10.3 Frame Values and Generated/Discharged Pollution Load by Sub-area

Projected frame values and generated/discharged pollution load by province for the years 1996, 2001 and 2011 were further broken down into 20 sub-areas the same way as in Section 9.4.

Population by sub-area for the years 1996, 2001 and 2011 were computed as presented in Tables 10.3.1 to 10.3.3. For the calculation of wastewater quantity and BOD load by sub-area for each target years, the same assumptions as mentioned in Section 9.4 are adopted. Details of computation results are presented in Supporting Report 10.3.

Generated and discharged BOD load for the years 1996, 2001 and 2011 by sub-area and water quality checking point are summarized in Tables 10.3.4 to 10.3.6 and Tables 10.3.7 to 10.3.9, respectively.

Table 10.3.1 Population by Sub-area (1996)

Province / Amphoe	Noi River						Lop Buri River						Pasak River						Main River (Upper Up. Part, R0-R1)					
	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y
	Sub-area N1																		Sub-area C1					
Chai Nat	60,516	0	0	0	8,389	54,127	0	0	0	0	0	0	0	0	0	0	0	0	26,260	0	15,977	0	0	10,283
** Muang Chai Nat	7,796	0	0	0	0	7,796	0	0	0	0	0	0	0	0	0	0	0	0	26,260	0	15,977	0	0	10,283
* Sankhaburi	47,595	0	0	0	6,389	41,206	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sanpheya	5,125	0	0	0	0	5,125	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N2						Sub-area L1																	
Sing Buri	102,962	0	0	0	37,484	65,478	23,151	0	0	0	0	23,151	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Sing Buri	9,948	0	0	0	0	9,948	4,831	0	0	0	0	4,831	0	0	0	0	0	0	0	0	0	0	0	0
* Khai Bang Rachan	32,406	0	0	0	3,766	28,640	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Chang	16,571	0	0	0	11,077	5,494	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Rachan	41,231	0	0	0	22,641	18,590	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Phrom Buri	2,414	0	0	0	0	2,414	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* In Buri	392	0	0	0	0	392	18,320	0	0	0	0	18,320	0	0	0	0	0	0	0	0	0	0	0	0
							Sub-area L2																	
Lop Buri	0	0	0	0	0	0	316,254	0	40,036	0	25,502	250,716	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Lop Buri	0	0	0	0	0	0	241,980	0	40,036	0	20,502	181,442	0	0	0	0	0	0	0	0	0	0	0	0
Khok Samrong	0	0	0	0	0	0	800	0	0	0	0	800	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Wung	0	0	0	0	0	0	47,274	0	0	0	5,000	42,274	0	0	0	0	0	0	0	0	0	0	0	0
Ban Mi	0	0	0	0	0	0	26,200	0	0	0	0	26,200	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N3																							
Ang Thong	189,153	0	0	0	40,480	148,673	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Ang Thong	15,526	0	0	0	0	15,526	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Chaiyo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Pa Mok	6,647	0	0	0	0	6,647	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pho Thong	58,572	0	0	0	7,012	51,560	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Wiset Chai Chan	60,452	0	0	0	22,461	37,991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Samko	10,692	0	0	0	7,204	3,488	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sawaengha	37,264	0	0	0	3,803	33,461	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N4						Sub-area L4						Sub-area P2											
Ayutthaya	138,865	0	5,432	0	79,040	54,393	39,864	0	0	0	13,540	26,324	120,201	0	0	10,057	40,373	69,771	0	0	0	0	0	0
** Muang Ayutthaya	2,447	0	0	0	0	2,447	2,266	0	0	0	0	2,266	20,930	0	0	0	12,780	8,050	0	0	0	0	0	0
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	53,740	0	0	10,057	19,081	24,622	0	0	0	0	0	0
* Nakhon Luang	0	0	0	0	0	0	1,677	0	0	0	0	1,677	34,272	0	0	0	8,532	25,740	0	0	0	0	0	0
* Bang Sai	11,513	0	0	0	6,289	5,224	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Sha	24,666	0	0	0	12,341	12,325	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Ban	16,762	0	0	0	12,149	4,613	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Pahan	0	0	0	0	0	0	19,181	0	0	0	7,956	10,225	4,812	0	0	0	0	4,812	0	0	0	0	0	0
* Bang Pa-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Ban Phraek	0	0	0	0	0	0	7,155	0	0	0	2,613	4,542	0	0	0	0	0	0	0	0	0	0	0	0
* Phak Hai	44,086	0	0	0	24,988	19,098	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Maha Rat	0	0	0	0	0	0	10,565	0	0	0	2,971	7,594	6,547	0	0	0	0	6,547	0	0	0	0	0	0
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Sena	39,391	0	5,432	0	23,273	10,686	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uthai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							Sub-area L3						Sub-area P1											
Saraburi	0	0	0	0	0	0	3,059	0	0	0	0	3,059	26,665	0	0	0	0	26,665	0	0	0	0	0	0
Don Phut	0	0	0	0	0	0	1,671	0	0	0	0	1,671	3,335	0	0	0	0	3,335	0	0	0	0	0	0
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	15,350	0	0	0	0	15,350	0	0	0	0	0	0
Nong Don	0	0	0	0	0	0	1,388	0	0	0	0	1,388	7,980	0	0	0	0	7,980	0	0	0	0	0	0
Total	491,496	0	5,432	0	163,393	322,671	362,328	0	40,036	0	39,042	303,250	146,866	0	0	10,057	40,373	96,436	26,260	0	15,977	0	0	10,283

Note: "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary district/s within the basin.

(...contd)

Table 10.3.1 Population by Sub-area (1996) (cont'n)

Province / Amphoe	Main River (Upper Part, R1-R2)						Main River (Middle Part, R2-R3)						Main River (Lower Part, R3-R4)						Total Population	Municipalities (Urban)			Sanitary Districts (Sub-urban)	Rural Community
	Total Population	Class A	Class B	Class C	Class C'	Rural Community	Total Population	Class A	Class B	Class C	Class C'	Rural Community	Total Population	Class A	Class B	Class C	Class C'	Rural Community		Class A	Class B	Class C		
	Sub-area C2																							
Chai Nat	67,904	0	0	0	6,373	61,531	0	0	0	0	0	0	0	0	0	0	0	0	154,690	0	15,977	0	12,762	125,941
** Muang Chai Nat	13,957	0	0	0	0	13,957	0	0	0	0	0	0	0	0	0	0	0	0	48,013	0	15,977	0	0	32,036
* Sankhaburi	4,180	0	0	0	0	4,180	0	0	0	0	0	0	0	0	0	0	0	0	51,775	0	0	0	8,389	43,386
* Sanphaya	49,767	0	0	0	6,373	43,394	0	0	0	0	0	0	0	0	0	0	0	0	54,902	0	0	0	6,373	48,529
	Sub-area C3																							
Sing Buri	118,576	0	25,085	0	16,149	77,342	0	0	0	0	0	0	0	0	0	0	0	0	244,689	0	25,085	0	53,633	165,971
** Muang Sing Buri	43,547	0	25,085	0	0	18,462	0	0	0	0	0	0	0	0	0	0	0	0	58,326	0	25,085	0	0	33,241
* Khai Bang Rachan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32,406	0	0	0	3,766	28,640
* Tha Chang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16,571	0	0	0	11,077	5,494
* Bang Rachan	1,229	0	0	0	0	1,229	0	0	0	0	0	0	0	0	0	0	0	0	42,460	0	0	0	22,641	19,819
* Phrom Buri	22,715	0	0	0	7,610	15,106	0	0	0	0	0	0	0	0	0	0	0	0	25,130	0	0	0	7,610	17,520
* In Buri	51,084	0	0	0	8,539	42,545	0	0	0	0	0	0	0	0	0	0	0	0	69,796	0	0	0	8,539	61,257
	Sub-area C4																							
Lop Buri	9,590	0	0	0	0	9,590	0	0	0	0	0	0	0	0	0	0	0	0	325,644	0	40,036	0	25,502	260,306
** Muang Lop Buri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	241,990	0	40,036	0	20,502	181,442
Khok Samrong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	800	0	0	0	0	800
* Tha Wung	9,590	0	0	0	0	9,590	0	0	0	0	0	0	0	0	0	0	0	0	56,984	0	0	0	5,000	51,984
Ban Mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26,200	0	0	0	0	26,200
	Sub-area C5																							
Ang Thong	77,668	0	23,413	0	12,773	41,482	0	0	0	0	0	0	0	0	0	0	0	0	266,821	0	23,413	0	53,253	190,155
** Muang Ang Thong	33,021	0	11,782	0	0	21,239	0	0	0	0	0	0	0	0	0	0	0	0	48,547	0	11,782	0	0	36,765
* Chaiyo	22,381	0	0	0	12,773	9,608	0	0	0	0	0	0	0	0	0	0	0	0	22,381	0	0	0	12,773	9,608
** Pa Mok	22,266	0	11,631	0	0	10,635	0	0	0	0	0	0	0	0	0	0	0	0	28,913	0	11,631	0	0	17,282
* Pho Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58,572	0	0	0	7,012	51,560
* Wiset Chai Chan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80,452	0	0	0	22,461	57,991
* Samko	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,692	0	0	0	7,204	3,488
* Sawaengha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37,284	0	0	0	3,803	33,481
	Sub-area C6						Sub-area C7						Sub-area C8											
Ayutthaya	128,931	83,138	0	0	0	45,793	65,971	0	0	0	14,680	51,291	81,389	0	0	0	4,031	77,358	575,221	83,138	5,432	10,057	151,664	324,930
** Muang Ayutthaya	92,796	83,138	0	0	0	9,660	12,396	0	0	0	0	12,396	0	0	0	0	0	0	190,757	83,138	0	0	12,780	94,839
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53,740	0	0	10,057	19,061	24,622
* Nakhon Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	35,949	0	0	0	8,532	27,417
* Bang Sai	0	0	0	0	0	0	0	0	0	0	0	0	4,756	0	0	0	0	4,756	16,269	0	0	0	6,289	9,980
* Bang Sahl	0	0	0	0	0	0	182	0	0	0	0	182	20,381	0	0	0	0	20,381	45,229	0	0	0	12,341	32,888
* Bang Ban	12,190	0	0	0	0	12,190	5,874	0	0	0	0	5,874	0	0	0	0	0	0	34,826	0	0	0	12,149	22,677
* Bang Pahan	14,955	0	0	0	0	14,955	0	0	0	0	0	0	0	0	0	0	0	0	37,948	0	0	0	7,956	29,992
* Bang Pa-In	0	0	0	0	0	0	47,049	0	0	0	14,680	32,369	12,426	0	0	0	4,031	8,395	56,475	0	0	0	18,711	40,764
* Ban Phraek	1,997	0	0	0	0	1,997	0	0	0	0	0	0	0	0	0	0	0	0	9,152	0	0	0	2,613	6,539
* Phak Hai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	44,066	0	0	0	24,988	19,078
* Maha Rat	6,991	0	0	0	0	6,991	0	0	0	0	0	0	0	0	0	0	0	0	24,103	0	0	0	2,971	21,132
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	22,723	0	0	0	0	22,723	22,723	0	0	0	0	22,723
** Sena	0	0	0	0	0	0	0	0	0	0	0	0	21,103	0	0	0	0	21,103	60,494	0	5,432	0	23,273	31,789
Uthai	0	0	0	0	0	0	470	0	0	0	0	470	0	0	0	0	0	0	470	0	0	0	0	470
													Sub-area C9											
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	326,008	143,928	0	0	20,828	161,352	326,008	143,928	0	0	20,828	161,352
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	110,433	21,104	0	0	5,872	83,457	110,433	21,104	0	0	5,872	83,457
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	43,848	0	0	0	8,729	35,119	43,848	0	0	0	8,729	35,119
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	39,752	0	0	0	6,227	33,525	39,752	0	0	0	6,227	33,525
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	42,996	42,996	0	0	0	0	42,996	42,996	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	27,922	27,922	0	0	0	0	27,922	27,922	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	61,057	51,816	0	0	0	9,251	61,057	51,816	0	0	0	9,251
													Sub-area C10											
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	553,429	411,060	0	0	0	142,369	553,429	411,060	0	0	0	142,369
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	252,632	231,409	0	0	0	21,223	252,632	231,409	0	0	0	21,223
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	10,216	0	0	0	0	10,216	10,216	0	0	0	0	10,216
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	79,203	52,607	0	0	0	26,596	79,203	52,607	0	0	0	26,596
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	211,378	127,064	0	0	0	84,314	211,378	127,064	0	0	0	84,314
Saraburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29,724	0	0	0	0	29,724
Don Phurt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,006	0	0	0	0	5,006
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,350	0	0	0	0	15,350
Nong Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,368	0	0	0	0	9,368
Total	402,668	83,138	48,498	0	35,295	235,738	65,971	0	0	0	14,680	51,291	960,826	554,908	0	0	24,859	381,058	2,476,416	638,046	109,943	10,057	317,642	1,400,728

Note: "*" refers to Amphoes that have a municipality within the basin.
"**" refers to Amphoes that have sanitary district/s within the basin.

