \mathrm{kg/d}$ R = 39.00 m D = 2.00 m 20 Tanks R = 39.00 m D = 2.00 m 40 Tanks -- 10.9 m/d - 47.502 m --- 5.5 m/d 261.000 47.784 261.000 47,502 47. 502 47. 784 Dinmeter Depth Number 23. 751 23, 892 23, 892 Diameter Depth Number 0.1 Hydraulie Loading 🏾 🗕 ÿ ú Design Flowrate BOD Loading Influent BOD Load = Design flowrate BOD Loading Influent BOD Load Hydraulic Loading 2. Trickling Filter 1)First Step a)Required Capacity c)Check Cross-Sectional Area e)Check Cross-Sectional Area 3)Second Step a)Roquired Capacity Required Cross -Sectional Area Required Cross -Sectional Area BOD Londing BOD Loading licm b)Dimensions b)Dinvensions

Table M-9 (4/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP)

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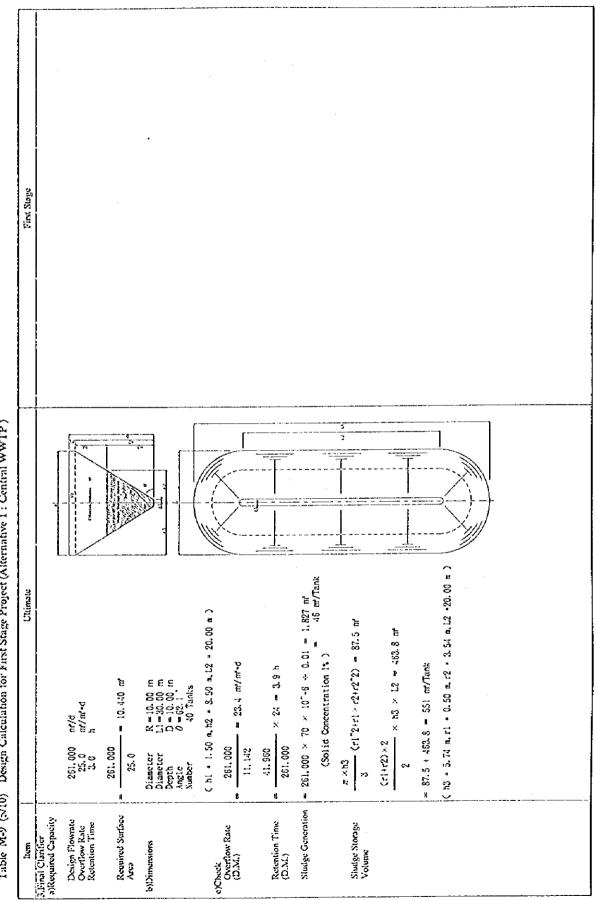


Table M-9 (5/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP)

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First Stage Table M-9 (6/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP) 2 V = V × Number of Tanks = 1.049 × 40 = 41.960 m² (h4 = 2.76 a.r2 = 3.54 a.r3 = 5.00 a. L2 = 20.00 a) $V2=\frac{\pi \times hl}{2} \times R^{2} + R \times L^{2} \times hl = 418 m^{2}$ Ultimate 4 (hi * l.50 m., R * l0.00 m.L2 = 20.00 m) $V = V1 + V2 = 631 + 418 = 1.045 m^{2}/Tank$ <u>x × hd</u> (r2^{*}2+r2×r3+r3^{*}2) = 159.6 m² $\frac{(r^{2}+r^{3})\times 2}{x} \times hl \times L^{2} = 471.4 \text{ m}$ VI= 159.6 + 471.4 = 631 m²/Tank 2 Effective Volume liem

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First Stage Ū ZЙ 5 2 V * V × Number of Tanks = 1,084 × 40 = 43,360 m² $v_{1} = \frac{\pi \times h2}{(r)^{2} (r)^{2} (r) \times r^{2} (r)^{2}} = 723 \text{ m}/Tank$ = Raw Sludge + Septage from Sanitation Facility Ultimate (Unheated Amerobic Digestion) - + 12.0 = 900 m⁷/d
(Raw Sludge Concentration 6%) 3 (h2 * 8.50 m.rl = 0.50 m.r2 = 8.75 m) = 238,000 × 280 × 0.3 × 10⁻6 + 0.84 $V2 = \frac{r \times h!}{2} \times R^2 2 = 361 \text{ art/Tank}$ 238.000 m/d (Duily Average) (hi = 1.50 a . R • 17.50 a) Chi+1.50 m.h2 + 8.50 m) K = 17.50 m D = 10.00 m 0 = 15.87 * 40 Tanks V = V] + V2 = 1.0% in 17ank ■ 53.3 + 0.84 = 54.1 t/d # 18 days $= 900 \times 47 = 42.300 \text{ m}^2$ 1 47 days 0.06 43, 360 Diameter Depth Angle Number 53.3 **006** R 4.Sludge Digester Tank (Open Tank) a)Required Capacity Design Flowrate Required Volume Influent Studge Volume Retention Time Retention Time Influent Solid Quantity ltem b)Dimensions e)Cheek

Table M-9 (7/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP)

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First Stage - × 365 × 10⁻³ = 167.9 kg-SS/m⁺yr = Raw Sludge + Septage from Sanitation Facility (Moisture Content of Dried Sludge: 60 %) $= 179,000 \times 280 \times 0.55 \times 10^{-6} + 0.24$ = 40.00 × 100.00 × 15 = 60.000 m² - 62,963 m -- = 71.0 t/d kg-SS/m-yr. $= 27.6 \pm 0.81 = 28.4 \text{ t/d}$ 40.00 m 100.00 m 15 tanks 27.6×365 160 1-0.6 60, 000 27.6 28.4 0.16 Width Length Number R g Table M-9 (8/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP) Volatile Solid Concentration of Raw Sludge : 65 % Volatile Solid Removal Rate : 50 % $\frac{35.0}{80.000} \times 365 \times 10^{-3} = 164.3 \text{ kg-SS/m-yr}$ (Noisture Content of Dried Sludge: 60 %) Ultimate ■ 53.3 × (1 - (0.65 × 0.5)) ■ 36.0 t/d $40.00 \times 100.00 \times 20 = 30.000 \text{ m}^{\circ}$ **-** 82.125 m² = 90.0 t/d kg-SS/m-yr. 40.00 m 100.00 m 20 tanks Digested Solids 35.0×365 1-0.6 160 35.0 0.16 Yidth Length Number ä 1 Drucd Sludge Quantity 5.Sludge Drving Bed a)Required Capacity Solids Loading Influent Solid Quantity Solids Loading Required Area ltem b)Dimensions Å ()Check

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= Supernutant Liquor from Sludge Drying Bed ⇒ Influent Sludge Volume to Sludge Drying Bed - Dried Sludge Volume (165 m) (165 m) First Stage 17 - 100 = 2.10 g/m/d1:3 1 Ponds 1.533 mt/Pond E 070 I 0 Trupezoid 13n ×13n 31n ×31n = 2T + 20 = 2 × 17 + 20 = 54 ≦ 1/7 27.6 + 12 - 71 = 401 m/d = 131 g/m/d - (1 - 0.54) × 500 - 230 Ъ # 835 = 3.8 days ≂ 20 × Cross-sectional Shape Effective Volume 20T - 100500 × 401 Surface Aera Water Depth 200 × 401 - 500 mg/L **Bottom Arre** 1. 533 Side Slope 1.533 240 Number 10; 0.06 H Supernaturt Liqquor from Digester Tank and Sludge Drying Bed
 Influent Sludge Volume from Digester Tank
 Digested Sludge Volume - Dried Sludge Volume
 CDigested Sludge Volume - Influent Sludge Volume for Sludge Drying Bed) C 100 14 C 1 Ultimate $= 20T - 100 = 20 \times 17 - 100 = 240 \text{ g/m/d}$ Trapezoid 12m ×13m (31m ×31m (5 m 3.0 m 1:2 2 Ponds 1.533 dr/Pond $[= 2T + 20 = 2 \times 17 + 20 = 54 \%$ ≈ 900 + _____ - 90 = 1.410 nf/d = (1 - 0.54) × 500 = 230 m/L = 229 g/m/d - 2.938 m # 2.2 days Cross-sectional Shape Effective Volume 500 × 1.410 500 × 1410 1.533 × 2 36.0 1, 533 × 2 Bottom Area Surface Area Water Depth Side Stope Number - 500 mg/L 1.410 240 Volumetric Loading = Rate(BOD) (for Supernatant Liquor) 1)Anaurobie Pomts a)Required Capacity Dessign filowrate d)Effluent Quality(BOD) Removal Rate Volumetric Loading Rate(BOD) Effluent Quality 6. Waste Stabilization Required Pond Volume Water Quality (BOD) Retention Time ltem b)Dimensions cyCheck Donci

Table M-9 (9/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP)

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(7.200 m⁻) (9.504 m⁻) (8.316 m⁻) KT = 0.3 × (1.05)^TT-20 = 0.3 × (1.05)^TT-20 = 0.26 First Stage 1:3 1 Ponds 16, 656 m//Pond = 350 × (1.107 - 0.002T) T -25 = 350 × (1.107 - 0.002 × 17) T -25 = 199 kr/hu/day Тгарсхоіd 120а × 60а 132а × 72а 126а × 66а 126а × 66а 19.5 mg/l. ≈ 401 × 230 × 10⁻³ = 92 kg/day # 111 hg/ha/day $\frac{92}{100} = 0.46 \text{ hz} = 4.600 \text{ m}^2$ 8 = 41.5 days $1 + 0.26 \times 41.5$ Cross-sectional Shape I Effective Volume $1.26~\times~0.66$ Mid depth Area WHERE Water Dopth Side Slope 230 Bottom Area Surface Area 401 m¹/d 16. 656 **3**5 Number ļ ¶. ą (7,200 m²) (9,504 m²) (8,316 m²) KT = 0.3 × (1.05)⁻7.-20 = 0.3 × (1.05)⁻17-20 = 0.20 Ultimate Trapezoid 120a × 60n (125a × 72a (125a × 66a (D = 2.0 m 1:3 2 Ponds 10, 656 m/Pond = 350 × (1.107 - 0.002T)²T-25 = 350 × (1.107 + 0.002 × 17)²T-25 = 199 kg/hu/day = 195 hg/ha/day $= 1.410 \times 230 \times 10^{-3} = 324$ kg/day u 32.2 mc/L $\frac{32.i}{100} = 1.63 ha = 16.300 m^2$ = 23.6 days Cross-sectional Shape Bottom Area Surface Depth Mid depth Area Water Depth 1.26 \times 0.66 \times 2 $1 + 0.26 \times 23.6$ Side Slope Number Effective Volume 16, 656 🖂 2 ★ 1,410 m/d WHERE 230 33 1.410 R Influent BOD Load 2)Facultative Ponds a)Required Capacity Design Flowrate Surface Loading Rate(BOD) Surface Loading Rate (at Mid depth) Required Surface Area Retention Time d)Effluent Quality (BOD) Iten b)Dimensions c)Check

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Table M-9 (10/10) Design Calculation for First Stage Project (Alternative 1 : Central WWTP)

Design Calculation for South 3 Region Wastewater Treatment Plant (First Stage)

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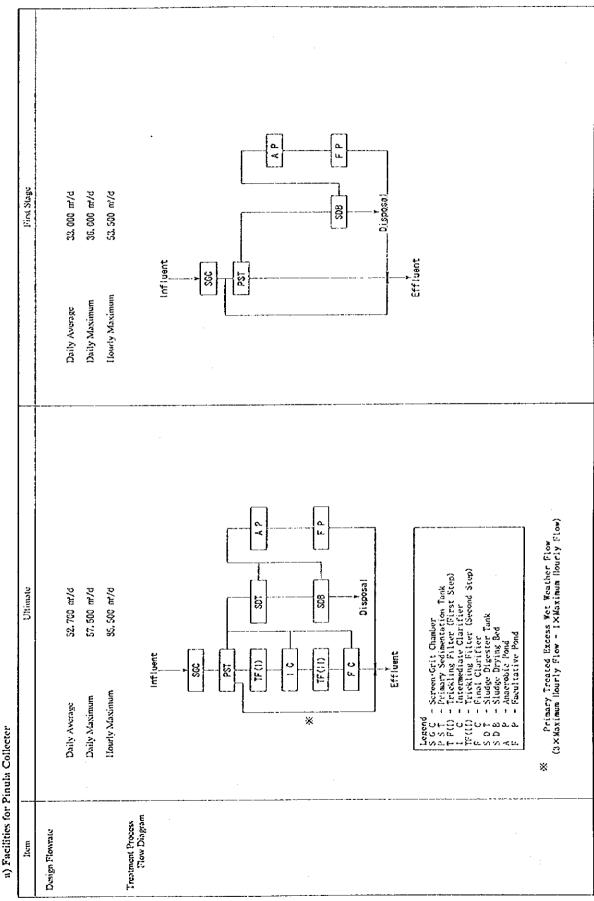


Table M-10 (1/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP) a) Facilities for Pinula Collecter

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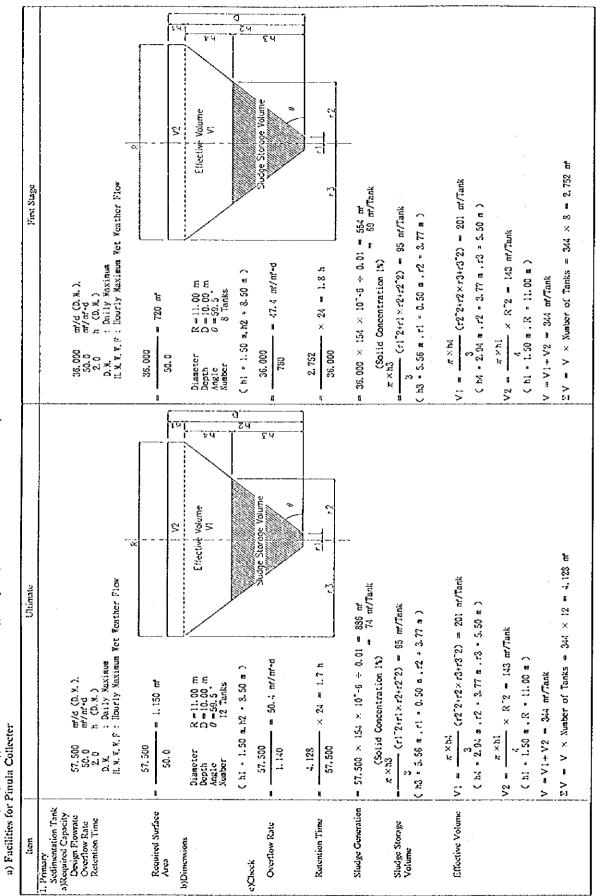


Table M-10 (2/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

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ltem	Ultimate	First Stage
2. Trickling Filter 1)First Step a)Required Capacity		
Design Flowrate BOD Loading Influent BOD Load	57.500 m7/d 1.0 kx-800/m1-d = 57.500 × 182 × 10 ⁻³ = 10.465 kg/d	36, 000 mr/d 1.0 kg+is00/mr+d = 35,000 × 182 × 10 3 = 5.552 kg/d
Required Cross -Sectional Area	10.455 m ⁻ 10.455 m ⁻	6.552 6.552 m 1.0 1.0
b)Dimensions	Diameter R = 34.00 m Depth D = 2.00 m Number 12 Tunks	Diameter $R = 34.00$ m Depth $D = 2.00$ m Number 8 Tanks
Sectional	= 17.00 ² 2× к × 12 = 10.895 nt	= 17.00 ⁻ 2× <i>π</i> × 8 = 7.263 m ²
BOD Loading	10.465 = 1.0 kg-b00/nt-d 10.895	в. 552 = 0.9 kg-b00/m²-d 7.263 = 0.9 kg-b00/m²-d
Nydraulic Loading	= 57.500 = 5.3 m/d 10.895	$= \frac{36,000}{7,263} = 5.0 \text{ m/d}$
Intermediate Clarifier	2) Intermediate Clarifier Intersectiate clarifier is the same size as primary section tank	Interactiate clarifier is the same size as primary solimentation tank.
3)Second Step a)Required Capacity		
Design flowrate BOD Loading Influent BOD Load	57.500 ±1/d 1.0 kx=800/mt-d = 57.500 × 91 × 10 ⁻² = 5,233 kz/d	$\begin{array}{cccccccccccccccccccccccccccccccccccc$
Required Cross -Sectional Area	5. 233 	$= \frac{3.276}{1.0} = 3.276 \text{ m}$
b)Dimensions	Dianctor R = 31.00 m Depth D = 2.00 m Number 6 Tinks	Diageter $R = 34.00 \text{ m}$ Depth $D = 2.00 \text{ m}$ Number 4.7 marks
cyCheck Cross-Sectional Acco	== 17.00 ² 2× <i>x</i> × δ = 5.448 m²	= 17.00 °2 × л × 4 + 3,632 m'
BOD Loading	5.233 = 1.0 kg-800/nr-d 5.418	$= \frac{3.276}{3.632} = 0.9 \text{ kg-800/mf-d}$
Hydraulie Loading	57.500 [0.6 m/d	36, 000 ≈ 0.0 m/d

