Appendix 5 References

5.1 Outline Design Drawings

5.2 Hydraulic Analysis of Water Distribution System

5.3 Letter on Water Intake

5.4 Environmental Monitoring Form

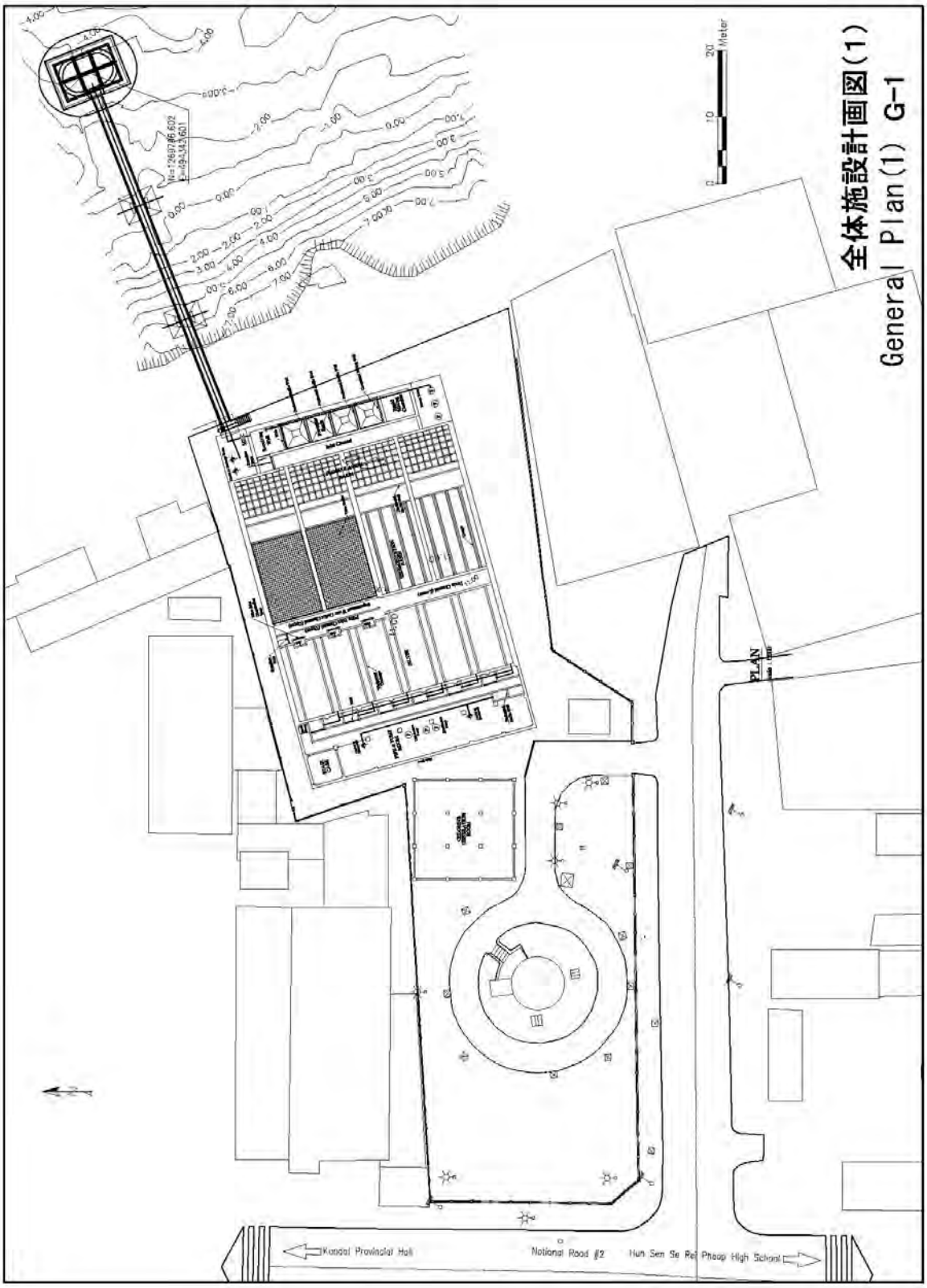
5.5 Environmental Checklist

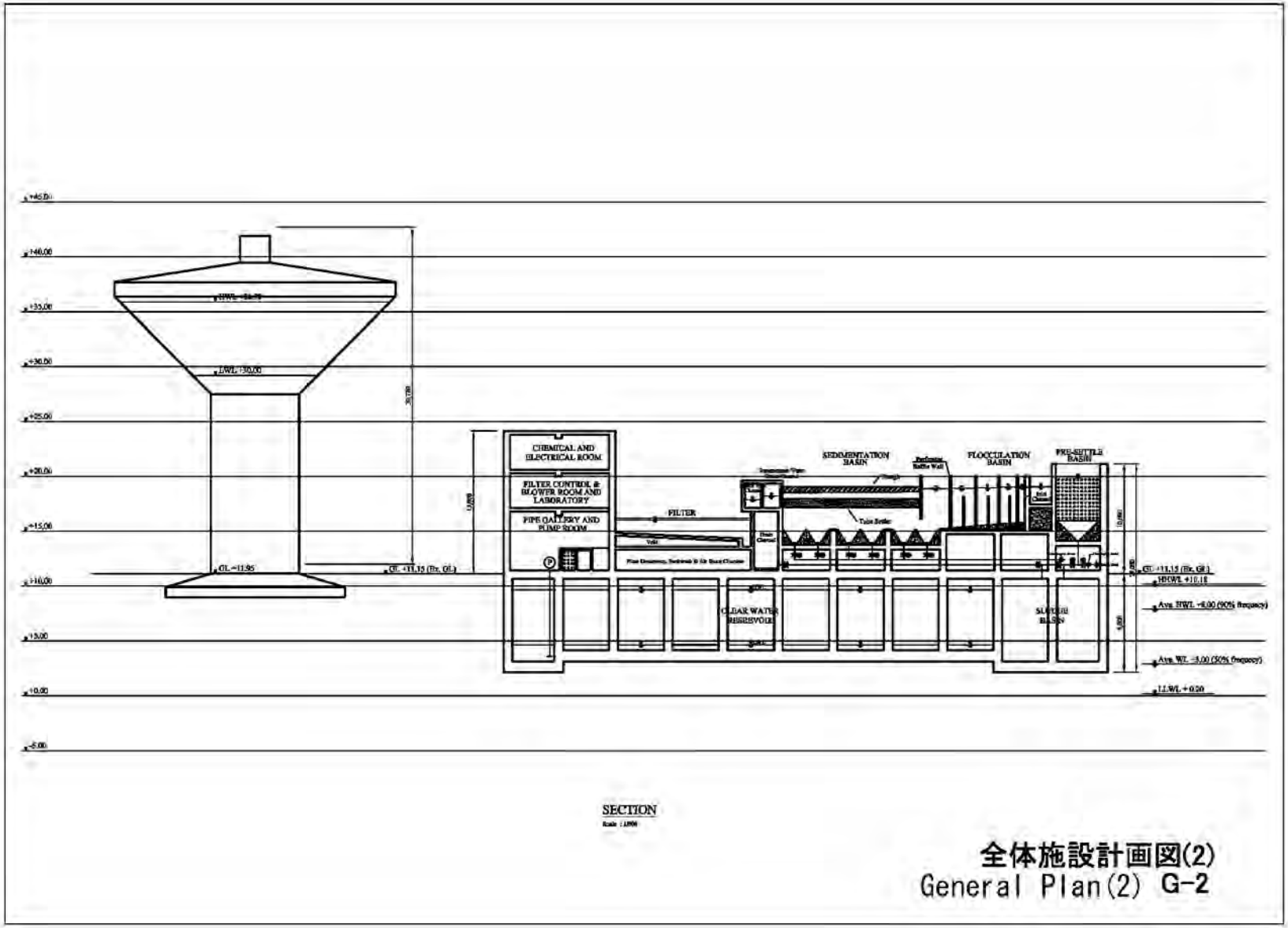
5.6 Environmental Management Plan

5.7 Production and consumption data for each WTP.

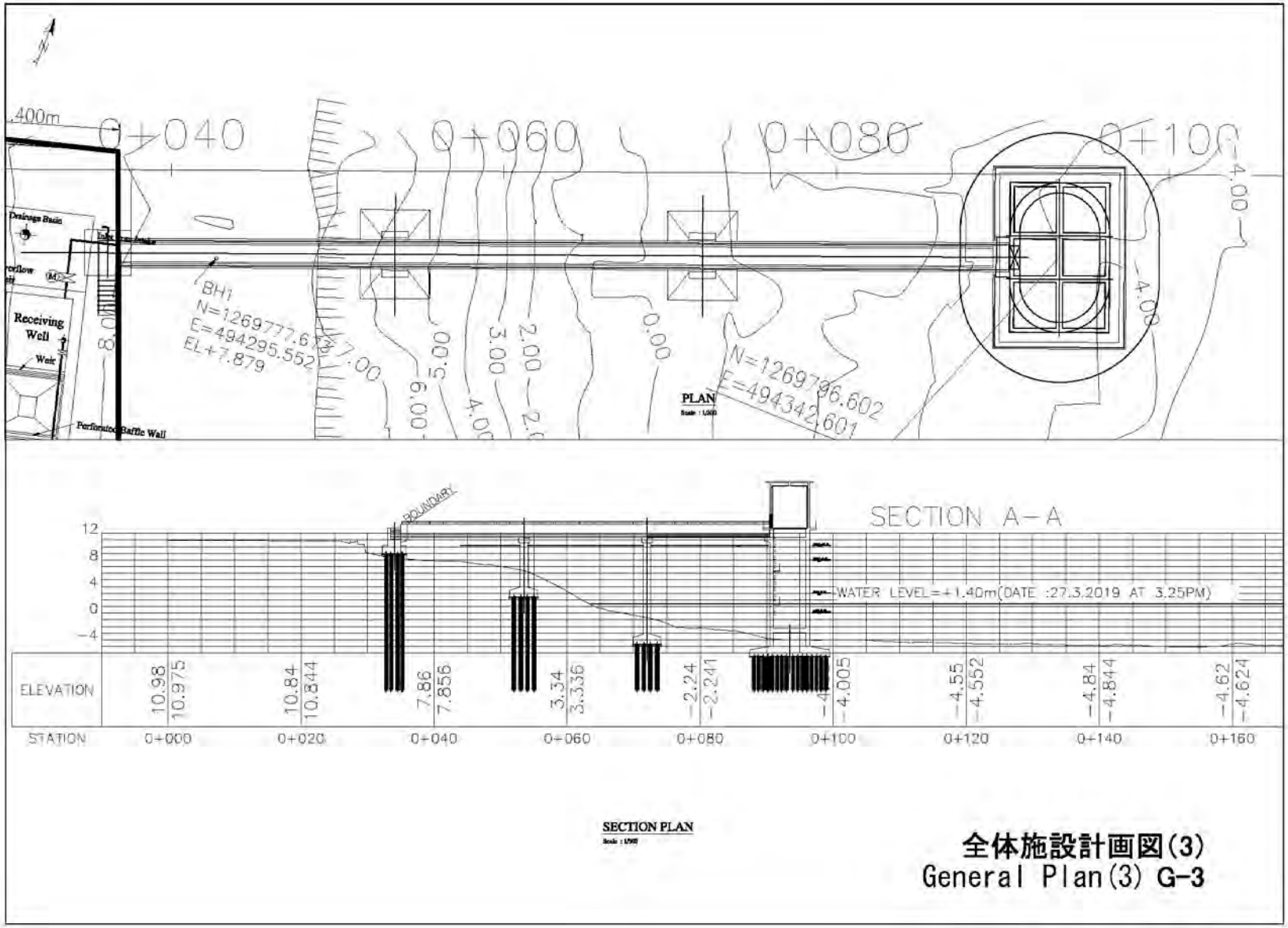
Appendix 5.1　Outline Design Drawings for Comparator Facilities

No.	Facility	Drawing Title	DWGNo.
1	General	General Plan(1)	G-1
2		General Plan(2)	G-2
3		General Plan(3)	G-3
4	Intake Facility	Intake Facility Plan(1)	I-1
5		Intake Facility Plan(2)	I-2
6		Intake Facility Plan(3)	I-3
7		Intake Facility Plan(4)	I-4
8		Intake Facility Plan(5)	I-5
9		Intake Facility Plan(6)	I-6
10		Intake Facility Plan(7)	I-7
11	Treatment Facility	Treatment Facility Plan(1)	W-1
12		Treatment Facility Plan(2)	W-2
13		Treatment Facility Plan(3)	W-3
14		Treatment Facility Plan(4)	W-4
15		Treatment Facility Plan(5)	W-5
16		Treatment Facility Plan(6)	W-6
17		Treatment Facility Plan(7)	W-7
18		Treatment Facility Plan(8)	W-8
19		Treatment Facility Plan(9)	W-9
20		Treatment Facility Plan(1 0)	W-10


全体施設計画図(1)
General Plan(1) G-1
Meter
Kandal Provincial Hall
National Road #2
Hun Sen Se Rei Pheap High School



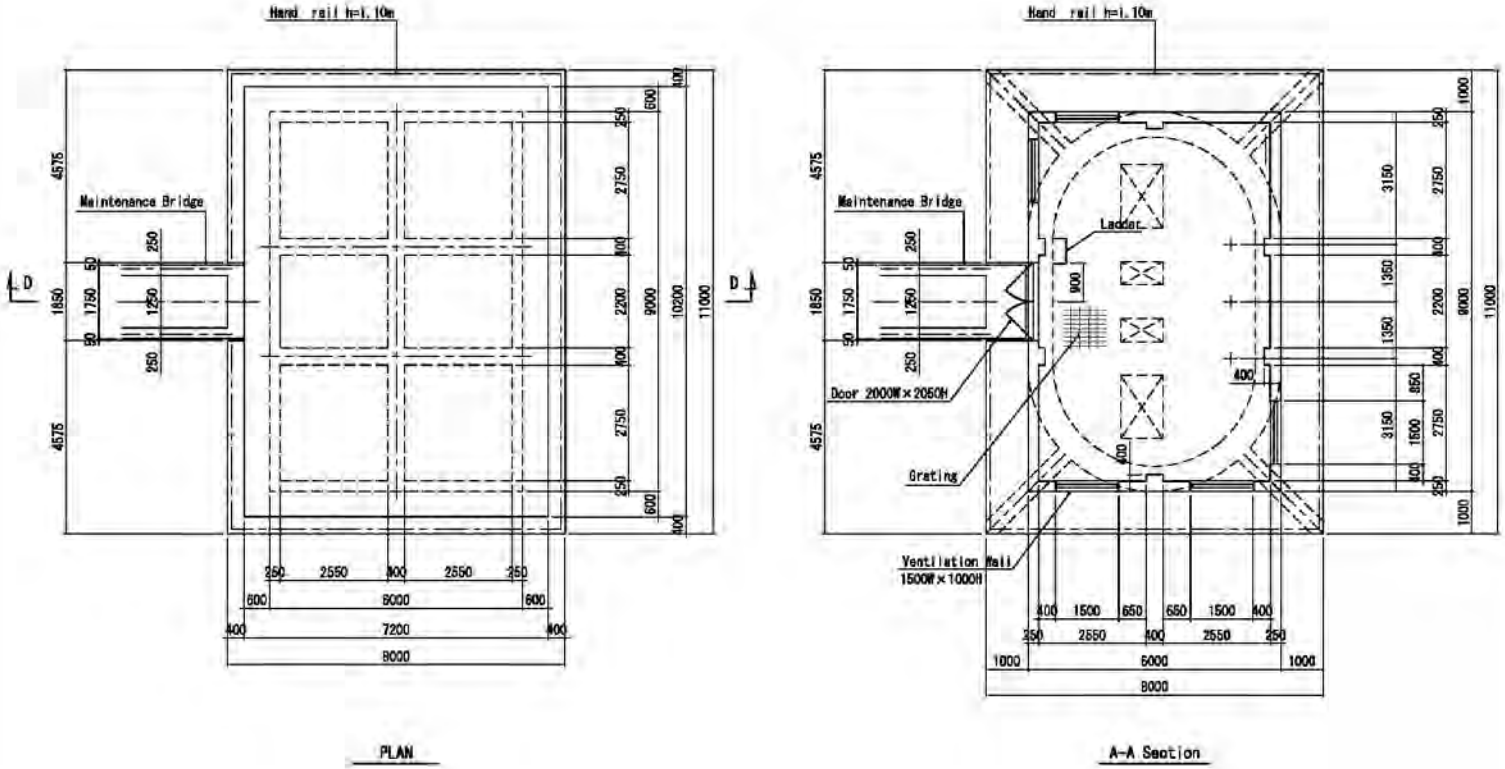
全体施設計画図(2)
General Plan(2) G-2



全体施設計画図(3)
General Plan(3) **G-3**

Intake Tower

Structure(1/3)　Scale=1/100

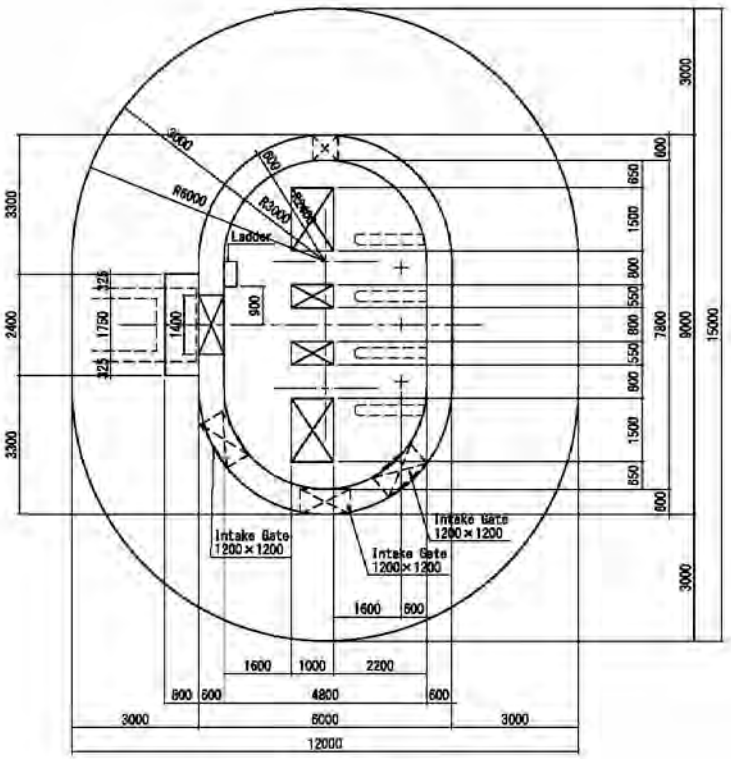


取水施設計画図(1)

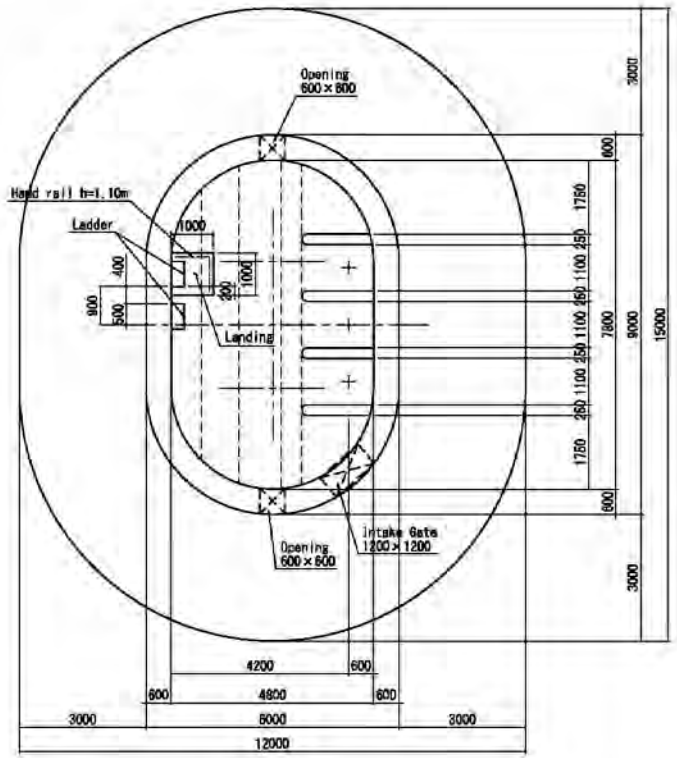
Intake Facility Plan(1) I-1

Intake Tower

Structure(2/3)　Scale=1/100



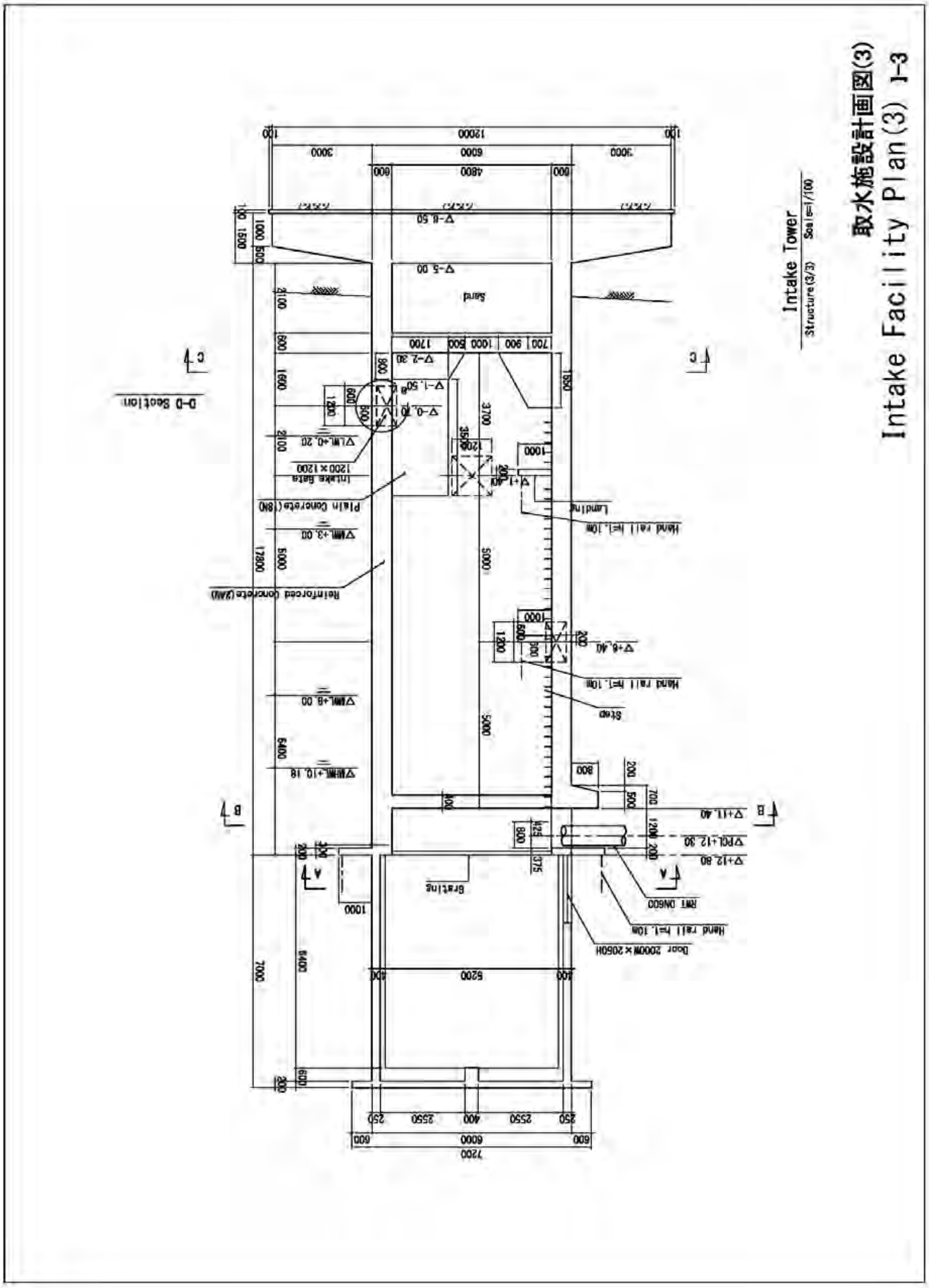
B-B Section



C-C Section

取水施設計画図(2)

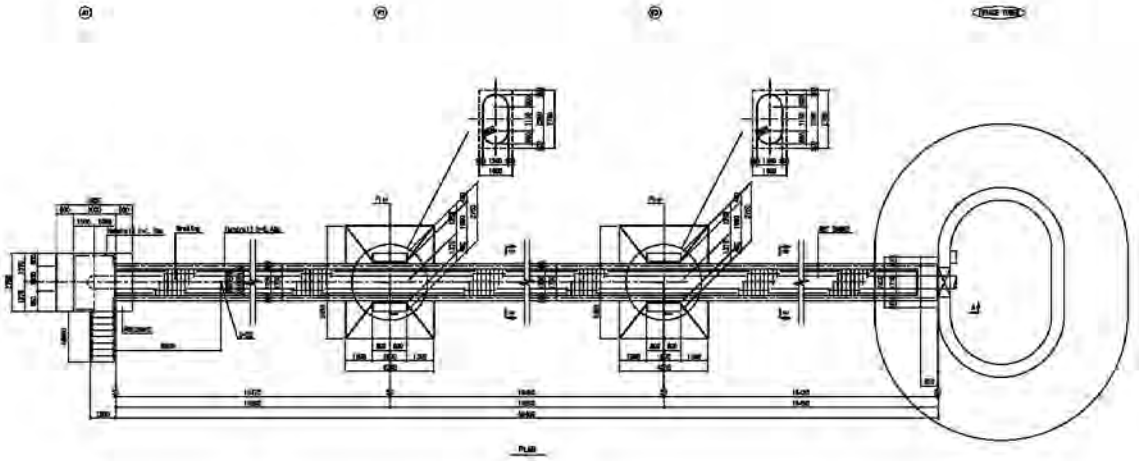
Intake Facility Plan(2)　I-2



取水施設計画図(3)
Intake Facility Plan(3) I-3
Intake Tower
Structure(3/3) Scale=1/100
D-D Section

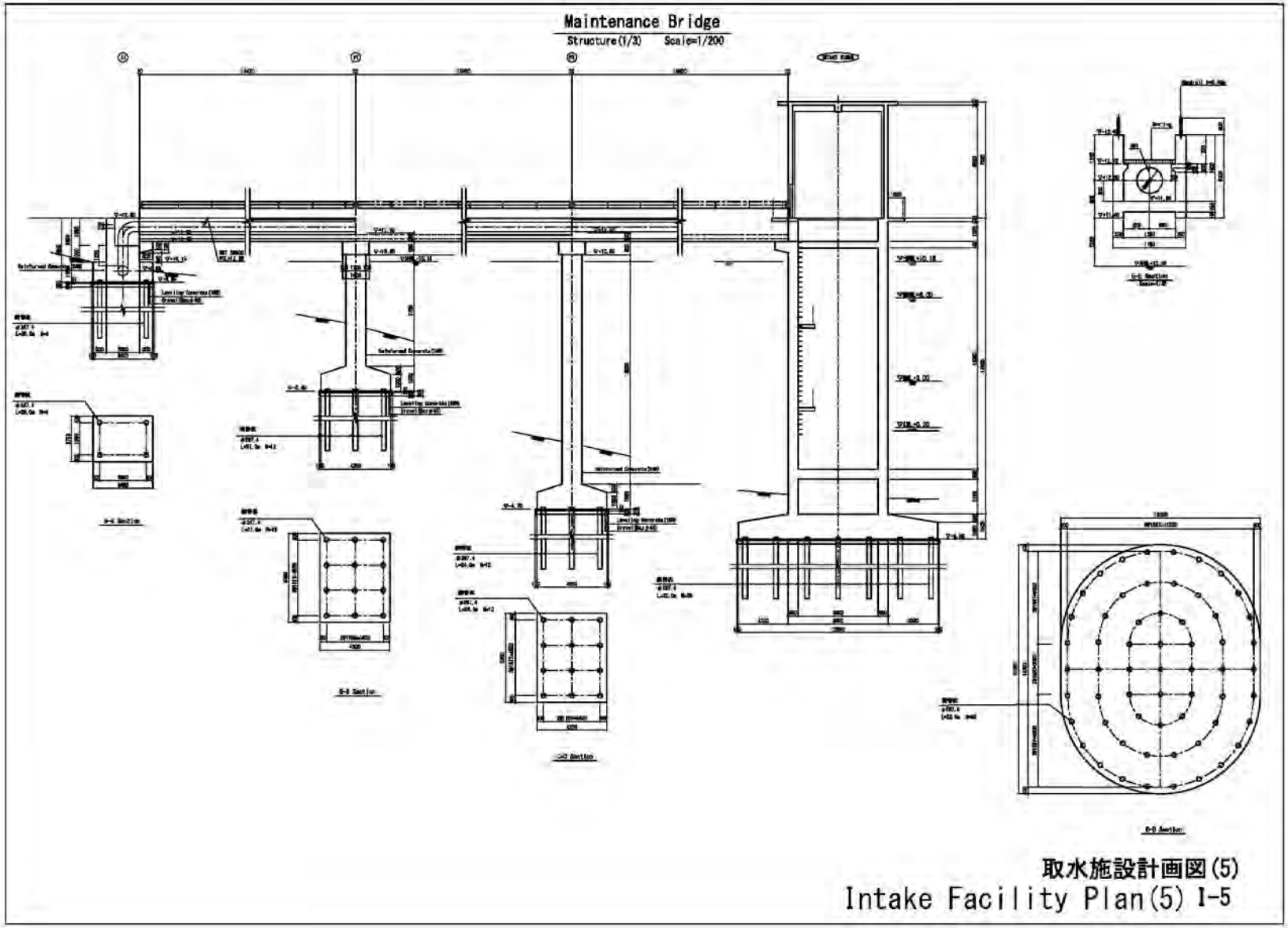
Maintenance Bridge

Structure(1/2)　Scale=1/200



取水施設計画図(4)

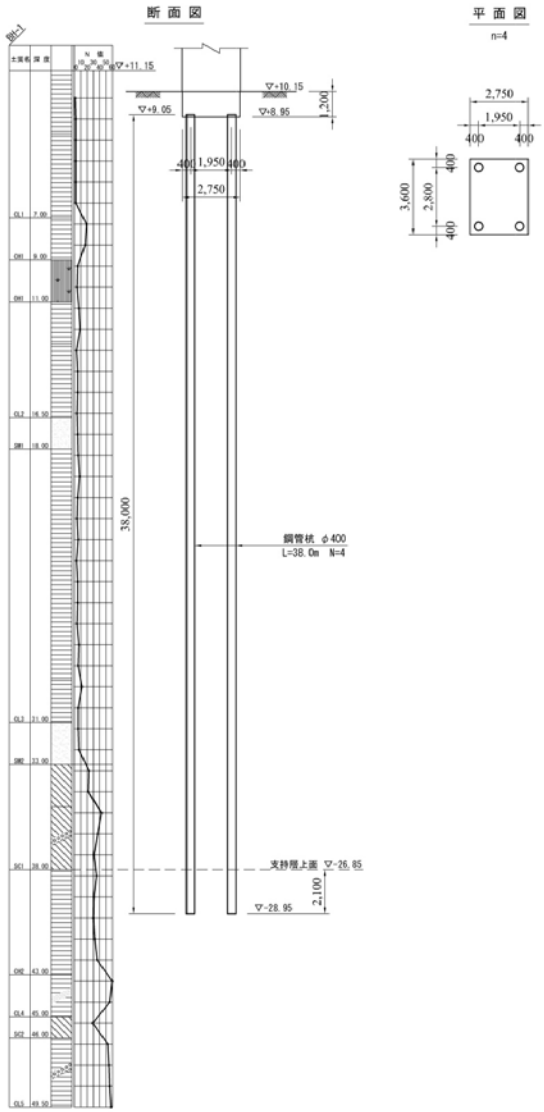
Intake Facility Plan(4) I-4



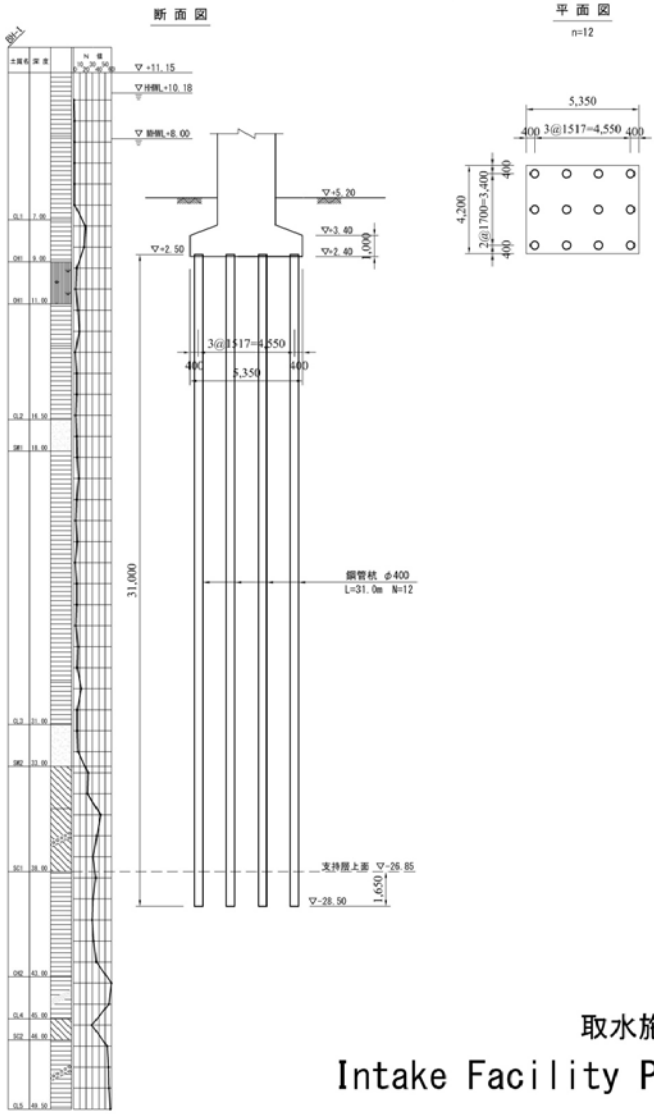
取水施設計画図(5)
Intake Facility Plan(5) I-5

杭詳細図 (1/2) S=1:100

A１橋台

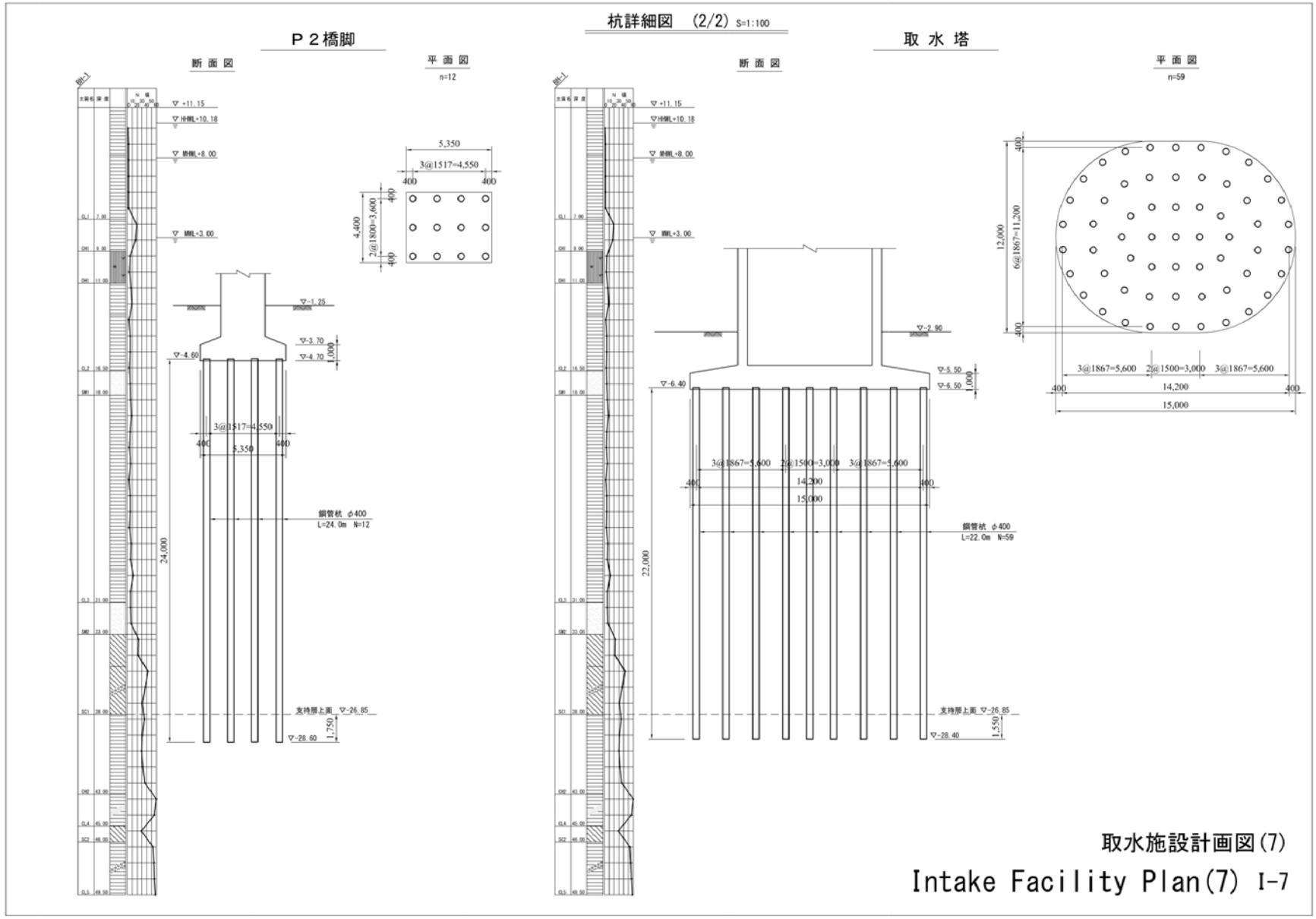


P１橋脚



取水施設計画図(6)