Table 10.3.2 Population by Sub-area (2001)

Province / Amphoe	Noi River						Lop Buri River						Pasak River						Main River (Upper Up. Part, R0-R1)					
	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y	Total Population	Class A	Class B	Class C	Class C'	Rural Commu'y
	Sub-area N1																		Sub-area C1					
Chai Nat	62,908	0	0	0	6,663	55,945	0	0	0	0	0	0	0	0	0	0	0	0	27,334	0	17,203	0	0	10,131
** Muang Chai Nat	7,681	0	0	0	0	7,681	0	0	0	0	0	0	0	0	0	0	0	0	27,334	0	17,203	0	0	10,131
* Sankhaburi	49,597	0	0	0	6,663	42,934	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sanphaya	5,330	0	0	0	0	5,330	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N2						Sub-area L1																	
Sing Buri	110,008	0	0	0	39,445	70,563	24,571	0	0	0	0	24,571	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Sing Buri	10,583	0	0	0	0	10,583	5,139	0	0	0	0	5,139	0	0	0	0	0	0	0	0	0	0	0	0
* Khai Bang Rachan	34,758	0	0	0	3,754	31,004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Chang	17,193	0	0	0	11,593	5,600	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Rachan	44,723	0	0	0	24,098	20,625	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Phrom Buri	2,335	0	0	0	0	2,335	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* In Buri	416	0	0	0	0	416	19,432	0	0	0	0	19,432	0	0	0	0	0	0	0	0	0	0	0	0
							Sub-area L2																	
Lop Buri	0	0	0	0	0	0	363,193	0	42,918	0	24,906	295,369	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Lop Buri	0	0	0	0	0	0	280,723	0	42,918	0	19,976	217,829	0	0	0	0	0	0	0	0	0	0	0	0
Khok Samrong	0	0	0	0	0	0	572	0	0	0	0	572	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Wung	0	0	0	0	0	0	52,081	0	0	0	4,930	47,151	0	0	0	0	0	0	0	0	0	0	0	0
Ban Mi	0	0	0	0	0	0	29,817	0	0	0	0	29,817	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N3																							
Ang Thong	195,963	0	0	0	42,702	153,261	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Ang Thong	15,430	0	0	0	0	15,430	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Chaiyo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Pa Mok	6,557	0	0	0	0	6,557	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pho Thong	62,062	0	0	0	6,832	55,230	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Wiset Chai Chan	81,340	0	0	0	24,035	37,305	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Samko	11,398	0	0	0	8,129	3,269	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sawaengha	39,178	0	0	0	3,706	35,470	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N4						Sub-area L4						Sub-area P2											
Ayutthaya	142,998	0	6,145	0	85,041	51,812	41,624	0	0	0	15,336	26,288	128,390	0	0	11,657	46,634	69,099	0	0	0	0	0	0
** Muang Ayutthaya	2,054	0	0	0	0	2,054	1,919	0	0	0	0	1,919	21,213	0	0	0	14,456	6,757	0	0	0	0	0	0
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	56,330	0	0	11,657	22,848	21,825	0	0	0	0	0	0
* Nakhon Luang	0	0	0	0	0	0	1,820	0	0	0	0	1,820	37,276	0	0	0	9,330	27,946	0	0	0	0	0	0
* Bang Sai	11,323	0	0	0	6,127	5,196	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Sai	25,973	0	0	0	13,422	12,551	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sang Ban	17,895	0	0	0	13,429	4,466	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Pahan	0	0	0	0	0	0	19,987	0	0	0	9,752	10,135	4,770	0	0	0	0	4,770	0	0	0	0	0	0
* Bang Pa-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Ban Phraek	0	0	0	0	0	0	7,072	0	0	0	2,546	4,526	0	0	0	0	0	0	0	0	0	0	0	0
* Phak Hai	43,258	0	0	0	25,952	17,306	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Maha Rat	0	0	0	0	0	0	10,926	0	0	0	3,038	7,888	6,801	0	0	0	0	6,801	0	0	0	0	0	0
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Sena	42,495	0	6,145	0	26,111	10,239	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uthai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							Sub-area L3						Sub-area P1											
Saraburi	0	0	0	0	0	0	2,884	0	0	0	0	2,884	26,670	0	0	0	0	26,670	0	0	0	0	0	0
Don Phunt	0	0	0	0	0	0	1,527	0	0	0	0	1,527	3,046	0	0	0	0	3,046	0	0	0	0	0	0
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	15,818	0	0	0	0	15,818	0	0	0	0	0	0
Nong Don	0	0	0	0	0	0	1,357	0	0	0	0	1,357	7,806	0	0	0	0	7,806	0	0	0	0	0	0
Total	511,577	0	6,145	0	173,851	331,581	432,272	0	42,918	0	40,242	349,112	153,060	0	0	11,657	46,634	94,769	27,334	0	17,203	0	0	10,131

Note: "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary district/s within the basin.

(...cont'd)

Table 10.3.2 Population by Sub-area (2001) (cont'n)

Province / Amphoe	Main River (Upper Part, R1-R2)						Main River (Middle Part, R2-R3)						Main River (Lower Part, R3-R4)						Total Population	Municipalities (Urban)			Sanitary Districts (Sub-urban)	Rural Commuy
	Total Population	Class A	Class B	Class C	Class C'	Rural Commuy	Total Population	Class A	Class B	Class C	Class C'	Rural Commuy	Total Population	Class A	Class B	Class C	Class C'	Rural Commuy		Class A	Class B	Class C		
	Sub-area C2																							
Chai Nat	69,992	0	0	0	5,757	63,235	0	0	0	0	0	0	0	0	0	0	0	0	156,934	0	17,203	0	13,420	129,311
** Muang Chai Nat	13,748	0	0	0	0	13,748	0	0	0	0	0	0	0	0	0	0	0	0	48,783	0	17,203	0	0	31,580
* Sankhaburi	4,354	0	0	0	0	4,354	0	0	0	0	0	0	0	0	0	0	0	0	53,951	0	0	0	5,663	47,288
* Sanphaya	51,890	0	0	0	5,757	45,133	0	0	0	0	0	0	0	0	0	0	0	0	57,220	0	0	0	6,757	50,463
	Sub-area C3																							
Sing Buri	126,290	0	28,375	0	17,175	80,740	0	0	0	0	0	0	0	0	0	0	0	0	260,869	0	28,375	0	56,620	175,874
** Muang Sing Buri	46,016	0	28,375	0	0	18,641	0	0	0	0	0	0	0	0	0	0	0	0	63,738	0	28,375	0	0	35,363
* Khai Bang Rachan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34,759	0	0	0	3,754	31,004
* Tha Chang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17,193	0	0	0	11,593	5,600
* Bang Rachan	1,364	0	0	0	0	1,364	0	0	0	0	0	0	0	0	0	0	0	0	46,087	0	0	0	24,098	21,989
* Phrom Buri	22,417	0	0	0	7,808	14,609	0	0	0	0	0	0	0	0	0	0	0	0	24,752	0	0	0	7,808	16,944
* In Buri	54,493	0	0	0	9,367	45,126	0	0	0	0	0	0	0	0	0	0	0	0	74,341	0	0	0	9,367	64,974
	Sub-area C4																							
Lop Buri	10,696	0	0	0	0	10,696	0	0	0	0	0	0	0	0	0	0	0	0	373,689	0	42,918	0	24,906	305,865
** Muang Lop Buri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	280,723	0	42,918	0	19,976	217,829
Khok Samrong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	572	0	0	0	0	572
* Tha Wung	10,696	0	0	0	0	10,696	0	0	0	0	0	0	0	0	0	0	0	0	62,777	0	0	0	4,930	57,847
Ban Mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29,817	0	0	0	0	29,817
	Sub-area C5																							
Ang Thong	79,329	0	25,387	0	14,301	39,641	0	0	0	0	0	0	0	0	0	0	0	0	275,292	0	25,387	0	57,003	192,902
** Muang Ang Thong	34,434	0	13,327	0	0	21,107	0	0	0	0	0	0	0	0	0	0	0	0	49,864	0	13,327	0	0	36,537
* Chaiyo	22,344	0	0	0	14,301	8,043	0	0	0	0	0	0	0	0	0	0	0	0	22,344	0	0	0	14,301	8,043
** Pa Mok	22,551	0	12,060	0	0	10,491	0	0	0	0	0	0	0	0	0	0	0	0	29,108	0	12,060	0	0	17,048
* Pho Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	62,062	0	0	0	6,832	55,230
* Wiset Chai Chan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61,340	0	0	0	24,035	37,305
* Samko	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,396	0	0	0	8,129	3,269
* Sawaengha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39,176	0	0	0	3,706	35,470
	Sub-area C6						Sub-area C7						Sub-area C8											
Ayutthaya	142,127	98,140	0	0	0	43,987	68,486	0	0	0	17,285	51,201	83,178	0	0	0	4,248	78,930	604,803	98,140	6,145	11,657	168,544	320,317
** Muang Ayutthaya	106,248	98,140	0	0	0	8,108	10,405	0	0	0	0	10,405	0	0	0	0	0	0	141,839	98,140	0	0	14,456	29,243
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	56,330	0	0	11,657	22,848	21,825
* Nakhon Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39,096	0	0	0	9,300	29,796
* Bang Sai	0	0	0	0	0	0	0	0	0	0	0	0	4,730	0	0	0	0	4,730	16,053	0	0	0	6,127	9,926
* Bang Sai	0	0	0	0	0	0	185	0	0	0	0	185	20,755	0	0	0	0	20,755	46,913	0	0	0	13,422	33,491
* Bang Ban	11,804	0	0	0	0	11,804	5,688	0	0	0	0	5,688	0	0	0	0	0	0	35,387	0	0	0	13,429	21,958
* Bang Pahan	14,822	0	0	0	0	14,822	0	0	0	0	0	0	0	0	0	0	0	0	39,479	0	0	0	9,752	29,727
* Bang Pa-in	0	0	0	0	0	0	51,719	0	0	0	17,285	34,434	13,179	0	0	0	4,248	8,931	64,898	0	0	0	21,533	43,365
* Ban Phraek	1,991	0	0	0	0	1,991	0	0	0	0	0	0	0	0	0	0	0	0	9,063	0	0	0	2,546	6,517
* Phak Hai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	43,258	0	0	0	25,952	17,306
* Maha Rat	7,262	0	0	0	0	7,262	0	0	0	0	0	0	0	0	0	0	0	0	24,989	0	0	0	3,038	21,951
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	24,293	0	0	0	0	24,293	24,293	0	0	0	0	24,293
** Sena	0	0	0	0	0	0	0	0	0	0	0	0	20,221	0	0	0	0	20,221	52,716	0	6,145	0	26,111	20,460
Uthai	0	0	0	0	0	0	489	0	0	0	0	489	0	0	0	0	0	0	489	0	0	0	0	489
													Sub-area C9											
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	372,455	162,102	0	0	22,740	187,613	372,455	162,102	0	0	22,740	187,613
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	130,632	24,910	0	0	6,604	99,028	130,632	24,910	0	0	6,604	99,028
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	48,401	0	0	0	9,079	39,322	48,401	0	0	0	9,079	39,322
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	43,981	0	0	0	6,967	37,014	43,981	0	0	0	5,967	37,014
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	49,075	49,075	0	0	0	0	49,075	49,075	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	31,170	31,170	0	0	0	0	31,170	31,170	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	69,196	56,947	0	0	0	12,249	69,196	56,947	0	0	0	12,249
													Sub-area C10											
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	714,281	507,268	0	0	0	207,013	714,281	507,268	0	0	0	207,013
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	329,631	296,470	0	0	0	33,161	329,631	296,470	0	0	0	33,161
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	11,306	0	0	0	0	11,306	11,306	0	0	0	0	11,306
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	95,127	60,396	0	0	0	34,731	95,127	60,396	0	0	0	34,731
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	278,217	150,402	0	0	0	127,815	278,217	150,402	0	0	0	127,815
Saraburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29,554	0	0	0	0	29,554
Don Phunt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,573	0	0	0	0	4,573
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,818	0	0	0	0	15,818
Nong Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,163	0	0	0	0	9,163
Total	428,434	99,140	53,762	0	38,233	236,299	68,486	0	0	0	17,285	51,201	1,169,914	669,370	0	0	26,988	473,556	2,791,077	767,510	120,029	11,657	343,233	1,548,649

Note: "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary district/s within the basin

Table 10.3.3 Population by Sub-area (2011)

