

Appendix-4

Results of Runoff Analysis

Flow Calculation Table of Interceptor

Line No.	Catchment Area No.	Length (m)	Current Flow 2DWF (2020) (m ³ /s)	Planned Flow SDWF (2040) (m ³ /s)	Diameter (mm)	Slope (/)	Full Velocity (m/s)	Flow Capacity (m ³ /s)	Intercepting rate (Capacity/DW F) (-)	Pipe Invert Elevation (m)		Ground Level (m)		Klong Bottom Level (m)		Maximum Water Level (m)
										Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	
11	1	470	0.022	0.081	600	1/472	1.000	0.283	5.0	-4.810	-5.806	3.500	1.000	-2.210	-2.000	-2.650
1	1	90	0.048	0.175	600	1/472	1.000	0.283	5.0	-5.806	-5.997	1.000	1.000	-2.000	-2.000	-2.720
2	2	75	0.054	0.197	600	1/472	1.000	0.283	5.0	-5.997	-6.156	1.000	1.000	-2.000	-2.000	-2.850
3	3	145	0.058	0.213	600	1/472	1.000	0.283	5.0	-6.156	-6.463	1.000	1.000	-2.000	-2.000	-2.960
4	4	200	0.066	0.243	600	1/472	1.000	0.283	5.0	-6.463	-6.887	1.000	1.000	-2.000	-2.000	-3.070
5	5	205	0.073	0.269	600	1/472	1.000	0.283	5.0	-6.887	-7.321	1.000	1.000	-2.000	-2.000	-3.230
6	6	345	0.082	0.303	800	1/692	1.000	0.503	5.0	-7.521	-8.020	1.000	1.000	-2.000	-2.000	-3.940
To 7																
12	2	210	0.018	0.066	600	1/472	1.000	0.283	5.0	-4.600	-5.045	3.361	0.361	-2.000	-2.000	-3.760
To 13-2																
13-1	3	420	0.026	0.095	600	1/472	1.000	0.283	5.0	-4.580	-5.470	1.730	0.361	-1.980	-2.000	-3.690
13-2	4	550	0.044	0.161	600	1/472	1.000	0.283	5.0	-5.470	-6.635	3.361	1.000	-2.000	-2.000	-3.800
7	7	535	0.141	0.520	1,000	1/932	1.000	0.785	5.0	-8.220	-8.794	1.000	0.811	-2.000	-	-4.220
8-1	8	555	0.153	0.563	1,000	1/932	1.000	0.785	5.0	-8.794	-9.389	3.811	0.606	-	-	-4.410
To 8-2																
14	4	480	0.008	0.029	300	1/187	1.000	0.071	5.0	-4.850	-7.417	1.000	0.606	-2.550	-	-4.290
8-2	4	460	0.161	0.592	1,000	1/932	1.000	0.785	5.0	-9.389	-9.883	3.606	1.305	-	-	-4.730
9-1	9	230	0.181	0.671	1,000	1/932	1.000	0.785	5.0	-9.883	-10.130	1.305	0.607	-	-	-5.070
To 9-2																
15	5	135	0.009	0.037	600	1/472	1.000	0.283	5.0	-5.680	-5.966	3.692	0.607	-1.080	-	-3.500
9-2	5	1,290	0.190	0.708	1,000	1/932	1.000	0.785	5.0	-10.130	-11.514	3.607	0.773	-	-3.200	-5.520
To 17-1																
10	0	340	0.045	0.177	600	1/472	1.000	0.283	5.0	-6.180	-6.900	3.300	0.300	-3.580	-3.580	-5.320
18	8	705	0.063	0.248	600	1/472	1.000	0.283	5.0	-6.900	-8.394	3.300	0.773	-3.580	-3.380	-5.640
17-1	7	205	0.275	1.041	1,000	1/932	1.000	0.785	3.8	-11.514	-11.734	3.773	0.773	-3.380	-3.380	-6.950
To 17-2																
28	8	960	0.021	0.084	600	1/472	1.000	0.283	5.0	-4.710	-6.744	1.778	1.778	-2.110	-2.210	-4.430
22	2	305	0.057	0.226	600	1/472	1.000	0.283	5.0	-6.744	-7.390	1.778	0.773	-2.210	-3.380	-6.420
17-2		545	0.332	1.267	1,200	1/1189	1.000	1.131	4.5	-11.934	-12.592	3.773	0.773	-3.380	-3.380	-7.560
16	6	410	0.345	1.319	1,200	1/1189	1.000	1.131	4.3	-12.392	-12.737	3.773	1.693	-3.380	-2.130	-8.310
21-1	1	265	0.355	1.359	1,200	1/1189	1.000	1.131	4.2	-12.737	-12.960	1.693	1.693	-2.130	-2.130	-8.950
To 21-2																
36	6	865	0.023	0.091	600	1/472	1.000	0.283	5.0	-4.090	-5.923	3.100	1.693	-1.490	-2.130	-3.790
21-2		335	0.378	1.450	1,200	1/1189	1.000	1.131	3.9	-12.960	-13.242	1.693	1.693	-2.130	-2.130	-9.370
31	1	105	0.381	1.464	1,200	1/1189	1.000	1.131	3.9	-13.242	-13.330	1.693	0.100	-2.130	-2.130	-10.000
32	2	445	0.386	1.482	1,200	1/1189	1.000	1.131	3.8	-13.330	-13.704	3.100	0.100	-2.130	-2.810	-10.280

Flow Calculation Table of Interceptor

Line No.	Catchment Area No.	Length (m)	Current Flow 2DWF (2020) (m ³ /s)	Planned Flow SDWF (2040) (m ³ /s)	Diameter (mm)	Slope (/)	Full Velocity (m/s)	Flow Capacity (m ³ /s)	Intercepting rate (Capacity/DWF) (/)	Pipe Invert Elevation (m)		Ground Level (m)		Klong Bottom Level (m)		Maximum Water Level (m)
										Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	
33	33	305	0.390	1.496	1,200	1/1189	1.000	1.131	3.8	-13.704	-13.961	0.100	0.100	-2.810	-2.810	-10.560
To 34-1																
35	35	585	0.004	0.017	600	1/472	1.000	0.283	5.0	-4.220	-5.459	1.000	0.100	-1.620	-2.810	-4.100
34-1	34	115	0.397	1.524	1,500	1/1600	1.000	1.767	5.0	-14.261	-14.333	0.100	0.300	-2.810	-2.810	-11.000
To 34-2																
44	44	910	0.014	0.055	450	1/321	1.001	0.159	5.0	-4.000	-6.835	0.800	1.955	-1.550	-1.550	-3.750
45	45	545	0.023	0.088	450	1/321	1.001	0.159	5.0	-6.835	-8.333	1.955	0.300	-1.550	-1.550	-6.580
34-2	34-2	230	0.420	1.612	1,500	1/1600	1.000	1.767	5.0	-14.333	-14.477	0.300	0.300	-2.810	-2.420	-11.290
46-1	46	165	0.436	1.675	1,500	1/1600	1.000	1.767	5.0	-14.477	-14.580	0.300	0.300	-2.420	-2.640	-11.520
To 46-2																
52	52	760	0.065	0.254	600	1/472	1.000	0.283	5.0	-5.030	-6.640	1.000	0.300	-2.430	-2.640	-4.480
To 46-2																
67	67	280	0.048	0.188	600	1/472	1.000	0.283	5.0	-5.400	-5.993	0.500	0.500	-2.800	-2.800	-4.950
72	72	270	0.052	0.202	600	1/472	1.000	0.283	5.0	-5.993	-6.565	0.500	2.000	-2.800	-2.800	-5.630
73	73	305	0.059	0.228	600	1/472	1.000	0.283	5.0	-6.565	-7.211	2.000	2.000	-2.800	-2.800	-6.200
To 75-2																
75-1	75	210	0.019	0.075	600	1/472	1.000	0.283	5.0	-5.400	-5.845	2.000	2.000	-2.800	-2.800	-5.130
75-2	75-2	35	0.078	0.303	800	1/692	1.000	0.303	5.0	-7.411	-7.462	2.000	2.000	-2.800	-2.800	-7.140
74	74	140	0.088	0.343	800	1/692	1.000	0.303	5.0	-7.462	-7.664	2.000	1.000	-2.800	-2.160	-7.370
71	71	240	0.100	0.392	800	1/692	1.000	0.303	5.0	-7.664	-8.011	1.000	1.000	-2.160	-2.160	-7.750
70	70	1,015	0.109	0.429	800	1/692	1.000	0.303	5.0	-8.011	-9.478	1.000	0.300	-2.160	-2.640	-7.990
46-2	46-2	2,095	0.610	2.358	1,500	1/1600	1.000	1.767	3.7	-14.580	-15.889	0.300	1.133	-2.640	-	-11.650
To Nongbon WWTP																
51	51	1,170	0.024	0.093	600	1/472	1.000	0.283	5.0	-5.140	-7.619	1.000	1.000	-2.540	-2.540	-4.840
58	58	75	0.029	0.112	600	1/472	1.000	0.283	5.0	-7.619	-7.778	1.000	1.000	-2.540	-2.540	-5.840
59	59	145	0.035	0.134	600	1/472	1.000	0.283	5.0	-7.778	-8.085	1.000	1.000	-1.920	-1.920	-5.990
60	60	155	0.041	0.159	600	1/472	1.000	0.283	5.0	-8.085	-8.413	1.000	1.000	-1.920	-1.920	-6.080
61	61	110	0.047	0.181	600	1/472	1.000	0.283	5.0	-8.413	-8.646	1.000	1.000	-1.920	-1.920	-6.240
62	62	100	0.051	0.198	600	1/472	1.000	0.283	5.0	-8.646	-8.858	1.000	1.000	-1.920	-1.920	-6.400
63	63	905	0.056	0.217	600	1/472	1.000	0.283	5.0	-8.858	-10.775	1.000	1.000	-1.620	-1.620	-6.610
64	64	325	0.066	0.257	600	1/472	1.000	0.283	5.0	-10.775	-11.464	1.000	1.000	-1.620	-1.620	-6.990
65	65	600	0.074	0.287	800	1/692	1.000	0.303	5.0	-11.664	-12.531	1.000	1.000	-1.620	-1.210	-7.610
66	66	150	0.076	0.293	800	1/692	1.000	0.303	5.0	-12.531	-12.748	1.000	1.000	-1.210	-1.210	-7.930
68	68	155	0.094	0.364	800	1/692	1.000	0.303	5.0	-12.748	-12.972	1.000	1.000	-1.210	-1.210	-8.030
69	69	810	0.105	0.402	800	1/692	1.000	0.303	5.0	-12.972	-14.143	1.000	0.200	-1.210	-1.910	-8.190
To 94-2																

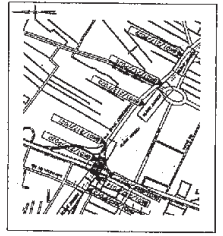
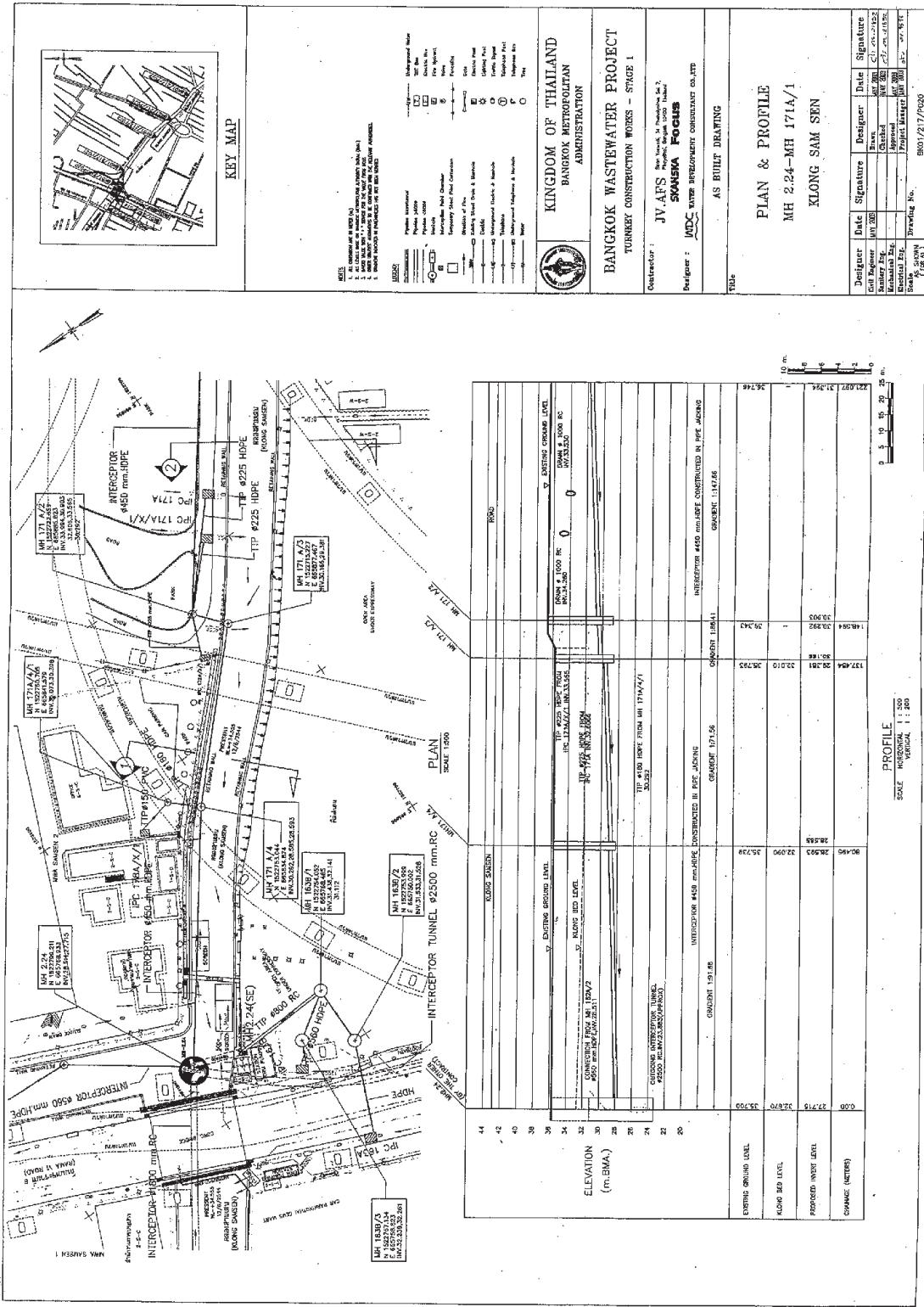
Flow Calculation Table of Interceptor

Line No.	Catchment Area No.	Length (m)	Current Flow 2DWF (2020) (m ³ /s)	Planned Flow 5DWF (2040) (m ³ /s)	Diameter (mm)	Slope (/)	Full Velocity (m/s)	Flow Capacity (m ³ /s)	Intercepting rate (Capacity/DW F)	Pipe Invert Elevation (m)		Ground Level (m)		Klong Bottom Level (m)		Maximum Water Level (m)
										Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	
86	86	1,015	0.032	0.112	600	1/472	1.000	0.283	5.0	-3.200	-5.350	1,000	2.300	-0.600	-1.980	-2.870
88	88	160	0.069	0.238	600	1/472	1.000	0.283	5.0	-5.350	-5.689	2,300	2,300	-1.980	-1.980	-4.200
89	89	435	0.081	0.278	600	1/472	1.000	0.283	5.0	-5.689	-6.611	2,300	2,300	-1.980	-1.980	-4.500
90	90	305	0.092	0.317	800	1/692	1.000	0.503	5.0	-6.811	-7.252	2,300	2,300	-1.980	-1.980	-5.400
91	91	575	0.113	0.391	800	1/692	1.000	0.503	5.0	-7.252	-8.083	2,300	2,300	-1.980	-1.980	-5.930
92	92	105	0.129	0.445	800	1/692	1.000	0.503	5.0	-8.083	-8.235	2,300	2,300	-1.980	-1.980	-6.540
93	93	730	0.146	0.503	800	1/692	1.000	0.503	5.0	-8.235	-9.290	2,300	2,300	-1.980	-1.670	-6.730
87	87	225	0.195	0.673	1,000	1/932	1.000	0.785	5.0	-9.490	-9.731	2,300	2,300	-1.670	-1.670	-8.000
94-1	94	325	0.224	0.773	1,000	1/932	1.000	0.785	5.0	-9.731	-10.080	2,300	2,300	-1.670	-1.900	-8.230
94-2	94-2	400	0.329	1.175	1,200	1/1189	1.000	1.131	4.8	-14.543	-14.879	0,200	0,200	-1.900	-1.900	-9.040
77	77	925	0.366	1.319	1,200	1/1189	1.000	1.131	4.3	-14.879	-15.657	0,200	0,500	-1.900	-1.610	-9.570
To 80																
85	85	2,110	0.046	0.180	600	1/472	1.000	0.283	5.0	-3.650	-8.120	1,000	0,800	-1.050	-1.080	-3.210
84	84	2,505	0.137	0.536	800	1/692	1.000	0.503	4.7	-8.320	-11.940	0,800	0,500	-1.080	-1.610	-7.990
80	80	430	0.522	1.928	1,500	1/1600	1.000	1.767	4.6	-15.957	-16.226	0,500	0,500	-1.610	-1.610	-11.560
79	79	305	0.532	1.969	1,500	1/1600	1.000	1.767	4.5	-16.226	-16.417	0,500	0,500	-1.610	-1.730	-11.990
To 78-2																
83	83	1,040	0.023	0.088	600	1/472	1.000	0.283	5.0	-4.330	-6.533	0,500	0,500	-1.730	-1.730	-4.040
78-1	78	80	0.033	0.126	600	1/472	1.000	0.283	5.0	-6.533	-6.702	0,500	0,500	-1.730	-1.730	-5.960
78-2	78-2	335	0.565	2.095	1,500	1/1600	1.000	1.767	4.2	-16.417	-16.626	0,500	2.171	-1.730	—	-12.390
76-1	76	985	0.617	2.297	1,500	1/1600	1.000	1.767	3.8	-16.626	-17.242	2.171	0.664	—	—	-13.740
To 76-2																
50	50	2,170	0.003	0.011	600	1/472	1.000	0.283	5.0	-4.410	-9.007	1,700	2.368	-1.810	—	-2.370
57	57	1,110	0.084	0.328	600	1/472	1.000	0.283	4.3	-9.007	-11.359	2,368	1.422	—	—	-2.370
56	56	3,235	0.134	0.523	800	1/692	1.000	0.503	4.8	-11.559	-16.234	1,422	0.452	—	—	-6.150
To 81																
82	82	295	0.032	0.201	600	1/472	1.000	0.283	5.0	-5.510	-6.135	0,452	0,452	-2.910	—	-5.040
To 81																
55	55	650	0.016	0.063	600	1/472	1.000	0.283	5.0	-5.510	-6.887	0,452	0,452	-2.910	—	-5.270
81	81	790	0.222	0.865	800	1/692	1.000	0.503	2.9	-16.234	-17.376	0,452	0.664	—	—	-11.710
76-2	76-2	505	0.839	3.162	1,500	1/1600	1.000	1.767	2.8	-18.076	-18.392	0,664	0.676	—	—	-15.360
To 53-2																
24-1	24	680	0.003	0.012	600	1/472	1.000	0.283	5.0	-6.750	-8.191	0,900	0,900	-4.150	-4.150	-4.970
To 24-2																
29	29	485	0.017	0.067	600	1/472	1.000	0.283	5.0	-4.310	-5.338	2,300	2.647	-1.710	-1.710	-4.060
23	23	490	0.058	0.228	600	1/472	1.000	0.283	5.0	-5.338	-6.376	2,647	0.900	-1.710	-4.150	-4.200

Flow Calculation Table of Interceptor (4/4)

