JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

DEPARTMENT OF PUBLIC WORKS AND TRANSPORT
PHNOM PENH CAPITAL CITY
KINGDOM OF CAMBODIA

THE STUDY ON DRAINAGE AND SEWERAGE IMPROVEMENT PROJECT IN PHNOM PENH METROPOLITAN AREA

FINAL REPORT

VOLUME III
ANNEX

DECEMBER 2016

CTI ENGINEERING INTERNATIONAL CO., LTD.
NIPPON KOEI CO., LTD.
KITAKYUSHU WATER SERVICE CO., LTD.

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COMPOSITION OF FINAL REPORT

VOLUME I: SUMMARY

VOLUME II: MAIN REPORT

VOLUME III: ANNEX

Currency Exchange Rates used in this Report

[Master Plan Stage]

USD	1.00	= Riel	3,988	= JPY	119.64
Riel	1.00	= USD	0.00025	= JPY	0.030
JPY	1.00	= USD	0.0084	= Riel	33.3

(As of 1st April 2015)

[Pre-Feasibility Study Stage]

USD	1.00	= Riel	4,033	= JPY	122.85
Riel	1.00	= USD	0.00025	= JPY	0.030
JPY	1.00	= USD	0.0081	= Riel	33.3

(As of 1st December 2015)

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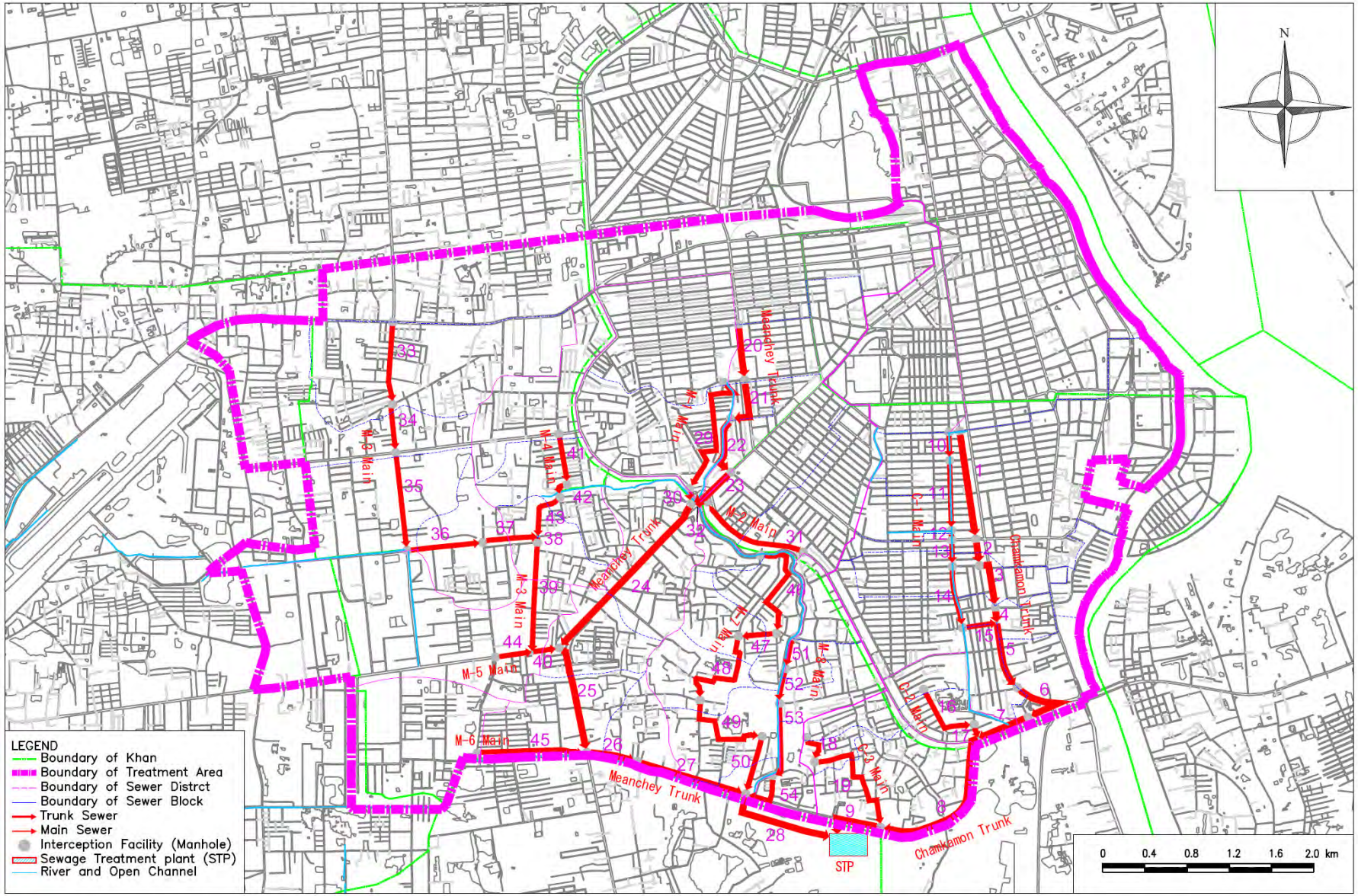
2. DRAINAGE MANAGEMENT

1. SEWAGE MANAGEMENT



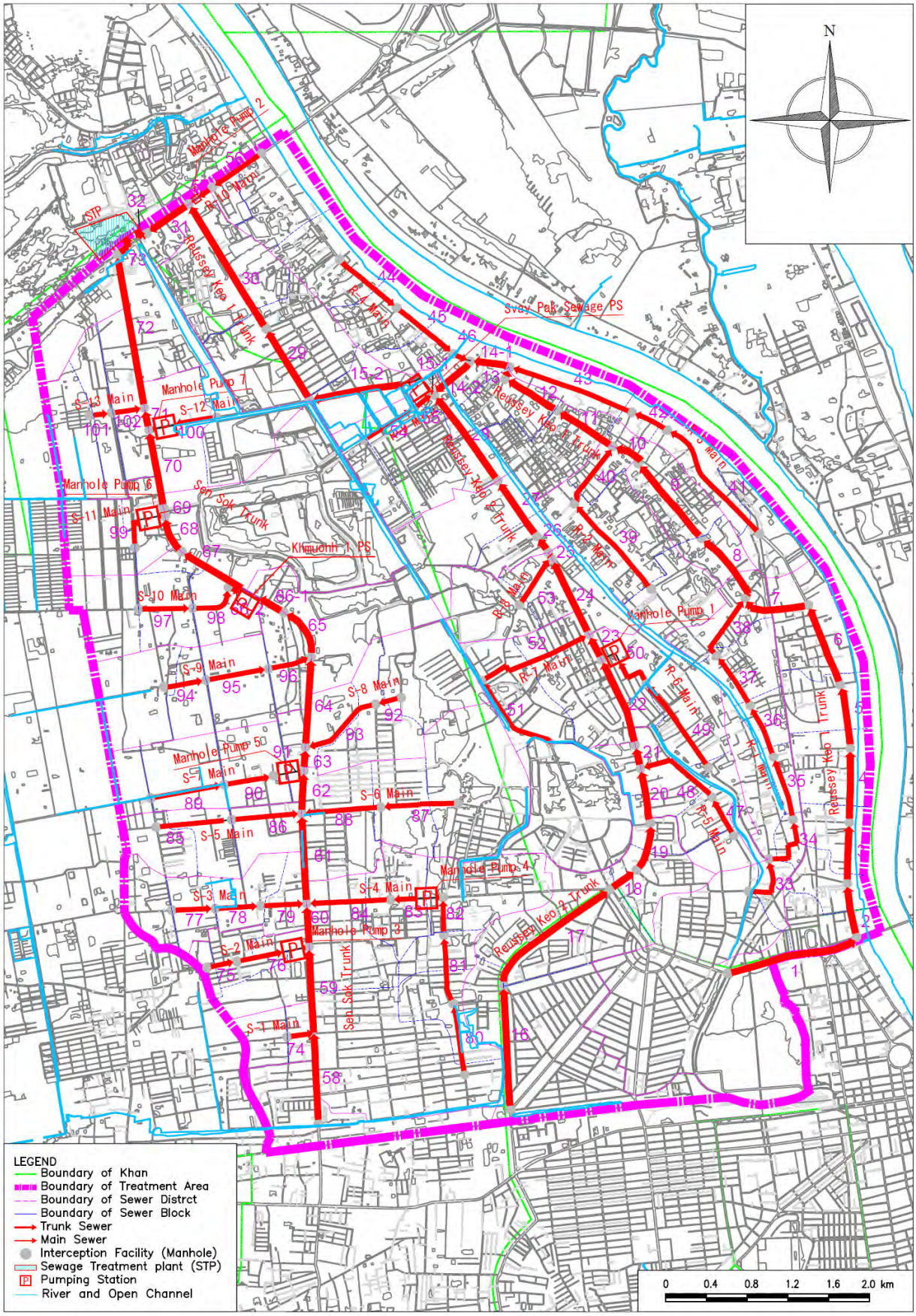
Pipe Layout and Number (Cheung Aek Treatment Area)

Flow Calculation (Cheung Aek Treatment Area) (1/2)