Province / Amphoe	Noi River						Lop Buri River						Pasak River						Main River (Upper Up. Part, R0-R1)					
	Total Population	Class A	Class B	Class C	Class C'	Rural Commuy	Total Population	Class A	Class B	Class C	Class C'	Rural Commuy	Total Population	Class A	Class B	Class C	Class C'	Rural Commuy	Total Population	Class A	Class B	Class C	Class C'	Rural Commuy
	Sub-area N1																		Sub-area C1					
Chai Nat	64,740	0	0	0	7,184	57,556	0	0	0	0	0	0	0	0	0	0	0	0	29,898	0	19,765	0	0	10,133
** Muang Chai Nat	7,692	0	0	0	0	7,692	0	0	0	0	0	0	0	0	0	0	0	0	29,898	0	19,765	0	0	10,133
* Sankhaburi	51,576	0	0	0	7,184	44,392	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sanphaya	5,482	0	0	0	0	5,482	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N2						Sub-area L1																	
Sing Buri	122,559	0	0	0	43,349	79,210	26,859	0	0	0	0	26,859	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Sing Buri	11,475	0	0	0	0	11,475	5,573	0	0	0	0	5,573	0	0	0	0	0	0	0	0	0	0	0	0
* Khai Bang Rachan	39,043	0	0	0	3,698	35,345	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Chang	18,074	0	0	0	12,592	5,482	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Rachan	51,403	0	0	0	27,059	24,344	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Phrom Buri	2,109	0	0	0	0	2,109	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* In Buri	456	0	0	0	0	456	21,286	0	0	0	0	21,286	0	0	0	0	0	0	0	0	0	0	0	0
							Sub-area L2																	
Lop Buri	0	0	0	0	0	0	461,381	0	49,320	0	23,546	388,515	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Lop Buri	0	0	0	0	0	0	363,651	0	49,320	0	18,792	295,539	0	0	0	0	0	0	0	0	0	0	0	0
Khok Samrong	0	0	0	0	0	0	148	0	0	0	0	148	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Wung	0	0	0	0	0	0	60,656	0	0	0	4,754	55,901	0	0	0	0	0	0	0	0	0	0	0	0
Ban Mi	0	0	0	0	0	0	36,927	0	0	0	0	36,927	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N3																							
Ang Thong	205,726	0	0	0	48,004	157,722	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Ang Thong	14,590	0	0	0	0	14,590	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Chaiyo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Pa Mok	6,145	0	0	0	0	6,145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pho Thong	68,109	0	0	0	6,428	51,681	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Wiset Chai Chan	61,915	0	0	0	27,831	34,084	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Samko	12,560	0	0	0	10,260	2,400	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sawaengha	42,317	0	0	0	3,485	38,832	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sub-area N4						Sub-area L4						Sub-area P2											
Ayutthaya	149,429	0	7,790	0	98,121	43,518	44,644	0	0	0	20,070	24,574	135,310	0	0	15,519	61,921	57,870	0	0	0	0	0	0
** Muang Ayutthaya	630	0	0	0	0	630	588	0	0	0	0	588	20,399	0	0	0	18,327	2,072	0	0	0	0	0	0
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	60,380	0	0	15,519	32,529	12,332	0	0	0	0	0	0
* Nakhon Luang	0	0	0	0	0	0	2,082	0	0	0	0	2,082	43,030	0	0	0	11,065	31,965	0	0	0	0	0	0
* Bang Sai	10,737	0	0	0	5,764	4,973	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Sai	28,289	0	0	0	15,732	12,557	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Ban	20,212	0	0	0	16,271	3,941	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Pahan	0	0	0	0	0	0	23,784	0	0	0	14,524	9,260	4,356	0	0	0	0	4,356	0	0	0	0	0	0
* Bang Pa-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Ban Phraek	0	0	0	0	0	0	6,754	0	0	0	2,395	4,359	0	0	0	0	0	0	0	0	0	0	0	0
* Phak Hai	40,631	0	0	0	27,761	12,870	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Maha Rat	0	0	0	0	0	0	11,436	0	0	0	3,151	8,285	7,143	0	0	0	0	7,143	0	0	0	0	0	0
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Sena	46,930	0	7,790	0	32,593	6,547	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uthai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
							Sub-area L3						Sub-area P1											
Saraburi	0	0	0	0	0	0	2,272	0	0	0	0	2,272	23,669	0	0	0	0	23,669	0	0	0	0	0	0
Don Phut	0	0	0	0	0	0	1,125	0	0	0	0	1,125	2,245	0	0	0	0	2,245	0	0	0	0	0	0
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	14,830	0	0	0	0	14,830	0	0	0	0	0	0
Nong Don	0	0	0	0	0	0	1,147	0	0	0	0	1,147	6,594	0	0	0	0	6,594	0	0	0	0	0	0
Total	542,454	0	7,790	0	196,656	336,006	535,156	0	49,320	0	43,616	442,220	159,979	0	0	15,519	61,921	61,539	29,898	0	19,765	0	0	10,133

Note: "*" refers to Amphoes that have a municipality within the basin.
" " refers to Amphoes that have sanitary district/s within the basin.

(....cont'd)

Table 10.3.3 Population by Sub-area (2011) (cont'n)

Province / Amphoe	Main River (Upper Part, R1~R2)						Main River (Middle Part, R2~R3)						Main River (Lower Part, R3~R4)						Total Population	Municipalities (Urban)			Sanitary Districts (Sub-urban)	Rural Community
	Total Population	Class A	Class B	Class C	Class C'	Rural Community	Total Population	Class A	Class B	Class C	Class C'	Rural Community	Total Population	Class A	Class B	Class C	Class C'	Rural Community		Class A	Class B	Class C		
	Sub-area C2																							
Chai Nat	72,209	0	0	0	7,536	64,673	0	0	0	0	0	0	0	0	0	0	0	0	168,847	0	19,765	0	14,720	132,362
** Muang Chai Nat	13,752	0	0	0	0	13,752	0	0	0	0	0	0	0	0	0	0	0	0	51,332	0	19,765	0	0	31,567
* Sankhaburi	4,503	0	0	0	0	4,503	0	0	0	0	0	0	0	0	0	0	0	0	58,079	0	0	0	7,184	43,895
* Sanphaya	53,954	0	0	0	7,536	46,418	0	0	0	0	0	0	0	0	0	0	0	0	59,436	0	0	0	7,536	51,900
	Sub-area C3																							
Sing Buri	140,821	0	35,973	0	19,320	85,528	0	0	0	0	0	0	0	0	0	0	0	0	290,239	0	35,973	0	52,669	191,597
** Muang Sing Buri	57,270	0	35,973	0	0	21,297	0	0	0	0	0	0	0	0	0	0	0	0	74,318	0	35,973	0	0	38,345
* Khai Bang Rachan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39,043	0	0	0	3,698	35,345
* Bang Rachan	1,610	0	0	0	0	1,610	0	0	0	0	0	0	0	0	0	0	0	0	18,074	0	0	0	12,592	5,482
* Phrom Buri	21,337	0	0	0	8,148	13,189	0	0	0	0	0	0	0	0	0	0	0	0	53,013	0	0	0	27,059	25,954
* In Buri	60,604	0	0	0	11,172	49,432	0	0	0	0	0	0	0	0	0	0	0	0	23,445	0	0	0	8,148	15,297
																			82,346	0	0	0	11,172	71,174
	Sub-area C4																							
Lop Buri	12,682	0	0	0	0	12,682	0	0	0	0	0	0	0	0	0	0	0	0	474,063	0	49,320	0	23,546	401,197
** Muang Lop Buri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	363,651	0	49,320	0	18,792	295,539
Khok Samrong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	148	0	0	0	0	148
* Tha Wung	12,682	0	0	0	0	12,682	0	0	0	0	0	0	0	0	0	0	0	0	73,337	0	0	0	4,754	68,583
Ban Mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	36,927	0	0	0	0	36,927
	Sub-area C5																							
Ang Thong	61,293	0	29,753	0	17,806	33,734	0	0	0	0	0	0	0	0	0	0	0	0	287,019	0	29,753	0	65,810	191,456
** Muang Ang Thong	36,840	0	16,896	0	0	19,944	0	0	0	0	0	0	0	0	0	0	0	0	51,420	0	16,896	0	0	34,524
* Chaiyo	21,764	0	0	0	17,806	3,958	0	0	0	0	0	0	0	0	0	0	0	0	21,764	0	0	0	17,806	3,958
** Pa Mok	22,689	0	12,857	0	0	9,832	0	0	0	0	0	0	0	0	0	0	0	0	29,834	0	12,857	0	0	15,977
* Pho Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68,109	0	0	0	6,428	61,681
* Wiset Chai Chan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	61,915	0	0	0	27,831	34,084
* Samko	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,660	0	0	0	10,260	2,400
* Sawaengha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42,317	0	0	0	3,485	38,832
	Sub-area C6						Sub-area C7						Sub-area C8											
Ayutthaya	171,517	135,531	0	0	0	35,986	70,081	0	0	0	23,785	46,296	83,575	0	0	0	4,675	79,900	654,556	135,531	7,790	15,519	208,572	287,144
** Muang Ayutthaya	138,017	135,531	0	0	0	2,486	3,190	0	0	0	0	3,190	0	0	0	0	0	0	162,824	135,531	0	0	18,327	8,966
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	60,380	0	0	15,519	32,529	12,332
* Nakhon Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	45,112	0	0	0	11,065	34,047
* Bang Sai	0	0	0	0	0	0	0	0	0	0	0	0	4,528	0	0	0	0	4,528	15,285	0	0	0	5,784	9,501
* Bang Sai	0	0	0	0	0	0	185	0	0	0	0	185	20,765	0	0	0	0	20,765	49,239	0	0	0	15,732	33,507
* Bang Pahan	10,414	0	0	0	0	10,414	5,018	0	0	0	0	5,018	0	0	0	0	0	0	35,644	0	0	0	16,271	19,373
* Bang Pa-In	13,542	0	0	0	0	13,542	0	0	0	0	0	0	0	0	0	0	0	0	41,684	0	0	0	14,524	27,160
* Ban Phraek	0	0	0	0	0	0	61,175	0	0	0	23,785	37,390	14,372	0	0	0	4,675	9,697	75,547	0	0	0	29,460	47,087
* Phak Hai	1,917	0	0	0	0	1,917	0	0	0	0	0	0	0	0	0	0	0	0	8,671	0	0	0	2,395	6,276
* Maha Rat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	40,531	0	0	0	27,761	12,770
* Lat Bua Luang	7,627	0	0	0	0	7,627	0	0	0	0	0	0	0	0	0	0	0	0	26,206	0	0	0	3,151	23,055
** Sena	0	0	0	0	0	0	0	0	0	0	0	0	27,029	0	0	0	0	27,029	27,029	0	0	0	0	27,029
Uthai	0	0	0	0	0	0	513	0	0	0	0	513	16,881	0	0	0	0	16,881	65,811	0	7,790	0	32,593	25,428
																			513	0	0	0	0	513
													Sub-area C9											
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	477,017	192,678	0	0	26,077	258,262	477,017	192,678	0	0	26,077	258,262
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	182,792	32,521	0	0	8,034	142,237	182,792	32,521	0	0	8,034	142,237
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	58,972	0	0	0	9,832	49,140	58,972	0	0	0	9,832	49,140
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	53,836	0	0	0	8,211	45,625	53,836	0	0	0	8,211	45,625
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	58,478	58,478	0	0	0	0	58,478	58,478	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	36,326	36,326	0	0	0	0	36,326	36,326	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	86,613	65,353	0	0	0	21,260	86,613	65,353	0	0	0	21,260
													Sub-area C10											
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	1,192,934	776,941	0	0	0	415,993	1,192,934	776,941	0	0	0	415,993
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	559,451	486,610	0	0	0	72,841	559,451	486,610	0	0	0	72,841
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	14,177	0	0	0	0	14,177	14,177	0	0	0	0	14,177
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	137,225	79,604	0	0	0	57,621	137,225	79,604	0	0	0	57,621
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	481,981	210,727	0	0	0	271,254	481,981	210,727	0	0	0	271,254
Saraburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25,941	0	0	0	0	25,941
Don Phut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,370	0	0	0	0	3,370
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,830	0	0	0	0	14,830
Nong Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,741	0	0	0	0	7,741
Total	478,522	135,531	65,726	0	44,662	232,603	70,081	0	0	0	23,785	46,296	1,753,428	969,619	0	0	30,752	753,055	3,568,516	1,105,150	142,601	15,519	401,394	1,903,852

Note: "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary district/s within the basin.

Table 10.3.4 Generated BOD Load by Sub-area (1996)

Water Quality Checking Point	Sub-area Code	Generated BOD Load (kg/day)													
		Domestic				Factory	Livestock				Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
		Urban	Sub-urban	Rural	Total		Buffaloes	Cattle	Swine	Total					
R1	C1	965	0	549	1,514	1,680	302	742	147	1,191	114	40	10	26	4,575
R2	C2	0	359	3,285	3,644	893	1,697	4,172	825	6,694	0	0	45	144	11,420
	C3	1,495	909	4,131	6,535	8,115	546	12,277	1,536	14,359	39	40	32	185	29,305
	C4	0	0	512	512	0	54	850	115	1,019	0	0	3	22	1,556
	C5	1,389	719	2,215	4,323	5,443	569	4,862	2,235	7,666	219	80	26	94	17,851
	C6	5,529	0	2,446	7,975	19,295	971	1,954	1,173	4,098	558	40	38	109	32,113
	Total	8,413	1,987	12,589	22,989	33,746	3,837	24,115	5,884	33,836	816	160	144	554	92,245
R3	C7	0	826	2,740	3,566	2,577	1,013	2,038	1,224	4,275	0	0	23	114	10,555
	N1	0	360	2,890	3,250	499	1,674	4,114	813	6,601	0	0	56	142	10,548
	N2	0	2,111	3,496	5,607	1,854	509	11,443	1,432	13,384	0	0	49	172	21,066
	N3	0	2,280	7,939	10,219	2,183	2,131	18,207	8,368	28,706	0	0	94	351	41,553
	N4	331	4,450	2,905	7,686	8,699	2,042	4,106	2,466	8,614	36	40	681	229	25,985
	N ST.	331	9,201	17,230	26,762	13,235	6,356	37,870	13,079	57,305	36	40	880	894	99,152
	P1	0	0	1,424	1,424	0	365	1,785	1,243	3,393	0	0	0	80	4,897
	P2	567	2,273	3,727	6,567	15,505	1,696	3,411	2,048	7,155	67	40	35	190	29,559
	P ST.	567	2,273	5,151	7,991	15,505	2,061	5,196	3,291	10,548	67	40	35	270	34,456
	L1	0	0	1,236	1,236	900	161	3,608	452	4,221	0	0	6	54	6,417
	L2	2,522	1,436	13,388	17,346	6,490	1,007	15,759	2,122	18,888	199	40	64	403	43,430
	L3	0	0	163	163	0	59	288	201	548	0	0	0	13	724
	L4	0	762	1,407	2,169	475	628	1,264	759	2,651	0	0	38	71	5,404
	L ST.	2,522	2,198	16,194	20,914	7,865	1,855	20,919	3,534	26,308	199	40	108	541	55,975
	Total	3,420	14,498	41,315	59,233	39,182	11,285	66,023	21,128	98,436	302	120	1,046	1,819	200,138
R4	C8	0	227	4,130	4,357	4,388	2,149	4,322	2,596	9,067	0	0	561	241	18,614
	C9	9,048	1,173	8,616	18,837	31,415	2,097	2,973	3,774	8,844	1,423	40	655	486	61,700
	C10	26,227	0	7,601	33,828	17,984	563	1,013	528	2,104	448	120	202	274	54,960
	Total	35,275	1,400	20,347	57,022	53,787	4,809	8,308	6,898	20,015	1,871	160	1,418	1,001	135,274
GRAND TOTAL		48,073	17,885	74,800	140,758	128,395	20,233	99,188	34,057	153,478	3,103	480	2,618	3,400	432,232

Table 10.3.5 Generated BOD Load by Sub-area (2001)