Intake Facility Plan(6) I-6

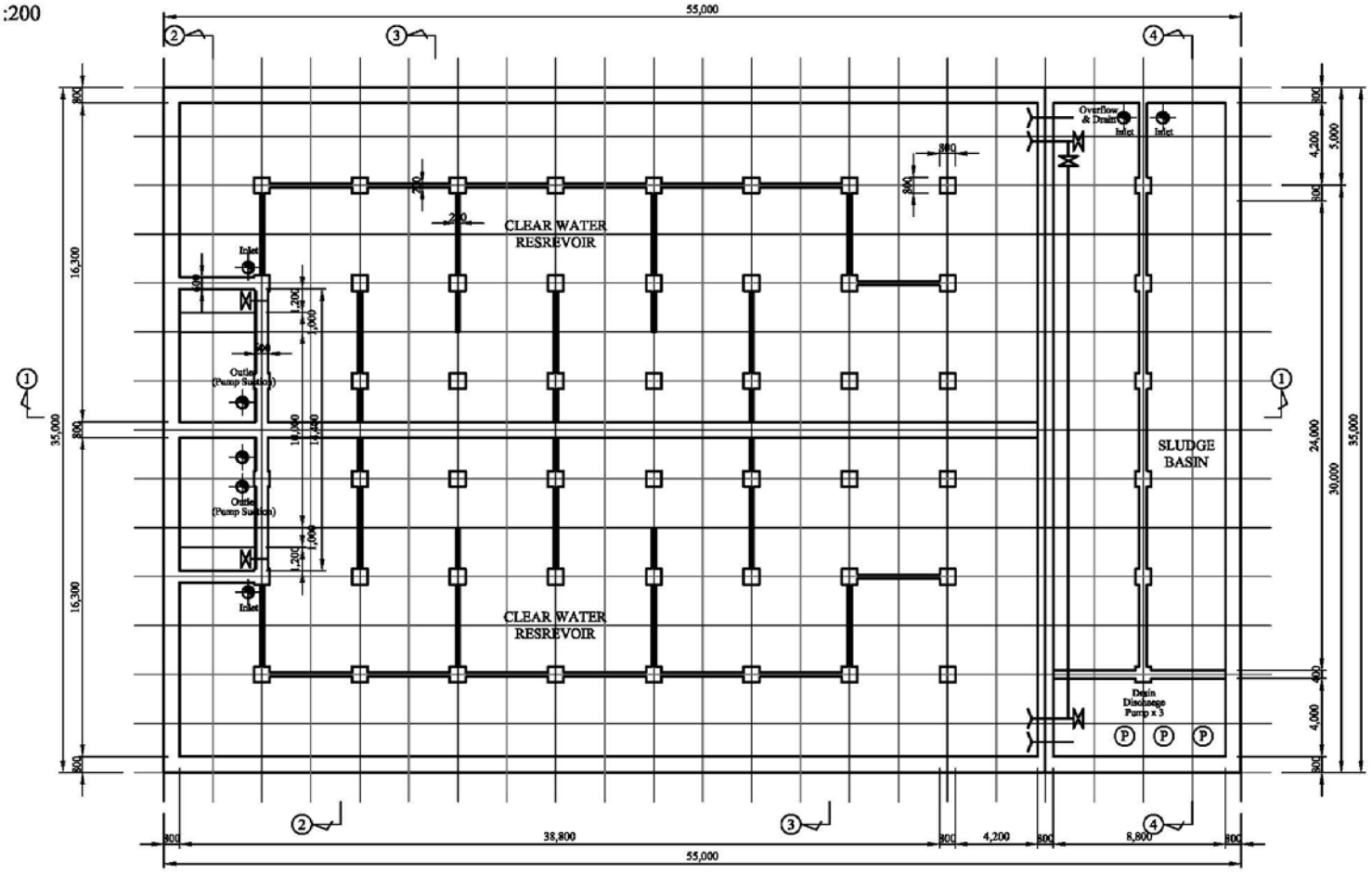


取水施設計画図(7)

Intake Facility Plan(7) I-7

WATER TREATMENT FACILITY
Clear Water Reservoir & Sludge Basin
BF
S=1:200

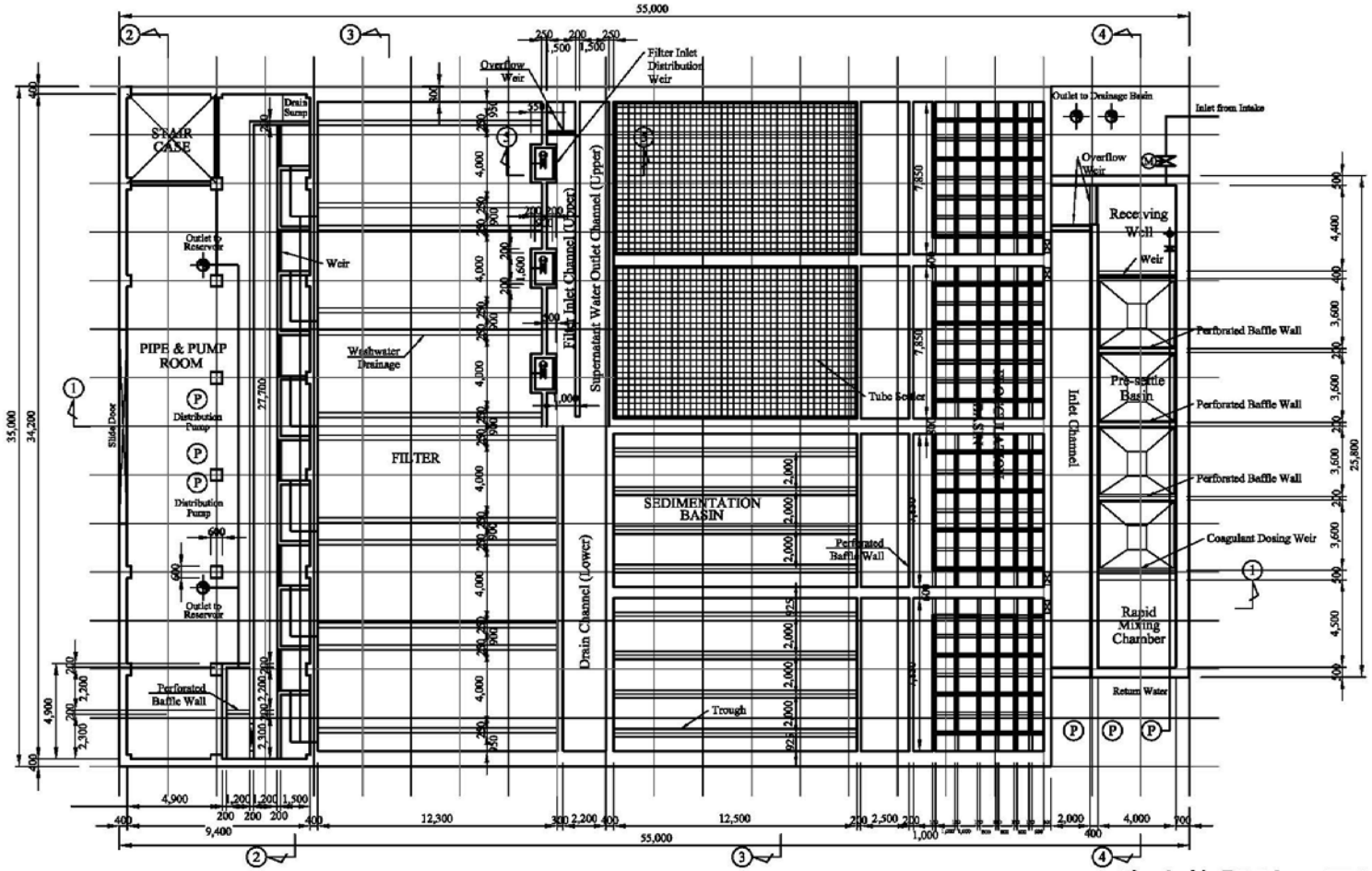
PLAN



浄水施設計画図(1)
Treatment Facility Plan(1) W-1

WATER TREATMENT FACILITY
Receiving Well, Pre-settle Basing, Rapid Mixing Chamber,
Flocculation Basin, Sedimentation Basin, Filter and Pipe & Pump Room
GF
S=1:200

PLAN

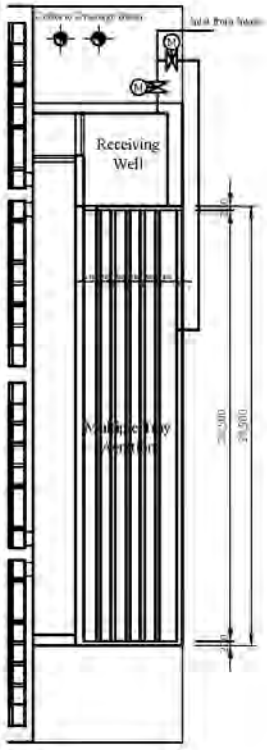


浄水施設計画図(2)

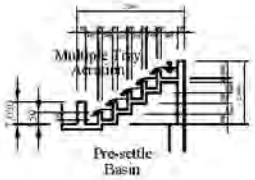
Treatment Facility Plan(2) W-2

WATER TREATMENT FACILITY
Multiple Tray Aeration
GF
S=1:200

PLAN



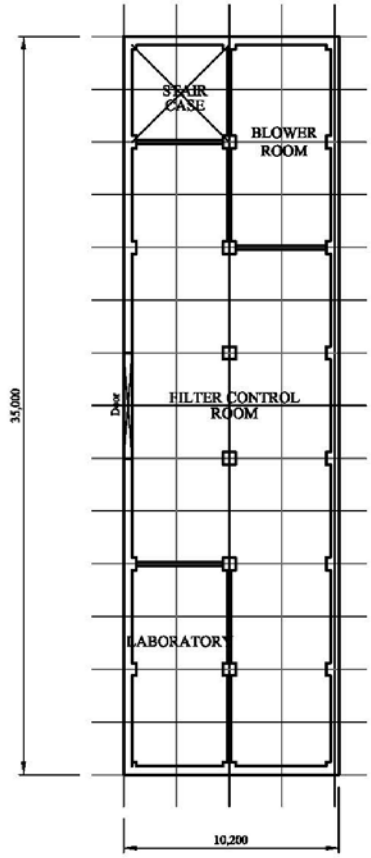
SECTION



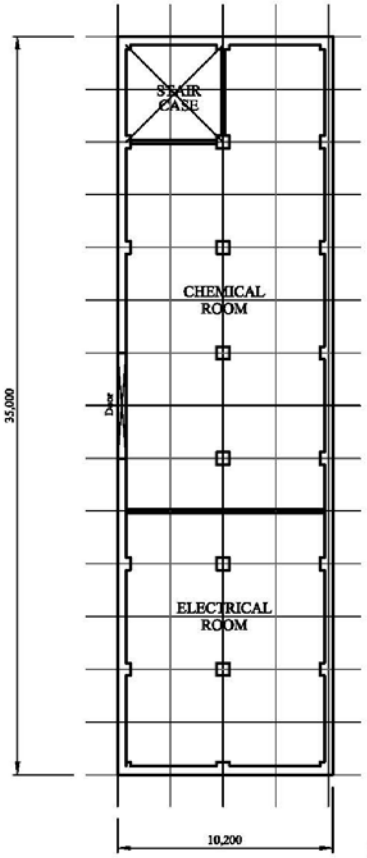
浄水施設計画図(3)
Treatment Facility Plan(3) W-3

WATER TREATMENT FACILITY
2F - Filter Control Room
3F - Chemical & Electrical Room
S=1:200

2F PLAN



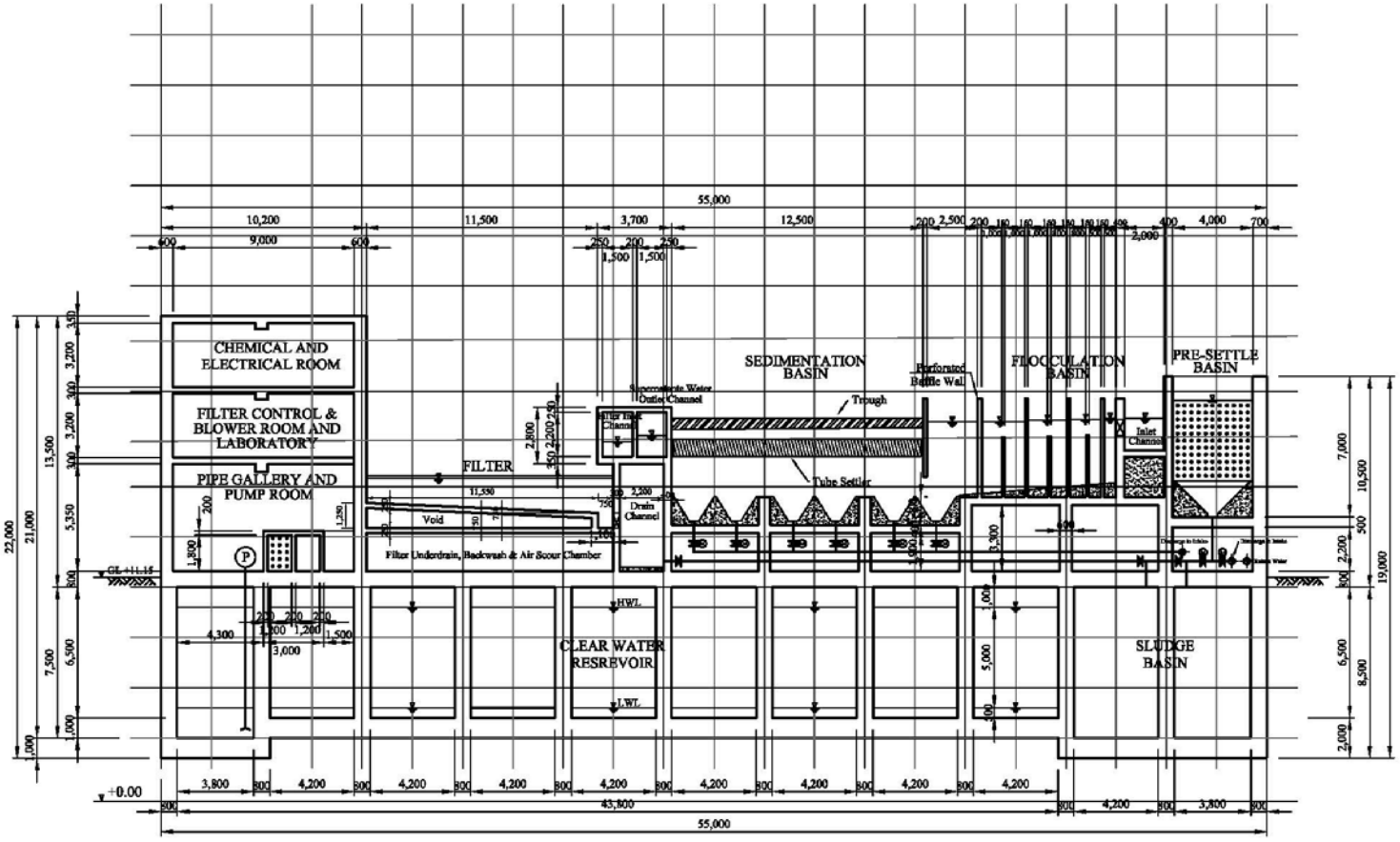
3F PLAN



浄水施設計画図(4)
Treatment Facility Plan(4) **W-4**

WATER TREATMENT FACILITY
General Section
S=1:200

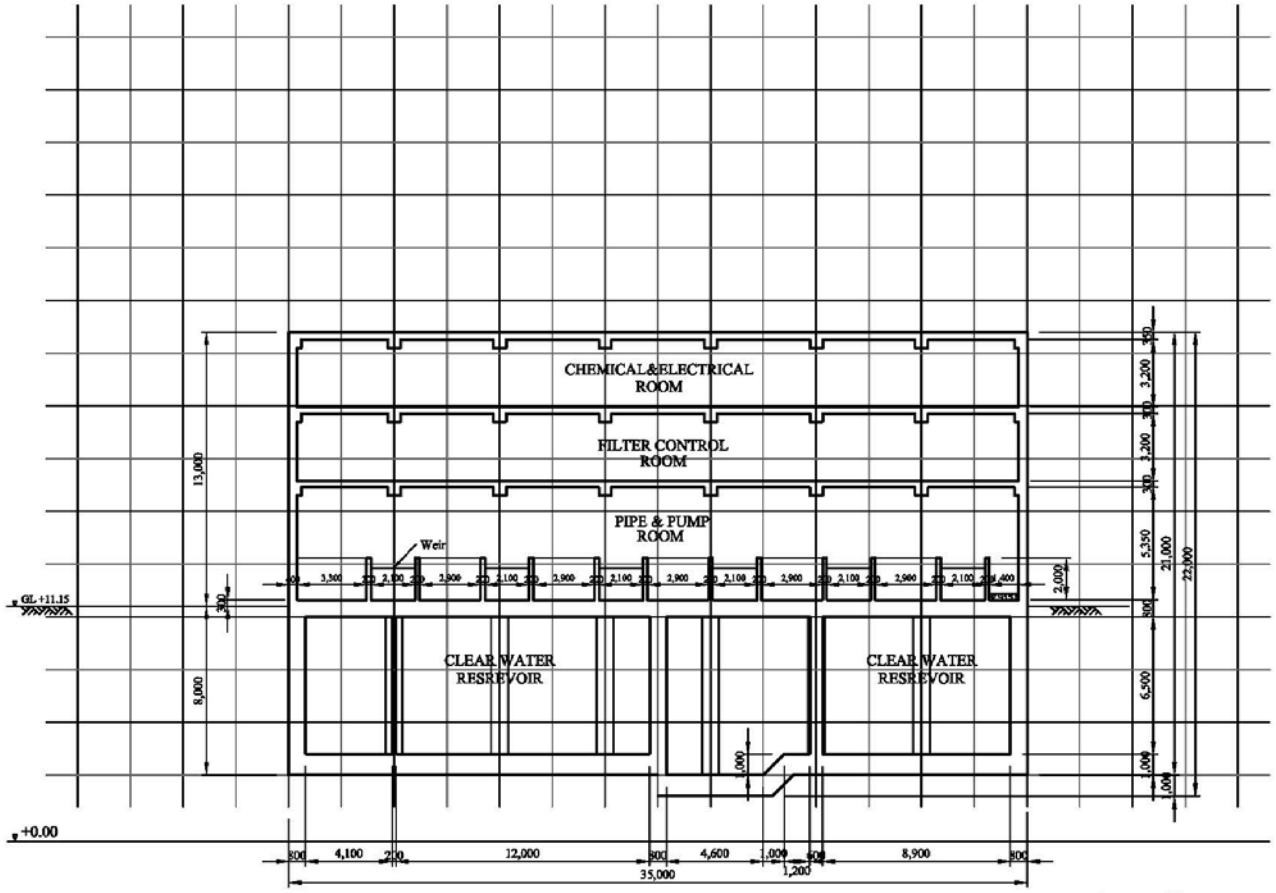
GENERAL SECTION 1-1



浄水施設計画図(5)
Treatment Facility Plan(5) **W-5**

WATER TREATMENT FACILITY
Section
S=1:200

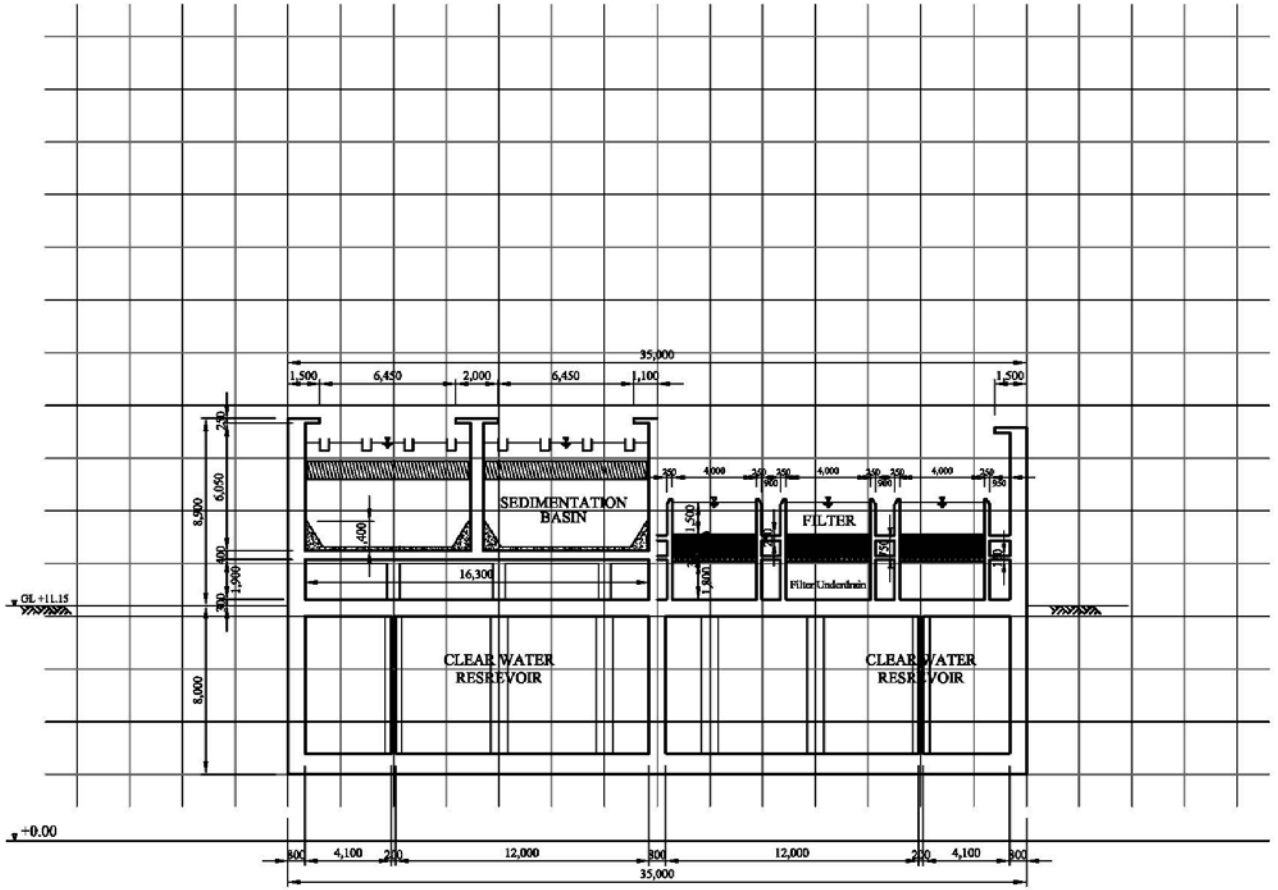
SECTION 2-2



浄水施設計画図(6)
Treatment Facility Plan(6) W-6

WATER TREATMENT FACILITY
Section
S=1:200

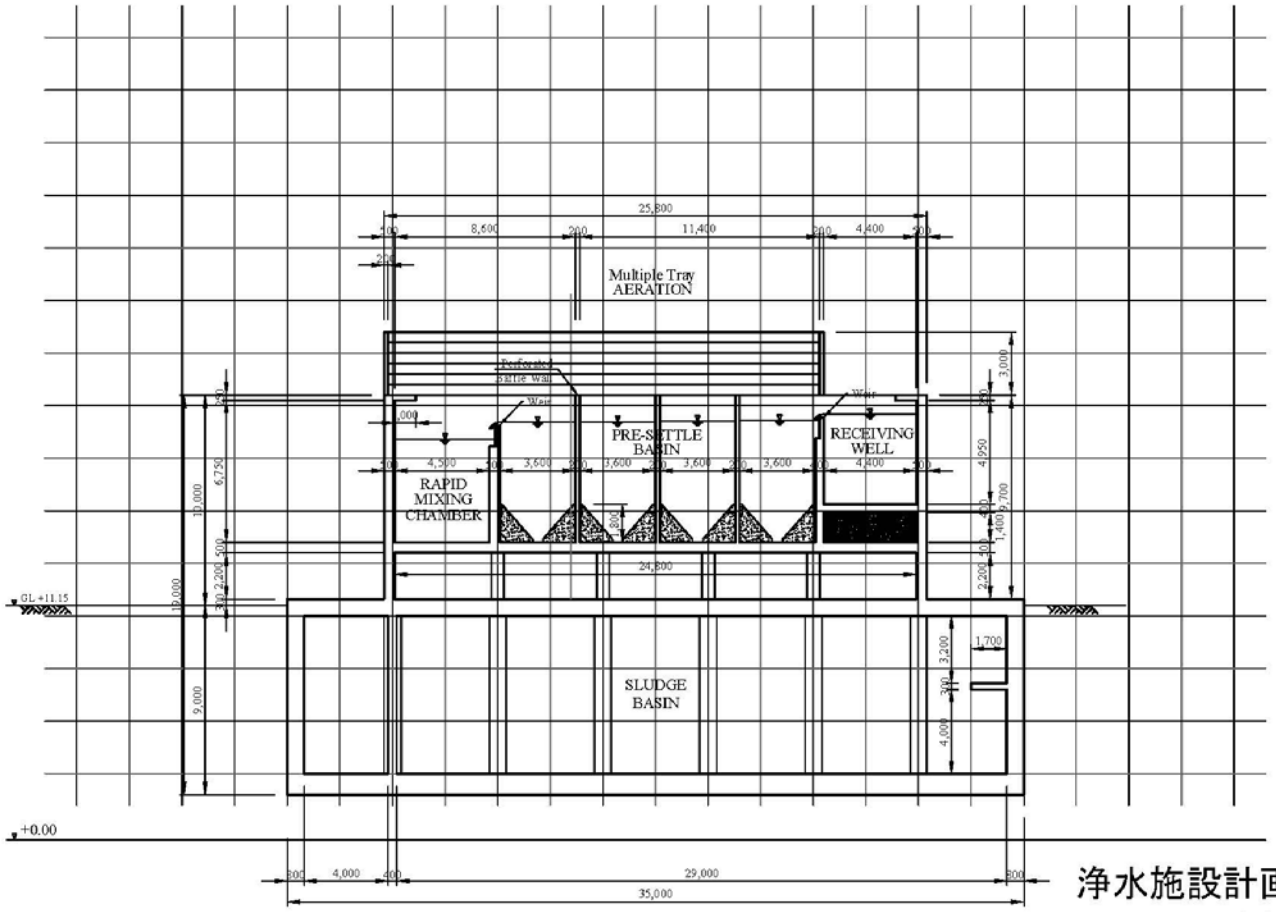
SECTION 3-3



浄水施設計画図(7)
Treatment Facility Plan(7) W-7

WATER TREATMENT FACILITY
Section
S=1:200

SECTION 4-4



浄水施設計画図(8)

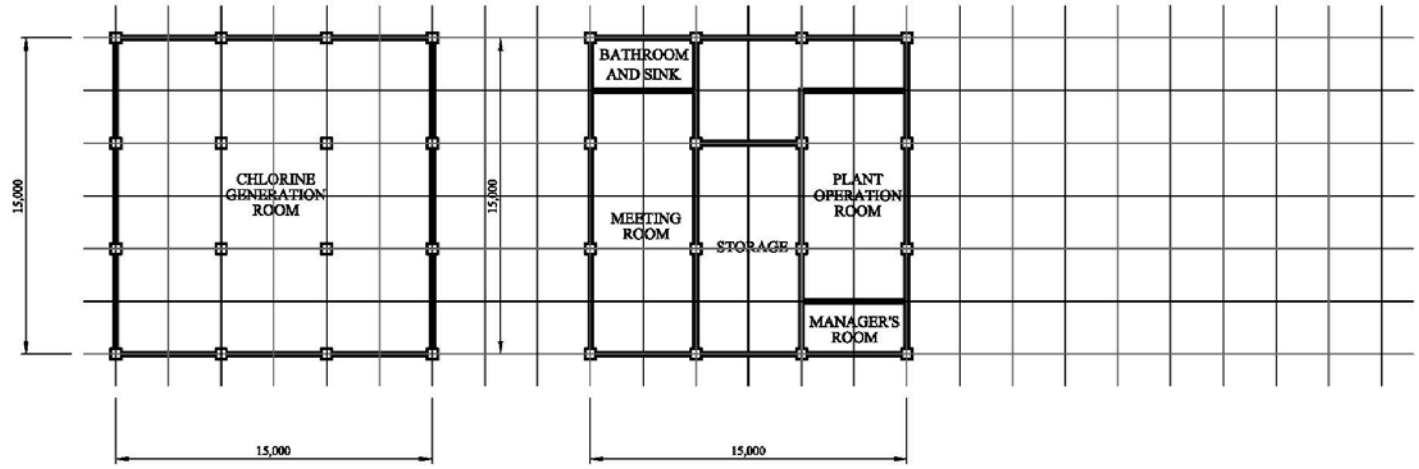
Treatment Facility Plan(8) W-8

CHEMICAL STORAGE AND ADMINISTRATION ROOM
S=1:200

PLAN

GF

2F

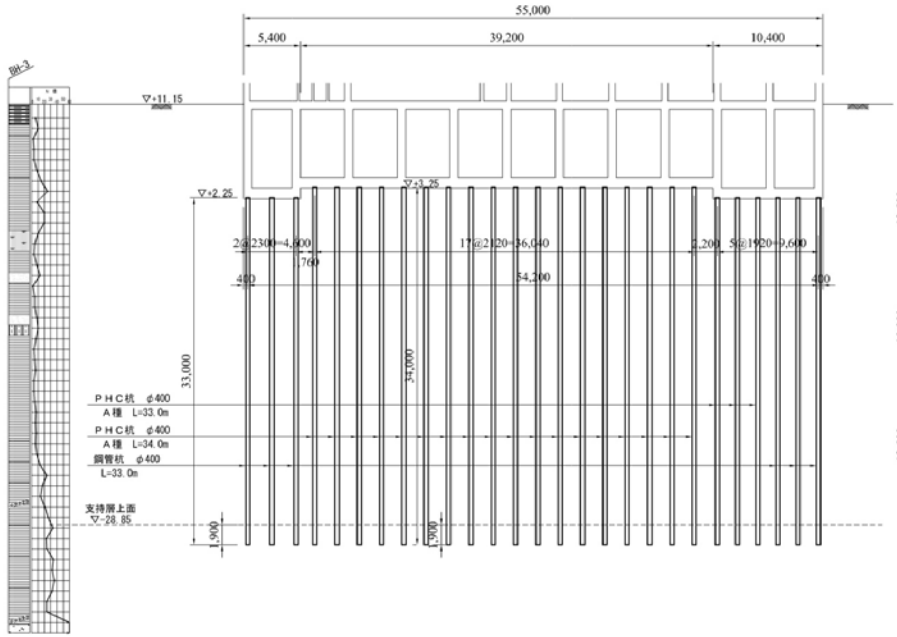


浄水施設計画図(9)
Treatment Facility Plan(9) W-9

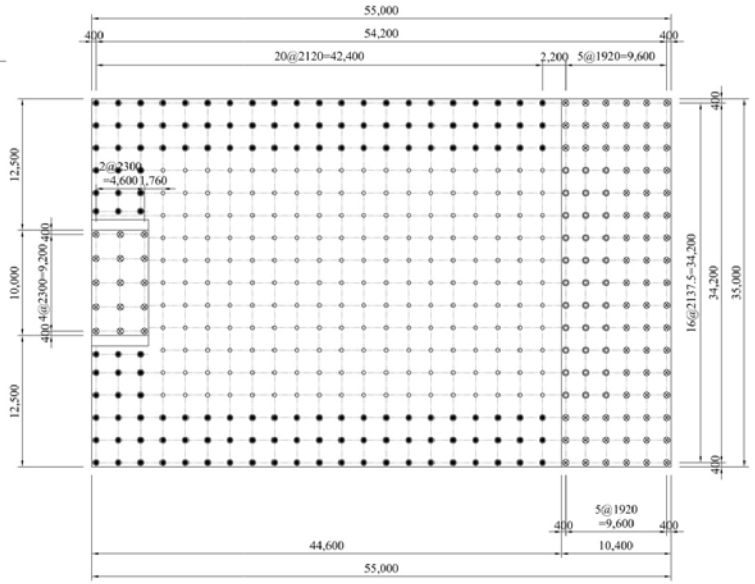
杭詳細図 S=1:200

浄水施設

断 面 図



平 面 図



		杭天端標高	杭長	杭本数
		± m	m	本
PHC杭 φ400 A種	○	3.25	34.0	198
PHC杭 φ400 A種	◎	2.25	33.0	33
鋼管杭 φ400	●	3.25	34.0	144
鋼管杭 φ400	⊗	2.25	33.0	84
Σ				459

浄水施設計画図(10)

Treatment Facility Plan(10) W-10

Appendix 5.2 Hydraulic Analysis of Water Distribution System

The Network calculation was done by EPANET ver2.0 with the following conditions.