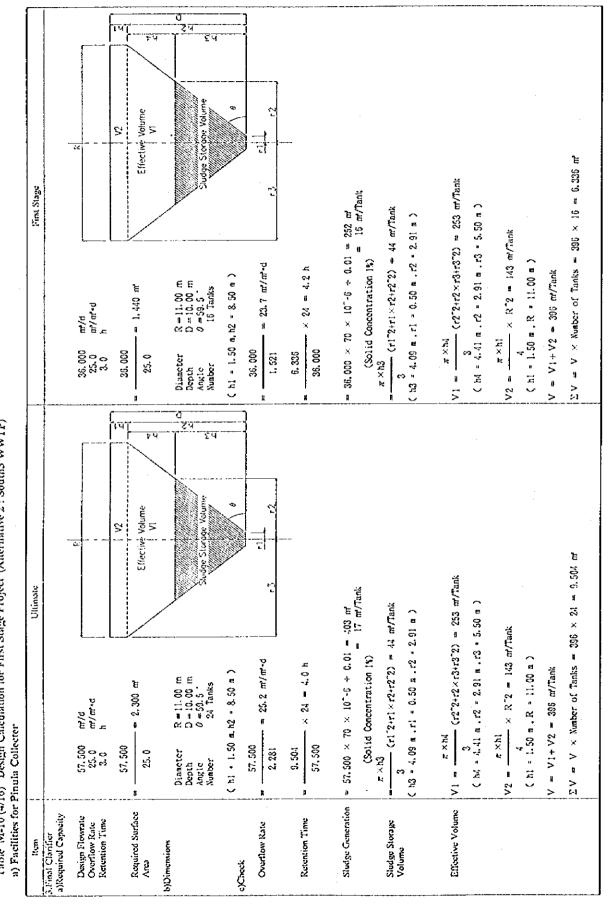


Table M-10 (4/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

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First Stage Table M-10 (5/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP) a) Facilities for Pinula Collecter 2 5 $\Sigma V = V \times Number of Tanks = 787 \times 12 = 9.444 m²$ = Ruw Sludge + Septuge from Sanitation Facility Ultimate 47 days (Unheated Anaerobic Digestion) — + 0.3 = 197.0 n?/d (Raw Sludge Concentration 6%) (h2 = 7.50 m.rl = 0.50 m.r2 = 7.75 m) = 52.700 \times 280 \times 0.8 \times 10°-6 \pm 0.02 $v2 = \frac{\pi \times hi}{2} \times R^2 = 233 \text{ af/Tank}$ 52.700 nt/d (Daily Average) (hi • 1.50 m, R • 15.50 m) (hi + 1.50 m,h2 + 7.50 m) R = 15. 50 m D = 9. 00 m 0 = 46 ° 12 Tanks = 18 cuys ** 11.8 + 0.02 = 11.8 t/d V = V1+V2= 787 m²/Tank $= 197.0 \times 47 = 9.259 \text{ m}^2$ ~ ----9 11 0.06 Diumeter Depth Angle Number 11.8 133 4.Slutge Digester Tank (Open Tank) a)Required Capacity Design Flowrate Required Volume Influent Sludge Volume Retention Time Retention Time Influent Solid Quantity ltem b)Dimensions c)Check

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Table M-10 (6/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP) a) Facilities for Pinula Collecter

$\frac{11.8 \times (1 - (0.15 \times 0.5)) = 8.0 \ 1/d}{11.8 \times (1 - (0.15 \times 0.5)) = 8.0 \ 1/d} = \frac{1.8 \times (1 - (0.15 \times 0.5)) = 8.0 \ 1/d}{0.1111 \ 20.11$	ltem	Ultimate	First Stage
-Directed Solids = 11.8 × (1 - (0.65 × 0.5)) = 8.0 t/d Yolatile Solid Concentration of Raw Sludge : 65 x Yolatile Solid Concentration of Raw Sludge : 65 x Yolatile Solid Concentration of Raw Sludge : 60 x (Maisture Content of Dried Sludge: 30 x) $\frac{8.0}{0.4}$ = 20.0 t/d (Maisture Content of Dried Sludge: 30 x) 150 kg-SS/m-yr. $\frac{8.0}{0.16}$ = 13.250 m Yidth 40.00 m Namber 5 Tarks = 40.00 × 80.00 × 6 = 19.200 m $\frac{8.0}{1920}$ × 355 × 10°3 = 152.1 kg-SS/m-yr	5.Sludge Drying Bed		
-Digested Solids = 11.8 × (1 - (0.05 × 0.5)) = 8.0 t/d Volutile Solid Concentration of Removal Pate : 50 % Volutile Solid Removal Pate : 50 % 8.0 = $\frac{8.0}{0.4}$ = 20.0 t/d (Noisture Content of Dried Studge: 60 %) 150 kg-SS/m ⁻ yr. 8.0 × 365 = 18,250 m Vidth 40.00 m Nidth 40.00 m Nidth 30.00 m Nidth 30.00 m Nidth 30.00 m Number 5 Tanks = 40.00 × 80.00 × 6 = 19.200 m ⁻ = 40.00 × 80.00 × 6 = 19.200 m ⁻ = 3.0 × 355 × 10 ⁻³ = 152.1 kg-SS/m ⁻ yr	a)Required Capacity		
$ \begin{array}{c} 11.8 \times (1 - (0.55 \times 0.5)) = 8.0 \ t/a \\ \text{Volatile Solid Coccentration of Bav Shutce: 65.5 X \\ \text{Volatile Solid Coccentration of Bav Shutce: 65 X \\ \text{Volatile Solid Coccentration of Bav Shutce: 50 X \\ \frac{8.0}{0.4} = 20.0 \ t/d \\ \frac{8.0}{0.4} = 20.0 \ t/d \\ \frac{8.0 \times 365}{0.16} = 18.250 \ \text{m} \\ \frac{7.4}{0.16} \\ \frac{1}{0.0} = 18.250 \ \text{m} \\ \frac{7.4}{0.00} \\ \frac{1}{1000} \\ \frac{8.0 \times 365}{0.000 \times 6} = 19.200 \ \text{m} \\ \frac{8.0}{0.00} \\ \frac{8.0}{0.00} \times 355 \times 10^23 = 192.1 \ \text{lw}-SS/\text{m-yr} \\ \frac{7.7}{1000} \\ \frac{8.0}{0.00} \\ \frac{8.0}{0.00} \times 355 \times 10^23 = 192.1 \ \text{lw}-SS/\text{m-yr} \\ \frac{7.7}{1000} \\ \frac{7.7}{1000} \\ \frac{7.7}{0.00} \\ \frac{7.7}{0.00}$	Influent Solid	- Digested Solids	= Raw Sludke + Septage from Sanitation Facility.
Volutile Solid Concentration of Raw Studge: 65 x= 7.4 $\frac{8.0}{0.4}$ = 20.0 t/d $\frac{8.0}{0.4}$ = 20.0 t/d $\frac{1.0}{0.4}$ C volutile Solid Renoval Rate : 50 x)150ks-SS/m ⁺ yr.150ks-SS/m ⁺ yr. $\frac{1.0}{0.16}$ = 13.250 m $\frac{0.16}{0.16}$ = 13.250 m $\frac{0.16}{0.16}$ = 13.250 m $\frac{1.0}{0.16}$ = 13.250 m $\frac{1.00}{0.16}$ = 19.200 m $\frac{1.00}{0.16}$ = 15.21 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$ > 365 x 10^2 a = 152.1 m $\frac{1.00}{0.00}$	Annual A	= $11.8 \times (1 - (0.65 \times 0.5)) = 8.0 t/d$	- 33.000 × 280 × 0.8 × 10 ⁻ 6 + 0.02
$\frac{8.0}{0.4} = 20.0 \text{ t/d}$ $\frac{0.4}{0.4} = 20.0 \text{ t/d}$ $(\text{Voisture Content of Dried Studge: 50 N})$ $\frac{1.50}{1.50} \text{ kg-SS/m-yr.}$ $\frac{8.0 \times 365}{0.15} = 13.250 \text{ m}$ $\frac{0.15}{0.15} = 13.250 \text{ m}$ $\frac{7.4}{1.4010}$ $\frac{0.00 \text{ m}}{1.600 \text{ m}}$ $\frac{7.4}{1.600} \text{ m}$ $\frac{1.60}{1.500} \times 365 \times 10^2 3 = 15.200 \text{ m}$ $\frac{8.0}{1.500} \times 355 \times 10^2 3 = 152.1 \text{ kg-SS/m-yr}$ $\frac{1.50}{1.500} \times 355 \times 10^2 3 = 152.1 \text{ kg-SS/m-yr}$		Volatile Solid Concentration of Raw Sludge : 65 % Volutile Solid Removal Rate : 50 %	
0.4 (Noisture Content of Dried Studge: 60 N) 160 kg-SS/m ⁻ yr. 160 kg-SS/m ⁻ yr. 8.0 × 365 = 18,250 m 0.16 = 18,250 m 7.4 0.16 = 18,250 m Nietch 30,00 m Neater 5 Tanks Number 5 Tanks 1000 × 80.00 × 6 = 19,200 m Name 1000 × 355 × 10 ⁻ 3 = 152.1 kg-SS/m ⁻ yr 10200 × 355 × 10 ⁻ 3 = 152.1 kg-SS/m ⁻ yr	Dried Sludge Quantity	8.0	7.4
$\frac{(Noisture Content of Dried Studge: 60 N)}{150 kg-SS/m-yr.}$ $\frac{(Noisture Content of Dried Studge: 60 N)}{150 kg-SS/m-yr.} = \frac{7.4}{1000} \frac{1000 m}{1000 m}$ $\frac{(Noisture Content of Dried Studge: 50 N)}{(2000 m)} = \frac{(0.00 m)}{1000 m}$ $\frac{(Noister N)}{(2000 m)} = \frac{(0.00 m)}{1000 m}$ $\frac{(0.00 \times 60.00 \times 6 = 19,200 m)}{1000 m}$ $\frac{(0.00 \times 80.00 \times 6 = 19,200 m)}{1000 m}$ $\frac{(0.00 \times 80.00 \times 6 = 19,200 m)}{1000 m}$ $\frac{(0.00 \times 80.00 \times 6 = 19,200 m)}{1000 m}$ $\frac{(0.00 \times 80.00 \times 6 = 19,200 m)}{1000 m}$			
* Loading 150 kg-SS/m ⁻ yr. 150 mg-10 kg-SS/m ⁻ yr. 150 mg-10 kg-SS/m ⁻ yr. 150 mg-10 kg-SS/m ⁻ yr 100 kg-SS/m ⁻ yr 100 kg-SS/m ⁻ yr 100 kg-SS/m ⁻ yr 1000 kg-SSS/m ⁻ yr 1000 kg-SSS/m ⁻ yr 1000 kg-SSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSSS		(Moisture Content of Dried Sludge: 60 %)	(Moisture Content of Dried Sludge: 60 %)
ired Area $= \frac{8.0 \times 363}{0.16} = 18.250 \text{ m} = \frac{0.16}{0.16} = 18.250 \text{ m} = \frac{0.16}{0.16} = \frac{0.16}{0.16} \text{ kidth}$ kions $= \frac{0.16}{10.00 \text{ m}} \text{ kidth} = \frac{0.00 \times 80.00 \times 6}{0.00 \text{ m}} \text{ kidth} \text{ kidth}$ $= \frac{0.00 \times 80.00 \times 6 = 19.200 \text{ m}}{12200 \text{ m}} = \frac{8.0}{1220} \times 365 \times 10^2 \text{ m} = 152.1 \text{ ke-SS/m-yr}$ $= \frac{3.0}{12200} \times 365 \times 10^2 \text{ m} = 152.1 \text{ ke-SS/m-yr}$	Solids Loading		
tions $ \begin{array}{c} 0.16 \\ \text{Victh} & 40.00 \text{ m} \\ \text{Length} & \text{Midth} \\ \text{Length} & 80.00 \text{ m} \\ \text{Number} & 8.00 \times 6 = 19.200 \text{ m} \\ \text{-} 40.00 \times 80.00 \times 6 = 19.200 \text{ m} \\ \text{-} 355 \times 10^2 = 152.1 \text{ tg-SS/m-yr} \\ \text{-} 19200 \\ \text{-} 19200 \\ \text{-} 19200 \end{array} $	Required Area	8.0 × 365	7.4 × 365
Yidth Yidth Length 80.00 m Number 5 Tanks Addres 5 Tanks Addres 6 = 19,200 m/ $= 40.00 \times 80.00 \times 6 = 19,200 m/ = 40.00 \times 80.00 \times 6 = 19,200 m/ = 3.0 = 3.0 = 3.0 = 3.0 = 3.0 = 3.0 = 19,200 m/ = 19,200 m/ = 10,200 m/ = 10,200$	hDimensions	0.15	
$= 40.00 \times 6 = 19.200 \text{ m}$ $= 40.00 \times 6 = 19.200 \text{ m}$ $= \frac{8.0}{19200} \times 355 \times 10^{-3} = 152.1 \text{ kg-SS/m}-\text{yr}$ $= \frac{7.4}{16000} \times \frac{1}{1000} \times \frac{1}{1000} \times \frac{1}{1000} \times \frac{1}{1000} \times \frac{1}{10000} \times \frac{1}{100$			
$= 40.00 \times 80.00 \times 6 = 19.200 \text{ m}^{2}$ $= \frac{40.00 \times 80.00 \times 6}{19200} \times 365 \times 10^{-3} = 152.1 \text{ kz-SS/m}^{-}\text{yr}$ $= \frac{8.0}{19200} \times 365 \times 10^{-3} = 152.1 \text{ kz-SS/m}^{-}\text{yr}$	e)Check		
$= \frac{8.0}{19200} \times 365 \times 10^{-3} = 152.1 \mathrm{lg} - \mathrm{SS/m} + \mathrm{yr}$	Area		
	Solids Loading	8.0 19200	7.4 16000 ×
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Table M-10 (7/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP) ... Southing for Planta Callerer:

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$ \begin{array}{c} \label{eq:constraints} \\ \mathcal{Constraints} \\ \mathcal{Constraints}$	Item	Ultimate	First Stage
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	8	<pre>= Supermatant Liqquor from Digester Tank and Sludge Drying Bed = Influent Studge Volume from Digester Tank + Digested Sludge Volume - Dried Sludge Volume CDigested Sludge Volume = Influent Sludge Volume for Sludge Drying Bed)</pre>	=Supernatant Liquor from Sludge Drying Bed ⇒Influent Sludge Volume to Sludge Drying Bed
$= 20T = 100 = 20 \times 17 - 100 = 2.00 \text{ g/m/d}$ $= 500 \text{ m/L}$ $= 500 \times 10^{2} = 2.19 \text{ m}$ $= 2.0 \text{ m}$		8.0 0.06 - 20	7.4 0.06 1 0.3 - 18.5
$ \begin{array}{c} = 500 \text{ m/L} \\ \hline 500 \times 310 \\ \hline 240 \\ \hline 250 \\ \hline 260 \\ \hline 261 \\ \hline 260 \\ \hline 261 \\ $	Volumetrie Loading Rate(BOD)	- 100 = 20 × 17	
$\frac{500 \times 100}{240} = 646 \text{ m} \frac{500 \times 105}{240} = 213 \text{ m} \frac{240}{240} = 2.0 \text{ m} \frac{240}{240} = 2.$	Water Quality	= 500 mc/L	± 500 ms/L
Conserctional Shape Traceoid Bottom Area is 7 Traceoid Bottom Area is 7 Traceoid Bottom Area is 7 Traceoid Bottom Area is 7 19 (1 m ²) Surface Area is 7 10 (1 m ²) Surface Area	Required Pond Volume	500 × 310 240	#
$\frac{381 \times 2}{646} = 1.2 \text{ days}$ $\frac{500 \times 646}{331 \times 2} = .24 \text{ g/m/d}$ $\frac{500 \times 646}{331 \times 2} = .24 \text{ g/m/d}$ $= 27 + 20 = 2 \times 17 + 20 = 54 \text{ g/s}$ $= 27 + 20 = 2 \times 17 + 20 = 54 \text{ g/s}$ $= (1 - 0.54) \times 500 = 230 \text{ m/L}$ $= (1 - 0.54) \times 500 = 230 \text{ m/L}$	b)Dirtensions	Trapezoid Im × Im 19a × 19m D = 3.0 m 1:3 2 Ponds 381 m/Pond	Trapezoid Im × In Im × 19m D = 3.0 m I:3 = 3.0 m I:3 381 mr/Pond
$\frac{500 \times 646}{331 \times 2} = \frac{500 \times 105}{381 \times 2} = \frac{500 \times 105}{381} = \frac{138}{381} = \frac{138}{381} = \frac{138}{381} = \frac{138}{381} = \frac{138}{381} = \frac{138}{381} = \frac{100}{281} = $	c)Chock Retention Time	381 × 2 646	
$= 2T + 20 = 2 \times 17 + 20 = 54 \%$ $= (1 - 0.54) \times 500 = 230 \frac{1}{10}/L$ $= (1 - 0.54) \times 500 = 230 \frac{1}{10}/L$	Volumetric Loadin <u>e</u> Rate(BOD)	500 × 646 381 × 2	500 × 105 381 =
= (1 - 0.5.1) × 500 = 230 m/L	d)Effluent Quality(BOD Removal Rate	= 2T + 20 = 2 × 17 + 20 ⊭	27 + 20 = 2 × 17 + 20
	Effluent Quality		(1 - 0.54) × 500 =

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Table M-10 (8/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP) a) Facilities for Pinula Collecter