Water Quality Checking Point	Sub-area Code	Generated BOD Load (kg/day)													
		Domestic				Factory	Livestock				Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
		Urban	Sub-urban	Rural	Total		Buffaloes	Cattle	Swine	Total					
R1	C1	1,061	0	546	1,607	2,539	311	776	141	1,228	118	40	10	26	5,568
R2	C2	0	387	3,409	3,796	1,277	1,749	4,366	792	6,907	0	0	45	144	12,169
	C3	1,737	984	4,352	7,073	11,971	460	14,692	1,285	16,437	33	40	32	185	35,771
	C4	0	0	577	577	0	45	921	111	1,077	0	0	3	22	1,679
	C5	1,551	819	2,137	4,507	7,685	470	5,307	2,838	8,615	245	80	26	94	21,252
	C6	6,605	0	2,370	8,975	29,272	769	2,019	1,404	4,192	664	40	38	109	43,290
	Total	9,893	2,190	12,845	24,928	50,205	3,493	27,305	6,430	37,228	942	160	144	554	114,161
R3	C7	0	990	2,760	3,750	2,867	803	2,106	1,464	4,373	0	0	23	114	11,127
	N1	0	382	3,015	3,397	714	1,725	4,306	781	6,812	0	0	56	142	11,121
	N2	0	2,260	3,803	6,063	2,639	429	13,694	1,198	15,321	0	0	49	172	24,244
	N3	0	2,446	8,261	10,707	2,965	1,760	19,875	10,626	32,261	0	0	94	351	46,378
	N4	382	4,872	2,793	8,047	12,273	1,617	4,244	2,950	8,811	42	40	681	229	30,123
	N ST.	382	9,960	17,872	28,214	18,591	5,531	42,119	15,555	63,205	42	40	880	894	111,866
	P1	0	0	1,438	1,438	0	304	1,742	1,487	3,533	0	0	0	80	5,051
	P2	669	2,672	3,670	7,011	21,363	1,343	3,525	2,450	7,318	79	40	35	190	36,036
	P ST.	669	2,672	5,108	8,449	21,363	1,647	5,267	3,937	10,851	79	40	35	270	41,087
	L1	0	0	1,324	1,324	1,281	135	4,318	378	4,831	0	0	6	54	7,496
	L2	2,725	1,427	15,920	20,072	9,737	840	17,073	2,054	19,967	191	40	64	403	50,474
	L3	0	0	155	155	0	49	281	240	570	0	0	0	13	738
	L4	0	879	1,416	2,295	529	498	1,306	908	2,712	0	0	38	71	5,645
	L ST.	2,725	2,306	18,815	23,846	11,547	1,522	22,978	3,580	28,080	191	40	108	541	64,353
	Total	3,776	15,928	44,555	64,259	54,368	9,503	72,470	24,536	106,509	312	120	1,046	1,819	228,433
R4	C8	0	243	4,254	4,497	5,571	1,702	4,467	3,105	9,274	0	0	561	241	20,144
	C9	10,545	1,303	10,112	21,960	33,997	2,729	3,543	4,518	10,790	1,374	40	655	486	69,302
	C10	33,327	0	11,157	44,484	19,461	675	1,041	624	2,340	466	120	202	274	67,347
	Total	43,872	1,546	25,523	70,941	59,029	5,106	9,051	8,247	22,404	1,840	160	1,418	1,001	156,793
GRAND TOTAL		58,602	19,664	83,469	161,735	166,141	18,413	109,602	39,354	167,369	3,212	480	2,618	3,400	504,955

Table 10.3.6 Generated BOD Load by Sub-area (2011)

Water Quality Checking Point	Sub-area Code	Generated BOD Load (kg/day)													
		Domestic				Factory	Livestock				Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
		Urban	Sub-urban	Rural	Total		Buffaloes	Cattle	Swine	Total					
R1	C1	1,275	0	556	1,831	4,433	332	845	130	1,307	132	40	10	26	7,779
R2	C2	0	450	3,550	4,000	2,039	1,869	4,755	729	7,353	0	0	45	144	13,581
	C3	2,320	1,153	4,695	8,168	20,359	374	17,653	1,078	19,105	28	40	32	185	47,917
	C4	0	0	696	696	0	38	1,064	104	1,206	0	0	3	22	1,927
	C5	1,919	1,063	1,852	4,834	12,634	396	6,186	3,603	10,185	299	80	26	94	28,152
	C6	9,365	0	1,975	11,340	55,125	644	2,150	1,685	4,479	820	40	38	109	71,951
	Total	13,604	2,666	12,768	29,038	90,157	3,321	31,808	7,199	42,328	1,147	160	144	554	163,528
R3	C7	0	1,420	2,541	3,961	1,274	672	2,243	1,758	4,673	0	0	23	114	10,045
	N1	0	429	3,160	3,589	1,139	1,843	4,689	719	7,251	0	0	56	142	12,177
	N2	0	2,588	4,348	6,936	4,079	348	16,454	1,005	17,807	0	0	49	172	29,043
	N3	0	2,867	8,658	11,525	4,398	1,482	23,164	13,493	38,139	0	0	94	351	54,507
	N4	502	5,857	2,389	8,748	19,795	1,353	4,519	3,541	9,413	47	40	681	229	38,953
	N ST.	502	11,741	18,555	30,798	29,411	5,026	48,826	18,758	72,610	47	40	880	894	134,680
	P1	0	0	1,299	1,299	0	255	1,656	1,785	3,696	0	0	0	80	5,075
	P2	926	3,697	3,177	7,800	32,264	1,124	3,754	2,942	7,820	94	40	35	190	48,243
	P ST.	926	3,697	4,476	9,099	32,264	1,379	5,410	4,727	11,516	94	40	35	270	53,318
	L1	0	0	1,475	1,475	1,981	110	5,189	317	5,616	0	0	6	54	9,132
	L2	3,181	1,406	21,329	25,916	16,878	699	19,711	1,919	22,329	179	40	64	403	65,809
	L3	0	0	125	125	0	41	267	288	596	0	0	0	13	734
	L4	0	1,198	1,348	2,546	235	417	1,391	1,090	2,898	0	0	38	71	5,788
	L ST.	3,181	2,604	24,277	30,062	19,094	1,267	26,558	3,614	31,439	179	40	108	541	81,463
	Total	4,609	19,462	49,849	73,920	82,043	8,344	83,037	28,857	120,238	320	120	1,046	1,819	279,506
R4	C8	0	279	4,332	4,611	6,742	1,425	4,757	3,728	9,910	0	0	561	241	22,065
	C9	13,314	1,557	14,179	29,050	50,436	3,217	4,256	5,422	12,895	1,348	40	655	486	94,910
	C10	53,687	0	22,832	76,519	28,864	900	1,154	747	2,801	529	120	202	274	109,309
	Total	67,001	1,836	41,343	110,180	86,042	5,542	10,167	9,897	25,606	1,877	160	1,418	1,001	226,284
GRAND TOTAL		86,489	23,964	104,516	214,969	262,675	17,539	125,857	46,083	189,479	3,476	480	2,618	3,400	677,097

Table 10.3.7 Discharged BOD Load by Sub-area (1996)

Water Quality Checking Point	Sub-area Code	Discharged BOD Load (kg/day)									
		Domestic			Factory	Live-stock	Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
		Urban	Suburban	Rural							
R1	C1	877	0	493	852	73	8	40	10	26	2,379
R2	C2	0	324	2,948	453	412	0	0	45	144	4,326
	C3	1,357	824	3,705	4,123	768	3	40	32	185	11,037
	C4	0	0	459	0	57	0	0	3	22	541
	C5	1,260	649	1,986	2,818	1,117	16	80	26	94	8,046
	C6	5,071	0	2,194	9,946	587	41	40	38	109	18,026
	Total	7,688	1,797	11,292	17,340	2,941	60	160	144	554	41,976
R3	C7	0	746	2,457	1,329	612	0	0	23	114	5,281
	N1	0	325	2,592	253	407	0	0	56	142	3,775
	N2	0	1,904	3,137	942	716	0	0	49	172	6,920
	N3	0	2,056	7,122	1,130	4,184	0	0	94	351	14,937
	N4	301	4,014	2,605	4,484	1,233	3	40	681	229	13,590
	N ST.	301	8,299	15,456	6,809	6,540	3	40	880	894	39,222
	P1	0	0	1,277	0	622	0	0	0	80	1,979
	P2	512	2,050	3,342	7,993	1,024	5	40	35	190	15,191
	P ST.	512	2,050	4,619	7,993	1,646	5	40	35	270	17,170
	L1	0	0	1,109	457	226	0	0	6	54	1,852
	L2	2,302	1,296	12,009	3,305	1,061	14	40	64	403	20,494
	L3	0	0	146	0	100	0	0	0	13	259
	L4	0	688	1,261	245	379	0	0	38	71	2,682
	L ST.	2,302	1,984	14,525	4,007	1,766	14	40	108	541	25,287
	Total	3,115	13,079	37,057	20,138	10,564	22	120	1,046	1,819	86,960
R4	C8	0	205	3,705	2,262	1,298	0	0	561	241	8,272
	C9	8,258	1,057	7,729	16,572	1,887	104	40	655	486	36,788
	C10	23,966	0	6,819	9,494	264	33	120	202	274	41,172
	Total	32,224	1,262	18,253	28,328	3,449	137	160	1,418	1,001	86,232
GRAND TOTAL		43,904	16,138	67,095	66,658	17,027	227	480	2,618	3,400	217,547

Table 10.3.8 Discharged BOD Load by Sub-area (2001)

Water Quality Checking Point	Sub-area Code	Discharged BOD Load (kg/day)									
		Domestic			Factory	Live-stock	Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
		Urban	Suburban	Rural							
R1	C1	967	0	490	1,289	70	9	40	10	26	2,901
R2	C2	0	350	3,060	648	396	0	0	45	144	4,643
	C3	1,580	889	3,908	6,081	642	2	40	32	185	13,359
	C4	0	0	518	0	55	0	0	3	22	598
	C5	1,411	741	1,919	3,979	1,419	18	80	26	94	9,687
	C6	6,065	0	2,127	15,094	702	48	40	38	109	24,223
	Total	9,056	1,980	11,532	25,802	3,214	68	160	144	554	52,510
R3	C7	0	895	2,479	1,478	732	0	0	23	114	5,721
	N1	0	345	2,708	362	391	0	0	56	142	4,004
	N2	0	2,043	3,415	1,340	599	0	0	49	172	7,618
	N3	0	2,212	7,418	1,535	5,313	0	0	94	351	16,923
	N4	348	4,405	2,507	6,329	1,475	3	40	681	229	16,017
	N ST.	348	9,005	16,048	9,566	7,778	3	40	880	894	44,562
	P1	0	0	1,291	0	744	0	0	0	80	2,115
	P2	605	2,416	3,296	11,016	1,225	6	40	35	190	18,829
	P ST.	605	2,416	4,587	11,016	1,969	6	40	35	270	20,944
	L1	0	0	1,190	651	189	0	0	6	54	2,090
	L2	2,489	1,290	14,296	4,958	1,027	14	40	64	403	24,581
	L3	0	0	140	0	120	0	0	0	13	273
	L4	0	794	1,273	273	454	0	0	38	71	2,903
	L ST.	2,489	2,084	16,899	5,882	1,790	14	40	108	541	29,847
	Total	3,442	14,400	40,013	27,942	12,269	23	120	1,046	1,819	101,074
R4	C8	0	220	3,821	2,873	1,553	0	0	561	241	9,269
	C9	9,653	1,178	9,080	17,972	2,259	100	40	655	486	41,423
	C10	30,537	0	10,019	10,295	312	34	120	202	274	51,793
	Total	40,190	1,398	22,920	31,140	4,124	134	160	1,418	1,001	102,485
GRAND TOTAL		53,655	17,778	74,955	86,173	19,677	234	480	2,618	3,400	258,970

Table 10.3.9 Discharged BOD Load by Sub-area (2011)

Water Quality Checking Point	Sub-area Code	Discharged BOD Load (kg/day)									
		Domestic			Factory	Live-stock	Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
		Urban	Suburban	Rural							
R1	C1	1,166	0	501	2,249	65	10	40	10	26	4,067
R2	C2	0	408	3,194	1,034	364	0	0	45	144	5,189
	C3	2,122	1,048	4,226	10,335	539	2	40	32	185	18,529
	C4	0	0	626	0	52	0	0	3	22	703
	C5	1,756	965	1,667	6,536	1,802	22	80	26	94	12,948
	C6	8,620	0	1,778	28,367	842	60	40	38	109	39,854
	Total	12,498	2,421	11,491	46,272	3,599	84	160	144	554	77,223
R3	C7	0	1,289	2,287	656	879	0	0	23	114	5,248
	N1	0	389	2,843	578	359	0	0	56	142	4,367
	N2	0	2,349	3,914	2,071	502	0	0	49	172	9,057
	N3	0	2,601	7,792	2,275	6,747	0	0	94	351	19,860
	N4	460	5,319	2,150	10,186	1,771	3	40	681	229	20,839
	N ST.	460	10,658	16,699	15,110	9,379	3	40	880	894	54,123
	P1	0	0	1,170	0	892	0	0	0	80	2,142
	P2	841	3,356	2,858	16,603	1,471	7	40	35	190	25,401
	P ST.	841	3,356	4,028	16,603	2,363	7	40	35	270	27,543
	L1	0	0	1,327	1,006	158	0	0	6	54	2,551
	L2	2,910	1,277	19,193	8,586	959	14	40	64	403	33,446
	L3	0	0	113	0	144	0	0	0	13	270
	L4	0	1,088	1,213	121	545	0	0	38	71	3,076
	L ST.	2,910	2,365	21,846	9,713	1,806	14	40	108	541	39,343
	Total	4,211	17,668	44,860	42,082	14,427	24	120	1,046	1,819	126,257
R4	C8	0	253	3,898	3,470	1,864	0	0	561	241	10,287
	C9	12,253	1,413	12,759	26,649	2,711	98	40	655	486	57,064
	C10	49,413	0	20,544	15,263	374	39	120	202	274	86,229
	Total	61,666	1,666	37,201	45,382	4,949	137	160	1,418	1,001	153,580
GRAND TOTAL		79,541	21,755	94,053	135,985	23,040	255	480	2,618	3,400	361,127

10.4 Concentrated BOD Load by Sub-area

Concentrated BOD load by different pollution source is calculated using assumed concentrated ratio presented in Section 9.5.1.