Item	Condition				Notes
Calculation	Hazen Williams Equation				
C Value	110				JWWA(2012) Design Criteria for Waterworks Facilities
Pump Head	2019:25m(Elevated Tank) 2024:40m 2030:40m				
Peak Factor	2019:1.0 2024:1.6 2030:1.6				
Distribution Area and Demand(m^3/day)(Day Max) from Ta Khmau WTP		2019	2024	2030	Chak Angre Krom(MC04) is located in Phnom Penh
	Ta Khmau	18,000	24,000	30,000	
	Chak Angre Krom(MC04)	-	6,000	0	

Water demand of Ta Khmau in 2024 is about 24,000m^3/day. Therefore, the surplus water amount of 6,000m^3/day in 2024 will be distributed to Southern area in Phnom Penh.

The network map, the distribution network calculation data and the results are as follows.

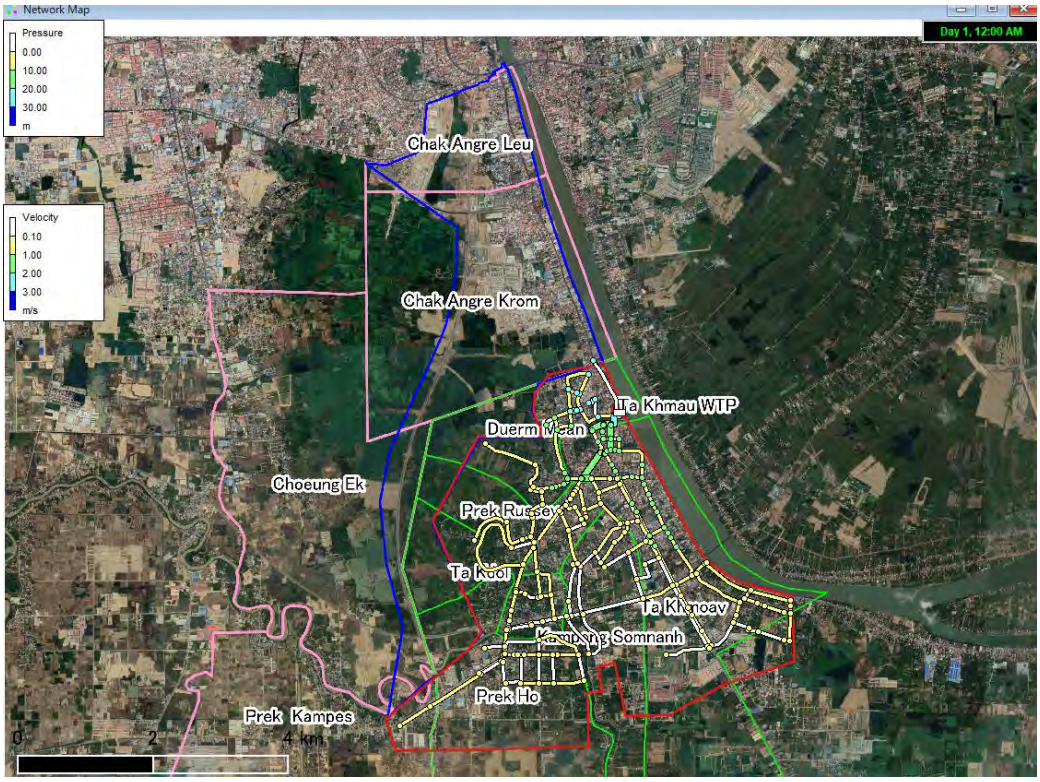


Figure A5.1 The network map and the distribution network calculation data (Pipe Network Analysis in 2019)

Table A5.1 The results of node data (Pipe Network Analysis in 2019)

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	24.9	24.9
3	0	24.6	24.6
4	0	24.6	24.6
5	0	24.9	24.9
6	0	24.4	24.4
7	0	24.2	24.2
8	0	24.1	24.1
9	0	23.9	23.9
10	0	22.6	22.6
11	0	24.1	24.1
14	0	18.7	18.7
15	0	18.1	18.1
16	0	18.6	18.6
17	0	18.0	18.0
18	650	17.1	17.1
20	0	16.3	16.3
21	650	15.6	15.6
22	650	12.2	12.2
23	0	12.2	12.2
24	0	12.8	12.8
25	0	11.6	11.6
26	0	12.2	12.2
31	0	15.6	15.6
32	0	15.6	15.6
33	0	15.9	15.9
35	650	16.1	16.1
37	0	16.0	16.0
40	0	14.2	14.2
41	650	13.5	13.5
43	0	13.6	13.6
45	650	13.6	13.6
46	0	14.1	14.1
48	0	13.2	13.2
49	0	12.7	12.7
51	650	12.3	12.3
53	0	12.0	12.0
54	0	12.3	12.3
64	650	11.9	11.9
72	0	14.7	14.7
77	0	11.2	11.2
78	0	11.3	11.3
80	0	11.1	11.1
81	0	10.5	10.5
82	650	10.2	10.2
83	0	9.6	9.6
84	0	9.4	9.4
85	715	9.1	9.1
86	715	8.3	8.3
87	715	8.2	8.2
88	0	8.2	8.2

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	8.3	8.3
90	0	9.1	9.1
92	715	7.9	7.9
93	0	8.1	8.1
94	0	8.1	8.1
95	0	8.2	8.2
96	0	8.2	8.2
97	0	8.2	8.2
98	0	7.9	7.9
99	0	7.9	7.9
100	0	7.9	7.9
101	0	7.9	7.9
102	715	7.9	7.9
103	0	8.0	8.0
104	0	8.3	8.3
105	0	9.4	9.4
107	0	9.8	9.8
108	0	11.0	11.0
109	650	10.8	10.8
110	0	8.3	8.3
111	0	9.0	9.0
113	0	8.8	8.8
115	0	8.3	8.3
117	0	7.8	7.8
118	715	7.8	7.8
119	0	7.8	7.8
120	0	7.8	7.8
125	0	8.4	8.4
126	0	8.8	8.8
127	0	9.8	9.8
128	650	7.9	7.9
129	715	7.8	7.8
130	715	7.7	7.7
131	0	9.6	9.6
132	0	9.0	9.0
133	0	8.3	8.3
134	650	7.9	7.9
135	0	7.8	7.8
136	0	7.9	7.9
137	0	7.8	7.8
138	715	7.7	7.7
140	715	7.7	7.7
141	0	7.7	7.7
142	0	7.8	7.8
143	0	7.8	7.8
144	650	7.7	7.7
145	0	7.7	7.7
147	650	7.7	7.7
151	0	7.8	7.8
152	0	7.8	7.8

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	7.7	7.7
154	715	7.7	7.7
155	0	7.7	7.7
156	0	7.7	7.7
157	0	7.7	7.7
158	0	8.1	8.1
160	0	8.7	8.7
161	0	7.9	7.9
162	0	9.6	9.6
163	0	8.9	8.9
164	0	8.1	8.1
165	0	8.1	8.1
166	0	8.0	8.0
167	0	8.3	8.3
168	0	8.1	8.1
169	0	9.0	9.0
170	0	9.0	9.0
171	0	9.1	9.1
172	0	9.3	9.3
173	0	9.4	9.4
174	650	8.7	8.7
175	0	8.9	8.9
176	0	8.9	8.9
177	0	9.0	9.0
178	0	8.9	8.9
179	650	8.6	8.6
180	0	9.2	9.2
181	650	9.9	9.9
182	715	8.9	8.9
183	0	8.8	8.8
184	0	8.5	8.5
185	715	8.1	8.1
186	0	7.9	7.9
187	0	7.8	7.8
188	0	8.1	8.1
191	0	7.7	7.7
192	715	7.7	7.7
193	0	7.7	7.7
194	0	7.7	7.7
195	0	7.7	7.7
198	0	7.6	7.6
199	0	7.6	7.6
200	0	7.5	7.5
201	0	7.5	7.5
202	0	7.5	7.5
203	0	7.4	7.4
204	0	7.4	7.4
205	0	7.4	7.4
207	715	7.0	7.0
209	0	7.2	7.2

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	715	7.0	7.0
211	0	7.3	7.3
212	0	7.4	7.4
213	0	7.4	7.4
214	0	7.5	7.5
215	0	7.5	7.5
216	0	7.5	7.5
217	0	7.4	7.4
218	0	7.5	7.5
219	715	7.5	7.5
220	0	7.4	7.4
221	0	7.7	7.7
223	0	7.3	7.3
224	0	8.9	8.9
225	0	8.8	8.8
226	0	8.9	8.9
227	0	8.4	8.4
229	715	7.9	7.9
232	0	9.1	9.1
233	0	9.2	9.2
234	0	9.3	9.3
235	715	9.3	9.3
237	0	9.0	9.0
239	0	20.0	20.0
240	0	18.4	18.4
241	0	18.4	18.4
242	650	17.1	17.1
243	0	19.3	19.3
244	650	23.3	23.3
250	715	7.0	7.0
251	0	7.7	7.7
252	0	17.2	17.2
253	0	16.7	16.7
256	650	15.9	15.9
257	0	17.5	17.5
259	0	17.8	17.8
12	715	8.4	8.4
13	0	10.9	10.9
34	0	10.7	10.7
38	0	24.4	24.4
42	0	24.4	24.4
50	0	8.8	8.8
52	0	9.0	9.0
58	0	9.0	9.0
59	0	7.7	7.7
60	0	7.8	7.8
61	0	7.9	7.9
63	0	7.9	7.9
65	0	7.4	7.4
66	0	7.5	7.5
67	0	7.4	7.4

Table A5.2 The results of pipe data (Pipe Network Analysis in 2019)

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	400	110	Open	17,089	1.57
3	3	4	10.87	400	110	Open	14,884	1.37
4	3	6	312.42	300	110	Open	2,205	0.36
5	2	5	900.15	250	110	Open	0	0
6	6	7	385.89	300	110	Open	2,205	0.36
7	7	10	56.56	110	110	Open	1,143	1.39
8	7	8	240.17	300	110	Open	1,063	0.17
9	8	9	46.95	110	110	Open	424	0.52
10	8	11	305.7	300	110	Open	639	0.1
13	4	14	244.2	300	110	Open	14,884	2.44
14	14	16	13.83	300	110	Open	7,769	1.27
15	14	15	105.74	300	110	Open	7,115	1.16
16	15	17	20.74	150	110	Open	855	0.56
17	15	18	210.31	300	110	Open	6,259	1.02
19	18	20	169.63	300	110	Open	5,863	0.96
21	20	21	184.4	300	110	Open	5,863	0.96
22	21	22	458.88	300	110	Open	7,888	1.29
23	22	26	18.79	160	110	Open	−199	0.11
24	26	23	193.56	160	110	Open	−199	0.11
25	23	24	98.95	160	110	Open	−1,412	0.81
26	23	25	125.34	160	110	Open	1,213	0.7
32	31	21	76.83	300	110	Open	2,422	0.4
33	31	32	17.8	300	110	Open	−2,422	0.4
34	32	33	65.73	300	110	Open	−5,406	0.89
36	33	35	59.18	300	110	Open	−5,406	0.89
38	35	37	63.31	225	110	Open	1,661	0.48
40	32	72	189.04	225	110	Open	2,984	0.87
45	40	41	187.67	225	110	Open	2,425	0.71
46	41	43	154.11	160	110	Open	−278	0.16
48	72	46	111.47	225	110	Open	2,984	0.87
50	46	45	101.35	225	110	Open	2,984	0.87
54	41	48	104.45	225	110	Open	2,307	0.67
55	48	49	155.62	225	110	Open	2,307	0.67
65	49	54	143.09	225	110	Open	2,307	0.67
66	45	51	417.79	225	110	Open	2,310	0.67
68	51	53	144.07	225	110	Open	1,914	0.56
82	54	64	138.9	225	110	Open	2,307	0.67
83	64	78	255.3	225	110	Open	1,910	0.56
85	78	77	252.69	90	110	Open	77	0.14
86	53	77	391.46	225	110	Open	1,914	0.56
87	78	80	91.9	225	110	Open	1,833	0.53
88	80	81	285.79	225	110	Open	1,833	0.53
89	81	82	149.02	225	110	Open	1,833	0.53
90	82	83	489.98	225	110	Open	1,437	0.42
91	83	84	63.82	225	110	Open	2,310	0.67
92	84	85	194.61	225	110	Open	1,689	0.49
93	83	107	276.77	225	110	Open	−873	0.25
94	107	105	166.1	160	110	Open	720	0.41
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	1,253	0.36
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	608	0.18
101	87	94	61.35	160	110	Open	172	0.1
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	172	0.1
105	93	92	406.94	160	110	Open	402	0.23
107	84	104	788.69	160	110	Open	621	0.36
108	104	103	186.16	160	110	Open	600	0.35
109	103	102	122.52	160	110	Open	600	0.35
110	104	110	86.63	160	110	Open	21	0.01

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	−209	0.12
112	110	95	209.06	160	110	Open	230	0.13
113	95	96	107.46	160	110	Open	230	0.13
114	96	97	299.79	160	110	Open	230	0.13
115	97	93	92.22	160	110	Open	230	0.13
120	101	100	28.76	160	110	Open	34	0.02
121	100	99	149.53	160	110	Open	34	0.02
122	99	98	388.58	160	110	Open	34	0.02
123	102	101	241.09	160	110	Open	34	0.02
124	77	108	97.16	225	110	Open	1,990	0.58
126	108	109	79.98	225	110	Open	1,990	0.58
128	109	107	649.05	225	110	Open	1,594	0.46
129	105	111	210.69	160	110	Open	720	0.41
131	111	113	123.66	160	110	Open	720	0.41
132	113	115	260.86	160	110	Open	720	0.41
137	115	117	258.79	160	110	Open	720	0.41
138	117	118	44.16	250	110	Open	850	0.2
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	−129	0.07
146	127	126	272.57	160	110	Open	1,052	0.61
147	126	125	102.72	160	110	Open	1,052	0.61
150	125	133	98.06	250	110	Open	1,052	0.25
151	127	132	221.07	160	110	Open	1,036	0.6
152	133	132	332.95	110	110	Open	−274	0.33
155	136	134	25.68	160	110	Open	−66	0.04
156	133	134	604.2	250	110	Open	1,326	0.31
158	134	135	344.51	250	110	Open	864	0.2
159	143	135	66.74	160	110	Open	−280	0.16
160	135	137	258.04	250	110	Open	584	0.14
161	137	138	445.65	250	110	Open	422	0.1
162	138	118	1027.9	250	110	Open	−414	0.1
163	137	142	212.46	160	110	Open	162	0.09
164	142	141	375.09	160	110	Open	162	0.09
165	141	140	289.84	160	110	Open	132	0.08
166	138	140	476.94	225	110	Open	400	0.12
167	143	144	300.24	160	110	Open	280	0.16
168	144	141	410.99	110	110	Open	−30	0.04
169	144	145	413.28	160	110	Open	−86	0.05
171	128	147	598.71	160	110	Open	271	0.16
173	147	129	293.36	160	110	Open	−121	0.07
174	131	162	27.47	160	110	Open	805	0.46
175	162	163	272.14	160	110	Open	805	0.46
176	163	161	506.93	160	110	Open	775	0.45
177	161	129	53.84	160	110	Open	712	0.41
178	161	151	74.03	110	110	Open	63	0.08
182	129	130	681.68	160	110	Open	155	0.09
183	151	152	552.87	110	110	Open	63	0.08
184	152	153	686.29	110	110	Open	63	0.08
185	140	130	911.28	225	110	Open	95	0.03
186	130	153	157	225	110	Open	−159	0.05
188	154	155	168.89	225	110	Open	−53	0.02
189	155	156	180.54	225	110	Open	−53	0.02
190	156	157	322.27	225	110	Open	−37	0.01
191	158	164	124.35	110	110	Open	−4	0
195	167	166	503.36	160	110	Open	372	0.21
196	160	167	363.39	160	110	Open	510	0.29
197	167	168	362.07	110	110	Open	138	0.17
200	132	179	168.35	160	110	Open	762	0.44
201	179	128	401.89	160	110	Open	692	0.4

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	−165	0.2
204	170	171	149.19	110	110	Open	−165	0.2
205	171	172	266	110	110	Open	−165	0.2
206	172	173	107.93	110	110	Open	−165	0.2
207	173	131	123.5	160	110	Open	−694	0.4
209	169	174	333.47	110	110	Open	165	0.2
210	174	175	119.64	160	110	Open	−559	0.32
211	173	180	167.26	160	110	Open	529	0.3
213	180	177	217.72	160	110	Open	529	0.3
215	177	176	72.45	160	110	Open	529	0.3
216	176	178	80.03	110	110	Open	−30	0.04
217	178	163	249.56	110	110	Open	−30	0.04
218	175	176	51.35	160	110	Open	−559	0.32
219	179	174	260.71	160	110	Open	−327	0.19
220	22	181	578.59	300	110	Open	5,603	0.92
221	181	131	25.02	150	110	Open	1,499	0.98
222	181	182	563.66	300	110	Open	3,708	0.61
230	193	191	349.77	160	110	Open	−17	0.01
231	130	195	22.34	160	110	Open	−27	0.02
232	156	193	31.21	160	110	Open	−17	0.01
233	157	191	126.11	225	110	Open	−37	0.01
234	191	192	31.85	250	110	Open	−53	0.01
235	194	221	634.06	225	110	Open	27	0.01
236	195	221	782.73	160	110	Open	−27	0.02
237	160	183	60.22	150	110	Open	−510	0.33
238	182	183	88.77	300	110	Open	2,971	0.49
239	183	184	286.9	300	110	Open	2,462	0.4
240	184	185	395.9	300	110	Open	2,666	0.44
241	185	158	16.02	150	110	Open	−4	0
242	185	188	19.85	300	110	Open	2,234	0.37
243	188	186	285.51	300	110	Open	2,234	0.37
244	186	187	146.45	300	110	Open	2,234	0.37
250	187	192	137.55	300	110	Open	2,234	0.37
251	192	198	238.62	300	110	Open	1,745	0.29
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	1,745	0.29
254	200	219	460.49	300	110	Open	817	0.13
255	219	218	25.44	200	110	Open	381	0.14
256	214	218	353.29	160	110	Open	55	0.03
257	218	220	868.13	225	110	Open	436	0.13
259	214	215	33.75	160	110	Open	161	0.09
260	201	214	107.36	160	110	Open	216	0.12
261	200	201	28.28	200	110	Open	928	0.34
262	201	202	17.78	110	110	Open	80	0.1
263	202	204	632.9	110	110	Open	80	0.1
264	204	207	713.14	110	110	Open	124	0.15
266	203	204	199.48	160	110	Open	44	0.03
267	203	205	16.29	160	110	Open	−44	0.03
271	209	207	300.21	160	110	Open	374	0.22
272	207	210	374.55	110	110	Open	62	0.08
273	205	212	412.83	225	110	Open	164	0.05
274	205	223	203.47	160	110	Open	381	0.22
275	223	209	69.13	160	110	Open	374	0.22
276	223	211	406.91	110	110	Open	8	0.01
277	211	210	449.15	160	110	Open	374	0.22
278	212	211	203.44	160	110	Open	367	0.21
279	213	212	270.61	160	110	Open	203	0.12
280	201	216	126.42	225	110	Open	631	0.18
283	217	213	412.13	110	110	Open	42	0.05
286	182	224	35.61	225	110	Open	300	0.09

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	95	0.05
290	227	229	653.56	160	110	Open	436	0.25
292	224	225	348.98	225	110	Open	205	0.06
293	225	184	1849.61	160	110	Open	205	0.12
302	242	24	658.31	160	110	Open	1,412	0.81
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	−1,424	0.82
305	10	239	94.41	110	110	Open	1,143	1.39
306	239	240	251.41	160	110	Open	1,424	0.82
307	239	243	209.09	110	110	Open	385	0.47
308	243	242	216.99	90	110	Open	385	0.7
311	9	244	128.73	110	110	Open	424	0.52
315	220	250	526.13	160	110	Open	436	0.25
316	154	251	188.69	225	110	Open	123	0.04
317	251	153	69.35	225	110	Open	96	0.03
318	251	194	20.58	225	110	Open	27	0.01
319	16	252	193.95	300	110	Open	7,769	1.27
320	252	35	170.73	300	110	Open	7,463	1.22
42	17	259	94.34	160	110	Open	855	0.49
153	259	257	94.52	160	110	Open	855	0.49
193	257	252	111.05	160	110	Open	855	0.49
223	252	253	122.83	160	110	Open	1,161	0.67
321	253	256	172.15	160	110	Open	1,161	0.67
322	98	92	86.27	160	110	Open	34	0.02
323	235	237	381.35	160	110	Open	436	0.25
324	45	43	187.67	160	110	Open	278	0.16
326	244	11	496.38	160	110	Open	−639	0.37
327	239	244	329.6	110	110	Open	−666	0.81
328	235	234	55.05	160	110	Open	341	0.2
329	234	233	167.35	160	110	Open	341	0.2
330	233	232	182.39	160	110	Open	341	0.2
332	164	165	207.25	110	110	Open	−4	0
333	165	168	38.67	110	110	Open	−4	0
334	168	166	157.76	110	110	Open	134	0.16
335	166	154	349.81	160	110	Open	506	0.29
338	237	12	802.56	160	110	Open	436	0.25
341	25	13	131.31	160	110	Open	1,213	0.7
342	13	34	43.17	160	110	Open	1,213	0.7
343	34	235	284.57	160	110	Open	1,213	0.7
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	436	0.25
12	50	227	499.62	160	110	Open	436	0.25
20	226	52	280.96	160	110	Open	−341	0.2
35	52	58	55.77	160	110	Open	−341	0.2
39	58	232	243.77	160	110	Open	−341	0.2
43	136	63	151.36	160	110	Open	66	0.04
51	63	128	111.52	160	110	Open	−25	0.01
52	63	61	156.22	110	110	Open	91	0.11
53	61	60	211	110	110	Open	91	0.11
56	60	59	353.71	110	110	Open	91	0.11
58	145	59	90.41	110	110	Open	−86	0.11
59	59	147	162.77	110	110	Open	5	0.01
60	215	65	318.75	160	110	Open	161	0.09
62	65	213	220	160	110	Open	161	0.09
67	216	66	49.94	225	110	Open	631	0.18
69	66	217	55.55	225	110	Open	631	0.18
70	217	67	46.22	225	110	Open	589	0.17
71	67	205	211.73	225	110	Open	589	0.17
27	127	22	128.62	150	110	Open	−2,088	1.37
1	1	2	19.87	400	110	Open	17,089	1.57
18	256	37	56.5	225	110	Open	−1,661	0.48
28	256	40	511.28	225	110	Open	2,425	0.71

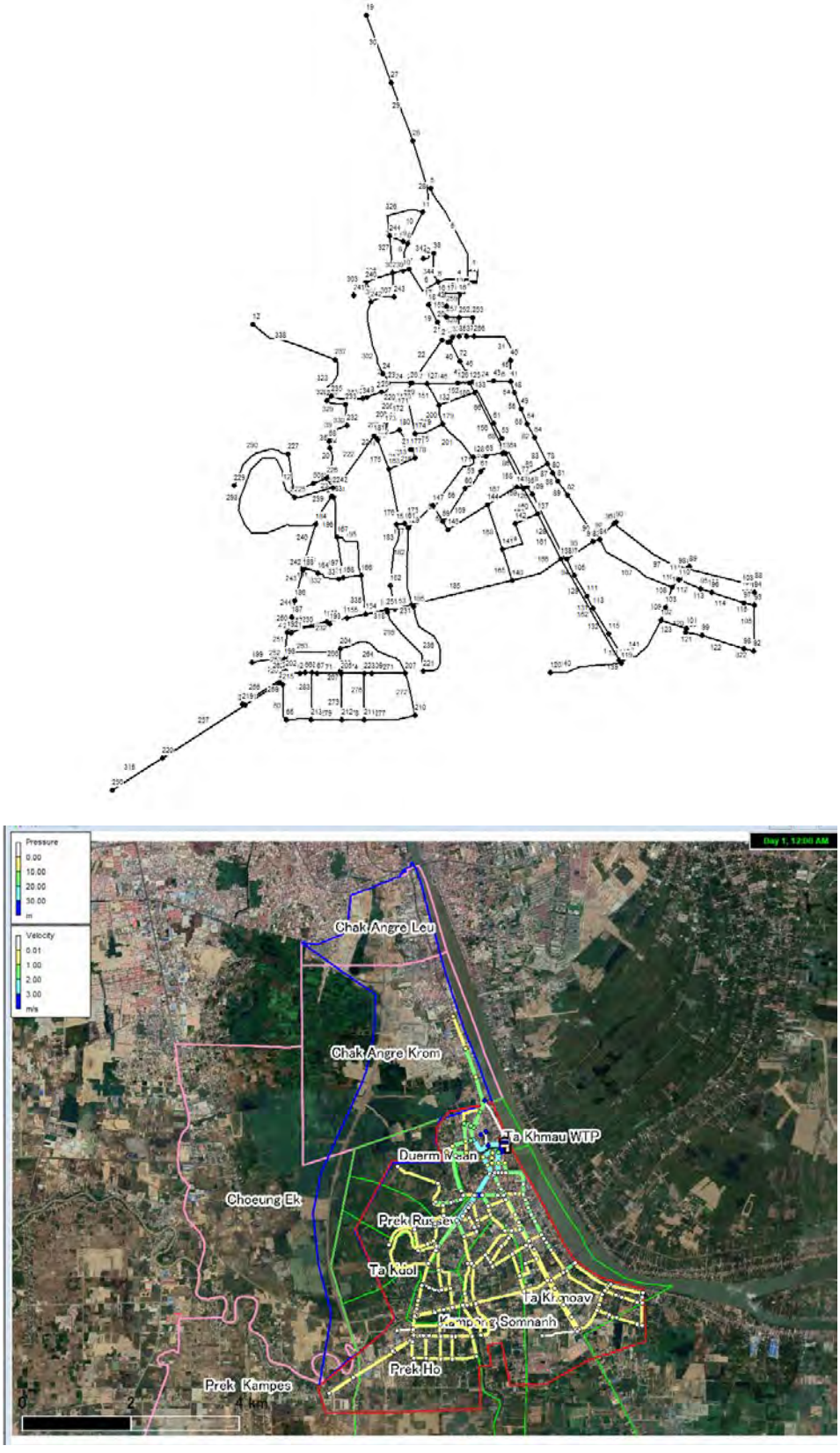


Figure A5.2 The network map and the distribution network calculation data (Pipe Network Analysis in 2024)

Table A5.3 The results of node data (Pipe Network Analysis in 2024)

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	40.0	40.0
3	0	38.6	38.6
4	0	38.3	38.3
5	0	40.0	40.0
6	0	31.8	31.8
7	0	23.5	23.5
8	0	19.8	19.8
9	0	18.5	18.5
10	0	17.1	17.1
11	0	16.0	16.0
14	0	11.4	11.4
15	0	8.5	8.5
16	0	11.0	11.0
17	0	8.1	8.1
18	600	3.8	3.8
20	0	0.5	0.5
21	600	−3.2	−3.2
22	600	−18.5	−18.5
23	0	−18.5	−18.5
24	0	−16.5	−16.5
25	0	−21.0	−21.0
26	0	−18.5	−18.5
31	0	−2.9	−2.9
32	0	−2.8	−2.8
33	0	−1.7	−1.7
35	600	−0.5	−0.5
37	0	−0.9	−0.9
40	0	−9.2	−9.2
41	600	−12.1	−12.1
43	0	−11.9	−11.9
45	600	−11.7	−11.7
46	0	−9.5	−9.5
48	0	−13.6	−13.6
49	0	−15.7	−15.7
51	600	−17.5	−17.5
53	0	−18.8	−18.8
54	0	−17.7	−17.7
64	600	−19.6	−19.6
72	0	−7.0	−7.0
77	0	−22.5	−22.5
78	0	−22.0	−22.0
80	0	−22.8	−22.8
81	0	−25.2	−25.2
82	600	−26.5	−26.5
83	0	−29.1	−29.1
84	0	−29.9	−29.9
85	571	−31.3	−31.3
86	571	−34.4	−34.4
87	571	−35.1	−35.1
88	0	−35.1	−35.1
89	0	−34.4	−34.4
90	0	−31.3	−31.3
92	571	−36.3	−36.3
93	0	−35.2	−35.2
94	0	−35.1	−35.1
95	0	−34.7	−34.7
96	0	−34.8	−34.8
97	0	−35.1	−35.1
98	0	−36.3	−36.3
99	0	−36.3	−36.3
100	0	−36.3	−36.3
101	0	−36.3	−36.3
102	571	−36.3	−36.3
103	0	−35.6	−35.6
104	0	−34.5	−34.5
105	0	−29.8	−29.8
107	0	−28.5	−28.5
108	0	−23.5	−23.5
109	600	−24.3	−24.3
110	0	−34.5	−34.5
111	0	−31.5	−31.5
113	0	−32.5	−32.5
115	0	−34.5	−34.5
117	0	−36.6	−36.6
118	571	−36.6	−36.6
119	0	−36.6	−36.6
120	0	−36.6	−36.6
125	0	−34.7	−34.7
126	0	−33.0	−33.0
127	0	−28.7	−28.7
128	600	−36.6	−36.6
129	571	−37.1	−37.1
130	571	−37.3	−37.3
131	0	−29.2	−29.2
132	0	−32.2	−32.2
133	0	−34.8	−34.8
134	600	−36.5	−36.5
135	0	−36.9	−36.9
136	0	−36.5	−36.5
137	0	−37.0	−37.0
138	571	−37.1	−37.1
140	571	−37.3	−37.3
141	0	−37.2	−37.2
142	0	−37.1	−37.1
143	0	−37.0	−37.0
144	600	−37.4	−37.4
145	0	−37.4	−37.4
147	600	−37.3	−37.3
151	0	−36.7	−36.7
152	0	−37.0	−37.0
153	0	−37.2	−37.2
154	571	−37.2	−37.2
155	0	−37.2	−37.2
156	0	−37.2	−37.2
157	0	−37.2	−37.2
158	0	−35.4	−35.4
160	0	−33.1	−33.1
161	0	−36.7	−36.7
162	0	−29.5	−29.5
163	0	−32.2	−32.2
164	0	−35.4	−35.4
165	0	−35.4	−35.4
166	0	−35.8	−35.8
167	0	−34.6	−34.6
168	0	−35.4	−35.4
169	0	−32.1	−32.1
170	0	−32.0	−32.0
171	0	−31.5	−31.5
172	0	−30.5	−30.5
173	0	−30.2	−30.2
174	600	−33.3	−33.3
175	0	−32.6	−32.6
176	0	−32.3	−32.3
177	0	−32.0	−32.0
178	0	−32.3	−32.3
179	600	−33.8	−33.8
180	0	−31.0	−31.0
181	600	−28.1	−28.1
182	571	−32.3	−32.3
183	0	−32.7	−32.7
184	0	−33.8	−33.8
185	571	−35.4	−35.4
186	0	−36.3	−36.3
187	0	−36.8	−36.8
188	0	−35.5	−35.5
191	0	−37.2	−37.2
192	571	−37.2	−37.2
193	0	−37.2	−37.2
194	0	−37.2	−37.2
195	0	−37.3	−37.3
198	0	−37.6	−37.6
199	0	−37.6	−37.6
200	0	−37.8	−37.8
201	0	−37.9	−37.9
202	0	−37.9	−37.9
203	0	−38.4	−38.4
204	0	−38.4	−38.4
205	0	−38.4	−38.4
207	571	−39.7	−39.7
209	0	−39.0	−39.0
210	571	−39.9	−39.9
211	0	−38.9	−38.9
212	0	−38.5	−38.5
213	0	−38.3	−38.3
214	0	−38.0	−38.0
215	0	−38.0	−38.0
216	0	−38.1	−38.1
217	0	−38.2	−38.2
218	0	−38.0	−38.0
219	571	−38.0	−38.0
220	0	−38.5	−38.5
221	0	−37.2	−37.2
223	0	−38.9	−38.9
224	0	−32.3	−32.3
225	0	−32.4	−32.4
226	0	−32.3	−32.3
227	0	−34.1	−34.1
229	571	−36.1	−36.1
232	0	−31.1	−31.1
233	0	−30.7	−30.7
234	0	−30.4	−30.4
235	571	−30.2	−30.2
237	0	−31.4	−31.4
239	0	6.5	6.5
240	0	0.7	0.7
241	0	0.7	0.7
242	600	−3.4	−3.4
243	0	3.9	3.9
244	600	14.7	14.7
250	572	−40.1	−40.1
251	0	−37.2	−37.2
252	0	4.6	4.6
253	0	2.1	2.1
256	600	−1.5	−1.5
257	0	5.9	5.9
259	0	7.0	7.0
12	571	−33.7	−33.7
13	0	−23.6	−23.6
34	0	−24.5	−24.5
38	0	31.8	31.8
42	0	31.8	31.8
50	0	−32.7	−32.7
52	0	−31.7	−31.7
58	0	−31.6	−31.6
59	0	−37.3	−37.3
60	0	−36.9	−36.9
61	0	−36.7	−36.7
63	0	−36.6	−36.6
65	0	−38.2	−38.2
66	0	−38.1	−38.1
67	0	−38.2	−38.2
19	2000	5.4	5.4
27	2000	6.2	6.2
28	2000	9.0	9.0