Line No.	Catchment Area No.	Length (m)	Current Flow 2DWF (2020) (m ³ /s)	Planned Flow SDWF (2040) (m ³ /s)	Diameter (mm)	Slope (/)	Full Velocity (m/s)	Fbw Capacity (m ³ /s)	Intercepting rate (Capacity/DW F) (-)	Pipe Invert Elevation (m)		Ground Level (m)		Klong Bottom Level (m)		Maximum Water Level (m)
										Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	
24-2		300	0.061	0.240	600	1/472	1.000	0.383	5.0	-8.191	-8.827	0.900	0.900	-4.150	-3.490	-4.970
19-1	19	660	0.120	0.472	800	1/692	1.000	0.303	5.0	-9.027	-9.981	0.900	0.500	-3.490	-3.490	-5.580
To 19-2																
30	30	200	0.017	0.068	600	1/472	1.000	0.383	5.0	-6.090	-6.514	2.286	2.286	-3.490	-3.490	-5.840
25	25	405	0.029	0.117	600	1/472	1.000	0.383	5.0	-6.514	-7.372	2.286	2.286	-3.490	-3.490	-6.310
19-2	1,080	1,080	0.149	0.589	800	1/692	1.000	0.303	4.3	-9.981	-11.542	0.500	0.885	-3.490	-3.490	-6.830
To 26-1																
20	20	90	0.045	0.177	600	1/472	1.000	0.383	5.0	-1.524	-1.715	1.680	0.885	1.680	-3.490	-5.410
26-1	26	295	0.209	0.824	1,000	1/932	1.000	0.785	4.8	-11.742	-12.059	0.885	0.885	-3.490	—	-8.800
To 26-2																
49	49	2,250	0.043	0.166	600	1/472	1.000	0.383	5.0	-4.410	-9.177	1.700	1.500	-1.810	—	-3.990
27	27	1,230	0.058	0.228	600	1/472	1.000	0.383	5.0	-9.177	-11.783	1.500	0.885	—	—	-7.320
26-2	740	740	0.267	1.052	1,000	1/932	1.000	0.785	3.7	-12.183	-12.977	0.885	0.720	—	—	-9.210
To 26-3																
43	43	705	0.028	0.110	600	1/472	1.000	0.383	5.0	-4.100	-5.594	0.481	0.720	-1.500	—	-3.770
26-3	220	220	0.295	1.162	1,200	1/1189	1.000	1.131	4.9	-13.177	-13.362	0.720	2.467	—	—	-10.850
42	42	1,165	0.322	1.267	1,200	1/1189	1.000	1.131	4.5	-13.362	-14.342	2.467	2.636	—	—	-11.320
41-1	41	210	0.354	1.391	1,200	1/1189	1.000	1.131	4.1	-14.342	-14.519	2.636	0.667	—	—	-12.470
To 41-2																
48	48	260	0.022	0.084	600	1/472	1.000	0.383	5.0	-3.800	-4.351	2.750	0.664	-1.200	—	-3.520
41-2	390	390	0.376	1.475	1,200	1/1189	1.000	1.131	3.8	-14.519	-14.847	0.664	2.881	—	—	-12.800
To 40																
54	54	795	0.051	0.198	600	1/472	1.000	0.383	5.0	-4.540	-6.224	0.500	2.881	-1.940	—	-4.080
40	40	1,310	0.432	1.692	1,500	1/1600	1.000	1.767	5.0	-15.147	-15.966	2.881	1.216	—	—	-13.590
To 53-1																
39	39	295	0.015	0.056	600	1/472	1.000	0.383	5.0	-4.610	-5.235	1.000	1.000	-2.010	-2.010	-4.380
38-1	38	340	0.030	0.117	600	1/472	1.000	0.383	5.0	-5.235	-5.955	1.000	1.000	-2.010	-2.010	-4.890
To 38-2																
37	37	950	0.041	0.156	600	1/472	1.000	0.383	5.0	-4.610	-6.623	1.000	1.000	-2.010	-2.010	-4.210
38-2	260	260	0.071	0.276	600	1/472	1.000	0.383	5.0	-6.623	-7.174	1.000	1.000	-2.010	-2.010	-6.100
47	47	270	0.080	0.310	800	1/692	1.000	0.303	5.0	-7.374	-7.764	1.000	1.216	-2.010	—	-7.130
53-1	53	1,140	0.564	2.205	1,500	1/1600	1.000	1.767	4.0	-15.966	-16.679	1.216	0.676	—	—	-14.440
53-2	385	385	1.403	5.367	2,000	1/2350	1.000	3.142	2.9	-18.892	-19.056	0.676	1.133	—	—	-16.100
To Nongkhon WWTP																

Appendix-5
Photos and Sample Drawings of
Manholes in Klong



KEY MAP

- NOTES
1. ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED.
 2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE SPECIFIED.
 3. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.
 4. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE SPECIFIED.

- LEGEND
- Proposed Tunnel
 - Proposed Manhole
 - Proposed Inlet
 - Proposed Outlet
 - Proposed Valve
 - Proposed Gate
 - Proposed Check Valve
 - Proposed Air Valve
 - Proposed Vent
 - Proposed Manhole
 - Proposed Inlet
 - Proposed Outlet
 - Proposed Valve
 - Proposed Gate
 - Proposed Check Valve
 - Proposed Air Valve
 - Proposed Vent

KINGDOM OF THAILAND
BANGKOK METROPOLITAN
ADMINISTRATION

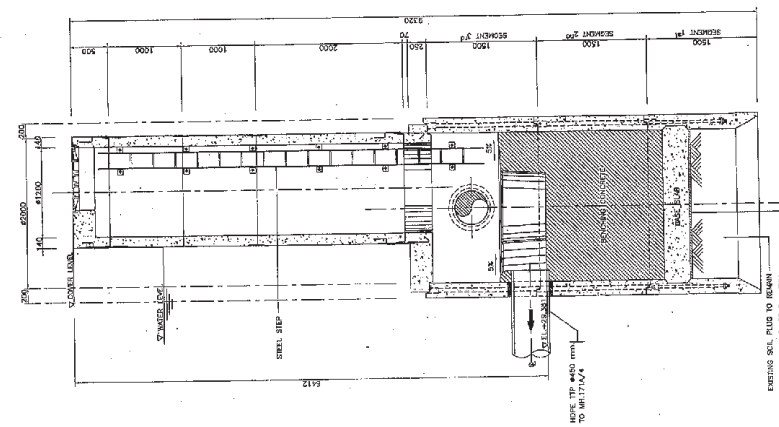
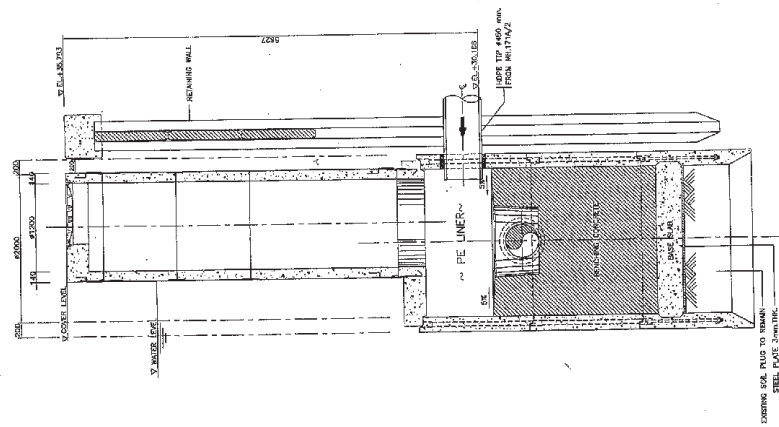
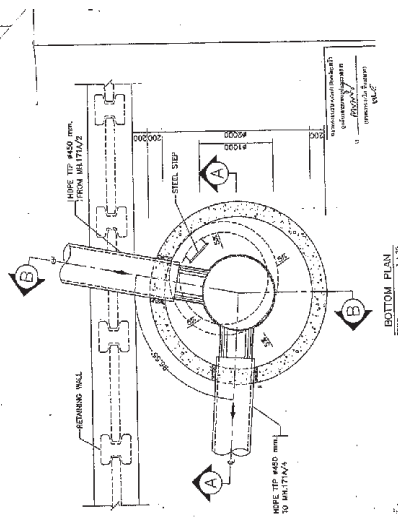
BANGKOK WASTEWATER PROJECT
TURNKEY CONSTRUCTION WORKS - STAGE 1

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Designer: JVC WATER DEVELOPMENT CONSULTANT CO., LTD.
SANGSA FOCUS

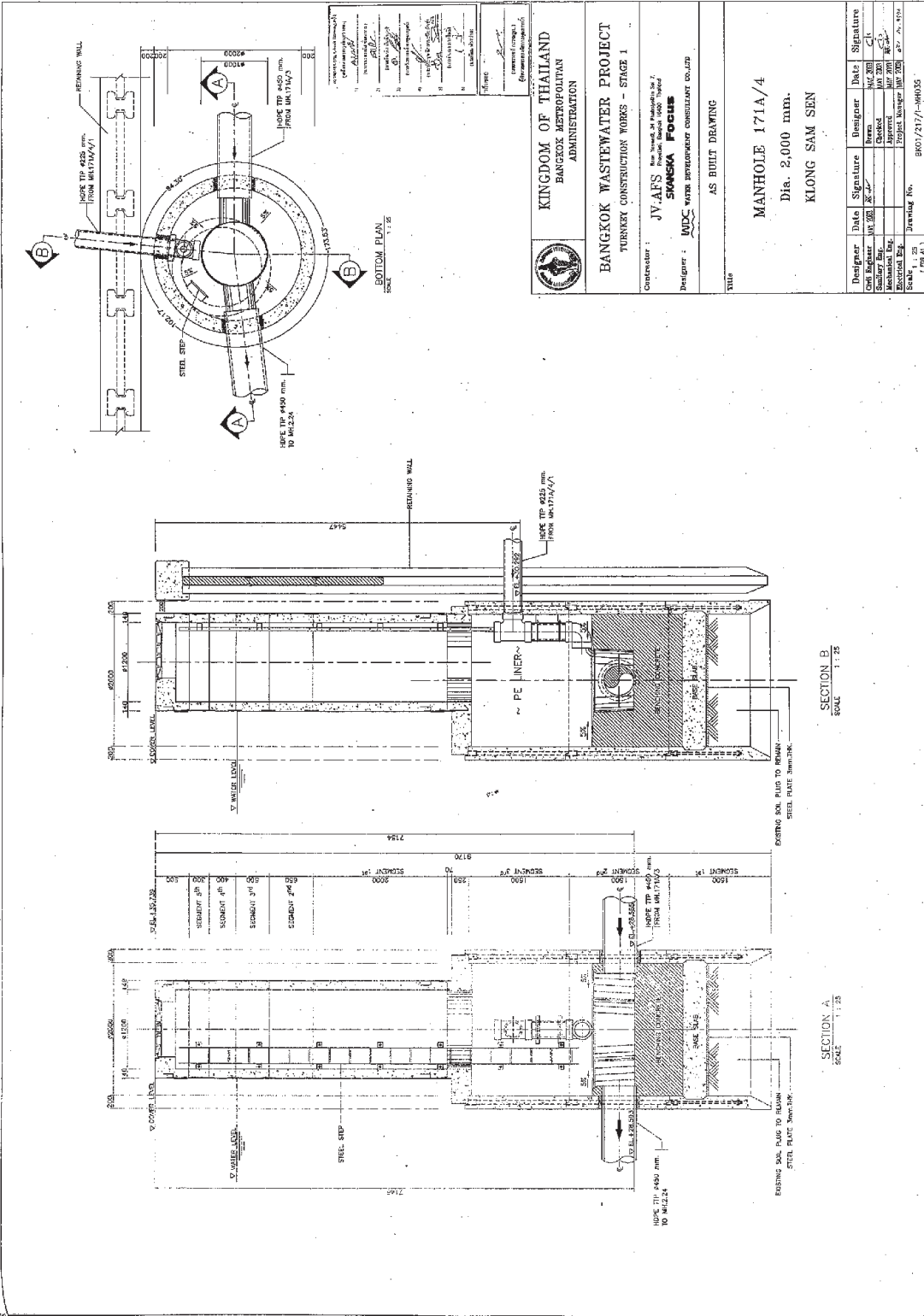
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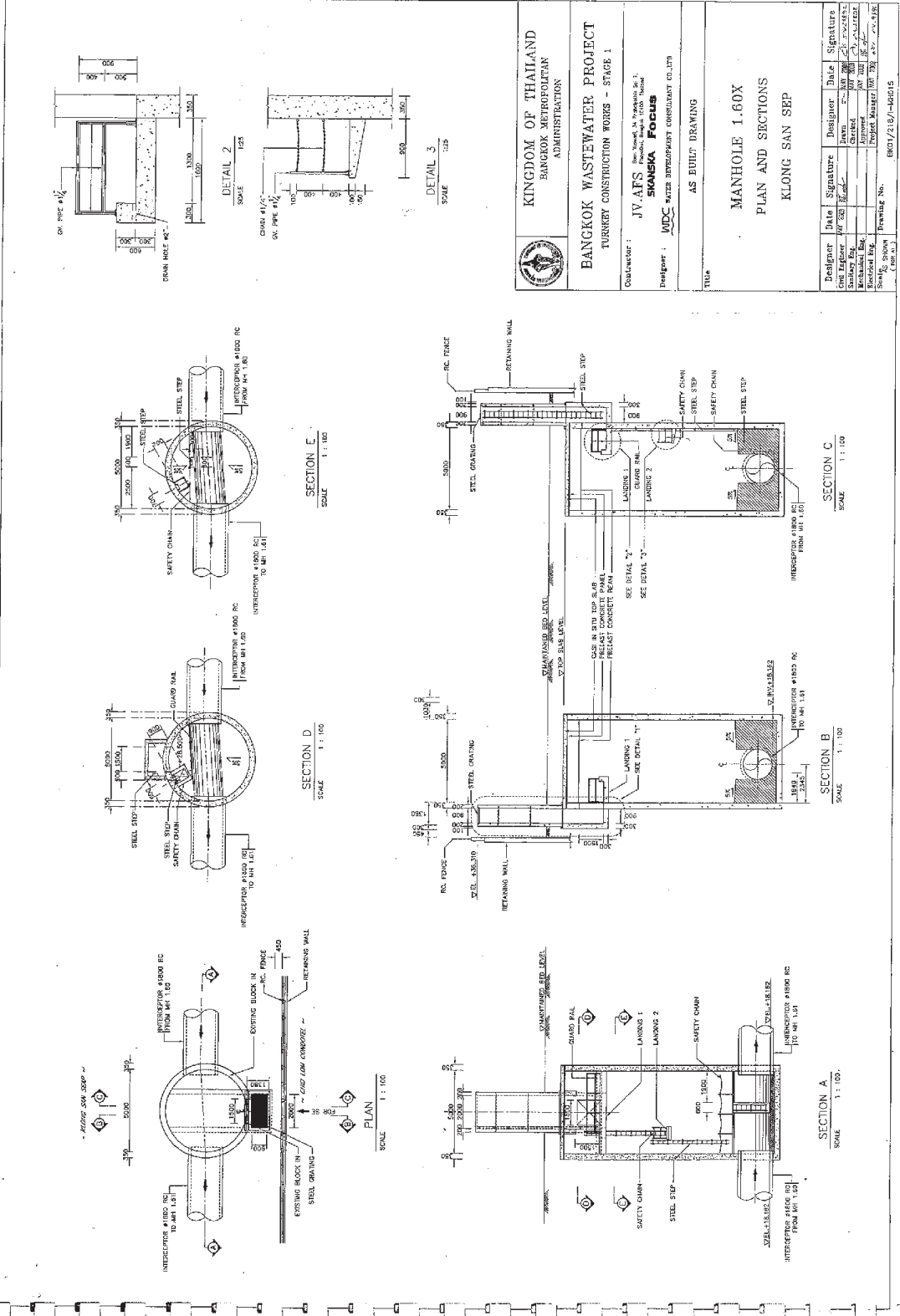
PLAN & PROFILE
MH 2.24-MH 171A/1
KLONG SAM SEN


Designer	Date	Signature	Date	Signature
Chief Engineer	10/20/20	[Signature]	10/20/20	[Signature]
Senior Engineer	10/20/20	[Signature]	10/20/20	[Signature]
Engineer	10/20/20	[Signature]	10/20/20	[Signature]
Assistant Engineer	10/20/20	[Signature]	10/20/20	[Signature]
Surveyor	10/20/20	[Signature]	10/20/20	[Signature]
Checker	10/20/20	[Signature]	10/20/20	[Signature]
Project Manager	10/20/20	[Signature]	10/20/20	[Signature]



		KINGDOM OF THAILAND BANGKOK METROPOLITAN ADMINISTRATION	
BANGKOK WASTEWATER PROJECT TURKEY CONSTRUCTION WORKS - STAGE 1			
CUSTOMER : JV AFS (Joint Venture of AEC Co., Ltd. and Samsang Engineering Co., Ltd.)		DESIGNER : JCDC (Joint Venture of JGC Corporation and Samsang Engineering Co., Ltd.)	
CONTRACT NO. : AS BUILT DRAWING		PROJECT NO. : 8001/217/-MPC034	
DRAWING NO. : MANHOLE 171A/3		SCALE : 1:25	
Designer Date Signature	Designer Date Signature	Checker Date Signature	Checker Date Signature
Civil Engineer Date Signature	Civil Engineer Date Signature	Mechanical Eng. Date Signature	Mechanical Eng. Date Signature
Project Manager Date Signature	Project Manager Date Signature	Project Manager Date Signature	Project Manager Date Signature






KINGDOM OF THAILAND
 BANGKOK METROPOLITAN
 ADMINISTRATION

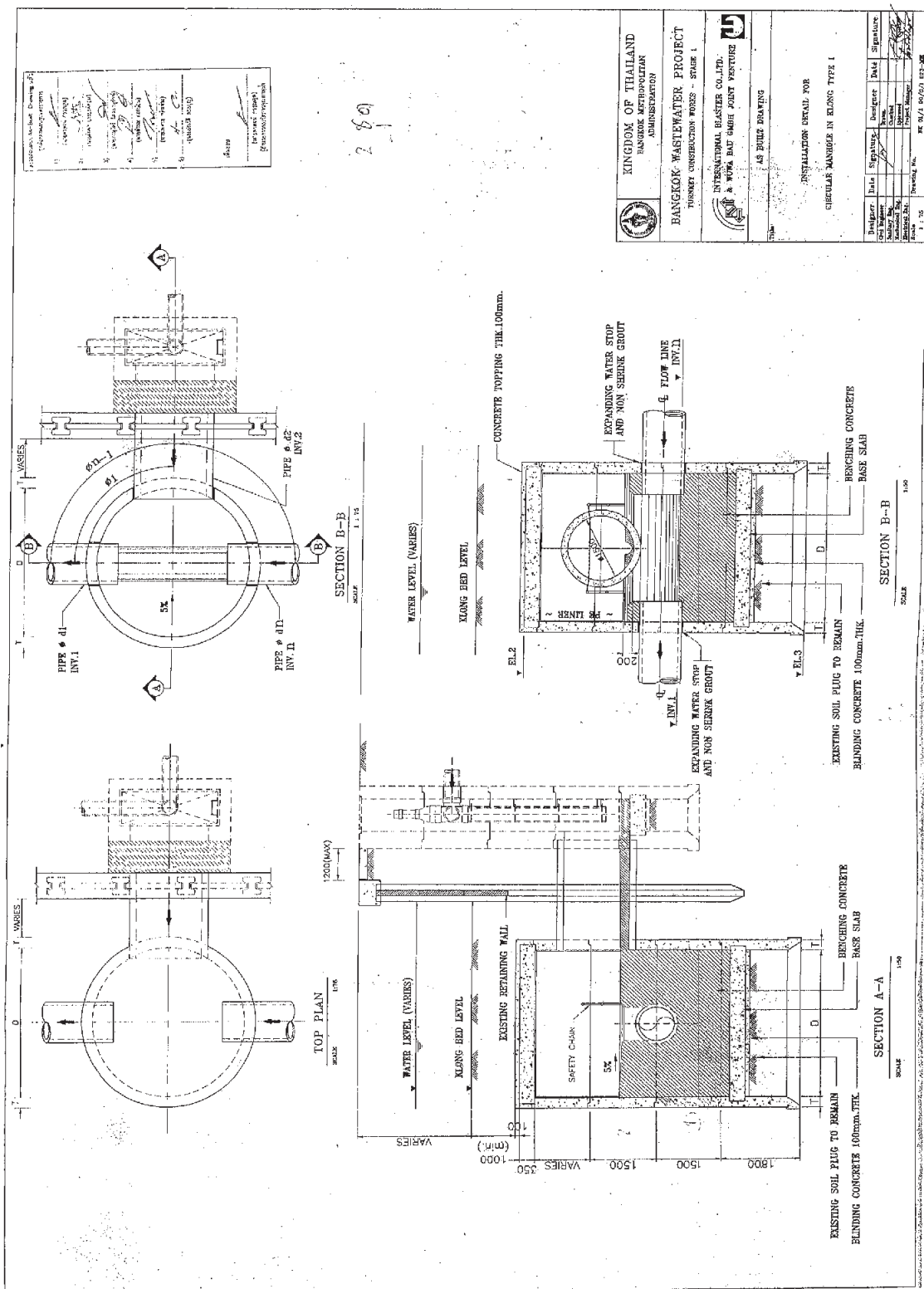
BANGKOK WASTEWATER PROJECT
 TURKEY CONSTRUCTION WORKS - STAGE 1

Collaborator : **JV AFS** (Assoc. of Architects, Engineers, Planners & Surveyors)
SKANSKA Focus
 Designer : **WDC** WATER DESIGN CONSULTANTS CO., LTD.
 AS BUILT DRAWING