Tables 10.4.1 to 10.4.3 present calculated concentrated pollution load in the years 1996, 2001 and 2011, respectively.

Table 10.4.1 Concentrated BOD Load by Sub-area (1996)

Water Quality Checking Point	Sub-area Code	Land Use	Concentration Ratio and Concentrated BOD Load by Sub-area (kg/day)									
			Domestic			Factory	Live-stock	Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
			Urban	Suburban	Rural							
		C.Rate UCR	0.5	0.2	0.1	0.2	0.1	0.2	0.5	0.1	1.0	-
		C.Rate BMR	0.9	0.5	0.2	0.5	0.2	0.5	0.9	0.2	1.0	-
R1	C1		438.5	0.0	49.3	170.4	7.3	1.6	20.0	1.0	26.0	714.1
R2	C2		0.0	64.8	294.8	90.6	41.2	0.0	0.0	4.5	144.0	639.9
	C3		678.5	164.8	370.5	824.6	76.8	0.6	20.0	3.2	185.0	2,324.0
	C4		0.0	0.0	45.9	0.0	5.7	0.0	0.0	0.3	22.0	73.9
	C5		630.0	129.8	198.6	563.6	111.7	3.2	40.0	2.6	94.0	1,773.5
	C6		2,535.5	0.0	219.4	1,989.2	58.7	8.2	20.0	3.8	109.0	4,943.8
	Total		3,844.0	359.4	1,129.2	3,468.0	294.1	12.0	80.0	14.4	554.0	9,755.1
R3	C7		0.0	149.2	245.7	265.8	61.2	0.0	0.0	2.3	114.0	838.2
	N1		0.0	65.0	259.2	50.6	40.7	0.0	0.0	5.6	142.0	563.1
	N2		0.0	380.8	313.7	188.4	71.6	0.0	0.0	4.9	172.0	1,131.4
	N3		0.0	411.2	712.2	226.0	418.4	0.0	0.0	9.4	351.0	2,128.2
	N4		150.5	802.8	260.5	896.8	123.3	0.6	20.0	68.1	229.0	2,551.6
	N ST.		150.5	1,659.8	1,545.6	1,361.8	654.0	0.6	20.0	88.0	894.0	6,374.3
	P1		0.0	0.0	127.7	0.0	62.2	0.0	0.0	0.0	80.0	269.9
	P2		256.0	410.0	334.2	1,598.6	102.4	1.0	20.0	3.5	190.0	2,915.7
	P ST.		256.0	410.0	461.9	1,598.6	164.6	1.0	20.0	3.5	270.0	3,185.6
	L1		0.0	0.0	110.9	91.4	22.6	0.0	0.0	0.6	54.0	279.5
	L2		1,151.0	259.2	1,200.9	661.0	106.1	2.8	20.0	6.4	403.0	3,810.4
	L3		0.0	0.0	14.6	0.0	10.0	0.0	0.0	0.0	13.0	37.6
	L4		0.0	137.6	126.1	49.0	37.9	0.0	0.0	3.8	71.0	425.4
	L ST.		1,151.0	396.8	1,452.5	801.4	176.6	2.8	20.0	10.8	541.0	4,552.9
	Total		1,557.5	2,615.8	3,705.7	4,027.6	1,056.4	4.4	60.0	104.6	1,819.0	14,951.0
R4	C8		0.0	41.0	370.5	452.4	129.8	0.0	0.0	56.1	241.0	1,290.8
	C9		7,432.2	528.5	1,545.8	8,286.0	377.4	52.0	36.0	131.0	486.0	18,874.9
	C10		21,569.4	0.0	1,363.8	4,747.0	52.8	16.5	108.0	40.4	274.0	28,171.9
	Total		29,001.6	569.5	3,280.1	13,485.4	560.0	68.5	144.0	227.5	1,001.0	48,337.6
GRAND TOTAL			34,841.6	3,544.7	8,164.3	21,151.4	1,917.8	86.5	304.0	347.5	3,400.0	73,757.8

Table 10.4.2 Concentrated BOD Load by Sub-area (2001)

Water Quality Checking Point	Sub-area Code	Land Use	Concentration Ratio and Concentrated BOD Load by Sub-area (kg/day)									
			Domestic			Factory	Live-stock	Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
			Urban	Suburban	Rural							
		C.Rate UCR	0.5	0.2	0.1	0.2	0.1	0.2	0.5	0.1	1.0	-
		C.Rate BMR	0.9	0.5	0.2	0.5	0.2	0.5	0.9	0.2	1.0	-
R1	C1		483.5	0.0	49.0	257.8	7.0	1.8	20.0	1.0	26.0	846.1
R2	C2		0.0	70.0	306.0	129.6	39.6	0.0	0.0	4.5	144.0	693.7
	C3		790.0	177.8	390.8	1,216.2	64.2	0.4	20.0	3.2	185.0	2,847.6
	C4		0.0	0.0	51.8	0.0	5.5	0.0	0.0	0.3	22.0	79.6
	C5		705.5	148.2	191.9	795.8	141.9	3.6	40.0	2.6	94.0	2,123.5
	C6		3,032.5	0.0	212.7	3,018.8	70.2	9.6	20.0	3.8	109.0	6,476.6
	Total		4,528.0	396.0	1,153.2	5,160.4	321.4	13.6	80.0	14.4	554.0	12,221.0
R3	C7		0.0	179.0	247.9	295.6	73.2	0.0	0.0	2.3	114.0	912.0
	N1		0.0	69.0	270.8	72.4	39.1	0.0	0.0	5.6	142.0	598.9
	N2		0.0	408.6	341.5	268.0	59.9	0.0	0.0	4.9	172.0	1,254.9
	N3		0.0	442.4	741.8	307.0	531.3	0.0	0.0	9.4	351.0	2,382.9
	N4		174.0	881.0	250.7	1,265.8	147.5	0.6	20.0	68.1	229.0	3,036.7
	N ST.		174.0	1,801.0	1,604.8	1,913.2	777.8	0.6	20.0	88.0	894.0	7,273.4
	P1		0.0	0.0	129.1	0.0	74.4	0.0	0.0	0.0	80.0	283.5
	P2		302.5	483.2	329.6	2,203.2	122.5	1.2	20.0	3.5	190.0	3,655.7
	P ST.		302.5	483.2	458.7	2,203.2	196.9	1.2	20.0	3.5	270.0	3,939.2
	L1		0.0	0.0	119.0	130.2	18.9	0.0	0.0	0.6	54.0	322.7
	L2		1,244.5	258.0	1,429.6	991.6	102.7	2.8	20.0	6.4	403.0	4,458.6
	L3		0.0	0.0	14.0	0.0	12.0	0.0	0.0	0.0	13.0	39.0
	L4		0.0	158.8	127.3	54.6	45.4	0.0	0.0	3.8	71.0	460.9
	L ST.		1,244.5	416.8	1,689.9	1,176.4	179.0	2.8	20.0	10.8	541.0	5,281.2
	Total		1,721.0	2,880.0	4,001.3	5,588.4	1,226.9	4.6	60.0	104.6	1,819.0	17,405.8
R4	C8		0.0	44.0	382.1	574.6	155.3	0.0	0.0	56.1	241.0	1,453.1
	C9		8,687.7	589.0	1,816.0	8,986.0	451.8	50.0	36.0	131.0	486.0	21,233.5
	C10		27,483.3	0.0	2,003.8	5,147.5	62.4	17.0	108.0	40.4	274.0	35,136.4
	Total		36,171.0	633.0	4,201.9	14,708.1	669.5	67.0	144.0	227.5	1,001.0	57,823.0
GRAND TOTAL			42,903.5	3,909.0	9,405.4	25,714.7	2,224.8	87.0	304.0	347.5	3,400.0	88,295.9

Table 10.4.3 Concentrated BOD Load by Sub-area (2011)

Water Quality Checking Point	Sub-area Code	Land Use / C.Rate	Concentration Ratio and Concentrated BOD Load by Sub-area (kg/day)									
			Domestic			Factory	Live-stock	Slaughter-house	Fresh Market	Fish Pond	Natural Pollution	TOTAL
			Urban	Suburban	Rural							
		UCR	0.5	0.2	0.1	0.2	0.1	0.2	0.5	0.1	1.0	-
		BMR	0.9	0.5	0.2	0.5	0.2	0.5	0.9	0.2	1.0	-
R1	C1		583.0	0.0	50.1	449.8	6.5	2.0	20.0	1.0	26.0	1,138.4
R2	C2		0.0	81.6	319.4	206.8	36.4	0.0	0.0	4.5	144.0	792.7
	C3		1,061.0	209.6	422.6	2,067.0	53.9	0.4	20.0	3.2	185.0	4,022.7
	C4		0.0	0.0	62.6	0.0	5.2	0.0	0.0	0.3	22.0	90.1
	C5		878.0	193.0	166.7	1,307.2	180.2	4.4	40.0	2.6	94.0	2,866.1
	C6		4,310.0	0.0	177.8	5,673.4	84.2	12.0	20.0	3.8	109.0	10,390.2
	Total		6,249.0	484.2	1,149.1	9,254.4	359.9	16.8	80.0	14.4	554.0	18,161.8
R3	C7		0.0	257.8	228.7	131.2	87.9	0.0	0.0	2.3	114.0	821.9
	N1		0.0	77.8	284.3	115.6	35.9	0.0	0.0	5.6	142.0	661.2
	N2		0.0	469.8	391.4	414.2	50.2	0.0	0.0	4.9	172.0	1,502.5
	N3		0.0	520.2	779.2	455.0	674.7	0.0	0.0	9.4	351.0	2,789.5
	N4		230.0	1,063.8	215.0	2,037.2	177.1	0.6	20.0	68.1	229.0	4,040.8
	N ST.		230.0	2,131.6	1,669.9	3,022.0	937.9	0.6	20.0	88.0	894.0	8,994.0
	P1		0.0	0.0	117.0	0.0	89.2	0.0	0.0	0.0	80.0	286.2
	P2		420.5	671.2	285.8	3,320.6	147.1	1.4	20.0	3.5	190.0	5,060.1
	P ST.		420.5	671.2	402.8	3,320.6	236.3	1.4	20.0	3.5	270.0	5,346.3
	L1		0.0	0.0	132.7	201.2	15.8	0.0	0.0	0.6	54.0	404.3
	L2		1,455.0	255.4	1,919.3	1,717.2	95.9	2.8	20.0	6.4	403.0	5,875.0
	L3		0.0	0.0	11.3	0.0	14.4	0.0	0.0	0.0	13.0	38.7
	L4		0.0	217.6	121.3	24.2	54.5	0.0	0.0	3.8	71.0	492.4
	L ST.		1,455.0	473.0	2,184.6	1,942.6	180.6	2.8	20.0	10.8	541.0	6,810.4
	Total		2,105.5	3,533.6	4,486.0	8,416.4	1,442.7	4.8	60.0	104.6	1,819.0	21,972.6
R4	C8		0.0	50.6	389.8	694.0	186.4	0.0	0.0	56.1	241.0	1,617.9
	C9		11,027.7	706.5	2,551.8	13,324.5	542.2	49.0	36.0	131.0	486.0	28,854.7
	C10		44,471.7	0.0	4,108.8	7,631.5	74.8	19.5	108.0	40.4	274.0	56,728.7
	Total		55,499.4	757.1	7,050.4	21,650.0	803.4	68.5	144.0	227.5	1,001.0	87,201.3
GRAND TOTAL			64,436.9	4,774.9	12,735.6	39,770.6	2,612.5	92.1	304.0	347.5	3,400.0	128,474.1

10.5 Flow Rate for Future Water Pollution Analysis

Flow rate at major points along subject rivers are studied considering diversion and confluence of the main river. Flow rate data at several RID stations during March and April in the last four (4) years (1988-1991) are the basis for this study. Data on the five (5) stations and eight (8) water intake points for drinking water supply and irrigation use are shown in Tables 10.5.1 and 10.5.2, respectively.

In accordance with flow model established for present pollution analysis, the following study was made and flow rate to be used for future pollution analysis are shown in Figure 10.5.1.

(1) Comparison of flow rate between the average of measurement results on June, 1992 and January, 1993, and average during March and April (1988-1991)

Both study period is under dry season and represents minimum flow rate through the year. In this connection, the flow rates at most of the points are within the same order or similar dimension as shown in Figure 10.5.1.

Flow rate at Bang Shai, Ayutthaya after confluence of the main river and major tributaries is almost same in both cases. Therefore, the average figure of March and April, 173.5 m^3/s is employed as the base figure at the point for calculation of other flow rates.

For those of Pasak, Lop Buri and Noi rivers, measurement results on June, 1992 and January, 1993 are adopted after adjustment to the expectable total flow of three rivers. Those at both Chao Phraya Dam and Ang Thong points are different between two cases with a larger amount in case of the average in March and April.