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lium	Ultimate	િંગાલ ઉતાયુલ
2)Facultative Ponds a)Required Capacity Design Flowrate	= 310 mt/d	= 105 nt/d
Surface Loading Rate(BOD)	= 350 × (1.107 − 0.002T) T -25 = 350 × (1.107 − 0.002 × 17) T -25 = 190 ks/ha/day	<pre># 350 × (1.107 - 0.002T)⁻T -25 # 350 × (1.107 - 0.002 × 17)⁻T -25 # 139 ½/ha/day</pre>
Influent BOD Load	= 3:0 × 230 × 10 ² -3 = 71 hg/day	= 105 × 230 × 10 [*] -3 = 2i kg/day
Roquired Surface Area	$\frac{71}{100}$ = 0.36 hz = 3,600 rt ²	$\frac{24}{199} = 0.12 \text{ ha} = 1.200 \text{ m}^2$
b)Dimensions	$ \begin{array}{llllllllllllllllllllllllllllllllllll$	Cross-sectional Shape Trapezoid Bottom Area Stare Trapezoid Buttake Depth $S2a \times 25a (1.352 m^2)$ Nui depth Area $52a \times 32a (1.856 m^2)$ Wild which $D = 2.0 m$ Wild stope 1:3 Number 1:7 Number 1 Ponds Rifective Volume 3.736 m7/Pond
c)Check Retention Time	$= \frac{3.736 \times 2}{310} = 24.1 \text{ days}$	3.736 = 35.6 days 105 = 35.6 days
Surface Loading Rate (at Mid depth)	$= \frac{71}{0.58 \times 0.32 \times 2} = 191 \text{ kg/ha/day}$	$= \frac{24}{0.58 \times 0.32} = 129 \text{ hg/hu/day}$
d)Effluent Quality (BOD)	$= \frac{230}{1+0.26 \times 24.1} = 31.7 \text{ms/L}$	$= \frac{230}{1+0.26 \times 35.6} = 22.4 \text{ms/L}$
	NVFERAS NT = 0.3 × (1.05) T -20 = 0.3 × (1.05) 17-20 = 0.26	W1JERE KT = 0.3 × (1.05) ⁻ T -20 = 0.3 × (1.05) ⁻ 17-20 = 0.26
:		

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First Stage Table M-6 (9/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP) b) Facilities for Hermosa Collecter с. Ц Primary Treated Excess Wet Weather Flow (3 XMaximum Hourly Flow - 1 XMaximum Hourly Flow) A P S G C = Screen.Grit Chamber F S T = Primery Sequentiation Tauk F S (1) = Trickling Filter (First Stop) T C (1) = Trickling Filter (Socond Step) F C = Final Charifier S D T = Studge Drysestformk S D B = Sludge Drysestformk S D B = Sludge Drysestformk A P = Anarobic Pond F P = Feeultarive Pond Disposal SOT Ultimate 14.500 nt/d 808 808 13.300 m²/d 21.500 m²/d Influent Effluent TF (1) TF (11) с Ч SGC PST Hourly Maximum Daily MaNimum Daily Average × Lexend * Treatment Process Flow Diagram Dusign Flowrate Item

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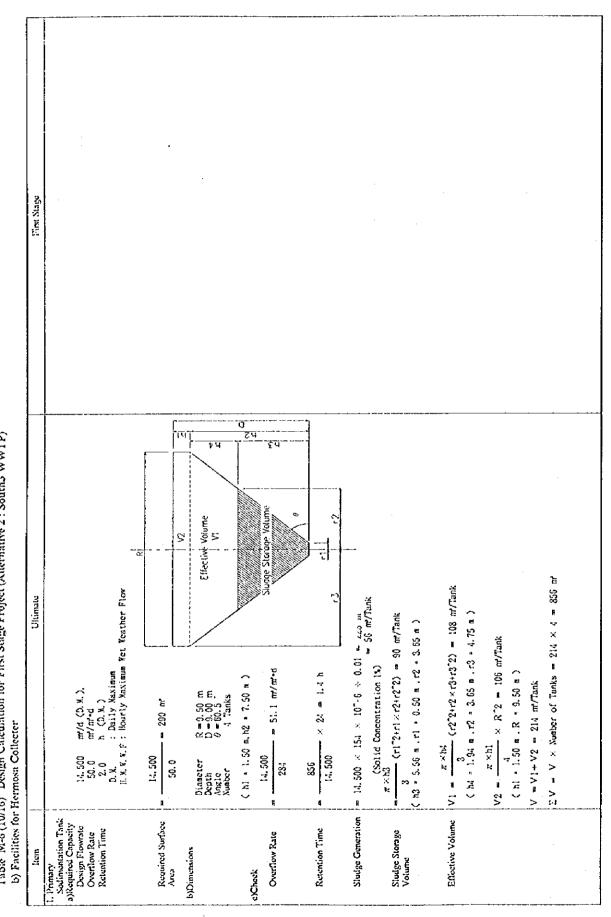


Table M-6 (10/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

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First Stage Watermediate Clarifier Interpediate clarifier is the same size as primary sedimentation tank. Ultimate 1.500 πr/d 1.0 kg·B00/πr-d 1.1.500 × 182 × 10⁻³ = 2.639 kg/d $\begin{array}{rrrr} 14.500 & m^{1}/d \\ 1.0 & kg-B02/m^{2}-d \\ m-14,500 & 91 & 10^{-3} & m-1,320 & kg/d \end{array}$ - 1.0 kg-B0D/nr-d 1.0 kg-800/m^{-d} H 14.50 2N XX 2 H 1.321 of $= 14.50^{\circ}2 \times \pi \times 4 = 2.642^{\circ}$ R = 29.00 m D = 2.00 m 2 Tanks R = 29.00 m D = 2.00 m 4 Tanks - il.0 m/d -- 5.5 m/d --- 1.320 m н 8.639 н b) Facilities for Hermosa Collecter 14.500 2.642 1. 320 1. 0 14.500 Diageter Depth Number 2. 639 2. 612 1. 320 1.321 1. 321 Diameter Depth Number 2.639 1:0 Hydraulie Loading 🔎 🗕 Ħ Design flowrate BOD Loading Influent BOD Load Design Flowrate BOD Loading Influent BOD Load Elydraulic Loading Trickling Filter
 First Step
 Required Capacity e)Check Cross-Sectional Area c)Check Cross-Sectional Area 3)Second Step a)Required Capacity Required Cross -Sectional Area Required Cross -Sectional Area BOD Loading BOD Loading Item b)Dimensions b)Dimensions

Table M-6 (11/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

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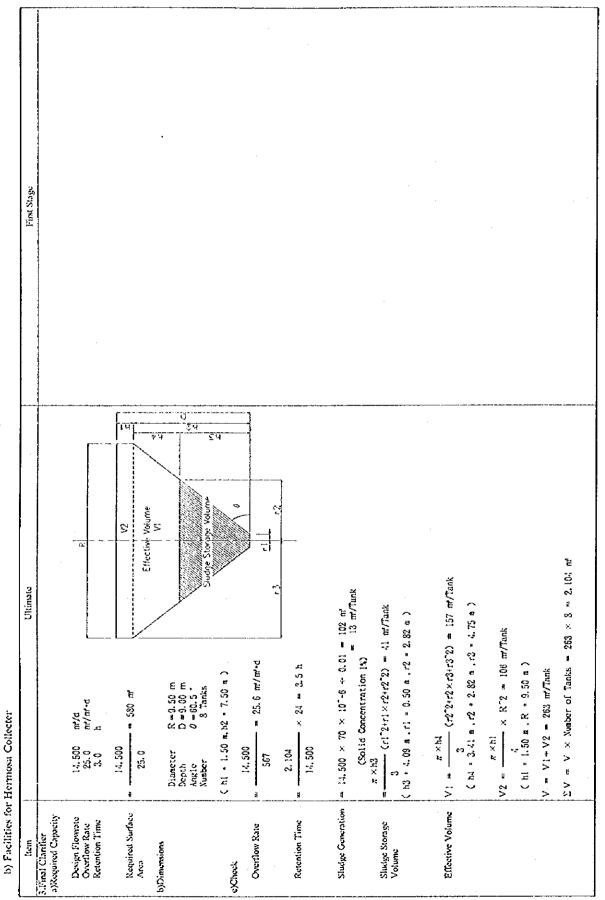


Table M-6 (12/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

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First Stage 5 2. V = V × Number of Tanks = 590 × 4 = 2,360 m² Ultimate (Unheated Anacrobic Digestion) - 50.0 m/d (Raw Sludge Concentration 5%) (h2 • 6.50 m.rt = 0.50 m.r2 = 7.00 m) $v2 = \frac{\pi \, \text{shl}}{231} \, \text{shl} + \frac{\pi \, \text{shl}}{231} \, \text{shl}$ m'/d (Daily Average) - 13.300 × 280 × 0.8 × 10⁻⁶ (hl = 1.50 a . R = 14.00 a) (h1 + 1.50 m.h2 + 5.50 m) R = 14.00 m D = 8.00 m 0 = 45 * 2 Tanks V = V [+ V2 = 590 m//Tank m 47 days = 50.0 × 47 = 2.350 m² b) Facilities for Hermosa Collecter 13.300 47 days - Raw Sludge Diameter Depth Angle Number 2.350 0. 06 ರ ೧ ≠ 3.0 t/d ន i. 4.Sludge Digester Tank (Open Tank) a)Required Capacity Design Flowrate Required Volume Influent Slucige Volume Retention Time Retention Time Influent Solid Quantity ltem b)Dimensions e)Cheek

Table M-6 (13/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

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Table M-6 (14/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP) b) Excitizing for Hommon Callerter

5.Studge Drying Bed	a Construction of the Cons	
a)Required Capacity		
Influent Solid - Digested Solids		
Quantity = $3.0 \times (1 - (0.65 \times 0.5)) = 2.0 t/d$		
Volatile Solid Concentration of Raw Sludge : 65 % Volatile Solid Removal Rate : 50 %		
Dried Studge Quantity $= \frac{2.0}{0.4} = 5.0 \text{ t/d}$,	
(Woisture Content of Dried Sludge: 60 %)		
Solids Londing 160 kg-SS/nt-yr.		
Required Area = $\frac{2.0 \times 365}{0.16}$ = 1.563 ar		
opumensions Tidth 30.00 m Length 30.00 m Number 2 Tanks		
c)Check		
Arts = 30.00 × 80.00 × 2 = 4.500 m ²		
Solids Loading = 2.0 × 365 × 10 ⁻ 3 = 152.1 hz-SS/nr-yr 4.800 × 3.800		

0

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First Stage Supernatant Liquor from Digester Tank and Sludge Drying Bed
 Influent Sludge Volume from Digester Tank
 Digested Sludge Volume - Dried Sludge Volume
 CDigested Sludge Volume - Influent Sludge Volume for Sludge Drying Bed) (1 a') (261 a') Ultimate Volumetric Loading = $20T - 100 = 20 \times 17 - 100 = 210 \text{ g/m}/d$ Rate(BOD) 1π × 1π 19π × 19π D = 3.0 m 1:3 1 Ponds 381 m//Pond = 2T + 20 = 2 × 17 + 20 = 54 % Trupezoid = (1 - 0.54) × 500 = 230 mg/L $\frac{2.0}{0.06} - 5 = 78\pi/d$ - 102 g/m/d •• 163 m² - 4.9 days Cross-sectional Shape b) Facilities for Hermosa Collecter Effective Volume Bottom Area Surface Depth Water Depth Sule Slope Number 500 × 78 500×78 - 500 ms/L 2.10 381 188 + ទ 9 Ø (for Supematant Liquor) 1)Anacrobic Ponds a)Required Capacity = Destign Flowrate = d)EtTuent Quality(BOD) Removal Rate Volumetric Loading Rate(BOD) Effluent Quality Waste Stabilization Required Pond Volume Retention Time Water Quality (BOD) ltom b)Dimensions c)Check Pond

Table M-6 (15/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

8

8

First Stage

 Table M-6 (16/16) Design Calculation for First Stage Project (Alternative 2 : South3 WWTP)

 b) Facilities for Hermosa Collecter

 (800 m) (1.664 m) (1.156 m) $KT = 0.3 \times (1.05)^{T} - 20$ = 0.3 × (1.05)^17-20 = 0.26 Ultimate Trapezoid 20a × 40a 22a × 52a 26a × 46a 26a × 46a 1:3 1:3 2.0 m 1:3 2.416 m/Pend = 350 × (1.107 - 0.002 T) T-25 = 350 × (1.107 - 0.002 × 17) T-25 = 193 lg/hg/dgy - 25.4 mg/l Influent BOD Load = 78 × 230 × 10^{*}-3 = 18 kg/day # 151 kg/ha/day = 0.09 ha = 900 m² 2.416 = 31.0 days Cross-sectional Shape Bottom Area Surface Depth Mid depth Area Water Depth Stue Stope Number $1 + 0.26 \times 31.0$ I Effective Volume 0.26 × 0.46 WHERE 230 * 661 = 78 n²/d <u>___</u> 23 п 2)Facultative Ponds a)Required Capacity Design Filowrate Surface Loading Rate(BOD) Required Surface Area Surface Loading Rate (at Mid depth) Retention Time d)Effluent Quality (BOD) ltern b)Dimensions c)Check