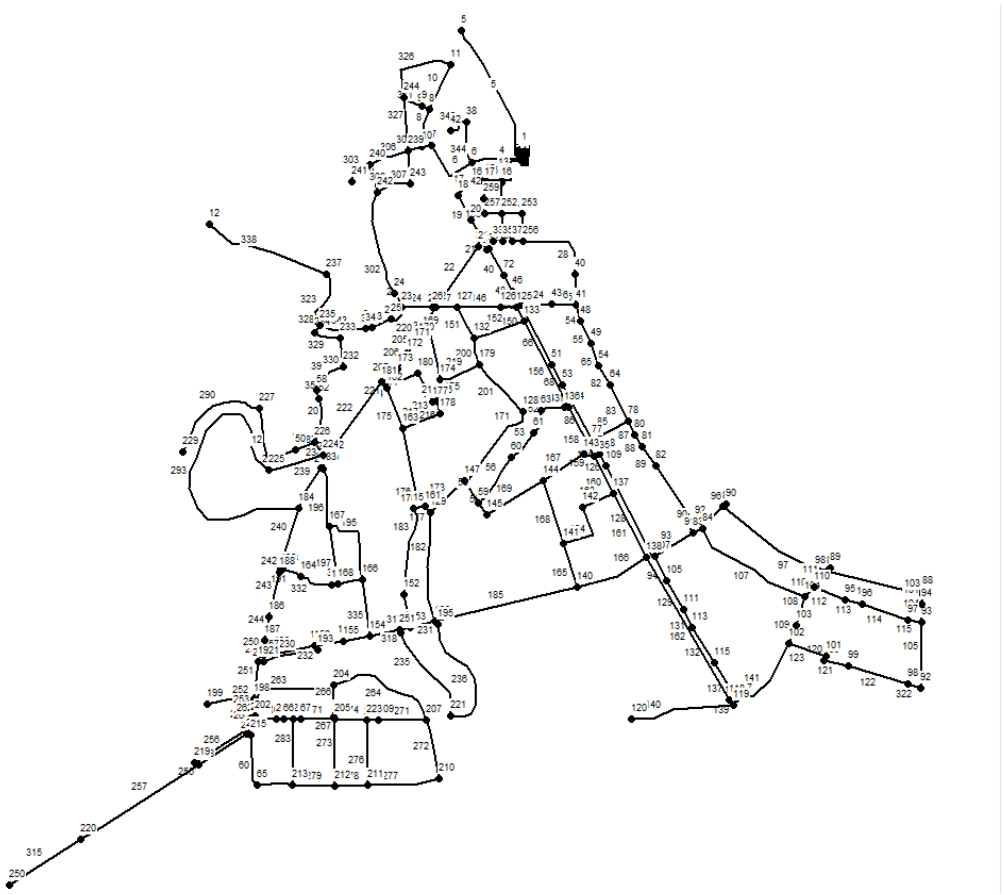
Table A5.4 The results of pipe data (Pipe Network Analysis in 2024)

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	400	110	Open	47,987	4.42
3	3	4	10.87	400	110	Open	33,894	3.12
4	3	6	312.42	300	110	Open	14,093	2.31
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	300	110	Open	14,093	2.31
7	7	10	56.56	110	110	Open	2,449	2.98
8	7	8	240.17	300	110	Open	11,644	1.91
9	8	9	46.95	110	110	Open	1,181	1.44
10	8	11	305.7	300	110	Open	10,463	1.71
13	4	14	244.2	300	110	Open	33,894	5.55
14	14	16	13.83	300	110	Open	17,658	2.89
15	14	15	105.74	300	110	Open	16,236	2.66
16	15	17	20.74	150	110	Open	1,939	1.27
17	15	18	210.31	300	110	Open	14,298	2.34
19	18	20	169.63	300	110	Open	13,338	2.18
21	20	21	184.4	300	110	Open	13,338	2.18
22	21	22	458.88	300	110	Open	17,788	2.91
23	22	26	18.79	160	110	Open	21	0.01
24	26	23	193.56	160	110	Open	21	0.01
25	23	24	98.95	160	110	Open	−2,573	1.48
26	23	25	125.34	160	110	Open	2,594	1.49
32	31	21	76.83	300	110	Open	5,410	0.89
33	31	32	17.8	300	110	Open	−5,410	0.89
34	32	33	65.73	300	110	Open	−12,106	1.98
36	33	35	73.14	300	110	Open	−12,106	1.98
38	35	37	49.39	225	110	Open	3,899	1.13
40	32	72	189.04	225	110	Open	6,696	1.95
45	40	41	187.67	225	110	Open	5,570	1.62
46	41	43	154.11	160	110	Open	−557	0.32
48	72	46	111.47	225	110	Open	6,696	1.95
50	46	45	101.35	225	110	Open	6,696	1.95
54	41	48	104.45	225	110	Open	5,167	1.5
55	48	49	155.62	225	110	Open	5,167	1.5
65	49	54	143.09	225	110	Open	5,167	1.5
66	45	51	417.79	225	110	Open	5,179	1.51
68	51	53	144.07	225	110	Open	4,219	1.23
82	54	64	138.9	225	110	Open	5,167	1.5
83	64	78	255.3	225	110	Open	4,207	1.22
85	78	77	252.69	90	110	Open	176	0.32
86	53	77	391.46	225	110	Open	4,219	1.23
87	78	80	91.9	225	110	Open	4,032	1.17
88	80	81	285.79	225	110	Open	4,032	1.17
89	81	82	149.02	225	110	Open	4,032	1.17
90	82	83	489.98	225	110	Open	3,072	0.89
91	83	84	63.82	225	110	Open	4,941	1.44
92	84	85	194.61	225	110	Open	3,607	1.05
93	83	107	276.77	225	110	Open	−1,869	0.54
94	107	105	166.1	160	110	Open	1,566	0.9
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	2,693	0.78
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,305	0.38
101	87	94	61.35	160	110	Open	392	0.23
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	392	0.23
105	93	92	406.94	160	110	Open	884	0.51
107	84	104	788.69	160	110	Open	1,334	0.77
108	104	103	186.16	160	110	Open	1,316	0.76
109	103	102	122.52	160	110	Open	1,316	0.76
110	104	110	86.63	160	110	Open	18	0.01

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	−474	0.27
112	110	95	209.06	160	110	Open	492	0.28
113	95	96	107.46	160	110	Open	492	0.28
114	96	97	299.79	160	110	Open	492	0.28
115	97	93	92.22	160	110	Open	492	0.28
120	101	100	28.76	160	110	Open	30	0.02
121	100	99	149.53	160	110	Open	30	0.02
122	99	98	388.58	160	110	Open	30	0.02
123	102	101	241.09	160	110	Open	30	0.02
124	77	108	97.16	225	110	Open	4,395	1.28
126	108	109	79.98	225	110	Open	4,395	1.28
128	109	107	649.05	225	110	Open	3,435	1
129	105	111	210.69	160	110	Open	1,566	0.9
131	111	113	123.66	160	110	Open	1,566	0.9
132	113	115	260.86	160	110	Open	1,566	0.9
137	115	117	258.79	160	110	Open	1,566	0.9
138	117	118	44.16	250	110	Open	1,938	0.46
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	−373	0.21
146	127	126	272.57	160	110	Open	2,291	1.32
147	126	125	102.72	160	110	Open	2,291	1.32
150	125	133	98.06	250	110	Open	2,291	0.54
151	127	132	221.07	160	110	Open	2,294	1.32
152	133	132	332.95	110	110	Open	−585	0.71
155	136	134	25.68	160	110	Open	−252	0.15
156	133	134	604.2	250	110	Open	2,876	0.68
158	134	135	344.51	250	110	Open	1,664	0.39
159	143	135	66.74	160	110	Open	−645	0.37
160	135	137	258.04	250	110	Open	1,019	0.24
161	137	138	445.65	250	110	Open	695	0.16
162	138	118	1027.9	250	110	Open	−1,025	0.24
163	137	142	212.46	160	110	Open	324	0.19
164	142	141	375.09	160	110	Open	324	0.19
165	141	140	289.84	160	110	Open	193	0.11
166	138	140	476.94	225	110	Open	806	0.23
167	143	144	300.24	160	110	Open	645	0.37
168	144	141	410.99	110	110	Open	−132	0.16
169	144	145	413.28	160	110	Open	−183	0.11
171	128	147	598.71	160	110	Open	564	0.32
173	147	129	293.36	160	110	Open	−389	0.22
174	131	162	27.47	160	110	Open	1,779	1.02
175	162	163	272.14	160	110	Open	1,779	1.02
176	163	161	506.93	160	110	Open	1,665	0.96
177	161	129	53.84	160	110	Open	1,544	0.89
178	161	151	74.03	110	110	Open	120	0.15
182	129	130	681.68	160	110	Open	241	0.14
183	151	152	552.87	110	110	Open	120	0.15
184	152	153	686.29	110	110	Open	120	0.15
185	140	130	911.27	225	110	Open	85	0.02
186	130	153	157	225	110	Open	−499	0.15
188	154	155	168.89	225	110	Open	−276	0.08
189	155	156	180.54	225	110	Open	−276	0.08
190	156	157	322.27	225	110	Open	−191	0.06
191	158	164	124.35	110	110	Open	1	0
195	167	166	503.36	160	110	Open	807	0.46
196	160	167	363.39	160	110	Open	1,104	0.64
197	167	168	362.07	110	110	Open	296	0.36
200	132	179	168.35	160	110	Open	1,709	0.98
201	179	128	401.89	160	110	Open	1,462	0.84

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	-373	0.45
204	170	171	149.19	110	110	Open	-373	0.45
205	171	172	266	110	110	Open	-373	0.45
206	172	173	107.93	110	110	Open	-373	0.45
207	173	131	123.5	160	110	Open	-1,559	0.9
209	169	174	333.47	110	110	Open	373	0.45
210	174	175	119.64	160	110	Open	-1,300	0.75
211	173	180	167.26	160	110	Open	1,186	0.68
213	180	177	217.72	160	110	Open	1,186	0.68
215	177	176	72.45	160	110	Open	1,186	0.68
216	176	178	80.03	110	110	Open	-115	0.14
217	178	163	249.56	110	110	Open	-115	0.14
218	175	176	51.35	160	110	Open	-1,300	0.75
219	179	174	260.72	160	110	Open	-714	0.41
220	22	181	578.59	300	110	Open	12,222	2
221	181	131	25.02	150	110	Open	3,338	2.19
222	181	182	563.66	300	110	Open	7,924	1.3
230	193	191	349.77	160	110	Open	-85	0.05
231	130	195	22.35	160	110	Open	-88	0.05
232	156	193	31.21	160	110	Open	-85	0.05
233	157	191	126.11	225	110	Open	-191	0.06
234	191	192	31.85	250	110	Open	-276	0.07
235	194	221	634.06	225	110	Open	88	0.03
236	195	221	782.73	160	110	Open	-88	0.05
237	160	183	60.22	150	110	Open	-1,104	0.72
238	182	183	88.77	300	110	Open	6,421	1.05
239	183	184	286.9	300	110	Open	5,317	0.87
240	184	185	395.9	300	110	Open	5,760	0.94
241	185	158	16.02	150	110	Open	1	0
242	185	188	19.85	300	110	Open	4,846	0.79
243	188	186	285.51	300	110	Open	4,846	0.79
244	186	187	146.45	300	110	Open	4,846	0.79
250	187	192	137.55	300	110	Open	4,846	0.79
251	192	198	238.62	300	110	Open	3,656	0.6
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	3,656	0.6
254	200	219	460.49	300	110	Open	1,713	0.28
255	219	218	25.44	200	110	Open	799	0.29
256	214	218	353.29	160	110	Open	116	0.07
257	218	220	868.14	225	110	Open	915	0.27
259	214	215	33.75	160	110	Open	338	0.19
260	201	214	107.36	160	110	Open	454	0.26
261	200	201	28.28	200	110	Open	1,943	0.72
262	201	202	17.78	110	110	Open	168	0.2
263	202	204	632.9	110	110	Open	168	0.2
264	204	207	713.14	110	110	Open	260	0.32
266	203	204	199.48	160	110	Open	92	0.05
267	203	205	16.29	160	110	Open	-92	0.05
271	209	207	300.21	160	110	Open	783	0.45
272	207	210	374.55	110	110	Open	130	0.16
273	205	212	412.83	225	110	Open	343	0.1
274	205	223	203.47	160	110	Open	799	0.46
275	223	209	69.13	160	110	Open	783	0.45
276	223	211	406.91	110	110	Open	16	0.02
277	211	210	449.15	160	110	Open	784	0.45
278	212	211	203.44	160	110	Open	768	0.44
279	213	212	270.61	160	110	Open	425	0.24
280	201	216	126.42	225	110	Open	1,321	0.38
283	217	213	412.13	110	110	Open	87	0.11
286	182	224	35.61	225	110	Open	590	0.17

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	147	0.08
290	227	229	653.56	160	110	Open	914	0.53
292	224	225	348.99	225	110	Open	443	0.13
293	225	184	1849.61	160	110	Open	443	0.25
302	242	24	658.31	160	110	Open	2,573	1.48
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	-2,781	1.6
305	10	239	94.41	110	110	Open	2,449	2.98
306	239	240	251.41	160	110	Open	2,781	1.6
307	239	243	209.09	110	110	Open	753	0.92
308	243	242	216.99	90	110	Open	753	1.37
311	9	244	128.73	110	110	Open	1,181	1.44
315	220	250	526.13	160	110	Open	915	0.53
316	154	251	188.69	225	110	Open	467	0.14
317	251	153	69.35	225	110	Open	378	0.11
318	251	194	20.58	225	110	Open	88	0.03
319	16	252	193.95	300	110	Open	17,658	2.89
320	252	35	167.94	300	110	Open	16,965	2.78
42	17	259	94.34	160	110	Open	1,939	1.12
153	259	257	94.52	160	110	Open	1,939	1.12
193	257	252	111.05	160	110	Open	1,939	1.12
223	252	253	122.83	160	110	Open	2,631	1.51
321	253	256	170.34	160	110	Open	2,631	1.51
322	98	92	86.27	160	110	Open	30	0.02
323	235	237	381.35	160	110	Open	914	0.53
324	45	43	187.67	160	110	Open	557	0.32
326	244	11	496.38	160	110	Open	-863	0.5
327	239	244	329.6	110	110	Open	-1,084	1.32
328	235	234	55.05	160	110	Open	767	0.44
329	234	233	167.35	160	110	Open	767	0.44
330	233	232	182.39	160	110	Open	767	0.44
332	164	165	207.25	110	110	Open	1	0
333	165	168	38.67	110	110	Open	1	0
334	168	166	157.76	110	110	Open	297	0.36
335	166	154	349.81	160	110	Open	1,104	0.64
338	237	12	802.56	160	110	Open	914	0.53
341	25	13	131.31	160	110	Open	2,594	1.49
342	13	34	43.17	160	110	Open	2,594	1.49
343	34	235	284.57	160	110	Open	2,594	1.49
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	914	0.53
12	50	227	499.62	160	110	Open	914	0.53
20	226	52	280.96	160	110	Open	-767	0.44
35	52	58	55.77	160	110	Open	-767	0.44
39	58	232	243.77	160	110	Open	-767	0.44
43	136	63	151.36	160	110	Open	252	0.15
51	63	128	111.52	160	110	Open	62	0.04
52	63	61	156.22	110	110	Open	191	0.23
53	61	60	211	110	110	Open	191	0.23
56	60	59	353.71	110	110	Open	191	0.23
58	145	59	90.41	110	110	Open	-183	0.22
59	59	147	162.77	110	110	Open	7	0.01
60	215	65	318.75	160	110	Open	338	0.19
62	65	213	220	160	110	Open	338	0.19
67	216	66	49.94	225	110	Open	1,321	0.38
69	66	217	55.55	225	110	Open	1,321	0.38
70	217	67	46.22	225	110	Open	1,234	0.36
71	67	205	211.73	225	110	Open	1,234	0.36
27	127	22	128.62	150	110	Open	-4,585	3
28	11	28	658.78	300	110	Open	9,600	1.57
29	28	27	550.12	300	110	Open	6,400	1.05
30	27	19	633.7	300	110	Open	3,200	0.52
18	256	37	65.6	225	110	Open	-3,899	1.13
31	256	40	487.51	225	110	Open	5,570	1.62



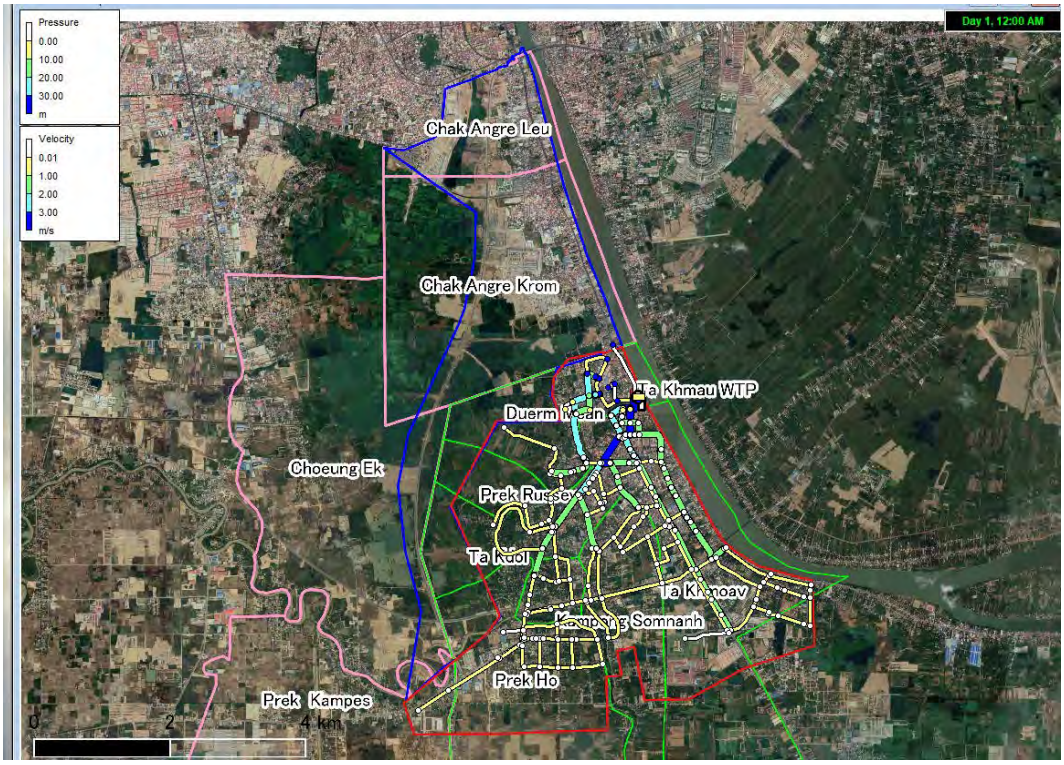


Figure A5.3 The network map and the distribution network calculation data (Pipe Network Analysis in 2030)

Table A5.5 The results of node data (Pipe Network Analysis in 2030)

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	41.7	41.7
3	0	40.5	40.5
4	0	40.1	40.1
5	0	41.7	41.7
6	0	39.2	39.2
7	0	37.6	37.6
8	0	37.3	37.3
9	0	36.1	36.1
10	0	28.3	28.3
11	0	37.2	37.2
14	0	5.2	5.2
15	0	1.3	1.3
16	0	4.6	4.6
17	0	0.9	0.9
18	650	-4.8	-4.8
20	0	-9.1	-9.1
21	650	-13.8	-13.8
22	650	-34.1	-34.1
23	0	-33.8	-33.8
24	0	-30.0	-30.0
25	0	-37.5	-37.5
26	0	-34.0	-34.0
31	0	-13.5	-13.5
32	0	-13.4	-13.4
33	0	-12.0	-12.0
35	650	-10.4	-10.4
37	0	-10.9	-10.9
40	0	-21.8	-21.8
41	650	-25.7	-25.7
43	0	-25.4	-25.4
45	650	-25.1	-25.1
46	0	-22.1	-22.1
48	0	-27.6	-27.6
49	0	-30.5	-30.5
51	650	-32.8	-32.8
53	0	-34.7	-34.7
54	0	-33.1	-33.1
64	650	-35.7	-35.7
72	0	-18.9	-18.9
77	0	-39.8	-39.8
78	0	-39.0	-39.0
80	0	-40.1	-40.1
81	0	-43.6	-43.6
82	650	-45.4	-45.4
83	0	-49.1	-49.1
84	0	-50.3	-50.3
85	715	-52.3	-52.3
86	715	-56.9	-56.9
87	715	-57.9	-57.9
88	0	-57.9	-57.9

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	-56.9	-56.9
90	0	-52.3	-52.3
92	715	-59.6	-59.6
93	0	-58.0	-58.0
94	0	-57.9	-57.9
95	0	-57.3	-57.3
96	0	-57.5	-57.5
97	0	-57.9	-57.9
98	0	-59.6	-59.6
99	0	-59.5	-59.5
100	0	-59.5	-59.5
101	0	-59.5	-59.5
102	715	-59.5	-59.5
103	0	-58.5	-58.5
104	0	-57.0	-57.0
105	0	-50.1	-50.1
107	0	-48.3	-48.3
108	0	-41.1	-41.1
109	650	-42.2	-42.2
110	0	-57.0	-57.0
111	0	-52.5	-52.5
113	0	-53.9	-53.9
115	0	-56.9	-56.9
117	0	-59.8	-59.8
118	715	-59.9	-59.9
119	0	-59.9	-59.9
120	0	-59.9	-59.9
125	0	-56.7	-56.7
126	0	-54.3	-54.3
127	0	-48.2	-48.2
128	650	-59.3	-59.3
129	715	-60.3	-60.3
130	715	-60.7	-60.7
131	0	-49.1	-49.1
132	0	-53.0	-53.0
133	0	-56.9	-56.9
134	650	-59.3	-59.3
135	0	-59.9	-59.9
136	0	-59.3	-59.3
137	0	-60.1	-60.1
138	715	-60.3	-60.3
140	715	-60.7	-60.7
141	0	-60.5	-60.5
142	0	-60.3	-60.3
143	0	-60.0	-60.0
144	650	-60.6	-60.6
145	0	-60.5	-60.5
147	650	-60.4	-60.4
151	0	-59.8	-59.8
152	0	-60.2	-60.2

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	-60.7	-60.7
154	715	-60.7	-60.7
155	0	-60.7	-60.7
156	0	-60.7	-60.7
157	0	-60.7	-60.7
158	0	-58.2	-58.2
160	0	-54.9	-54.9
161	0	-59.7	-59.7
162	0	-49.5	-49.5
163	0	-53.2	-53.2
164	0	-58.2	-58.2
165	0	-58.2	-58.2
166	0	-58.7	-58.7
167	0	-57.0	-57.0
168	0	-58.2	-58.2
169	0	-53.0	-53.0
170	0	-52.7	-52.7
171	0	-52.1	-52.1
172	0	-50.9	-50.9
173	0	-50.4	-50.4
174	650	-54.5	-54.5
175	0	-53.6	-53.6
176	0	-53.3	-53.3
177	0	-52.8	-52.8
178	0	-53.2	-53.2
179	650	-55.1	-55.1
180	0	-51.4	-51.4
181	650	-47.6	-47.6
182	715	-53.7	-53.7
183	0	-54.4	-54.4
184	0	-55.8	-55.8
185	715	-58.2	-58.2
186	0	-59.5	-59.5
187	0	-60.1	-60.1
188	0	-58.3	-58.3
191	0	-60.7	-60.7
192	715	-60.7	-60.7
193	0	-60.7	-60.7
194	0	-60.7	-60.7
195	0	-60.7	-60.7
198	0	-61.3	-61.3
199	0	-61.3	-61.3
200	0	-61.6	-61.6
201	0	-61.8	-61.8
202	0	-61.8	-61.8
203	0	-62.6	-62.6
204	0	-62.6	-62.6
205	0	-62.6	-62.6
207	715	-64.5	-64.5
209	0	-63.5	-63.5

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	715	-64.8	-64.8
211	0	-63.3	-63.3
212	0	-62.6	-62.6
213	0	-62.4	-62.4
214	0	-61.9	-61.9
215	0	-62.0	-62.0
216	0	-62.0	-62.0
217	0	-62.2	-62.2
218	0	-62.0	-62.0
219	715	-62.0	-62.0
220	0	-62.7	-62.7
221	0	-60.7	-60.7
223	0	-63.3	-63.3
224	0	-53.7	-53.7
225	0	-53.8	-53.8
226	0	-53.8	-53.8
227	0	-56.5	-56.5
229	715	-59.4	-59.4
232	0	-52.1	-52.1
233	0	-51.6	-51.6
234	0	-51.2	-51.2
235	715	-51.0	-51.0
237	0	-52.7	-52.7
239	0	12.9	12.9
240	0	2.9	2.9
241	0	2.9	2.9
242	650	-4.3	-4.3
243	0	8.3	8.3
244	650	32.7	32.7
250	715	-65.0	-65.0
251	0	-60.7	-60.7
252	0	-3.7	-3.7
253	0	-7.0	-7.0
256	650	-11.6	-11.6
257	0	-2.0	-2.0
259	0	-0.6	-0.6
12	715	-56.3	-56.3
13	0	-41.4	-41.4
34	0	-42.7	-42.7
38	0	39.2	39.2
42	0	39.2	39.2
50	0	-54.3	-54.3
52	0	-53.0	-53.0
58	0	-52.8	-52.8
59	0	-60.4	-60.4
60	0	-59.9	-59.9
61	0	-59.6	-59.6
63	0	-59.3	-59.3
65	0	-62.2	-62.2
66	0	-62.1	-62.1
67	0	-62.3	-62.3

Table A5.6 The results of pipe data (Pipe Network Analysis in 2030)

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	400	110	Open	44,824	4.13
3	3	4	10.87	400	110	Open	39,037	3.6
4	3	6	312.42	300	110	Open	5,787	0.95
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	300	110	Open	5,787	0.95
7	7	10	56.56	110	110	Open	2,998	3.65
8	7	8	240.17	300	110	Open	2,788	0.46
9	8	9	46.95	110	110	Open	1,113	1.36
10	8	11	305.7	300	110	Open	1,676	0.27
13	4	14	244.2	300	110	Open	39,037	6.39
14	14	16	13.83	300	110	Open	20,342	3.33
15	14	15	105.74	300	110	Open	18,696	3.06
16	15	17	20.74	150	110	Open	2,234	1.46
17	15	18	210.31	300	110	Open	16,462	2.7
19	18	20	169.63	300	110	Open	15,422	2.53
21	20	21	184.4	300	110	Open	15,422	2.53
22	21	22	458.88	300	110	Open	20,672	3.38
23	22	26	18.79	160	110	Open	-526	0.3
24	26	23	193.56	160	110	Open	-526	0.3
25	23	24	98.95	160	110	Open	-3,707	2.13
26	23	25	125.34	160	110	Open	3,181	1.83
32	31	21	76.83	300	110	Open	6,290	1.03
33	31	32	17.8	300	110	Open	-6,290	1.03
34	32	33	65.73	300	110	Open	-14,054	2.3
36	33	35	73.14	300	110	Open	-14,054	2.3
38	35	37	49.39	225	110	Open	4,454	1.3
40	32	72	189.04	225	110	Open	7,764	2.26
45	40	41	187.67	225	110	Open	6,442	1.88
46	41	43	154.11	160	110	Open	-664	0.38
48	72	46	111.47	225	110	Open	7,764	2.26
50	46	45	101.35	225	110	Open	7,764	2.26
54	41	48	104.45	225	110	Open	6,066	1.77
55	48	49	155.62	225	110	Open	6,066	1.77
65	49	54	143.09	225	110	Open	6,066	1.77
66	45	51	417.79	225	110	Open	6,059	1.76
68	51	53	144.07	225	110	Open	5,019	1.46
82	54	64	138.9	225	110	Open	6,066	1.77
83	64	78	255.3	225	110	Open	5,026	1.46
85	78	77	252.69	90	110	Open	206	0.38
86	53	77	391.46	225	110	Open	5,019	1.46
87	78	80	91.9	225	110	Open	4,820	1.4
88	80	81	285.79	225	110	Open	4,820	1.4
89	81	82	149.02	225	110	Open	4,820	1.4
90	82	83	489.98	225	110	Open	3,780	1.1
91	83	84	63.82	225	110	Open	6,070	1.77
92	84	85	194.61	225	110	Open	4,438	1.29
93	83	107	276.77	225	110	Open	-2,290	0.67
94	107	105	166.1	160	110	Open	1,895	1.09
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	3,294	0.96
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,599	0.47
101	87	94	61.35	160	110	Open	455	0.26
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	455	0.26
105	93	92	406.94	160	110	Open	1,058	0.61
107	84	104	788.69	160	110	Open	1,632	0.94
108	104	103	186.16	160	110	Open	1,580	0.91
109	103	102	122.52	160	110	Open	1,580	0.91
110	104	110	86.63	160	110	Open	52	0.03

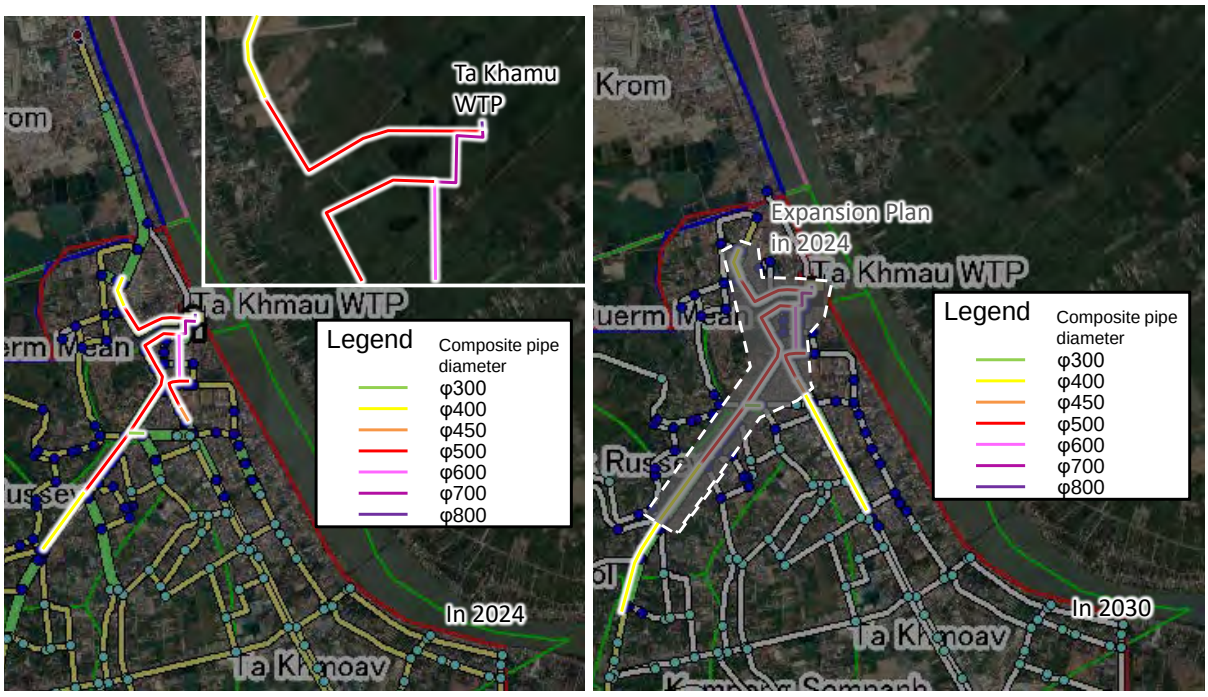
Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	-551	0.32
112	110	95	209.06	160	110	Open	603	0.35
113	95	96	107.46	160	110	Open	603	0.35
114	96	97	299.79	160	110	Open	603	0.35
115	97	93	92.22	160	110	Open	603	0.35
120	101	100	28.76	160	110	Open	86	0.05
121	100	99	149.53	160	110	Open	86	0.05
122	99	98	388.58	160	110	Open	86	0.05
123	102	101	241.09	160	110	Open	86	0.05
124	77	108	97.16	225	110	Open	5,225	1.52
126	108	109	79.98	225	110	Open	5,225	1.52
128	109	107	649.05	225	110	Open	4,185	1.22
129	105	111	210.69	160	110	Open	1,895	1.09
131	111	113	123.66	160	110	Open	1,895	1.09
132	113	115	260.86	160	110	Open	1,895	1.09
137	115	117	258.79	160	110	Open	1,895	1.09
138	117	118	44.16	250	110	Open	2,245	0.53
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	-350	0.2
146	127	126	272.57	160	110	Open	2,756	1.59
147	126	125	102.72	160	110	Open	2,756	1.59
150	125	133	98.06	250	110	Open	2,756	0.65
151	127	132	221.07	160	110	Open	2,715	1.56
152	133	132	332.95	110	110	Open	-719	0.88
155	136	134	25.68	160	110	Open	-175	0.1
156	133	134	604.2	250	110	Open	3,475	0.82
158	134	135	344.51	250	110	Open	2,260	0.53
159	143	135	66.74	160	110	Open	-735	0.42
160	135	137	258.04	250	110	Open	1,524	0.36
161	137	138	445.65	250	110	Open	1,100	0.26
162	138	118	1027.9	250	110	Open	-1,101	0.26
163	137	142	212.46	160	110	Open	425	0.24
164	142	141	375.09	160	110	Open	425	0.24
165	141	140	289.84	160	110	Open	346	0.2
166	138	140	476.94	225	110	Open	1,057	0.31
167	143	144	300.24	160	110	Open	735	0.42
168	144	141	410.99	110	110	Open	-79	0.1
169	144	145	413.28	160	110	Open	-226	0.13
171	128	147	598.71	160	110	Open	710	0.41
173	147	129	293.36	160	110	Open	-317	0.18
174	131	162	27.47	160	110	Open	2,110	1.21
175	162	163	272.14	160	110	Open	2,110	1.21
176	163	161	506.93	160	110	Open	2,031	1.17
177	161	129	53.84	160	110	Open	1,865	1.07
178	161	151	74.03	110	110	Open	166	0.2
182	129	130	681.68	160	110	Open	405	0.23
183	151	152	552.87	110	110	Open	166	0.2
184	152	153	686.29	110	110	Open	166	0.2
185	140	130	911.28	225	110	Open	259	0.08
186	130	153	157	225	110	Open	-411	0.12
188	154	155	168.89	225	110	Open	-133	0.04
189	155	156	180.54	225	110	Open	-133	0.04
190	156	157	322.27	225	110	Open	-95	0.03
191	158	164	124.35	110	110	Open	-10	0.01
195	167	166	503.36	160	110	Open	975	0.56
196	160	167	363.39	160	110	Open	1,336	0.77
197	167	168	362.07	110	110	Open	361	0.44
200	132	179	168.35	160	110	Open	1,997	1.15
201	179	128	401.89	160	110	Open	1,814	1.04