Sewer Number	Pipe Length			Catchment Area			Population			Sewage Flow				GWI	Q design	Proposed Sewer Dsign						Ground Level		Sewer Invert Level		Earth Covering Depth	
										Direct	Daily Average		Houly Maximum															
	Direct	Up Stream	Total	Direct	Up Stream	Total	Direct	Up Stream	Total	205 lcpd	Up Stream	Total	1.66	0.0868 l/s/ha	1.00	Diameter	Gradient	Velocity	Flow Rate	Water Depth	Ratio	Up Stream	Down Stream	Up Stream	Down Stream	Up Stream	Down Stream
	L	L_u	L_t	A	A_u	A_t	P	P_u	P_t	Q_d	Q_{DAu}	Q_{DAt}	1.66	Q_g	Q_d	D	S	V	Q_d/Q_{full}	h	h/D	EL	EL	EL	EL	GL-	GL-
	m	m	m	ha	ha	ha	persons	persons	persons	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	mm	m/m	m/s	-	mm	-	m	m	m	m	m	m
1	1,039	0	1,039	540.4	0.0	540.4	114,676	0	114,676	0.2721	0.0000	0.2721	0.4513	0.0469	0.4982	1000	0.0010	1.039	0.63	606	0.61	7.15	7.43	1.65	0.61	4.40	5.72
2	256	1,039	1,295	297.5	540.4	837.9	53,972	114,676	168,648	0.1281	0.2721	0.4001	0.6637	0.0727	0.7364	1100	0.0009	1.105	0.77	795	0.72	7.43	6.45	0.61	0.38	5.61	4.87
3	497	1,295	1,792	35.0	837.9	872.9	6,421	168,648	175,069	0.0152	0.4001	0.4154	0.6889	0.0758	0.7647	1100	0.0009	1.112	0.80	824	0.75	6.45	7.65	0.38	(0.07)	4.87	6.52
4	148	1,792	1,940	63.7	872.9	936.6	10,420	175,069	185,489	0.0247	0.4154	0.4401	0.7299	0.0813	0.8112	1200	0.0009	1.148	0.72	809	0.67	7.65	7.62	(0.07)	(0.21)	6.41	6.51
10	271	0	271	117.1	0.0	117.1	62,880	0	62,880	0.1492	0.0000	0.1492	0.2474	0.0102	0.2576	800	0.0013	0.937	0.51	408	0.51	6.99	6.57	1.99	1.65	4.12	4.04
11	667	271	938	39.8	117.1	156.9	15,754	62,880	78,634	0.0374	0.1492	0.1866	0.3094	0.0136	0.3231	900	0.0011	0.952	0.51	454	0.50	6.57	6.65	1.65	0.91	3.93	4.75
12	91	938	1,029	38.1	156.9	195.0	13,668	78,634	92,302	0.0324	0.1866	0.2190	0.3632	0.0169	0.3802	900	0.0011	1.003	0.60	519	0.58	6.65	6.89	0.91	0.81	4.75	5.09
13	251	1,029	1,280	14.5	195.0	209.5	3,880	92,302	96,182	0.0092	0.2190	0.2282	0.3785	0.0182	0.3967	1000	0.0011	1.015	0.51	503	0.50	6.89	6.00	0.81	0.53	4.98	4.37
14	595	1,280	1,875	43.4	209.5	252.9	11,394	96,182	107,576	0.0270	0.2282	0.2552	0.4233	0.0220	0.4453	1000	0.0011	1.054	0.57	552	0.55	6.00	6.60	0.53	(0.12)	4.37	5.62
15	326	1,875	2,201	75.3	252.9	328.2	19,434	107,576	127,010	0.0461	0.2552	0.3014	0.4998	0.0285	0.5283	1000	0.0011	1.106	0.67	636	0.64	6.60	7.62	(0.12)	(0.48)	5.62	7.00
5	658	4,141	4,799	0.0	1,264.8	1,264.8	0	312,499	312,499	0.0000	0.7415	0.7415	1.2297	0.1098	1.3395	1500	0.0007	1.159	0.76	1063	0.71	7.62	7.08	(0.21)	(0.65)	6.19	6.09
6	751	4,799	5,550	80.0	1,264.8	1,344.7	14,607	312,499	327,106	0.0347	0.7415	0.7761	1.2872	0.1167	1.4040	1500	0.0007	1.169	0.79	1111	0.74	7.08	10.24	(0.65)	(1.15)	6.09	9.75
7	512	5,550	6,062	8.4	1,344.7	1,353.1	2,010	327,106	329,116	0.0048	0.7761	0.7809	1.2951	0.1175	1.4126	1500	0.0007	1.170	0.80	1117	0.74	10.24	10.27	(1.15)	(1.49)	9.75	10.12
16	705	0	705	22.1	0.0	22.1	5,310	0	5,310	0.0126	0.0000	0.0126	0.0209	0.0019	0.0228	250	0.0047	0.810	0.46	118	0.47	6.25	6.02	3.25	(0.06)	2.70	5.78
17	138	705	843	31.5	22.1	53.6	7,552	5,310	12,862	0.0179	0.0126	0.0305	0.0506	0.0047	0.0553	400	0.0027	0.823	0.44	181	0.45	6.02	10.27	(0.06)	(0.44)	5.62	10.25
8	1,557	6,905	8,462	0.0	1,406.7	1,406.7	0	341,978	341,978	0.0000	0.8114	0.8114	1.3457	0.1221	1.4679	1650	0.0007	1.194	0.69	1070	0.65	10.27	10.50	(0.44)	(1.45)	8.91	10.15
18	327	0	327	27.8	0.0	27.8	7,702	0	7,702	0.0183	0.0000	0.0183	0.0303	0.0024	0.0327	300	0.0037	0.810	0.46	141	0.47	5.95	7.25	2.95	1.74	2.64	5.15
19	1,217	327	1,544	17.7	27.8	45.6	4,967	7,702	12,669	0.0118	0.0183	0.0301	0.0499	0.0040	0.0538	400	0.0027	0.815	0.43	177	0.44	7.25	10.50	1.74	(1.55)	5.05	11.59
9	566	10,006	10,572	128.2	1,452.3	1,580.6	35,742	354,647	390,389	0.0848	0.8415	0.9263	1.5363	0.1372	1.6735	1650	0.0007	1.227	0.78	1204	0.73	10.50	4.40	(1.55)	(1.91)	10.25	4.51
20	530	0	530	233.1	0.0	233.1	79,590	0	79,590	0.1888	0.0000	0.1888	0.3132	0.0202	0.3334	900	0.0011	0.963	0.52	467	0.52	8.13	6.11	3.13	2.54	4.01	2.58
21	537	530	1,067	101.3	233.1	334.4	34,935	79,590	114,525	0.0829	0.1888	0.2717	0.4507	0.0290	0.4797	1000	0.0010	1.027	0.61	586	0.59	6.11	7.04	2.54	2.00	2.47	3.94
22	596	1,067	1,663	18.5	334.4	352.9	5,841	114,525	120,366	0.0139	0.2717	0.2856	0.4737	0.0306	0.5043	1000	0.0010	1.042	0.64	612	0.61	7.04	8.63	2.00	1.41	3.94	6.12
23	490	1,663	2,153	38.2	352.9	391.1	12,479	120,366	132,845	0.0296	0.2856	0.3152	0.5228	0.0340	0.5567	1000	0.0010	1.068	0.71	666	0.67	8.63	8.25	1.41	0.92	6.12	6.23
29	1,077	0	1,077	134.1	0.0	134.1	35,552	0	35,552	0.0844	0.0000	0.0844	0.1399	0.0116	0.1515	600	0.0017	0.907	0.54	317	0.53	7.04	10.25	2.04	0.25	4.32	9.33
30	149	1,077	1,226	102.0	134.1	236.1	27,312	35,552	62,864	0.0648	0.0844	0.1492	0.2474	0.0205	0.2679	800	0.0013	0.949	0.53	420	0.53	10.25	8.25	0.25	0.06	9.13	7.31
31	1,139	0	1,139	91.8	0.0	91.8	25,404	0	25,404	0.0603	0.0000	0.0603	0.1000	0.0080	0.1079	500	0.0020	0.886	0.55	269	0.54	10.49	9.69	5.49	3.21	4.43	5.91
32	156	1,139	1,295	77.8	91.8	169.6	23,741	25,404	49,145	0.0563	0.0603	0.1166	0.1934	0.0147	0.2081	700	0.0014	0.933	0.54	372	0.53	9.69	8.25	1.21	0.99	7.69	6.47
24	1,863	4,674	6,537	162.4	796.8	959.2	42,410	244,854	287,264	0.1006	0.5810	0.6816	1.1304	0.0833	1.2137	1500	0.0007	1.135	0.69	973	0.65	8.25	8.25	0.06	(1.18)	6.55	7.79
33	790	0	790	154.0	0.0	154.0	30,876	0	30,876	0.0733	0.0000	0.0733	0.1215	0.0134	0.1349	600	0.0017	0.872	0.48	289	0.48	11.25	9.61	5.25	3.93	5.32	5.00
34	461	790	1,251	181.6	154.0	335.6	36,159	30,876	67,035	0.0858	0.0733	0.1591	0.2638	0.0291	0.2929	800	0.0013	0.976	0.58	451	0.56	9.61	9.25	3.93	3.36	4.80	5.01
35	937	1,251	2,188	164.8	335.6	500.4	20,865	67,035	87,900	0.0495	0.1591	0.2086	0.3459	0.0434	0.3893	900	0.0011	1.010	0.61	529	0.59	9.25	8.25	3.36	2.32	4.90	4.94
36	724	2,188	2,912	124.4	500.4	624.8	22,229	87,900	110,129	0.0527	0.2086	0.2613	0.4334	0.0542	0.4876	1000	0.0010	1.032	0.62	595	0.60	8.25	8.18	2.32	1.59	4.83	5.49
37	536	2,912	3,448	88.7	624.8	713.6	14,522	110,129	124,651	0.0345	0.2613	0.2958	0.4905	0.0619	0.5525	1000	0.0010	1.067	0.70	662	0.66	8.18	4.40	1.59	1.06	5.49	2.24
41	489	0	489	86.2	0.0	86.2	17,684	0	17,684	0.0420	0.0000	0.0420	0.0696	0.0075	0.0771	500	0.0021	0.809	0.39	207	0.41	8.27	9.25	3.27	2.24	4.43	6.44
42	174	489	663	48.3	86.2	134.6	9,658	17,684	27,342	0.0229	0.0420	0.0649	0.1076	0.0117	0.1193	500	0.0020	0.914	0.61	292	0.58	9.25	10.25	2.24	1.90	6.44	7.78
43	498	663	1,161	44.2	134.6	178.7	11,521	27,342	38,863	0.0273	0.0649	0.0922	0.1529	0.0155	0.1684	600	0.0017	0.937	0.60	345	0.58	10.25	4.40	1.90	1.07	7.67	2.65
38	58	4,609	4,667	0.0	892.3	892.3	0	163,514	163,514	0.0000	0.3880	0.3880	0.6435	0.0775	0.7209	1200	0.0008	1.072	0.64	729	0.61	4.25	7.91	0.56	0.51	2.38	6.09
39	1,042	4,667	5,709	72.1	892.3	964.5	18,101	163,514	181,615	0.0429	0.3880	0.4309	0.7147	0.0837	0.7984	1200	0.0008	1.100	0.71	796	0.66	7.91	10.25	0.51	(0.36)	6.09	9.30
44	352	0	352	325.2	0.0	325.2	30,903	0	30,903	0.0733	0.0000	0.0733	0.1216	0.0282	0.1498	600	0.0017	0.903	0.53	313	0.52	8.25	10.25	3.25	2.66	4.32	6.91
40	264	6,061	6,325	0.0	1,289.6	1,289.6	0	212,518	212,518	0.0000	0.5042	0.5042	0.8363	0.1119	0.9482	1350	0.0007	1.105	0.66	849	0.63	10.25	8.25	(0.36)	(0.56)	9.14	7.33

Flow Calculation (Cheung Aek Treatment Area) (2/2)

Sewer Number	Pipe Length			Catchment Area			Population			Sewage Flow				GWI	Q design	Proposed Sewer Dsign						Ground Level		Sewer Invert Level		Earth Covering Depth	
										Direct	Daily Average		Houly Maximum									Up Stream	Down Stream	Up Stream	Down Stream	Up Stream	Down Stream
	Direct	Up Stream	Total	Direct	Up Stream	Total	Direct	Up Stream	Total	205 lcpd	Up Stream	Total		0.0868 l/s/ha	1.00	Diameter	Gradient	Velocity	Flow Rate	Water Depth	Ratio						
	L	L_u	L_t	A	A_u	A_t	P	P_u	P_t	Q_d	Q_{DAu}	Q_{DAt}	1.66	Q_g	Q_d	D	S	V	Q_d/Q_{full}	h	h/D	EL	EL	EL	EL	GL-	GL-
	m	m	m	ha	ha	ha	persons	persons	persons	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	mm	m/m	m/s	-	mm	-	m	m	m	m	m	m
25	1,046	12,862	13,908	91.1	2,248.9	2,339.9	23,744	499,782	523,526	0.0563	1.1858	1.2422	2.0602	0.2031	2.2633	1900	0.0005	1.216	0.80	1413	0.74	8.25	9.25	(0.56)	(1.11)	6.74	8.29
45	1,044	0	1,044	149.5	0.0	149.5	8,880	0	8,880	0.0211	0.0000	0.0211	0.0349	0.0130	0.0479	400	0.0035	0.890	0.38	162	0.40	9.11	9.25	4.11	0.46	4.54	8.33
26	490	14,952	15,442	127.6	2,489.4	2,617.0	33,275	532,406	565,681	0.0790	1.2632	1.3422	2.2261	0.2272	2.4532	2000	0.0005	1.223	0.78	1457	0.73	9.25	10.78	(1.11)	(1.35)	8.18	9.96
27	1,074	15,442	16,516	60.0	2,617.0	2,677.1	15,651	565,681	581,332	0.0371	1.3422	1.3793	2.2876	0.2324	2.5200	2000	0.0005	1.228	0.80	1495	0.75	10.78	10.13	(1.35)	(1.89)	9.96	9.84
46	1,150	0	1,150	26.0	0.0	26.0	6,775	0	6,775	0.0161	0.0000	0.0161	0.0267	0.0023	0.0289	300	0.0040	0.807	0.41	128	0.43	9.25	5.87	6.25	1.65	2.64	3.86
47	360	1,150	1,510	70.8	26.0	96.7	19,482	6,775	26,257	0.0462	0.0161	0.0623	0.1033	0.0084	0.1117	500	0.0020	0.896	0.57	277	0.55	5.87	6.04	1.65	0.93	3.65	4.54
48	1,071	1,510	2,581	54.3	96.7	151.1	14,570	26,257	40,827	0.0346	0.0623	0.0969	0.1607	0.0131	0.1738	600	0.0017	0.945	0.61	353	0.59	6.04	6.45	0.93	(0.86)	4.43	6.63
49	951	2,581	3,532	70.3	151.1	221.4	18,714	40,827	59,541	0.0444	0.0969	0.1413	0.2343	0.0192	0.2535	800	0.0014	0.987	0.50	403	0.50	6.45	5.59	(0.86)	(2.19)	6.43	6.90
50	568	3,532	4,100	83.2	221.4	304.5	22,795	59,541	82,336	0.0541	0.1413	0.1954	0.3240	0.0264	0.3504	900	0.0012	1.017	0.55	485	0.54	5.59	10.13	(2.19)	(2.87)	6.79	12.01
51	318	0	318	25.4	0.0	25.4	7,116	0	7,116	0.0169	0.0000	0.0169	0.0280	0.0022	0.0302	300	0.0039	0.809	0.43	133	0.44	5.09	5.37	2.09	0.85	2.64	4.16
52	339	318	657	18.0	25.4	43.4	5,033	7,116	12,149	0.0119	0.0169	0.0288	0.0478	0.0038	0.0516	500	0.0029	0.816	0.26	154	0.31	5.37	4.74	0.85	(0.13)	3.95	4.30
53	738	657	1,395	46.1	43.4	89.5	12,888	12,149	25,037	0.0306	0.0288	0.0594	0.0985	0.0078	0.1063	600	0.0018	0.833	0.38	241	0.40	4.74	5.56	(0.13)	(1.46)	4.19	6.34
54	482	1,395	1,877	34.4	89.5	123.9	9,635	25,037	34,672	0.0229	0.0594	0.0823	0.1364	0.0108	0.1472	600	0.0017	0.898	0.52	309	0.52	5.56	10.13	(1.46)	(2.27)	6.34	11.72
28	1,039	22,493	23,532	15.8	3,105.5	3,121.3	4,426	698,340	702,766	0.0105	1.6569	1.6674	2.7655	0.2709	3.0365	2200	0.0005	1.246	0.80	1636	0.74	10.13	4.40	(2.27)	(2.74)	10.01	4.75
STP		34,104	34,104		4,701.9	4,701.9		1,093,155	1,093,155		2.5937	2.5937	4.3018	0.4082	4.7099												



Pipe Layout and Number (Tamok Treatment Area: Off-Site Treatment) (Reference)

Flow Calculation (Tamok Treatment Area) (1/3) (Reference)