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LAYOUT PLAN FOR MASTER PLAN

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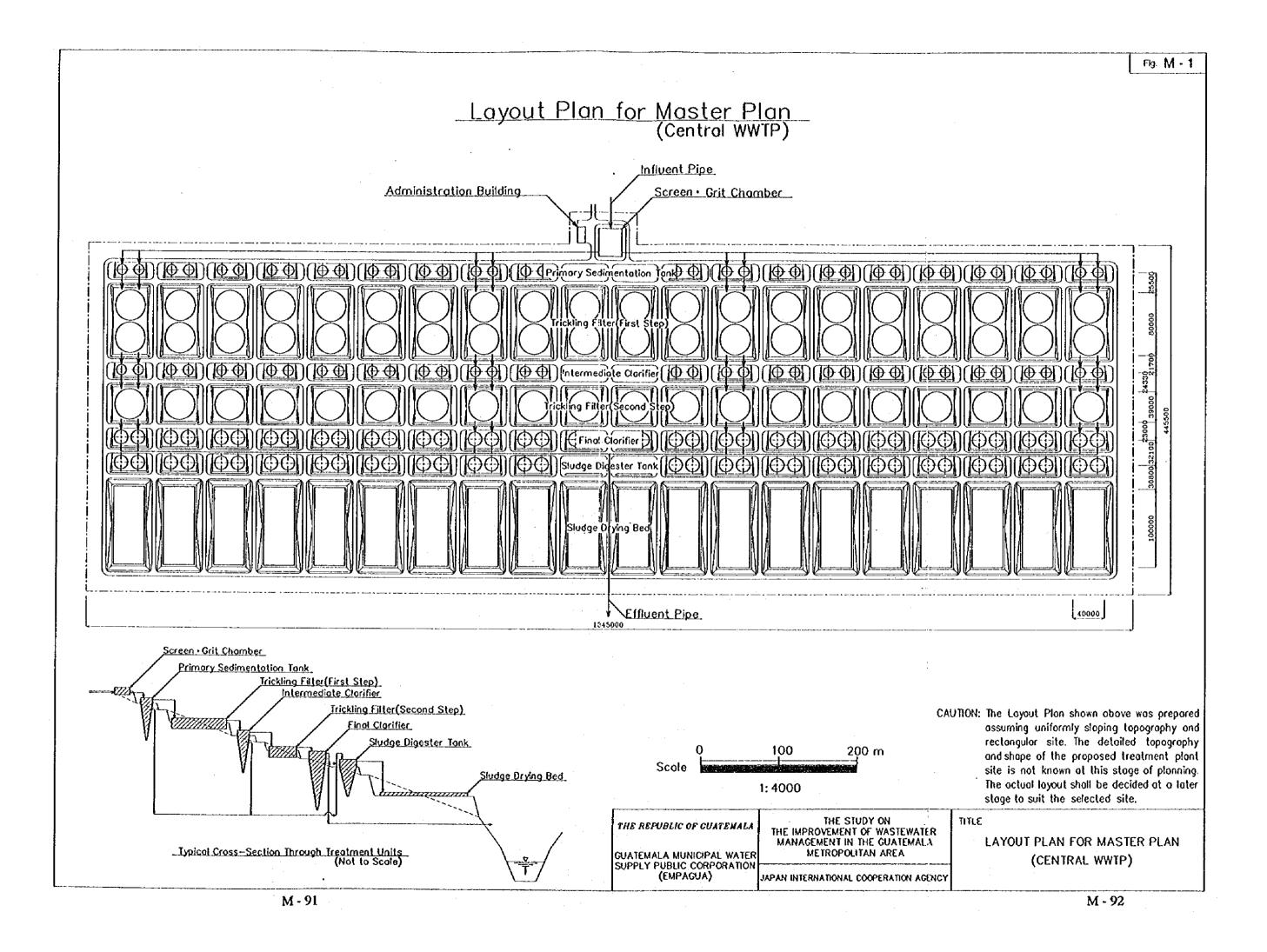
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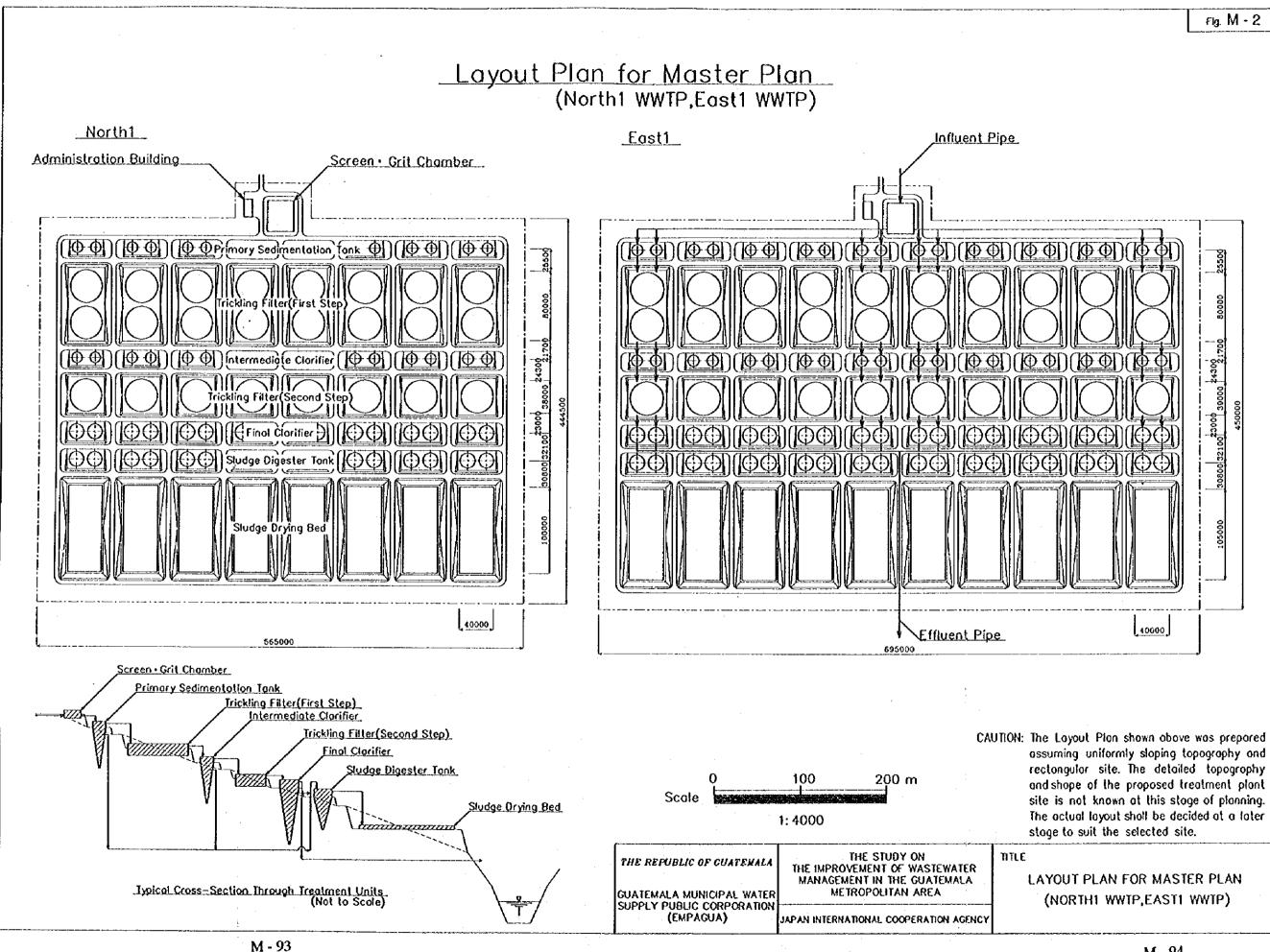
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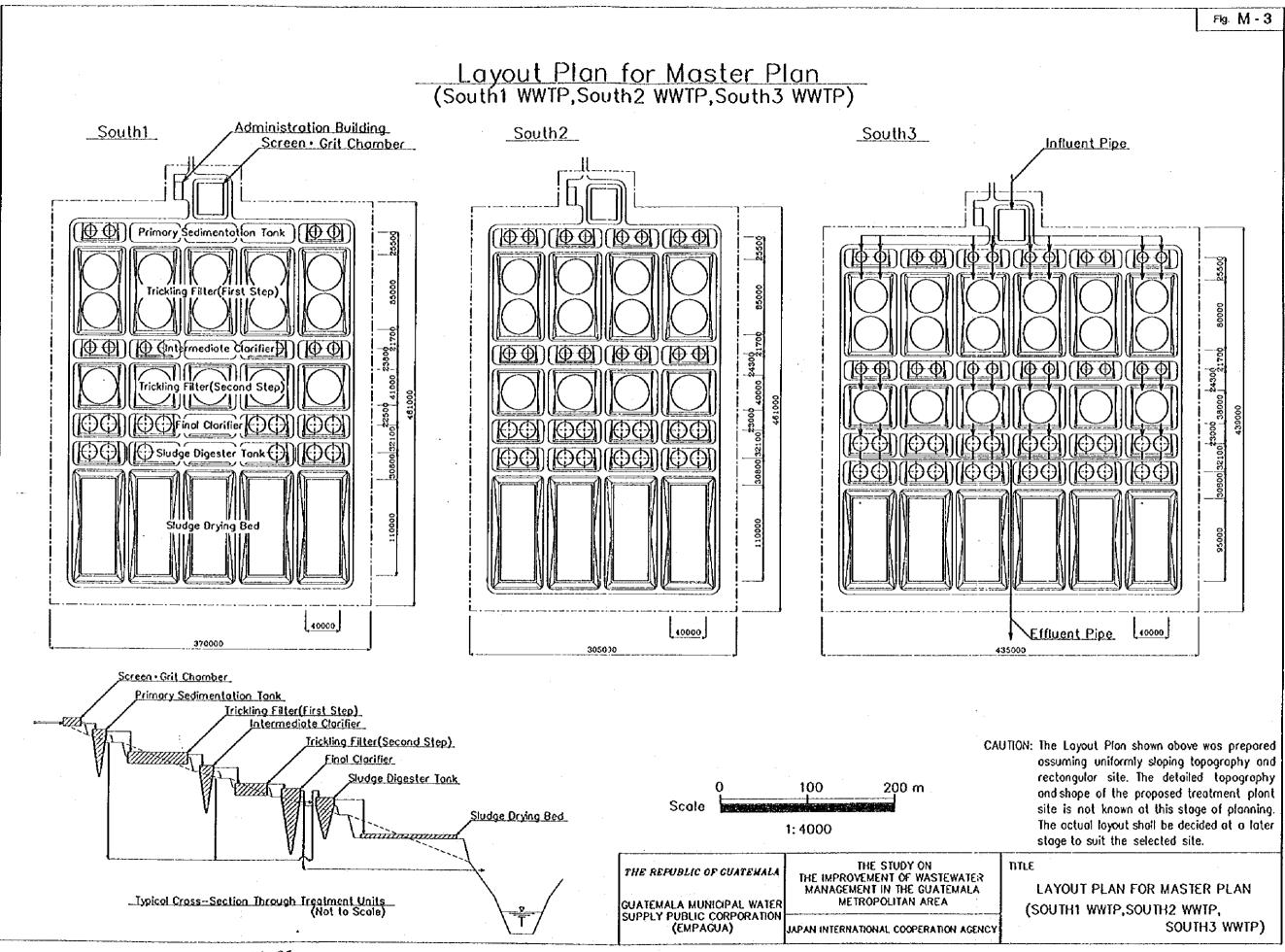
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LAYOUT PLAN FOR FIRST STAGE

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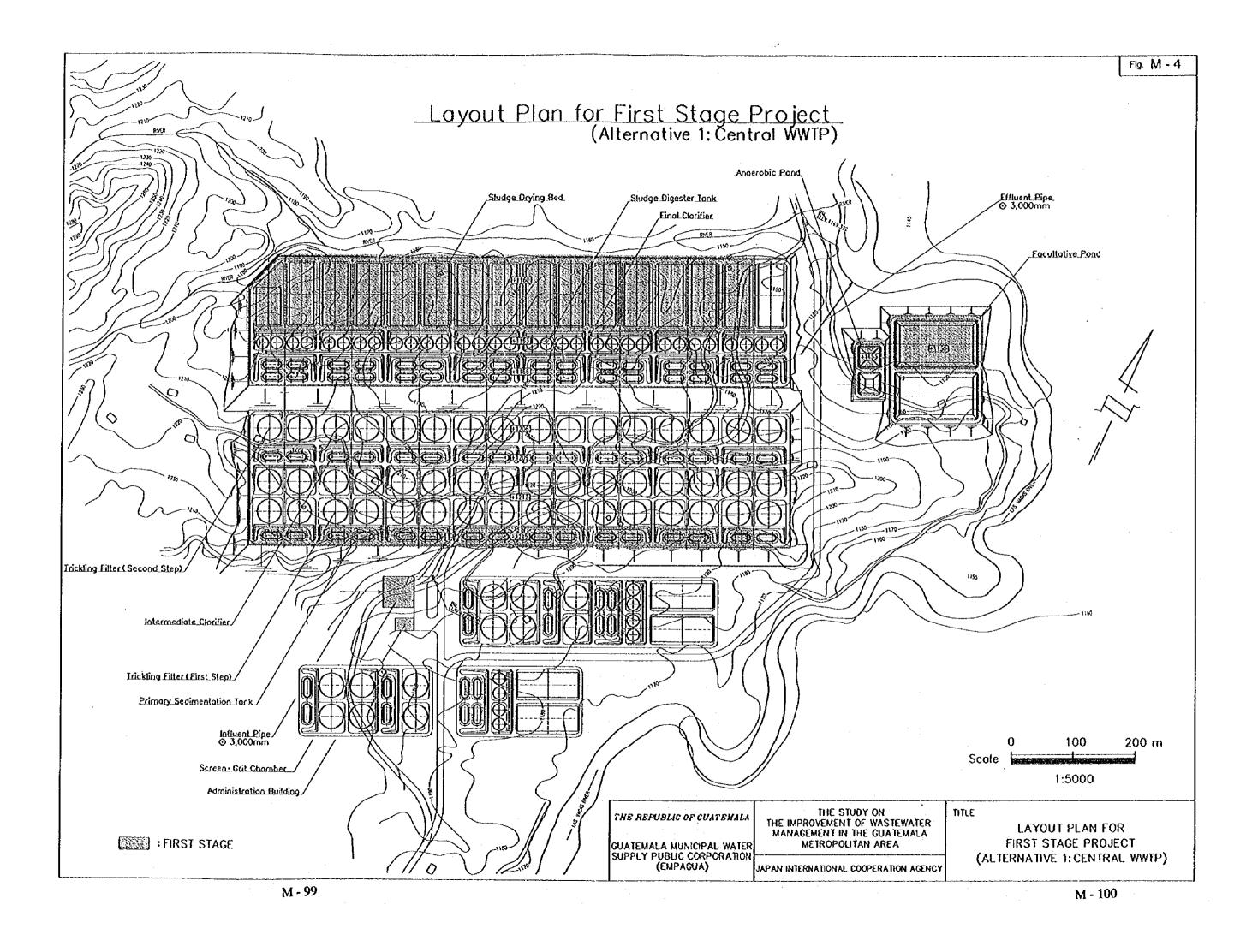
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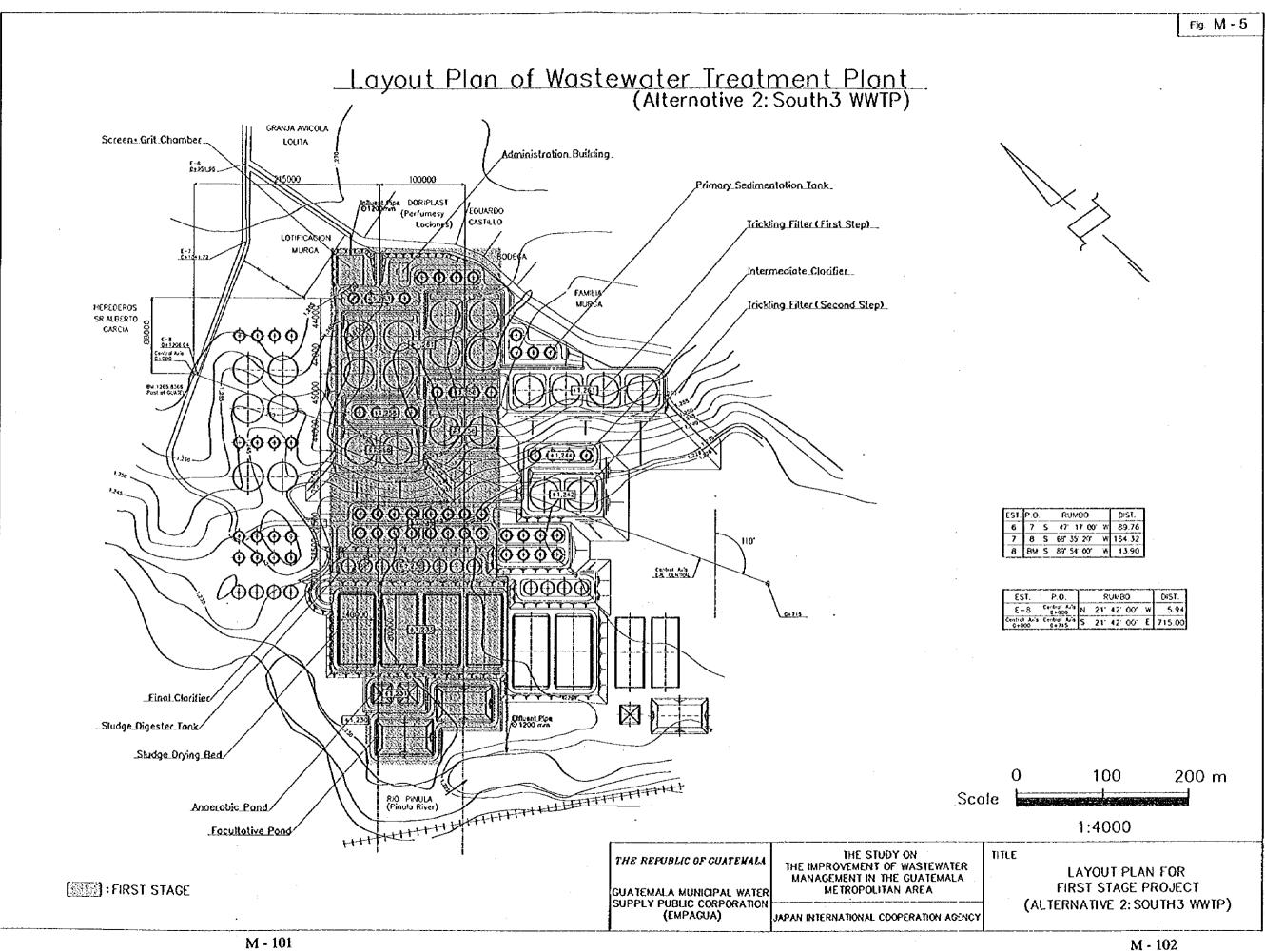
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SUPPORTING REPORT N

6

SANITATION SYSTEM

SUPPORTING REPORT N SANITATION SYSTEM

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N1 General

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To improve environmental conditions in high risk and medium risk settlements as identified in UNICEF survey "Caracterization de Las Areas Precarias En La Ciudad De Guatemala (1991), wastewater generated should be collected and treated before discharging to river bodies. Most of these settlements lack drainage facilities and are located close to the ravine and have poor accessibility. Hence these settlements are difficult to connect to the proposed sewerage system and are considered to be covered by Sanitation System. Sanitation system consists of (1) a collection system to convey the wastewater from the community and (2) treatment and effluent disposal system.

Sanitation system of Central Region and South 3 Region are identified among the priority projects in Chapter 11. Further financial Evaluation showed that it is recommendable to cover sanitation system in second stage, however this chapter intends to give an idea of sanitation system of South 3 Region and Central Region (first stage).

N2 Settlements to be Covered by Sanitation System

Settlements which are proposed to be implemented in first stage of Central region project and second stage of south 3 region project are mentioned below in Table N - 1 and their location is shown in Fig. N - 1 (a-g) and Fig. N - 2 (a-b) respectively.

Population of these settlements have been adapted from UNICEF survey and future population in 2015 is assumed to be same as that of present population. Further it is important to comment that most of these settlements are slum or high risk areas and the above assumption holds good but some settlements have possibility of population expansion. Loma Blanca which is located in the suburbs of South 3 Region has lot of unutilized land in the settlement which will be occupied by houses in future. Hence sanitation system is designed for the population foreasted in the year 2015.

Also possibility of illegal invasion in slums can not be ruled out. For example it was reported in the Newspaper "Prensa Libre" dated 29 February 1996 that about 150 families invaded the settlement Incienso.