MANHOLE 1.60X
 PLAN AND SECTIONS
 KLONG SAN SEP

Designer	Date	Signature	Designer	Date	Signature
Structural Eng.	17/02/2016	[Signature]	Structural Eng.	17/02/2016	[Signature]
Mechanical Eng.	17/02/2016	[Signature]	Mechanical Eng.	17/02/2016	[Signature]
Electrical Eng.	17/02/2016	[Signature]	Electrical Eng.	17/02/2016	[Signature]
Sanitary Eng.	17/02/2016	[Signature]	Sanitary Eng.	17/02/2016	[Signature]

Drawing No. : **8007/218/-400015**
 (REV. 1)



Professional Engineer Drawing (PE)

1. Design/Drawn	2. Checked	3. Approved	4. Reviewed	5. Verified	6. Inspected	7. Approved	8. Issued

DATE: 28/01/2024

PROJECT: BANGKOK WASTEWATER PROJECT

280

KINGDOM OF THAILAND
BANGKOK METROPOLITAN
ADMINISTRATION

BANGKOK WASTEWATER PROJECT
 TURNKEY CONSTRUCTION WORKS - STAGE 1

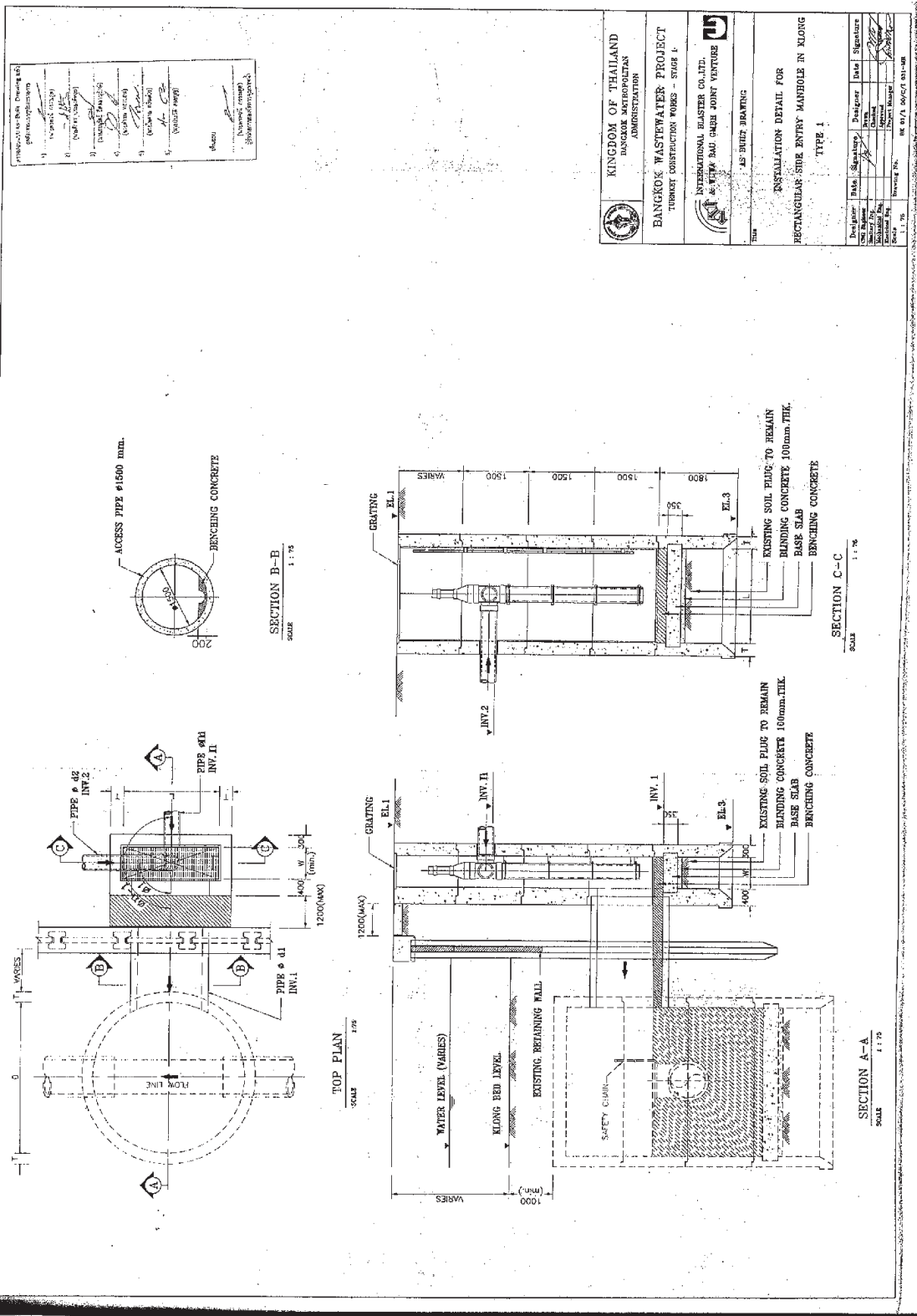
INTERNATIONAL BLASTER CO., LTD.
 & WATA BUD GAGH JOINT VENTURE

AS BUILT DRAWING

INSTALLATION DETAILS FOR
 CIRCULAR MANHOLE IN BLDG TYPE 1

Designer	Date	Supervisor	Engineer	Date	Signature
Checked		Checked			
Approved		Approved			

Drawing No. BK-W/1/06/01/003-008



KINGDOM OF THAILAND
BANGKOK METROPOLITAN
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BANGKOK WASTEWATER PROJECT
TURBID CONSTRUCTION WORKS - STAGE 1

INTERNATIONAL ELASTER CO. LTD.
& **PT. PRAJASRI JOINT VENTURE**

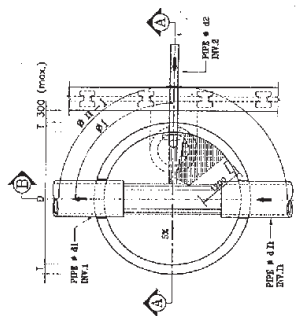
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**INSTALLATION DETAIL FOR
RECTANGULAR SIDE ENTRY MANHOLE IN LONG
TYPE 1**

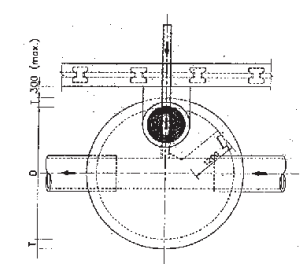
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Revision No.	Revision No.	Revision No.	Revision No.	Revision No.

REV 01/A 006/A 01-08

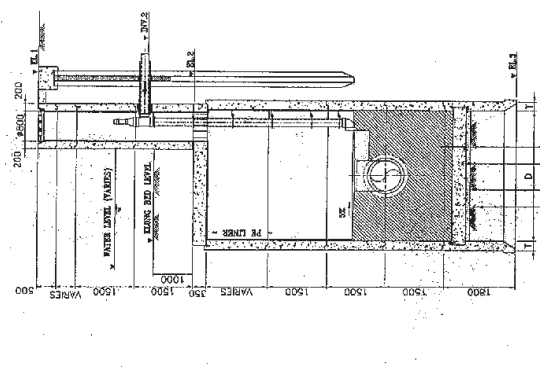
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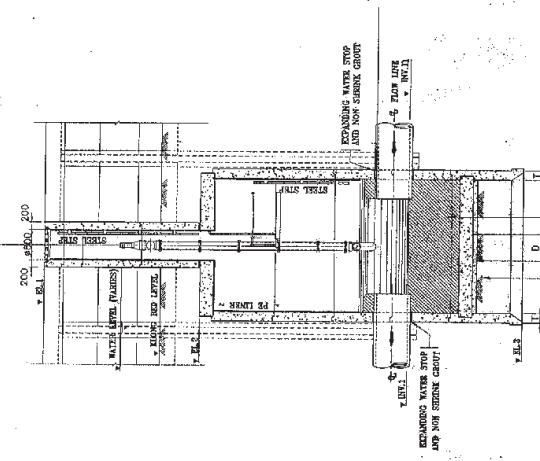
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SCALE 1:50



BOTTOM PLAN
SCALE 1:50



SECTION A-A
SCALE 1:50

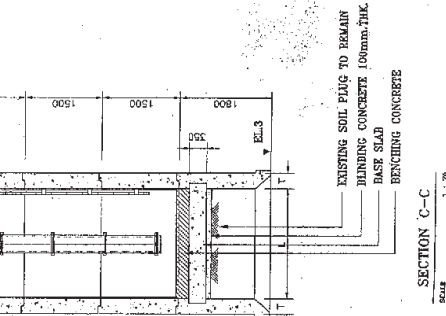
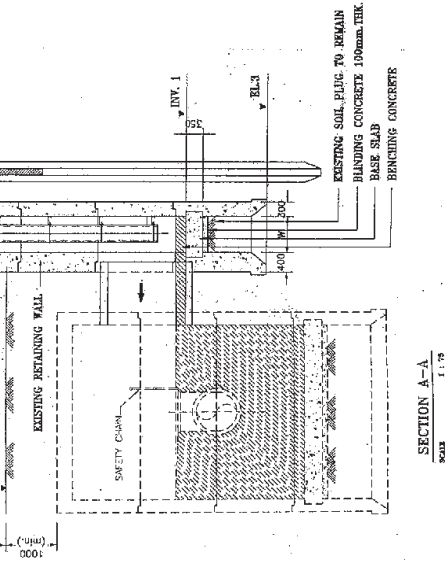
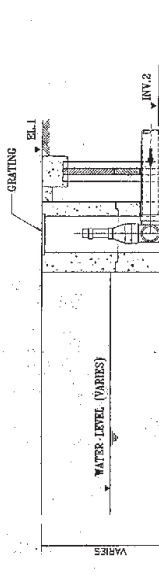
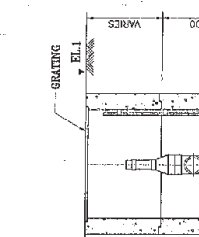
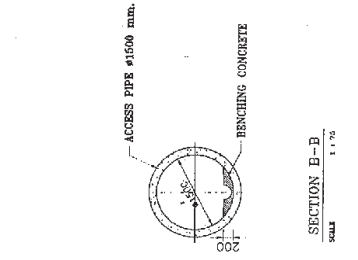


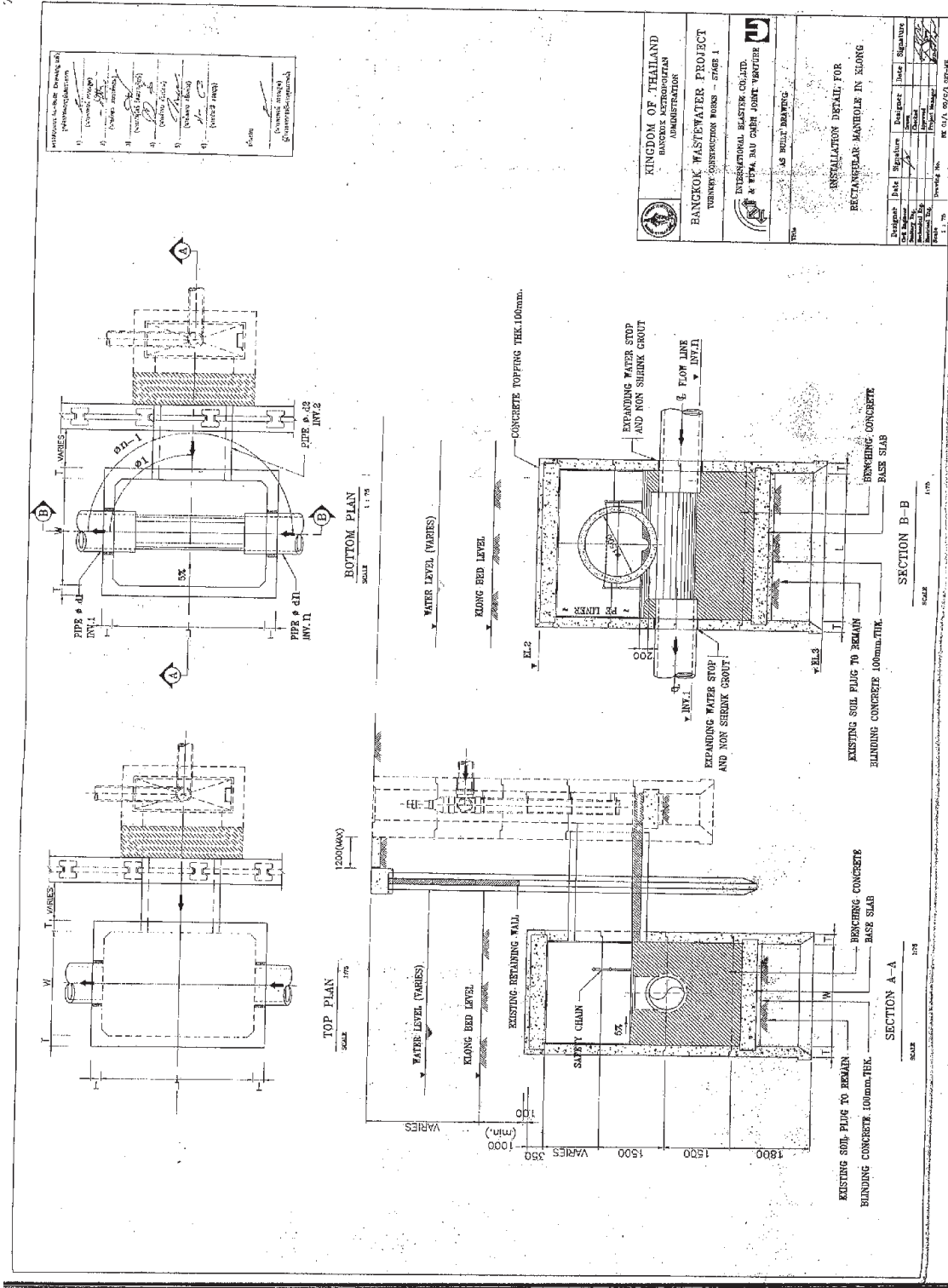
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AS BUILT DRAWING		INSTALLATION DETAIL FOR CIRCULAR MANHOLE WITH SIDE ENTRY TYPE II	
Designer Date Checked Approved Project Manager	Structural Date Checked Approved Project Manager	Producer Date Checked Approved Project Manager	Signature Date Checked Approved Project Manager
Scale 1 : 50		No. 31/1 89/CA 83-88	

Approved for Bid Drawing of
 Construction
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		KINGDOM OF THAILAND BANGKOK METROPOLITAN ADMINISTRATION	
		BANGKOK WASTEWATER PROJECT TURNKEY CONSTRUCTION WORKS - STAGE 1	
		INTERNATIONAL PLASTER CO., LTD. M. WIPHA BUI GROUP JOINT VENTURE	
		AS HIGHER DRAWING	
INSTALLATION DETAIL FOR RECTANGULAR SUB ENTRY MANHOLE IN KLONG TYPE II			
Designer	Drawn	Checked	Signature
Scale	Scale	Scale	Scale
Revision No.	Revision No.	Revision No.	Revision No.
Project No.	Project No.	Project No.	Project No.
Drawn By	Drawn By	Drawn By	Drawn By
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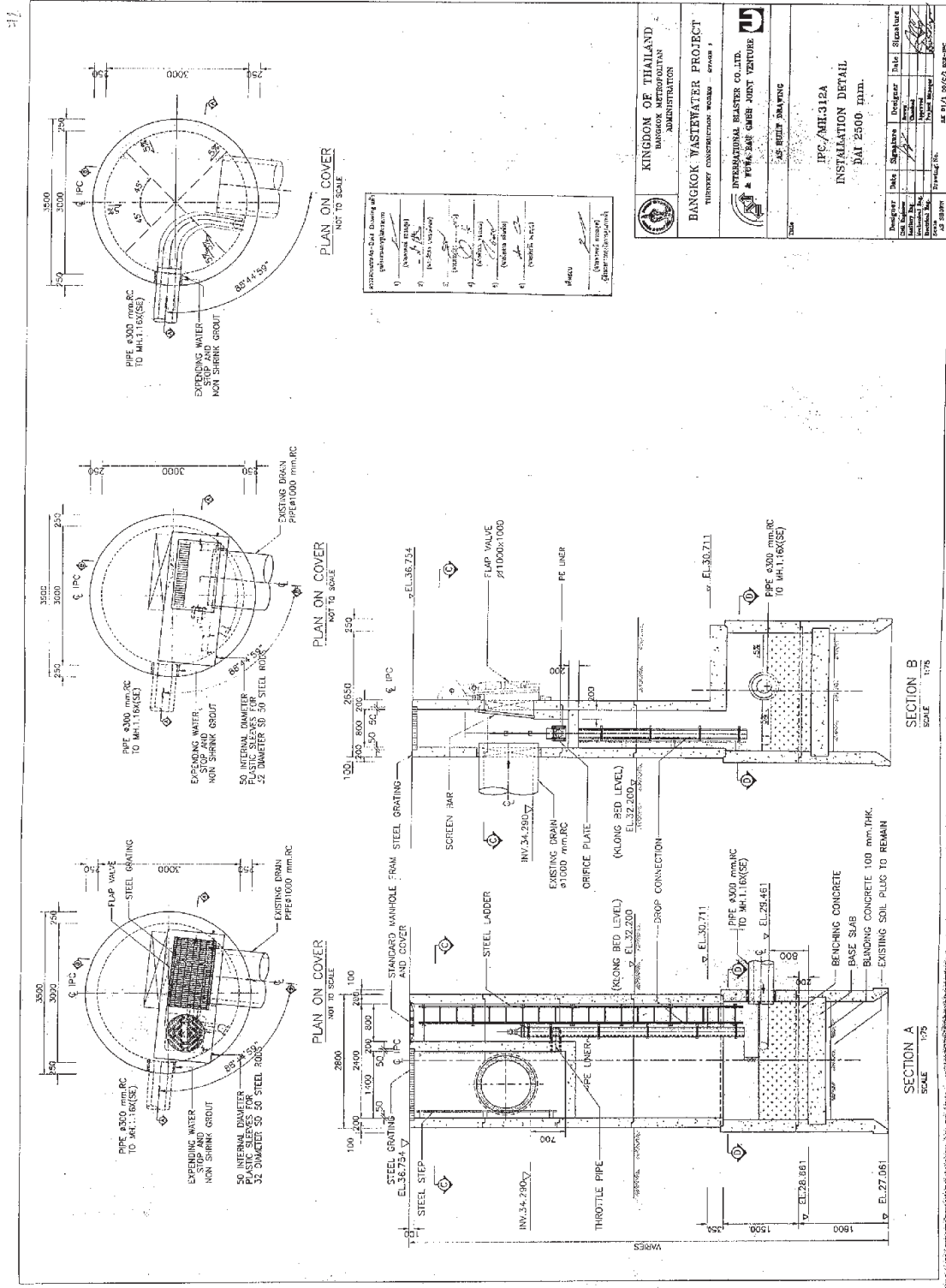




REVISIONS

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KINGDOM OF THAILAND BANGKOK METROPOLITAN ADMINISTRATION	
BANGKOK WASTEWATER PROJECT TURNKEY CONSTRUCTION WORKS - STAGE 1	
INTERNATIONAL BLENSTER CO., LTD. & TPA, BAU SAH JOINT VENTURE	
AS BUILT DRAWING	
INSTALLATION DETAIL FOR RECTANGULAR MANHOLE IN KLONG	
Design No.	10/10/2010
Project No.	10/10/2010
Sheet No.	10/10/2010
Scale	1/25
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Checker	
Designer	
Signatures	



- Engineering Data Drawing with
particulars/notes
- 1) (WORKING DRAWING)
 - 2) (REVISED DRAWING)
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Date: [Date]

KINGDOM OF THAILAND
BANGKOK METROPOLITAN
ADMINISTRATION

BANGKOK WASTEWATER PROJECT
THANON CHANGKROH WASTEWATER TREATMENT PLANT

INTERNATIONAL WATER CO., LTD.
A JOINT VENTURE
OF THE BANGKOK WATER SUPPLY AUTHORITY

AS-BUILT DRAWING

IPC/MH-312A
INSTALLATION DETAIL
SHEET 2500 FROM

Project No.	IPC/MH-312A
Sheet No.	2500
Scale	AS-BUILT
Revision	
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Date	01/11/2024



Appendix 5-12



Appendix-6

Facility Planning for Nong Bon WWTP

Master Plan targeting 2040

Feasibility Study targeting 2020

- 1) Design Parameters and Criteria**
- 2) Design Calculation of Sewage Treatment Facilities**
- 3) Design Calculation of Aeration Requirement**
- 4) Design Calculation of Sludge Treatment Facilities**

Master Plan targeting 2040

1) Design Parameters and Criteria

➤ Design Flow

Daily Average DWF	135,000 m ³ /day
Daily Maximum DWF	169,000 m ³ /day
Hourly Maximum DFW	270,000 m ³ /day

➤ Design Water Quality

	Influent	Aeration tank	Effluent
BOD	150 mg/l	164 mg/l	20 mg/l
SS	150 mg/l	164 mg/l	30 mg/l
T-N	30 mg/l	30 mg/l	10 mg/l
T-P	8 mg/l	8 mg/l	2 mg/l

➤ Design Water Temperature

Average temperature	30 °C
Minimum temperature	25 °C

2) Design Calculation of Sewage Treatment Facilities

➤ Lift Pump

Lift pump	Double suction volute pump
Design flow in rainy weather (to facilities)	405,000 m ³ /day (3DWF)
Design flow in rainy weather (direct discharge)	270,000 m ³ /day (2DWF)
Specification of large pump	94 m ³ /min x 38 mH x 800 kW
Number of large pump	3 nos. (1 standby)
Specification of large pump	32 m ³ /min x 38 mH x 280 kW
Number of large pump	3 nos.