Table 10.5.1 Flow Rate at RID's Observation Stations

River	RID Sta. No.	Location	Dist. from River Mouth (km) *	Monthly average flow rate (m3/s)						
					1989	1990	1991	1992	Monthly Average	Average of Mar. & Apr.
Chao Phraya	C.2	A. Muang Nakorn Sawan Prov.	372.0	March	–	486.46	365.20	274.71	375.5	
				April	522.56	471.08	371.48	–	455.1	415.3
	–	Chao Phraya Dam Chainat Prov.	272.0	March	82.94	94.16	72.19	75.77	81.3	
				April	91.13	88.73	79.03	75.40	83.5	82.4
	C.13	Ban Re Rai A. Sanphraya, Chainat	261.0	March	–	93.33	78.77	68.83	80.3	
				April	89.08	93.73	75.47	–	86.1	83.2
	C.7A	Ban Bang Kaeo A. Muang, Ang Thong	180.0	March	–	130.89	143.91	113.91	129.6	
				April	110.67	143.76	124.53	–	126.3	128.0
	–	A. Bang Shai Ayuthaya	117.0	March	–	–	–	–	** 147.0	
				April	–	–	–	–	** 200.0	173.5
Lop Buri	L.5	A. Ban Phraek Ayutthaya	187.0	March	–	1.59	1.11	0.44	1.0	
				April	1.02	2.17	0.91	–	1.4	1.2
Pasak	–	Rama VI Dam		March	0.00	0.00	0.00	0.00	0.0	
				April	0.00	0.00	0.00	0.00	0.0	0.0

Note : * Distance from river mouth of Lop Buri and Noi river is measured from PCD's set up point at Pompetch, A. Muang, Ayutthaya (142.0 km from river mouth) and at Nonthaburi Provincial Office, Nonthaburi (62.0 from river mouth) along that river respectively

** Flow rate at Bang Shai is calculated from the study results by AIT in 1988 (JICA's report)

Table 10.5.2 Intake Amount by Major Irrigation Gates

River	Gate of Gate	Location	Dist. from River Mouth (km) *	Monthly average flow rate (m3/s)						
					1989	1990	1991	1992	Monthly Average	Average of Mar. & Apr.
Chao Phraya	Bang Bua Thong	Pathum Thani	72.0	March	22.90	6.53	20.44	26.56	19.1	
				April	19.05	16.85	20.88	23.00	19.9	19.5
	Phra Udom	Pathum Thani	74.0	March	11.20	8.75	14.62	13.46	12.0	
				April	10.55	16.71	14.78	12.64	13.6	12.8
	Chula–longkorn	South Rangsit, Pathum Thani	84.0	March	0.00	0.00	0.00	0.00	0.0	
				April	0.00	0.00	0.00	0.00	0.0	0.0
	Phra Intraracha	North Rangsit, Pathum Thani	100.0	March	0.00	0.00	0.00	0.00	0.0	
				April	0.00	0.00	0.00	0.00	0.0	0.0
	Singhanat	Pathum Thani	108.0	March	0.00	0.00	5.85	2.80	2.2	
				April	0.00	0.00	0.00	1.40	0.3	1.2
	Average distance from river mouth = (weighted average of flow rate and distance)		74.0					Total	33.2	
									33.8	33.5
Chao Phraya	MWA Intake	Sam Lae, Pathum Thani	98.0	March	30.00	30.00	30.00	30.00	30.0	
				April	30.00	30.00	30.00	30.00	30.0	30.0
Chao Phraya	Bang Ban Pump. Station	Ayutthaya	126.0	March	0.00	0.00	0.00	0.00	0.0	
				April	0.00	0.00	0.00	0.00	0.0	0.0
Noi	Jap Jed	Ang Thong	136.0	March	0.00	0.00	0.00	0.00	0.0	
				April	0.00	0.00	0.00	0.00	0.0	0.0

Note : * Distance from river mouth of Lop Buri and Noi river is measured from PCD's set up point at Pompetch, A. Muang, Ayutthaya (142.0 km from river mouth) and at Nonthaburi Provincial Office, Nonthaburi (62.0 from river mouth) along that river respectively

** Flow rate at Bang Shai is calculated from the study results by AIT in 1988 (JICA's report)

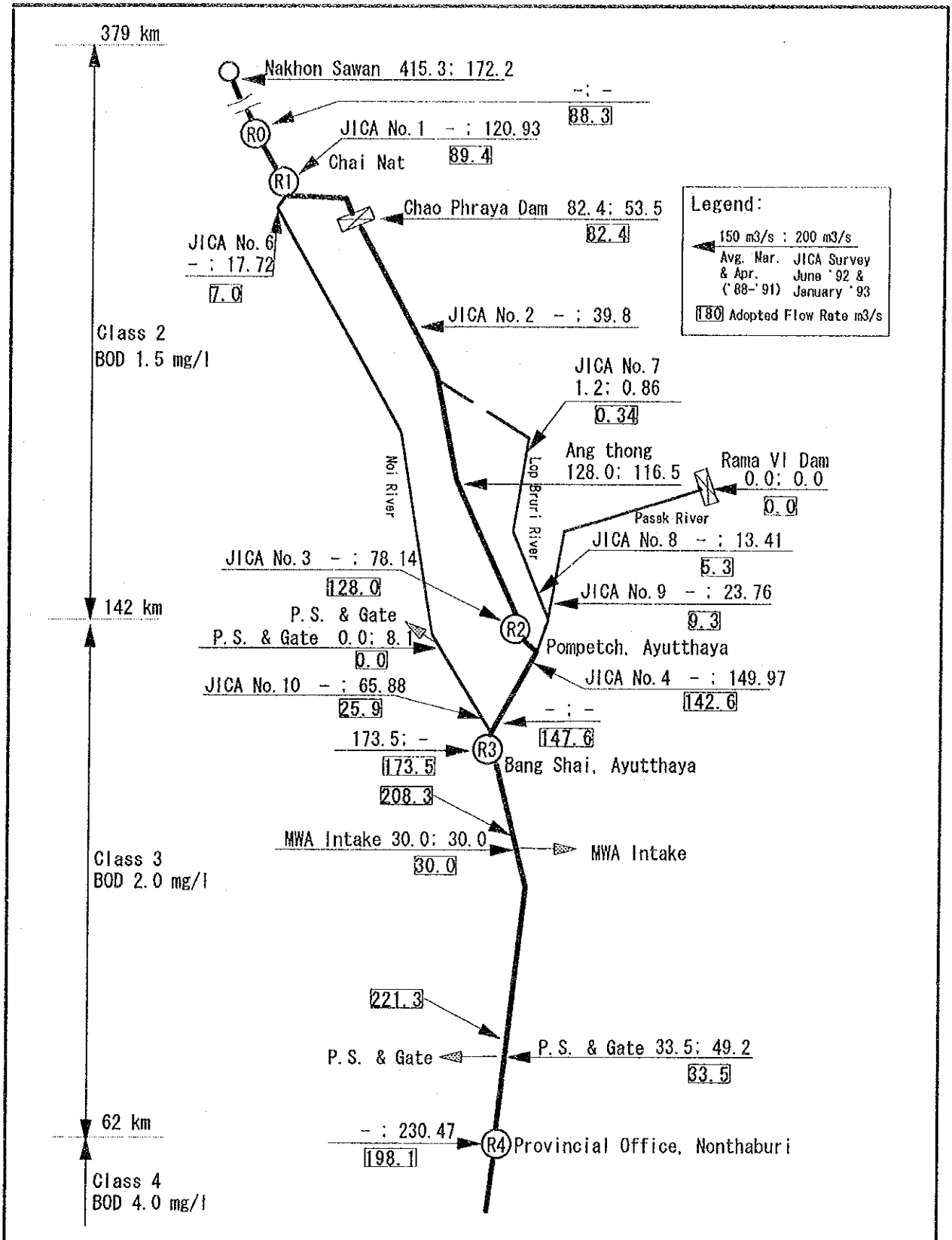

Figure 10.5.1 Flow Rate for Future Water Pollution Analysis

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(2) Setting up/calculation of flow rate

- R3 checking point:

  173.5 m^3/s (14.99 x $10^6 m^3/d$)

- R4 checking point

  (Specific discharged rate x R3-R4 area) + (Flow rate at R3)
  - (Intake rate at MWA P.S and consolidated P.S & gate)
  = 0.071 $m^3/s/km^2$ x 1,241.4 km^2 + 173.5 m^3/s
  - (30.0 m^3/s + 33.5 m^3/s)
  = 198.1 m^3/s (17.12 x 10^6 m^3/d)

- R2 checking point:

  Through the field measurement on June, 1992 and January 1993, flow rates at Ang Thong RID station and R2 are almost same. Therefore, an average of March and April, 128.0 m^3/s at Ang Thong station is adopted.
  128.0 m^3/s (11.06 x 10^6 m^3/d).

- Pasak, Lop Buri and Noi rivers:

  a) Total flow:
  (Flow rate at R3) - (Flow rate at R2)
  - (Specific discharge rate x R2-R3 area)
  = 173.5 m^3/s - 128.0 m^3/s - 0.022 $m^3/s/km^2$ x 227.4 km^2
  = 40.5 m^3/s (3.50 x 10^6 m^3/d)

  b) Starting point of Lop Buri river:
  0.86 m^3/s x 40.5/(13.41+23.76+65.88)
  = 0.34 m^3/s (0.03 x 10^6 m^3/d)

  c) Lop Buri river before confluence with Pasak river:
  13.41 m^3/s x 40.5/(13.41+23.76+65.88)
  = 5.3 m^3/s (0.46 x 10^6 m^3/d)

d) Pasak river before confluence with Lop Buri river:

23.76 m^3/s x 40.5/(13.41+23.76+65.88)

= 9.3 m^3/s (0.80 x 10^6 m^3/d)

e) Noi river after diversion from the main river:

17.72 m^3/s x 40.5/(13.41+23.76+65.88)

= 7.0 m^3/s (0.60 x 10^6 m^3/d)

f) Noi river before confluence with main river:

65.88 m^3/s x 40.5/(13.41+23.76+65.88)

= 25.9 m^3/s (2.24 x 10^6 m^3/d)

- Main river after confluence with Pasak river:

The junction, R2 and confluence of Pasak & Lop Buri rivers are nearly located. Thus, flow rate at the junction may be calculated as follows:

(Flow rate at R2) + (Flow rate of Pasak & Lop Buri rivers before confluence)

= 128.0 m^3/s + (5.3 m^3/s + 9.3 m^3/s)

= 142.6 m^3/s (12.32 x 10^6 m^3/d)

- Main river before confluence with Noi river:

(Flow rate after confluence of the main river with Pasak river) + (Specific discharged rate x R2-R3 area)

= 142.6 m^3/s + 0.022 $m^3/s/km^2$ x 227.4 km^2

= 147.6 m^3/s (12.75 x 10^6 m^3/d)

- R1 checking point:

Since more than three times of flow rate at the upstream of Chao Phraya Dam/R1, Nakhon Sawan RID station is obtained as the average of March and April comparing the value on June, 1992 and January, 1993, the storage of water at Chao Phraya Dam may be neglected. Therefore, flow rate at R1 is concluded as follows:

(Flow rate of Noi river after diversion from the main river) + (Discharged rate at Chao Phraya Dam)

= 7.0 m^3/s + 82.4 m^3/s

= 89.4 m^3/s (7.72 x 10^6 m^3/d)

- R0 checking point:

(Flow rate at R1 point)
+ (Specific discharged rate x R0-R1 area)

= 89.4 m^3/s - 0.022 m^3/s x 51.3 km^2

= 88.3 m^3/s (7.63 x 10^6 m^3/d)

- Flow rate of the main river before intake of water between R3 and R4:

a) Before intake by MWA:

(Flow rate at R3 point)
+ (Specific discharged rate x drainage area)

= 173.5 m^3/s + 0.071 $m^3/s/km^2$ x 490 km^2

= 208.3 m^3/s (18.00 x 10^6 m^3/d)

b) Before intake by consolidated P.S & Gate:

(Flow rate at R3 point)
+ (Specific discharged rate x drainage area)
- (MWA intake rate)

= 173.5 m^3/s + (0.071 $m^3/s/km^2$ x 1,096.3 km^2)
- 30.0 m^3/s

= 221.3 m^3/s (19.12 x 10^6 m^3/d)

10.6 Projection of Water Quality at Water Quality Checking Points

Water quality at water quality checking points in the year 1996, 2001 and 2011 are projected using the flow rate summarized on Figure 10.5.1, remaining ratios after purification obtained in Section 9 and the concentrated BOD load presented in Tables 10.4.1 to 10.4.3.

Calculation results are presented in Tables 10.6.1 to 10.6.3 and illustrated on Figures 10.6.1 to 10.6.6.

In the calculation, following considerations are given:

- Initial pollution load at R0 is:

  7.63 M m^3/day x 1.5 mg/litter = 11,445 kg/day

- At the diversion point of Noi river from Chao Phraya river, a part of pollution load is assumed to be diverted with river water at following ratio.

  Flow rate of Chao Phraya river at the point: 7.72 M m^3/day
  Flow rate of diverted water: 0.60 M m^3/day
  Diversion ratio of pollution load at the point:
  0.60 / 7.72 = 0.0777 = 7.8%

- Flow from Chao Phraya Dam:

  7.72 - 0.60 = 7.12 M m^3/day

- Reduction of pollution load by diversion:

  MWA intake; 2.59 M m^3/day
  Flow rate of Chao Phraya river at the point 18.00 M m^3/day
  Diversion ratio at the point 2.59 / 18.00 = 0.1439 = 14.4%

  Irrigation intake; 2.89 M m^3/day
  Flow rate of Chao Phraya river at the point 19.12 M m^3/day
  Diversion ratio at the point 2.89 / 19.12 = 0.1512 = 15.1%

Calculation results are summarized in Table 10.6.4.