Sewer Number	Number		Pipe Length			Catchment Area			Population			Sewage Flow				GWI	Q design	Proposed Sewer Dsign						Ground Level		Sewer Invert Level		Earth Covering Depth	
												Direct	Daily Average																
	Up Stream	Down Stream	Direct	Up Stream	Total	Direct	Up Stream	Total	Direct	Up Stream	Total	205 lcpd	Up Stream	Total	Houly Maximum	15%	1.00	Diameter	Gradient	Velocity	Flow Rate	Water Depth	Ratio	Up Stream	Down Stream	Up Stream	Down Stream	Up Stream	Down Stream
			L	L_u	L_t	A	A_u	A_t	P	P_u	P_t	Q_d	Q_{DAu}	Q_{DAt}	1.66	Q_g	Q_d	D	S	V	Q_d/Q_{full}	h	h/D	EL	EL	EL	EL	GL-	GL-
			m	m	m	ha	ha	ha	persons	persons	persons	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	mm	m/m	m/s	-	mm	-	m	m	m	m	m	m
1	1	2	1,356	0	1,356	303.2	0.0	303.2	33,566	0	33,566	0.0796	0.0000	0.0796	0.1321	0.0131	0.1452	600	0.0017	0.894	0.51	306	0.51	9.93	10.20	4.93	2.67	4.32	6.85
2	2	3	1,538	1,356	2,894	53.6	303.2	356.8	8,865	33,566	42,431	0.0210	0.0796	0.1007	0.1670	0.0166	0.1835	700	0.0014	0.895	0.48	337	0.48	10.20	10.78	2.67	0.47	6.74	9.52
3	3	4	596	2,894	3,490	12.8	356.8	369.6	5,627	42,431	48,058	0.0134	0.1007	0.1140	0.1891	0.0188	0.2079	700	0.0014	0.933	0.54	372	0.53	10.78	11.25	0.47	(0.38)	9.52	10.84
4	4	5	730	3,490	4,220	14.2	369.6	383.9	6,253	48,058	54,310	0.0148	0.1140	0.1289	0.2137	0.0212	0.2349	800	0.0014	0.961	0.47	379	0.47	11.25	11.25	(0.38)	(1.40)	10.75	11.77
5	5	6	630	4,220	4,850	90.7	383.9	474.6	6,343	54,310	60,653	0.0150	0.1289	0.1439	0.2387	0.0237	0.2624	800	0.0014	0.997	0.52	413	0.52	11.25	11.37	(1.40)	(2.28)	11.77	12.77
6	6	7	844	4,850	5,694	76.2	474.6	550.8	5,332	60,653	65,985	0.0127	0.1439	0.1566	0.2597	0.0258	0.2854	800	0.0014	1.025	0.57	443	0.55	11.37	10.16	(2.28)	(3.46)	12.77	12.74
7	7	8	681	5,694	6,375	112.1	550.8	662.9	7,492	65,985	73,477	0.0178	0.1566	0.1743	0.2891	0.0287	0.3178	900	0.0014	1.063	0.50	449	0.50	10.16	7.25	(3.46)	(4.42)	12.63	10.68
33	33	34	564	0	564	32.2	0.0	32.2	14,143	0	14,143	0.0336	0.0000	0.0336	0.0557	0.0055	0.0612	400	0.0025	0.821	0.49	196	0.49	8.15	9.25	3.15	1.74	4.54	7.05
34	34	35	654	564	1,218	58.8	32.2	91.0	8,853	14,143	22,996	0.0210	0.0336	0.0546	0.0905	0.0090	0.0995	500	0.0020	0.863	0.51	252	0.50	9.25	7.75	1.74	0.43	6.94	6.75
35	35	36	645	1,218	1,863	10.4	91.0	101.4	2,090	22,996	25,086	0.0050	0.0546	0.0595	0.0987	0.0098	0.1085	500	0.0020	0.888	0.55	270	0.54	7.75	8.25	0.43	(0.86)	6.75	8.54
36	36	37	554	1,863	2,417	25.4	101.4	126.8	1,777	25,086	26,863	0.0042	0.0595	0.0637	0.1057	0.0105	0.1162	500	0.0020	0.907	0.59	286	0.57	8.25	10.25	(0.86)	(1.97)	8.54	11.65
37	37	38	591	2,417	3,008	34.6	126.8	161.4	2,420	26,863	29,283	0.0057	0.0637	0.0695	0.1152	0.0114	0.1267	600	0.0019	0.910	0.45	275	0.46	10.25	7.25	(1.97)	(3.09)	11.54	9.66
38	38	8	591	3,008	3,599	62.6	161.4	224.0	4,235	29,283	33,518	0.0100	0.0695	0.0795	0.1319	0.0131	0.1450	600	0.0019	0.954	0.51	306	0.51	7.25	7.25	(3.09)	(4.21)	9.66	10.78
8	8	9	770	9,974	10,744	49.2	886.9	936.1	2,951	106,996	109,947	0.0070	0.2539	0.2609	0.4327	0.0429	0.4756	1000	0.0011	1.075	0.61	583	0.58	5.25	7.59	(4.21)	(5.06)	8.36	11.55
9	9	10	962	10,744	11,706	30.9	936.1	967.0	1,850	109,947	111,797	0.0044	0.2609	0.2653	0.4399	0.0437	0.4836	1000	0.0011	1.080	0.62	591	0.59	7.59	8.25	(5.06)	(6.12)	11.55	13.27
10	10	11	371	11,706	12,077	63.5	967.0	1,030.5	3,626	111,797	115,423	0.0086	0.2653	0.2739	0.4542	0.0451	0.4993	1000	0.0011	1.089	0.64	606	0.61	8.25	8.25	(6.12)	(6.53)	13.27	13.68
39	39	40	1,127	0	1,127	57.8	0.0	57.8	3,466	0	3,466	0.0082	0.0000	0.0082	0.0136	0.0014	0.0150	200	0.0061	0.802	0.48	96	0.48	10.25	7.88	5.25	(1.62)	4.75	9.25
40	40	11	696	1,127	1,823	119.4	57.8	177.2	6,626	3,466	10,091	0.0157	0.0082	0.0239	0.0397	0.0039	0.0437	350	0.0030	0.802	0.45	162	0.46	7.88	8.25	(1.62)	(3.71)	9.09	11.55
11	11	12	649	13,900	14,549	40.7	1,207.7	1,248.4	2,033	125,514	127,548	0.0048	0.2978	0.3026	0.5019	0.0498	0.5517	1000	0.0011	1.118	0.70	660	0.66	8.25	7.72	(6.53)	(7.24)	13.68	13.86
12	12	13	601	14,549	15,150	87.2	1,248.4	1,335.6	4,645	127,548	132,193	0.0110	0.3026	0.3137	0.5202	0.0516	0.5718	1100	0.0011	1.143	0.60	638	0.58	7.72	9.00	(7.24)	(7.90)	13.75	15.70
13	13	14	127	15,150	15,277	42.2	1,335.6	1,377.8	2,531	132,193	134,724	0.0060	0.3137	0.3197	0.5302	0.0526	0.5828	1100	0.0011	1.150	0.61	648	0.59	9.00	10.95	(7.90)	(8.04)	15.70	17.78
41	41	42	1,390	0	1,390	53.9	0.0	53.9	3,232	0	3,232	0.0077	0.0000	0.0077	0.0127	0.0013	0.0140	250	0.0067	0.805	0.28	82	0.33	8.87	12.25	6.57	(2.74)	2.00	14.69
42	42	43	393	1,390	1,783	50.2	53.9	104.1	2,815	3,232	6,047	0.0067	0.0077	0.0143	0.0238	0.0024	0.0262	300	0.0043	0.806	0.37	119	0.40	12.25	12.25	(2.74)	(4.43)	14.64	16.33
43	43	14	1,275	1,783	3,058	20.9	104.1	125.0	1,043	6,047	7,090	0.0025	0.0143	0.0168	0.0279	0.0028	0.0307	350	0.0040	0.814	0.32	124	0.35	12.25	10.95	(4.43)	(9.53)	16.27	20.07
14-1	14	14-1	353	18,335	18,688	57.8	1,502.8	1,560.5	3,251	141,814	145,066	0.0077	0.3365	0.3442	0.5709	0.0567	0.6275	1100	0.0011	1.173	0.66	688	0.63	10.95	11.32	(9.53)	(9.92)	19.28	20.04
44	55	54	733	0	733	44.9	0.0	44.9	2,695	0	2,695	0.0064	0.0000	0.0064	0.0106	0.0011	0.0117	200	0.0073	0.802	0.37	79	0.40	12.25	10.60	7.25	1.90	4.75	8.45
45	54	53	715	733	1,448	35.0	44.9	79.9	2,099	2,695	4,793	0.0050	0.0064	0.0114	0.0189	0.0019	0.0207	300	0.0051	0.803	0.29	100	0.33	10.60	11.05	1.90	(1.75)	8.34	12.44
46	53	14-1	143	1,448	1,591	50.9	79.9	130.7	3,053	4,793	7,846	0.0072	0.0114	0.0186	0.0309	0.0031	0.0339	350	0.0036	0.803	0.35	134	0.38	11.05	11.32	(1.75)	(2.26)	12.39	13.17
14-2	14-1	15	529	20,279	20,808	0.0	1,691.2	1,691.2	0	152,912	152,912	0.0000	0.3628	0.3628	0.6017	0.0597	0.6615	1100	0.0011	1.189	0.70	722	0.66	10.95	6.25	(9.92)	(10.50)	19.67	15.55
16	16	17	1,221	0	1,221	126.8	0.0	126.8	18,565	0	18,565	0.0440	0.0000	0.0440	0.0731	0.0073	0.0803	500	0.0020	0.802	0.41	214	0.43	10.25	11.25	6.25	3.81	3.43	6.87
17	17	18	1,451	1,221	2,672	70.3	126.8	197.1	6,658	18,565	25,223	0.0158	0.0440	0.0598	0.0993	0.0099	0.1091	500	0.0020	0.889	0.56	271	0.54	11.25	11.25	3.81	0.91	6.87	9.77
18	18	19	322	2,672	2,994	51.7	197.1	248.8	7,028	25,223	32,251	0.0167	0.0598	0.0765	0.1269	0.0126	0.1395	600	0.0017	0.891	0.49	296	0.49	11.25	9.21	0.91	0.36	9.66	8.17
19	19	20	496	2,994	3,490	17.8	248.8	266.5	7,871	32,251	40,122	0.0187	0.0765	0.0952	0.1579	0.0157	0.1736	700	0.0015	0.899	0.45	323	0.46	9.21	8.29	0.36	(0.39)	8.06	7.89
20	20	21	546	3,490	4,036	8.4	266.5	275.0	3,783	40,122	43,905	0.0090	0.0952	0.1042	0.1728	0.0172	0.1899	700	0.0015	0.927	0.49	346	0.49	8.29	10.25	(0.39)	(1.20)	7.89	10.66
47	44	45	434	0	434	7.5	0.0	7.5	3,282	0	3,282	0.0078	0.0000	0.0078	0.0129	0.0013	0.0142	200	0.0064	0.806	0.45	92	0.46	9.25	9.25	6.25	3.47	2.75	5.53
48	45	21	853	434	1,287	9.5	7.5	17.0	4,195	3,282	7,477	0.0100	0.0078	0.0177	0.0294	0.0029	0.0323	300	0.0037	0.806	0.46	140	0.47	9.25	10.25	3.47	0.32	5.42	9.58
21	21	22	233	5,323	5,556	15.0	292.0	307.0	6,591	51,382	57,973	0.0156	0.1219	0.1376	0.2281	0.0226	0.2508	800	0.0013	0.929	0.50	399	0.50	10.25	9.25	(1.20)	(1.50)	10.57	9.87
22	22	23	907	5,556	6,463	7.1	307.0	314.1	3,269	57,973	61,242	0.0078	0.1376	0.1453	0.2410	0.0239	0.2649	800	0.0013	0.946	0.53	416	0.52	9.25	7.24	(1.50)	(2.63)	9.87	8.99
49	46	47	1,026	0	1,026	23.1	0.0	23.1	3,137	0	3,137	0.0074	0.0000	0.0074	0.0123	0.0012	0.0136	200	0.0066	0.805	0.43	89	0.45	6.25	8.25	4.00	(2.77)	2.00	10.77
50	47	23	673	1,026	1,699	94.1	23.1	117.2	6,316	3,137	9,453	0.0150	0.0074	0.0224	0.0372	0.0037	0.0409	350	0.0032	0.810	0.43	154	0.44	8.25	7.24	(2.77)	(4.93)	10.61	11.76
PS	(Manhole Pump No. 1)																0.0409									(4.93)	(2.93)		
23	23	24	276	8,162	8,438	60.7	431.3	492.0	3,894	70,695	74,589	0.0092	0.1677	0.1770	0.2935	0.0291	0.3227	900	0.0011	0.952	0.51	454	0.50	7.24	7.83	(2.93)	(3.23)	9.18	10.07
51	48	49	962	0	962	55.4	0.0	55.4	22,986	0	22,986	0.0545	0.0000	0.0545	0.0905	0.0090	0.0994	600	0.0018	0.812	0.35	229	0.38	7.25	8.25	2.25	0.52	4.32	7.05
52	49	24	1,197	962	2,159	34.5	55.4	89.9	11,568	22,986	34,554	0.0274	0.0545	0.0820	0.1360	0.0135	0.1495	700	0.0014	0.832	0.39	288	0.41	8.25	7.83	0.52	(1.19)	6.94	8.23

Flow Calculation (Tamok Treatment Area) (2/3) (Reference)