Specification of direct discharge pump	94 m ³ /min x 25 mH x 540 kW
Number of direct discharge pump	3 nos. (1 standby)

➤ **Grit Chamber**

Grit chamber	Gravity settling grit chamber
Design flow in dry weather	270,000 m ³ /day (2DWF)
Design flow in rainy weather	405,000 m ³ /day (3DWF)
Hydraulic overflow rate (dry weather)	1,800 m ³ /m ² /day
Hydraulic overflow rate (wet weather)	3,600 m ³ /m ² /day
Grit chamber	2.0 mW x 9.5 mL (19.0 m ²)
Number of grit chamber	6 channels

➤ **Aeration Tank**

Aeration tank	Anoxic tank and Aerobic tank
Number of tank	12 tanks
Capacity of tank	11,250 m ³ /day/tank
MLSS concentration	2,000 mg/l
Return sludge concentration	8,000 mg/l
Return sludge ratio	0.33
Circulation ratio	1.47
Hydraulic retention time of aerobic tank	3.0 hour
Aerobic tank	15.0 mW x 17.0 mL x 5.5 mD (1,403 m ³ /tank)
Nitrified T-N	253.1 kg/day/tank
Nitrification rate (for reference)	156.5 mg-N/carrier-L/hour (=3.76 kg/ carrier-m ³ /day)
Amount of carrier (for reference)	68 Carrier-m ³ /tank
Nitrogen loading	162 kg/day/tank
De-nitrification rate	3.27 mg-N/g-SS-hour
Hydraulic retention time of anoxic tank	2.3 hour
Anoxic tank	15.0 mW x 13.0 mL x 5.5 mD (1,073 m ³ /tank)

➤ **Settling Tank**

Settling tank	Rectangle settling tank
---------------	-------------------------

Number of tank	24 tanks
Capacity of tank	5,625 m ³ /day/tank
Hydraulic surface loading	25 m ³ /m ² /day
Settling tank	7.5 mW x 30.0 mL x 4.0 mD (225 m ² /tank)

3) Design Calculation of Aeration Requirement

Oxygen for oxidation of organic substance	9,331 kg-O ₂ /day
Oxygen for nitrification of NH ₄	13,881 kg-O ₂ /day
Oxygen for endogenous respiration of MLSS	2,693 kg-O ₂ /day
Oxygen for endogenous respiration of carrier	1,567 kg-O ₂ /day
Oxygen for maintaining dissolved oxygen	1,134 kg-O ₂ /day
Total actual oxygen requirement (AOR)	28,606 kg-O ₂ /day
Standard oxygen requirement (SOR)	50,977 kg-O ₂ /day
Aeration requirement	1,240,003 m ³ /day
Specification of Blower	160 m ³ /min x 6,500 mmAq x 260 kW
Number of blower	6 nos. (3 standby)

4) Design Calculation of Sludge Treatment Facilities

Dewatering machine	Belt press dewatering machine
Dry solid of generated sludge	23,014 kg-DS/day
Volume of generated sludge	2,877 m ³ /day
Solid concentration	0.8 %
Recovery rate of sludge	90 %
Dosing rate of coagulant	1.4 %
Filtration ration	80 kg-DS/m h
Operation rate	90 %
Operation time	24 hours
Wide of belt	3 m
Number of dewatering machine	6 nos. (1 standby)
Moisture content of sludge cake	82 %
Generation of sludge cake	117 m ³ /day

Feasibility Study targeting 2020

1) Design Parameters and Criteria

➤ Design Flow

Daily Average DWF	90,000 m ³ /day
Daily Maximum DWF	112,500 m ³ /day
Hourly Maximum DFW	180,000 m ³ /day

➤ Design Water Quality

	Influent	Aeration tank	Effluent
BOD	100 mg/l	109 mg/l	20 mg/l
SS	100 mg/l	109 mg/l	30 mg/l
T-N	20 mg/l	20 mg/l	10 mg/l
T-P	6 mg/l	6 mg/l	2 mg/l

➤ Design Water Temperature

Average temperature	30 °C
Minimum temperature	25 °C

2) Design Calculation of Sewage Treatment Facilities

➤ Lift Pump

Lift pump	Double suction volute pump
Design flow in rainy weather (to facilities)	270,000 m ³ /day (3DWF)
Design flow in rainy weather (direct discharge)	180,000 m ³ /day (2DWF)
Specification of large pump	94 m ³ /min x 38 mH x 800 kW
Number of large pump	2 nos. (1 standby)
Specification of large pump	32 m ³ /min x 38 mH x 280 kW
Number of large pump	3 nos.

Specification of direct discharge pump	94 m ³ /min x 25 mH x 540 kW
Number of direct discharge pump	3 nos. (1 standby)

➤ **Grit Chamber**

Grit chamber	Gravity settling grit chamber
Design flow in dry weather	180,000 m ³ /day (2DWF)
Design flow in rainy weather	270,000 m ³ /day (3DWF)
Hydraulic overflow rate (dry weather)	1,800 m ³ /m ² /day
Hydraulic overflow rate (wet weather)	3,600 m ³ /m ² /day
Grit chamber	2.0 mW x 9.5 mL (19.0 m ²)
Number of grit chamber	4 channels

➤ **Aeration Tank**

Aeration tank	Anoxic tank and Aerobic tank
Number of tank	8 tanks
Capacity of tank	11,250 m ³ /day/tank
MLSS concentration	2,000 mg/l
Return sludge concentration	8,000 mg/l
Return sludge ratio	0.33
Circulation ratio	1.47
Hydraulic retention time of aerobic tank	3.0 hour
Aerobic tank	15.0 mW x 17.0 mL x 5.5 mD (1,403 m ³ /tank)
Nitrified T-N	253.1 kg/day/tank
Nitrification rate (for reference)	156.5 mg-N/carrier-L/hour (=3.76 kg/ carrier-m ³ /day)
Amount of carrier (for reference)	45 Carrier-m ³ /tank
Nitrogen loading	101 kg/day/tank
De-nitrification rate	2.18 mg-N/g-SS-hour
Hydraulic retention time of anoxic tank	2.3 hour
Anoxic tank	15.0 mW x 13.0 mL x 5.5 mD (1,073 m ³ /tank)

➤ **Settling Tank**

Settling tank	Rectangle settling tank
---------------	-------------------------

Number of tank	16 tanks
Capacity of tank	5,625 m ³ /day/tank
Hydraulic surface loading	25 m ³ /m ² /day
Settling tank	7.5 mW x 30.0 mL x 4.0 mD (225 m ² /tank)

3) Design Calculation of Aeration Requirement

Oxygen for oxidation of organic substance	3,834 kg-O ₂ /day
Oxygen for nitrification of NH ₄	6,170 kg-O ₂ /day
Oxygen for endogenous respiration of MLSS	1,795 kg-O ₂ /day
Oxygen for endogenous respiration of carrier	691 kg-O ₂ /day
Oxygen for maintaining dissolved oxygen	756 kg-O ₂ /day
Total actual oxygen requirement (AOR)	13,245 kg-O ₂ /day
Standard oxygen requirement (SOR)	23,604 kg-O ₂ /day
Aeration requirement for treatment	574,156 m ³ /day
Specification of Blower	160 m ³ /min x 6,500 mmAq x 260 kW
Number of blower	4 nos. (2 standby)

4) Design Calculation of Sludge Treatment Facilities

Dewatering machine	Belt press dewatering machine
Dry solid of generated sludge	9,107 kg-DS/day
Volume of generated sludge	1,138 m ³ /day
Solid concentration	0.8 %
Recovery rate of sludge	90 %
Dosing rate of coagulant	1.4 %
Filtration ration	80 kg-DS/m h
Operation rate	90 %
Operation time	24 hours
Wide of belt	3 m
Number of dewatering machine	3 nos. (1 standby)
Moisture content of sludge cake	82 %
Generation of sludge cake	46 m ³ /day

Appendix-7

Breakdown of Project Cost

Master Plan targeting 2040

Feasibility Study targeting 2020

Master Plan targeting 2040

1) JICA ODA Loan Version

Item Description	Amount (Baht)		Total Amount (Baht)
	L.C	F.C	
1 Construction Cost			
A Wastewater treatment plant			
-A1 Lift pump facilities			
Civil & Architecture works	114,855,000	0	114,855,000
Mechanical works	37,474,000	253,645,000	291,422,000
Electrical works	10,271,000	92,436,000	102,707,000
Sub Total of -A1	162,903,000	346,081,000	508,984,000
-A2 Grit chamber facilities			
Civil & Architecture works	34,664,000	0	34,664,000
Mechanical works	17,474,000	117,325,000	134,799,000
Electrical works	3,598,000	32,379,000	35,977,000
Sub Total of -A2	55,736,000	149,704,000	205,440,000
-A3 Aeration tank facilities			
Civil & Architecture works	157,618,000	0	157,618,000
Mechanical works	77,478,000	693,686,000	771,164,000
Electrical works	11,007,000	99,066,000	110,073,000
Sub Total of -A3	246,103,000	792,751,000	1,038,855,000
-A4 Settling tank facilities			
Civil & Architecture works	264,799,000	0	264,799,000
Mechanical works	27,059,000	181,680,000	208,739,000
Electrical works	7,731,000	69,580,000	77,311,000
Sub Total of -A4	299,589,000	251,260,000	550,849,000
-A5 Effluent and recycle facilities			
Civil & Architecture works	103,579,000	0	103,579,000
Mechanical works	11,261,000	75,610,000	86,871,000
Electrical works	2,989,000	26,899,000	29,888,000
Sub Total of -A5	117,829,000	102,509,000	220,338,000
-A6 Sludge dewatering facilities			
Civil & Architecture works	81,438,000	0	81,438,000
Mechanical works	22,389,000	150,329,000	172,718,000
Electrical works	6,397,000	57,573,000	63,970,000
Sub Total of -A6	110,224,000	207,902,000	318,126,000
-A7 Administration building			
Civil & Architecture works	176,609,000	0	176,609,000
Mechanical works	0	0	0
Electrical works	1,300,000	11,697,000	12,997,000
Sub Total of -A7	176,909,000	11,697,000	189,606,000
-A8 Power facilities			
Civil & Architecture works	0	0	0
Mechanical works	5,992,000	40,231,000	46,223,000
Electrical works	23,779,000	214,010,000	237,789,000
Sub Total of -A8	29,771,000	254,241,000	284,012,000
Sub Total of A	1,200,064,000	2,116,146,000	3,316,210,000
Civil & Architecture works	933,562,000	0	933,562,000
Mechanical works	199,430,000	1,512,506,000	1,711,936,000

Item Description		Amount (Baht)		Total Amount (Baht)
		L.C	F.C	
Electrical works		67,072,000	603,640,000	670,712,000
B Interceptor				
-B1 Pipe jacking				
Civil works		1,609,424,000	0	1,609,424,000
Sub Total of -B1		1,609,424,000	0	1,609,424,000
-B2 Pipe jacking shaft				
Civil works		721,165,000	0	721,165,000
Sub Total of -B2		721,165,000	0	721,165,000
-B3 Interceptor chamber				
Civil works		137,000,000	0	137,000,000
Sub Total of -B3		137,000,000	0	137,000,000
Sub Total of B		2,467,589,000	0	2,467,589,000
Civil Works		2,467,589,000	0	2,467,589,000
Sub Total of Construction Cost		3,667,653,000	2,116,146,000	5,783,799,000
Civil & Architecture works		3,401,151,000	0	3,401,151,000
Mechanical works		199,430,000	1,512,506,000	1,711,936,000
Electrical works		67,072,000	603,640,000	670,712,000
2 Administration Expenses				
-1 Administration Cost				
Administration Cost of Item 1	2.0%	115,676,000	0	115,676,000
Sub-Total of -1		115,676,000	0	115,676,000
3 Engineering Cost				
-1 Engineering Cost				
Engineering Cost of Item 1	10.0%	366,765,000	211,615,000	578,380,000
Sub-Total of -1		366,765,000	211,615,000	578,380,000
4 Physical Contingency				
-1 For Local Portion of Item 1-3	10.0%	415,009,000	0	415,009,000
-2 For Foreign Portion of Item 1-3	10.0%	0	232,776,000	232,776,000
Sub-Total of -1+-2		415,009,000	232,776,000	647,785,000
5 Price Contingency				
-1 For Local Portion of Item 1-3	3.3%	713,382,000	0	713,382,000
-2 For Foreign Portion of Item 1-3	2.4%	0	288,058,000	288,058,000
Sub-Total of -1+-2		713,382,000	288,058,000	1,001,440,000
6 Interest during construction				
-1 Interest during construction	0.65%	65,353,000	34,453,000	99,806,000
Sub-Total of -1		65,353,000	34,453,000	99,806,000
7 Commitment charge				
-1 Commitment charge	0.10%	20,813,000	11,315,000	32,128,000
Sub-Total of -1		20,813,000	11,315,000	32,128,000
8 Tax				
-1 VAT	7%	375,526,000	202,605,000	578,131,000
-2 Custom	5%	0	190,578,000	190,578,000
Sub-Total of -1		375,526,000	393,183,000	768,709,000
Total of 1+2+3+4+5+6+7+8		5,740,177,000	3,287,546,000	9,027,723,000
(including TAX)				
Total of 1+2+3+4+5+6+7		5,364,651,000	2,894,363,000	8,259,014,000
(excluding TAX)				

2) DDS Budget Request Form Version

Item Description	Amount (Baht)		Total Amount (Baht)
	L.C	F.C	
1 Construction Cost			
A Wastewater treatment plant			
-A1 Lift pump facilities			
Civil & Architecture works	114,855,000	0	114,855,000
Mechanical works	37,474,000	253,645,000	291,422,000
Electrical works	10,271,000	92,436,000	102,707,000
Sub Total of -A1	162,903,000	346,081,000	508,984,000
-A2 Grit chamber facilities			
Civil & Architecture works	34,664,000	0	34,664,000
Mechanical works	17,474,000	117,325,000	134,799,000
Electrical works	3,598,000	32,379,000	35,977,000
Sub Total of -A2	55,736,000	149,704,000	205,440,000
-A3 Aeration tank facilities			
Civil & Architecture works	157,618,000	0	157,618,000
Mechanical works	77,478,000	693,686,000	771,164,000
Electrical works	11,007,000	99,066,000	110,073,000
Sub Total of -A3	246,103,000	792,751,000	1,038,855,000
-A4 Settling tank facilities			
Civil & Architecture works	264,799,000	0	264,799,000
Mechanical works	27,059,000	181,680,000	208,739,000
Electrical works	7,731,000	69,580,000	77,311,000
Sub Total of -A4	299,589,000	251,260,000	550,849,000
-A5 Effluent and recycle facilities			
Civil & Architecture works	103,579,000	0	103,579,000
Mechanical works	11,261,000	75,610,000	86,871,000
Electrical works	2,989,000	26,899,000	29,888,000
Sub Total of -A5	117,829,000	102,509,000	220,338,000
-A6 Sludge dewatering facilities			
Civil & Architecture works	81,438,000	0	81,438,000
Mechanical works	22,389,000	150,329,000	172,718,000
Electrical works	6,397,000	57,573,000	63,970,000
Sub Total of -A6	110,224,000	207,902,000	318,126,000
-A7 Administration building			
Civil & Architecture works	176,609,000	0	176,609,000
Mechanical works	0	0	0
Electrical works	1,300,000	11,697,000	12,997,000
Sub Total of -A7	176,909,000	11,697,000	189,606,000
-A8 Power facilities			
Civil & Architecture works	0	0	0
Mechanical works	5,992,000	40,231,000	46,223,000
Electrical works	23,779,000	214,010,000	237,789,000
Sub Total of -A8	29,771,000	254,241,000	284,012,000
Sub Total of A	1,200,064,000	2,116,146,000	3,316,210,000
Civil & Architecture works	933,562,000	0	933,562,000
Mechanical works	199,430,000	1,512,506,000	1,711,936,000
Electrical works	67,072,000	603,640,000	670,712,000
B Interceptor			
-B1 Pipe jacking			
Civil works	1,609,424,000	0	1,609,424,000
Sub Total of -B1	1,609,424,000	0	1,609,424,000

Item Description		Amount (Baht)		Total Amount (Baht)
		L.C	F.C	
-B2 Pipe jacking shaft				
Civil works		721,165,000	0	721,165,000
Sub Total of -B2		721,165,000	0	721,165,000
-B3 Interceptor chamber				
Civil works		137,000,000	0	137,000,000
Sub Total of -B3		137,000,000	0	137,000,000
Sub Total of B		2,467,589,000	0	2,467,589,000
Civil Works		2,467,589,000	0	2,467,589,000
Sub Total of Construction Cost		3,667,653,000	2,116,146,000	5,783,799,000
Civil & Architecture works		3,401,151,000	0	3,401,151,000
Mechanical works		199,430,000	1,512,506,000	1,711,936,000
Electrical works		67,072,000	603,640,000	670,712,000
2 Engineering Cost				
-1 Engineering Cost				
Engineering Cost of Item 1	3.0%	110,030,000	63,484,000	173,514,000
Sub-Total of -1		110,030,000	63,484,000	173,514,000
3 Tax				
-1 VAT	7%	264,438,000	152,574,000	417,012,000
-2 Custom	5%	0	190,578,000	190,578,000
Sub-Total of -1		264,438,000	343,152,000	607,590,000
Total of 1+2+3		4,042,121,000	2,522,782,000	6,564,903,000
(including TAX)				
Total of 1+2		3,777,683,000	2,179,630,000	5,957,313,000
(excluding TAX)				

3) Breakdown of Construction Cost of Nong Bon WWTP

Item Description	Amount (Baht)		Total Amount (Baht)
	L.C	F.C	
A 1 Lift Pump facilities			
Earth work	3,291,000	0	3,291,000
Consecutive wall	71,293,000	0	71,293,000
Others of foundation work	11,560,000	0	11,560,000
Structure work	20,715,000	0	20,715,000
Others of structure work	7,996,000	0	7,996,000
Sub Total of –C&A	114,855,000	0	114,855,000
Mechanical equipment	0	184,011,000	184,011,000
Installation and others of mechanical work	32,202,000	32,202,000	64,404,000
Electrical equipment	0	70,028,000	70,028,000
Installation and others of electrical work	8,754,000	8,754,000	17,507,000
Sub Total of –M&E	40,956,000	294,995,000	335,951,000
Sub Total of –A1	155,811,000	294,995,000	450,806,000
A 2 Grit chamber facilities			
Structure work	25,010,000	0	25,010,000
Others of structure work	9,754,000	0	9,754,000
Sub Total of –C&A	34,664,000	0	34,664,000
Mechanical equipment	0	83,734,000	83,734,000
Installation and others of mechanical work	14,653,000	14,653,000	29,307,000
Electrical equipment	0	22,334,000	22,334,000
Installation and others of electrical work	2,792,000	2,792,000	5,584,000
Sub Total of –M&E	17,445,000	123,513,000	140,958,000
Sub Total of –A2	52,109,000	123,513,000	175,622,000
A 3 Aeration tank facilities			
Structure work	113,722,000	0	113,722,000
Others of structure work	43,897,000	0	43,897,000
Sub Total of –C&A	157,618,000	0	157,618,000
Mechanical equipment	0	368,934,000	368,934,000
Installation and others of mechanical work	50,678,000	50,678,000	101,355,000
Electrical equipment	0	58,701,000	58,701,000
Installation and others of electrical work	7,338,000	7,338,000	14,675,000
Sub Total of –M&E	58,016,000	485,651,000	543,667,000
Sub Total of –A3	215,634,000	480,650,000	696,284,000
A 4 Settling tank facilities			
Earth work	9,095,000	0	9,095,000
Piling work	88,349,000	0	88,349,000
Others of foundation work	14,329,000	0	14,329,000
Structure work	114,016,000	0	114,016,000
Others of structure work	44,010,000	0	44,010,000
Sub Total of –C&A	264,799,000	0	264,799,000
Mechanical equipment	0	103,081,000	103,081,000
Installation and others of mechanical work	18,039,000	18,039,000	36,078,000
Electrical equipment	0	41,232,000	41,232,000
Installation and others of electrical work	5,154,000	5,154,000	10,308,000
Sub Total of –M&E	23,193,000	167,506,000	190,700,000
Sub Total of –A4	287,992,000	167,506,000	455,498,000
A 5 Effluent and recycle facilities			
Earth work	440,000	0	440,000
Piling work	8,019,000	0	8,019,000
Others of foundation work	1,311,000	0	1,311,000