Table 10.6.1 Water Pollution Analysis (1996)

Current Point No.	Next Point No.	W. Q. C. P.	Distance from Estuary (km)	Section Length (km)	Average Velocity (m/sec)	Time of Flow (day) to next Point	Time of Flow (day) to next W.Q.C.P.	Run-off BOD from Upstream (kg/day)	Concent'd BOD Load (kg/day)	Diverted BOD Load (kg/day)	BOD Load at Current Pt. (kg/day)	Purified BOD Load (kg/day)	P. Load at Next Pt. (kg/day)	at Next Point: Planned Flow per second (m3/sec)	at Next Point: Planned Flow per day (M m3/day)	at Next Point: Calc'd Quality (mg/lt.)	P. L. Remaining Ratio to next Point	P. L. Remaining Ratio to next W.Q.C.P.	kr Value
R0	C1		283.0	2.0	0.08	0.289	1.157	11,445.0	0.0	0.0	11,445.0	594.1	10,850.9	–	–	–	0.948	0.808	0.08
C1	R1 (J1)	*	281.0	6.0	0.08	0.868	0.868	10,850.9	714.1	0.0	11,565.0	1,709.0	9,856.1	89.40	7.72	1.3	0.852	0.852	0.08
R1 (J1)	SP1		275.0	0.5	0.08	0.072	7.273	9,856.1	0.0	0.0	9,856.1	130.5	9,725.6	–	–	–	0.987	0.262	0.08
SP1	IP1		274.5	2.4	0.08	0.347	7.201	9,725.6	0.0	755.9	8,969.7	555.7	8,414.0	–	–	–	0.936	0.265	0.08
IP1	SP2		272.1	0.1	0.08	0.014	6.854	8,414.0	0.0	0.0	8,414.0	22.4	8,391.6	82.40	7.12	1.2	0.997	0.283	0.08
SP2	C2		272.0	3.0	0.22	0.158	6.839	8,391.6	0.0	0.0	8,391.6	240.5	8,151.1	–	–	–	0.971	0.284	0.08
C2	J2		269.0	48.0	0.22	2.525	6.681	8,151.1	639.9	0.0	8,791.0	3,270.0	5,521.0	–	–	–	0.628	0.292	0.08
J2	C3		221.0	3.0	0.22	0.158	4.156	5,521.0	0.0	0.0	5,521.0	158.2	5,362.8	–	–	–	0.971	0.455	0.08
C3	C4		218.0	24.0	0.22	1.263	3.998	5,362.8	2,324.0	0.0	7,686.8	1,595.1	6,091.7	–	–	–	0.792	0.479	0.08
C4	C5		194.0	13.0	0.22	0.684	2.736	6,091.7	73.9	0.0	6,165.6	729.8	5,435.7	–	–	–	0.882	0.604	0.08
C5	C6		181.0	35.0	0.22	1.841	2.052	5 435.7	1,773.5	0.0	7,209.2	2,073.7	5,135.5	–	–	–	0.712	0.685	0.08
C6	R2 (J3)	*	146.0	4.0	0.22	0.210	0.210	5,135.5	4,943.8	0.0	10,079.3	383.2	9,696.1	128.00	11.06	0.9	0.962	0.962	0.08
R2 (J3)	SP4		142.0	0.5	0.22	0.026	2.119	9,696.1	0.0	0.0	9,696.1	0.0	9,696.1	–	–	–	1.000	1.000	0.00
L0	L1		251.0	20.0	0.04	5.787	28.743	0.0	0.0	0.0	0.0	0.0	0.0	–	–	–	0.766	0.293	0.02
L1	L2		231.0	20.0	0.04	5.787	22.956	0.0	279.5	0.0	279.5	65.4	214.1	–	–	–	0.766	0.383	0.02
L2	J7		211.0	2.0	0.04	0.579	17.169	214.1	3,810.4	0.0	4,024.5	105.8	3,918.7	–	–	–	0.974	0.499	0.02
J7	L3		209.0	43.0	0.05	9.954	16.590	3,918.7	0.0	0.0	3,918.7	1,440.9	2,477.8	–	–	–	0.632	0.513	0.02
L3	L4		166.0	13.0	0.06	2.508	6.636	2,477.8	37.6	0.0	2,515.4	274.3	2,241.1	–	–	–	0.891	0.611	0.02
L4	J8		153.0	7.5	0.06	1.447	4.128	2,241.1	425.4	0.0	2,666.5	171.9	2,494.6	5.30	0.46	5.4	0.936	0.911	0.02
J8	SP3'		145.5	0.5	0.07	0.083	2.682	2,494.6	0.0	0.0	2,494.6	9.5	2,485.1	–	–	–	0.996	0.979	0.02
P0	P1		203.5	17.5	0.09	2.251	10.122	0.0	0.0	0.0	0.0	0.0	0.0	–	–	–	0.902	0.691	0.02
P1	P2		186.0	15.0	0.09	1.929	7.872	0.0	269.9	0.0	269.9	22.9	247.0	–	–	–	0.915	0.765	0.02
P2	J9		171.0	25.8	0.09	3.318	5.943	247.0	2,915.7	0.0	3,162.7	448.1	2,714.5	9.30	0.80	3.4	0.858	0.858	0.02
J9	SP3'		145.2	0.2	0.09	0.026	2.625	2,714.5	0.0	0.0	2,714.5	3.2	2,711.3	–	–	–	0.999	0.976	0.02
SP3'	SP3		145.0	0.0	0.08	0.000	2.599	5,196.4	0.0	0.0	5,196.4	0.0	5,196.4	14.60	1.26	4.1	1.000	0.977	0.02
SP3	SP4		145.0	3.5	0.08	0.506	2.599	5,196.4	0.0	0.0	5,196.4	119.8	5,076.6	–	–	–	0.977	0.977	0.02
SP4	J4		141.5	0.5	0.15	0.039	2.093	14,772.7	0.0	0.0	14,772.7	0.0	14,772.7	142.60	12.32	1.2	1.000	1.000	0.00
J4	C7		141.0	13.0	0.14	1.075	2.054	14,772.7	0.0	0.0	14,772.7	0.0	14,772.7	–	–	–	1.000	1.000	0.00
C7	SP5		128.0	10.5	0.13	0.935	0.979	14,772.7	838.2	0.0	15,610.9	0.0	15,610.9	147.60	12.75	1.2	1.000	1.000	0.00
N0 (J6)	N1		277.0	37.0	0.27	1.586	9.638	755.9	0.0	0.0	755.9	53.2	702.6	(at N0 7.00 m3/s or 0.60 M.m3/d)			0.930	0.643	0.02
N1	N2		240.0	39.0	0.23	1.661	8.052	702.6	563.1	0.0	1,265.7	93.2	1,172.5	–	–	–	0.926	0.692	0.02
N2	N3		207.0	34.0	0.20	1.968	6.391	1,172.5	1,131.4	0.0	2,303.9	199.5	2,104.4	–	–	–	0.913	0.747	0.02
N3	N4		173.0	32.0	0.16	2.315	4.423	2,104.4	2,128.2	0.0	4,232.6	428.0	3,804.6	–	–	–	0.899	0.817	0.02
N4	IP2		141.0	5.0	0.14	0.413	2.109	3,804.6	2,551.6	0.0	6,356.2	119.9	6,236.3	–	–	–	0.981	0.909	0.02
IP2	J10		136.0	18.0	0.13	1.603	1.695	6,236.3	0.0	0.0	6,236.3	443.7	5,792.7	25.90	2.24	2.6	0.929	0.927	0.02
J10	SP5		118.0	0.5	0.12	0.048	0.093	5,792.7	0.0	0.0	5,792.7	12.9	5,779.8	–	–	–	0.998	0.998	0.02
SP5	R3	*	117.5	0.5	0.13	0.045	0.045	21,390.7	0.0	0.0	21,390.7	0.0	21,390.7	173.50	14.99	1.4	1.000	1.000	0.00
R3	C8		117.0	3.0	0.13	0.267	5.681	21,390.7	0.0	0.0	21,390.7	0.0	21,390.7	–	–	–	1.000	1.000	0.00
C8	IP3		114.0	16.0	0.12	1.543	5.414	21,390.7	1,290.8	0.0	22,681.5	0.0	22,681.5	208.30	18.00	1.3	1.000	1.000	0.00
IP3	C9		98.0	5.0	0.12	0.482	3.870	22,681.5	0.0	3,263.8	19,417.9	0.0	19,417.9	–	–	–	1.000	1.000	0.00
C9	IP4		93.0	19.0	0.11	1.999	3.388	19,417.9	18,874.9	0.0	38,292.8	0.0	38,292.8	221.30	19.12	2.0	1.000	1.000	0.00
IP4	C10		74.0	11.0	0.10	1.273	1.389	38,292.8	0.0	5,788.0	32,504.8	0.0	32,504.8	–	–	–	1.000	1.000	0.00
C10	R4 (J5)	*	63.0	1.0	0.10	0.116	0.116	32,504.8	28,171.9	0.0	60,676.7	0.0	60,676.7	198.10	17.12	3.5	1.000	1.000	0.00
R4 (J5)	–		62.0	–	–	–	–	60,676.7	0.0	0.0	60,676.7	–	–	–	–	–	–	–	–

R0–R4: Water quality checking point
C1–C10, L1–L4, P1–P2, N0–N4: Pollution load inflow point
IP1–IP4: Water intake point
SP1–SP5: Temporary point for computation
J1–J10: Survey points by JICA team

Table 10.6.2 Water Pollution Analysis (2001)

Current Point No.	Next Point No.	W.Q.C.P.	Distance from Estuary (km)	Section Length (km)	Average Velocity (m/sec)	Time of Flow (day) to next Point	Time of Flow (day) to next W.Q.C.P.	Run-off BOD from Upstream (kg/day)	Concent'd BOD Load (kg/day)	Diverted BOD Load (kg/day)	BOD Load at Current Pt. (kg/day)	Purified BOD Load (kg/day)	P. Load at Next Pt. (kg/day)	at Next Point: Planned Flow per second (m3/sec)	at Next Point: Planned Flow per day (M m3/day)	at Next Point: Calc'd Quality (mg/lit.)	P. L. Remaining Ratio to next Point	P. L. Remaining Ratio to next W.Q.C.P.	kr Value
R0	C1		283.0	2.0	0.08	0.289	1.157	11,445.0	0.0	0.0	11,445.0	594.1	10,850.9	–	–	–	0.948	0.808	0.08
C1	R1 (J1)	*	281.0	6.0	0.08	0.868	0.868	10,850.9	846.1	0.0	11,697.0	1,728.5	9,968.5	89.40	7.72	1.3	0.852	0.852	0.08
R1 (J1)	SP1		275.0	0.5	0.08	0.072	7.273	9,968.5	0.0	0.0	9,968.5	132.0	9,836.6	–	–	–	0.987	0.282	0.08
SP1	IP1		274.5	2.4	0.08	0.347	7.201	9,836.6	0.0	764.5	9,072.1	562.1	8,510.0	–	–	–	0.938	0.265	0.08
IP1	SP2		272.1	0.1	0.08	0.014	6.854	8,510.0	0.0	0.0	8,510.0	22.6	8,487.4	82.40	7.12	1.2	0.997	0.283	0.08
SP2	C2		272.0	3.0	0.22	0.158	6.839	8,487.4	0.0	0.0	8,487.4	243.2	8,244.2	–	–	–	0.971	0.284	0.08
C2	J2		269.0	48.0	0.22	2.525	6.681	8,244.2	693.7	0.0	8,937.9	3,324.6	5,613.2	–	–	–	0.628	0.292	0.08
J2	C3		221.0	3.0	0.22	0.158	4.156	5,613.2	0.0	0.0	5,613.2	160.8	5,452.4	–	–	–	0.971	0.465	0.08
C3	C4		218.0	24.0	0.22	1.263	3.998	5,452.4	2,847.6	0.0	8,300.0	1,722.4	6,577.6	–	–	–	0.792	0.479	0.08
C4	C5		194.0	13.0	0.22	0.684	2.736	6,577.6	79.6	0.0	6,657.2	788.0	5,869.2	–	–	–	0.882	0.604	0.08
C5	C6		181.0	35.0	0.22	1.841	2.052	5,869.2	2,123.5	0.0	7,992.7	2,299.1	5,693.6	–	–	–	0.712	0.685	0.08
C6	R2 (J3)	*	146.0	4.0	0.22	0.210	0.210	5,693.6	6,476.6	0.0	12,170.2	462.7	11,707.5	128.00	11.06	1.1	0.962	0.962	0.08
R2 (J3)	SP4		142.0	0.5	0.22	0.026	2.119	11,707.5	0.0	0.0	11,707.5	0.0	11,707.5	–	–	–	1.000	1.000	0.00
L0	L1		251.0	20.0	0.04	5.787	28.743	0.0	0.0	0.0	0.0	0.0	0.0	–	–	–	0.766	0.293	0.02
L1	L2		231.0	20.0	0.04	5.787	22.956	0.0	322.7	0.0	322.7	75.5	247.2	–	–	–	0.766	0.383	0.02
L2	J7		211.0	2.0	0.04	0.579	17.169	247.2	4,458.6	0.0	4,705.8	123.8	4,582.1	–	–	–	0.974	0.499	0.02
J7	L3		209.0	43.0	0.05	9.954	16.590	4,582.1	0.0	0.0	4,582.1	1,684.8	2,897.2	–	–	–	0.632	0.513	0.02
L3	L4		166.0	13.0	0.06	2.508	6.636	2,897.2	39.0	0.0	2,936.2	320.2	2,616.0	–	–	–	0.891	0.811	0.02
L4	J8		153.0	7.5	0.06	1.447	4.128	2,616.0	460.9	0.0	3,076.9	198.3	2,878.6	5.30	0.46	6.3	0.936	0.911	0.02
J8	SP3'		145.5	0.5	0.07	0.083	2.682	2,878.6	0.0	0.0	2,878.6	10.9	2,867.6	–	–	–	0.996	0.973	0.02
P0	P1		203.5	17.5	0.09	2.251	10.122	0.0	0.0	0.0	0.0	0.0	0.0	–	–	–	0.902	0.691	0.02
P1	P2		186.0	15.0	0.09	1.929	7.872	0.0	283.5	0.0	283.5	24.1	259.4	–	–	–	0.915	0.766	0.02
P2	J9		171.0	26.8	0.09	3.318	5.943	259.4	3,655.7	0.0	3,915.1	554.7	3,360.4	9.30	0.80	4.2	0.858	0.838	0.02
J9	SP3'		145.2	0.2	0.09	0.026	2.625	3,360.4	0.0	0.0	3,360.4	4.0	3,356.4	–	–	–	0.999	0.976	0.02
SP3'	SP3		145.0	0.0	0.08	0.000	2.599	6,224.0	0.0	0.0	6,224.0	0.0	6,224.0	14.60	1.26	4.9	1.000	0.977	0.02
SP3	SP4		145.0	3.5	0.08	0.506	2.599	6,224.0	0.0	0.0	6,224.0	143.5	6,080.6	–	–	–	0.977	0.977	0.02
SP4	J4		141.5	0.5	0.15	0.039	2.093	17,788.0	0.0	0.0	17,788.0	0.0	17,788.0	142.60	12.32	1.4	1.000	1.000	0.00
J4	C7		141.0	13.0	0.14	1.075	2.054	17,788.0	0.0	0.0	17,788.0	0.0	17,788.0	–	–	–	1.000	1.000	0.00
C7	SP5		128.0	10.5	0.13	0.935	0.979	17,788.0	912.0	0.0	18,700.0	0.0	18,700.0	147.60	12.75	1.5	1.000	1.000	0.00
N0 (J6)	N1		277.0	37.0	0.27	1.586	9.638	764.5	0.0	0.0	764.5	53.8	710.7	(at N0 7.00 m3/s or 0.60 M.m3/d)			0.930	0.643	0.02
N1	N2		240.0	33.0	0.23	1.661	8.052	710.7	598.9	0.0	1,309.6	96.4	1,213.1	–	–	–	0.926	0.692	0.02
N2	N3		207.0	34.0	0.20	1.968	6.391	1,213.1	1,254.9	0.0	2,468.0	213.8	2,254.2	–	–	–	0.913	0.747	0.02
N3	N4		173.0	32.0	0.16	2.315	4.423	2,254.2	2,382.9	0.0	4,637.1	468.9	4,168.3	–	–	–	0.899	0.817	0.02
N4	IP2		141.0	5.0	0.14	0.413	2.109	4,168.3	3,036.7	0.0	7,205.0	135.9	7,069.1	–	–	–	0.981	0.909	0.02
IP2	J10		136.0	18.0	0.13	1.603	1.695	7,069.1	0.0	0.0	7,069.1	502.9	6,566.2	25.90	2.24	2.9	0.929	0.927	0.02
J10	SP5		118.0	0.5	0.12	0.048	0.093	6,566.2	0.0	0.0	6,566.2	14.6	6,551.6	–	–	–	0.998	0.998	0.02
SP5	R3	*	117.5	0.5	0.13	0.045	0.045	25,251.6	0.0	0.0	25,251.6	0.0	25,251.6	173.50	14.99	1.7	1.000	1.000	0.00
R3	C8		117.0	3.0	0.13	0.267	5.661	25,251.6	0.0	0.0	25,251.6	0.0	25,251.6	–	–	–	1.000	1.000	0.00
C8	IP3		114.0	16.0	0.12	1.543	5.414	25,251.6	1,453.1	0.0	26,704.7	0.0	26,704.7	208.30	18.00	1.5	1.000	1.000	0.00
IP3	C9		98.0	5.0	0.12	0.482	3.870	26,704.7	0.0	3,842.5	22,862.2	0.0	22,862.2	–	–	–	1.000	1.000	0.00
C9	IP4		93.0	19.0	0.11	1.999	3.388	22,862.2	21,233.5	0.0	44,095.7	0.0	44,095.7	221.30	19.12	2.3	1.000	1.000	0.00
IP4	C10		74.0	11.0	0.10	1.273	1.389	44,095.7	0.0	6,665.1	37,430.6	0.0	37,430.6	–	–	–	1.000	1.000	0.00
C10	R4 (J5)	*	63.0	1.0	0.10	0.116	0.116	37,430.6	35,136.4	0.0	72,567.0	0.0	72,567.0	198.10	17.12	4.2	1.000	1.000	0.00
R4 (J5)	–		62.0	–	–	–	–	72,567.0	0.0	0.0	72,567.0	–	–	–	–	–	–	–	–