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	-432	0.53
204	170	171	149.19	110	110	Open	-432	0.53
205	171	172	266	110	110	Open	-432	0.53
206	172	173	107.93	110	110	Open	-432	0.53
207	173	131	123.5	160	110	Open	-1,819	1.05
209	169	174	333.47	110	110	Open	432	0.53
210	174	175	119.64	160	110	Open	-1,465	0.84
211	173	180	167.26	160	110	Open	1,387	0.8
213	180	177	217.72	160	110	Open	1,387	0.8
215	177	176	72.45	160	110	Open	1,387	0.8
216	176	178	80.03	110	110	Open	-78	0.1
217	178	163	249.56	110	110	Open	-78	0.1
218	175	176	51.35	160	110	Open	-1,465	0.84
219	179	174	260.71	160	110	Open	-857	0.49
220	22	181	578.59	300	110	Open	14,687	2.4
221	181	131	25.02	150	110	Open	3,929	2.57
222	181	182	563.66	300	110	Open	9,718	1.59
230	193	191	349.77	160	110	Open	-38	0.02
231	130	195	22.34	160	110	Open	-70	0.04
232	156	193	31.21	160	110	Open	-38	0.02
233	157	191	38.44	225	110	Open	-95	0.03
234	191	192	31.85	250	110	Open	-133	0.03
235	194	221	634.06	225	110	Open	70	0.02
236	195	221	782.73	160	110	Open	-70	0.04
237	160	183	60.22	150	110	Open	-1,336	0.87
238	182	183	88.77	300	110	Open	7,786	1.27
239	183	184	286.9	300	110	Open	6,450	1.06
240	184	185	395.9	300	110	Open	6,987	1.14
241	185	158	16.02	150	110	Open	-10	0.01
242	185	188	19.85	300	110	Open	5,853	0.96
243	188	186	285.51	300	110	Open	5,853	0.96
244	186	187	146.45	300	110	Open	5,853	0.96
250	187	192	137.55	300	110	Open	5,853	0.96
251	192	198	238.62	300	110	Open	4,576	0.75
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	4,576	0.75
254	200	219	460.49	300	110	Open	2,143	0.35
255	219	218	25.44	200	110	Open	999	0.37
256	214	218	353.29	160	110	Open	145	0.08
257	218	220	868.13	225	110	Open	1,144	0.33
259	214	215	33.75	160	110	Open	423	0.24
260	201	214	107.36	160	110	Open	568	0.33
261	200	201	28.28	200	110	Open	2,433	0.9
262	201	202	17.78	110	110	Open	211	0.26
263	202	204	632.9	110	110	Open	211	0.26
264	204	207	713.14	110	110	Open	326	0.4
266	203	204	199.48	160	110	Open	115	0.07
267	203	205	16.29	160	110	Open	-115	0.07
271	209	207	300.21	160	110	Open	980	0.56
272	207	210	374.55	110	110	Open	162	0.2
273	205	212	412.83	225	110	Open	429	0.13
274	205	223	203.47	160	110	Open	1,000	0.58
275	223	209	69.13	160	110	Open	980	0.56
276	223	211	406.91	110	110	Open	20	0.02
277	211	210	449.15	160	110	Open	982	0.57
278	212	211	203.44	160	110	Open	961	0.55
279	213	212	270.61	160	110	Open	532	0.31
280	201	216	126.42	225	110	Open	1,654	0.48
283	217	213	412.13	110	110	Open	109	0.13
286	182	224	35.61	225	110	Open	788	0.23

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	251	0.14
290	227	229	653.56	160	110	Open	1,144	0.66
292	224	225	348.98	225	110	Open	537	0.16
293	225	184	1849.61	160	110	Open	537	0.31
302	242	24	658.31	160	110	Open	3,707	2.13
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	-3,736	2.15
305	10	239	94.41	110	110	Open	2,998	3.65
306	239	240	251.41	160	110	Open	3,736	2.15
307	239	243	209.09	110	110	Open	1,011	1.23
308	243	242	216.99	90	110	Open	1,011	1.84
311	9	244	128.73	110	110	Open	1,113	1.36
315	220	250	526.13	160	110	Open	1,144	0.66
316	154	251	188.69	225	110	Open	315	0.09
317	251	153	69.35	225	110	Open	245	0.07
318	251	194	20.58	225	110	Open	70	0.02
319	16	252	193.95	300	110	Open	20,342	3.33
320	252	35	167.94	300	110	Open	19,548	3.2
42	17	259	94.34	160	110	Open	2,234	1.29
153	259	257	94.52	160	110	Open	2,234	1.29
193	257	252	111.05	160	110	Open	2,234	1.29
223	252	253	122.83	160	110	Open	3,028	1.74
321	253	256	170.34	160	110	Open	3,028	1.74
322	98	92	86.27	160	110	Open	86	0.05
323	235	237	381.35	160	110	Open	1,144	0.66
324	45	43	187.67	160	110	Open	664	0.38
326	244	11	496.38	160	110	Open	-1,676	0.96
327	239	244	329.6	110	110	Open	-1,748	2.13
328	235	234	55.05	160	110	Open	893	0.51
329	234	233	167.35	160	110	Open	893	0.51
330	233	232	182.39	160	110	Open	893	0.51
332	164	165	207.25	110	110	Open	-10	0.01
333	165	168	38.67	110	110	Open	-10	0.01
334	168	166	157.76	110	110	Open	351	0.43
335	166	154	349.81	160	110	Open	1,326	0.76
338	237	12	802.56	160	110	Open	1,144	0.66
341	25	13	131.31	160	110	Open	3,181	1.83
342	13	34	43.17	160	110	Open	3,181	1.83
343	34	235	284.57	160	110	Open	3,181	1.83
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	1,144	0.66
12	50	227	499.62	160	110	Open	1,144	0.66
20	226	52	280.96	160	110	Open	-893	0.51
35	52	58	55.77	160	110	Open	-893	0.51
39	58	232	243.77	160	110	Open	-893	0.51
43	136	63	151.36	160	110	Open	175	0.1
51	63	128	111.52	160	110	Open	-64	0.04
52	63	61	156.22	110	110	Open	239	0.29
53	61	60	211	110	110	Open	239	0.29
56	60	59	353.71	110	110	Open	239	0.29
58	145	59	90.41	110	110	Open	-226	0.27
59	59	147	162.77	110	110	Open	14	0.02
60	215	65	318.75	160	110	Open	423	0.24
62	65	213	220	160	110	Open	423	0.24
67	216	66	49.94	225	110	Open	1,654	0.48
69	66	217	55.55	225	110	Open	1,654	0.48
70	217	67	46.22	225	110	Open	1,545	0.45
71	67	205	211.73	225	110	Open	1,545	0.45
27	127	22	128.62	150	110	Open	-5,471	3.58
18	256	37	65.6	225	110	Open	-4,454	1.3
28	256	40	493.84	225	110	Open	6,442	1.88

As the result of the network calculations, it became clear that it was difficult for the existing network to secure a terminal water pressure of 20 m or more at the hourly maximum.

In order to secure water pressure in 2024 and 2030, it is necessary to install water distribution pipes as shown in **Figure A5.4**.



Ex. Pipe	New Pipe	Expansion Length in 2024	Expansion Length in 2030
400	700	15	
400	800	30	
300	350	815	780
300	450	2635	
300	600	385	
300	700	250	
200	400	0	960
200	450	115	105
200	500	190	
150	300	130	
		unit m	unit m

Figure A5.4 Overview of water distribution mains

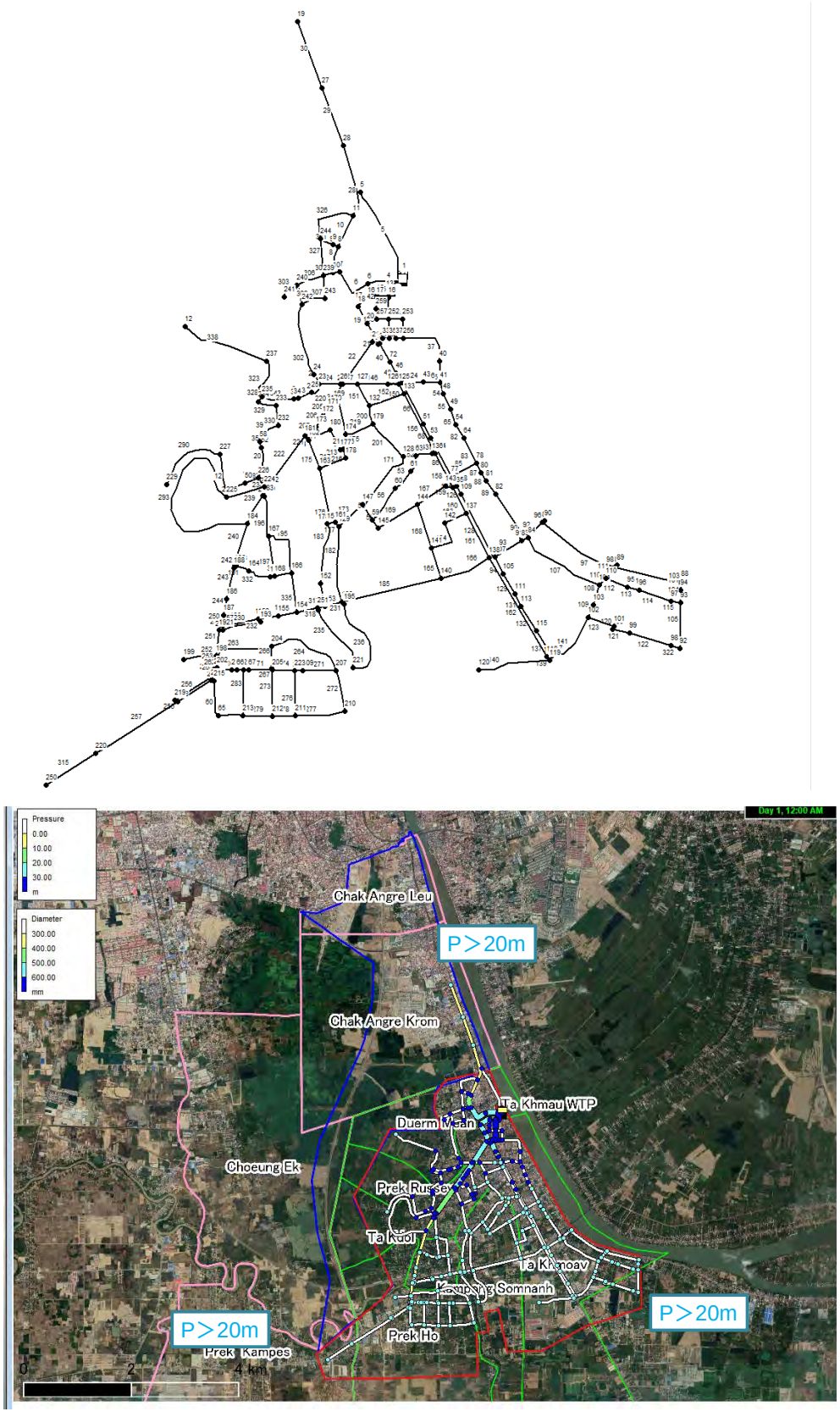


Figure A5.5 The network map and the distribution network calculation data (Pipe Expansion Plan in 2024)

Table A5.7 The results of node data (Pipe Expansion Plan in 2024)

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	40.0	40.0
3	0	40.0	40.0
4	0	39.9	39.9
5	0	40.0	40.0
6	0	39.6	39.6
7	0	39.1	39.1
8	0	38.4	38.4
9	0	37.5	37.5
10	0	37.7	37.7
11	0	35.2	35.2
14	0	39.4	39.4
15	0	39.2	39.2
16	0	39.4	39.4
17	0	39.2	39.2
18	600	38.7	38.7
20	0	38.3	38.3
21	600	37.9	37.9
22	600	36.0	36.0
23	0	34.7	34.7
24	0	34.7	34.7
25	0	33.9	33.9
26	0	35.8	35.8
31	0	38.5	38.5
32	0	38.7	38.7
33	0	38.8	38.8
35	600	38.9	38.9
37	0	38.9	38.9
40	0	35.3	35.3
41	600	34.1	34.1
43	0	35.0	35.0
45	600	36.2	36.2
46	0	38.5	38.5
48	0	33.2	33.2
49	0	32.0	32.0
51	600	32.0	32.0
53	0	31.1	31.1
54	0	30.9	30.9
64	600	29.8	29.8
72	0	38.6	38.6
77	0	28.6	28.6
78	0	28.6	28.6
80	0	28.1	28.1
81	0	26.8	26.8
82	600	26.0	26.0
83	0	24.9	24.9
84	0	24.4	24.4
85	571	23.6	23.6
86	571	22.1	22.1
87	571	21.7	21.7
88	0	21.7	21.7

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	22.1	22.1
90	0	23.6	23.6
92	571	21.3	21.3
93	0	21.7	21.7
94	0	21.7	21.7
95	0	22.0	22.0
96	0	21.9	21.9
97	0	21.7	21.7
98	0	21.4	21.4
99	0	21.6	21.6
100	0	21.8	21.8
101	0	21.8	21.8
102	571	22.0	22.0
103	0	22.0	22.0
104	0	22.2	22.2
105	0	25.1	25.1
107	0	25.4	25.4
108	0	28.0	28.0
109	600	27.5	27.5
110	0	22.1	22.1
111	0	24.7	24.7
113	0	24.4	24.4
115	0	23.9	23.9
117	0	23.4	23.4
118	571	23.4	23.4
119	0	23.4	23.4
120	0	23.4	23.4
125	0	27.7	27.7
126	0	29.8	29.8
127	0	35.5	35.5
128	600	25.3	25.3
129	571	25.0	25.0
130	571	24.9	24.9
131	0	33.6	33.6
132	0	30.9	30.9
133	0	27.4	27.4
134	600	25.3	25.3
135	0	24.6	24.6
136	0	25.3	25.3
137	0	24.3	24.3
138	571	23.9	23.9
140	571	24.0	24.0
141	0	24.1	24.1
142	0	24.2	24.2
143	0	24.5	24.5
144	600	24.1	24.1
145	0	24.3	24.3
147	600	24.6	24.6
151	0	25.4	25.4
152	0	25.3	25.3

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	25.1	25.1
154	571	25.6	25.6
155	0	25.8	25.8
156	0	25.9	25.9
157	0	26.1	26.1
158	0	28.7	28.7
160	0	31.9	31.9
161	0	25.4	25.4
162	0	33.3	33.3
163	0	30.4	30.4
164	0	28.7	28.7
165	0	28.7	28.7
166	0	27.9	27.9
167	0	29.7	29.7
168	0	28.6	28.6
169	0	30.6	30.6
170	0	30.8	30.8
171	0	31.3	31.3
172	0	32.2	32.2
173	0	32.6	32.6
174	600	29.4	29.4
175	0	30.1	30.1
176	0	30.4	30.4
177	0	30.7	30.7
178	0	30.4	30.4
179	600	29.0	29.0
180	0	31.8	31.8
181	600	34.8	34.8
182	571	33.0	33.0
183	0	32.4	32.4
184	0	31.0	31.0
185	571	28.7	28.7
186	0	27.4	27.4
187	0	26.8	26.8
188	0	28.6	28.6
191	0	26.2	26.2
192	571	26.2	26.2
193	0	26.0	26.0
194	0	25.2	25.2
195	0	24.9	24.9
198	0	25.8	25.8
199	0	25.8	25.8
200	0	25.6	25.6
201	0	25.5	25.5
202	0	25.4	25.4
203	0	25.0	25.0
204	0	24.9	24.9
205	0	25.0	25.0
207	571	23.7	23.7
209	0	24.3	24.3

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	571	23.5	23.5
211	0	24.5	24.5
212	0	24.9	24.9
213	0	25.1	25.1
214	0	25.4	25.4
215	0	25.4	25.4
216	0	25.3	25.3
217	0	25.2	25.2
218	0	25.3	25.3
219	571	25.4	25.4
220	0	24.9	24.9
221	0	25.2	25.2
223	0	24.5	24.5
224	0	33.0	33.0
225	0	32.9	32.9
226	0	32.3	32.3
227	0	30.5	30.5
229	571	28.6	28.6
232	0	31.7	31.7
233	0	31.5	31.5
234	0	31.4	31.4
235	571	31.3	31.3
237	0	30.2	30.2
239	0	35.5	35.5
240	0	35.0	35.0
241	0	35.0	35.0
242	600	34.6	34.6
243	0	35.2	35.2
244	600	35.2	35.2
250	572	23.3	23.3
251	0	25.2	25.2
252	0	39.2	39.2
253	0	38.9	38.9
256	600	38.5	38.5
257	0	39.2	39.2
259	0	39.2	39.2
12	571	27.9	27.9
13	0	33.2	33.2
34	0	32.9	32.9
50	0	31.9	31.9
52	0	32.0	32.0
58	0	32.0	32.0
59	0	24.5	24.5
60	0	24.9	24.9
61	0	25.1	25.1
63	0	25.3	25.3
65	0	25.2	25.2
66	0	25.3	25.3
67	0	25.2	25.2
19	2000	24.5	24.5
27	2000	25.4	25.4
28	2000	28.2	28.2

Table A5.8 The results of pipe data (Pipe Expansion Plan in 2024)

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	800	110	Open	47,987	1.1
3	3	4	10.87	700	110	Open	36,517	1.1
4	3	6	312.42	500	110	Open	11,470	0.68
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	500	110	Open	11,470	0.68
7	7	10	56.56	110	110	Open	1,069	1.3
8	7	8	240.17	400	110	Open	10,401	0.96
9	8	9	46.95	110	110	Open	910	1.11
10	8	11	305.7	300	110	Open	9,491	1.55
13	4	14	244.2	700	110	Open	36,517	1.1
14	14	16	13.83	600	110	Open	19,948	0.82
15	14	15	105.74	500	110	Open	16,570	0.98
16	15	17	20.74	150	110	Open	155	0.1
17	15	18	210.31	500	110	Open	16,414	0.97
19	18	20	169.63	500	110	Open	15,454	0.91
21	20	21	184.4	500	110	Open	15,454	0.91
22	21	22	458.88	500	110	Open	22,543	1.33
23	22	26	18.79	160	110	Open	1,364	0.79
24	26	23	193.56	160	110	Open	1,364	0.79
25	23	24	98.95	160	110	Open	50	0.03
26	23	25	125.34	160	110	Open	1,314	0.76
32	31	21	76.83	300	110	Open	8,049	1.32
33	31	32	17.8	300	110	Open	−8,049	1.32
34	32	33	65.73	500	110	Open	−14,763	0.87
36	33	35	73.14	500	110	Open	−14,763	0.87
38	35	37	49.39	500	110	Open	3,589	0.21
40	32	72	189.04	500	110	Open	6,714	0.4
45	40	41	187.67	225	110	Open	3,420	1
46	41	43	154.11	160	110	Open	−1,386	0.8
48	72	46	111.47	450	110	Open	6,714	0.49
50	46	45	101.35	225	110	Open	6,714	1.95
54	41	48	104.45	225	110	Open	3,846	1.12
55	48	49	155.62	225	110	Open	3,846	1.12
65	49	54	143.09	225	110	Open	3,846	1.12
66	45	51	417.79	225	110	Open	4,368	1.27
68	51	53	144.08	225	110	Open	3,408	0.99
82	54	64	138.9	225	110	Open	3,846	1.12
83	64	78	255.3	225	110	Open	2,886	0.84
85	78	77	252.69	90	110	Open	−48	0.09
86	53	77	391.46	225	110	Open	3,408	0.99
87	78	80	91.9	225	110	Open	2,934	0.85
88	80	81	285.79	225	110	Open	2,934	0.85
89	81	82	149.02	225	110	Open	2,934	0.85
90	82	83	489.98	225	110	Open	1,974	0.57
91	83	84	63.82	225	110	Open	3,649	1.06
92	84	85	194.61	225	110	Open	2,740	0.8
93	83	107	276.77	225	110	Open	−1,675	0.49
94	107	105	166.1	160	110	Open	725	0.42
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	1,826	0.53
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,008	0.29
101	87	94	61.35	160	110	Open	95	0.05
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	95	0.05
105	93	92	406.94	160	110	Open	483	0.28
107	84	104	788.69	160	110	Open	909	0.52
108	104	103	186.16	160	110	Open	425	0.24
109	103	102	122.52	160	110	Open	425	0.24
110	104	110	86.63	160	110	Open	484	0.28

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	96	0.06
112	110	95	209.06	160	110	Open	388	0.22
113	95	96	107.46	160	110	Open	388	0.22
114	96	97	299.79	160	110	Open	388	0.22
115	97	93	92.22	160	110	Open	388	0.22
120	101	100	28.76	160	110	Open	431	0.25
121	100	99	149.53	160	110	Open	431	0.25
122	99	98	388.58	160	110	Open	431	0.25
123	102	101	241.09	160	110	Open	431	0.25
124	77	108	97.16	225	110	Open	3,360	0.98
126	108	109	79.98	225	110	Open	3,360	0.98
128	109	107	649.05	225	110	Open	2,400	0.7
129	105	111	210.69	160	110	Open	725	0.42
131	111	113	123.66	160	110	Open	725	0.42
132	113	115	260.86	160	110	Open	725	0.42
137	115	117	258.79	160	110	Open	725	0.42
138	117	118	44.16	250	110	Open	−194	0.05
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	919	0.53
146	127	126	272.57	160	110	Open	2,643	1.52
147	126	125	102.72	160	110	Open	2,643	1.52
150	125	133	98.05	250	110	Open	2,643	0.62
151	127	132	221.07	160	110	Open	2,627	1.51
152	133	132	332.94	110	110	Open	−681	0.83
155	136	134	25.68	160	110	Open	5	0
156	133	134	604.2	250	110	Open	3,324	0.78
158	134	135	344.51	250	110	Open	2,370	0.56
159	143	135	66.74	160	110	Open	−601	0.35
160	135	137	258.04	250	110	Open	1,769	0.42
161	137	138	445.65	250	110	Open	1,489	0.35
162	138	118	1027.9	250	110	Open	1,108	0.26
163	137	142	212.46	160	110	Open	279	0.16
164	142	141	375.09	160	110	Open	279	0.16
165	141	140	289.84	160	110	Open	252	0.14
166	138	140	476.94	225	110	Open	−532	0.15
167	143	144	300.24	160	110	Open	601	0.35
168	144	141	410.99	110	110	Open	−27	0.03
169	144	145	413.28	160	110	Open	−332	0.19
171	128	147	598.71	160	110	Open	537	0.31
173	147	129	293.36	160	110	Open	−562	0.32
174	131	162	27.47	160	110	Open	1,840	1.06
175	162	163	272.14	160	110	Open	1,840	1.06
176	163	161	506.93	160	110	Open	1,762	1.01
177	161	129	53.84	160	110	Open	1,670	0.96
178	161	151	74.03	110	110	Open	93	0.11
182	129	130	681.68	160	110	Open	194	0.11
183	151	152	552.87	110	110	Open	93	0.11
184	152	153	686.29	110	110	Open	93	0.11
185	140	130	911.28	225	110	Open	−1,194	0.35
186	130	153	157	225	110	Open	−1,611	0.47
188	154	155	168.89	225	110	Open	−1,296	0.38
189	155	156	180.54	225	110	Open	−1,296	0.38
190	156	157	322.27	225	110	Open	−897	0.26
191	158	164	124.35	110	110	Open	85	0.1
195	167	166	503.36	160	110	Open	1,011	0.58
196	160	167	363.39	160	110	Open	1,354	0.78
197	167	168	362.07	110	110	Open	343	0.42
200	132	179	168.35	160	110	Open	1,946	1.12
201	179	128	401.89	160	110	Open	1,695	0.98

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	-378	0.46
204	170	171	149.19	110	110	Open	-378	0.46
205	171	172	266	110	110	Open	-378	0.46
206	172	173	107.93	110	110	Open	-378	0.46
207	173	131	123.5	160	110	Open	-1,591	0.92
209	169	174	333.47	110	110	Open	378	0.46
210	174	175	119.64	160	110	Open	-1,291	0.74
211	173	180	167.26	160	110	Open	1,213	0.7
213	180	177	217.72	160	110	Open	1,213	0.7
215	177	176	72.45	160	110	Open	1,213	0.7
216	176	178	80.03	110	110	Open	-78	0.1
217	178	163	249.56	110	110	Open	-78	0.1
218	175	176	51.35	160	110	Open	-1,291	0.74
219	179	174	260.71	160	110	Open	-709	0.41
220	22	181	578.59	500	110	Open	14,950	0.88
221	181	131	25.02	150	110	Open	3,431	2.25
222	181	182	563.66	400	110	Open	10,558	0.97
230	193	191	349.77	160	110	Open	-399	0.23
231	130	195	22.34	160	110	Open	-302	0.17
232	156	193	31.21	160	110	Open	-399	0.23
233	157	191	126.11	225	110	Open	-897	0.26
234	191	192	31.85	250	110	Open	-1,296	0.31
235	194	221	634.06	225	110	Open	302	0.09
236	195	221	782.73	160	110	Open	-302	0.17
237	160	183	60.22	150	110	Open	-1,354	0.89
238	182	183	88.77	300	110	Open	7,698	1.26
239	183	184	286.9	300	110	Open	6,344	1.04
240	184	185	395.9	300	110	Open	6,864	1.12
241	185	158	16.02	150	110	Open	85	0.06
242	185	188	19.85	300	110	Open	5,865	0.96
243	188	186	285.51	300	110	Open	5,865	0.96
244	186	187	146.45	300	110	Open	5,865	0.96
250	187	192	137.55	300	110	Open	5,865	0.96
251	192	198	238.62	300	110	Open	3,656	0.6
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	3,656	0.6
254	200	219	460.49	300	110	Open	1,713	0.28
255	219	218	25.44	200	110	Open	799	0.29
256	214	218	353.29	160	110	Open	116	0.07
257	218	220	868.13	225	110	Open	915	0.27
259	214	215	33.75	160	110	Open	338	0.19
260	201	214	107.36	160	110	Open	454	0.26
261	200	201	28.28	200	110	Open	1,943	0.72
262	201	202	17.78	110	110	Open	168	0.2
263	202	204	632.9	110	110	Open	168	0.2
264	204	207	713.14	110	110	Open	260	0.32
266	203	204	199.48	160	110	Open	92	0.05
267	203	205	16.29	160	110	Open	-92	0.05
271	209	207	300.21	160	110	Open	783	0.45
272	207	210	374.55	110	110	Open	130	0.16
273	205	212	412.83	225	110	Open	343	0.1
274	205	223	203.47	160	110	Open	799	0.46
275	223	209	69.13	160	110	Open	783	0.45
276	223	211	406.91	110	110	Open	16	0.02
277	211	210	449.15	160	110	Open	784	0.45
278	212	211	203.44	160	110	Open	768	0.44
279	213	212	270.61	160	110	Open	425	0.24
280	201	216	126.42	225	110	Open	1,321	0.38
283	217	213	412.13	110	110	Open	87	0.11
286	182	224	35.61	225	110	Open	1,947	0.57

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	1,427	0.82
290	227	229	653.56	160	110	Open	914	0.53
292	224	225	348.98	225	110	Open	520	0.15
293	225	184	1849.61	160	110	Open	520	0.3
302	242	24	658.31	160	110	Open	-50	0.03
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	-716	0.41
305	10	239	94.41	110	110	Open	1,069	1.3
306	239	240	251.41	160	110	Open	716	0.41
307	239	243	209.09	110	110	Open	194	0.24
308	243	242	216.99	90	110	Open	194	0.35
311	9	244	128.73	110	110	Open	910	1.11
315	220	250	526.13	160	110	Open	915	0.53
316	154	251	188.69	225	110	Open	1,821	0.53
317	251	153	69.35	225	110	Open	1,518	0.44
318	251	194	20.58	225	110	Open	302	0.09
319	16	252	193.95	600	110	Open	19,948	0.82
320	252	35	167.94	600	110	Open	19,311	0.79
42	17	259	94.34	160	110	Open	155	0.09
153	259	257	94.52	160	110	Open	155	0.09
193	257	252	111.05	160	110	Open	155	0.09
223	252	253	122.83	160	110	Open	791	0.46
321	253	256	170.34	160	110	Open	791	0.46
322	98	92	86.27	160	110	Open	431	0.25
323	235	237	381.35	160	110	Open	914	0.53
324	45	43	187.67	160	110	Open	1,386	0.8
326	244	11	496.38	160	110	Open	109	0.06
327	239	244	329.6	110	110	Open	159	0.19
328	235	234	55.05	160	110	Open	-513	0.3
329	234	233	167.35	160	110	Open	-513	0.3
330	233	232	182.39	160	110	Open	-513	0.3
332	164	165	207.25	110	110	Open	85	0.1
333	165	168	38.67	110	110	Open	85	0.1
334	168	166	157.76	110	110	Open	428	0.52
335	166	154	349.82	160	110	Open	1,438	0.83
338	237	12	802.56	160	110	Open	914	0.53
341	25	13	131.31	160	110	Open	1,314	0.76
342	13	34	43.17	160	110	Open	1,314	0.76
343	34	235	284.57	160	110	Open	1,314	0.76
11	226	50	126.42	160	110	Open	914	0.53
12	50	227	499.62	160	110	Open	914	0.53
20	226	52	280.96	160	110	Open	513	0.3
35	52	58	55.77	160	110	Open	513	0.3
39	58	232	243.77	160	110	Open	513	0.3
43	136	63	151.36	160	110	Open	-5	0
51	63	128	111.52	160	110	Open	-197	0.11
52	63	61	156.22	110	110	Open	192	0.23
53	61	60	211	110	110	Open	192	0.23
56	60	59	353.71	110	110	Open	192	0.23
58	145	59	90.41	110	110	Open	-332	0.4
59	59	147	162.77	110	110	Open	-140	0.17
60	215	65	318.75	160	110	Open	338	0.19
62	65	213	220	160	110	Open	338	0.19
67	216	66	49.94	225	110	Open	1,321	0.38
69	66	217	55.55	225	110	Open	1,321	0.38
70	217	67	46.22	225	110	Open	1,234	0.36
71	67	205	211.73	225	110	Open	1,234	0.36
27	127	22	128.62	300	110	Open	-5,270	0.86
28	11	28	658.78	300	110	Open	9,600	1.57
29	28	27	550.12	300	110	Open	6,400	1.05
30	27	19	633.7	300	110	Open	3,200	0.52
31	256	37	60.93	225	110	Open	-3,589	1.04
37	256	40	504.85	225	110	Open	3,420	1

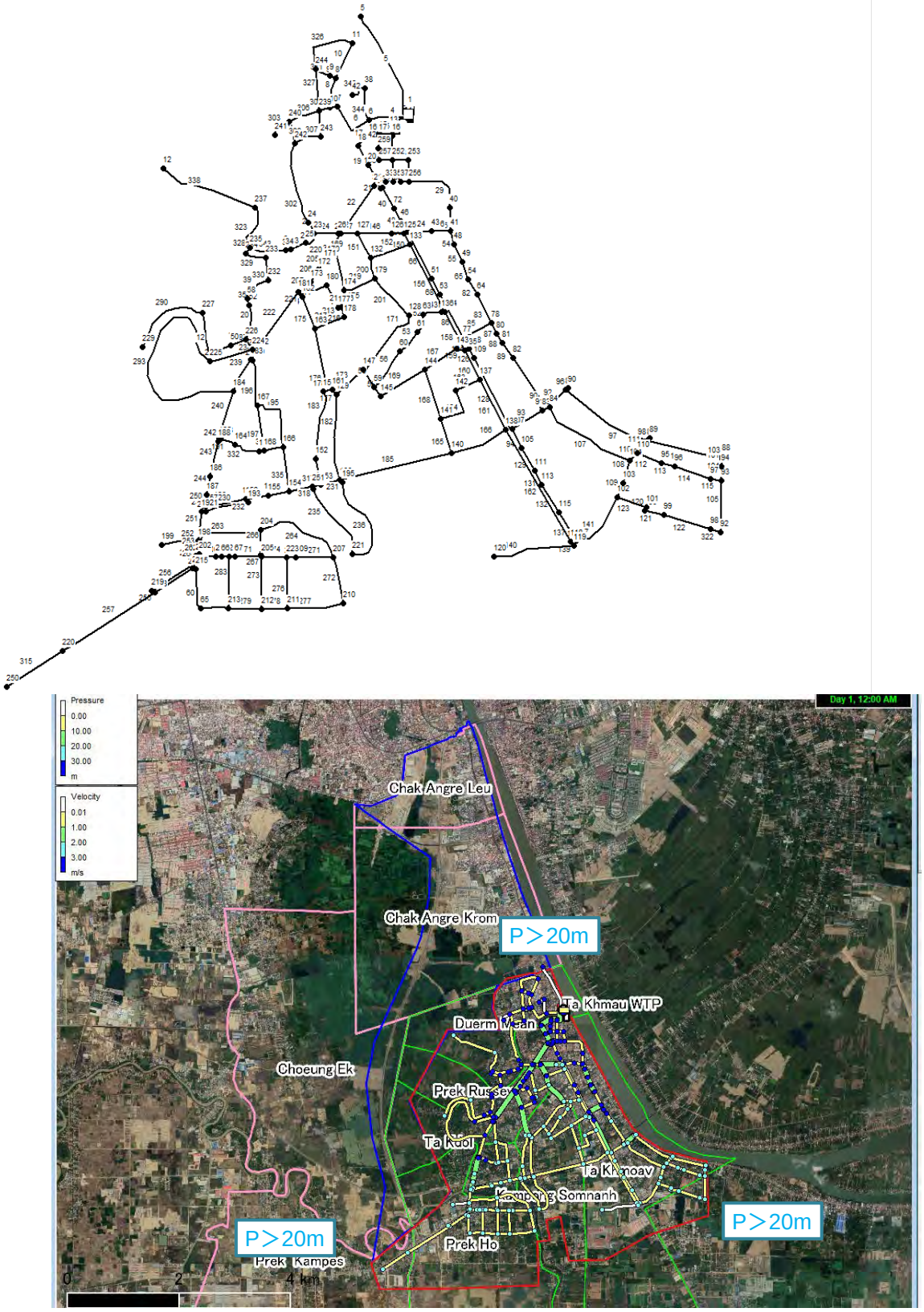


Figure A5.6 The network map and the distribution network calculation data (Pipe Expansion Plan in 2030）

Table A5.9 The results of node data (Pipe Expansion Plan in 2030)

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
2	0	41.7	41.7
3	0	41.7	41.7
4	0	41.6	41.6
5	0	41.7	41.7
6	0	41.6	41.6
7	0	41.6	41.6
8	0	41.6	41.6
9	0	41.2	41.2
10	0	40.3	40.3
11	0	41.6	41.6
14	0	41.0	41.0
15	0	40.7	40.7
16	0	41.0	41.0
17	0	40.7	40.7
18	650	40.0	40.0
20	0	39.6	39.6
21	650	39.0	39.0
22	650	36.6	36.6
23	0	35.5	35.5
24	0	35.6	35.6
25	0	34.3	34.3
26	0	36.5	36.5
31	0	39.8	39.8
32	0	39.9	39.9
33	0	40.1	40.1
35	650	40.3	40.3
37	0	40.3	40.3
40	0	37.5	37.5
41	650	36.6	36.6
43	0	37.8	37.8
45	650	39.3	39.3
46	0	39.6	39.6
48	0	35.9	35.9
49	0	34.9	34.9
51	650	38.7	38.7
53	0	38.6	38.6
54	0	33.9	33.9
64	650	33.0	33.0
72	0	39.8	39.8
77	0	38.2	38.2
78	0	32.1	32.1
80	0	31.6	31.6
81	0	30.1	30.1
82	650	29.3	29.3
83	0	28.1	28.1
84	0	27.3	27.3
85	715	25.9	25.9
86	715	23.0	23.0
87	715	22.3	22.3
88	0	22.3	22.3

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
89	0	23.0	23.0
90	0	25.9	25.9
92	715	21.6	21.6
93	0	22.3	22.3
94	0	22.3	22.3
95	0	22.8	22.8
96	0	22.7	22.7
97	0	22.4	22.4
98	0	21.7	21.7
99	0	22.0	22.0
100	0	22.1	22.1
101	0	22.1	22.1
102	715	22.3	22.3
103	0	22.6	22.6
104	0	23.1	23.1
105	0	28.4	28.4
107	0	29.4	29.4
108	0	36.8	36.8
109	650	35.6	35.6
110	0	23.0	23.0
111	0	27.2	27.2
113	0	26.4	26.4
115	0	24.9	24.9
117	0	23.4	23.4
118	715	23.3	23.3
119	0	23.3	23.3
120	0	23.3	23.3
125	0	27.4	27.4
126	0	29.8	29.8
127	0	36.1	36.1
128	650	24.8	24.8
129	715	24.4	24.4
130	715	24.4	24.4
131	0	33.7	33.7
132	0	30.9	30.9
133	0	27.2	27.2
134	650	24.8	24.8
135	0	24.1	24.1
136	0	24.8	24.8
137	0	23.8	23.8
138	715	23.5	23.5
140	715	23.5	23.5
141	0	23.6	23.6
142	0	23.7	23.7
143	0	24.0	24.0
144	650	23.5	23.5
145	0	23.7	23.7
147	650	24.0	24.0
151	0	24.9	24.9
152	0	24.8	24.8