Item Description	Amount (Baht)		Total Amount (Baht)
	L.C	F.C	
Structure work	7,725,000	0	7,725,000
Others of structure work	2,982,000	0	2,982,000
Piping work	83,102,000	0	83,102,000
Sub Total of –C&A	103,579,000	0	103,579,000
Mechanical equipment	0	46,598,000	46,598,000
Installation and others of mechanical work	8,155,000	8,155,000	16,309,000
Electrical equipment	0	17,029,000	17,029,000
Installation and others of electrical work	2,128,000	2,128,000	4,256,000
Sub Total of –M&E	10,283,000	73,907,000	84,190,000
Sub Total of –A5	113,862,000	73,907,000	187,769,000
A 6 Sludge dewatering facilities			
Earth work	970,000	0	970,000
Piling and pile wall work	24,549,000	0	24,549,000
Others of foundation work	3,955,000	0	3,955,000
Structure work	11,141,000	0	11,141,000
Others of structure work	4,300,000	0	4,300,000
Architecture work	36,522,000	0	36,522,000
Sub Total of –C&A	81,438,000	0	81,438,000
Mechanical equipment	0	68,531,000	68,531,000
Installation and others of mechanical work	11,993,000	11,993,000	23,986,000
Electrical equipment	0	27,412,000	27,412,000
Installation and others of electrical work	3,427,000	3,427,000	6,853,000
Sub Total of –M&E	15,420,000	111,364,000	126,783,000
Sub Total of –A6	96,858,000	111,363,000	208,221,000
A 7 Administration building			
Piling work	5,346,000	0	5,346,000
Others of foundation work	829,000	0	829,000
Architecture work	170,435,000	0	170,435,000
Sub Total of –C&A	176,609,000	0	176,609,000
Electrical equipment	0	10,397,000	10,397,000
Installation and others of electrical work	1,300,000	1,300,000	2,599,000
Sub Total of –M&E	1,300,000	11,697,000	12,996,000
Sub Total of –A7	177,909,000	11,697,000	189,606,000
A 8 Power facilities			
Mechanical equipment	0	22,826,000	22,826,000
Installation and others of mechanical work	3,995,000	3,995,000	7,989,000
Electrical equipment	0	130,096,000	130,096,000
Installation and others of electrical work	16,262,000	16,262,000	32,524,000
Sub Total of –M&E	20,257,000	173,179,000	193,436,000
Sub Total of –A8	20,257,000	173,179,000	193,436,000

4) Breakdown of Construction Cost of Interceptor

Item Description	Quantity	Unit price	Amount (Baht)		Total Amount (Baht)
			L.C	F.C	
B 1 Pipe jacking	m	Baht/m			
Pipe jacking under road					
Interceptor (Dia. 300mm)	480	14,200	6,816,000	0	6,816,000
Interceptor (Dia. 450mm)	0	17,100	0	0	0
Interceptor (Dia. 600mm)	4,970	20,000	99,400,000	0	99,400,000
Interceptor (Dia. 800mm)	4,025	23,800	95,795,000	0	95,795,000
Interceptor (Dia. 1,000mm)	4,240	27,700	117,448,000	0	117,448,000
Interceptor (Dia. 1,200mm)	1,595	31,500	50,242,500	0	50,242,500
Interceptor (Dia. 1,500mm)	4,970	37,200	184,884,000	0	184,884,000
Interceptor (Dia. 2,000mm)	385	46,600	17,941,000	0	17,941,000
Sub Total of –under road			572,526,500	0	572,526,500
Pipe jacking under klong					
Interceptor (Dia. 300mm)	0	14,900	0	0	0
Interceptor (Dia. 450mm)	1,455	17,500	25,462,500	0	25,462,500
Interceptor (Dia. 600mm)	24,900	20,200	502,980,000	0	502,980,000
Interceptor (Dia. 800mm)	9,720	24,300	236,196,000	0	236,196,000
Interceptor (Dia. 1,000mm)	755	28,800	21,744,000	0	21,744,000
Interceptor (Dia. 1,200mm)	4,125	33,800	139,425,000	0	139,425,000
Interceptor (Dia. 1,500mm)	2,645	42,000	111,090,000	0	111,090,000
Interceptor (Dia. 2,000mm)	0	57,900	0	0	0
Sub Total of –under klong			1,036,897,500	0	1,036,897,500
Sub Total of –B1			1,609,424,000	0	1,609,424,000
B 2 Pipe jacking shaft	m	Baht/m			
Pipe jacking under road					
Interceptor (Dia. 300mm)	28	122,300	3,375,480	0	3,375,480
Interceptor (Dia. 450mm)	0	127,600	0	0	0
Interceptor (Dia. 600mm)	270	132,900	35,883,000	0	35,883,000
Interceptor (Dia. 800mm)	402	140,000	56,322,000	0	56,322,000
Interceptor (Dia. 1,000mm)	257	147,100	37,863,540	0	37,863,540
Interceptor (Dia. 1,200mm)	184	154,200	28,326,540	0	28,326,540
Interceptor (Dia. 1,500mm)	399	164,800	65,755,200	0	65,755,200
Interceptor (Dia. 2,000mm)	62	182,500	11,278,500	0	11,278,500
Sub Total of –under road			238,804,260	0	238,804,260
Pipe jacking under klong					
Interceptor (Dia. 300mm)	0	113,000	0	0	0
Interceptor (Dia. 450mm)	86	132,300	11,351,340	0	11,351,340
Interceptor (Dia. 600mm)	1,393	151,700	211,348,440	0	211,348,440
Interceptor (Dia. 800mm)	500	177,500	88,750,000	0	88,750,000
Interceptor (Dia. 1,000mm)	67	203,300	13,519,450	0	13,519,450
Interceptor (Dia. 1,200mm)	340	229,100	77,985,640	0	77,985,640
Interceptor (Dia. 1,500mm)	296	267,900	79,405,560	0	79,405,560
Interceptor (Dia. 2,000mm)	0	332,400	0	0	0
Sub Total of –under klong			482,360,430	0	482,360,430
Sub Total of –B2			721,165,000	0	721,165,000
B 3 Interceptor chamber	Nos.	Baht/nos.			
Interceptor chamber	136	1,004,000	137,000,000	0	137,000,000
Sub Total of –B3			137,000,000	0	137,000,000

5) Comparison of Construction Cost of Interceptor Chamber

Item Description	Quantity	Unit price	Amount (Baht)		Total Amount (Baht)
			L.C	F.C	
B 3 Interceptor chamber	Nos.	Baht/nos.			
Dia. 600mm	44	801,000	35,244,000	0	35,244,000
Dia. 800mm	17	882,000	14,994,000	0	14,994,000
Dia. 1,000mm	8	965,000	7,720,000	0	7,720,000
Dia. 1,200mm	62	1,082,000	67,084,000	0	67,084,000
Dia. 1,500mm	5	1,580,000	7,900,000	0	7,900,000
Sub Total of -B3	136		132,942,000	0	132,942,000

6) Unit Construction Cost of Connection pipes

Item Description	Unit price (Baht)
Connecting pipe (Dia. 150mm)	1,300 Baht/m
Connecting pipe (Dia. 200mm)	1,400 Baht/m
Manhole (Top=600mm/Bottom=900mm ,Height=0.9m)	45,000 Baht/nos.
Manhole (Top=600mm/Bottom=900mm ,Height=2.1m)	64,000 Baht/nos.

7) Assignments of Experts

Experts	Assignments
Project manager	Project manager is an international expert. Assignment of project manager is organize consultant team and to manage quality and schedule of consulting service. Project manager is in charge of negotiating with the Client, the Contractor and the authorities concerned as a representative of consultants.
Deputy project manager	Deputy project manager is a local expert. Assignment of deputy project manager is to organize consultant team and to manage quality and schedule of consulting service with the project manager. Deputy project manager also assist the project engineer to negotiate.
Process engineer	Assignment of process engineers is to design process of wastewater treatment and sludge treatment including mass balance calculation of pollution loading within STP, capacity calculation of treatment facilities and calculation of hydraulic profile.
Structural engineer	Assignment of structural engineers is to conduct structural calculation of civil and architectural structures and give instruction to CAD operators regarding arrangement of re-bar of structures. Structural engineers are also in charge of designing of foundations of structure.
Architect	Assignment of architects is to arrange architectural structures considering required spaces for operation and maintenance and configuration of equipment. Architects are also in charge of finishing of buildings and buildings services including ventilation, low voltage system, fire prevention and sanitary system.
Mechanical engineer	Assignment of mechanical engineers is to design mechanical equipment including process calculation of treatment process and capacity calculation of mechanical equipment. Mechanical engineers also assist process engineers to design treatment processes and capacity calculation of treatment facilities.

Electrical engineer	Assignment of electrical engineers is to design electrical equipment including power distribution system, instrumentation / monitoring system and emergency power supply system. Electrical engineers also assist architects to design low voltage system of building services.
Pipeline engineer	Assignment of pipelines engineers is to design collection system including pipe jacking and shafts of interceptors and structures of interceptor chambers. Pipelines engineers are also in charge of planning execution scheme of interceptors.
Site survey supervisor	Assignment of survey supervisors is to prepare the contract documents of survey works including geotechnical and topographic survey for outsourcing. Site survey supervisor are also in charge of manage of quality and schedule by instructing the Contractors of survey works.
Cost estimator	Assignment of cost estimators is to estimate expected cost of the project including preparation of bill of quantities, price inquiry of local market / procurement from foreign countries and pricing all items which are on the bill of quantities.
Contract specialist	Assignment of contract specialists is to prepare for the prequalification documents and tender documents including general and particular conditions of the Contract and instruction to tenderers. Contract specialists assist evaluation of prequalification and tender and negotiation with the tenderers.
Environmental expert	Assignment of environmental experts is to prepare the countermeasures to reduce negative impacts against environment and society by implementation of the project. Environmental experts also prepare monitoring plan to measure negative impacts.
Technical assistance expert	Assignment of technical assistance experts is to conduct training programs in order to develop the capacities of the responsible agencies regarding management and operation necessary to take over the newly constructed facilities smoothly.

Feasibility Study targeting 2020

1) JICA ODA Loan Version

Item Description	Amount (Baht)		Total Amount (Baht)
	L.C	F.C	
1 Construction Cost			
A Wastewater treatment plant			
-A1 Lift pump facilities			
Civil & Architecture works	114,855,000	0	114,855,000
Mechanical works	32,202,000	216,213,000	248,415,000
Electrical works	8,754,000	78,782,000	87,536,000
Sub Total of -A1	155,811,000	294,995,000	450,806,000
-A2 Grit chamber facilities			
Civil & Architecture works	34,664,000	0	34,664,000
Mechanical works	14,653,000	98,387,000	113,040,000
Electrical works	2,792,000	25,126,000	27,918,000
Sub Total of -A2	52,109,000	123,513,000	175,622,000
-A3 Aeration tank facilities			
Civil & Architecture works	157,618,000	0	157,618,000
Mechanical works	50,678,000	414,611,000	465,289,000
Electrical works	7,338,000	66,039,000	73,377,000
Sub Total of -A3	215,634,000	480,650,000	696,284,000
-A4 Settling tank facilities			
Civil & Architecture works	264,799,000	0	264,799,000
Mechanical works	18,039,000	121,120,000	139,159,000
Electrical works	5,154,000	46,386,000	51,540,000
Sub Total of -A4	287,992,000	167,506,000	455,498,000
-A5 Effluent and recycle facilities			
Civil & Architecture works	103,579,000	0	103,579,000
Mechanical works	8,155,000	54,753,000	62,908,000
Electrical works	2,128,000	19,154,000	21,282,000
Sub Total of -A5	113,862,000	73,907,000	187,769,000
-A6 Sludge dewatering facilities			
Civil & Architecture works	81,438,000	0	81,438,000
Mechanical works	11,993,000	80,524,000	92,517,000
Electrical works	3,427,000	30,839,000	34,266,000
Sub Total of -A6	96,858,000	111,363,000	208,221,000
-A7 Administration building			
Civil & Architecture works	176,609,000	0	176,609,000
Mechanical works	0	0	0
Electrical works	1,300,000	11,697,000	12,997,000
Sub Total of -A7	176,909,000	11,697,000	189,606,000
-A8 Power facilities			
Civil & Architecture works	0	0	0
Mechanical works	3,995,000	26,821,000	30,816,000
Electrical works	16,262,000	146,358,000	162,620,000
Sub Total of -A8	20,257,000	173,179,000	193,436,000
Sub Total of A	1,120,432,000	1,436,810,000	2,557,242,000
Civil & Architecture works	933,562,000	0	933,562,000
Mechanical works	139,715,000	1,012,429,000	1,152,144,000

Item Description		Amount (Baht)		Total Amount (Baht)
		L.C	F.C	
Electrical works		47,155,000	424,381,000	471,536,000
B Interceptor				
-B1 Pipe jacking				
Civil works		1,609,424,000	0	1,609,424,000
Sub Total of -B1		1,609,424,000	0	1,609,424,000
-B2 Pipe jacking shaft				
Civil works		721,165,000	0	721,165,000
Sub Total of -B2		721,165,000	0	721,165,000
-B3 Interceptor chamber				
Civil works		137,000,000	0	137,000,000
Sub Total of -B3		137,000,000	0	137,000,000
Sub Total of B		2,467,589,000	0	2,467,589,000
Civil Works		2,467,589,000	0	2,467,589,000
Sub Total of Construction Cost		3,588,021,000	1,436,810,000	5,024,831,000
Civil & Architecture works		3,401,151,000	0	3,401,151,000
Mechanical works		139,715,000	1,012,429,000	1,152,144,000
Electrical works		47,155,000	424,381,000	471,536,000
2 Administration Expenses				
-1 Administration Cost				
Administration Cost of Item 1	2.0%	100,497,000	0	100,497,000
Sub-Total of -1		100,497,000	0	100,497,000
3 Engineering Cost				
-1 Engineering Cost				
Engineering Cost of Item 1	10.0%	358,802,000	143,681,000	502,483,000
Sub-Total of -1		358,802,000	143,681,000	502,483,000
4 Physical Contingency				
-1 For Local Portion of Item 1-3	10.0%	404,732,000	0	404,732,000
-2 For Foreign Portion of Item 1-3	10.0%	0	158,049,000	158,049,000
Sub-Total of -1+-2		404,732,000	158,049,000	562,781,000
5 Price Contingency				
-1 For Local Portion of Item 1-3	3.3%	696,347,000	0	696,347,000
-2 For Foreign Portion of Item 1-3	2.4%	0	195,584,000	195,584,000
Sub-Total of -1+-2		696,347,000	195,584,000	891,931,000
6 Interest during construction				
-1 Interest during construction	0.65%	63,587,000	23,393,000	86,980,000
Sub-Total of -1		63,587,000	23,393,000	86,980,000
7 Commitment charge				
-1 Commitment charge	0.10%	20,320,000	7,683,000	28,003,000
Sub-Total of -1		20,320,000	7,683,000	28,003,000
8 Tax				
-1 VAT	7%	366,261,000	137,564,000	503,825,000
-2 Custom	5%	0	133,223,000	133,223,000
Sub-Total of -1		366,261,000	270,787,000	637,048,000
Total of 1+2+3+4+5+6+7+8		5,598,567,000	2,235,987,000	7,834,554,000
(including TAX)				
Total of 1+2+3+4+5+6+7		5,232,306,000	1,965,200,000	7,197,506,000
(excluding TAX)				

2) DDS Budget Request Form Version

Item Description	Amount (Baht)		Total Amount (Baht)
	L.C	F.C	
1 Construction Cost			
A Wastewater treatment plant			
-A1 Lift pump facilities			
Civil & Architecture works	114,855,000	0	114,855,000
Mechanical works	32,202,000	216,213,000	248,415,000
Electrical works	8,754,000	78,782,000	87,536,000
Sub Total of -A1	155,811,000	294,995,000	450,806,000
-A2 Grit chamber facilities			
Civil & Architecture works	34,664,000	0	34,664,000
Mechanical works	14,653,000	98,387,000	113,040,000
Electrical works	2,792,000	25,126,000	27,918,000
Sub Total of -A2	52,109,000	123,513,000	175,622,000
-A3 Aeration tank facilities			
Civil & Architecture works	157,618,000	0	157,618,000
Mechanical works	50,678,000	414,611,000	465,289,000
Electrical works	7,338,000	66,039,000	73,377,000
Sub Total of -A3	215,634,000	480,650,000	696,284,000
-A4 Settling tank facilities			
Civil & Architecture works	264,799,000	0	264,799,000
Mechanical works	18,039,000	121,120,000	139,159,000
Electrical works	5,154,000	46,386,000	51,540,000
Sub Total of -A4	287,992,000	167,506,000	455,498,000
-A5 Effluent and recycle facilities			
Civil & Architecture works	103,579,000	0	103,579,000
Mechanical works	8,155,000	54,753,000	62,908,000
Electrical works	2,128,000	19,154,000	21,282,000
Sub Total of -A5	113,862,000	73,907,000	187,769,000
-A6 Sludge dewatering facilities			
Civil & Architecture works	81,438,000	0	81,438,000
Mechanical works	11,993,000	80,524,000	92,517,000
Electrical works	3,427,000	30,839,000	34,266,000
Sub Total of -A6	96,858,000	111,363,000	208,221,000
-A7 Administration building			
Civil & Architecture works	176,609,000	0	176,609,000
Mechanical works	0	0	0
Electrical works	1,300,000	11,697,000	12,997,000
Sub Total of -A7	176,909,000	11,697,000	189,606,000
-A8 Power facilities			
Civil & Architecture works	0	0	0
Mechanical works	3,995,000	26,821,000	30,816,000
Electrical works	16,262,000	146,358,000	162,620,000
Sub Total of -A8	20,257,000	173,179,000	193,436,000
Sub Total of A	1,120,432,000	1,436,810,000	2,557,242,000
Civil & Architecture works	933,562,000	0	933,562,000
Mechanical works	139,715,000	1,012,429,000	1,152,144,000
Electrical works	47,155,000	424,381,000	471,536,000
B Interceptor			
-B1 Pipe jacking			
Civil works	1,609,424,000	0	1,609,424,000
Sub Total of -B1	1,609,424,000	0	1,609,424,000

Item Description		Amount (Baht)		Total Amount (Baht)
		L.C	F.C	
-B2 Pipe jacking shaft				
Civil works		721,165,000	0	721,165,000
Sub Total of -B2		721,165,000	0	721,165,000
-B3 Interceptor chamber				
Civil works		137,000,000	0	137,000,000
Sub Total of -B3		137,000,000	0	137,000,000
Sub Total of B		2,467,589,000	0	2,467,589,000
Civil Works		2,467,589,000	0	2,467,589,000
Sub Total of Construction Cost		3,588,021,000	1,436,810,000	5,024,831,000
Civil & Architecture works		3,401,151,000	0	3,401,151,000
Mechanical works		139,715,000	1,012,429,000	1,152,144,000
Electrical works		47,155,000	424,381,000	471,536,000
2 Engineering Cost				
-1 Engineering Cost				
Engineering Cost of Item 1	3.0%	107,641,000	43,104,000	150,745,000
Sub-Total of -1		107,641,000	43,104,000	150,745,000
3 Tax				
-1 VAT	7%	258,686,000	103,594,000	362,290,000
-2 Custom	5%	0	133,223,000	133,223,000
Sub-Total of -1		258,696,000	236,817,000	495,513,000
Total of 1+2+3		3,954,358,000	1,716,731,000	5,671,089,000
(including TAX)				
Total of 1+2		3,695,662,000	1,479,914,000	5,175,576,000
(excluding TAX)				

Appendix-8

Economic and Financial Analysis

表8.1 経済分析結果(ケース1: 支払意思額を採用)
Table 8.1 Economic Evaluation of the Project (WTP)