Sewer Number	Number		Pipe Length			Catchment Area			Population			Sewage Flow				GWI	Q design	Proposed Sewer Dsign						Ground Level		Sewer Invert Level		Earth Covering Depth	
												Direct	Daily Average		Houly Maximum														
	Up Stream	Down Stream	Direct	Up Stream	Total	Direct	Up Stream	Total	Direct	Up Stream	Total	205 lcpd	Up Stream	Total	1.66	15%	1.00	Diameter	Gradient	Velocity	Flow Rate	Water Depth	Ratio	Up Stream	Down Stream	Up Stream	Down Stream	Up Stream	Down Stream
			L	L_u	L_t	A	A_u	A_t	P	P_u	P_t	Q_d	Q_{DAu}	Q_{DAt}		Q_g	Q_d	D	S	V	Q_d/Q_{full}	h	h/D	EL	EL	EL	EL	GL-	GL-
			m	m	m	ha	ha	ha	persons	persons	persons	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	mm	m/m	m/s	-	mm	-	m	m	m	m	m	m
24	24	25	821	10,597	11,418	61.7	581.9	643.6	11,670	109,143	120,813	0.0277	0.2590	0.2867	0.4754	0.0472	0.5226	1200	0.0008	0.969	0.46	564	0.47	7.83	4.25	(3.23)	(3.92)	9.75	6.85
25	25	26	82	11,418	11,500	42.8	643.6	686.4	2,505	120,813	123,318	0.0059	0.2867	0.2926	0.4853	0.0482	0.5334	1200	0.0008	0.975	0.47	572	0.48	4.25	4.75	(3.92)	(3.98)	6.85	7.42
53	50	26	619	0	619	53.8	0.0	53.8	5,560	0	5,560	0.0132	0.0000	0.0132	0.0219	0.0022	0.0241	300	0.0046	0.808	0.34	112	0.37	5.25	4.75	0.25	(2.60)	4.64	6.99
26	26	27	192	12,119	12,311	37.1	740.2	777.3	2,070	128,878	130,948	0.0049	0.3058	0.3107	0.5153	0.0512	0.5665	1200	0.0008	0.995	0.50	600	0.50	4.75	6.25	(3.98)	(4.14)	7.42	9.08
27	27	28	665	12,311	12,976	40.7	777.3	818.0	2,036	130,948	132,983	0.0048	0.3107	0.3155	0.5233	0.0519	0.5753	1200	0.0008	1.000	0.51	608	0.51	6.25	8.25	(4.14)	(4.70)	9.08	11.63
28	28	15	1,066	12,976	14,042	111.5	818.0	929.5	5,756	132,983	138,739	0.0137	0.3155	0.3292	0.5460	0.0542	0.6002	1200	0.0008	1.014	0.53	628	0.52	8.25	6.25	(4.70)	(5.59)	11.63	10.52
54	51	52	577	0	577	27.4	0.0	27.4	1,414	0	1,414	0.0034	0.0000	0.0034	0.0056	0.0006	0.0061	200	0.0121	0.801	0.19	50	0.25	8.75	8.40	3.75	(3.23)	4.75	11.38
55	52	15	245	577	822	75.6	27.4	102.9	4,452	1,414	5,866	0.0106	0.0034	0.0139	0.0231	0.0023	0.0254	300	0.0044	0.806	0.36	116	0.39	8.40	6.25	(3.23)	(4.31)	11.27	10.20
15-1	15	PS1	33	35,672	35,705	41.2	2,723.7	2,765.0	2,474	297,517	299,991	0.0059	0.7059	0.7118	1.1805	0.1172	1.2977	1500	0.0007	1.152	0.73	1033	0.69	6.25	7.26	(10.50)	(10.53)	15.11	16.15
PS	(Svay Pak)				35,705			2,765.0			299,991	0.0059	0.7059	0.7118	1.1805	0.1172	1.2977												
15-2	PS1	29	1,247	35,705	36,952	0.0	2,765.0	2,765.0	0	299,991	299,991	0.0000	0.7118	0.7118	1.1805	0.1172	1.2977	1500	0.0007	1.152	0.73	1033	0.69	7.87	7.92	4.23	3.40	2.00	2.88
29	29	30	824	36,952	37,776	33.6	2,765.0	2,798.6	1,908	299,991	301,898	0.0045	0.7118	0.7163	1.1880	0.1179	1.3060	1500	0.0007	1.153	0.74	1037	0.69	7.92	7.25	3.40	2.85	2.88	2.76
30	30	31	1,439	37,776	39,215	100.3	2,798.6	2,898.8	4,957	301,898	306,855	0.0118	0.7163	0.7281	1.2075	0.1199	1.3274	1500	0.0007	1.158	0.75	1054	0.70	7.25	9.73	2.85	1.89	2.76	6.20
56	56	57	589	0	589	45.0	0.0	45.0	2,703	0	2,703	0.0064	0.0000	0.0064	0.0106	0.0011	0.0117	200	0.0073	0.803	0.37	80	0.40	11.25	10.25	6.25	1.95	4.75	8.05
57	57	31	280	589	869	10.9	45.0	55.9	653	2,703	3,356	0.0015	0.0064	0.0080	0.0132	0.0013	0.0145	200	0.0063	0.807	0.46	94	0.47	10.25	9.73	1.95	0.19	8.05	9.29
PS	(Manhole Pump No. 2)																0.0145									0.19	1.89		
31	31	32	502	40,084	40,586	82.0	2,954.7	3,036.7	4,510	310,211	314,721	0.0107	0.7360	0.7467	1.2385	0.1229	1.3614	1650	0.0007	1.214	0.64	1002	0.61	9.73	10.40	1.89	1.54	6.04	7.06
32	32	STP	140	40,586	40,726	12.1	3,036.7	3,048.8	726	314,721	315,447	0.0017	0.7467	0.7485	1.2413	0.1232	1.3646	1650	0.0007	1.215	0.64	1005	0.61	10.40	6.25	1.54	1.45	7.06	3.00
58	59	60	888	0	888	137.8	0.0	137.8	9,635	0	9,635	0.0229	0.0000	0.0229	0.0379	0.0038	0.0417	350	0.0031	0.803	0.43	156	0.45	11.25	11.25	6.25	3.50	4.59	7.34
74	76	60	260	0	260	39.3	0.0	39.3	2,749	0	2,749	0.0065	0.0000	0.0065	0.0108	0.0011	0.0119	200	0.0072	0.802	0.38	81	0.40	10.25	11.25	5.65	3.78	4.35	7.22
59	60	61	851	1,148	1,999	24.0	177.1	201.1	1,681	12,384	14,065	0.0040	0.0294	0.0334	0.0553	0.0055	0.0608	400	0.0025	0.820	0.48	195	0.49	11.25	11.25	3.50	1.37	7.29	9.42
75	77	78	298	0	298	14.7	0.0	14.7	1,028	0	1,028	0.0024	0.0000	0.0024	0.0040	0.0004	0.0044	200	0.0159	0.806	0.14	40	0.20	10.25	9.42	8.00	3.26	2.00	5.91
76	78	61	722	298	1,020	42.8	14.7	57.5	2,996	1,028	4,024	0.0071	0.0024	0.0095	0.0158	0.0016	0.0174	250	0.0057	0.808	0.35	96	0.38	9.42	11.25	3.26	(0.85)	5.85	11.80
PS	(Manhole Pump No. 3)																0.0174									(0.85)	1.15		
60	61	62	424	3,019	3,443	89.6	258.6	348.2	6,267	18,089	24,356	0.0149	0.0429	0.0578	0.0958	0.0095	0.1054	500	0.0020	0.880	0.54	264	0.53	11.25	10.25	1.15	0.30	9.53	9.38
77	79	80	425	0	425	54.2	0.0	54.2	3,794	0	3,794	0.0090	0.0000	0.0090	0.0149	0.0015	0.0164	250	0.0059	0.805	0.33	92	0.37	9.52	9.69	7.22	4.71	2.00	4.67
78	80	81	448	425	873	44.3	54.2	98.6	3,100	3,794	6,894	0.0074	0.0090	0.0164	0.0271	0.0027	0.0298	300	0.0040	0.815	0.42	131	0.44	9.69	9.25	4.71	2.92	4.62	5.97
79	81	62	452	873	1,325	56.5	98.6	155.1	3,952	6,894	10,846	0.0094	0.0164	0.0257	0.0427	0.0042	0.0469	350	0.0030	0.823	0.49	171	0.49	9.25	10.25	2.92	1.56	5.92	8.28
80	82	83	709	0	709	32.5	0.0	32.5	2,462	0	2,462	0.0058	0.0000	0.0058	0.0097	0.0010	0.0106	200	0.0078	0.801	0.34	74	0.37	9.25	7.25	4.25	(1.28)	4.75	8.28
81	83	84	683	709	1,392	30.1	32.5	62.6	2,104	2,462	4,566	0.0050	0.0058	0.0108	0.0180	0.0018	0.0198	250	0.0052	0.809	0.40	105	0.42	7.25	6.20	(1.28)	(4.83)	8.23	10.73
82	84	85	372	1,392	1,764	42.9	62.6	105.5	3,002	4,566	7,568	0.0071	0.0108	0.0180	0.0298	0.0030	0.0327	300	0.0037	0.810	0.46	141	0.47	6.20	7.23	(4.83)	(6.21)	10.67	13.08
PS	(Manhole Pump No. 4)																0.0327									(6.21)	3.29		
83	85	86	515	1,764	2,279	116.9	105.5	222.4	9,168	7,568	16,736	0.0218	0.0180	0.0397	0.0659	0.0065	0.0724	450	0.0022	0.818	0.46	209	0.46	7.23	9.25	3.29	2.15	3.42	6.59
84	86	62	823	2,279	3,102	87.0	222.4	309.4	6,086	16,736	22,822	0.0144	0.0397	0.0541	0.0898	0.0089	0.0987	500	0.0020	0.861	0.50	251	0.50	9.25	10.25	2.15	0.50	6.53	9.18
61	62	63	886	7,870	8,756	164.1	812.7	976.8	11,477	58,024	69,501	0.0272	0.1377	0.1649	0.2735	0.0271	0.3006	800	0.0013	0.984	0.60	461	0.58	10.25	10.40	0.30	(0.81)	9.07	10.33
85	87	88	743	0	743	53.7	0.0	53.7	3,534	0	3,534	0.0084	0.0000	0.0084	0.0139	0.0014	0.0153	200	0.0060	0.801	0.49	98	0.49	9.56	9.83	7.31	2.85	2.00	6.73
86	88	63	691	743	1,434	47.5	53.7	101.2	2,932	3,534	6,465	0.0070	0.0084	0.0153	0.0254	0.0025	0.0280	300	0.0041	0.807	0.40	125	0.42	9.83	10.40	2.85	0.02	6.62	10.02
87	89	90	760	0	760	146.4	0.0	146.4	13,696	0	13,696	0.0325	0.0000	0.0325	0.0539	0.0053	0.0592	400	0.0025	0.811	0.47	191	0.48	5.00	6.25	2.54	0.64	2.00	5.15
88	90	63	776	760	1,536	67.7	146.4	214.1	4,441	13,696	18,137	0.0105	0.0325	0.0430	0.0714	0.0071	0.0785	450	0.0022	0.841	0.49	222	0.49	6.25	10.40	0.64	(1.08)	5.10	10.97

Flow Calculation (Tamok Treatment Area) (3/3) (Reference)