	• 1 Settlements to be Provi			
<u>S. No.</u>	Name of settlement	Zone	Population ^a	Estimated Area (ha) ^b
	CENTRAL REGION		مەنبە كەرىپ قەرىپ خالغان مەنبە يەرپ يەرىپ سەر يەرپ قالغان كارىپ كەرىپ	
1	Final	14	500	16
2	El Pilar	14	1,500	48
3	El Cambary	14	300	7
4	Campo Seco	16	1,200	6
5	Finca El Carmen	6	1,000	6
6	Modrno San Antonio	6	1,000	6
7	Jocotales	6	2,600	17
8	Quintanal	6	3,700	24
9	Santa Faz	6	600	4
10	El Tuerto	1	500	4
11	Colinas I y II	1	900	7
12	Bethania Sec I	1	1,400	11
13	Bethania Sec III	. 7	1,600	11
14	Bethania Sec IV			3
15	Seis de Octubre	7	1,500	10
16	Joya I	7	2,500	16
17	Joya II	7	2,500	16
18	Joya III	7	2,500	16
19	La Joya IV	7	1,500	10
20	Colon. Argueta	2	2,000	26
21	Incienso	3	4,200	19
	Total	1 	33,900	283
	SOUTH 3 REGION			
1	Loma Blanca I	12	900°	9
2	Loma Blanca II	12	1000¢	9
3	Plaza de Toros	13	1,000	24
	Total		2900	42

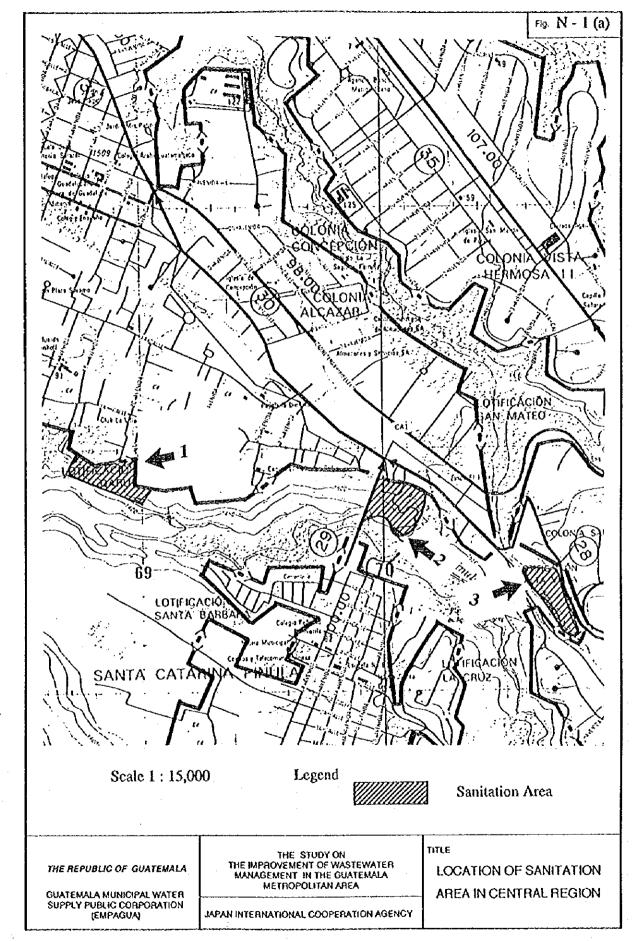
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Table N - 1 Settlements to be Provided with Sanitation System

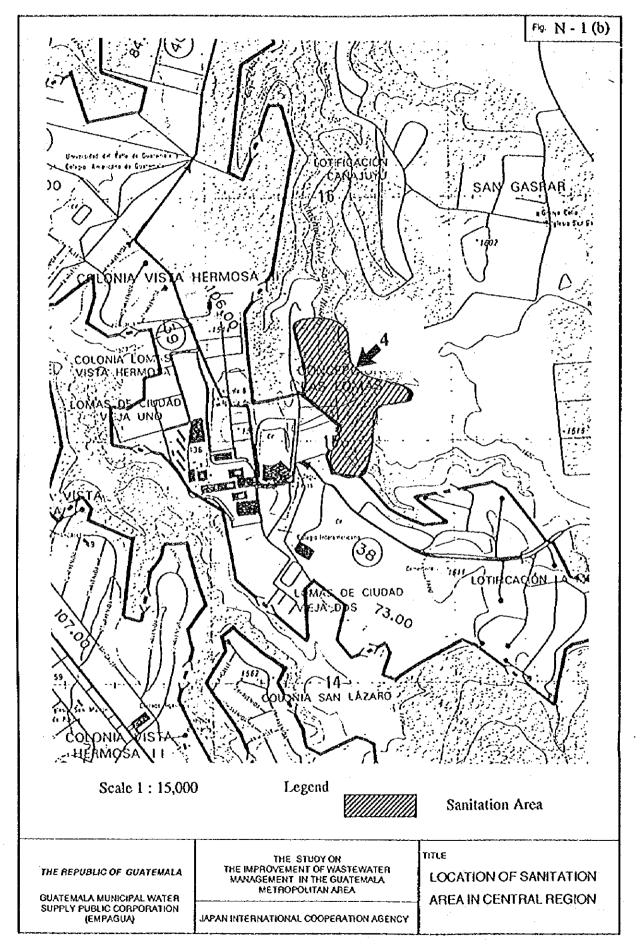
^a Adapted from UNICEF Survey "Caracterizacion De Las Areas Precarias En La Ciudad De Guatemala", (1991) and population in the year 2015 is assumed to be same as that of present.

^b Estimated Area = (Population / Population Density of the respective Zone)

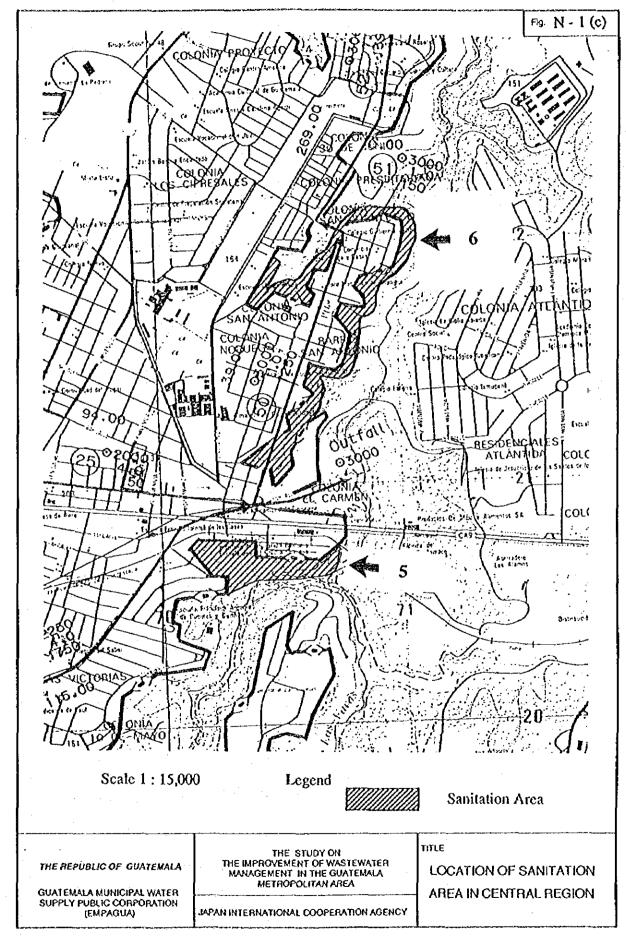
^c Population expansion is taken into account and is mentioned for the year 2015.



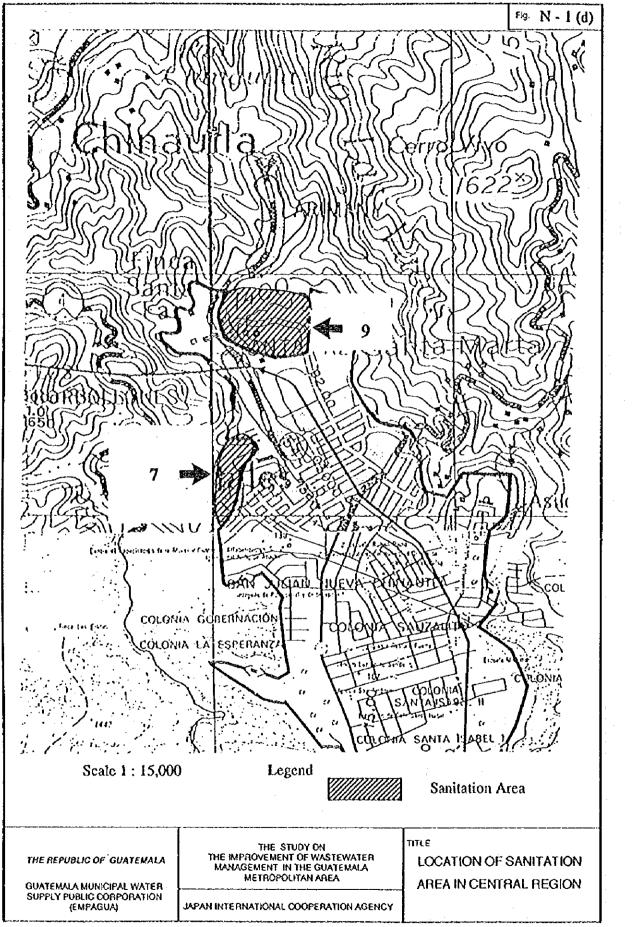
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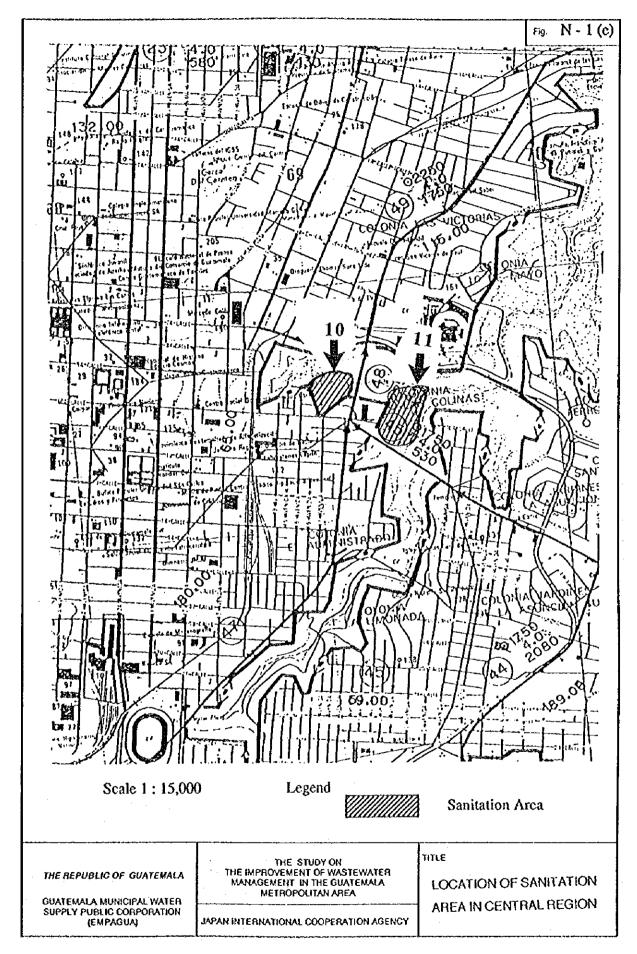
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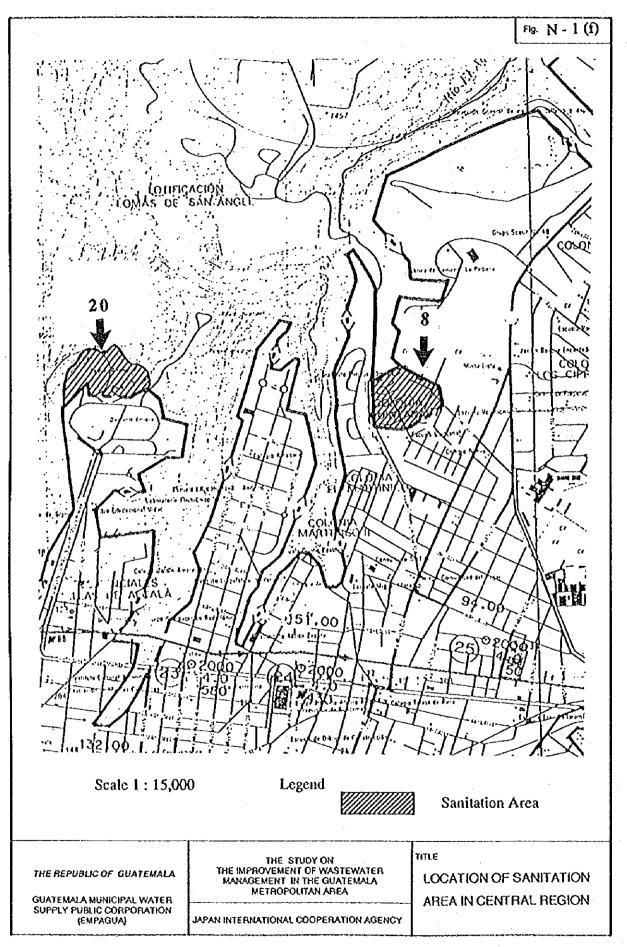
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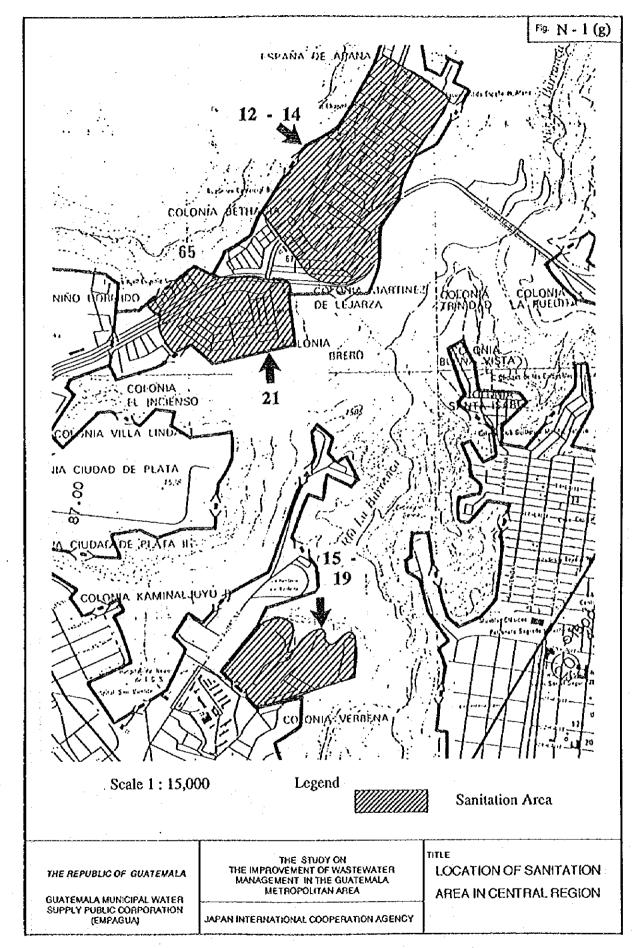
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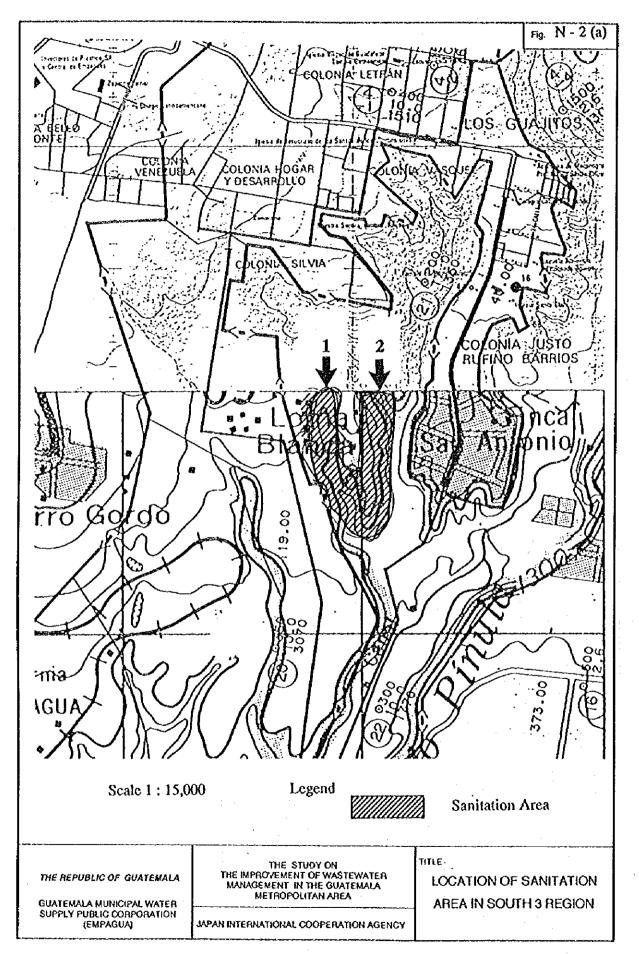
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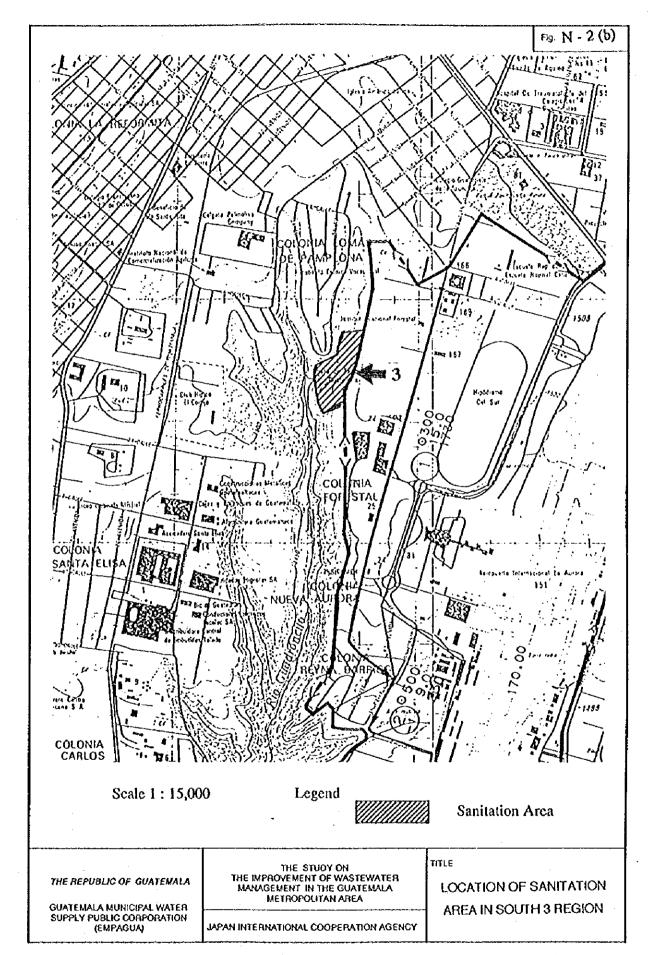
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N - 11

N3 Sanitation Collection System

A Conventional Gravity sewerage system is proposed for collecting and transporting the wastewater to the community sanitation treatment facility. The design criteria are briefly summarized below.

- Minimum cover between the top of the sewer and road surface should be one meter.

- Minimum diameter of sewer considered (excluding house connection) is 200mm.

- Minimum flow velocity allowed in the sewer is 0.6 m/sec.

- Maximum flow velocity allowed in the sewer is 3.0 m/sec.

- Manning equation is used to determine the sewer capacity.