年	Year	事業実施費 Initial Construction Cost	維持管理費 O&M Cost	費用合計 Total Economic Cost	①支払意思額 Environment Improvement	②土地価格の上昇 2.Land Price Increase	③処理水の再利用 3. Reuse of Treated Waste Water	便益合計 Total Economic Benefit	キャッシュフロー Cash Flow
2012	2012	-24.40	0.00	-24.40	0.00	0.00	0.00	0.0	-24.4
2013	2013	-128.90	0.00	-128.90	0.00	0.00	0.00	0.0	-128.9
2014	2014	-128.60	0.00	-128.60	0.00	0.00	0.00	0.0	-128.6
2015	2015	-1,901.60	0.00	-1,901.60	0.00	0.00	0.00	0.0	-1,901.6
2016	2016	-1,887.10	0.00	-1,887.10	0.00	0.00	0.00	0.0	-1,887.1
2017	2017	-1,872.00	0.00	-1,872.00	0.00	0.00	0.00	0.0	-1,872.0
2018	2018	0.00	-94.21	-94.21	42.71	0.00	13.00	55.7	-38.5
2019	2019	0.00	-96.96	-96.96	42.93	0.00	19.20	62.1	-34.8
2020	2020	0.00	-99.71	-99.71	43.14	1,290.00	19.70	1,352.8	1,253.1
2021	2021	-530.80	-102.47	-633.27	43.37	1,290.00	20.30	1,353.7	720.4
2022	2022	0.00	-105.22	-105.22	43.60	1,290.00	20.80	1,354.4	1,249.2
2023	2023	0.00	-107.97	-107.97	43.83	387.00	21.30	452.1	344.2
2024	2024	0.00	-110.73	-110.73	44.06	387.00	21.90	453.0	342.2
2025	2025	0.00	-113.48	-113.48	44.29	387.00	22.40	453.7	340.2
2026	2026	0.00	-116.23	-116.23	44.52	387.00	23.00	454.5	338.3
2027	2027	0.00	-118.99	-118.99	44.75	387.00	23.50	455.3	336.3
2028	2028	0.00	-121.74	-121.74	44.98	387.00	24.10	456.1	334.3
2029	2029	0.00	-124.49	-124.49	45.21	387.00	24.60	456.8	332.3
2030	2030	0.00	-127.25	-127.25	45.44	387.00	25.10	457.5	330.3
2031	2031	-530.80	-129.81	-660.61	45.68	387.00	25.70	458.4	-202.2
2032	2032	-1,249.90	-132.37	-1,382.27	45.92	387.00	26.20	459.1	-923.2
2033	2033	0.00	-134.94	-134.94	46.16	387.00	26.70	459.9	324.9
2034	2034	0.00	-137.49	-137.49	46.40	387.00	27.20	460.6	323.1
2035	2035	0.00	-140.06	-140.06	46.64	387.00	27.70	461.3	321.3
2036	2036	-530.80	-142.62	-673.42	46.88	387.00	28.20	462.1	-211.3
2037	2037	0.00	-145.19	-145.19	47.12	387.00	28.70	462.8	317.8
2038	2038	0.00	-147.74	-147.74	47.36	387.00	29.20	463.6	315.8
2039	2039	0.00	-150.30	-150.30	47.60	387.00	29.70	464.3	314.0
2040	2040	0.00	-152.87	-152.87	47.84	387.00	30.20	465.0	312.2
2041	2041	0.00	-154.59	-154.59	48.08	387.00	30.60	465.7	311.1
2042	2042	0.00	-154.59	-154.59	48.32	387.00	30.60	465.9	311.3
2043	2043	0.00	-154.59	-154.59	48.56	387.00	30.60	466.2	311.6
2044	2044	0.00	-154.59	-154.59	48.80	387.00	30.60	466.4	311.8
2045	2045	0.00	-154.59	-154.59	49.04	387.00	30.60	466.6	312.1
2046	2046	-530.80	-154.59	-685.39	49.28	387.00	30.60	466.9	-218.5
2047	2047	2,415.60	-154.59	2,261.01	49.52	387.00	30.60	467.1	2,728.1
Total	Total	-6,900	-3,935	-10,835	1,382.03	13,545.00	772.60	15,699.6	4,864.6
NPV	NPV	-4,614.24	-678.77	-5,293.01	260.95	3,000.57	131.04	3,392.57	-1,900.44
								EIRR	4.0%
								NPV (D.R.=10%)	-1,900
								B/C	0.64

出典: 調査団
Source: Study Team

感度分析
Sensitivity Analysis

年	Year	費用+10% Cost +10%		便益-10% Benefit -10%	
		CF ケース2 CF Case2	B: Sensibility CF Case2	CF ケース3 CF Case3	D: Sensibility CF Case4
2012	2012	-24.4	-26.84	0.0	0.0
2013	2013	-128.9	-141.79	0.0	0.0
2014	2014	-128.6	-141.46	0.0	0.0
2015	2015	-1,901.6	-2,091.76	0.0	0.0
2016	2016	-1,887.1	-2,075.81	0.0	0.0
2017	2017	-1,872.0	-2,059.2	0.0	0.0
2018	2018	-44.1	-103.63	50.1	50.1
2019	2019	-41.1	-106.66	55.9	55.9
2020	2020	1,117.9	-109.68	1,243.16	1,107.92
2021	2021	585.0	-696.60	657.07	521.7
2022	2022	1,113.8	-115.74	1,238.66	1,103.26
2023	2023	298.9	-118.77	333.36	288.13
2024	2024	297.0	-121.80	331.16	285.9
2025	2025	294.8	-124.83	328.86	283.47
2026	2026	292.9	-127.85	326.67	281.25
2027	2027	290.7	-130.89	324.36	278.81
2028	2028	288.8	-133.91	322.17	276.59
2029	2029	286.6	-136.94	319.87	274.16
2030	2030	284.6	-139.98	317.56	271.82
2031	2031	-248.1	-726.67	-268.29	-314.17
2032	2032	-969.1	-1,520.50	-1,061.38	-1,107.3
2033	2033	279.0	-148.43	311.43	265.47
2034	2034	277.0	-151.24	309.36	263.26
2035	2035	275.1	-154.07	307.27	261.13
2036	2036	-257.5	-740.76	-278.68	-324.86
2037	2037	271.3	-159.71	303.11	256.79
2038	2038	269.5	-162.51	301.05	254.69
2039	2039	267.6	-165.33	298.97	252.57
2040	2040	265.6	-168.16	296.88	250.34
2041	2041	264.5	-170.05	295.63	249.05
2042	2042	264.7	-170.05	295.87	249.25
2043	2043	264.9	-170.05	296.11	249.45
2044	2044	265.2	-170.05	296.35	249.75
2045	2045	265.4	-170.05	296.59	249.95
2046	2046	-265.2	-755.93	-287.05	-333.73
2047	2047	2,681.4	2,487.11	2,954.23	2,907.51
Total	Total	3,294.5	-11,918.6	3,781.0	2,211.0
NPV	NPV	-2,240	-5,822.3	-2,430	-2,769
EIRR	EIRR	2.8%		2.9%	1.7%
B/C	B/C	0.58		0.58	0.52

表8.2 経済分析結果(ケース2: 支払可能環境改善) Table 8.2 Economic Evaluation of the Project (A TP)

年	事業実施費	維持管理費	費用合計	①支払可能額	②土地価格の上昇	③処理水の再利用	便益合計	キャッシュフロー
Year	Initial Construction Cost	O&M Cost	Total Economic Cost	Environmental Improvement	2.Land Price Increase	3.Reuse of Treated Waste Water	Total Economic Benefit	Cash Flow
2012	-24.40	0.00	-24.40	0.0	0.0	0.0	0.0	-24.4
2013	-128.90	0.00	-128.90	0.0	0.0	0.0	0.0	-128.9
2014	-128.60	0.00	-128.60	0.0	0.0	0.0	0.0	-128.6
2015	-1,901.60	0.00	-1,901.60	0.0	0.0	0.0	0.0	-1,901.6
2016	-1,887.10	0.00	-1,887.10	0.0	0.0	0.0	0.0	-1,887.1
2017	-1,872.00	0.00	-1,872.00	0.0	0.0	0.0	0.0	-1,872.0
2018	0.00	-94.21	-94.21	194.6	0.0	13.0	207.6	113.4
2019	0.00	-96.96	-96.96	195.6	0.0	19.2	214.8	117.8
2020	0.00	-99.71	-99.71	196.6	1,290.0	19.7	1,506.3	1,406.6
2021	-530.80	-102.47	-633.27	197.6	1,290.0	20.3	1,509.9	874.6
2022	0.00	-105.32	-105.32	198.7	1,290.0	20.8	1,509.5	1,404.3
2023	0.00	107.97	107.97	199.7	387.0	21.3	608.0	500.0
2024	0.00	110.73	110.73	200.8	387.0	21.9	609.7	499.0
2025	0.00	113.48	113.48	201.8	387.0	22.4	611.2	497.7
2026	0.00	116.23	116.23	202.9	387.0	23.0	612.9	496.7
2027	0.00	118.99	118.99	203.9	387.0	23.5	614.4	495.4
2028	0.00	121.74	121.74	205.0	387.0	24.1	616.1	494.4
2029	0.00	-124.49	-124.49	206.0	387.0	24.6	617.6	493.1
2030	0.00	-127.25	-127.25	207.0	387.0	25.1	619.1	491.9
2031	-530.80	-129.81	-660.61	208.1	387.0	25.7	620.8	-39.8
2032	-1,249.90	-132.37	-1,382.27	209.2	387.0	26.2	622.4	-759.9
2033	0.00	-134.94	-134.94	210.3	387.0	26.7	624.0	489.1
2034	0.00	-137.49	-137.49	211.4	387.0	27.2	625.6	488.1
2035	0.00	-140.06	-140.06	212.5	387.0	27.7	627.2	487.1
2036	-530.80	-142.62	-673.42	213.6	387.0	28.2	628.8	-44.6
2037	0.00	-145.19	-145.19	214.7	387.0	28.7	630.4	485.2
2038	0.00	-147.74	-147.74	215.8	387.0	29.2	632.0	484.3
2039	0.00	-150.30	-150.30	216.9	387.0	29.7	633.6	483.3
2040	0.00	-152.87	-152.87	218.0	387.0	30.2	635.2	482.3
2041	0.00	-154.59	-154.59	219.1	387.0	30.6	636.7	482.1
2042	0.00	-154.59	-154.59	220.2	387.0	30.6	637.8	483.2
2043	0.00	-154.59	-154.59	221.3	387.0	30.6	638.9	484.3
2044	0.00	-154.59	-154.59	222.4	387.0	30.6	640.0	485.4
2045	0.00	-154.59	-154.59	223.5	387.0	30.6	641.1	486.5
2046	-530.80	-154.59	-685.39	224.6	387.0	30.6	642.2	-43.2
2047	2,415.60	-154.59	2,261.01	225.7	387.0	30.6	643.3	2,904.3
Total	-6,900	-3,935	-10,835	6,297.5	13,345.0	772.6	20,615.1	9,760.0
NPV	-4,614.24	-678.77	-5,293.01	1,189.1	3,000.6	131.0	4,320.68	-972.3
						EIRR		7.2%
						NPV (D.R.=10%)		-972
						B/C		0.82

出典:調査団
Source: Study Team

感度分析 Sensibility Analysis

年	B:感度分析 CF Case2	C:感度分析 CF Case3	D:感度分析 CF Case4	費用+1 0%	便益-1 0%
Year	B: Sensibility CF Case2	C: Sensibility CF Case3	D: Sensibility CF Case4	Cost +10%	Benefit -10%
2012	-24.4	-26.84	-26.84	-26.84	0
2013	-128.9	-141.79	-141.79	-141.79	0
2014	-128.6	-141.46	-141.46	-141.46	0
2015	-1,901.6	-2,091.76	-2,091.76	-2,091.76	0
2016	-1,887.1	-2,075.81	-2,075.81	-2,075.81	0
2017	-1,872.0	-2,059.20	-2,059.20	-2,059.2	0
2018	92.6	103.97	83.17	-103.63	186.8
2019	96.3	108.14	86.64	-106.66	193.3
2020	1,256.0	1,396.62	1,246.02	-109.68	1,355.7
2021	723.8	811.30	660.5	-696.60	1,357.1
2022	1,253.4	1,393.76	1,242.86	-115.74	1,358.6
2023	439.2	489.23	428.43	-118.77	547.2
2024	438.0	487.90	426.9	-121.80	548.7
2025	436.6	486.37	425.27	-124.83	550.1
2026	435.4	485.05	423.75	-127.85	551.6
2027	434.0	483.51	422.11	-130.89	553
2028	432.8	482.19	420.59	-133.91	554.5
2029	431.3	480.66	418.86	-136.94	555.8
2030	430.0	479.12	417.22	-139.98	557.2
2031	-101.9	-105.87	-167.97	-726.67	558.7
2032	-82.1	-89.10	-96.03	-1520.50	560.2
2033	426.7	475.57	413.17	-148.43	561.6
2034	425.5	474.36	411.76	-151.24	563
2035	424.4	473.13	410.43	-154.07	564.5
2036	-107.5	-11.96	-174.86	-740.76	565.9
2037	422.2	470.69	407.69	-159.71	567.4
2038	421.1	469.49	406.29	-162.51	568.8
2039	419.9	468.27	404.87	-165.33	570.2
2040	418.8	467.04	403.54	-168.16	571.7
2041	418.4	466.65	402.95	-170.05	573
2042	419.4	467.75	403.95	-170.05	574
2043	420.4	468.85	404.95	-170.05	575
2044	421.4	469.95	405.95	-170.05	576
2045	422.4	471.05	406.95	-170.05	577
2046	-107.4	-11.73	-175.93	-753.93	578
2047	2,840.0	3,130.41	3,066.11	2,487.11	579
Total	7,718.5	8,696.3	8,635.0	-11,918.0	18,388.6
NPV	-1,404.4	-1,501.6	-1,933.7	-5,822.3	3,888.6
EIRR	5.8%	5.9%	4.7%		
NPV	-1.404	-1.502	-1.934		
B/C	0.73	0.74	0.67		

表8.3 財務費用計算

Table 8.3 Total Cost Calculation

年	專案基礎費 / Initial Construction Cost										合計財務費用 / Total Financial Cost												
	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5		Alternative 6 (BOT scheme)	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6 (BOT scheme)						
	100% BMA Budget	0% BMA Budget	40% BMA Budget	60% BMA Budget	85% ODA Loan Accumulate d Amount	15% BMA Budget + 85% ODA Loan Repayment	0% Subsidized	85.0%	15.0%	0% BMA Budget								40% BMA Budget	60% BMA Budget	0% BMA Budget	15% BMA Budget, 85% ODA Loan Repayment	Total Cost	Cash Flow Balance
Year	①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮	⑯	⑰	⑱	㉑	㉒	㉓		
2012	28.2	28.2	28.2	28.2	21.0	21.0	21.0	21.0	21.0	21.0	21.0	28.2	28.2	28.2	28.2	28.2	28.2	28.2	28.2	28.2	28.2	28.2	
2013	47.3	47.3	47.3	47.3	22.1	22.1	22.1	22.1	22.1	22.1	22.1	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	47.3	
2014	172	172	172	172	22.1	22.1	22.1	22.1	22.1	22.1	22.1	172	172	172	172	172	172	172	172	172	172	172	
2015	2,218.9	1,331.3	887.6	0.0	332.8	1,886.1	2,163.3	332.8	0.0	0.0	0.0	2,218.9	1,331.3	887.6	0.0	332.8	1,886.1	2,163.3	332.8	0.0	0.0	2,218.9	
2016	2,206.8	1,324.1	882.7	0.0	331.0	1,875.8	2,153.2	331.0	0.0	0.0	0.0	2,206.8	1,324.1	882.7	0.0	331.0	1,875.8	2,153.2	331.0	0.0	0.0	2,206.8	
2017	2,194.2	1,316.5	877.7	0.0	329.1	1,865.1	2,141.6	329.1	0.0	0.0	0.0	2,194.2	1,316.5	877.7	0.0	329.1	1,865.1	2,141.6	329.1	0.0	0.0	2,194.2	
2018																							
2019																							
2020																							
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合計	6,942.60	4,294.60	2,970.70		1,041.30	5,901.30	8,002.70	1,041.30	5,901.30	7,761.40	7,761.40	11,948.94	9,300.94	7,977.04	5,329.04	12,767.74	11,948.94	11,948.94	11,948.94	11,948.94	11,948.94	11,948.94	21,315.00

表8.4 總收入予測

Table 8.4 Calculation of Total Revenue

年	給水量(m ³ /年)			Revenue of Basic Plan (Baht/Year)			Revenue of Total Revenue	
	生活用	業務用	合計給水量	生活用	業務用	追加収入	Water Supply Amount (m ³ /year)	Total
Year	Living Use	Commercial Use	Total	Living Use	Commercial Use	Total	Living Use	Total
Unit Cost	Referring to MIP Report table 1.1.6							
2012	0	0	0	2.00	2.37	2.22	0	0
2013	0	0	0	0	0	0	0	0
2014	0	0	0	0	0	0	0	0
2015	0	0	0	0	0	0	0	0
2016	0	0	0	0	0	0	0	0
2017	0	0	0	0	0	0	0	0
2018	15,841,805	23,753,526	39,595,331	108,480	31,683,610	56,295,857	87,979,467	87,979,467
2019	16,029,107	24,039,070	40,068,177	109,776	32,058,214	56,972,596	89,030,810	89,030,810
2020	16,216,469	24,324,614	40,541,083	111,071	32,432,818	57,649,334	90,082,132	90,082,132
2021	16,403,711	24,610,158	41,013,869	112,367	32,807,422	58,326,074	91,133,496	91,133,496
2022	16,591,013	24,895,702	41,486,715	113,662	33,182,026	59,002,814	92,184,840	92,184,840
2023	16,778,315	25,181,246	41,959,561	114,958	33,556,630	59,679,553	93,236,183	93,236,183
2024	16,965,617	25,466,790	42,432,407	116,253	33,931,234	60,356,292	94,287,526	94,287,526
2025	17,152,919	25,752,334	42,905,253	117,549	34,305,838	61,033,032	95,338,870	95,338,870
2026	17,340,221	26,037,878	43,378,099	118,844	34,680,442	61,709,771	96,390,213	96,390,213
2027	17,527,523	26,323,422	43,850,945	120,140	35,055,046	62,386,510	97,441,556	97,441,556
2028	17,714,825	26,608,966	44,323,791	121,435	35,429,650	63,063,249	98,492,899	98,492,899
2029	17,902,127	26,894,510	44,796,637	122,731	35,804,254	63,739,989	99,544,243	99,544,243
2030	18,089,428	27,180,055	45,269,483	124,026	36,178,857	64,416,730	100,595,587	100,595,587
2031	18,276,729	27,465,600	45,742,329	125,321	36,553,461	65,093,471	101,646,930	101,646,930
2032	18,464,030	27,751,145	46,215,175	126,616	36,928,065	65,770,212	102,698,173	102,698,173
2033	18,651,331	28,036,690	46,688,021	127,911	37,302,669	66,446,953	103,749,416	103,749,416
2034	18,838,632	28,322,235	47,160,867	129,206	37,677,273	67,121,694	104,800,659	104,800,659
2035	19,025,933	28,607,780	47,633,713	130,501	38,051,877	67,794,435	105,851,902	105,851,902
2036	19,213,234	28,893,325	48,106,559	131,796	38,426,481	68,467,176	106,903,145	106,903,145
2037	19,400,535	29,178,870	48,579,405	133,091	38,801,085	69,139,917	107,954,388	107,954,388
2038	19,587,836	29,464,415	49,052,251	134,386	39,175,689	69,814,658	109,005,631	109,005,631
2039	19,775,137	29,749,960	49,525,097	135,681	39,550,293	70,489,400	110,056,874	110,056,874
2040	19,962,438	30,035,505	50,000,000	136,976	39,924,897	71,164,142	111,108,117	111,108,117
2041	20,149,739	30,321,050	50,470,000	138,271	40,299,501	71,838,884	112,159,360	112,159,360
2042	20,337,040	30,606,595	50,940,000	139,566	40,674,105	72,513,626	113,210,603	113,210,603
2043	20,524,341	30,892,140	51,410,000	140,861	41,048,709	73,188,368	114,261,846	114,261,846
2044	20,711,642	31,177,685	51,880,000	142,156	41,423,313	73,863,110	115,313,089	115,313,089
2045	20,898,943	31,463,230	52,350,000	143,451	41,797,917	74,537,852	116,364,332	116,364,332
2046	21,086,244	31,748,775	52,820,000	144,746	42,172,521	75,212,594	117,415,575	117,415,575
2047	21,273,545	32,034,320	53,300,000	146,041	42,547,125	75,887,336	118,466,818	118,466,818