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
153	0	24.7	24.7
154	715	25.4	25.4
155	0	25.7	25.7
156	0	26.1	26.1
157	0	26.4	26.4
158	0	30.5	30.5
160	0	31.7	31.7
161	0	24.9	24.9
162	0	33.4	33.4
163	0	30.3	30.3
164	0	30.1	30.1
165	0	29.5	29.5
166	0	28.2	28.2
167	0	29.9	29.9
168	0	29.4	29.4
169	0	30.4	30.4
170	0	30.6	30.6
171	0	31.2	31.2
172	0	32.2	32.2
173	0	32.6	32.6
174	650	29.2	29.2
175	0	29.9	29.9
176	0	30.2	30.2
177	0	30.6	30.6
178	0	30.2	30.2
179	650	28.7	28.7
180	0	31.7	31.7
181	650	35.0	35.0
182	715	32.3	32.3
183	0	32.1	32.1
184	0	31.5	31.5
185	715	30.5	30.5
186	0	28.5	28.5
187	0	27.5	27.5
188	0	30.4	30.4
191	0	26.5	26.5
192	715	26.5	26.5
193	0	26.1	26.1
194	0	24.8	24.8
195	0	24.4	24.4
198	0	25.9	25.9
199	0	25.9	25.9
200	0	25.6	25.6
201	0	25.4	25.4
202	0	25.4	25.4
203	0	24.6	24.6
204	0	24.6	24.6
205	0	24.6	24.6
207	715	22.7	22.7
209	0	23.7	23.7

Node ID	Demand (m3/d)	Head (m)	Pressure (m)
210	715	22.4	22.4
211	0	23.9	23.9
212	0	24.6	24.6
213	0	24.9	24.9
214	0	25.3	25.3
215	0	25.3	25.3
216	0	25.2	25.2
217	0	25.0	25.0
218	0	25.2	25.2
219	715	25.3	25.3
220	0	24.5	24.5
221	0	24.8	24.8
223	0	23.9	23.9
224	0	32.2	32.2
225	0	32.2	32.2
226	0	31.3	31.3
227	0	28.6	28.6
229	715	25.7	25.7
232	0	30.6	30.6
233	0	30.4	30.4
234	0	30.1	30.1
235	715	30.1	30.1
237	0	28.4	28.4
239	0	38.2	38.2
240	0	37.0	37.0
241	0	37.0	37.0
242	650	36.1	36.1
243	0	37.7	37.7
244	650	40.1	40.1
250	715	22.2	22.2
251	0	24.8	24.8
252	0	40.6	40.6
253	0	40.3	40.3
256	650	39.9	39.9
257	0	40.6	40.6
259	0	40.6	40.6
12	715	24.8	24.8
13	0	33.1	33.1
34	0	32.7	32.7
38	0	41.6	41.6
42	0	41.6	41.6
50	0	30.8	30.8
52	0	31.0	31.0
58	0	30.9	30.9
59	0	23.9	23.9
60	0	24.3	24.3
61	0	24.6	24.6
63	0	24.8	24.8
65	0	25.0	25.0
66	0	25.1	25.1
67	0	25.0	25.0

Table A5.10 The results of pipe data (Pipe Expansion Plan in 2030)

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
2	2	3	27.18	800	110	Open	44,824	1.03
3	3	4	10.87	700	110	Open	42,268	1.27
4	3	6	312.42	500	110	Open	2,556	0.15
5	2	5	900.16	250	110	Open	0	0
6	6	7	385.89	500	110	Open	2,556	0.15
7	7	10	56.56	110	110	Open	1,028	1.25
8	7	8	240.17	400	110	Open	1,529	0.14
9	8	9	46.95	110	110	Open	610	0.74
10	8	11	305.7	300	110	Open	919	0.15
13	4	14	244.18	700	110	Open	42,268	1.27
14	14	16	13.83	600	110	Open	23,323	0.95
15	14	15	105.74	500	110	Open	18,945	1.12
16	15	17	20.74	150	110	Open	208	0.14
17	15	18	210.31	500	110	Open	18,737	1.1
19	18	20	169.63	500	110	Open	17,697	1.04
21	20	21	184.4	500	110	Open	17,697	1.04
22	21	22	458.88	500	110	Open	25,569	1.51
23	22	26	18.79	160	110	Open	1,229	0.71
24	26	23	193.56	160	110	Open	1,229	0.71
25	23	24	98.95	160	110	Open	−476	0.27
26	23	25	125.34	160	110	Open	1,705	0.98
32	31	21	76.83	300	110	Open	8,913	1.46
33	31	32	17.8	300	110	Open	−8,913	1.46
34	32	33	65.73	500	110	Open	−18,488	1.09
36	33	35	59.29	500	110	Open	−18,488	1.09
38	35	37	63.39	500	110	Open	3,197	0.19
40	32	72	189.04	500	110	Open	9,575	0.56
45	40	41	185.54	225	110	Open	2,963	0.86
46	41	43	152.5	160	110	Open	−1,576	0.91
48	72	46	111.47	450	110	Open	9,575	0.7
50	46	45	101.34	400	110	Open	9,575	0.88
54	41	48	106.9	225	110	Open	3,499	1.02
55	48	49	155.62	225	110	Open	3,499	1.02
65	49	54	143.09	225	110	Open	3,499	1.02
66	45	51	417.79	400	110	Open	6,959	0.64
68	51	53	144.07	400	110	Open	5,919	0.55
82	54	64	138.9	225	110	Open	3,499	1.02
83	64	78	255.3	225	110	Open	2,459	0.72
85	78	77	252.69	90	110	Open	−628	1.14
86	53	77	391.46	400	110	Open	5,919	0.55
87	78	80	91.9	225	110	Open	3,087	0.9
88	80	81	285.79	225	110	Open	3,087	0.9
89	81	82	149.02	225	110	Open	3,087	0.9
90	82	83	489.98	225	110	Open	2,047	0.6
91	83	84	63.82	225	110	Open	4,958	1.44
92	84	85	194.61	225	110	Open	3,691	1.07
93	83	107	276.77	225	110	Open	−2,911	0.85
94	107	105	166.1	160	110	Open	1,340	0.77
96	85	90	24.11	160	110	Open	0	0
97	85	86	768.88	225	110	Open	2,547	0.74
98	86	89	27.93	160	110	Open	0	0
100	86	87	616.51	225	110	Open	1,325	0.39
101	87	94	61.35	160	110	Open	181	0.1
103	88	87	19.75	160	110	Open	0	0
104	94	93	110.6	160	110	Open	181	0.1
105	93	92	406.94	160	110	Open	691	0.4
107	84	104	788.69	160	110	Open	1,267	0.73
108	104	103	186.16	160	110	Open	835	0.48
109	103	102	122.52	160	110	Open	835	0.48
110	104	110	86.63	160	110	Open	432	0.25

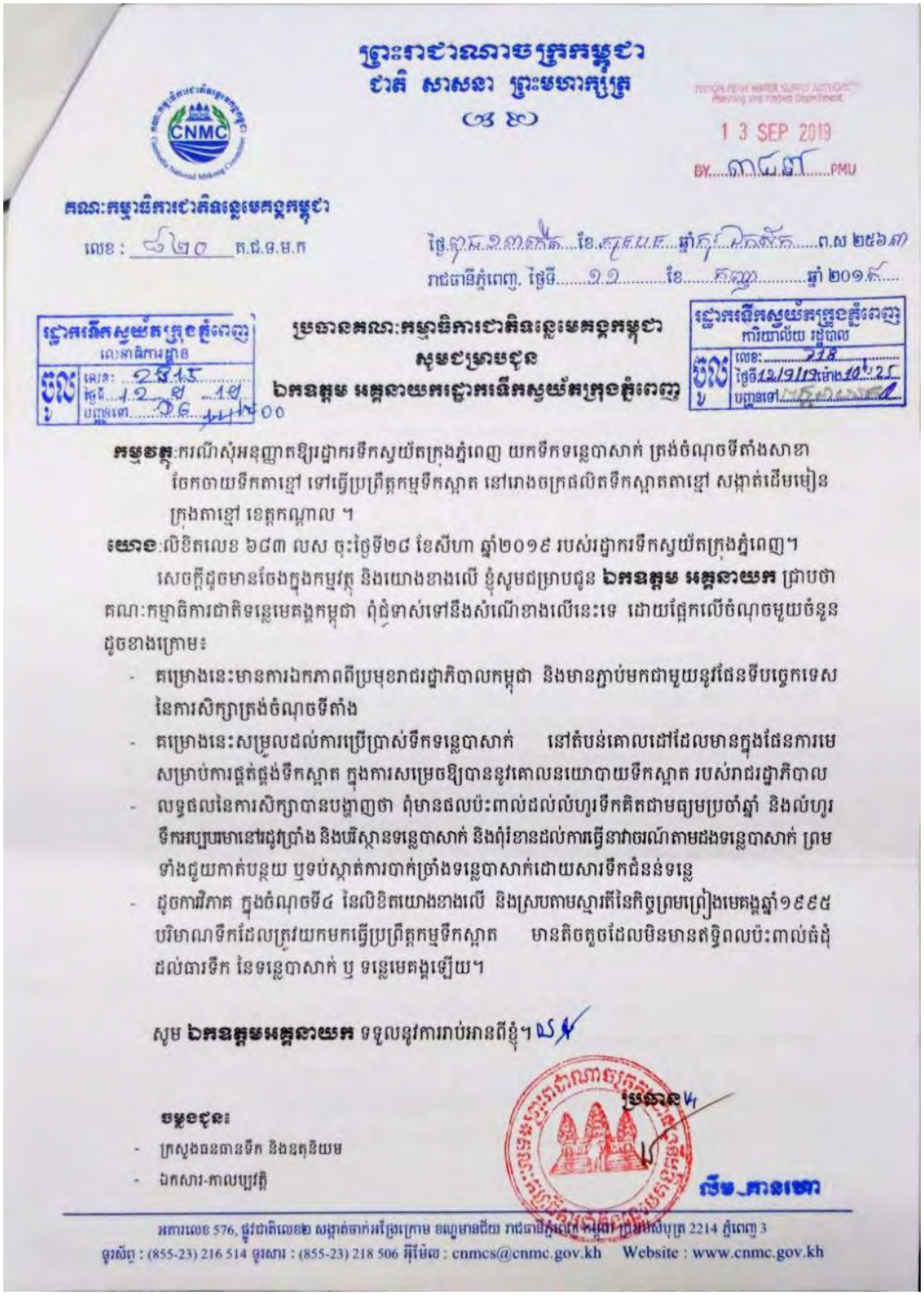
Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
111	110	86	125.24	160	110	Open	−78	0.04
112	110	95	209.06	160	110	Open	510	0.29
113	95	96	107.46	160	110	Open	510	0.29
114	96	97	299.79	160	110	Open	510	0.29
115	97	93	92.22	160	110	Open	510	0.29
120	101	100	28.76	160	110	Open	453	0.26
121	100	99	149.53	160	110	Open	453	0.26
122	99	98	388.58	160	110	Open	453	0.26
123	102	101	241.09	160	110	Open	453	0.26
124	77	108	97.16	225	110	Open	5,291	1.54
126	108	109	79.98	225	110	Open	5,291	1.54
128	109	107	649.05	225	110	Open	4,251	1.24
129	105	111	210.69	160	110	Open	1,340	0.77
131	111	113	123.66	160	110	Open	1,340	0.77
132	113	115	260.86	160	110	Open	1,340	0.77
137	115	117	258.79	160	110	Open	1,340	0.77
138	117	118	44.16	250	110	Open	578	0.14
139	118	119	39.5	250	110	Open	0	0
140	119	120	645.75	160	110	Open	0	0
141	117	102	504.75	160	110	Open	762	0.44
146	127	126	272.57	160	110	Open	2,785	1.6
147	126	125	102.72	160	110	Open	2,785	1.6
150	125	133	98.06	250	110	Open	2,785	0.66
151	127	132	221.07	160	110	Open	2,794	1.61
152	133	132	332.95	110	110	Open	−709	0.86
155	136	134	25.68	160	110	Open	−80	0.05
156	133	134	604.2	250	110	Open	3,494	0.82
158	134	135	344.51	250	110	Open	2,374	0.56
159	143	135	66.74	160	110	Open	−650	0.37
160	135	137	258.04	250	110	Open	1,725	0.41
161	137	138	445.65	250	110	Open	1,416	0.33
162	138	118	1027.9	250	110	Open	566	0.13
163	137	142	212.46	160	110	Open	309	0.18
164	142	141	375.09	160	110	Open	309	0.18
165	141	140	289.84	160	110	Open	240	0.14
166	138	140	476.94	225	110	Open	−294	0.09
167	143	144	300.24	160	110	Open	650	0.37
168	144	141	410.99	110	110	Open	−69	0.08
169	144	145	413.28	160	110	Open	−322	0.19
171	128	147	598.71	160	110	Open	585	0.34
173	147	129	293.36	160	110	Open	−571	0.33
174	131	162	27.47	160	110	Open	1,918	1.1
175	162	163	272.14	160	110	Open	1,918	1.1
176	163	161	506.93	160	110	Open	1,832	1.05
177	161	129	53.84	160	110	Open	1,764	1.02
178	161	151	74.03	110	110	Open	68	0.08
182	129	130	681.68	160	110	Open	49	0.03
183	151	152	552.87	110	110	Open	68	0.08
184	152	153	686.29	110	110	Open	68	0.08
185	140	130	911.28	225	110	Open	−1,198	0.35
186	130	153	157	225	110	Open	−1,929	0.56
188	154	155	168.89	225	110	Open	−1,800	0.52
189	155	156	180.54	225	110	Open	−1,800	0.52
190	156	157	322.27	225	110	Open	−1,245	0.36
191	158	164	124.35	110	110	Open	351	0.43
195	167	166	503.36	160	110	Open	992	0.57
196	160	167	363.39	160	110	Open	1,217	0.7
197	167	168	362.07	110	110	Open	225	0.27
200	132	179	168.35	160	110	Open	2,084	1.2
201	179	128	401.89	160	110	Open	1,751	1.01

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
203	169	170	48.22	110	110	Open	-395	0.48
204	170	171	149.19	110	110	Open	-395	0.48
205	171	172	266	110	110	Open	-395	0.48
206	172	173	107.93	110	110	Open	-395	0.48
207	173	131	123.5	160	110	Open	-1,660	0.96
209	169	174	333.47	110	110	Open	395	0.48
210	174	175	119.64	160	110	Open	-1,351	0.78
211	173	180	167.26	160	110	Open	1,265	0.73
213	180	177	217.72	160	110	Open	1,265	0.73
215	177	176	72.45	160	110	Open	1,265	0.73
216	176	178	80.03	110	110	Open	-86	0.1
217	178	163	249.56	110	110	Open	-86	0.1
218	175	176	51.35	160	110	Open	-1,351	0.78
219	179	174	260.71	160	110	Open	-706	0.41
220	22	181	578.59	500	110	Open	17,722	1.04
221	181	131	25.02	150	110	Open	3,578	2.34
222	181	182	563.66	400	110	Open	13,104	1.21
230	193	191	349.77	160	110	Open	-555	0.32
231	130	195	22.34	160	110	Open	-363	0.21
232	156	193	31.21	160	110	Open	-555	0.32
233	157	191	126.11	225	110	Open	-1,245	0.36
234	191	192	31.85	250	110	Open	-1,800	0.42
235	194	221	634.06	225	110	Open	363	0.11
236	195	221	782.73	160	110	Open	-363	0.21
237	160	183	60.22	150	110	Open	-1,217	0.8
238	182	183	88.77	400	110	Open	9,916	0.91
239	183	184	286.9	400	110	Open	8,699	0.8
240	184	185	395.9	400	110	Open	9,016	0.83
241	185	158	16.02	150	110	Open	351	0.23
242	185	188	19.85	300	110	Open	7,520	1.23
243	188	186	285.51	300	110	Open	7,520	1.23
244	186	187	146.45	300	110	Open	7,520	1.23
250	187	192	137.55	300	110	Open	7,520	1.23
251	192	198	238.62	300	110	Open	4,576	0.75
252	198	199	290.5	160	110	Open	0	0
253	198	200	119.83	300	110	Open	4,576	0.75
254	200	219	460.49	300	110	Open	2,143	0.35
255	219	218	25.44	200	110	Open	999	0.37
256	214	218	353.29	160	110	Open	145	0.08
257	218	220	868.13	225	110	Open	1,144	0.33
259	214	215	33.75	160	110	Open	423	0.24
260	201	214	107.36	160	110	Open	568	0.33
261	200	201	28.28	200	110	Open	2,433	0.9
262	201	202	17.78	110	110	Open	211	0.26
263	202	204	632.9	110	110	Open	211	0.26
264	204	207	713.14	110	110	Open	326	0.4
266	203	204	199.48	160	110	Open	115	0.07
267	203	205	16.29	160	110	Open	-115	0.07
271	209	207	300.21	160	110	Open	980	0.56
272	207	210	374.55	110	110	Open	162	0.2
273	205	212	412.83	225	110	Open	429	0.13
274	205	223	203.47	160	110	Open	1,000	0.58
275	223	209	69.13	160	110	Open	980	0.56
276	223	211	406.91	110	110	Open	20	0.02
277	211	210	449.15	160	110	Open	982	0.57
278	212	211	203.44	160	110	Open	961	0.55
279	213	212	270.61	160	110	Open	532	0.31
280	201	216	126.42	225	110	Open	1,654	0.48
283	217	213	412.13	110	110	Open	109	0.13
286	182	224	35.61	225	110	Open	2,044	0.59

Pipe ID	Node start	Node end	Length (m)	Diameter (mm)	C value	Status	Flow(m3/day)	Velocity (m/s)
287	224	226	97.56	160	110	Open	1,727	0.99
290	227	229	653.56	160	110	Open	1,144	0.66
292	224	225	348.98	225	110	Open	317	0.09
293	225	184	1849.61	160	110	Open	317	0.18
302	242	24	658.31	160	110	Open	476	0.27
303	240	241	173.51	160	110	Open	0	0
304	242	240	181.77	160	110	Open	-1,193	0.69
305	10	239	94.41	110	110	Open	1,028	1.25
306	239	240	251.41	160	110	Open	1,193	0.69
307	239	243	209.09	110	110	Open	323	0.39
308	243	242	216.99	90	110	Open	323	0.59
311	9	244	128.73	110	110	Open	610	0.74
315	220	250	526.13	160	110	Open	1,144	0.66
316	154	251	188.69	225	110	Open	2,225	0.65
317	251	153	69.35	225	110	Open	1,861	0.54
318	251	194	20.58	225	110	Open	363	0.11
319	16	252	193.95	600	110	Open	23,323	0.95
320	252	35	167.94	600	110	Open	22,725	0.93
42	17	259	94.34	160	110	Open	208	0.12
153	259	257	94.52	160	110	Open	208	0.12
193	257	252	111.05	160	110	Open	208	0.12
223	252	253	122.83	160	110	Open	806	0.46
321	253	256	170.34	160	110	Open	806	0.46
322	98	92	86.27	160	110	Open	453	0.26
323	235	237	381.35	160	110	Open	1,144	0.66
324	45	43	187.67	160	110	Open	1,576	0.91
326	244	11	496.38	160	110	Open	-919	0.53
327	239	244	329.6	110	110	Open	-489	0.6
328	235	234	55.05	160	110	Open	-583	0.34
329	234	233	167.35	160	110	Open	-583	0.34
330	233	232	182.39	160	110	Open	-583	0.34
332	164	165	207.25	110	110	Open	351	0.43
333	165	168	38.67	110	110	Open	351	0.43
334	168	166	157.76	110	110	Open	577	0.7
335	166	154	349.81	160	110	Open	1,569	0.9
338	237	12	802.56	160	110	Open	1,144	0.66
341	25	13	131.31	160	110	Open	1,705	0.98
342	13	34	43.17	160	110	Open	1,705	0.98
343	34	235	284.57	160	110	Open	1,705	0.98
344	6	38	262.11	160	110	Open	0	0
346	38	42	143.69	160	110	Open	0	0
11	226	50	126.42	160	110	Open	1,144	0.66
12	50	227	499.62	160	110	Open	1,144	0.66
20	226	52	280.96	160	110	Open	583	0.34
35	52	58	55.77	160	110	Open	583	0.34
39	58	232	243.77	160	110	Open	583	0.34
43	136	63	151.36	160	110	Open	80	0.05
51	63	128	111.52	160	110	Open	-125	0.07
52	63	61	156.22	110	110	Open	205	0.25
53	61	60	211	110	110	Open	205	0.25
56	60	59	353.71	110	110	Open	205	0.25
58	145	59	90.41	110	110	Open	-322	0.39
59	59	147	162.77	110	110	Open	-116	0.14
60	215	65	318.75	160	110	Open	423	0.24
62	65	213	220	160	110	Open	423	0.24
67	216	66	49.94	225	110	Open	1,654	0.48
69	66	217	55.55	225	110	Open	1,654	0.48
70	217	67	46.22	225	110	Open	1,545	0.45
71	67	205	211.73	225	110	Open	1,545	0.45
27	127	22	128.62	300	110	Open	-5,578	0.91
28	256	37	65.6	225	110	Open	-3,197	0.93
29	256	40	490.73	225	110	Open	2,963	0.86

Appendix 5.3 Letter on Water Intake

From CNMC



ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

13 SEP 2019
BY.....PMU

គណៈកម្មាធិការជាតិទន្លេមេគង្គកម្ពុជា

លេខ : ៦២០ គ.ជ.ទ.ម.ក

ថ្ងៃសុក្រ ១៣កើត ខែភទ្របទ ឆ្នាំកុរ ឯកស័ក ព.ស ២៥៦៣
រាជធានីភ្នំពេញ, ថ្ងៃទី ១១ ខែ កញ្ញា ឆ្នាំ ២០១៩

ប្រធានគណៈកម្មាធិការជាតិទន្លេមេគង្គកម្ពុជា
សូមជម្រាបជូន
ឯកឧត្តម អគ្គនាយកជ្រោះអភិវឌ្ឍស្វយ័តក្រុងភ្នំពេញ

ជ្រោះអភិវឌ្ឍស្វយ័តក្រុងភ្នំពេញ
លេខាធិការដ្ឋាន
ចូល លេខ: 2815
ថ្ងៃទី 12 មិថុនា 19
បញ្ជូនទៅ ...

ជ្រោះអភិវឌ្ឍស្វយ័តក្រុងភ្នំពេញ
ការិយាល័យ រដ្ឋបាល
ចូល លេខ: 218
ថ្ងៃទី 12/9/19 ម៉ោង 10:21
បញ្ជូនទៅ ...

កម្មវត្ថុ:ករណីសុំអនុញ្ញាតឱ្យរដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ យកទឹកទន្លេចាសាក់ ត្រង់ចំណុចទីតាំងសាខាចែកចាយទឹកតាខ្មៅ ទៅធ្វើប្រព្រឹត្តកម្មទឹកស្អាត នៅភោងចក្រផលិតទឹកស្អាតតាខ្មៅ សង្កាត់ដើមមៀន ក្រុងតាខ្មៅ ខេត្តកណ្តាល ។

យោង:លិខិតលេខ ៦៨៣ លស ចុះថ្ងៃទី២៨ ខែសីហា ឆ្នាំ២០១៩ របស់រដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ។

សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុ និងយោងខាងលើ ខ្ញុំសូមជម្រាបជូន **ឯកឧត្តម អគ្គនាយក** ជ្រាបថា គណៈកម្មាធិការជាតិទន្លេមេគង្គកម្ពុជា ពុំជំទាស់ទៅនឹងសំណើខាងលើនេះទេ ដោយផ្អែកលើចំណុចមួយចំនួនដូចខាងក្រោម៖

- គម្រោងនេះមានការឯកភាពពីប្រមុខរាជរដ្ឋាភិបាលកម្ពុជា និងមានភ្ជាប់មកជាមួយនូវផែនទីបច្ចេកទេសនៃការសិក្សាត្រង់ចំណុចទីតាំង
- គម្រោងនេះសម្រួលដល់ការប្រើប្រាស់ទឹកទន្លេចាសាក់ នៅតំបន់គោលដៅដែលមានក្នុងផែនការមេសម្រាប់ការផ្គត់ផ្គង់ទឹកស្អាត ក្នុងការសម្រេចឱ្យបាននូវគោលនយោបាយទឹកស្អាត របស់រាជរដ្ឋាភិបាល
- លទ្ធផលនៃការសិក្សាបានបង្ហាញថា ពុំមានផលប៉ះពាល់ដល់លំហូរទឹកគិតជាមធ្យមប្រចាំឆ្នាំ និងលំហូរទឹករបស់ប្រភេទមានៅជុំវិញ និងបរិស្ថានទន្លេចាសាក់ និងពុំរំខានដល់ការធ្វើនាវាចរណ៍តាមដងទន្លេចាសាក់ ព្រមទាំងជួយកាត់បន្ថយ ឬទប់ស្កាត់ការបាក់ច្រាំងទន្លេចាសាក់ដោយសារទឹកជំនន់ទន្លេ
- ដូចការវិភាគ ក្នុងចំណុចទី៤ នៃលិខិតយោងខាងលើ និងស្របតាមស្មារតីនៃកិច្ចព្រមព្រៀងមេគង្គឆ្នាំ១៩៩៥ បរិមាណទឹកដែលត្រូវយកមកធ្វើប្រព្រឹត្តកម្មទឹកស្អាត មានតិចតួចដែលមិនមានឥទ្ធិពលប៉ះពាល់ធំដុំដល់ធារទឹក នៃទន្លេចាសាក់ ឬ ទន្លេមេគង្គឡើយ។

សូម **ឯកឧត្តមអគ្គនាយក** ទទួលនូវការរាប់អានពីខ្ញុំ។

ប្រធាន

លឹម គានហោ

ចម្លងជូន:
- ក្រសួងធនធានទឹក និងឧតុនិយម
- ឯកសារ-កាលប្បវត្តិ

អគារលេខ 576, ផ្លូវជាតិលេខ2 សង្កាត់ចាក់អង្រែក្រោម ខណ្ឌមានជ័យ រាជធានីភ្នំពេញ ក.ប.ស.បុត្រ 2214 ភ្នំពេញ 3
ទូរស័ព្ទ : (855-23) 216 514 ទូរសារ : (855-23) 218 506 អ៊ីម៉ែល : cnmcs@cnmc.gov.kh Website : www.cnmc.gov.kh

From MOWRAM

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងធនធានទឹក និងឧតុនិយម

លេខ ២៩០៤ ធទឧ

ថ្ងៃ[illegible] ខែ[illegible] ឆ្នាំ[illegible] ស័ក ពស ២៥៦៣
រាជធានីភ្នំពេញ, ថ្ងៃទី ២៨ ខែ តុលា ឆ្នាំ ២០១៩

ឧត្តមរដ្ឋលេខាធិការដ្ឋាន
លេខ: 3263
ថ្ងៃទី 28/10/19 ម៉ោង 15:50
បញ្ជូនទៅ: DG

រដ្ឋាករឹតស្វយ័តក្រុងភ្នំពេញ
ការិយាល័យ រដ្ឋបាល
លេខ: 3823
ថ្ងៃទី 28/10/19 ម៉ោង 15:40
បញ្ជូនទៅ: [illegible]

រដ្ឋមន្ត្រីក្រសួងធនធានទឹក និងឧតុនិយម
ជម្រាបជូន
ឯកឧត្តម អគ្គនាយករដ្ឋាករឹតស្វយ័តក្រុងភ្នំពេញ

កម្មវត្ថុ ៖ សំណើសុំលិខិតអនុញ្ញាត សម្រាប់ដកយកទឹកទន្លេបាសាក់ ត្រង់ចំណុចទីតាំងសាខាចែកចាយទឹកស្អាតគាខ្មៅ ទៅធ្វើប្រព្រឹត្តកម្មទឹកស្អាតនៅរោងចក្រផលិតទឹកស្អាតគាខ្មៅ សង្កាត់ដើមមៀន ក្រុងគាខ្មៅ ខេត្តកណ្តាល ។

យោង ៖ លិខិតលេខ ៧៦៧ ល.ស ចុះថ្ងៃទី ២៥ ខែ កញ្ញា ឆ្នាំ ២០១៩ របស់រដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ

ន័យដូចមានចែងក្នុងកម្មវត្ថុ និងយោងខាងលើ សូមជម្រាបឯកឧត្តម អគ្គនាយករដ្ឋាករទឹកស្វយ័តក្រុងភ្នំពេញ ជ្រាបថា ក្រសួងធនធានទឹក និងឧតុនិយម អនុញ្ញាតឲ្យទាញយកទឹកដើម្បីផលិតទឹកស្អាតចំនួន ៣០,០០០ម៉ែត្រគូប/ថ្ងៃ តាមសំណើសុំខាងលើ ដោយផ្អែកលើចំណុចមួយចំនួនដូចខាងក្រោម៖

- គម្រោងនេះមានការឯកភាពពីប្រមុខរាជរដ្ឋាភិបាលកម្ពុជា និងមានភ្ជាប់មកជាមួយនូវផែនទីបច្ចេកទេស នៃការសិក្សាត្រង់ចំណុចទីតាំង
- គម្រោងនេះសម្រួលដល់ការប្រើប្រាស់ទឹកទន្លេបាសាក់ នៅតំបន់គោលដៅដែលមានក្នុងផែនការមេសម្រាប់ផ្គត់ផ្គង់ទឹកស្អាត ក្នុងការសម្រេចឲ្យបាននូវគោលនយោបាយទឹកស្អាត របស់រាជរដ្ឋាភិបាល
- លទ្ធផលនៃការសិក្សាបានបង្ហាញថា ពុំមានផលប៉ះពាល់ដល់លំហូរទឹកគិតជាមធ្យមប្រចាំឆ្នាំ និងលំហូរទឹកអប្បបរមានៅរដូវប្រាំង និងបរិស្ថានទន្លេបាសាក់ និងពុំរំខានដល់ការធ្វើនាវាចរណ៍តាមដងទន្លេបាសាក់
- ដូចការវិភាគ ក្នុងចំណុចទី៤ នៃលិខិតលេខ ៦៨៣ លស ចុះថ្ងៃទី ២៨ ខែ សីហា ឆ្នាំ ២០១៩ និងស្របតាមស្មារតីនៃកិច្ចព្រមព្រៀង មេគង្គឆ្នាំ ១៩៩៥ បរិមាណទឹកដែលត្រូវយកមកធ្វើប្រព្រឹត្តកម្មទឹកស្អាត មានតិចតួចដែលមិនមានឥទ្ធិពលប៉ះពាល់ធំដុំដល់ធារទឹកនៃទន្លេបាសាក់ ឬ ទន្លេមេគង្គឡើយ ។

សូមឯកឧត្តមអគ្គនាយកទទួលនូវការរាប់អានដ៏ស្មោះពីខ្ញុំ ។

រដ្ឋមន្ត្រី

លីម គានហោ

ចម្លងជូន៖
-ថ្នាក់ដឹកនាំក្រសួងធនធានទឹក និងឧតុនិយម
-អគ្គនាយកក្រសួង
-អគ្គាធិការ
-ខុទ្ទកាល័យឯកឧត្តមរដ្ឋមន្ត្រី
"ដើម្បីជូនជ្រាប"
-ឯកសារ-កាលប្បវត្តិ

អគារលេខ: ៣៦៤ មហាវិថី ព្រះមុនីវង្ស សង្កាត់ ផ្សារដើមថ្កូវ ខណ្ឌ ចំការមន រាជធានីភ្នំពេញ ទូរស័ព្ទលេខ: ៨៥៥ ២៣ ២១៦ ៦៧០
#364 Monivong Blvd, Phum Doungkeo, Chamkarmon, Phnom Penh, Cambodia. Phone: (855)23 216 670

Appendix 5.4 Environmental Monitoring Form

Environmental Monitoring Form (Construction Phase)

The latest results of the below monitoring items should be submitted to JICA Cambodia Office as part of Quarterly Progress Report throughout the construction phase.

1. Response/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of formal comments made by the public	
Number and contents of responses from government agencies (such as MoE etc.)	