- Manhole should be provided at each change in direction, change in grade and change in sewer diameter, and should not exceed the maximum spacing shown below:

Sewer diameter (mm)	Maximum Manhole Spacing (m)
300 or less	50
600 or less	80

Table N - 2 describes length of sewer required in each settlement for Central and South 3 Region. Most of the settlements require sewer even less than 200 mm, however in this report minimum diameter considered is 200 mm. Sewer network plan and profile of main sewer for the typical settlements are shown from Fig. N - 3 to Fig. N - 12.

1	 2 Length of Sewers Requirement 	Zone	Dia of main	Length
S. No.	Name of Semement	Zone	Sewer (mm)	(Km)
			Sewer (mm)	(Kiii)
	CENTRAL REGION	· · · · · · · · · · · · · · · · · · ·	000	<u> </u>
1	Final	14	200	3.7
2	El Pilar	14	200	11.1
3	El Cambary	14	200	1.7
4	Campo Seco	16	200	1.4
5	Finca El Carmen	6	200	1.5
6	Modrno San Antonio	6	200	1.5
7	Jocotales	6	200~250	3.8
8	Quintanal	6	200~300	5.5
9	Santa Faz	6	200	0.9
10	El Tuerto	1	200	0.9
11	Colinas I y II	1	200	1.6
12	Bethania Sec I	1	200	2.5
13	Bethania Sec II	7	200~250	3.0
14	Seis de Octubre	7	200	2.2
15	Joya I	7	200~250	3.8
16	Joya II	7	200~250	3.8
17	Joya III	7	200~250	3.8
18	La Joya IV	7	200	2.3
19	Colon. Argueta	2	200~250	5.9
20	Incienso	3	200~400	4.3
	Total			65.2
	SOUTH 3 REGION			
1	Loma Blanca I	12	200	2.0
2	Loma Blanca II	12	200	2.0
5	Plaza de Toros	13	200	5.6
	Total			9.6

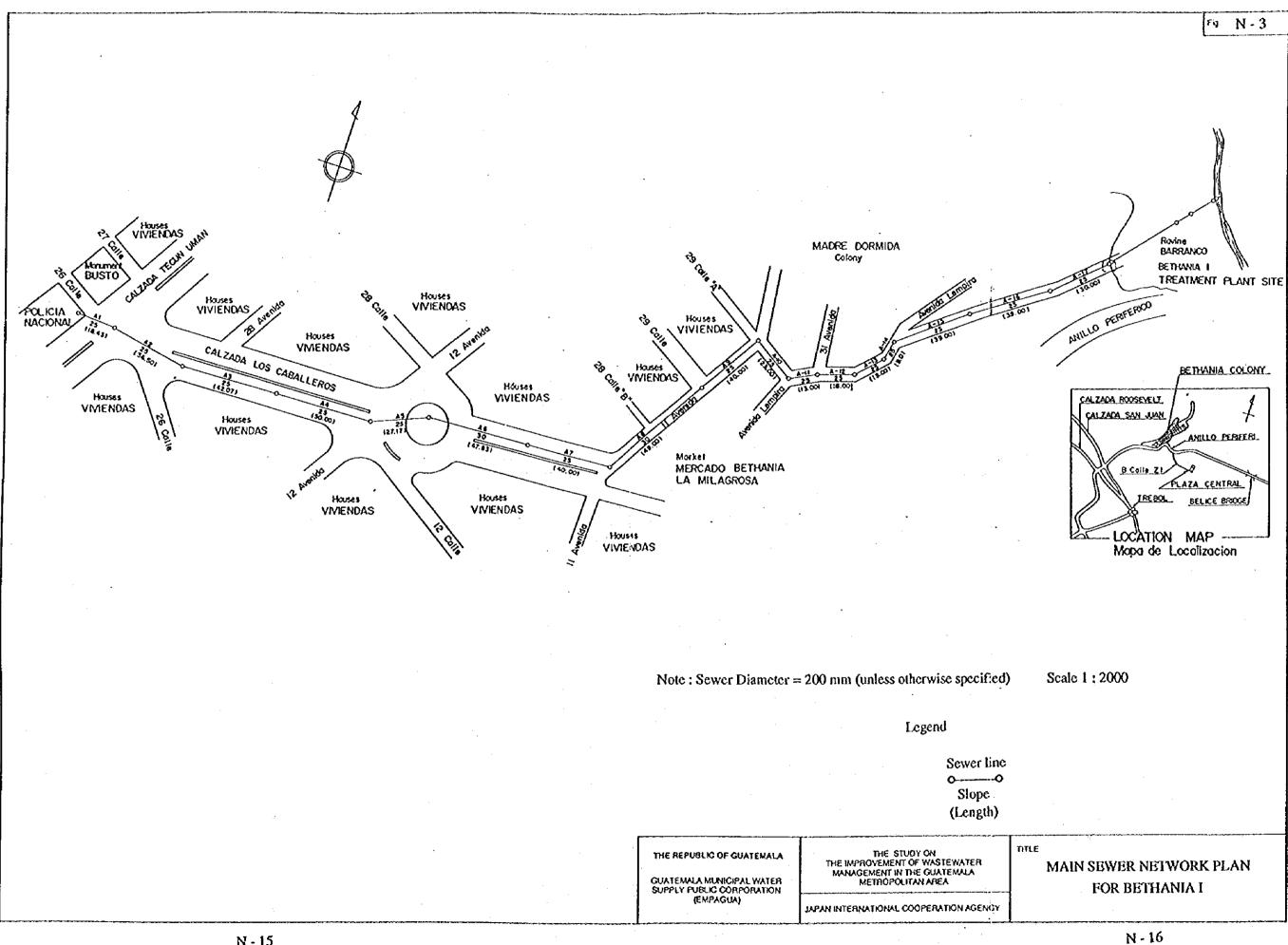
Table N - 2 Length of Sewers Required for Each Settlement

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Note Bethania III and IV are considered as one community and is mentioned as Bethania II

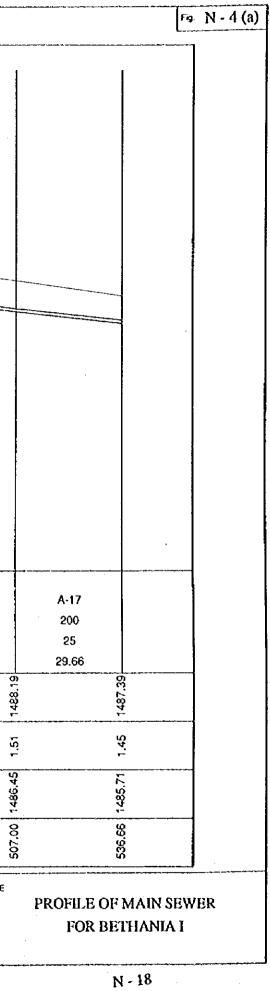
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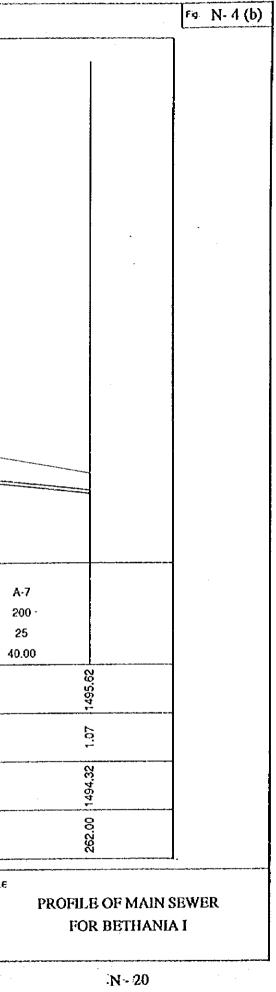


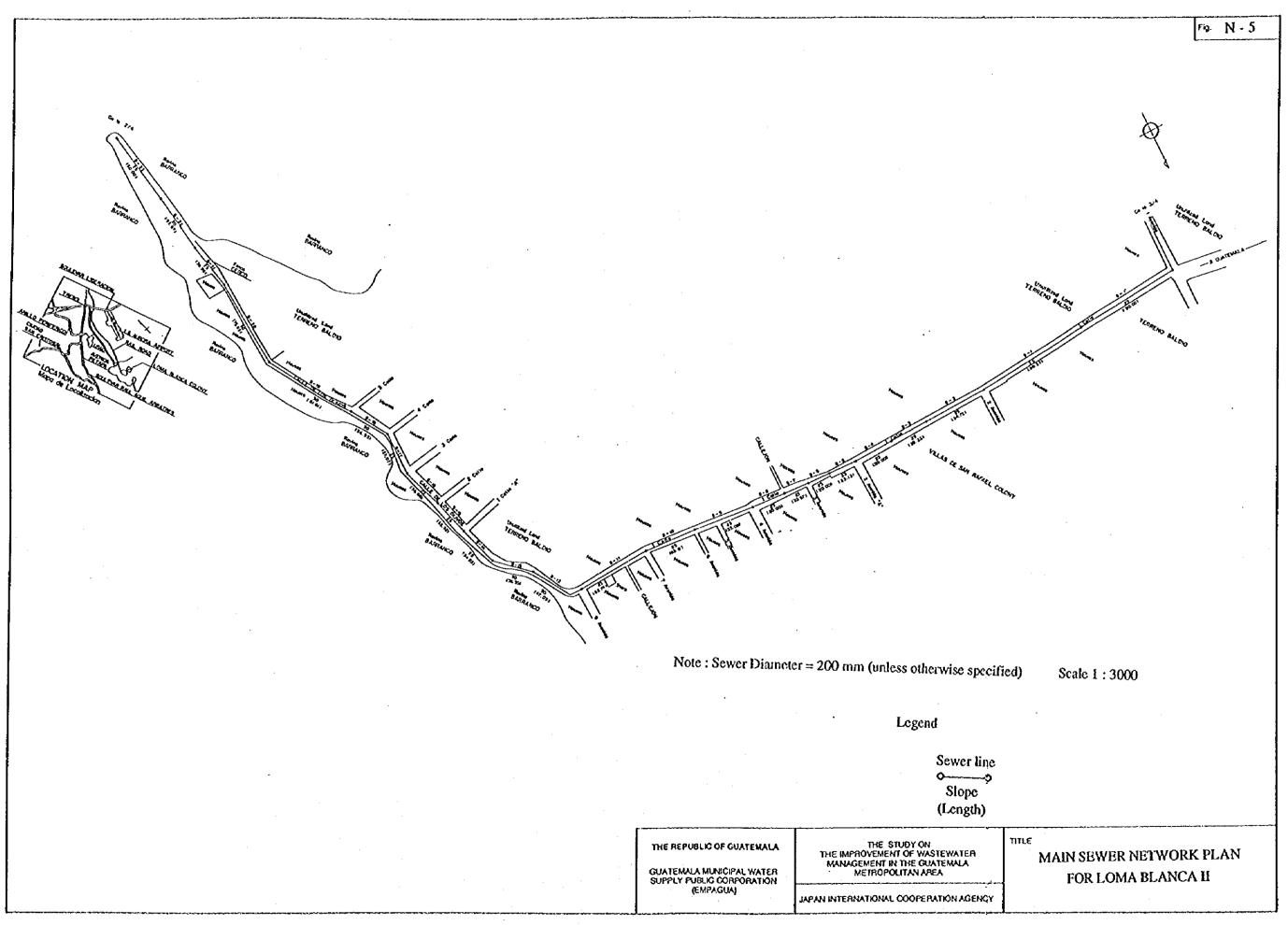
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			•		- -		BLIC OF GUATEMALA A MUNICIPAL WATER	THE STUD THE IMPROVEMENT O MANAGEMENT IN TH METROPOLIT/	Y ON F WASTEWATER E GUATEMALA W AREA	πτιε
Cu. Length (m)	262.00		311.00	351.00	374.00	387.00	420.00	ç	} ; ;	
Invert Elevation (m)	1494.32		1492.85	1491.85			1489.01 1489.01 1488.64 1488.64 1488.41	00	<u>}</u>	10 10 10 10
Earth Cover (m)	1.07		1.28	1.26	1.29	6F. 6	1.43	Ĩ		
Ground Elevation (m)	1495.62		1494.36	1493.34	1492.30	1491.38	1490.30			0
H=1/1000 Slop	oe (%) gth (m)	30 49.00	25 40.00	25	25 13.00	25 18.00	25 25 15.00 9.00	25 39.00	25 39.00	
Sewer Line No. V=1/200 Dia.	(mm)	• A-8	A-9 200	A-10 200	A-11 200	A-12 200	A-13 A-14 200 200	A-15 200	A-16 200	
1470.00										
1475.00		· · ·								
1480.00										
1485.00										
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1500.00										
Bethania - I						•••••••••				