Sewer Number	Number		Pipe Length			Catchment Area			Population			Sewage Flow				GWI	Q design	Proposed Sewer Dsign						Ground Level		Sewer Invert Level		Earth Covering Depth	
												Direct	Daily Average		Houly Maximum														
	Up Stream	Down Stream	Direct	Up Stream	Total	Direct	Up Stream	Total	Direct	Up Stream	Total	205 lcpd	Up Stream	Total		15%	1.00	Diameter	Gradient	Velocity	Flow Rate	Water Depth	Ratio	Up Stream	Down Stream	Up Stream	Down Stream	Up Stream	Down Stream
			L	L_u	L_t	A	A_u	A_t	P	P_u	P_t	Q_d	Q_{DAu}	Q_{DAt}	1.66	Q_g	Q_d	D	S	V	Q_d/Q_{full}	h	h/D	EL	EL	EL	EL	GL-	GL-
			m	m	m	ha	ha	ha	persons	persons	persons	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	m^3/s	mm	m/m	m/s	-	mm	-	m	m	m	m	m	m
62	63	64	423	11,726	12,149	157.7	1,292.2	1,449.9	10,272	94,104	104,375	0.0244	0.2233	0.2476	0.4107	0.0408	0.4515	1000	0.0010	1.009	0.57	558	0.56	10.40	9.81	(1.08)	(1.51)	10.38	10.22
89	91	92	732	0	732	25.1	0.0	25.1	858	0	858	0.0020	0.0000	0.0020	0.0034	0.0003	0.0037	200	0.0182	0.800	0.12	35	0.18	9.15	10.25	6.90	(6.42)	2.00	16.42
90	92	93	628	732	1,360	63.8	25.1	88.9	2,177	858	3,034	0.0052	0.0020	0.0072	0.0119	0.0012	0.0131	200	0.0067	0.802	0.42	87	0.43	10.25	9.25	(6.42)	(10.63)	16.42	19.63
91	93	64	166	1,360	1,526	60.1	88.9	149.0	2,052	3,034	5,086	0.0049	0.0072	0.0121	0.0200	0.0020	0.0220	250	0.0048	0.808	0.45	115	0.46	9.25	9.81	(10.63)	(11.43)	19.58	20.93
PS	(Manhole Pump No. 5)																0.0220									(11.43)	(1.53)		
63	64	65	230	13,675	13,905	20.2	1,598.9	1,619.1	786	109,461	110,247	0.0019	0.2597	0.2616	0.4338	0.0431	0.4769	1000	0.0010	1.026	0.61	584	0.58	9.81	9.33	(1.53)	(1.76)	10.24	9.99
92	94	95	258	0	258	67.1	0.0	67.1	4,138	0	4,138	0.0098	0.0000	0.0098	0.0163	0.0016	0.0179	250	0.0055	0.803	0.36	98	0.39	8.14	9.25	3.14	1.72	4.70	7.22
93	95	65	843	258	1,101	12.2	67.1	79.3	633	4,138	4,771	0.0015	0.0098	0.0113	0.0188	0.0019	0.0206	250	0.0050	0.807	0.42	109	0.44	9.25	9.33	1.72	(2.49)	7.22	11.52
64	65	66	890	15,006	15,896	24.0	1,698.4	1,722.4	1,239	115,018	116,257	0.0029	0.2729	0.2758	0.4575	0.0454	0.5029	1000	0.0010	1.041	0.64	611	0.61	9.33	8.25	(2.49)	(3.38)	10.72	10.53
94	96	97	421	0	421	80.8	0.0	80.8	2,759	0	2,759	0.0065	0.0000	0.0065	0.0109	0.0011	0.0119	200	0.0072	0.804	0.38	81	0.40	8.71	9.25	6.46	3.43	2.00	5.57
95	97	98	622	421	1,043	36.5	80.8	117.3	1,248	2,759	4,006	0.0030	0.0065	0.0095	0.0158	0.0016	0.0173	250	0.0057	0.808	0.35	96	0.38	9.25	9.71	3.43	(0.12)	5.52	9.52
96	98	66	440	1,043	1,483	66.0	117.3	183.4	2,254	4,006	6,261	0.0053	0.0095	0.0149	0.0246	0.0024	0.0271	300	0.0043	0.816	0.38	122	0.41	9.71	8.25	(0.12)	(2.01)	9.47	9.90
65	66	67	548	17,379	17,927	46.1	1,905.8	1,951.9	1,675	122,518	124,193	0.0040	0.2907	0.2947	0.4887	0.0485	0.5372	1000	0.0010	1.059	0.68	646	0.65	8.25	9.00	(3.38)	(3.93)	10.53	11.83
66-1	67	PS2	316	17,927	18,243	95.3	1,951.9	2,047.3	4,926	124,193	129,119	0.0117	0.2947	0.3064	0.5081	0.0504	0.5585	1000	0.0010	1.069	0.71	668	0.67	9.00	9.25	(3.93)	(4.25)	11.83	12.40
97	99	100	530	0	530	57.7	0.0	57.7	1,971	0	1,971	0.0047	0.0000	0.0047	0.0078	0.0008	0.0085	200	0.0093	0.804	0.27	63	0.32	8.08	9.25	5.83	0.90	2.00	8.10
98	100	68	550	530	1,080	48.6	57.7	106.3	1,660	1,971	3,631	0.0039	0.0047	0.0086	0.0143	0.0014	0.0157	200	0.0060	0.808	0.50	100	0.50	9.25	9.25	0.90	(2.40)	8.10	11.40
66-2	68	PS2	246	1,080	1,326	47.5	106.3	153.8	1,622	3,631	5,253	0.0038	0.0086	0.0125	0.0207	0.0021	0.0227	250	0.0047	0.809	0.46	118	0.47	9.25	9.25	(2.40)	(3.56)	11.34	12.50
PS	(Khmuonh 1)				19,569			2,201.1			134,372						0.5813												
67	PS2	69	805	19,569	20,374	0.0	2,201.1	2,201.1	0	134,372	134,372	0.0000	0.3188	0.3188	0.5288	0.0525	0.5813	1000	0.0010	1.079	0.74	693	0.69	9.25	9.25	5.65	4.85	2.50	3.30
68	69	70	396	20,374	20,770	11.2	2,201.1	2,212.3	382	134,372	134,754	0.0009	0.3188	0.3197	0.5303	0.0526	0.5829	1000	0.0010	1.079	0.74	694	0.69	9.25	7.60	4.85	4.45	3.30	2.05
99	101	70	587	0	587	59.7	0.0	59.7	2,037	0	2,037	0.0048	0.0000	0.0048	0.0080	0.0008	0.0088	200	0.0090	0.801	0.28	65	0.32	7.97	7.60	5.72	0.44	2.00	6.91
PS	(Manhole Pump No. 6)																0.0088									0.44	4.44		
69	70	71	82	21,357	21,439	37.6	2,272.0	2,309.5	1,283	136,791	138,073	0.0030	0.3246	0.3276	0.5433	0.0539	0.5973	1000	0.0010	1.084	0.76	710	0.71	7.60	9.25	4.44	4.36	2.06	3.80
70	71	72	781	21,439	22,220	218.2	2,309.5	2,527.7	11,273	138,073	149,347	0.0267	0.3276	0.3544	0.5877	0.0583	0.6460	1100	0.0010	1.127	0.68	707	0.64	9.25	9.40	4.36	3.57	3.69	4.62
100	102	72	672	0	672	55.9	0.0	55.9	2,722	0	2,722	0.0065	0.0000	0.0065	0.0107	0.0011	0.0118	200	0.0073	0.805	0.37	80	0.40	8.20	9.40	5.95	1.04	2.00	8.11
PS	(Manhole Pump No. 7)																0.0118									1.04	3.54		
71	72	73	221	22,892	23,113	62.0	2,583.6	2,645.6	2,818	152,069	154,887	0.0067	0.3608	0.3675	0.6095	0.0605	0.6700	1100	0.0010	1.137	0.71	730	0.66	9.40	8.67	3.54	3.32	4.65	4.14
101	103	104	213	0	213	63.6	0.0	63.6	2,170	0	2,170	0.0051	0.0000	0.0051	0.0085	0.0008	0.0094	200	0.0086	0.801	0.30	68	0.34	8.96	9.25	6.71	4.88	2.00	4.12
102	104	73	327	213	540	46.6	63.6	110.2	1,590	2,170	3,761	0.0038	0.0051	0.0089	0.0148	0.0015	0.0163	250	0.0059	0.802	0.33	91	0.37	9.25	8.67	4.88	2.95	4.07	5.42
72	73	74	1,530	23,653	25,183	63.2	2,755.8	2,819.0	2,158	158,648	160,806	0.0051	0.3764	0.3815	0.6328	0.0628	0.6956	1100	0.0010	1.146	0.73	754	0.69	8.67	8.25	2.95	1.42	4.52	5.63
73	74	STP	224	25,183	25,407	151.4	2,819.0	2,970.4	5,170	160,806	165,976	0.0123	0.3815	0.3938	0.6531	0.0648	0.7180	1100	0.0010	1.154	0.76	776	0.71	8.25	6.25	1.42	1.19	5.63	3.85
	STP			66,133	66,133		6,019.2	6,019.2		481,423	481,423		1.1423	1.1423	1.8945	0.1881	2.0825												

Design Calculation for Cheung Aek STP (Preparatory Project Stage) (1/7)

	Item	Calculation	Remarks
1.	**Fundamentals**		
1.1	Inflow	4,600 m^3/daily average 5,000 m^3/daily maximum 7,300 m^3/hourly maximum	1.10
1.2	Influent Quality	BOD 230 mg/l (Including assumed returned load from sludge facilities) SS 250 mg/l (Ditto)	
	Wastewater Temperature(Tw)	25 Degrees C (Coldest month)	
1.3	Influent Quality (mg/l)	P.Sett,in / Re,in / Sec. Clarifier,eff BOD 230 161 17 SS 250 150 19	
	Removal Rate (%)	P.Sett / Total BOD 30 92.5 SS 40 92.5	
2.	**Wastewater Treatment Facility**		
2.1	Grit Chamber	width / length / pond W= 0.8 m × L= 2.6 m × 2 H= 1.0 m A= 4 m^2 V= 4 m^3	
	Surface Loading	Ls= Q/A 7,300 / 4 = 1,755 $m^3/(m^2 day)$	
	Average flow velocity	V= Q/(W×H) = 0.07 m/s	
	Settling time	T= W×L×H/Q = 35.9 s	
2.2	Primary Sedimentation Tank		
	Dimension	Width / Length / Depth / Pond 3.6 m× 15.0 m× 3.0 m× 2 × 1 Series	
	Area	108 m^2	
	Volume	324 m^3	
	Surface Loading	46.3 $m^3/m^2/day$	
	Settling Time	1.6 hr	
2.3	Reactor		
	Dimension	Width / Length / Depth / Pond 7.55 m× 34.0 m× 6.0 m× 1 × 1 Series	
	Area	257 m^2	
	Volume	1,542 m^3	
	HRT	7.4 hr	

Design Calculation for Cheung Aek STP (Preparatory Project Stage) (2/7)

Item	Calculation	Remarks
2.4 Final Sedimentation Tank		
Dimension	Width 3.6 m× Length 35.0 m× Depth 3.5 m× Pond 2 × 1 Series	
Area	252 m^2	
Volume	882 m^3	
Surface Loading	19.8 $m^3/m^2/day$	
Settling Time	4.2 hr	
2.5 Brower		
AOR (Actual oxygen requirement)	1) Oxygen requirement for degradation of BOD (D_B)	
	$D_B=\{(C_{BOD,in}-C_{BOD,eff})\cdot Q_{in}\cdot 10^{-3}-(L_{NOX,DN}-L_{NOX,A})\cdot K\}\cdot A$	
	= 432 kgO_2/day	
	$C_{BOD,in}$: 161 mg/l	
	$C_{BOD,eff}$: 17 mg/l	
	Qin : 5,000 m^3/day	
	$L_{NOX,DN}$: 0 kgN/day	
	$L_{NOX,A}$: 0 kgN/day	
	K : 2.50 kgBOD/kgN	
	A : 0.60 $kgO_2/kgBOD$	
	2) Oxygen requirement for endogenous respiration (D_E)	
	$D_E=B\cdot V\cdot MLVSS$	
	= 171 kgO_2/day	
	B : 0.10 $kgO_2/kgMLVSS\cdot day$	
	V : 1,542 m^3	
	MLVSS : 1,108 mg/l	
	MLSS 1,385 mg/l	
	MLVSS/MLSS : 0.80	
	3) Oxygen requirement for dissolved oxygen in the tank (D_O)	
	$D_o=C_{O.A}\cdot(Q_{in}+Q_r+Q_C)$	
	= 10.0 kgO_2/day	
	$C_{O.A}$: 1.50 mg/l	
	Q_r : 1,500 m^3/day (Amount of return sludge)	
	Return sludge ratio : 30%	
	Q_c : 0 m^3/day (Amount of circulating water)	
	AOR= $D_B+D_E+D_O$	
	613 kgO_2/day	

Design Calculation for Cheung Aek STP (Preparatory Project Stage) (3/7)

Item	Calculation	Remarks
SOR	$SOR=\frac{AOR\cdot C_{S1}\cdot\gamma}{1.024^{(T2-T1)}\cdot\alpha(\beta\cdot C_{S2}\cdot\gamma-C_O)}\cdot\frac{101.3}{P}$ = 896 kgO_2/day C_{S1} : 8.84 mg/l C_{S2} : 8.11 mg/l C_O : 1.50 mg/l α : 0.83 β : 0.95 γ : 1.218 $\gamma= 1/2\cdot(\frac{10.332+h}{10.332}+1)$ h : 4.5 m P : 101.3 Air requirement (Gs) $Gs=\frac{SOR}{E_A\cdot\rho\cdot O_w}\cdot 100\cdot\frac{273+T_2}{273}$ = 21,736 m^3/day= 15.1 m^3/min E_A : 15 % ρ : 1.293 kg/air m3N O_W : 0.232 kgO_2/kg air Air Volume required is 4.3 times of Wastewater Inflow	
Blower	m^3/min× units 20 m^3/min× 2 units (including 1 standby)	
Total capacity	20 m^3/min	OK
Power requirement	$L_{AD}=\frac{\kappa}{\kappa-1}\cdot\frac{P_S\cdot Q_S}{60}\cdot\{(P_D/P_S)^{((\kappa-1)/\kappa)}-1\}$ = 14 kw κ : 1.4 (ratio of specific heat) P_S : 101.3 kPa (absolute pressure for suction) Q_S : 15.0 m^3/min P_D : 171.3 kPa (absolute pressure for discharge) $P=\frac{L_{AD}}{\eta}\cdot\alpha$ = 28 kw α : 1.2 (margin) η : 0.6 (adiabatic efficiency)	
Power requirement	Power requirement (reference) $P_{kW}=\frac{AOR}{E_P\cdot 24}$ = 14 kW E_P : 1.8 kgO2/kWh	

Design Calculation for Cheung Aek STP (Preparatory Project Stage) (4/7)

Item	Calculation	Remarks
3. Sludge Treatment Facility		
3.1 Sludge of Primary Sedimentation Tank	Solid Quantity $5{,}000\ m^3/day \times \left(\frac{250 - 150}{1{,}000}\right)$ = 500 kg/day → 0.5 t/day Moisture Content 99 % Sludge Volume $0.5\ t/day \times \left(\frac{100}{100 - 99}\right)$ = 50 m^3/day	
3.2 Sludge of Final Sedimentation Tank	Solid Quantity $= Q_{in} \cdot (a \cdot C_{s\text{-}BOD,in} + b \cdot C_{ss,in} - c \cdot \tau \cdot X - C_{ss,out}) \cdot 10^{-3}$ a: Conversion Ration of S-BOD to Sludge(mgMLSS/mg 0.55 b: Conversion Ration of SS to Sludge(mgMLSS/mgSS) 0.95 c: Reduction Coefficient by Endogenous Respiration(1/d) 0.03 $C_{s\text{-}BOD,in}$: $C_{s\text{-}BOD,in\ of\ Reactor}$(mg/l) 107 $C_{ss,in}$: SS Conc,in of Reactor(mg/l) 150 τ: HRT(d) 0.31 X: MLSS Concentration(mg/l) 1,385 $C_{ss,out}$: SS Conc,eff of Reactor(mg/l) 19 Solid Quantity = 847 kg/day → 0.8 t/day Moisture Content 99.4 % Sludge Volume $0.8\ t/day \times \left(\frac{100}{100 - 99.4}\right)$ = 133 m^3/day	
3.3 Gravity Thickener (for Primary Sedimentation Tank)	Solid Quantity = 500 kg/day → 0.5 t/day Spec φ 3.0 m× 1 Unit D 4.0 m Area 7 m^2 Solids Loading 71 $kg/m^2/day$ Retention Time 13.4 hr Solid Recovery Rate 85% Sludge Density 3 % Solid Quantity = 0.5 t/day × 85% = 0.4 t/day Thickened Sludge Volume $0.4\ t/day \times \left(\frac{100}{100 - 97.0}\right)$ = 13 m^3/day	

Design Calculation for Cheung Aek STP (Preparatory Project Stage) (5/7)

	Item	Calculation	Remarks
3.4	Mechanical Thickener (for Primary Sedimentation Tank) Belt Type Filtering Thickening Machine	Solid Quantity = 847 kg/day → 0.8 t/day Sludge Volume = 133 m^3/day = 6 m^3/h Operating Hours 24 hr Spec 10 m^3/hr× 2 Unit(Including 1 Stand by) → 240 m^3/day Solid Recovery rate 90% Injection Ratio 0.3% Sludge Density 4 % Solid Quantity = 0.8 t/day × 90% = 0.7 t/day Thickened Sludge Volume 0.7 t/day×(100 / (100 − 96.0)) = 18 m^3/day	
3.5	Mechanical Dewatering Equipemnt (High Efficiency Screw Press Type)	Total Sludge Volume 31 m^3/day from Gravity Thickener 13 m^3/day from Mechanical Thickener 18 m^3/day Total Solid Quantity 1.1 t-DS/day from Gravity Thickener 0.4 t-DS/day from Mechanical Thickener 0.7 t-DS/day Moisture Content of Cake 76% Injection Ratio 1% Solid Recovery Rate 95% Operating Hours t= 10.0 hr If operating hours is 24, it needs to have screen washing time (6-8hours) Number of dehydrator N= 2 (Including 1 stand-by) Solids Quantity per 1 dehydrator $Q_0 = S_0 \times 1/(t \times N)$ = 110 kg･DS/h･dehydrator Q_0: Solid Quantity per one dehydrator per ho kg･DS/h･dehydrator S_0: Solid Quantity kg･DS/d Screen Diameter $A = (Q_0/Q_{100})^{\wedge(1/2.2)} \times 100$ = 428 ≒ 500 A: Diameter of Screen (mm) Q_{100}= 4.50 kg･DS/h･ϕ 100 Q_{100}: Basic dehydrated quantity on 100mm diameter of screen	