2. Pollution

2.1 Water Quality

Parameter	Unit	Measures Value (Average)	Measures Value (Max.)	Cambodian Standards	Japanese Standards	To be meet the requirements instructed by PPWSA	Measurement Point	Frequency
pH	-					To be confirmed	2 points (1 at upstream of WTP intake, 1 at downstream of the WTP intake) for intake construction	Preconstruction: 1 time/point Construction: 1 time/point
SS	mg/L					To be confirmed		
Turbidity	mg/L					To be confirmed		
COD	mg/L					To be confirmed		
NH_4-N	mg/L					To be confirmed		
Coliform	MPN/100mL					To be confirmed		
SS	mg/L			120	80	120	1 point (at the discharge point to existing sewerage system) for sewage management in construction site	1 time/point/month
BOD	mg/L			80	40	80		
COD	mg/L			100	40	100		

2.2 Air Quality

Parameter	Unit	Measures Value (Average)	Measures Value (Max.)	Cambodian Standards	Japanese Standards	Standards for Contract	Measurement Point	Frequency
CO	mg/m^3			20	20	20	1 point (1 at the WTP site)	Preconstruction: 1 time/point Construction:
NO_2				0.1	0.04	0.1		
SO_2				0.3	0.04	0.3		

Parameter	Unit	Measures Value (Average)	Measures Value (Max.)	Cambodian Standards	Japanese Standards	Standards for Contract	Measurement Point	Frequency
O_3				0.2	0.06	0.2		1 time/point/6 months
Pb				0.005	-	0.005		
TSP				0.33	0.1	0.33		
PM_{10}				0.005	-	0.005		
$PM_{2.5}$				0.025	0.015	0.025		

2.3 Noise and Vibration and Solid Waste

Parameter	Unit	Measures Value (Average)	Measures Value (Max.)	Waste Disposal Method	Cambodian Standards	Japanese Standards	Standards for Contract	Measurement Point	Frequency
Equivalent continuous A sound level (Laeq, 10)	dB(A)			-	75 (6:00-18:00)	70	75	2 points (1 at the WTP, 1 at western boundary of the WTP)	Preconstruction: 1 time/point Construction: 1 time/point/6 months
Vibration level (Lv10)	dB(A)			-	-	65 (8:00-19:00)	65	2 points (1 at the WTP, 1 at western boundary of the WTP)	Preconstruction: 1 time/point Construction: 1 time/point/6 months
Volume of wastes (waste soil)	m^3				-	-	-	2 points (1 at Gate of the WTP, 1 at Boeng Tompun Lagoon)	1 time (24 hr)/month
Volume of wastes (other construction wastes)	m^3				-	-	-	2 points (1 at Gate of the WTP, 1 at existing Dangkor landfill site by 2021 or new landfill sit after 2021)	1 time (24 hr)/month

Environmental Monitoring Form (Operation Phase)

3.1 Water Quality

Parameter	Unit	Measures Value (Average)	Measures Value (Max.)	Cambodian Standards	Japanese Standards	Standards for Contract	Measurement Point	Frequency
SS	mg/L			120	80	120	1 point (at the discharge point to existing sewerage system)	1 time/point/month
BOD	mg/L			80	40	80		
COD	mg/L			100	40	100		

3.2 Air Quality

Parameter	Unit	Measures Value (Average)	Measures Value (Max.)	Cambodian Standards	Japanese Standards	Standards for Contract	Measurement Point	Frequency
CO	mg/m^3			20	20	20	1 point (1 at the WTP site)	Preconstruction: 1 time/point Construction: 1 time/point/6 months
NO_2				0.1	0.04	0.1		
SO_2				0.3	0.04	0.3		
O_3				0.2	0.06	0.2		
Pb				0.005	-	0.005		
TSP				0.33	0.1	0.33		
PM_{10}				0.005	-	0.005		
$PM_{2.5}$				0.025	0.015	0.025		

3.3 Solid Waste

Parameter	Unit	Measures Value (Average)	Measures Value (Max.)	Sludge Disposal Method	Cambodian Standards	Standards for Contract	Measurement Point	Frequency
Volume of sludge	m^3			[1] Landfill [2] Reuse for backfilling [3] Other	-	-	2 points (1 at Gate of the WTP, 1 at new landfill site or reuse site)	1 time (24 hr)/6 months

Appendix 5.5 Environmental Checklist

Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1. Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	Y	(a) Initial Environmental Impact Assessment (IEIA) report has been prepared and submitted to Ministry of Environment (MoE) in the end of August, 2019.
		(b) Have EIA reports been approved by authorities of the host country's government?	N	(b) The IEIA report is currently under review by MoE. It is expected that MoE will issue approval letter on the IEIA report by the end of November, 2019.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	N	(c) The IEIA report is currently under review by MoE.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	N	(d) In addition to the above approvals, a permit for water intake is required. On Sep. 12, 2019, approval letter for the water extraction right was issued by Cambodia National Mekong Committee (CNMC) signed by Chief of Committee, H.E. LIM Kean Hor (Minister of Water Resources and Meteorology).
	(2) Explanation to the Public	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the local stakeholders?	Y	(a) Stakeholder consultation meetings were held in Derm Mien Village on June 22, 2019 and in Kandal Provincial Department of Environment (DoE) on July 18, 2019. During the meetings, the project contents and the potential impacts are explained to the local stakeholders. Understanding was obtained from the local stakeholders considering the discussion and comments collected from them during the meetings. In addition, information disclosure has been also carried out through local authorities and NGOs.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	Y	(b) Local residents required to increase house connection, regular water supply, appropriate water tariff and lower price of house connection. These comments and requirements have been reflected in the project design (increasing service population from current 48,000 to 120,000, providing 24 hours water supply, providing subsidized connections and tariff for low income households.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	Y	(a) Three alternative studies (without project, conventional treatment and advanced treatment) have been examined. In order to avoid land acquisition and resettlement, conventional treatment method is selected.
2. Mitigation Measure	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution?	N	(a) On-site sodium hypochlorite generation system with high safety will be applied. Therefore, chlorine gas will not be used in the WTP and leakage of chlorine is not expected.
		(b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	Y	(b) In the on-site sodium hypochlorite generation system, the disinfectant is produced and stored in liquid form. Therefore, there is no danger of gas leaks from high-pressure chlorine cylinders. In addition, in Cambodia there are no regulations on chlorine concentrations within working environments..

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	Y	(a) During construction period: Domestic wastewater generated from construction site at Ta Khmau WTP will be discharged into existing sewerage system. During operation period: Wastewater from the WTP administration building will be treated at wastewater treatment facility before being discharged into existing sewerage system. SS, BOD, COD of effluents discharged from the WTP will comply with Cambodia effluent standards to sewerage system (Sub-decree No. 27 on the Water Pollution Control; SS<120 mg/L, BOD<80 mg/L and COD<100 mg/L).
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	N	(a) In Cambodia, there are no laws or regulations on WTP sludge disposal. During construction phase: part of construction waste soil (app. 1,000 m^3) will be reused for backfilling at construction site. The remaining waste soil (app. 1,000 m^3) will be reused for backfilling of Boeng Tompun (lagoon, 3 km far from the WTP). During operation period: WTP sludge will be collected and transported to new landfill site by PPWSA who is conducting a detailed survey on the reuse of sludge for backfilling. In addition, the amount of the sludge is limited (app. 3 tDS/day).
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	Y	(a) During construction period: Current noise levels around the WTP are 57 to 69 dB(A). During construction, the noise level at boundary of the WTP is estimated to be 78-87 dB(A) due to construction equipment and vehicles operation, which exceeds the standard (75 dB) slightly. However, no sensitive facilities have been identified around the WTP site. In addition, EMP has been prepared and contractor will follow the EMP to minimize noise and vibration during construction period. Current vibration levels (equivalent levels) at the project area are 17 to 26 dB, which are much lower than that of Japanese standards (65 dB). Therefore, it is estimated that vibration levels during construction period will comply with Japanese standards (no vibration standards in Cambodia). During operation period: All pumps will be installed within pump stations, therefore, the noise and vibration level in outside of pump stations is considered to be same as the background level of the site.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	N	(a) During construction period and operation period, no groundwater will be extracted. Therefore, the impacts of subsidence are not expected.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3. Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	N	(a) The project sites are not located in protected area or environmentally sensitive areas designated by Cambodia laws or international treaties. In addition, all proposed treatment facilities will be located within the existing WTP site. Therefore, there is no possibility that the project will affect the protected areas.
	(2) Ecosystem and Biota	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?	N	(a) The project site doesn't encompass primeval forests, tropical rain forests, and ecologically valuable habitats.
		(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?	N	(b) Within the project site, there are no protected habitats of endangered species designated by Cambodia laws or international treaties and conventions.
		(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?	N	(c) It is not anticipated to cause significant ecological impacts because there are no protected habitats in the area of the WTP site.
		(d) Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	Y	(d) Raw water of 0.38 m^3/s will be intaken from Bassac River, which is much less than low flow (40 m^3/s) of the River. Therefore, the impacts of the project on aquatic environments of Bassac River are considered to be not significant. In addition, an approval letter has been obtained from Cambodia National Mekong Committee. PPWSA will prepare water supply plan during dry period in cooperation with MoE in order to ensure suitable environmental flow of Bassac River in the future.
	(3) Hydrology	a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	N	(e) Compared with low flow (40 m^3/s) of Bassac River, intake volume (33,000 m^3/d or 0.38 m^3/ s) will not have significant impacts on surface water and groundwater flow. In addition, an approval letter has been obtained from Cambodia National Mekong Committee.
4. Social Environment	(1) Resettlement	a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?	N	(a) Because the considerations for avoiding resettlement are made and the WTP will be constructed within existing WTP site of PPWSA, there is no resettlement caused by the project.
		(b) Is adequate explanation on compensation and resettlement given to affected people prior to resettlement?	N	(b) For the proposed project, no resettlement will take place.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	N	(c) For the proposed project, neither resettlement nor land acquisition will take place. Therefore, preparation of resettlement plan including compensation is not needed.
		(d) Is the compensations going to be paid prior to the resettlement?	N	(d) For the proposed project, neither resettlement nor land acquisition will take place. Therefore, no compensations will be necessary for the resettlement.
		(e) Is the compensation policies prepared in document?	N	(e) For the proposed project, neither resettlement nor land acquisition will take place. Therefore, preparation of compensation policies is not expected.
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	N	(f) For the proposed project, there is no resettlement or land acquisition.
		(g) Are agreements with the affected people obtained prior to resettlement?	N	(g) For the proposed project, there is no resettlement and land acquisition. Therefore, it is not necessary to get agreement with the affected people.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	N	(h) For the proposed project, there is no resettlement and land acquisition.
		(i) Are any plans developed to monitor the impacts of resettlement?	N	(i) For the proposed project, alternative studies have been carried out to avoid resettlement. As the results, there is no resettlement or land acquisition will be required. Therefore, it is not necessary to monitoring the impacts of resettlement.
		(j) Is the grievance redress mechanism established?	N	(j) For the proposed project, there is no resettlement or land acquisition. Thus, it is not necessary to establish grievance redress mechanism.
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	N	(a) All proposed facilities will be located within the existing WTP site and will not affect the living environment of the land other than the construction site. The project is expected to improve the living environment as the water supply rate increases. Fishing activity is prohibited from July 1 to November 30 each year because this is the breeding season for all kinds of fish. Therefore, the impacts of the construction on fishing activity are not expected during this period. During fishing season, the construction of the WTP may create impacts on fishing activity. However, fishing activity can be conducted at upstream or downstream (500m or more) of intake construction site. Therefore, the impacts on fishing activity are low and mitigable

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	N	(a) Comparing with low flow (40 m^3/s) of Bassac River, intake amount (33,000 m^3/d or 0.38 m^3/ s) will not have significant impacts on the existing water uses and water area uses. In addition, an approval letter has been obtained from Cambodia National Mekong Committee.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	N	(a) Ta Khmau WTP site is located within existing WTP site. Thus, the impact is considered to be negligible.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	N	(a) The WTP is located within the existing WTP site, and area is small (0.45 ha). In addition, tree planting will be conducted in the WTP.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?	Y	(a) There is no ethnic minority or indigenous group in the project area. In addition, water service rate will be increased up to 100%.
		(b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	Y	(b) Ditto
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?	Y	(a) Cambodian laws and ordinances (such as Labor Law 1997 and amendment Law 2018, the Law on Social Security, Sub-Decree 11/16, on Health Care Scheme etc.) associated with working conditions (such as wage and hours of work etc.) will be followed by the project proponent during construction works and operation of the project based on Environmental Management Plan (EMP).
		(b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?	Y	(b) Safety considerations will be taken during construction works and operation of the project based on the EMP prepared (such as ear protection equipment must be provided to workers when a noise level exceeds 80 dB(A) in the WTP construction site or within pump station). In addition, inspections of PPWSA and other authorities on safety will be conducted.
		(c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.?	Y	(c) Safety and health program and safety training for workers will be planned and implemented during construction works and operation of the project based on EMP prepared. (such as wearing safety shoes and elements during construction, following Standard Operation Procedures for the works during operation)

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	Y	(d) Appropriate measures will be taken based on EMP prepared. (such as specific security guards will be assigned by contractor and PPWSA will conduct regular inspection during construction and operation)
5. Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?	Y	(a) Mitigation measures on utilization of local resources (fishing), water usage/water right, traffic control, poor households, accidents (such as safety plan preparation, O/M manual etc.), air pollution (such as covering trucks and spraying exposed areas with water etc.), water pollution, wastes (sludge reuse methods etc.), noise and vibrations (such as application of reasonable construction schedule and methods etc.) have been proposed.
		(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?	Y	(b) All construction works of Ta Khmau WTP will be carried out within the existing WTP site. Therefore, the impacts on the natural environment (ecosystem) will be very limited.
		(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	Y	(c) Before construction starts, information will be delivered to fisherman via commune and village chiefs in advance. A detailed traffic control plan will be prepared. In addition, proper construction schedule and methods to reduce traffic disruption and traffic accident. Education of staff/workers on the safety and fire will also be conducted to reduce impacts.
		(d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	Y	(d) Proper construction plan of the WTP and traffic control plan will be prepared before construction,
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?	Y	(a) Environmental monitoring program has been prepared in the IEIA report based on the recommendations from the JICA Survey Team.
		(b) What are the items, methods and frequencies of the monitoring program?	Y	(b) The items, methods and frequencies of the monitoring program have been proposed and presented in Preparatory Survey Report. Basically, air quality (CO, NO_2, SO_2, O_3, Pb TSP PM_{10} and $PM_{2.5}$): time/6 months; basin water quality (pH, temperature, TDS, TSS, DO, BOD, COD, Oil and Grease, NO_3, T-N, T-P, As, Hg, Total Coliform etc. 17 parameters): time/two weeks, noise and vibration: time/6 months, traffic (along National Highway 102): regularly.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?	Y	(c) Monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework) has been prepared.
		(d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	Y	(d) Monitoring format has been proposed.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	N	(a) Not necessary.
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	Y	(b) Not necessary.

Appendix 5.6 Environmental Management Plan

Draft Environmental Management Plan

Impacts	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
Before / During Construction				
Traffic	1) Prepare a detailed traffic control plan and to coordinate with local government. 2) Prepare proper construction schedule and methods to reduce traffic disruption and traffic accident. 3) Assign traffic control person at the entrance of the WTP while construction is taking place.	Contractor	PPWSA	Included in the construction cost
Air Pollution	1) Cover stored materials with plastic or other materials. 2) Cover trucks, and to spray exposed areas with water. 3) Wash vehicles before going out the construction site. 4) Minimize traffic over freshly exposed surfaces. 5) Install barrier walls for limiting wind dispersing if necessary. 6) Prepare air quality monitoring plan and carry out it during construction. 7) Update the Environmental Monitoring Plan during Detailed Design	Contractor	PPWSA	2,000 USD/year (Included in the construction cost)
Waste	1) Prepare reasonable plan for solid waste disposal, especially for excavated soil. 2) Install temporary toilet at the construction site for workers, and set sanitary bins for domestic wastes. 3) PPWSA has a plan to sell the surplus waste soil to buyer as backfilling materials. 4) Dispose solid wastes appropriately	Contractor	PPWSA	Included in the construction cost
Noise	1) Prepare a detailed plan for noise control and coordinate with local government. 2) Prepare proper construction schedule and methods. 3) Set speed limits for vehicles and train workers on mitigation measures for environmental impacts. 4) Use low noise level equipment, if necessary. 5) Prepare noise monitoring plan and carrying out monitoring during construction.	Contractor	PPWSA	1,000 USD/year (Included in the construction cost)
Water Pollution	1) The embankment will be constructed to prevent land erosion during the rainfall. 2) Carry out water quality monitoring. 3) Install wastewater treatment system within the WTP to treat domestic wastewater during construction and operation.	Contractor	PPWSA	1,000 USD/year (Included in the construction cost)
During Operation				
Air quality	1) Preparing air quality monitoring plan. 2) Implementation of air quality monitoring.	Operator	PPWSA	1,000 USD/year (Included in the O&M cost)
Waste	1) Monitoring on volume of sludge and solid wastes from the WTP. 2) Implementation of EMP for operation of the WTP.	Operator	PPWSA	Included in the O&M cost
Water pollution	1) Preparing water quality monitoring plan. 2) Implementation of water quality monitoring at downstream of the WTP.	Operator	PPWSA	2,000 USD/year (Included in the O&M cost)

Appendix 5.7 Production and consumption data for each WTP

(1) Production and consumption data for each WTP in 2014

សរុបការប្រើប្រាស់វត្ថុធាតុដើម និងថាមពលអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

Month	រោងចក្រភ្នំពេញកែ Phum Prek WTP		រោងចក្រជ្រោយចង្វារ Chrouy Chang War WTP		រោងចក្រចាក្រមន Cham Car Morn WTP		រោងចក្រនិរោធ Niroth WTP		សរុប Total	
	150,000 m³/day		130,000 m³/day		20,000 m³/day		130,000 m³/day		430,000 m³/day	
	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water
1	4,889,105	**4,644,650**	3,735,430	**3,660,670**	66,608	**63,152**	3,218,754	**3,118,172**	**11,909,897**	**11,486,644**
2	4,392,031	**4,172,428**	3,719,260	**3,638,060**	38,819	**39,026**	2,965,998	**2,877,592**	**11,116,108**	**10,727,106**
3	5,034,693	**4,782,960**	4,604,290	**4,491,770**	292,178	**284,034**	3,223,174	**3,111,673**	**13,154,335**	**12,670,437**
4	4,818,431	**4,577,511**	4,082,120	**3,986,860**	295,495	**283,914**	2,907,946	**2,804,014**	**12,103,992**	**11,652,299**
5	5,391,261	**5,121,699**	4,719,890	**4,610,330**	345,661	**329,815**	3,277,651	**3,209,035**	**13,734,463**	**13,270,879**
6	4,921,961	**4,675,862**	4,440,790	**4,329,060**	346,570	**328,155**	3,741,662	**3,663,442**	**13,450,983**	**12,996,519**
7	4,418,604	**4,205,752**	3,985,980	**3,886,440**	406,116	**393,317**	4,863,949	**4,701,050**	**13,674,649**	**13,186,559**
8	4,434,160	**4,223,007**	4,163,840	**4,041,700**	431,962	**419,618**	4,706,760	**4,519,509**	**13,736,722**	**13,203,834**
9	3,895,602	**3,700,818**	3,716,980	**3,605,010**	357,689	**355,315**	4,257,365	**4,111,350**	**12,227,636**	**11,772,493**
10	4,453,437	**4,230,762**	4,005,610	**3,915,890**	416,311	**406,531**	4,612,314	**4,516,030**	**13,487,672**	**13,069,213**
11	4,224,289	**4,013,411**	4,020,400	**3,929,410**	408,715	**395,125**	4,277,910	**4,201,560**	**12,931,314**	**12,539,506**
12	4,407,892	**4,187,497**	4,121,050	**4,030,970**	422,586	**402,147**	4,457,639	**4,355,992**	**13,409,167**	**12,976,606**
សរុបរួម Total	**55,281,466**	**52,536,357**	**49,315,640**	**48,126,170**	**3,828,710**	**3,700,149**	**46,511,122**	**45,189,419**	**154,936,938**	**149,552,095**
មធ្យម AVG		**4,378,030**		**4,010,514**		**308,346**		**3,765,785**		**12,462,675**
អតិបរម MAX		**5,121,699**		**4,610,330**		**419,618**		**4,701,050**		**13,270,879**

សរុបការប្រើប្រាស់វត្តធាតុគីមី និងចរន្តអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

Month	PAC		សាជូរ Alum		កបល្អី Lime		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kwh)	(wh)
1	80,675	7.02	-	-	-	-	33,055	2.9	3,029,686	264
2	71,300	6.65	-	-	-	-	30,448	2.8	2,917,099	272
3	88,625	6.99	-	-	540.000	0.0	37,642	3.0	3,512,135	277
4	79,800	6.85	-	-	-	-	30,569	2.6	3,263,394	280
5	107,650	8.11	-	-	-	-	31,686	2.4	3,813,178	287
6	64,150	4.94	-	-	-	-	30,055	2.3	3,613,740	278
7	130,950	9.93	-	-	-		29,904	2.3	3,273,347	248
8	96,950	7.34	-	-	-	-	27,859	2.1	3,139,008	238
9	62,600	5.32	5,550	0.471	-	-	24,503	2.1	2,718,870	231
10	63,825	4.88	5,250	0.402	-	-	28,824	2.2	3,121,149	239
11	56,000	4.47	-	-	-	-	28,497	2.3	3,141,935	251
12	58,150	4.48	-	-	-	-	31,521	2.4	3,374,510	260
សរុបរួម Total	960,675	6.42	10,800	0.07	540.000	0.00	364,563	2.4	38,918,051	260.2
មធ្យម AVG	80,056	6.42	-	-	-	-	30,380	2.45	3,243,171	260
អតិបរម MAX	130,950	9.93	-	-	-	-	37,642	2.97	3,813,178	287

ការប្រើប្រាស់វត្តធាតុគីមី និងចរន្តអគ្គិសនីរោងចក្រភូមិព្រែក
RAW MAETERIAL AND POWER CONSUMPTION FOR PHUM PREK WTP

Month	PAC		សាជូរ Alum		កបល្អី Lime		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kwh)	(wh)
1	43,200	9.3	-	-	-	-	14,620	3.1	1,203,019	259
2	41,600	10.0	-	-	-	-	13,557	3.2	1,121,864	269
3	60,000	12.5	-	-	-	-	17,418	3.6	1,308,693	274
4	63,200	13.8	-	-	-	-	15,139	3.3	1,299,120	284
5	90,800	17.7	-	-	-	-	14,610	2.9	1,519,066	297
6	31,200	6.7	-	-	-	-	12,914	2.8	1,340,299	287
7	48,000	11.4					9,053	2.2	1,053,787	251
8	30,400	7.2	-	-	-	-	7,839	1.9	1,010,989	239
9	17,600	4.8	-	-	-	-	8,290	2.2	854,827	231
10	19,200	4.5	-	-	-	-	9,199	2.2	1,008,397	238
11	20,000	5.0	-	-	-	-	9,188	2.3	996,430	248
12	22,400	5.3	-	-	-	-	10,164	2.4	1,086,757	260
សរុបរួម Total	487,600	9.28	-	-	-	-	141,991	2.70	13,803,248	263
មធ្យម AVG	40,633	9.02					11,833	2.67	1,150,271	261
អតិបរម MAX	90,800	17.73					17,418	3.64	1,519,066	297

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រជ្រោយចង្វារ
RAW MAETERIAL AND POWER CONSUMPTION FOR CHROY CHANG WA WTP

Month	PAC		សង្ឃដូរ Alum		កំបោរ Lime		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kwh)	(wh)
1	11,575	3.2	-	-	-	-	6,530	1.8	968,230	264.5
2	7,000	1.9	-	-	-	-	6,670	1.8	1,002,380	275.5
3	6,500	1.4	-	-	-	-	7,850	1.7	1,263,690	281.3
4	5,500	1.4	-	-	-	-	7,210	1.8	1,112,930	279.1
5	9,050	2.0	-	-	-	-	8,730	1.9	1,319,140	286.1
6	17,075	3.9	-	-	-	-	8,250	1.9	1,208,130	279.1
7	36,000	9.3					8,600	2.2	973,750	250.6
8	28,225	7.0	-	-	-	-	8,670	2.1	974,030	241.0
9	19,100	5.3	-	-	-	-	7,180	2.0	836,640	232.1
10	17,650	4.5	-	-	-	-	7,400	1.9	934,090	238.5
11	13,950	3.6	-	-	-	-	7,490	1.9	976,960	248.6
12	12,150	3.0	-	-	-	-	7,330	1.8	1,035,270	256.8
សរុបរួម Total	183,775	3.82	-	-	-	-	91,910	1.91	12,605,240	262
មធ្យម AVG	15,315	3.87	-	-	-	-	7,659	1.91	1,050,437	261
អតិបរមា MAX	36,000	9.26	-	-	-	-	8,730	2.21	1,319,140	286

ការប្រើប្រាស់វត្ថុធាតុដើម និងថាមពលអគ្គិសនីរោងចក្រចំការមន
RAW MAETERIAL AND POWER CONSUMPTION FOR CHAMCAR MORN WTP

Month	PAC		សង្ឃរ Alum		កំបោរ Lime		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kwh)	(wh)
1	**400**	6.3	-	-	-	-	**137**	2.2	**24,150**	382
2	**200**	5.1	-	-	-	-	**113**	2.9	**16,350**	419
3	**1,875**	6.6	-	-	-	-	**765**	2.7	**88,270**	311
4	**1,725**	6.1	-	-	-	-	**588**	2.1	**88,546**	312
5	**1,800**	5.5	-	-	-	-	**650**	2.0	**103,802**	315
6	**3,000**	9.1	-	-	-	-	**598**	1.8	**102,196**	311
7	**5,200**	13.2					**661**	1.7	**112,600**	286
8	**4,325**	10.3	-	-	-	-	**703**	1.7	**115,940**	276
9	**900**	2.5	5,550	15.6	-	-	**645**	1.8	**97,685**	275
10	**975**	2.4	5,250	12.9	-	-	**891**	2.2	**112,337**	276
11	**2,300**	5.8	-	-	-	-	**872**	2.2	**113,128**	286
12	**2,600**	6.5	-	-	-	-	**901**	2.2	**119,144**	296
សរុបរួម Total	**25,300**	**6.84**	**10,800**	**2.9**	-	-	**7,524**	**2.03**	**1,094,148**	**296**
មធ្យម AVG	**2,108**	**6.62**	-	-	-	-	**627**	**2.12**	**91,179**	**312**
អតិបរម MAX	**5,200**	**13.22**	-	-	-	-	**901**	**2.90**	**119,144**	**419**

ការប្រើប្រាស់វត្តុធាតុដើម និងថាមពលអគ្គិសនីរោងចក្រនិរោធ
RAW MAETERIAL AND POWER CONSUMPTION FOR NIROTH WTP

Month	PAC		សាជូរ Alum		កំបោរ Lime		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (Kwh)	(wh)
1	**25,500**	8.2	-	-	-	-	**11,768**	3.8	**834,287**	268
2	**22,500**	7.8	-	-	-	-	**10,108**	3.5	**776,505**	270
3	**20,250**	6.5	-	-	540	0.2	**11,609**	3.7	**851,482**	274
4	**9,375**	3.3	-	-	-	-	**7,632**	-	**762,798**	272
5	**6,000**	1.9	-	-	-	-	**7,696**	2.4	**871,170**	271
6	**12,875**	3.5	-	-	-	-	**8,293**	2.3	**963,115**	263
7	**41,750**	8.9					**11,590**	2.5	**1,133,210**	241
8	**34,000**	7.5	-	-	-	-	**10,647**	2.4	**1,038,049**	230
9	**25,000**	6.1	-	-	-	-	**8,388**	2.0	**929,718**	226
10	**26,000**	5.8	-	-	-	-	**11,334**	2.5	**1,066,325**	236
11	**19,750**	4.7	-	-	-	-	**10,947**	2.6	**1,055,417**	251
12	**21,000**	4.8	-	-	-	-	**13,126**	3.0	**1,133,339**	260
សរុបរួម Total	**264,000**	5.84	-	-	540	0.01	**123,138**	2.72	**11,415,415**	253
មធ្យម AVG	**22,000**	**5.75**	-	-	-	-	**10,262**	**2.56**	**951,285**	**255**
អតិបរម MAX	**41,750**	**8.88**	-	-	-	-	**13,126**	**3.77**	**1,133,339**	**274**

(2) Production and consumption data for each WTP in 2015

សរុបការប្រើប្រាស់វត្តជាតុដើម និងចរន្តអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

Month	រោងចក្រភ្នំពេញកែ Phum Prek WTP		រោងចក្រជ្រោយចង្វារ Chrouy Chang War WTP		រោងចក្រចាក មន Cham Car Morn WTP		រោងចក្រនិរោធ Niroth WTP		សរុប Total	
	150,000 m³/day		130,000 m³/day		20,000 m³/day		130,000 m³/day		430,000 m³/day	
	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water
1	4,249,549	**4,037,072**	4,271,650	**4,164,180**	427,459	**408,034**	4,320,213	**4,239,902**	**13,268,871**	**12,849,188**
2	4,134,854	**3,928,111**	3,747,480	**3,678,720**	382,936	**369,722**	3,950,521	**3,853,475**	**12,215,791**	**11,830,028**
3	4,733,305	**4,496,638**	4,447,870	**4,358,080**	426,838	**415,813**	4,811,165	**4,683,329**	**14,419,178**	**13,953,860**
4	4,157,193	**3,949,334**	4,080,600	**3,998,580**	370,176	**360,630**	4,281,749	**4,172,015**	**12,889,718**	**12,480,559**
5	4,871,906	**4,628,310**	4,666,360	**4,573,290**	457,182	**436,693**	4,845,710	**4,747,404**	**14,841,158**	**14,385,697**
6	4,707,758	**4,472,370**	4,734,240	**4,657,460**	396,870	**376,092**	4,541,140	**4,437,350**	**14,380,008**	**13,943,272**
7	5,047,070	**4,794,719**	4,707,280	**4,585,810**	404,895	**384,074**	4,709,739	**4,548,199**	**14,868,984**	**14,312,802**
8	5,217,167	**4,956,310**	4,589,690	**4,444,820**	390,770	**369,121**	4,635,860	**4,408,290**	**14,833,487**	**14,178,541**
9	4,985,729	**4,736,440**	4,536,880	**4,375,370**	393,515	**372,926**	4,629,869	**4,353,620**	**14,545,993**	**13,838,356**
10	4,773,497	**4,534,821**	4,318,410	**4,188,560**	355,160	**335,940**	4,325,580	**4,151,679**	**13,772,647**	**13,211,000**
11	4,862,419	**4,619,297**	4,643,070	**4,472,360**	345,162	**326,649**	4,385,439	**4,268,500**	**14,236,090**	**13,686,806**
12	4,915,921	**4,670,123**	4,910,650	**4,796,890**	370,982	**354,409**	4,828,040	**4,657,569**	**15,025,593**	**14,478,991**
សរុបរួម Total	56,656,368	**53,823,545**	53,654,180	**52,294,120**	4,721,945	**4,510,103**	54,265,025	**52,521,332**	169,297,518	**163,149,100**
មធ្យម AVG		**4,485,295**		**4,357,843**		**375,842**		**4,376,778**		**13,595,758**
អតិបរម MAX		**4,956,310**		**4,796,890**		**436,693**		**4,747,404**		**14,478,991**

សរុបការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

Month	PAC		ក្លរ រ Chlorine (Cl_2)		ថា មពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ឯកត (g)	គីឡូ (Kg)	ឯកត (g)	គីឡូ (Kwh)	(wh)
1	**64,125**	4.99	**33,927**	2.64	**3,418,630**	266
2	**68,575**	5.80	**34,034**	2.88	**3,207,459**	271
3	**68,750**	4.93	**39,477**	2.83	**3,769,991**	270
4	**38,050**	3.05	**28,602**	2.29	**3,271,907**	262
5	**40,150**	2.79	**33,108**	2.30	**3,882,382**	270
6	**48,275**	3.46	**33,235**	2.38	**3,663,044**	263
7	**119,525**	8.35	**35,063**	2.45	**3,695,201**	258
8	**123,975**	8.74	**31,467**	2.22	**3,408,921**	240
9	**106,825**	7.72	**28,843**	2.08	**3,270,833**	236
10	**86,825**	6.57	**28,012**	2.12	**3,068,444**	232
11	**97,275**	7.11	**33,309**	2.43	**3,420,200**	250
12	**104,925**	7.25	**37,717**	2.60	**3,795,937**	262
សរុបរួម Total	**967,275**	5.93	**396,794**	2.43	**41,872,949**	257
មជ្ឈ AVG	**80,606**	**5.90**	**33,066**	**2.44**	**3,489,412**	**257**
អតិបរម MAX	**123,975**	**8.74**	**39,477**	**2.88**	**3,882,382**	**271**

ការប្រើប្រាស់វត្ថុធាតុដើម និងបរិមាណអគ្គិសនីរោងចក្រភូមិព្រែក
RAW MAETERIAL AND POWER CONSUMPTION FOR PHUM PREK WTP

Month	PAC		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**28,800**	7.1	**11,731**	2.9	**1,068,380**	264.6
2	**40,800**	10.4	**14,389**	3.7	**1,060,344**	269.9
3	**33,600**	7.5	**17,872**	4.0	**1,231,169**	273.8
4	**11,200**	2.8	**12,148**	3.1	**1,051,815**	266.3
5	**10,400**	2.2	**12,824**	2.8	**1,259,000**	272.0
6	**12,800**	2.9	**13,328**	3.0	**1,195,069**	267.2
7	**29,600**	6.2	**15,679**	3.3	**1,256,664**	262.1
8	**36,800**	7.4	**12,507**	2.5	**1,200,456**	242.2
9	**28,800**	6.1	**10,576**	2.2	**1,126,201**	237.8
10	**19,600**	4.3	**10,170**	2.2	**1,039,598**	229.2
11	**34,400**	7.4	**11,156**	2.4	**1,151,105**	249.2
12	**43,200**	9.3	**13,078**	2.8	**1,235,297**	264.5
សរុបរួម Total	**330,000**	6.13	**155,458**	2.89	**13,875,098**	258
មធ្យម AVG	**27,500**	**6.14**	**12,955**	**2.90**	**1,156,258**	**258**
អតិបរមា MAX	**43,200**	**10.39**	**17,872**	**3.97**	**1,259,000**	**274**

ការប្រើប្រាស់វត្តជាតុដើម និងចរន្តអគ្គិសនីរោងចក្រជ្រោយចង្វារ
RAW MAETERIAL AND POWER CONSUMPTION FOR CHROY CHANG WA WTP

Month	PAC		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	8,700	2.1	7,640	1.8	1,105,890	265.6
2	7,100	1.9	7,460	2.0	1,005,360	273.3
3	8,300	1.9	8,940	2.1	1,195,950	274.4
4	6,900	1.7	7,600	1.9	1,071,010	267.8
5	8,700	1.9	9,110	2.0	1,295,500	283.3
6	12,200	2.6	9,320	2.0	1,274,660	273.7
7	46,400	10.1	9,090	2.0	1,221,790	266.4
8	39,500	8.9	8,880	2.0	1,098,470	247.1
9	32,000	7.3	8,410	1.9	1,057,360	241.7
10	27,150	6.5	8,020	1.9	1,009,180	240.9
11	24,550	5.5	8,700	1.9	1,158,960	259.1
12	12,050	2.5	9,490	2.0	1,305,280	272.1
សរុបរួម Total	233,550	4.47	102,660	1.96	13,799,410	264
មធ្យម AVG	19,463	4.41	8,555	1.96	1,149,951	264
អតិបរម MAX	46,400	10.12	9,490	2.05	1,305,280	283

ការប្រើប្រាស់វត្តុធាតុដើម និងថាមពលអគ្គិសនីរោងចក្រចំការមន
RAW MAETERIAL AND POWER CONSUMPTION FOR CHAMCAR MORN WTP

Month	PAC		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**3,000**	7.4	**869**	2.1	**122,206**	299.5
2	**2,675**	7.2	**741**	2.0	**111,685**	302.1
3	**2,850**	6.9	**802**	1.9	**124,342**	299.0
4	**1,950**	5.4	**636**	1.8	**107,342**	298
5	**2,300**	5.3	**858**	2.0	**130,062**	297.8
6	**3,025**	8.0	**759**	2.0	**110,475**	293.7
7	**6,150**	16.0	**753**	2.0	**111,722**	290.9
8	**7,675**	20.8	**710**	1.9	**103,970**	281.7
9	**7,775**	20.8	**665**	1.8	**103,922**	278.7
10	**5,200**	15.5	**625**	1.9	**93,886**	279.5
11	**3,450**	10.6	**655**	2.0	**93,690**	286.8
12	**4,525**	12.8	**706**	2.0	**103,085**	290.9
សរុបរួម Total	**50,575**	11.21	**8,779**	1.9	**1,316,387**	291.9
មធ្យម AVG	**4,215**	**11.39**	**732**	**1.94**	**109,699**	**292**
អតិបរម MAX	**7,775**	**20.85**	**869**	**2.13**	**130,062**	**302**

ការប្រើប្រាស់វត្តុធាតុដើម និងថាមពលអគ្គិសនីរោងចក្រនិរោធ
RAW MAETERIAL AND POWER CONSUMPTION FOR NIROTH WTP