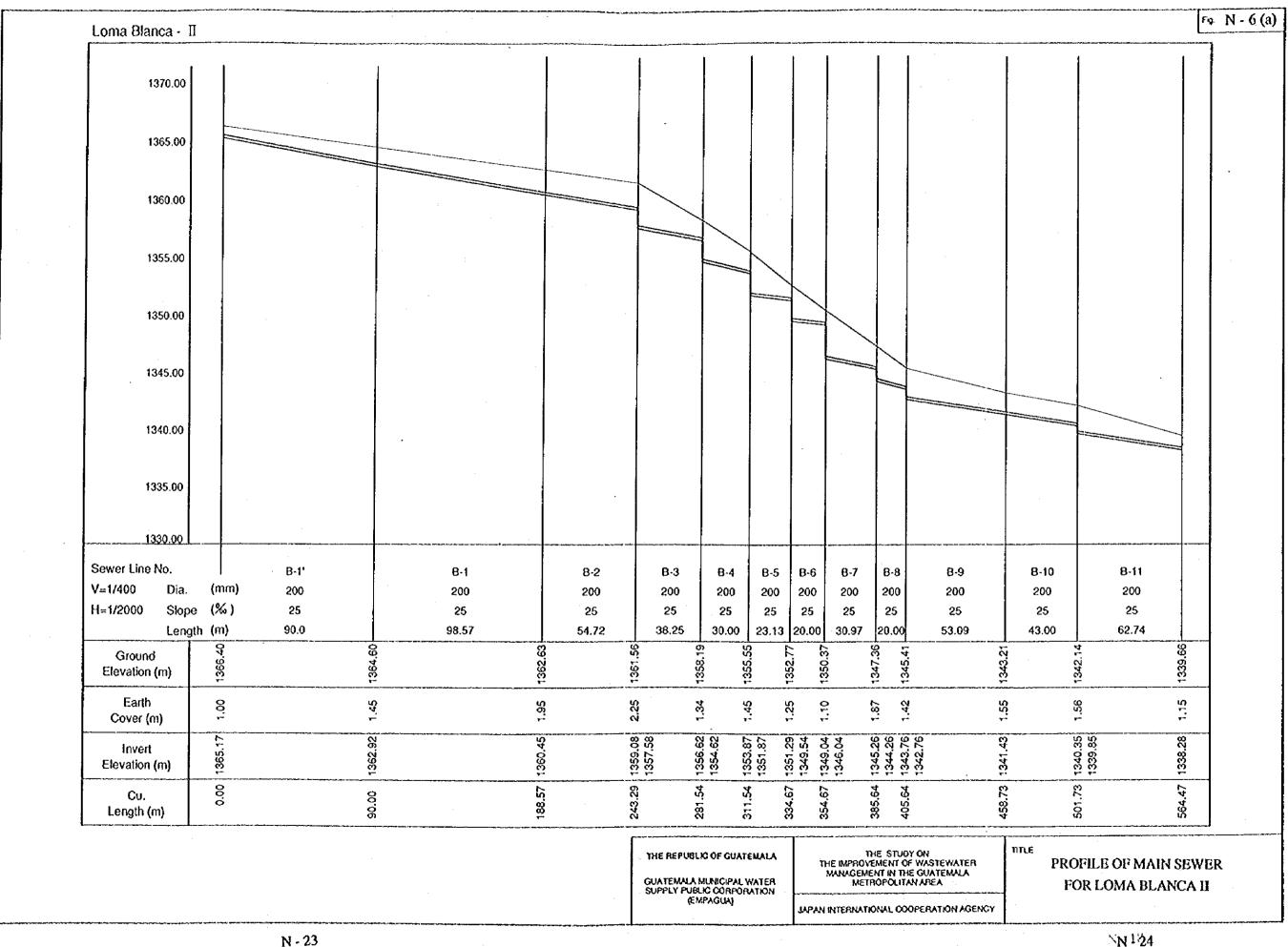


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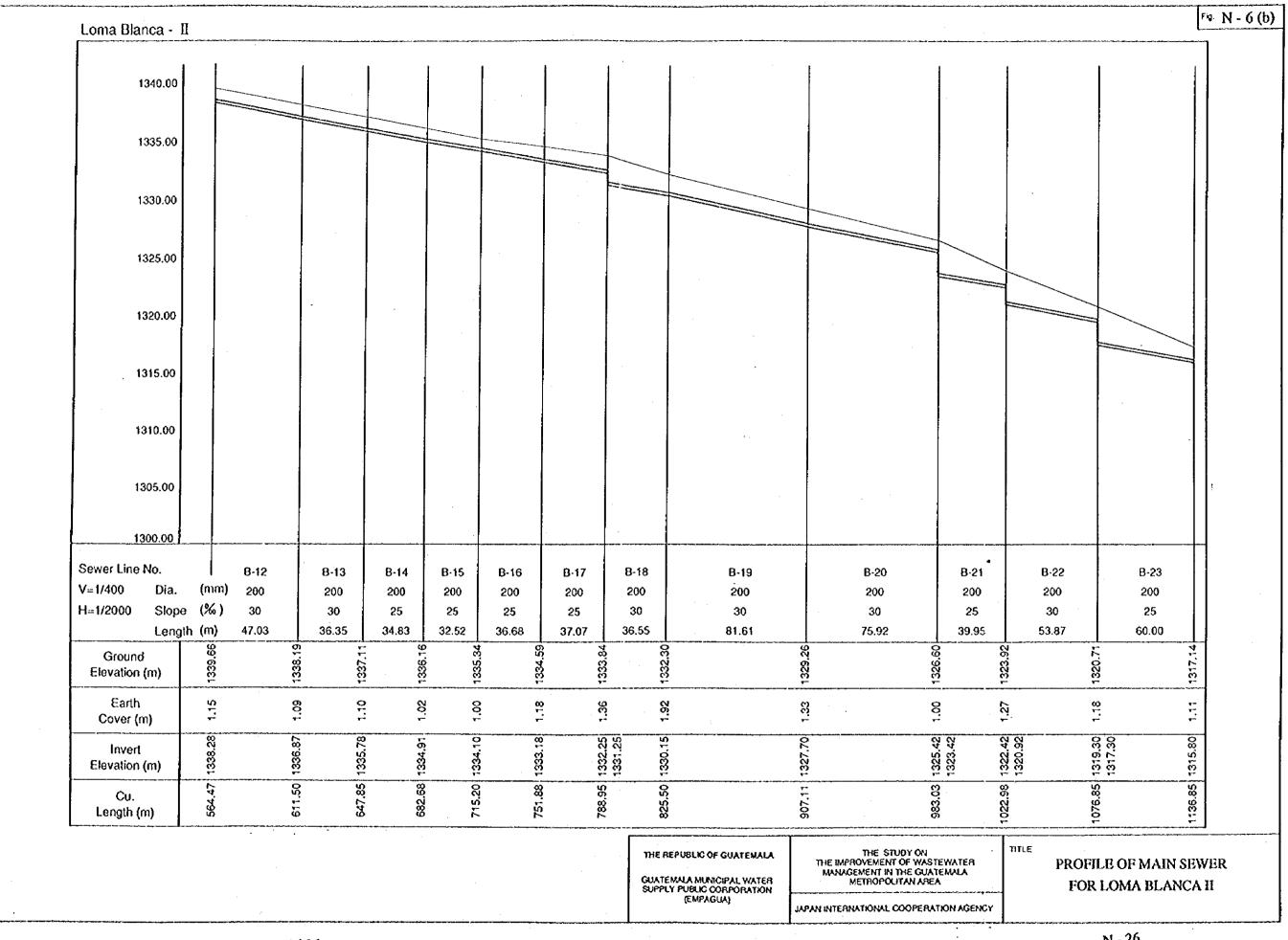
Length (m)						¥		V)	
Cu.	0.0	18.43	54.93		00.78	147.00		174.17	
Invert Elevation (m)	1502.61	1502.15 1501.15	1500.24		2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	1497.94			1495.32
Earth Cover (m)	2.00	1.48	1.53		2	1.05		24. 80. 80.	
Ground Elevation (m)	1504.84	1503.86	1502.00		1500.73	1 499.22		1498.94 1497.13	
H=1/5000 Slop)th (m) 18.4	3 36.50		25 42.07	5	25 0.00	25 27.17	30 47.83	
Sewer line No. V=1/200 Dia.	A-1 (mm) 200	200		A-3 200		A-4 200	A-5 200	A-6 200	
1490.00									
1495.00									
1500.00									
1505.00									
1510.00									
1515.00		-				-			
1520.00									
1520.00									

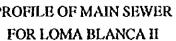


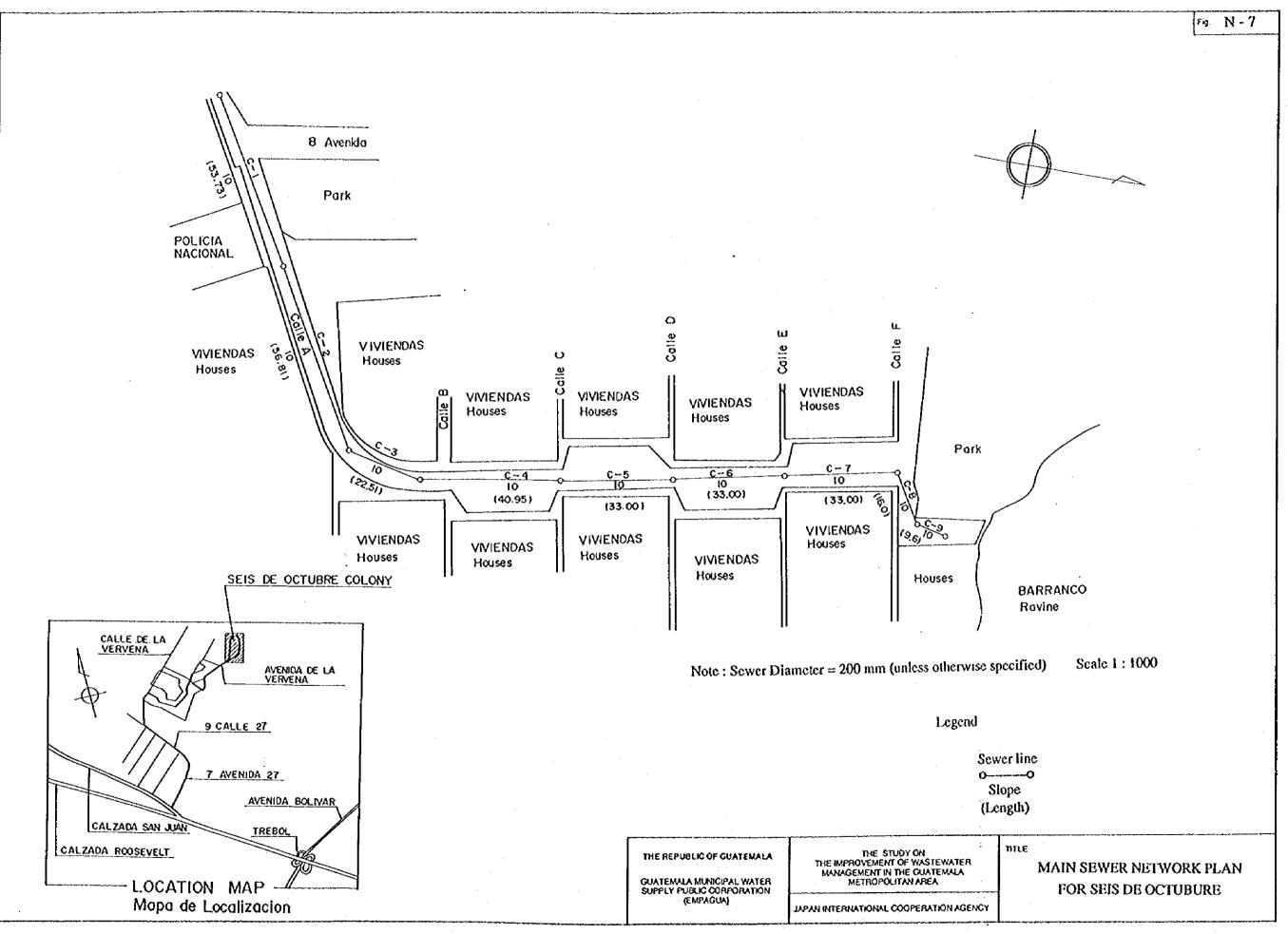




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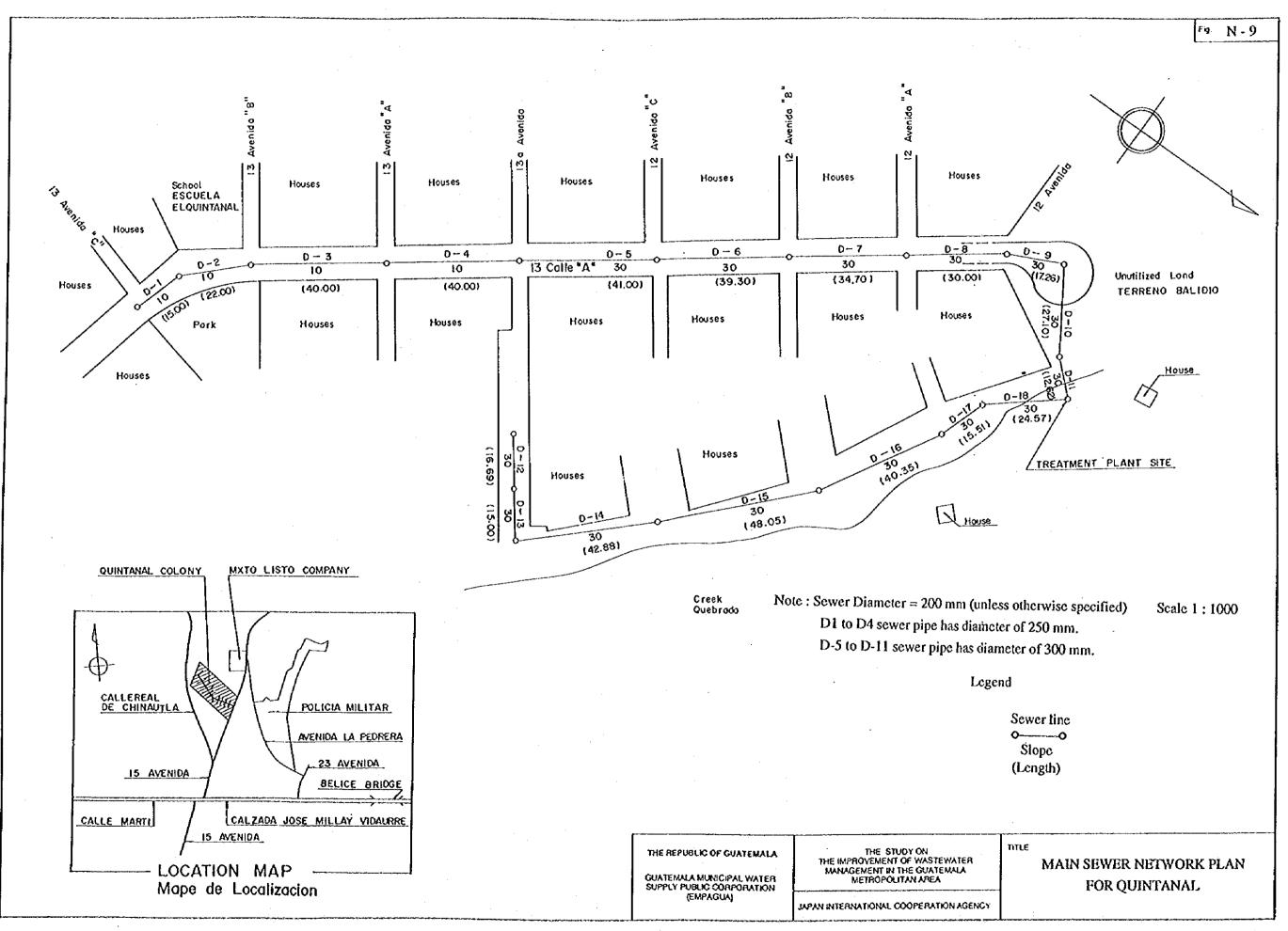






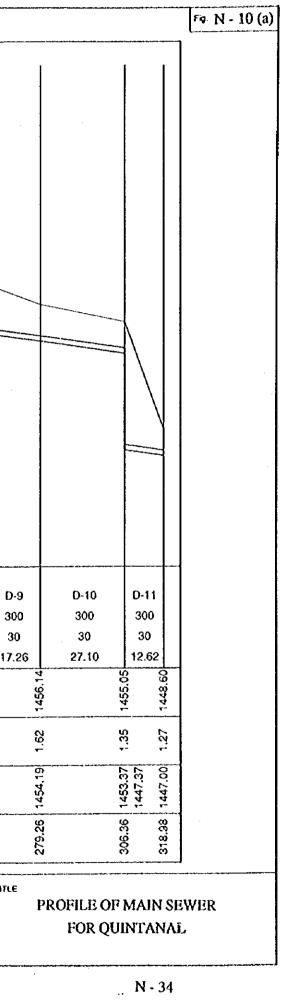
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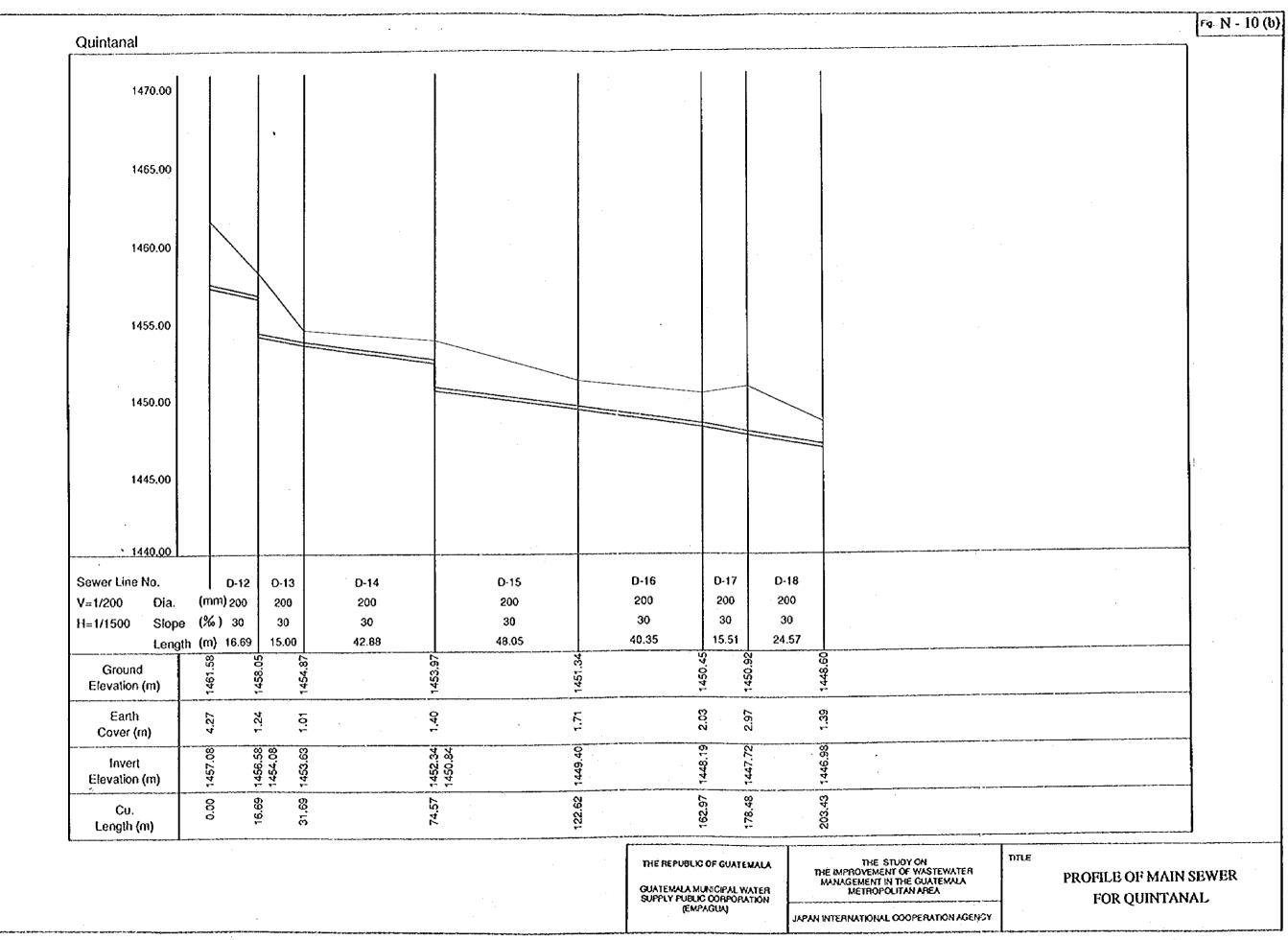
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Sewer Line No. V≕1/200 Dia. (n H=1/1500 Slope (¾ Length (n	ő) 10	C-2 200 10 56.81	C-3 200 10 22.51	C-4 200 10 40.95	C-5 200 10 33.00	C-6 200 10 33.00	C-7 200 10 33.00	C-8 C-9 200 200 10 10 16.00 9.63	
Ground Elevation (m)		1510.86	1510.81	1510.88	1511.05	1510.50		1508.64 1508.64 1507.63	
Earth & S Cover (m)		1.87	5 5 0	8 5 9 9	5 3.27	5 3.05 53		30 2.01 30 1.10	
Invert Elevation (m)		1508.76	1508.19	1507.96	0 1507.55	0 1507.22		0 1506.40 33 1506.40 33 1506.30	
Cu. Length (m)	3	53.73	110.54	83 83 83 83	174.00	207.00		2/3.00 289.00 298.63	
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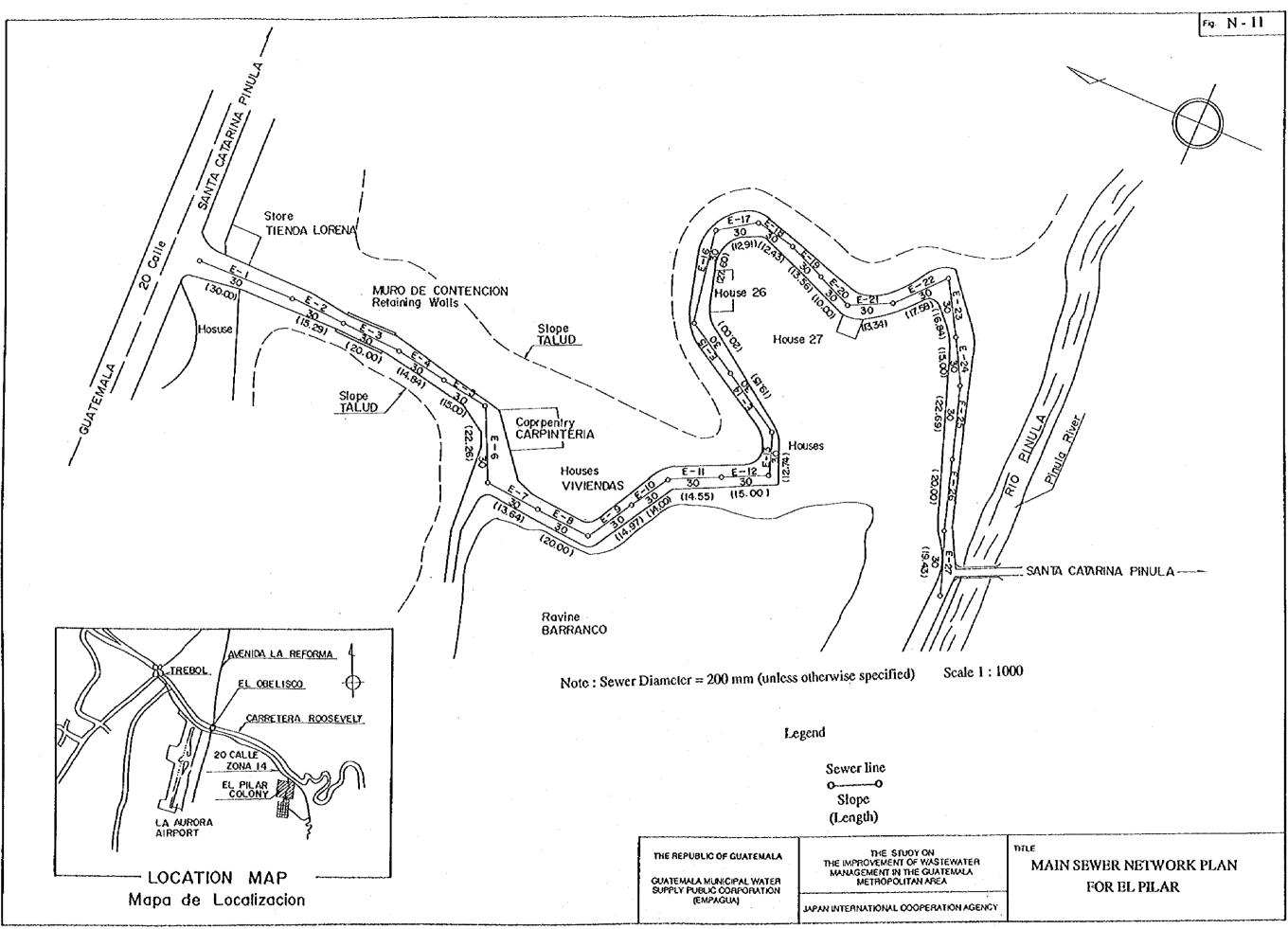
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	Leng Ground Elevation (m)	th (m) 1464.06	15.00 96 7 8 97 15.00	22.00	1463.83	40.00	1463.27	40.00	1462.64	41.0	1461.42	39.30	1459.37	34.70	1457.55 25. 2000 2000 2000	1457.55	7.1
	Earth Cover (m)	2.00	2.05		2.14		1.98		1.75		1.76		2.39	•	19. 1	2.51	
	Invert Elevation (m)	1461.78	1461.63		1461.41	**_*_*	1461.01		1460.61 1460.56		1459.33	1457.83	1456.65		1455.61	1454.71	
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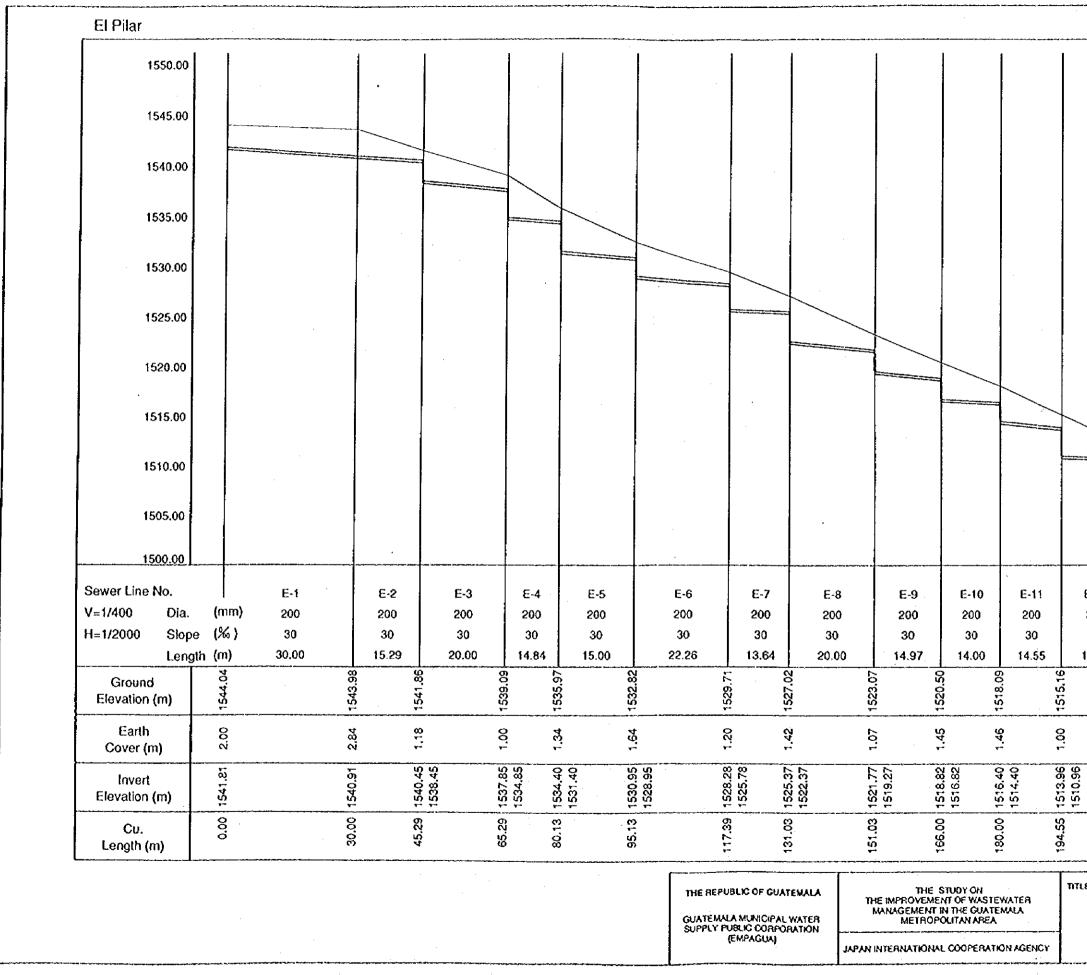