Design Calculation for Cheung Aek STP (Preparatory Project Stage) (6/7)

Item	Calculation	Remarks
Sludge Pump	N= 2 (Including 1 stand-by) Monoaxial screw sludge pump is recommended Variable delivery pump $Q_1 = S \times 100/C_0 \times 1/60 \times 10^{-3} \times k$ = 0.05 ×k = 0.03 ～ 0.08 m^3/min Q_1: Delivery quantity per sludge pump (m^3/min) S: Solid Quantity per one dehydrator per hour (kg･DS/h) C_0: Sludge density (%) k Coefficient of variable capacitance (0.5～1.5)	
Solid Quantity	= 1.1 t/day × 95% = 1.0 t/day	
Storage and Hopper	TYPE: Hopper type Sludge Cake volume Qd= 4 m^3/day Capacity of hopper Q= 4 m^3 Reserved storage time T= 24 hours Quantity of hopper N= 1	

Design Calculation for Cheung Aek STP (Preparatory Project Stage) (7/7)

	Item	Calculation	Remarks
4.	**Disinfection (Chlorine Disinfection)**		
4.1	Inflow	5,000 m^3/daily maximum	
	Dimension	Width Length Depth Channel 3.0 m× 10.0 m× 4.0 m× 1	
	Area	30 m^2	
	Volume	120 m^3	
	Contact Time (t)	34.6 min	
	Chlorine requirement	$N= N_0 \times (C_R t/b)^n$ where: C_R= Chlorine requirement b= 4.0 n= 2.8 N_0= 1.0E+07 N= 1.0E+03 C_R= 3.1 mg/L	
	NaOCl requirement	$R_{Cl,L} = Q \times C_R \times 100/C \times 1/\kappa \times 10^{-3}$ where: $R_{Cl,L}$= NaOCl requirement (1/h) Q= Inflow (m^3/h) C_R= Chlorine requirement C= Effective concentration of chlorine (12%) κ = Specific gravity of NaOCl solution (set at 1.0 for safe side) $R_{Cl,L}$= 5 L/h	

Design Calculation for Cheung Aek STP (Ultimate Stage) (1/7)

	Item	Calculation	Remarks
1.	**Fundamentals**		
1.1	Inflow	260,000 m^3/daily average 282,000 m^3/daily maximum 407,000 m^3/hourly maximum	1.10
1.2	Influent Quality	BOD 230 mg/l (Including assumed returned load from sludge facilities) SS 250 mg/l (Ditto)	
	Wastewater Temperature(Tw)	25 Degrees C (Coldest month)	
1.3	Influent Quality (mg/l)	P.Sett,in / Re,in / Sec. Clarifier,eff BOD 230 161 17 SS 250 150 19	
	Removal Rate (%)	P.Sett / Total BOD 30 92.5 SS 40 92.5	
2.	**Wastewater Treatment Facility**		
2.1	Grit Chamber	width / length / pond W= 3.0 m × L= 13.0 m × 6 H= 2.6 m A= 234 m^2 V= 608 m^3	
	Surface Loading	Ls= Q/A 407,000 / 234 = 1,739 $m^3/(m^2 day)$	
	Average flow velocity	V= Q/(W×H) = 0.42 m/s	
	Settling time	T= W×L×H/Q = 31.1 s	
2.2	Primary Sedimentation Tank		
	Dimension	Width / Length / Depth / Pond 3.6 m× 15.0 m× 3.0 m× 8 × 2 Series 5.3 m× 15.0 m× 3.0 m× 8 × 8 Series	
	Area	5,952 m^2	
	Volume	17,856 m^3	
	Surface Loading	47.4 $m^3/m^2/day$	
	Settling Time	1.5 hr	
2.3	Reactor		
	Dimension	Width / Length / Depth / Pond 7.55 m× 34.0 m× 6.0 m× 4 × 2 Series 10.95 m× 34.0 m× 6.0 m× 4 × 8 Series	
	Area	13,967 m^2	
	Volume	83,802 m^3	
	HRT	7.1 hr	

Design Calculation for Cheung Aek STP (Ultimate Stage) (2/7)

Item	Calculation	Remarks

2.4 Final Sedimentation Tank

Dimension

Width		Length		Depth		Pond		
3.6	m×	35.0	m×	3.5	m×	8	×	2 Series
5.3	m×	35.0	m×	3.5	m×	8	×	8 Series

Area 13,888 m^2

Volume 48,608 m^3

Surface Loading 20.3 $m^3/m^2/day$

Settling Time 4.1 hr

2.5 Brower

AOR (Actual oxygen requirement)

1) Oxygen requirement for degradation of BOD (D_B)

$D_B=\{(C_{BOD,in}-C_{BOD,eff})\cdot Q_{in}\cdot 10^{-3}-(L_{NOX,DN}-L_{NOX,A})\cdot K\}\cdot A$

= 24,365 kgO_2/day

$C_{BOD,in}$	:	161	mg/l
$C_{BOD,eff}$	:	17	mg/l
Qin	:	282,000	m^3/day
$L_{NOX,DN}$	:	0	kgN/day
$L_{NOX,A}$	:	0	kgN/day
K	:	2.50	kgBOD/kgN
A	:	0.60	$kgO_2/kgBOD$

2) Oxygen requirement for endogenous respiration (D_E)

$D_E=B\cdot V\cdot MLVSS$

= 9,285 kgO_2/day

B	:	0.10	$kgO_2/kgMLVSS\cdot day$
V	:	83,802	m^3
MLVSS	:	1,108	mg/l
MLSS		1,385	mg/l
MLVSS/MLSS	:	0.80	

3) Oxygen requirement for dissolved oxygen in the tank (D_O)

$D_o=C_{O.A}\cdot(Q_{in}+Q_r+Q_C)$

= 550.0 kgO_2/day

$C_{O.A}$	:	1.50	mg/l
Q_r	:	84,600	m^3/day (Amount of return sludge)
Return sludge ratio	:	30%	
Q_c	:	0	m^3/day (Amount of circulating water)

$AOR= D_B+D_E+D_O$

34,200 kgO_2/day

Design Calculation for Cheung Aek STP (Ultimate Stage) (3/7)

Item	Calculation	Remarks
SOR	$SOR=\frac{AOR\cdot C_{S1}\cdot\gamma}{1.024^{(T2-T1)}\cdot\alpha(\beta\cdot C_{S2}\cdot\gamma-C_O)}\cdot\frac{101.3}{P}$	
	= 49,980 kgO_2/day	
	C_{S1} : 8.84 mg/l	
	C_{S2} : 8.11 mg/l	
	C_O : 1.50 mg/l	
	α : 0.83	
	β : 0.95	
	γ : 1.218	
	$\gamma= 1/2\cdot(\frac{10.332+h}{10.332}+1)$	
	h : 4.5 m	
	P : 101.3	
	Air requirement (Gs)	
	$Gs=\frac{SOR}{E_A\cdot\rho\cdot O_w}\cdot 100\cdot\frac{273+T_2}{273}$	
	= 1,212,473 m^3/day= 842 m^3/min	
	E_A : 15 %	
	ρ : 1.293 kg/air m3N	
	O_W : 0.232 kgO_2/kg air	
	Air Volume required is 4.3 times of Wastewater Inflow	
Blower	90 m^3/min × 2 units	
	180 m^3/min × 5 units (including 1 standby)	
Total capacity	900 m^3/min	OK
Power requirement	$L_{AD}=\frac{\kappa}{\kappa-1}\cdot\frac{P_S\cdot Q_S}{60}\cdot\{(P_D/P_S)^{((\kappa-1)/\kappa)}-1\}$	
	= 806 kw	
	κ : 1.4 (ratio of specific heat)	
	P_S : 101.3 kPa (absolute pressure for suction)	
	Q_S : 842.0 m^3/min	
	P_D : 171.3 kPa (absolute pressure for discharge)	
	$P=\frac{L_{AD}}{\eta}\cdot\alpha$	
	= 1,612 kw	
	α : 1.2 (margin)	
	η : 0.6 (adiabatic efficiency)	
Power requirement	Power requirement (reference)	
	$P_{kW}=\frac{AOR}{E_P\cdot 24}$	
	= 792 kW	
	E_P : 1.8 kgO2/kWh	

Design Calculation for Cheung Aek STP (Ultimate Stage) (4/7)

Item	Calculation	Remarks
3. Sludge Treatment Facility		
3.1 Sludge of Primary Sedimentation Tank	Solid Quantity 282,000 m^3/day × (250 − 150 / 1,000) = 28,200 kg/day → 28.2 t/day Moisture Content 99 % Sludge Volume 28.2 t/day × (100 / 100 − 99) = 2,820 m^3/day	
3.2 Sludge of Final Sedimentation Tank	Solid Quantity $= Q_{in} \cdot (a \cdot C_{s\text{-}BOD,in} + b \cdot C_{ss,in} - c \cdot \tau \cdot X - C_{ss,out}) \cdot 10^{-3}$ a: Conversion Ration of S-BOD to Sludge(mgMLSS/mgI 0.55 b: Conversion Ration of SS to Sludge(mgMLSS/mgSS) 0.95 c: Reduction Coefficient by Endogenous Respiration(1/d) 0.03 $C_{s\text{-}BOD,in}$: $C_{s\text{-}BOD,in\ of\ Reactor}$(mg/l) 107 $C_{ss,in}$: SS Conc,in of Reactor(mg/l) 150 τ: HRT(d) 0.30 X: MLSS Concentration(mg/l) 1,385 $C_{ss,out}$: SS Conc,eff of Reactor(mg/l) 19 Solid Quantity = 47,908 kg/day → 47.9 t/day Moisture Content 99.4 % Sludge Volume 47.9 t/day × (100 / 100 − 99.4) = 7,983 m^3/day	
3.3 Gravity Thickener (for Primary Sedimentation Tank)	Solid Quantity = 28,200 kg/day → 28.2 t/day	
Spec	φ 11.0 m× 4 Unit D 4.0 m	
Area	380 m^2	
Solids Loading	74 kg/m^2/day	
Retention Time	12.9 hr	
Solid Recovery Rate	85%	
Sludge Density	3 %	
Solid Quantity	= 28.2 t/day × 85% = 24.0 t/day	
Thickened Sludge Volume	24.0 t/day x (100 / 100 − 97.0) = 800 m^3/day	

Design Calculation for Cheung Aek STP (Ultimate Stage) (5/7)

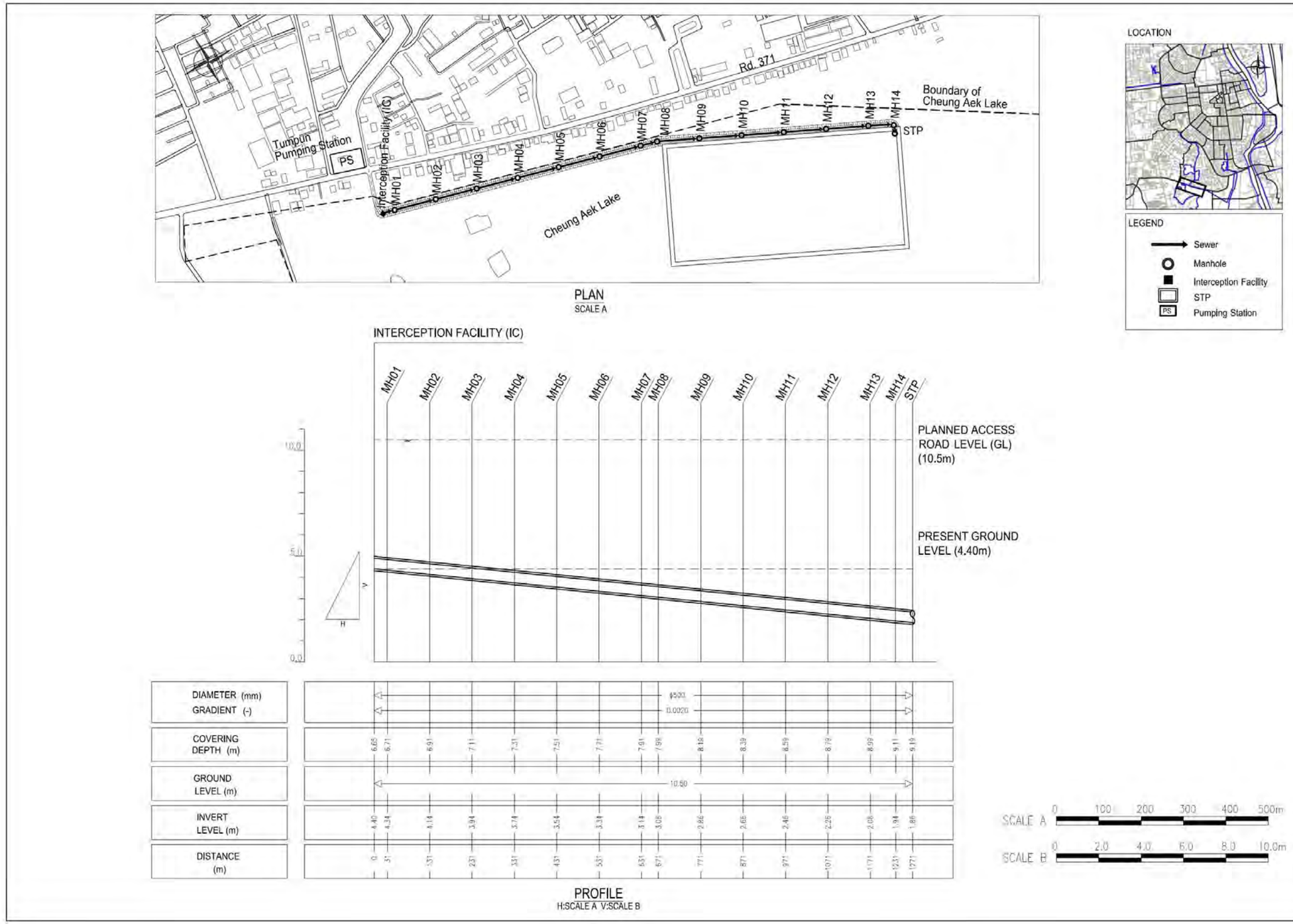
	Item	Calculation	Remarks
3.4	Mechanical Thickener (for Primary Sedimentation Tank) Belt Type Filtering Thickening Machine	Solid Quantity = 47,908 kg/day → 47.9 t/day	
		Sludge Volume = 7,983 m^3/day = 333 m^3/h	
	Operating Hours	24 hr	
	Spec	50 m^3/hr× 8 Unit(Including 1 Stand by) → 8,400 m^3/day	
	Solid Recovery rate	90%	
	Injection Ratio	0.3%	
	Sludge Density	4 %	
	Solid Quantity	= 47.9 t/day × 90% = 43.1 t/day	
	Thickened Sludge Volume	$43.1\ \text{t/day} \times \left(\frac{100}{100 - 96.0}\right)$ = 1,078 m^3/day	
3.5	Mechanical Dewatering Equipemnt (High Efficiency Screw Press Type)	Total Sludge Volume 1,878 m^3/day from Gravity Thickener 800 m^3/day from Mechanical Thickener 1,078 m^3/day	
		Total Solid Quantity 67.1 t-DS/day from Gravity Thickener 24.0 t-DS/day from Mechanical Thickener 43.1 t-DS/day	
	Moisture Content of Cake	76%	
	Injection Ratio	1%	
	Solid Recovery Rate	95%	
	Operating Hours	t= 10.0 hr If operating hours is 24, it needs to have screen washing time (6-8hours)	
	Number of dehydrator	N= 9 (Including 1 stand-by)	
	Solids Quantity per 1 dehydrator	$Q_0 = S_0 \times 1/(t \times N)$ = 839 kg･DS/h･dehydrator ⇒ 840 kg･DS/h･dehydrator	
		Q_0: Solid Quantity per one dehydrator per ho kg･DS/h･dehydrator S_0: Solid Quantity kg･DS/d	
	Screen Diameter	$A = (Q_0/Q_{100})^{\wedge(1/2.2)} \times 100$ = 1,077 ≒ 1,100 A: Diameter of Screen (mm)	
		Q_{100}= 4.50 kg･DS/h･ ϕ 100 Q_{100}: Basic dehydrated quantity on 100mm diameter of screen	