Month	PAC		ក្លរ រ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**23,625**	5.6	**13,687**	3.2	**1,122,154**	264.7
2	**18,000**	4.7	**11,444**	3.0	**1,030,070**	267.3
3	**24,000**	5.1	**11,863**	2.5	**1,218,530**	260.2
4	**18,000**	4.3	**8,218**	2.0	**1,041,740**	249.7
5	**18,750**	3.9	**10,316**	2.2	**1,197,820**	252.3
6	**20,250**	4.6	**9,828**	2.2	**1,082,840**	244.0
7	**37,375**	8.2	**9,541**	2.1	**1,105,025**	243.0
8	**40,000**	9.1	**9,370**	2.1	**1,006,025**	228.2
9	**38,250**	8.8	**9,192**	2.1	**983,350**	225.9
10	**34,875**	8.4	**9,197**	2.2	**925,780**	223.0
11	**34,875**	8.2	**12,798**	3.0	**1,016,445**	238.1
12	**45,150**	9.7	**14,443**	3.1	**1,152,275**	247.4
សរុបរួម Total	**353,150**	6.72	**129,897**	2.47	**12,882,054**	245
មធ្យម AVG	**29,429**	**6.71**	**10,825**	**2.48**	**1,073,505**	**245**
អតិបរម MAX	**45,150**	**9.69**	**14,443**	**3.23**	**1,218,530**	**267**

(3) Production and consumption data for each WTP in 2016

សរុបការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

Month	រោងចក្រភ្នំមុលកែ Phum Prek WTP		រោងចក្រជ្រោយចង្វារ Chrouy Chang War WTP		រោងចក្រចំការមន Cham Car Morn WTP		រោងចក្រនិរោធ Niroth WTP		សរុប Total	
	150,000 m³/day		130,000 m³/day		20,000 m³/day		260,000 m³/day		560,000 m³/day	
	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water
1	5,070,463	**4,816,940**	4,776,660	**4,670,860**	354,703	**333,174**	4,897,659	**4,733,190**	15,099,485	**14,554,164**
2	4,735,286	**4,498,520**	4,474,850	**4,372,600**	284,498	**267,053**	4,542,620	**4,382,719**	14,037,254	**13,520,892**
3	5,274,968	**5,011,220**	5,166,900	**5,027,120**	372,596	**354,283**	4,989,929	**4,821,820**	15,804,393	**15,214,443**
4	5,015,430	**4,763,707**	4,860,280	**4,709,020**	310,529	**296,255**	4,498,920	**4,366,859**	14,685,159	**14,135,841**
5	5,603,398	**5,323,227**	5,207,500	**5,107,090**	467,425	**447,421**	5,005,859	**4,906,040**	16,284,182	**15,783,778**
6	5,158,940	**4,900,993**	4,939,790	**4,840,520**	463,819	**438,368**	4,821,770	**4,732,549**	15,384,319	**14,912,430**
7	5,526,306	**5,249,990**	5,065,190	**4,960,680**	426,861	**399,976**	-	**4,707,890**	11,018,357	**15,318,536**
8	5,684,534	**5,400,305**	5,025,320	**4,918,050**	410,648	**385,772**	5,049,730	**4,825,070**	16,170,232	**15,529,197**
9	5,304,177	**5,038,966**	4,754,510	**4,651,530**	383,813	**358,413**	4,643,849	**4,429,690**	15,086,349	**14,478,599**
10	5,323,036	**5,056,887**	4,573,490	**4,441,100**	294,951	**275,451**	5,042,380	**4,948,720**	15,233,857	**14,722,158**
11	5,229,221	**4,967,760**	4,339,139	**4,191,190**	143,236	**135,539**	5,644,200	**5,495,420**	15,355,796	**14,789,909**
12	5,221,021	**4,959,970**	4,461,810	**4,319,360**	156,643	**147,922**	5,954,230	**5,846,840**	15,793,704	**15,274,092**
សរុបរួម Total Year	63,146,780	**59,988,485**	57,645,439	**56,209,120**	4,069,722	**3,839,627**	55,091,146	**58,196,807**	179,953,087	**178,234,039**
មធ្យម AVG		**4,999,040**		**4,684,093**		**319,969**		**4,849,734**		**14,852,837**
អតិបរមា MAX		**5,400,305**		**5,107,090**		**447,421**		**5,846,840**		**15,783,778**

សរុបការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

Month	PAC		ក្លរ Chlorine		ក្លរទឹក Sodium Hypochlorite Solution			ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)	គីឡូ (L)	ក្រាម (Kg)	ក្រាម (g)	គីឡូ (Kg)	ក្រាម (g)
1	135,650	9.32	38,068	2.62	–	–	–	3,847,847	264
2	123,600	9.14	35,099	2.60	–	–	–	3,596,639	266
3	77,425	5.09	38,602	2.54	–	–	–	4,046,540	266
4	36,400	2.58	32,533	2.30	–	–	–	3,619,563	256
5	32,575	2.06	36,689	2.32	–	–	–	4,082,603	259
6	63,650	4.27	33,393	2.24	–	–	–	3,887,880	261
7	163,725	10.69	28,861	1.88	41,800	992.35	0.06	3,902,148	255
8	129,750	8.36	22,033	1.42	57,750	1498.04	0.10	3,924,127	253
9	125,900	8.70	19,754	1.36	55,500	1358.40	0.38	3,522,991	243
10	107,550	7.31	27,960	1.90	23,000	475.56	0.03	3,531,386	240
11	110,575	7.48	30,928	2.09	6,000	205.23	0.01	3,709,943	251
12	127,150	8.32	25,012	1.64	65,500	1,876.22	0.12	4,041,298	265
សរុបរួម Total Year	1,233,950	6.92	368,932	2.07	249,550	6,405.81	0.11	45,712,965	256
មធ្យម AVG	102,829	6.94	30,744	2.08	20,796	534	0.06	3,809,414	256
អតិបរមា MAX	163,725	10.69	38,602	2.62	65,500	1,876	0	4,082,603	266

ការប្រើប្រាស់វត្ថុធាតុដើម និងថាមពលអគ្គិសនីរោងចក្រភូមិព្រែក
RAW MAETERIAL AND POWER CONSUMPTION FOR PHUM PREK WTP

Month	PAC		ក្លរ Chlorine		ក្លរទឹក Sodium Hypochlorite Solution			ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (L)	ឯកតា (Kg)	ឯកតា (g)	គីឡូ (Kg)	ឯកតា (g)
1	72,800	15.1	15,150	3.1	-	-	-	1,254,306	260.4
2	76,000	16.9	16,656	3.7	-	-	-	1,165,706	259.1
3	33,200	6.6	18,692	3.7	-	-	-	1,302,116	259.8
4	8,400	1.8	15,069	3.2	-	-	-	1,174,477	246.5
5	6,800	1.3	15,896	3.0	-	-	-	1,347,116	253.1
6	12,400	2.5	13,374	2.7	-	-	-	1,262,949	257.7
7	56,000	10.7	7,262	1.4	41,800	992.3	0.19	1,329,291	253.2
8	48,000	8.9	1,160	0.2	57,750	1,498.0	0.28	1,382,944	256.1
9	44,800	8.9	0.00	0.00	55,500	1,358.4	0.27	1,221,715	242.5
10	33,600	6.6	6,952	1.4	23,000	475.6	0.09	1,180,206	233.4
11	38,400	7.7	8,700	1.8	6,000	205.2	0.04	1,190,133	239.6
12	41,600	8.4	0.00	0.00	65,500	1,876.2	0.38	1,312,464	264.6
សរុបរួម Total Year	472,000	7.87	118,911	1.98	249,550.0	6,405.8	0.11	15,123,423	252
មធ្យម AVG	39,333	7.95	9,909	2.02	20,795.8	533.8	0.10	1,260,285	252
អតិបរមា MAX	76,000	16.89	18,692	3.73	65,500.0	1,876.2	0.38	1,382,944	265

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រជ្រោយចង្វារ
RAW MAETERIAL AND POWER CONSUMPTION FOR CHROY CHANG WA WTP

Month	PAC		ក្លរ រ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	11,050	2.4	9,130	2.0	1,302,530	278.9
2	8,800	2.0	8,530	2.0	1,247,780	285.4
3	9,600	1.9	9,900	2.0	1,431,910	284.8
4	8,400	1.8	9,350	2.0	1,301,960	276.5
5	8,700	1.7	10,040	2.0	1,425,080	279.0
6	28,100	5.8	9,210	1.9	1,358,010	280.6
7	52,450	10.6	9,520	1.9	1,338,070	269.7
8	38,600	7.8	9,540	1.9	1,295,420	263.4
9	34,050	7.3	9,090	2.0	1,172,700	252.1
10	33,250	7.5	8,670	2.0	1,108,450	249.6
11	24,550	5.9	8,680	2.1	1,073,720	256.2
12	25,250	5.8	8,840	2.0	1,163,720	269.4
សរុបរួម Total Year	282,800	5.03	110,500	1.97	15,219,350	270.8
មធ្យម AVG	23,567	5.04	9,208	1.97	1,268,279	
អតិបរមា MAX	52,450	10.57	10,040	2.07	1,431,910	

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រចំការមន
RAW MAETERIAL AND POWER CONSUMPTION FOR CHAMCAR MORN WTP

Month	PAC		ក្លរ រ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**4,300**	12.9	**712**	2.1	**98,696**	296.2
2	**4,050**	15.2	**532**	2.0	**79,878**	299.1
3	**3,000**	8.5	**693**	2.0	**105,644**	298.2
4	**1,100**	3.7	**582**	2.0	**87,893**	297
5	**1,700**	3.8	**909**	2.0	**132,800**	296.8
6	**3,275**	7.5	**897**	2.0	**131,205**	299.3
7	**7,400**	18.5	**806**	2.0	**117,513**	293.8
8	**5,150**	13.3	**764**	2.0	**109,423**	283.6
9	**5,175**	14.4	**705**	2.0	**99,836**	278.6
10	**2,475**	9.0	**595**	2.2	**77,720**	282.2
11	**1,250**	9.2	**372**	2.7	**40,440**	298.4
12	**1,300**	8.8	**447**	3.0	**44,524**	301.0
សរុបរួម Total Year	**40,175**	**10.5**	**8,014**	**2.09**	**1,125,572**	**293.1**
មធ្យម AVG	**3,348**	**10.40**	**668**	**2.17**	**93,798**	**293.65**
អតិបរមា MAX	**7,400**	**18.50**	**909**	**3.02**	**132,800**	**301.00**

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រនិរោធ
RAW MAETERIAL AND POWER CONSUMPTION FOR NIROTH WTP

Month	PAC		ក្លរ រ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**47,500**	10.0	**13,076**	2.8	**1,192,315**	251.9
2	**34,750**	7.9	**9,381**	2.1	**1,103,275**	251.7
3	**31,625**	6.6	**9,317**	1.9	**1,206,870**	250.3
4	**18,500**	4.2	**7,532**	1.7	**1,055,233**	241.6
5	**15,375**	3.1	**9,844**	2.0	**1,177,607**	240.0
6	**19,875**	4.2	**9,912**	2.1	**1,135,716**	240.0
7	**47,875**	10.2	**11,273**	2.4	**1,117,274**	237.3
8	**38,000**	7.9	**10,569**	2.2	**1,136,340**	235.5
9	**41,875**	9.5	**9,959**	2.2	**1,028,740**	232.2
10	**38,225**	7.7	**11,743**	2.4	**1,165,010**	235.4
11	**46,375**	8.4	**13,176**	2.4	**1,405,650**	255.8
12	**59,000**	10.1	**15,725**	2.7	**1,520,590**	260.1
សរុបរួម Total Year	**438,975**	**7.5**	**131,507**	**2.26**	**14,244,620**	**245**
មធ្យម AVG	**36,581**	**7.5**	**10,959**	**2.25**	**1,187,052**	**244**
អតិបរមា MAX	**59,000**	**10.2**	**15,725**	**2.76**	**1,520,590**	**260**

(4) Production and consumption data for each WTP in 2017

ផលិតកម្មទឹកស្អាតសរុបតាមរោងចក្រ
TOTAL PRODUCTION FOR EACH WTPS

Month	រោងចក្រភ្នំពេញថ្មី Phum Prek WTP (150,000m3/day)		រោងចក្រជ្រោយចង្វារ Chrouy Chang War WTP (130,000m3/day)		រោងចក្រចំការមន Cham Car Morn WTP		រោងចក្រនិរោធ Niroth WTP		សរុប Total	
	150,000 m3/day		130,000 m3/day		20,000 m3/day		260,000 m3/day		560,000 m3/day	
	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water
1	5,107,620	**4,852,239**	4,432,320	**4,225,900**	180,267	**169,588**	6,138,570	**5,989,039**	15,858,777	**15,236,766**
2	4,697,249	**4,462,387**	4,142,060	**4,025,740**	398,309	**381,343**	5,458,579	**5,352,040**	14,696,197	**14,221,510**
3	5,200,286	**4,940,272**	4,620,870	**4,503,470**	420,195	**402,685**	6,758,649	**6,589,629**	17,000,000	**16,436,056**
4	4,602,424	**4,372,303**	4,004,280	**3,875,280**	330,434	**314,794**	6,304,700	**6,167,740**	15,241,838	**14,730,117**
5	5,285,421	**5,021,150**	4,383,900	**4,231,449**	295,158	**279,779**	7,165,579	**6,953,759**	17,130,058	**16,486,137**
6	5,010,717	**4,760,181**	4,652,030	**4,491,510**	184,206	**174,900**	7,097,259	**6,840,929**	16,944,212	**16,267,520**
7	4,980,234	**4,731,222**	4,891,440	**4,727,438**	188,458	**171,940**	7,669,940	**7,370,240**	17,730,072	**17,000,840**
8	4,999,848	**4,749,856**	4,761,290	**4,619,120**	104,235	**98,561**	8,061,879	**7,778,959**	17,927,252	**17,246,496**
9	4,516,125	**4,290,319**	4,378,300	**4,241,920**	-	**-**	7,362,769	**7,117,509**	16,257,194	**15,649,748**
10	4,965,708	**4,717,423**	4,522,650	**4,377,800**	-	**-**	8,683,150	**8,422,699**	18,171,508	**17,517,922**
11	4,776,216	**4,537,407**	4,414,480	**4,280,520**	-	**-**	7,851,608	**7,661,319**	17,042,304	**16,479,246**
12	4,891,574	**4,646,995**	4,424,120	**4,305,000**	-	**-**	8,043,170	**7,813,480**	17,358,864	**16,765,475**
សរុបរួម Total	59,033,421	**56,081,754**	53,627,740	**51,905,147**	2,101,262	**1,993,590**	86,595,852	**84,057,342**	201,358,275	**194,037,833**
មធ្យម AVG		**4,673,480**		**4,325,429**		**166,133**		**7,004,779**		**16,169,819**
អតិបរមា MAX		**5,021,150**		**4,727,438**		**402,685**		**8,422,699**		**17,517,922**

សរុបការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

PAC		កបល Lime		ក្លរ Chlorine		អំបិល Salt	ក្លរទឹក Sodium Hypochlorite Solution			ថាមពលអគ្គិសនី Electricity	
គីឡូ (Kg)	ឯកទ (g)	គីឡូ (Kg)	ឯកទ (g)	គីឡូ (Kg)	ឯកទ (g)	គីឡូ (Kg)	គីឡូ (L)	ឯកទ (Kg)	ឯកទ (g)	គីឡូ (Kwh)	(wh)
130,125	8.54	**600**	0.10	**27,982**	1.84	**64,150**	**2,200,810**	15,405.67	3.17	**4,177,576**	274
126,800	8.92			**26,264**	1.85	**32,000**	**1,739,213**	12,174.49	2.73	**3,969,267**	279
112,850	6.87			**24,394**	1.48	**50,000**	**2,171,242**	15,198.69	3.08	**4,721,093**	287
75,250	5.11			**19,926**	1.35	**45,000**	**2,117,788**	14,824.52	3.39	**4,219,971**	286
81,500	4.94			**22,704**	1.38	**34,500**	**1,996,100**	13,972.70	2.78	**4,788,070**	290
183,750	11.30			**26,358**	1.62	**41,750**	**1,906,834**	400.58	0.08	**4,560,773**	280
191,525	11.27			**29,947**	1.76	**35,000**	**1,451,753**	10,162.27	2.15	**4,580,759**	269
168,525	9.77			**28,851**	1.67	**25,750**	**1,379,226**	9,654.58	2.03	**4,487,384**	260
128,550	8.21			**24,495**	1.57	**28,500**	**1,258,801**	8,472.46	1.97	**4,009,688**	256
122,725	7.01			**30,077**	1.72	**31,000**	**1,353,687**	9,219.67	1.95	**4,712,887**	269
108,850	6.61			**32,725**	1.99	**37,375**	**1,525,594**	10,679.16	2.35	**4,659,482**	283
110,575	6.60			**31,398**	1.87	**54,250**	**1,960,947**	13,726.63	2.95	**4,819,874**	287
1,541,025	**7.94**	**600**	**0.10**	**325,121**	**1.68**	**479,275**	**21,061,995**	**133,891.42**	**2.39**	**53,706,824**	**277**
128,419	**7.93**			**27,093**	**1.67**	**39,940**	**1,755,166**	**11,158**	**2.39**	**4,475,569**	**277**
183,750	**11.30**			**27,982**	**1.85**	**64,150**	**2,200,810**	**15,405.67**	**3.39**	**4,788,070**	**290**

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រភូមិព្រែក
RAW MAETERIAL AND POWER CONSUMPTION FOR PHUM PREK WTP

Month	PAC		ក្លរ Chlorine		អំបិល Salt	ក្លរទឹក Sodium Hypochlorite Solution			ចរមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	គិតជា (L)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**52,000**	10.72	**-**	-	**64,150**	**2,200,810**	**15,406**	3.17	**1,376,962**	284
2	**64,000**	14.34	**2,026**	0.45	**32,000**	**1,739,213**	**12,174**	2.73	**1,265,369**	284
3	**68,800**	13.93	**624**	0.13	**50,000**	**2,171,242**	**15,199**	3.08	**1,414,888**	286
4	**39,200**	8.97	**-**	-	**45,000**	**2,117,788**	**14,825**	3.39	**1,230,482**	281
5	**26,000**	5.18	**258**	0.05	**34,500**	**1,996,100**	**13,973**	2.78	**1,410,391**	281
6	**54,400**	11.43	**277**	0.06	**41,750**	**1,906,834**	**401**	0.08	**1,307,576**	275
7	**52,800**	11.16	**1,726**	0.36	**35,000**	**1,451,753**	**10,162**	2.15	**1,256,282**	266
8	**43,200**	9.10	**995**	0.21	**25,750**	**1,379,226**	**9,655**	2.03	**1,274,984**	268
9	**28,800**	6.71	**-**	-	**28,500**	**1,258,801**	**8,472**	1.97	**1,128,638**	263
10	**24,800**	5.26	**291**	0.06	**31,000**	**1,353,687**	**9,220**	1.95	**1,292,187**	274
11	**26,400**	5.82	**1,979**	0.44	**37,375**	**1,525,594**	**10,679**	2.35	**1,267,362**	279
12	**30,000**	6.46	**-**	-	**54,250**	**1,960,947**	**13,727**	2.95	**1,296,895**	279
សរុបរួម Total	**510,400**	**9.10**	**8,176**	**0.15**	**479,275**	**21,061,995**	**133,891**	**2.39**	**15,522,016**	**277**
មធ្យម AVG	**50,733**	**10.76**	**531**	**0.11**	**44,567**	**1,755,166**	**11,996.11**	**2.54**	**1,334,278**	**282**
អតិបរម MAX	**68,800**	**14.34**	**2,026**	**0.45**	**64,150**	**2,200,810**	**15,405.67**	**3.39**	**1,414,888**	**286**

ការប្រើប្រាស់វត្ថុធាតុដើម និងថាមពលអគ្គិសនីរោងចក្រជ្រោងចង្វារ
RAW MAETERIAL AND POWER CONSUMPTION FOR CHROY CHANG WA WTP

Month	PAC		ក្លរ Chlorine (Cl_2)		ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (Kg)	ឯកតា (g)	គីឡូ (Kwh)	(wh)
1	**14,250**	3.37	**9,370**	2.22	**1,168,470**	277
2	**6,800**	1.69	**8,630**	2.14	**1,119,830**	278
3	**5,800**	1.29	**9,680**	2.15	**1,297,960**	288
4	**5,750**	1.48	**8,560**	2.21	**1,122,960**	290
5	**14,450**	3.41	**9,180**	2.17	**1,268,900**	300
6	**47,800**	10.64	**10,000**	2.23	**1,261,610**	281
7	**49,050**	10.38	**10,400**	2.20	**1,271,310**	269
8	**40,700**	8.81	**10,340**	2.24	**1,178,540**	255
9	**27,250**	6.42	**9,560**	2.25	**1,066,940**	252
10	**29,600**	6.76	**9,890**	2.26	**1,135,690**	259
11	**23,800**	5.56	**9,830**	2.30	**1,136,250**	265
12	**17,850**	4.15	**9,960**	2.31	**1,189,350**	276
សរុបរួម Total	**283,100**	**5.45**	**115,400**	**2.22**	**14,217,810**	**274**
មធ្យម AVG	**15,808**	**5.33**	**9,617**	**2.22**	**1,184,818**	**274**
អតិបរម MAX	**47,800**	**10.64**	**10,400**	**2.31**	**1,297,960**	**300**

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រចំការមន
RAW MAETERIAL AND POWER CONSUMPTION FOR CHAMCAR MON WTP

Month	PAC		ក្លរ Chlorine		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**1,750**	10.32	**549**	3.24	**50,284**	297
2	**4,375**	11.47	**1,069**	2.80	**111,158**	291
3	**4,125**	10.24	**1,061**	2.63	**119,215**	296
4	**2,550**	8.10	**782**	2.48	**94,039**	299
5	**2,675**	9.56	**636**	2.27	**83,869**	300
6	**3,425**	19.58	**409**	2.34	**52,067**	298
7	**4,425**	25.74	**523**	3.04	**51,417**	299
8	**1,625**	16.49	**262**	2.66	**29,270**	297
9						
10						
11						
12						
សរុបរួម Total	**24,950**	**12.52**	**5,291**	**2.65**	**591,319**	**297**
មធ្យម AVG	**3,119**	**13.94**	**661**	**2.68**	**73,915**	**297**
អតិបរមា MAX	**4,425**	**25.74**	**1,069**	**3.24**	**119,215**	**300**

ផ្ទាកដំណើរការផលិត

ការប្រើប្រាស់វត្ថុធាតុដើម និងបរិមាណអគ្គិសនីរោងចក្រនិរោធ
RAW MAETERIAL AND POWER CONSUMPTION FOR NIROTH WTP

Month	PAC		កំបោរ Lime		ក្លរ Chlorine		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**62,125**	10.37	**600**	0.10	**18,063**	3.02	**1,581,860**	264
2	**51,625**	9.65			**14,539**	2.72	**1,472,910**	275
3	**34,125**	5.18			**13,029**	1.98	**1,889,030**	287
4	**27,750**	4.50			**10,584**	1.72	**1,772,490**	287
5	**38,375**	5.52			**12,630**	1.82	**2,024,910**	291
6	**78,125**	11.42			**15,672**	2.29	**1,939,520**	284
7	**85,250**	11.57			**17,298**	2.35	**2,001,750**	272
8	**83,000**	10.67			**17,254**	2.22	**2,004,590**	258
9	**72,500**	10.19			**14,935**	2.10	**1,814,110**	255
10	**68,325**	8.11			**19,896**	2.36	**2,285,010**	271
11	**58,650**	7.66			**20,916**	2.73	**2,255,870**	294
12	**62,725**	8.03			**21,438**	2.74	**2,333,629**	299
សរុបរួម Total	**722,575**	**8.60**	**600**	**0.10**	**196,254**	**2.33**	**23,375,679**	**278**
មធ្យម AVG	**60,215**	**8.57**			**16,355**	**2.34**	**1,947,973**	**278**
អតិបរមា MAX	**85,250**	**11.57**			**21,438**	**3.02**	**2,333,629**	**299**

(5) Production and consumption data for each WTP in 2018

ផលិតកម្មទឹកស្អាតសរុបតាមរោងចក្រ
TOTAL PRODUCTION FOR EACH WTPS

Month	រោងចក្រភ្នំព្រែក Phum Prek WTP (150,000m3/day)		រោងចក្រជ្រោយចង្វារ Chrouy Chang War WTP (130,000m3/day)		រោងចក្រចំការមន Cham Car Morn WTP		រោងចក្រនៃរតh Nirath WTP		សរុប Total	
	150,000 m3/day		130,000 m3/day		20,000 m3/day		260,000 m3/day		560,000 m3/day	
	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water	ទឹកឆៅ M³ Raw water	ទឹកស្អាត M³ Treated water
1	5,250,093	**5,000,088**	4,524,040	**4,407,600**	-	-	7,775,098	**7,595,949**	17,549,231	**17,003,637**
2	4,717,122	**4,481,266**	4,174,400	**4,055,270**	-	-	6,685,140	**6,491,999**	15,576,662	**15,028,535**
3	5,439,983	**5,167,984**	5,110,750	**4,980,660**	-	-	7,487,630	**7,295,220**	18,038,363	**17,443,864**
4	4,917,283	**4,671,419**	4,907,240	**4,781,270**	-	-	7,094,378	**6,908,009**	16,918,901	**16,360,698**
5	5,318,096	**5,052,191**	5,141,820	**5,045,699**	-	-	7,871,380	**7,693,489**	18,331,296	**17,791,379**
6	5,102,323	**4,847,207**	4,920,820	**4,784,110**	-	-	8,044,300	**7,866,729**	18,067,443	**17,498,046**
7	5,271,664	**5,008,081**	4,984,790	**4,849,320**	-	-	8,244,808	**8,031,279**	18,501,262	**17,888,680**
8	5,378,461	**5,109,538**	5,087,420	**4,963,480**	-	-	8,554,830	**8,318,710**	19,020,711	**18,391,728**
9	5,269,909	**5,006,414**	4,927,590	**4,774,590**	-	-	8,467,738	**8,256,849**	18,665,237	**18,037,853**
10	5,210,659	**4,950,126**	4,918,410	**4,774,400**	-	-	7,933,410	**7,777,849**	18,062,479	**17,502,375**
11	5,362,680	**5,094,546**	4,811,570	**4,702,700**	-	-	8,214,499	**8,064,359**	18,388,749	**17,861,605**
12	5,189,816	**4,930,325**	5,332,919	**5,216,720**	-	-	8,145,904	**7,949,274**	18,668,639	**18,096,319**
សរុបរួម Total	62,428,089	**59,319,185**	58,841,769	**57,335,819**			94,519,115	**92,249,715**	215,788,973	**208,904,719**
មធ្យម AVG		**4,943,265**		**4,777,985**				**7,687,476**		**17,408,727**
អតិបរម MAX		**5,167,984**		**5,216,720**				**8,318,710**		**18,391,728**

សរុបការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីតាមរោងចក្រទាំងបួន
TOTAL OF RAW MAETERIAL AND POWER CONSUMPTION FOR THE FOURTH WTPS

Month	PAC		ក្លរ Chlorine		អំបិល Salt	ក្លរទឹក Sodium Hypochlorite Solution			ថាមពលអគ្គិសនី Electricity	
	គីឡូ (Kg)	ឯកត (g)	គីឡូ (Kg)	ឯកត (g)	គីឡូ (Kg)	គីឡូ (L)	ឯកត (Kg)	ឯកត (g)	គីឡូ (Kwh)	(wh)
1	**113,250**	6.66	**36,042**	2.12	**45,000**	**1,341,208**	9,388	1.88	**4,967,329**	292
2	**89,925**	5.98	**30,824**	2.05	**47,500**	**2,017,379**	14,122	3.15	**4,492,937**	299
3	**103,200**	5.92	**30,632**	1.76	**68,750**	**2,436,304**	17,054	3.30	**5,152,590**	295
4	**89,300**	5.46	**24,419**	1.49	**52,000**	**1,854,252**	12,980	2.78	**4,844,429**	296
5	**82,700**	4.65	**25,731**	1.45	**58,000**	**1,953,693**	13,676	2.71	**5,243,876**	295
6	**121,100**	6.92	**24,864**	1.42	**52,750**	**2,008,185**	14,057	2.90	**5,057,060**	289
7	**177,100**	9.90	**26,897**	1.50	**48,000**	**1,725,731**	12,080	2.41	**4,783,748**	267
8	**161,100**	8.76	**30,331**	1.65	**37,500**	**1,487,042**	10,409	2.04	**4,562,617**	248
9	**142,300**	7.89	**28,820**	1.60	**43,000**	**1,573,041**	11,011	2.20	**4,294,062**	238
10	**102,700**	5.87	**24,231**	1.38	**46,500**	**1,672,908**	11,710	2.37	**4,194,475**	240
11	**106,225**	5.95	**31,262**	1.75	**62,000**	**1,966,799**	13,768	2.70	**4,784,755**	268
12	**127,000**	7.02	**32,252**	1.78	**75,000**	**2,434,442**	17,041	3.46	**5,048,944**	279
សរុបរួម Total	**1,415,900**	**6.78**	**346,305**	**1.66**	**636,000**	**22,470,984**	**157,297**	**2.65**	**57,426,822**	**275**
មធ្យម AVG	**117,992**	**6.75**	**28,859**	**1.66**	**53,000**	**1,872,582**	**13,108**	**2.66**	**4,785,569**	**276**
អតិបរម MAX	**177,100**	**9.90**	**36,042**	**2.12**	**75,000**	**2,436,304**	**17,054.13**	**3.46**	**5,243,876**	**299**

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រភូមិព្រែក
RAW MAETERIAL AND POWER CONSUMPTION FOR PHUM PREK WTP

Month	PAC		ក្លរ Chlorine		អំបិល Salt	ក្លរទឹក Sodium Hypochlorite Solution			ចំ មពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	គិតជា (L)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**45,200**	9.04	**3,408**	0.68	**45,000**	**1,341,208**	**9,388**	1.88	**1,418,699**	284
2	**45,600**	10.18	**3,522**	0.79	**47,500**	**2,017,379**	**14,122**	3.15	**1,298,177**	290
3	**65,600**	12.69	**4,002**	0.77	**68,750**	**2,436,304**	**17,054**	3.30	**1,448,470**	280
4	**51,200**	10.96	**856**	-	**52,000**	**1,854,252**	**12,980**	2.78	**1,307,429**	280
5	**27,200**	5.38	**766**	0.15	**58,000**	**1,953,693**	**13,676**	2.71	**1,437,666**	285
6	**32,000**	6.60	**-**	-	**52,750**	**2,008,185**	**14,057**	2.90	**1,381,160**	285
7	**46,400**	9.27	**-**	-	**48,000**	**1,725,731**	**12,080**	2.41	**1,339,688**	268
8	**45,600**	8.92	**-**	-	**37,500**	**1,487,042**	**10,409**	2.04	**1,282,547**	251
9	**32,800**	6.55	**-**	-	**43,000**	**1,573,041**	**11,011**	2.20	**1,246,152**	249
10	**26,400**	5.33	**-**	-	**46,500**	**1,672,908**	**11,710**	2.37	**1,230,165**	249
11	**35,200**	6.91	**-**	-	**62,000**	**1,966,799**	**13,768**	2.70	**1,387,926**	272
12	**45,600**	9.25	**-**	-	**75,000**	**2,434,442**	**17,041**	3.46	**1,371,574**	278
សរុបរួម Total	**498,800**	**8.41**	**12,554**	**0.21**	**636,000**	**22,470,984**	**157,297**	**2.65**	**16,149,653**	**272**
មធ្យម AVG	**41,567**	**8.42**	**1,046**	**0.20**	**53,000**	**1,872,582**	**13,108.07**	**2.66**	**1,345,804**	**272**
អតិបរម MAX	**65,600**	**12.69**	**4,002**	**0.79**	**75,000**	**2,436,304**	**17,054.13**	**3.46**	**1,448,470**	**290**

ការប្រើប្រាស់វត្ថុធាតុដើម និងចរន្តអគ្គិសនីរោងចក្រជ្រោងចង្វារ
RAW MAETERIAL AND POWER CONSUMPTION FOR CHROY CHANG WA WTP

Month	PAC		ក្លរ Chlorine		អំបិល Salt	ក្លរទឹក Sodium Hypochlorite Solution			ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	គិតជា (L)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**12,550**	2.85	**9,870**	2.24					**1,266,830**	287
2	**7,200**	1.78	**8,940**	2.20					**1,216,220**	300
3	**8,400**	1.69	**10,320**	2.07					**1,517,220**	305
4	**8,100**	1.69	**9,340**	1.95					**1,460,610**	305
5	**17,250**	3.42	**10,180**	2.02					**1,524,970**	302
6	**39,350**	8.23	**9,750**	2.04					**1,375,960**	288
7	**55,450**	11.43	**10,380**	2.14					**1,289,460**	266
8	**44,000**	8.86	**10,910**	2.20					**1,272,080**	256
9	**34,250**	7.17	**10,790**	2.26					**1,219,540**	255
10	**26,800**	5.61	**9,420**	1.97					**1,205,550**	253
11	**22,775**	4.84	**10,510**	2.23					**1,249,930**	266
12	**19,850**	3.81	**4,940**	0.95	**29,075**	**949,934**	**6,533**	1.25	**1,470,460**	282
សរុបរួម Total	**295,975**	**5.16**	**115,350**	**2.01**					**16,068,830**	**280**
មធ្យម AVG	**24,665**	**5.12**	**9,613**	**2.02**					**1,339,069**	**280**
អតិបរម MAX	**55,450**	**11.43**	**10,910**	**2.26**					**1,524,970**	**305**

ការប្រើប្រាស់វត្តជាតុដើម និងថាមពលអគ្គិសនីរោងចក្រនិរោធ
RAW MAETERIAL AND POWER CONSUMPTION FOR NIROTH WTP

Month	PAC		ក្លរ Chlorine		ថាមពលអគ្គិសនី Electricity	
	គិតជា (Kg)	ឯកត (g)	គិតជា (Kg)	ឯកត (g)	គិតជា (Kwh)	(wh)
1	**55,500**	7.31	**22,764**	3.00	**2,281,800**	300
2	**37,125**	5.72	**18,362**	2.83	**1,978,540**	305
3	**29,200**	4.00	**16,310**	2.24	**2,186,900**	300
4	**30,000**	4.34	**14,223**	2.06	**2,076,390**	301
5	**38,250**	4.97	**14,785**	1.92	**2,281,240**	297
6	**49,750**	6.32	**15,114**	1.92	**2,299,940**	292
7	**75,250**	9.37	**16,517**	2.06	**2,154,600**	268
8	**71,500**	8.60	**19,421**	2.33	**2,007,990**	241
9	**75,250**	9.11	**18,030**	2.18	**1,828,370**	221
10	**49,500**	6.36	**14,811**	1.90	**1,758,760**	226
11	**48,250**	5.98	**20,752**	2.57	**2,146,899**	266
12	**61,550**	7.74	**27,312**	3.44	**2,206,910**	278
សរុបរួម Total	**621,125**	**6.73**	**218,401**	**2.37**	**25,208,339**	**273**
មធ្យម AVG	**51,760**	**6.65**	**18,200**	**2.37**	**2,100,695**	**275**
អតិបរមា MAX	**75,250**	**9.37**	**27,312**	**3.44**	**2,299,940**	**305**