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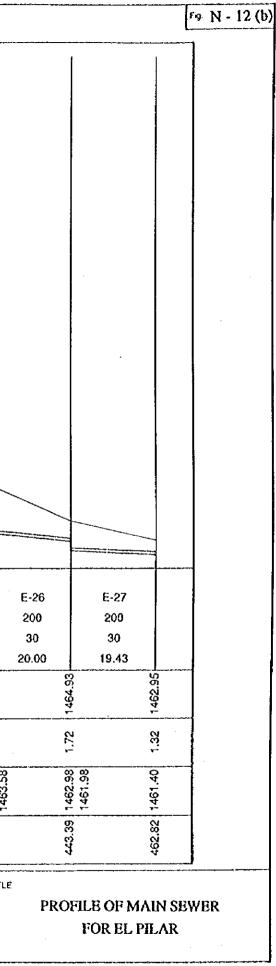


N - 39

PROFILE OF MAIN SEWER FOR EL PILAR

				Fig.	N -	12	(a)
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E-12	E-13						
200 30	200 30						
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Sewer Line No. V≈1/500 Dia. H=1/1000 Slop	E-14 (MM) 200 e (%) 30	200		E-16 200 30	E-17 200 30	E-18 200 30	E-19 200 30	E-3	0 200	E-22 200 30		E-23 200 30	E-24 200 30	E-25 200 30	
	th (m) 19.1			27.60	12.91	12.43	13.56	10.				16.84	15.00	22.69	
Ground Elevation (m)	1510.28	1506.88	1503.33		1499.03	1496.32	1493.34	1490.00	1487.50	1484.25	1480.59		1476.44	1472.75	1468.59
Earth Cover (m)	1.92	1.60	1.15		5. 8	1.36	1.25	1.32	1.12	1.27	1.13		00.1	1.26	1.28
Invert Elevation (m)	1508.13	1505.05	1501.95 1498.45		1497.62 1495.12	1492.23 1492.23	1491.86 1488.86	1488.45 1486.45	1486.15 1483.15	1482.75 1479.75	1479.22	1475.72	1475.21	1471.26 1467.76	1467.08
Cu. Length (m)	222.29	241.44	261.44					327.94	337.94	351.28	368.86		385.70	400.70	423.39
						· · · · · · · · · · · · · · · · · · ·			· .	LIC OF GUATEMA MUNICIPAL WAT LIC CORPORATK MPAGUA)		THE IM MAN/	THE STU PROVEMENT (SEMENT IN TI METROPOLIT	DY ON DF WASTEWATER HE GUATEMALA IAN AREA	TITL
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N - 42

N4 Sanitation Treatment System

a) Treatment Process

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The wastewater collected from the settlement is proposed to be treated at community plant. The sanitation treatment system consist of treatment and effluent disposal system. In Master plan following two alternatives were described:

- Septic tank followed by soil absorption well
- Septic tank with upflow anaerobic filter and effluent to be discharged to the river.

At present soil absorption system is being used for disposal of septic tank effluent in the study area, however in future most of the area is basically to be covered by sewerage system and settlements to be covered by sanitation system are located on the steep slope and are closer to the valley. Limited area is available for the treatment site in these settlements. Most of the settlements have river nearby.

Further soil percolation test conducted at five locations showed that soil is predominantly clay/clayey silt. And as the proposed septic tank system is closed to the valley, possibility of underground channel of porous materials can not be ruled out as found in Bethania II. (Ref. Supporting Report III for more details)

Based on the above site conditions, treatment system consisting of septic tank with upflow filter and effluent discharged to the river is preferred. By treating septic tank effluent through upflow anaerobic filter and then discharging into the river, possibility of contamination of ground water can be avoided. However for settlement Final and El Pilar, where Pinula river is used for domestic purposes at the downstream, septic tank effluent is proposed to be disposed by means of soil absorption system.

b) Design Criteria

Design criteria of sanitation treatment system are summarized below in the Table N - 3.

Facility	Item	Unit	Design Range	Applied
Septic Tank	Detention Time (Start up)	days	3	3
	Sludge accumulation rate	l∕c/d	30-40	40
	Max sludge accumulation		1/2-1/3 of	1/3 of tank
	allowed before desludging		tank	
	Length : Width		2-3:1	2:1
	Clearance above liquid level	m	0.2-0.4	0.4
Upflow	Detention time	hrs	6-8	8
Anaerobic	Max hydraulic loading	m ³ /d/m ²	3.4	1.7
Filter	Max., height	m	0.9-1.5	1.2

Table N -3 Design Criteria of Septic Tank and Upflow Anaerobic Filter

References :

- Appropriate Technology for Water Supply and Sanitation : A Planner's Guide, World Bank 1980.

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- Sewage Treatment in Hot Climates, Duncan Mara, (1976)

- Wastewater Engineering; Treatment, Disposal and Reuse, Metcalf & Eddy, Third Edition, (1991)

- Anaerobic Wastewater treatment-Attached growth and sludge Blanket Process, ENSIC, AIT (1986)

- Design Criteria Development of RBC and Anaerobic Filter system for Sewage Treatment, AIT (1983)

c) Treated Water Quality

Treated water Quality from sanitation treatment system is described below in the Table N - 4.

Parameter	Removal Rate	Influent (mg/l)	Effluent (mg/l)
BOD5	75 %	330	83
SS	75 %	330	83

Table N - 4 Treated Water Quality from Sanitation Treatment System

d) Design Details of Treatment System

Table N - 5 shows details of community plants for Central and South 3 Region. Design calculations for the community plant to serve 1000 people are shown in Table N - 6 and details for typical settlements of Central and South 3 Region are shown from Fig. N - 13 to Fig. N - 17.

Tab	Fable N - 5 Details of Community Treatment Plant						
Na	Name of Settlement	Zone	Daily Maximum	Septic Tank	Upflow Filter		
<u> </u>			Flowrate m ³ /d	(LxWxD) m	(LxWxD) m		
	CENTRAL REGION						
1	Final	14	90	17.0x8.5x2.0	*		
2	El Pilar	14	270	28.0x14.5x2.0	•		
3	El Cambary	14	60	13.0x7.0x2.0	5.5x7.0x1.2		
4	Campo Seco	16	220	25.5x13.0x2.0	10.5x13.0x1.2		
5	Finca El Carmen	6	180	23.5x11.5x2.0	10.0x11.5x1.2		
6	Modrno San Antonio	6	180	23.5x11.5x2.0	10.0x11.5x1.2		
7	Jocotales	6	470	37.5x19.0x2.0	15.5x19.0x1.2		
8	Quintanal	6	670	45.0x22.5x2.0	18.5x22.5x1.2		
9	Santa Faz	6	110	18.5x9.0x2.0	7.5x9.0x1.2		
10	El Tuerto	1	90	17.0x8.5x2.0	6.5x8.5x1.2		
11	Colinas I y ll	1	170	22.0x11.5x2.0	9.5x11.5x1.2		
12	Bethania Sec I	1	260	28.0x14.0x2.0	11.5x14.0x1.2		
13	Bethania Sec II	7	360	33.0x16.5x2.0	13.5x16.5x1.2		
14	Seis de Octubre	7	270	28.0x14.5x2.0	11.5x14.5x1.2		
15	Joya I	7	450	36.5x18.5x2.0	15.0x18.5x1.2		
16	Joya II	7	450	36.5x18.5x2.0	15.0x18.5x1.2		
17	Joya III	7	450	36.5x18.5x2.0	15.0x18.5x1.2		
18	La Joya IV	7	270	28.0x14.5x2.0	11.5x14.5x1.2		
19	Colon. Argueta	2	360	33.0x16.5x2.0	13.5x16.5x1.2		
20	Incienso	3	760	47.5x24.0x2.0	20.0x24.0x1.2		
	SOUTH 3 REGION						
1	Loma Blanca I	12	170	22.0x11.5x2.0	9.5x11.5x1.2		
2	Loma Blanca II	12	180	23.5x11.5x2.0	10.0x11.5x1.2		
3	Plaza de Toros	13	180	23.5x11.5x2.0	10.0x11.5x1.2		

 Table N - 5 Details of Community Treatment Plant

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Note 1. Bethania III and IV are considered as one community and is mentioned as Bethania II.

Note 2. Effective dimensions of septic tank and upflow filter are mentioned above. Note 3. LxWxD = Length x Width x Depth

Item	Calculation				
Design Flowrate	Daily Average 165 lpcd = 165 m ³ /day Daily Maximum 180 lpcd = 180 m ³ /day				
1.Septic tank					
A) Required Capacity	i de la construcción de la constru				
Design flowrate	180 m³/day				
Detention time	3 days				
Effective Tank Volume	540 m ³				
B) Check for sludge accumulation					
Sludge accumulation rate	0.04 m ³ /capita/year				
Frequency of desluddging	3 years				
(including factor of safety)					
Sludge accumulation	120 m ³				
Volume reserved for	1/3 of tank Volume				
sludge accumulation	$=180m^{3}$				
C) Dimensions					
Depth	2.0m				
Area	$270 \mathrm{m}^2$				
length : Width	2:1				
length	23.5 m				
Width	11.5 m				
2.Upflow Filter					
A) Required Capacity					
Filter media (void ratio)	20 - 25 mm broken stones (0.45)				
Detention time	8 hrs				
Design flow	180 m³/day				
Required void volume	60 m ³				
Required filter volume	134 m ³				
B) Dimensions					
Depth	1.2 m				
Атеа	112 m^2				
Width	11.5 m				
length	10.0 m				
C) Check for Hydraulic loading.	2. A. A.				
Hydraulic loading to the filter	$1.61 \text{ m}^3/\text{m}^2/\text{d}$				
Recommended Hydraulic loading	$1.7 \text{ m}^{3}/\text{m}^{2}/\text{d}$				

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Table N • 6 Design Calculation s for Community plant to serve 1000 people

e) Septage Treatment

It is proposed that septage be treated at the sludge treatment facility of the wastewater treatment plant to be constructed in the respective region. The quantity of septage is calculated based on a sludge accumulation rate of 0.04 m³/capita/year. The quantity of

septage to be desludged from each settlement in Central region and South 3 region are described below in the Table N - 7.

S. No.	Name of Settlement	Zone	Septage to be
an a			desludged (m³/year)
	CENTRAL REGION		
1	Final	14	20
2	El Pilar	14	60
3	El Cambary	14	12
4	Campo Seco	16	48
5	Finca El Carmen	6	40
6	Modrno San Antonio	6	40
7	Jocotales	6	104
8	Quintanal	6	148
9	Santa Faz	6	24
10	El Tuerto	<u> </u>	20
11	Colinas I y 11	1	36
12	Bethania Sec I	1	56
13	Bethania Sec II	7	80
14	Seis de Octubre	7	60
15	Joya I	7	100
16	Joya II	7	100
17	Joya III	7	100
18	La Joya IV	7	60
19	Colon. Argueta	2	80
20	Incienso	3	168
	Total		1,356
	SOUTH 3 REGION		
1	Loma Blanca I	12	36
2	Loma Blanca II	12	40
3	Plaza de Toros	13	40
	Total		116

Table N -7 Quantity of Septage to be Desludged in the First Stage