Design Calculation for Cheung Aek STP (Ultimate Stage) (6/7)

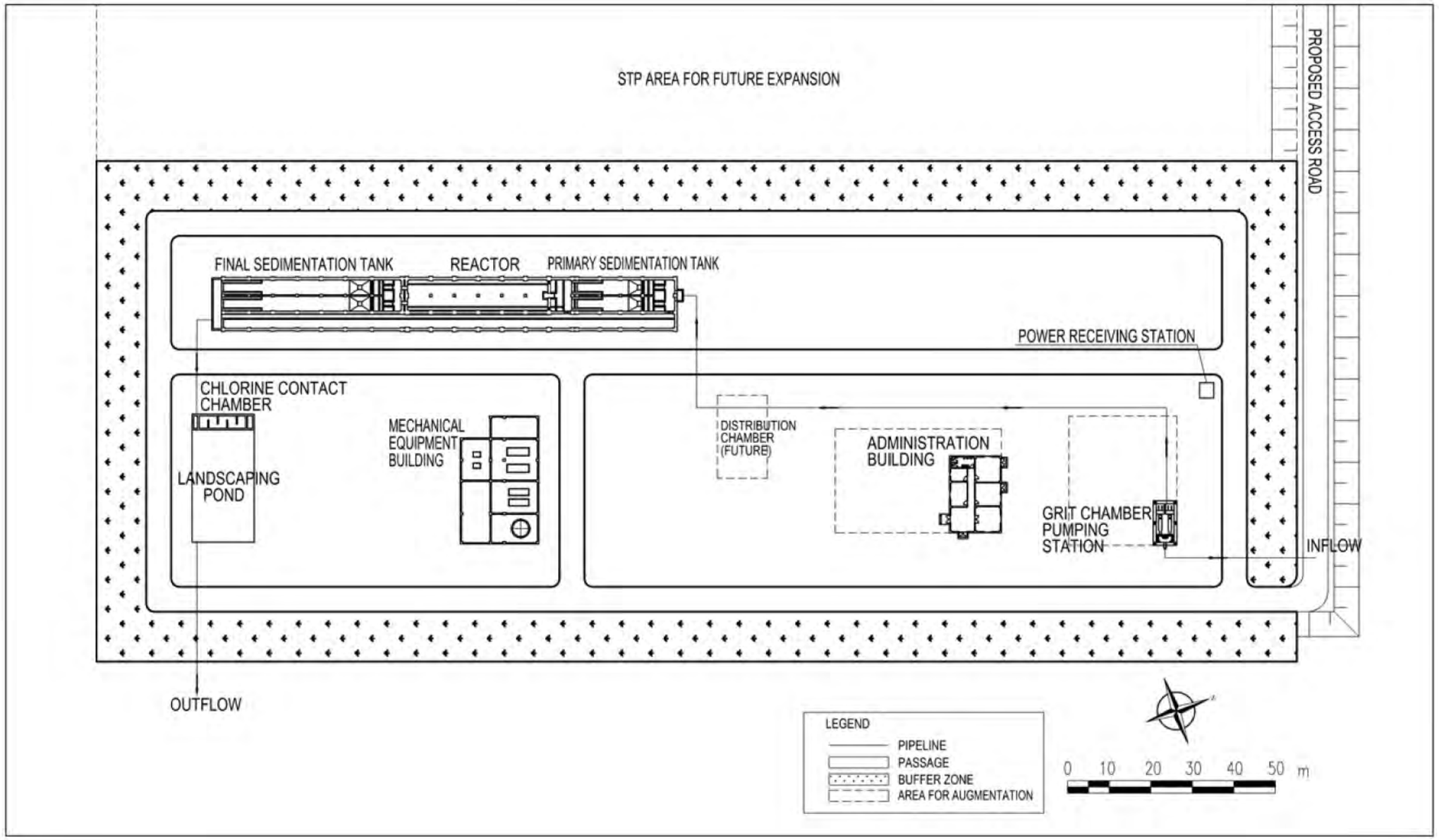
Item	Calculation	Remarks
Sludge Pump	N= 9 (Including 1 stand-by) Monoaxial screw sludge pump is recommended Variable delivery pump $Q_1 = S \times 100/C_0 \times 1/60 \times 10^{-3} \times k$ = 0.35 ×k = 0.18 ～ 0.53 m^3/min Q_1: Delivery quantity per sludge pump (m^3/min) S: Solid Quantity per one dehydrator per hour (kg･DS/h) C_0: Sludge density (%) k Coefficient of variable capacitance (0.5～1.5)	
Solid Quantity	= 67.1 t/day × 95% = 63.7 t/day	
Storage and Hopper	TYPE: Hopper type Sludge Cake volume Qd= 265 m^3/day Capacity of hopper Q= 100 m^3 Reserved storage time T= 48 hours Quantity of hopper N= 6	

Design Calculation for Cheung Aek STP (Ultimate Stage) (7/7)

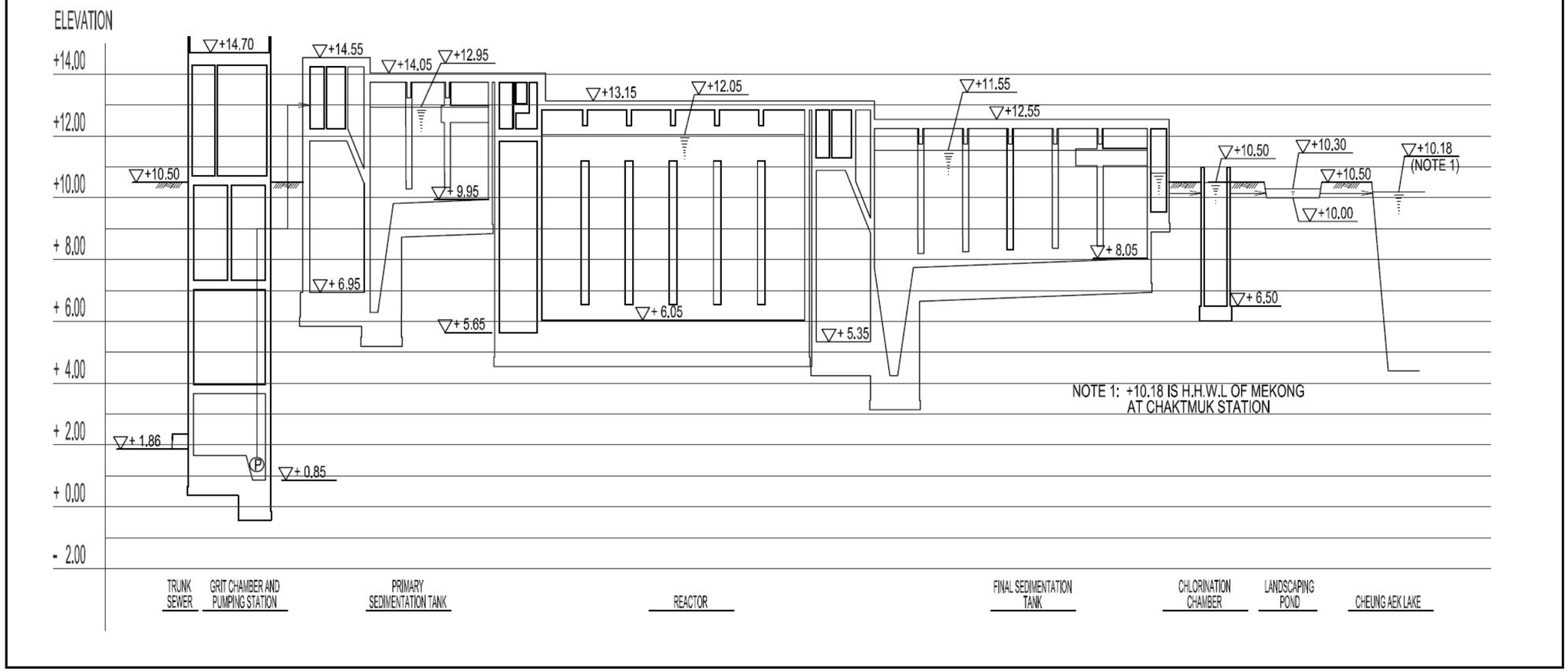
	Item	Calculation	Remarks
4.	**Disinfection (Chlorine Disinfection)**		
4.1	Inflow	282,000 m^3/daily maximum	
	Dimension	Width Length Depth Channel 30.0 m× 50.0 m× 4.0 m× 1	
	Area	1,500 m^2	
	Volume	6,000 m^3	
	Contact Time (t)	30.6 min	
	Chlorine requirement	$N= N_0 \times (C_R t/b)^n$ where: C_R= Chlorine requirement b= 4.0 n= 2.8 N_0= 1.0E+07 N= 1.0E+03 C_R= 3.5 mg/L	
	NaOCl requirement	$R_{Cl,L}= Q \times C_R \times 100/C \times 1/\kappa \times 10^{-3}$ where: $R_{Cl,L}$= NaOCl requirement (1/h) Q= Inflow (m^3/h) C_R= Chlorine requirement C= Effective concentration of chlorine (12%) κ = Specific gravity of NaOCl solution (set at 1.0 for safe side) $R_{Cl,L}$= 343 L/h	



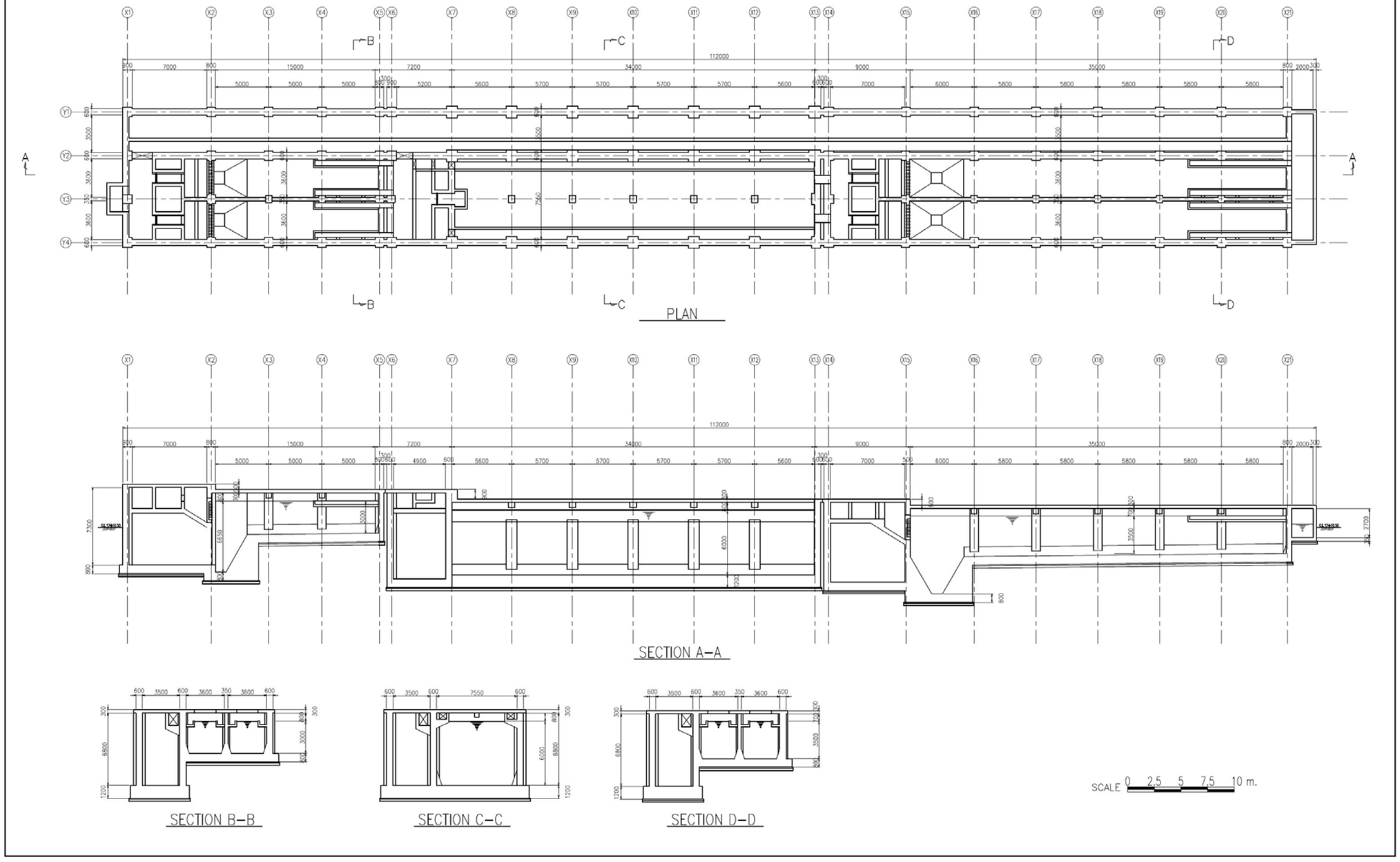
Plan and Profile of Sewer Line in the Preparatory Project