Collection Rate = 99.2%

年	Total Revenue			Total Revenue with Collection Fee (Million Baht/Year)		
	料金徴収委託	平均料金	平均料金	収入試算1 10%/5Year	収入試算2 20%/5Year	収入試算3 30%/5Year
Year	Collection Fee to MWA	Average Tariff	Average Tariff	Alternative 1 10%/5Year	Alternative 2 20%/5Year	Alternative 3 30%/5Year
Unit Cost	3.36/baht /Month					
2012	0	2.22	2.22	0	0	0
2013	0	2.22	2.22	0	0	0
2014	0	2.22	2.22	0	0	0
2015	0	2.22	2.22	0	0	0
2016	0	2.22	2.22	0	0	0
2017	0	2.44	2.66	0	0	0
2018	3,498,160	2,444	2,666	95,839,707	104,480,992	113,515,063
2019	3,044,496	2,444	2,666	96,984,221	105,728,700	114,870,655
2020	3,039,700	2,444	2,666	98,128,733	106,976,407	116,226,247
2021	3,074,988	2,444	2,666	99,273,250	108,224,116	117,581,841
2022	3,090,360	2,688	3.19	110,294,921	131,283,880	154,742,128
2023	3,105,816	2,688	3.19	111,552,010	132,780,192	156,505,806
2024	3,121,356	2,688	3.19	112,809,100	134,276,503	158,269,484
2025	3,136,980	2,688	3.19	114,066,189	135,772,815	160,033,161
2026	3,152,646	2,688	3.19	115,323,279	137,269,127	161,796,839
2027	3,168,396	2,955	3.83	128,325,405	166,605,526	212,715,672
2028	3,184,230	2,955	3.83	129,709,142	168,402,039	215,009,391
2029	3,200,148	2,955	3.83	131,092,879	170,198,551	217,303,110
2030	3,216,150	2,955	3.83	132,476,616	171,995,065	219,596,832
2031	3,232,236	2,955	3.83	133,875,506	173,792,579	221,890,555
2032	3,248,406	3,255	4.60	147,929,420	209,377,025	289,486,495
2033	3,264,660	3,255	4.60	148,919,723	210,778,684	291,424,442
2034	3,280,998	3,255	4.60	149,910,026	212,180,344	293,562,389
2035	3,297,420	3,255	4.60	150,900,329	213,582,004	295,700,336
2036	3,313,926	3,255	4.60	151,890,632	214,983,664	297,838,284
2037	3,330,516	3,588	5.52	168,404,230	259,662,389	389,023,180
2038	3,347,148	3,588	5.52	169,495,088	261,344,381	391,543,121
2039	3,363,864	3,588	5.52	170,585,945	263,026,373	394,063,062
2040	3,380,664	3,588	5.52	171,676,818	264,708,389	396,583,040
2041	3,397,548	3,588	5.52	172,767,676	266,390,384	399,102,984
2042	3,414,516	3,944	6.62	190,140,962	319,475,424	518,785,620
2043	3,431,568	3,944	6.62	190,140,962	319,475,424	518,785,620
2044	3,448,746	3,944	6.62	190,140,962	319,475,424	518,785,620
2045	3,466,008	3,944	6.62	190,140,962	319,475,424	518,785,620
2046	3,483,354	3,944	6.62	190,140,962	319,475,424	518,785,620
2047	3,500,784	4,333	7.94	208,962,022	383,177,472	674,662,602

Collection Rate = 99.2%

年	Total Revenue with Collection Fee (Million Baht/Year)		
	収入試算1 10%/5Year	収入試算2 20%/5Year	収入試算3 30%/5Year
Year	Alternative 1 10%/5Year	Alternative 2 20%/5Year	Alternative 3 30%/5Year
Unit Cost			
2012	0.0	0.0	0.0
2013	0.0	0.0	0.0
2014	0.0	0.0	0.0
2015	0.0	0.0	0.0
2016	0.0	0.0	0.0
2017	0.0	0.0	0.0
2018	92.3	101.0	110.0
2019	93.9	102.7	111.8
2020	93.1	103.9	113.2
2021	96.2	105.1	114.5
2022	107.2	128.2	151.7
2023	108.4	129.7	153.4
2024	109.7	131.2	155.1
2025	110.9	132.6	156.9
2026	112.2	134.1	158.6
2027	125.2	163.4	209.5
2028	126.5	165.2	211.8
2029	127.9	167.0	214.1
2030	129.3	168.8	216.4
2031	130.1	169.9	217.9
2032	144.7	206.1	286.2
2033	145.7	207.5	288.2
2034	146.6	208.9	290.1
2035	147.6	210.3	292.0
2036	148.6	211.7	293.9
2037	165.1	256.3	385.7
2038	166.1	258.0	388.2
2039	167.2	259.7	390.7
2040	168.3	261.3	393.2
2041	169.4	263.0	395.7
2042	186.7	316.1	515.4
2043	186.7	316.0	515.3
2044	186.7	316.0	515.3
2045	186.7	316.0	515.3
2046	186.7	316.0	515.3
2047	205.5	379.7	671.2
Total	4,273.2	6,205.4	8,946.7

表8.5 費用・収入の代替案毎のキャッシュフロー
Table 8.5 Cash Flow of All Alternatives (Cost, Revenue)

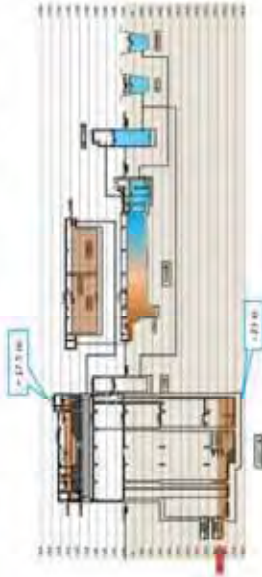
Cost Alternative	Alternative1		Alternative2		Alternative3		Alternative4		Alternative5		Alternative6			
	Full Cost Recovery		40% Subsidized		60% Subsidized		Only O&M Cost		Full Cost Recovery, ICA ODA Loan 8%		Private Company, 30years BOT			
	e1	e2	e1	e2	e1	e2	e1	e2	e1	e2	e1	e2		
	10%/5y	30%/5y	10%/5y	30%/5y	10%/5y	30%/5y	10%/5y	30%/5y	10%/5y	20%/5y	30%/5y	10%/5y	20%/5y	30%/5y
2012	-28.20	-28.20	-28.20	-28.20	-28.20	-28.20	-28.20	-28.20	-28.20	-4.20	-4.20	0.00	0.00	0.00
2013	-147.30	-147.30	-147.30	-147.30	-147.30	-147.30	-147.30	-147.30	-147.30	-22.10	-22.10	0.00	0.00	0.00
2014	-147.20	-147.20	-147.20	-147.20	-147.20	-147.20	-147.20	-147.20	-147.20	-22.10	-22.10	0.00	0.00	0.00
2015	-2,218.90	-2,218.90	-1,331.30	-1,331.30	-887.60	-887.60	-887.60	-887.60	0.00	-332.80	-332.80	0.00	0.00	0.00
2016	3,206.80	3,206.80	2,306.80	2,306.80	1,331.10	882.70	882.70	882.70	0.00	331.00	331.00	0.00	0.00	0.00
2017	-2,194.30	-2,194.30	-2,166.50	-2,166.50	-2,316.50	-877.70	-877.70	-877.70	0.00	-329.70	-329.70	0.00	0.00	0.00
2018	10.16	1.40	7.60	10.16	16.10	6.60	7.60	10.16	1.40	7.60	10.16	6.60	7.60	10.16
2019	-21.39	-21.39	6.41	-21.39	-21.39	6.41	-21.39	6.41	-21.39	6.41	-21.39	6.41	-21.39	6.41
2020	-13.28	-13.28	4.82	-13.28	-13.28	4.82	-13.28	4.82	-13.28	4.82	-13.28	4.82	-13.28	4.82
2021	-535.98	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08	-537.08
2022	7.17	13.83	37.33	7.17	13.83	37.33	7.17	13.83	37.33	7.17	13.83	37.33	7.17	13.83
2023	9.03	30.48	78.08	9.03	30.48	78.08	9.03	30.48	78.08	9.03	30.48	78.08	9.03	30.48
2024	-10.66	10.84	34.74	-10.66	10.84	34.74	-10.66	10.84	34.74	-10.66	10.84	34.74	-10.66	10.84
2025	12.45	33.55	92.25	12.45	33.55	92.25	12.45	33.55	92.25	12.45	33.55	92.25	12.45	33.55
2026	-12.14	7.76	32.26	-12.14	7.76	32.26	-12.14	7.76	32.26	-12.14	7.76	32.26	-12.14	7.76
2027	-1.14	34.06	80.16	-1.14	34.06	80.16	-1.14	34.06	80.16	-1.14	34.06	80.16	-1.14	34.06
2028	-5.83	32.87	79.47	-5.83	32.87	79.47	-5.83	32.87	79.47	-5.83	32.87	79.47	-5.83	32.87
2029	-7.12	31.68	78.78	-7.12	31.68	78.78	-7.12	31.68	78.78	-7.12	31.68	78.78	-7.12	31.68
2030	-5.1.86	-502.00	-511.80	-512.00	-511.80	-511.80	-511.80	-511.80	-511.80	-511.80	-511.80	-511.80	-511.80	-511.80
2031	9.03	30.48	78.08	9.03	30.48	78.08	9.03	30.48	78.08	9.03	30.48	78.08	9.03	30.48
2032	1,093.68	1,187.68	1,107.58	1,209.08	1,187.68	1,107.58	1,209.08	1,187.68	1,107.58	1,209.08	1,187.68	1,107.58	1,209.08	1,187.68
2033	60.83	141.53	60.83	141.53	60.83	141.53	60.83	141.53	60.83	141.53	60.83	141.53	60.83	141.53
2034	3.85	59.45	140.65	3.85	59.45	140.65	3.85	59.45	140.65	3.85	59.45	140.65	3.85	59.45
2035	-1.64	58.06	139.76	-1.64	58.06	139.76	-1.64	58.06	139.76	-1.64	58.06	139.76	-1.64	58.06
2036	-537.22	-734.12	-537.22	-734.12	-537.22	-734.12	-537.22	-734.12	-537.22	-734.12	-537.22	-734.12	-537.22	-734.12
2037	7.29	98.49	227.89	7.29	98.49	227.89	7.29	98.49	227.89	7.29	98.49	227.89	7.29	98.49
2038	5.51	97.41	227.61	5.51	97.41	227.61	5.51	97.41	227.61	5.51	97.41	227.61	5.51	97.41
2039	3.83	96.33	227.33	3.83	96.33	227.33	3.83	96.33	227.33	3.83	96.33	227.33	3.83	96.33
2040	2.14	227.04	2.14	227.04	2.14	227.04	2.14	227.04	2.14	227.04	2.14	227.04	2.14	227.04
2041	1.37	94.97	227.67	1.37	94.97	227.67	1.37	94.97	227.67	1.37	94.97	227.67	1.37	94.97
2042	18.67	148.07	347.37	18.67	148.07	347.37	18.67	148.07	347.37	18.67	148.07	347.37	18.67	148.07
2043	18.67	147.97	347.37	18.67	147.97	347.37	18.67	147.97	347.37	18.67	147.97	347.37	18.67	147.97
2044	18.67	147.97	347.27	18.67	147.97	347.27	18.67	147.97	347.27	18.67	147.97	347.27	18.67	147.97
2045	18.67	147.97	347.27	18.67	147.97	347.27	18.67	147.97	347.27	18.67	147.97	347.27	18.67	147.97
2046	5.12.13	382.83	183.53	5.12.13	382.83	183.53	5.12.13	382.83	183.53	5.12.13	382.83	183.53	5.12.13	382.83
2047	2,681.37	2,855.57	3,147.07	2,681.37	2,855.57	3,147.07	2,681.37	2,855.57	3,147.07	2,681.37	2,855.57	3,147.07	2,681.37	2,855.57
NPV (DR=0%)	-7,675.7	-5,743.5	-3,002.2	-5,027.7	-3,095.5	-354.2	-3,203.8	-1,771.6	969.7	-8,494.5	-6,562.3	-3,821.0	-17,041.8	-12,368.3
FIRR	-5.7%	-3.8%	-1.7%	-4.8%	-2.6%	-0.3%	-4.2%	-1.8%	0.8%	-1.7%	-1.7%	-5.5%	n.a.	n.a.
NPV (DR=3.13%)	-7,125	-6,247	-5,033	-4,783	-3,906	-2,692	-3,613	-2,735	-1,521	-5,182	-4,304	-3,090	-8,649	-7,435

Appendix-9

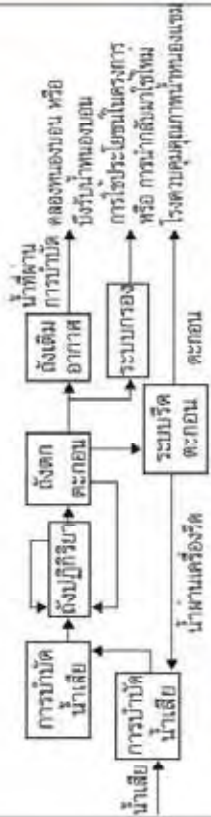
Pamphlet of Nong Bon Wastewater Treatment Project

การบำบัดน้ำเสีย

ภาพถ่ายแสดงกระบวนการบำบัดน้ำเสียแบบ Carrier Added Activated Sludge Process



แผนภาพแสดงกระบวนการบำบัดน้ำเสียแบบของบอง



เป้าหมายในการดำเนินโครงการ เพื่อปรับปรุงคุณภาพน้ำในคลองในพื้นที่บริการ



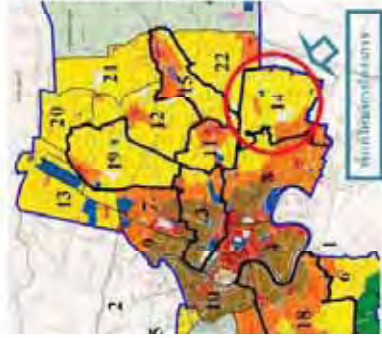
สามารถดูข้อมูลเพิ่มเติมได้ที่
สำนักงานจัดการคุณภาพน้ำ สำนักงานเขตบางนา โทร. ๐-๒๒๖๗-๘๐๓๓
www.ods.bangkok.go.th



โครงการบำบัดน้ำเสียบึงหนองบอน



โครงการบำบัดน้ำเสียบึงหนองบอนจัดทำขึ้นเพื่อแก้ไขปัญหาน้ำเน่าเสียในพื้นที่ให้บริการ เช่น คลองระเวศบุรีรัมย์ คลองใต้บึงทองหนองบอน คลองระวานเขต คลองเตย และ คลองซำซรีบุรีรัมย์ เป็นต้น โครงการพื้นที่ของระเวศบุรีรัมย์และ บางส่วนของเขตบางนาและเขตสวนหลวง รวมทั้งมีประมาณ ๖๔.๕ ตารางกิโลเมตร ซึ่งจะใช้การบำบัดน้ำเสียแบบประจุไฟฟ้า ในขนาดประมาณ ๒๕๐,๐๐๐ คน โดยระบบมีศักยภาพในการบำบัดน้ำเสียประมาณ ๓๕๕,๐๐๐ ลูกบาศก์เมตรต่อวัน



สำหรับการบ่งชี้ คุณสมบัติของน้ำ ระบุตามเกณฑ์ ระบุใน คู่มือทำรายงาน JICA

แนวทอรวบรวมน้ำเสียโครงการบำบัดน้ำเสียบึงหนองบอน

จะทำการรวบรวมน้ำเสียในชั้นที่เขตปกครอง และบางส่วนของเขตบางและเขตสวนหลวง โดยวางแนวทอรวบรวมน้ำเสียได้แก่คลองและได้ไว้จากรา ความสัมพันธ์ในแผนที่ ดังรูป



→ แนวท่อได้ถนน ระยะทางรวมประมาณ ๕๓.๕๐ กม.
→ แนวท่อใต้คลอง ระยะทางรวมประมาณ ๒๐.๗๘ กม.

การก่อสร้างระบบรวมน้ำเสีย



แผนผังแสดงพื้นที่ก่อสร้างระบบบำบัดน้ำเสียบึงหนองบอน



ข้อกำหนดการบำบัดน้ำเสีย

ค่าชี้วัด	น้ำเสียระยอง	น้ำทิ้งท่าอากาศยาน	ค่าชี้วัด	น้ำเสียระยอง	น้ำทิ้งท่าอากาศยาน
ค่าบีโอดี - pH	-	๕.๕-๕.๐	ค่าพีเอช	๘ มก. / ลิตร	ไม่เกิน ๒ มก. / ลิตร
ค่าบีโอดี - BOD	๑๕๐ มก. / ลิตร	ไม่เกิน ๒๐ มก. / ลิตร	สมมติเป็น	-	ไม่เกิน ๕ มก. / ลิตร
ปริมาณสารแขวนลอย	๑๕๐ มก. / ลิตร	ไม่เกิน ๓๐ มก. / ลิตร	ค่าออกซิเจนละลายในน้ำ	-	ไม่ต่ำกว่า ๕ มก. / ลิตร
ไนโตรเจน	๓๐ มก. / ลิตร	ไม่เกิน ๑๐ มก. / ลิตร	ไนโตรเจนรวม	-	ไม่เกิน ๕ มก. / ลิตร

ที่ตั้งโรงบำบัดน้ำเสีย
 ความสามารถในการบำบัดน้ำเสีย
 กระบวนการบำบัด

อยู่ติดกับบึงน้ำหนองบอน ใกล้สวนหลวง ร.๙
 ประมาณ ๓๓.๕๐๐ ๓๓.๕๐๐ ตูณภาคถนนศรีอยุธยา
 แบบ Carrier added activated sludge



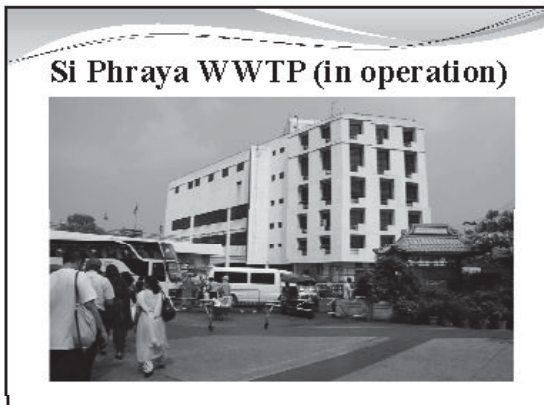
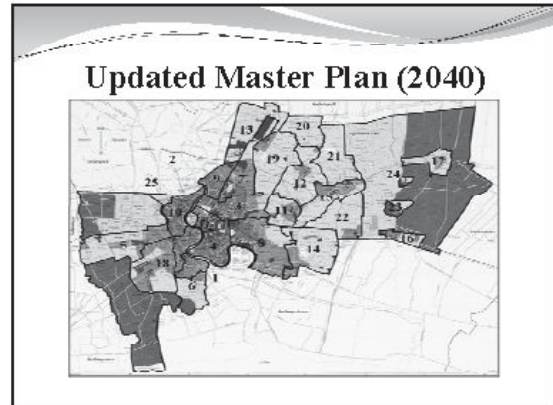
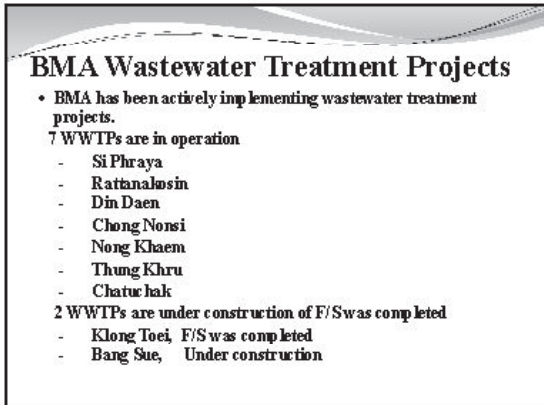
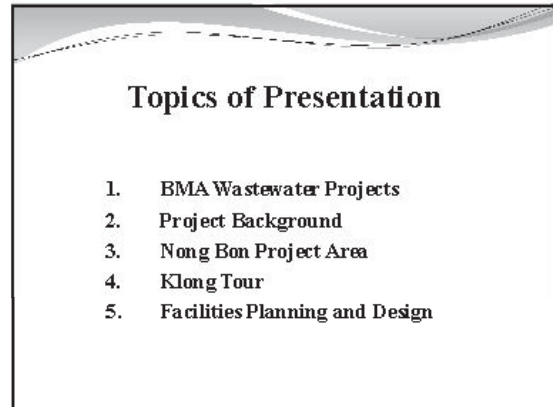
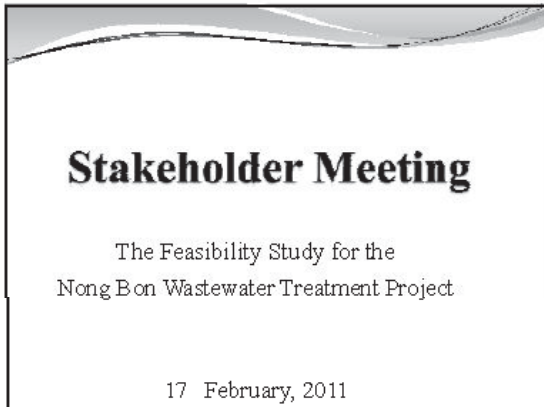
Appendix-10