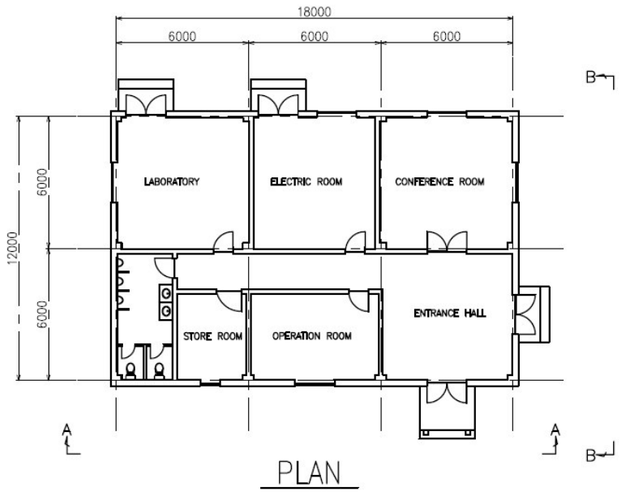
General Layout of STP constructed in the Preparatory Project



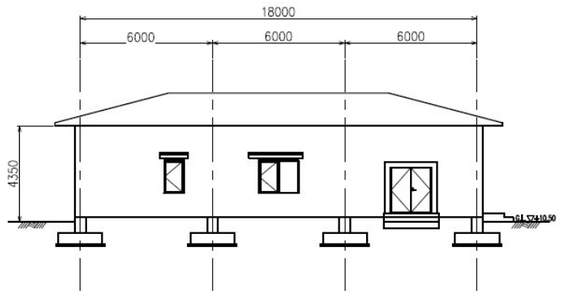
Hydraulic Profile of the Preparatory Project



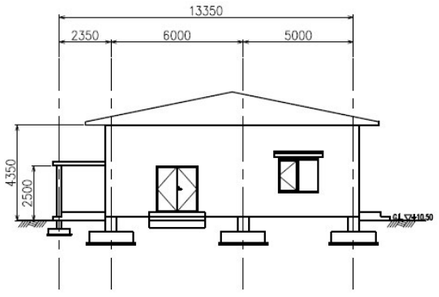
Plan and Section of Major facilities in the Preparatory Project (1/3)



PLAN

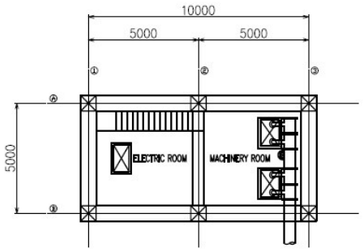


SECTION A–A

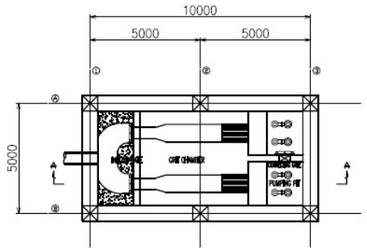


SECTION B–B

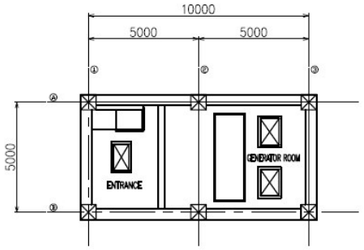
ADMINISTARATION BUILDING



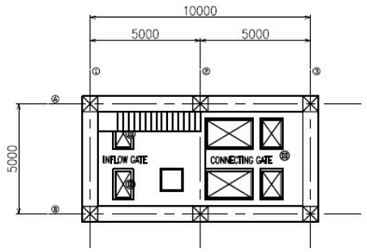
PLAN (1ST BASEMENT FLOOR)



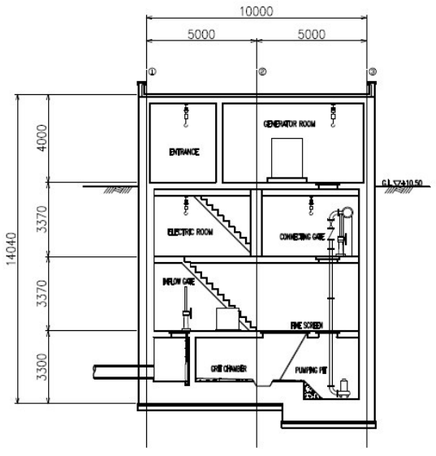
PLAN (3RD BASEMENT FLOOR)



PLAN (GROUND FLOOR)



PLAN (2ND BASEMENT FLOOR)

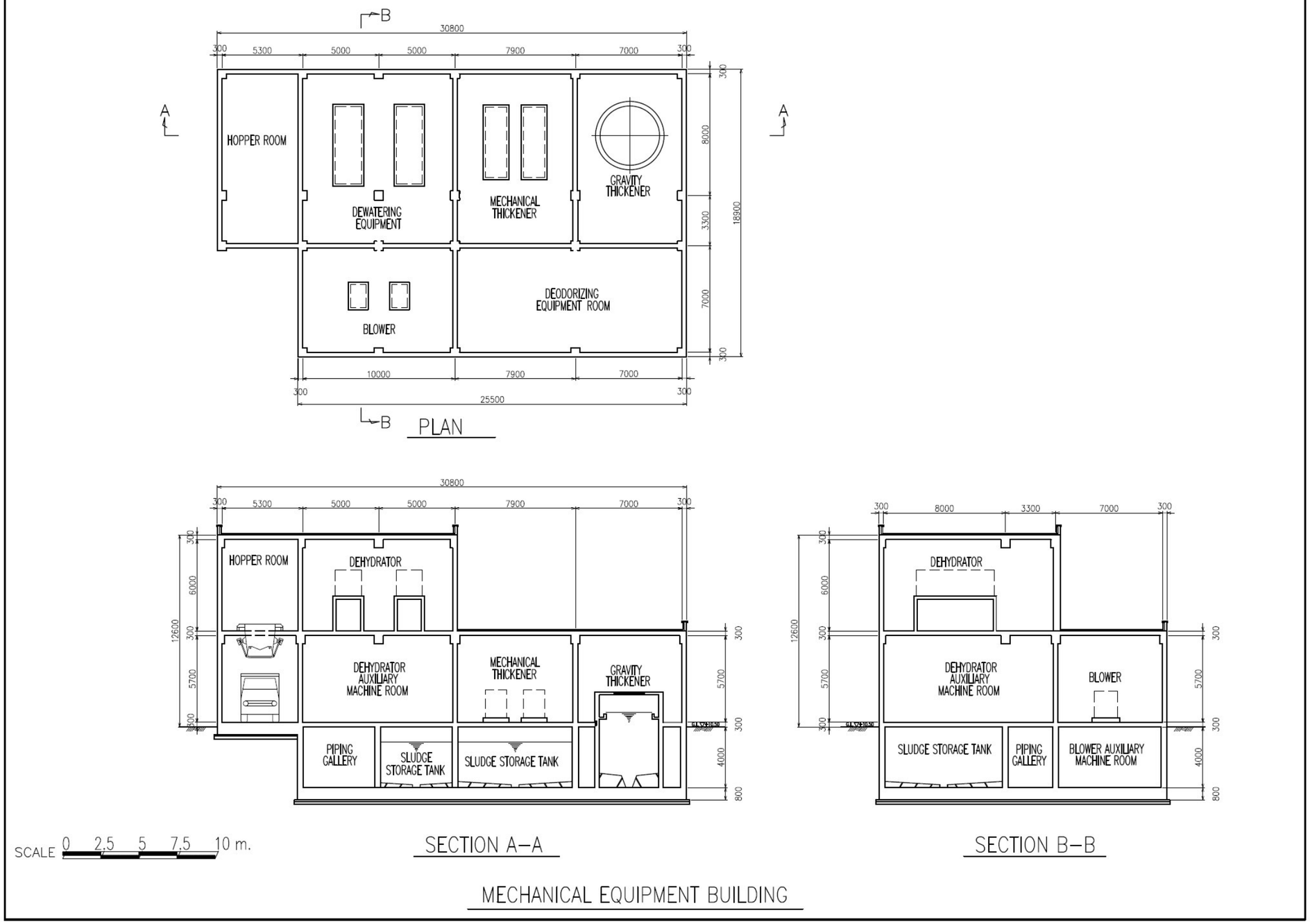


SECTION A–A

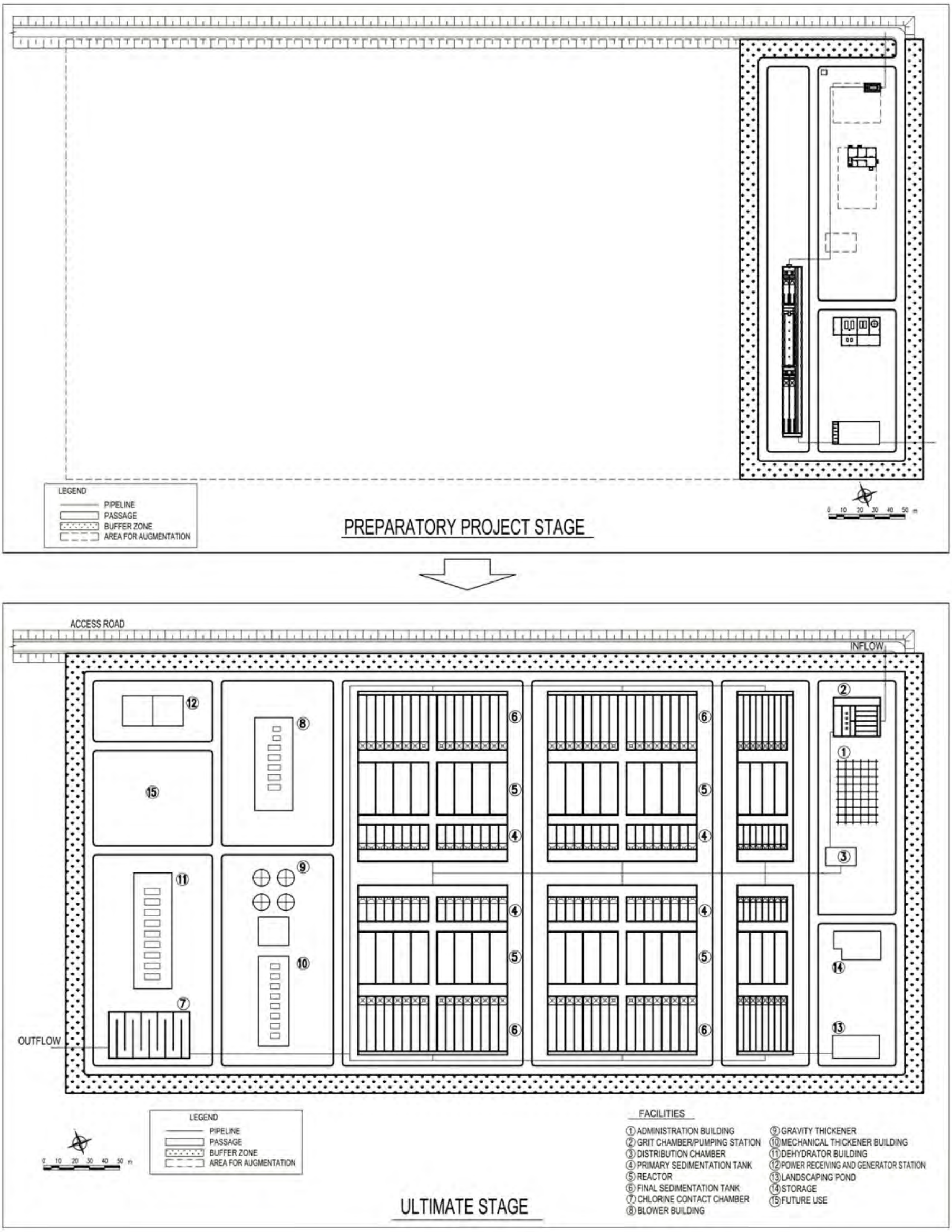
SCALE 0 2.5 5 7.5 10 m.

GRIT CHAMBER AND PUMPING STATION

Plan and Section of Major facilities in the Preparatory Project (2/3)



Plan and Section of Major facilities in the Preparatory Project (3/3)



Transition from Preparatory Project Stage to Ultimate Stage of Cheung Aek STP