Presentation Materials for Stakeholder Meetings

- 1) First stakeholder meeting held on 17th February,**
- 2) Second stakeholder meeting held on 29th March**

English version and Thai version

1)-1 First stakeholder meeting held on 17th February (English version)



Chong Nonsi WWTP (in operation)



Nong Khaem WWTP (in operation) 1



Nong Khaem WWTP (in operation) 2



Chatuchak WWTP (in operation)



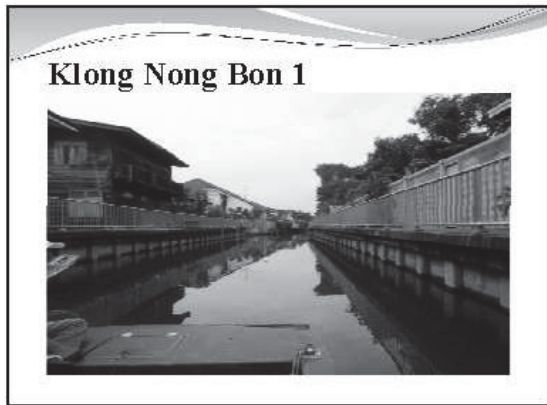
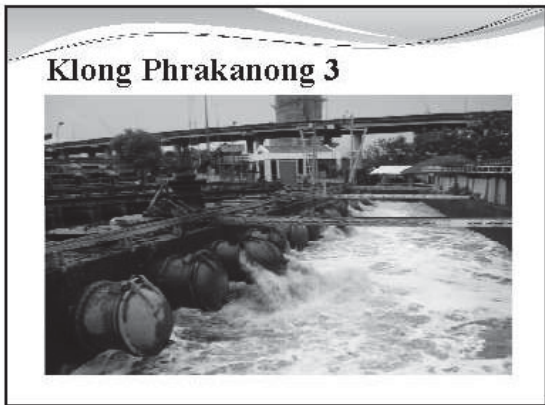
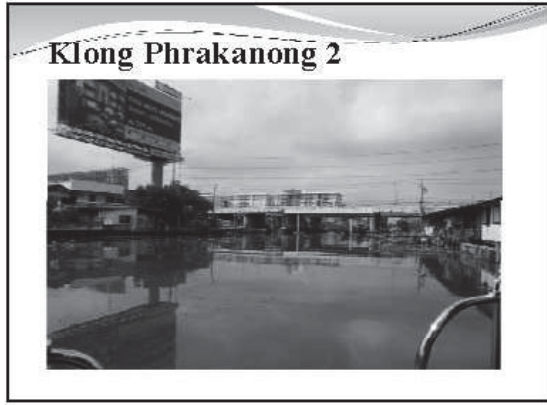
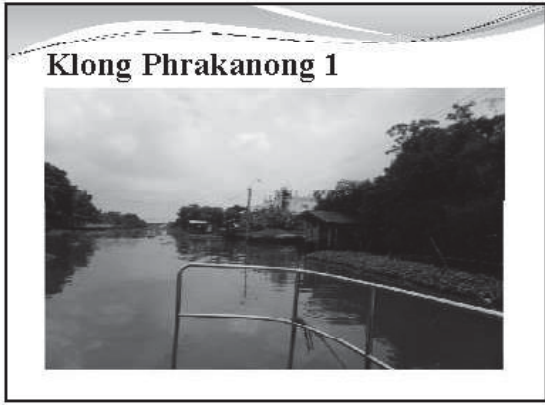
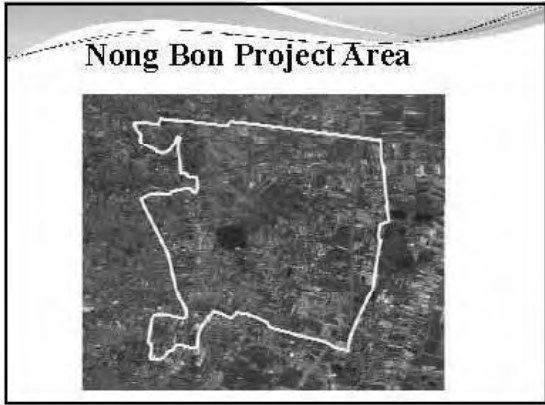
Bang Sue WWTP (under construction)



Nong Bon Project

- JICA Survey Team commenced master plan update in March, 2010 and is now conducting feasibility study for Nong Bon Project. Project area consists of the following three districts and totals 6,385 ha.

- - Prawet District
- - Suan Luang District
- - Bang Na District



Klong Nong Bon 2



Klong Khlet 1



Klong Khlet 2



Klong Bang Na 1

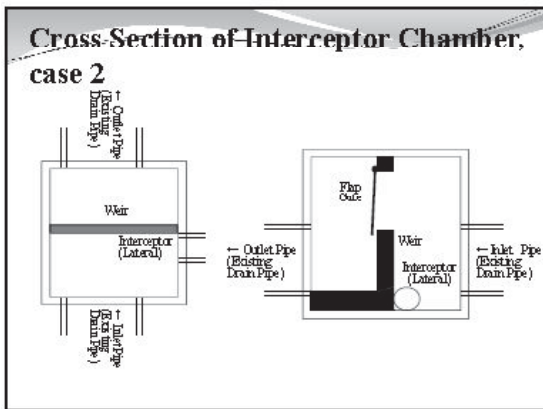
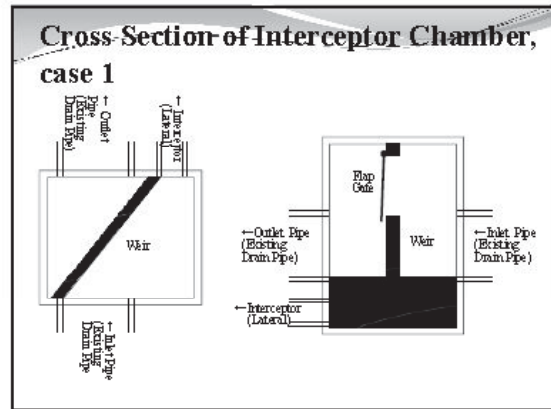
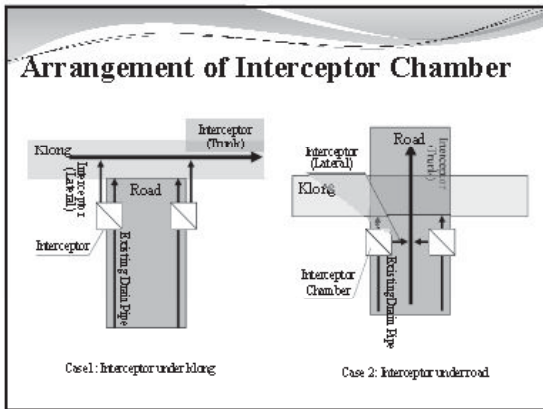


Klong Bang Na 2



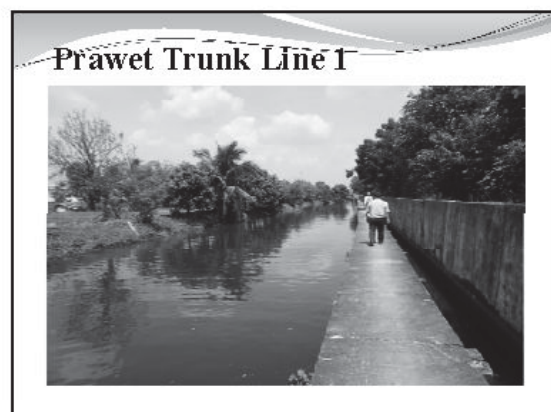
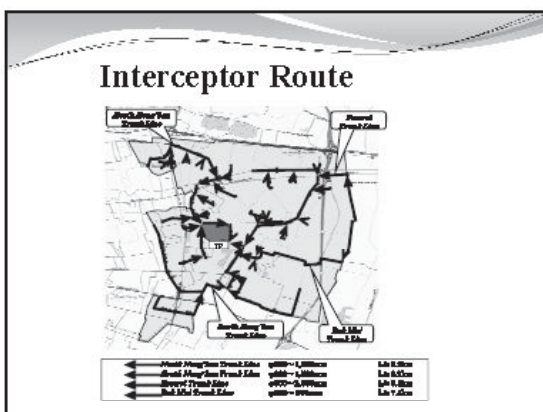
Facilities Planning and Design

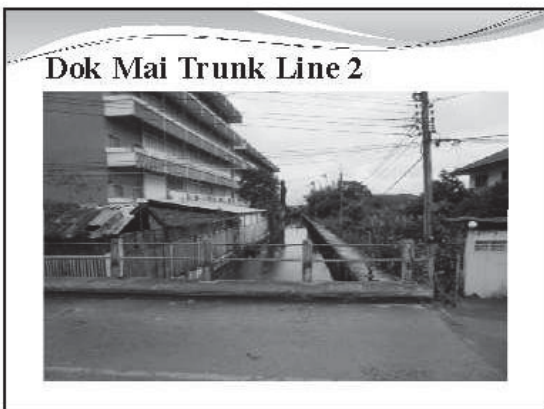
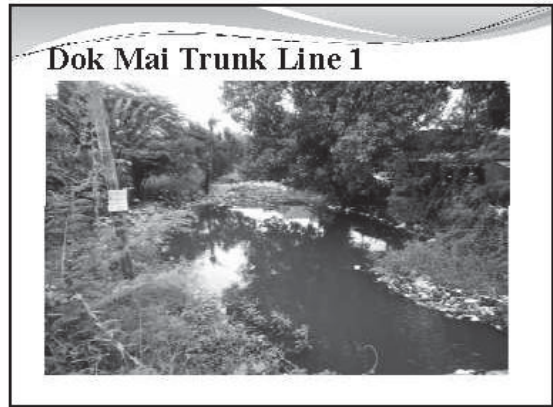
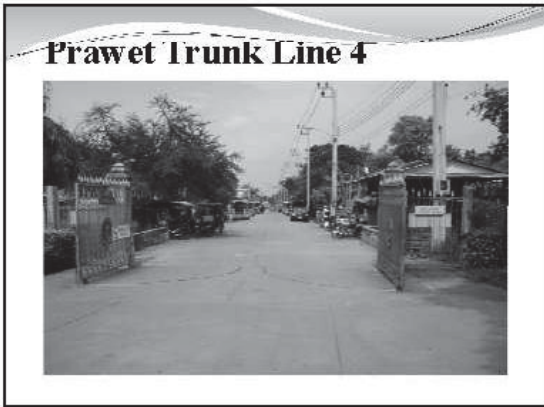
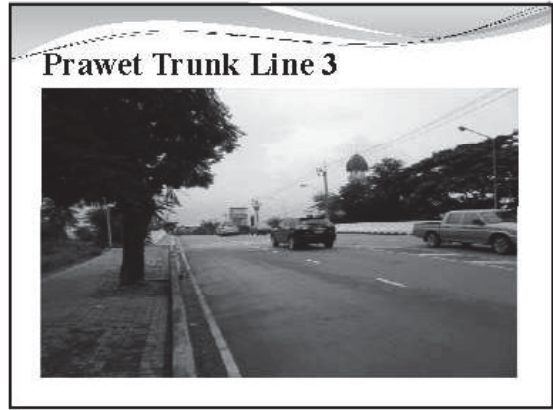
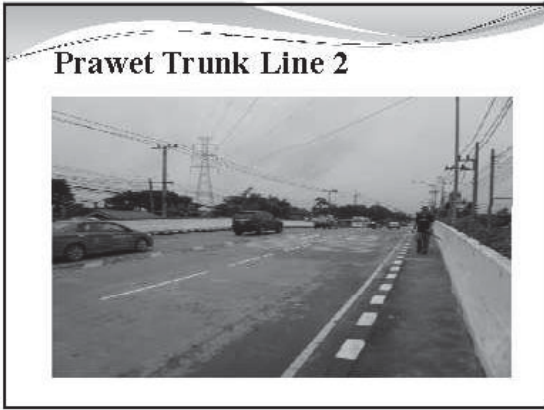
- Interceptor Chamber
- Interceptors
- Wastewater Treatment Plant (WWTP)

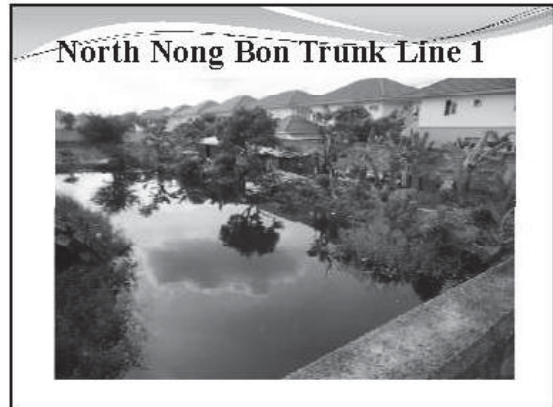
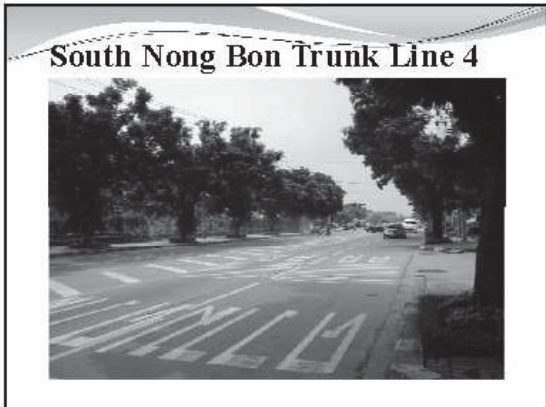
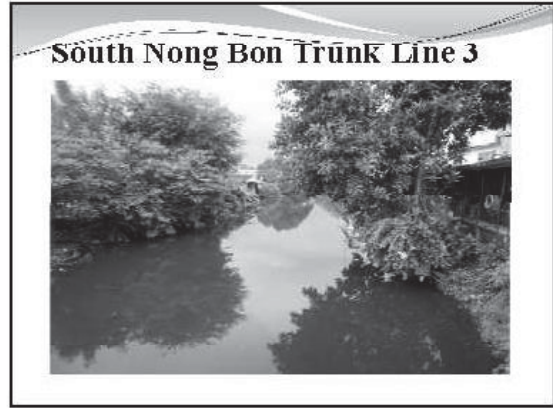
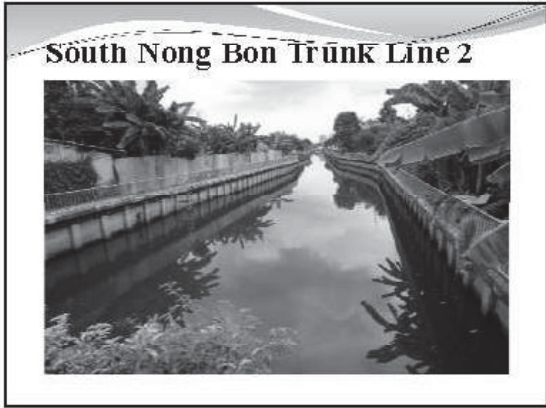
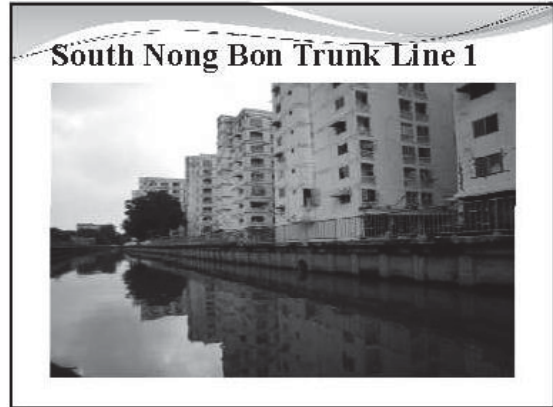
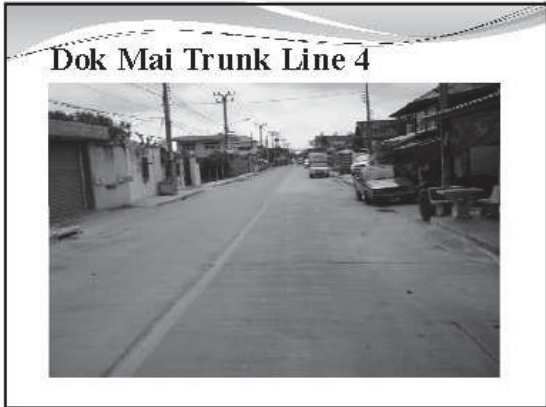


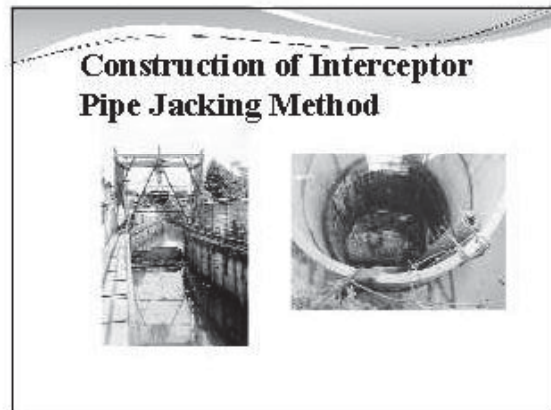
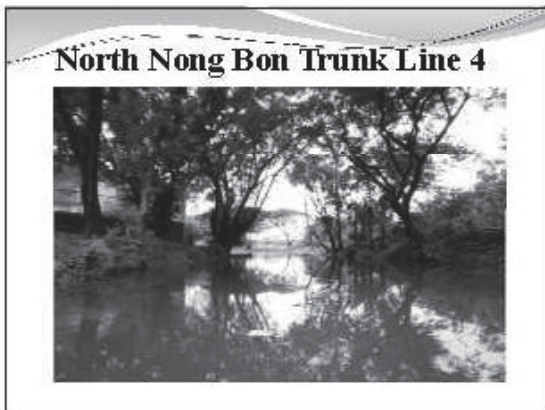
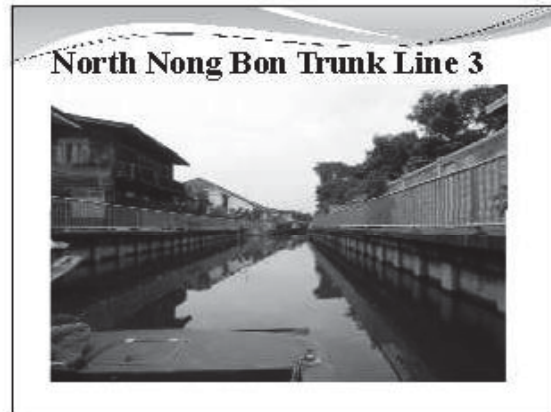
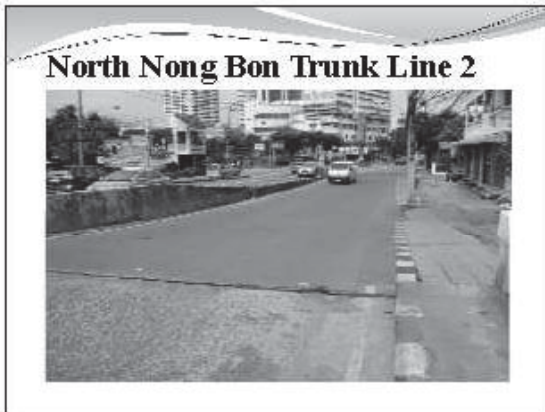
Location of Outlets

- **136 Existing outlets**
Wastewater from these outlets to be intercepted
- 94 small catchment areas**
Project area is divided by these outlets









Nong Bon Wastewater Treatment Plant

- Location: Near Rama IX Park,
Next to Storm Water Reservoir
- Design Capacity: 135,000 m³/day (daily average)
- Treatment Process: Carrier added activated Sludge



Wastewater Characteristics

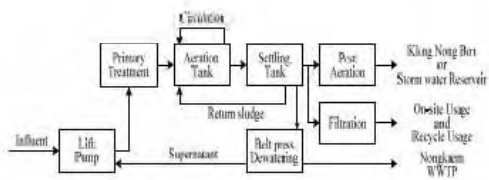
Parameter	Influent	Effluent
pH	-	5.5 – 9.0
BOD	150 mg/l	20 mg/l
SS	150 mg/l	30 mg/l
T-N	30 mg/l	10 mg/l
NH ₄		5 mg/l
T-P	8 mg/l	2 mg/l
DO	-	5 mg/l
Oil & Grease	-	5 mg/l

Wastewater Treatment Plant

Carrier
added
activated
sludge
process
WWTP
in Japan



Treatment Process



Improvement of Water Quality in Klong



Thank you