R0–R4: Water quality checking point
C1–C10, L1–L4, P1–P2, N0–N4: Polution load inflow point
IP1–IP4: Water intake point
SP1–SP5: Temporary point for computation
J1–J10: Survey points by JICA team

Table 10.6.3 Water Pollution Analysis (2011)

Current Point No.	Next Point No.	W.Q.C.P.	Distance from Estuary (km)	Section Length (km)	Average Velocity (m/sec)	Time of Flow (day) to next Point	Time of Flow (day) to next W.Q.C.P.	Run-off BOD from Upstream (kg/day)	Concent'd BOD Load (kg/day)	Diverted BOD Load (kg/day)	BOD Load at Current Pt. (kg/day)	Purified BOD Load (kg/day)	P. Load at Next Pt. (kg/day)	at Next Point: Planned Flow per second (m3/sec)	at Next Point: Planned Flow per day (M m3/day)	at Next Point: Calc'd Quality (mg/lt.)	P. L. Remaining Ratio to next Point	P. L. Remaining Ratio to next W.Q.C.P.	kr Value
R0	C1		283.0	2.0	0.08	0.289	1.157	11,445.0	0.0	0.0	11,445.0	594.1	10,850.9	–	–	–	0.946	0.808	0.08
C1	R1 (J1)	*	281.0	6.0	0.08	0.868	0.868	10,850.9	1,138.4	0.0	11,989.3	1,771.7	10,217.7	89.40	7.72	1.3	0.852	0.852	0.08
R1 (J1)	SP1		275.0	0.5	0.08	0.072	7.273	10,217.7	0.0	0.0	10,217.7	135.2	10,082.4	–	–	–	0.987	0.262	0.08
SP1	IP1		274.5	2.4	0.08	0.347	7.201	10,082.4	0.0	783.6	9,298.8	576.1	8,722.7	–	–	–	0.938	0.265	0.08
IP1	SP2		272.1	0.1	0.08	0.014	6.854	8,722.7	0.0	0.0	8,722.7	23.2	8,699.4	82.40	7.12	1.2	0.997	0.283	0.08
SP2	C2		272.0	3.0	0.22	0.158	6.839	8,699.4	0.0	0.0	8,699.4	249.3	8,450.2	–	–	–	0.971	0.284	0.08
C2	J2		269.0	48.0	0.22	2.525	6.681	8,450.2	792.7	0.0	9,242.9	3,438.1	5,804.8	–	–	–	0.628	0.292	0.08
J2	C3		221.0	3.0	0.22	0.158	4.156	5,804.8	0.0	0.0	5,804.8	166.3	5,638.5	–	–	–	0.971	0.465	0.08
C3	C4		218.0	24.0	0.22	1.263	3.998	5,638.5	4,022.7	0.0	9,661.2	2,004.9	7,656.3	–	–	–	0.792	0.479	0.08
C4	C5		194.0	13.0	0.22	0.684	2.736	7,656.3	90.1	0.0	7,746.4	916.9	6,829.5	–	–	–	0.882	0.604	0.08
C5	C6		181.0	35.0	0.22	1.841	2.052	6,829.5	2,866.1	0.0	9,695.6	2,788.9	6,906.6	–	–	–	0.712	0.685	0.08
C6	R2 (J3)	*	146.0	4.0	0.22	0.210	0.210	6,906.6	10,390.2	0.0	17,296.8	657.7	16,639.2	128.00	11.06	1.5	0.962	0.962	0.08
R2 (J3)	SP4		142.0	0.5	0.22	0.026	2.119	16,639.2	0.0	0.0	16,639.2	0.0	16,639.2	–	–	–	1.000	1.000	0.00
L0	L1		251.0	20.0	0.04	5.787	28.743	0.0	0.0	0.0	0.0	0.0	0.0	–	–	–	0.766	0.293	0.02
L1	L2		231.0	20.0	0.04	5.787	22.956	0.0	404.3	0.0	404.3	94.6	309.7	–	–	–	0.766	0.383	0.02
L2	J7		211.0	2.0	0.04	0.579	17.169	309.7	5,875.0	0.0	6,184.7	162.6	6,022.1	–	–	–	0.974	0.499	0.02
J7	L3		209.0	43.0	0.05	9.954	16.590	6,022.1	0.0	0.0	6,022.1	2,214.3	3,807.8	–	–	–	0.632	0.513	0.02
L3	L4		166.0	13.0	0.06	2.508	6.636	3,807.8	38.7	0.0	3,846.5	419.5	3,427.0	–	–	–	0.891	0.811	0.02
L4	J8		153.0	7.5	0.06	1.447	4.128	3,427.0	492.4	0.0	3,919.4	252.8	3,666.7	5.80	0.46	8.0	0.936	0.911	0.02
J8	SP3'		145.5	0.5	0.07	0.083	2.682	3,666.7	0.0	0.0	3,666.7	13.9	3,652.8	–	–	–	0.996	0.973	0.02
P0	P1		203.5	17.5	0.09	2.251	10.122	0.0	0.0	0.0	0.0	0.0	0.0	–	–	–	0.902	0.691	0.02
P1	P2		186.0	15.0	0.09	1.929	7.872	0.0	286.2	0.0	286.2	24.3	261.9	–	–	–	0.915	0.766	0.02
P2	J9		171.0	25.8	0.09	3.318	5.943	261.9	5,060.1	0.0	5,322.0	754.1	4,567.9	9.30	0.80	5.7	0.858	0.858	0.02
J9	SP3'		145.2	0.2	0.09	0.026	2.625	4,567.9	0.0	0.0	4,567.9	5.4	4,562.5	–	–	–	0.999	0.976	0.02
SP3'	SP3		145.0	0.0	0.08	0.000	2.599	8,215.3	0.0	0.0	8,215.3	0.0	8,215.3	14.60	1.26	6.5	1.000	0.977	0.02
SP3	SP4		145.0	3.5	0.08	0.506	2.599	8,215.3	0.0	0.0	8,215.3	189.4	8,025.9	–	–	–	0.977	0.977	0.02
SP4	J4		141.5	0.5	0.15	0.039	2.093	24,665.1	0.0	0.0	24,665.1	0.0	24,665.1	142.60	12.32	2.0	1.000	1.000	0.00
J4	C7		141.0	13.0	0.14	1.075	2.054	24,665.1	0.0	0.0	24,665.1	0.0	24,665.1	–	–	–	1.000	1.000	0.00
C7	SP5		128.0	10.5	0.13	0.935	0.979	24,665.1	821.9	0.0	25,487.0	0.0	25,487.0	147.60	12.75	2.0	1.000	1.000	0.00
N0 (J6)	N1		277.0	37.0	0.27	1.586	9.638	783.6	0.0	0.0	783.6	55.2	728.4	(at N0 7.00 m3/s or 0.60 M.m3/d)			0.930	0.643	0.02
N1	N2		240.0	33.0	0.23	1.661	8.052	728.4	661.2	0.0	1,389.6	102.3	1,287.3	–	–	–	0.926	0.692	0.02
N2	N3		207.0	34.0	0.20	1.968	6.391	1,287.3	1,502.5	0.0	2,789.8	241.7	2,548.1	–	–	–	0.913	0.747	0.02
N3	N4		173.0	32.0	0.16	2.315	4.423	2,548.1	2,789.5	0.0	5,337.6	539.7	4,797.9	–	–	–	0.899	0.817	0.02
N4	IP2		141.0	5.0	0.14	0.413	2.109	4,797.9	4,040.8	0.0	8,838.7	166.7	8,672.0	–	–	–	0.981	0.909	0.02
IP2	J10		136.0	18.0	0.13	1.603	1.695	8,672.0	0.0	0.0	8,672.0	617.0	8,055.1	25.90	2.24	3.6	0.929	0.927	0.02
J10	SP5		118.0	0.5	0.12	0.048	0.093	8,055.1	0.0	0.0	8,055.1	17.9	8,037.2	–	–	–	0.998	0.998	0.02
SP5	R3	*	117.5	0.5	0.13	0.045	0.045	33,524.2	0.0	0.0	33,524.2	0.0	33,524.2	173.50	14.99	2.2	1.000	1.000	0.00
R3	C8		117.0	3.0	0.13	0.267	5.681	33,524.2	0.0	0.0	33,524.2	0.0	33,524.2	–	–	–	1.000	1.000	0.00
C8	IP3		114.0	16.0	0.12	1.543	5.414	33,524.2	1,617.9	0.0	35,142.1	0.0	35,142.1	208.30	18.00	2.0	1.000	1.000	0.00
IP3	C9		98.0	5.0	0.12	0.462	3.870	35,142.1	0.0	5,056.6	30,085.5	0.0	30,085.5	–	–	–	1.000	1.000	0.00
C9	IP4		93.0	19.0	0.11	1.999	3.368	30,085.5	28,854.7	0.0	58,940.2	0.0	58,940.2	221.30	19.12	3.1	1.000	1.000	0.00
IP4	C10		74.0	11.0	0.10	1.273	1.369	58,940.2	0.0	8,908.9	50,031.4	0.0	50,031.4	–	–	–	1.000	1.000	0.00
C10	R4 (J5)	*	63.0	1.0	0.10	0.116	0.116	50,031.4	56,728.7	0.0	106,760.1	0.0	106,760.1	198.10	17.12	6.2	1.000	1.000	0.00
R4 (J5)	–		62.0	–	–	–	–	106,760.1	0.0	0.0	106,760.1	–	–	–	–	–	–	–	–

R0–R4: Water quality checking point
C1–C10, L1–L4, P1–P2, N0–N4: Pollution load inflow point
IP1–IP4: Water intake point
SP1–SP5: Temporary point for computation
J1–J10: Survey points by JICA team

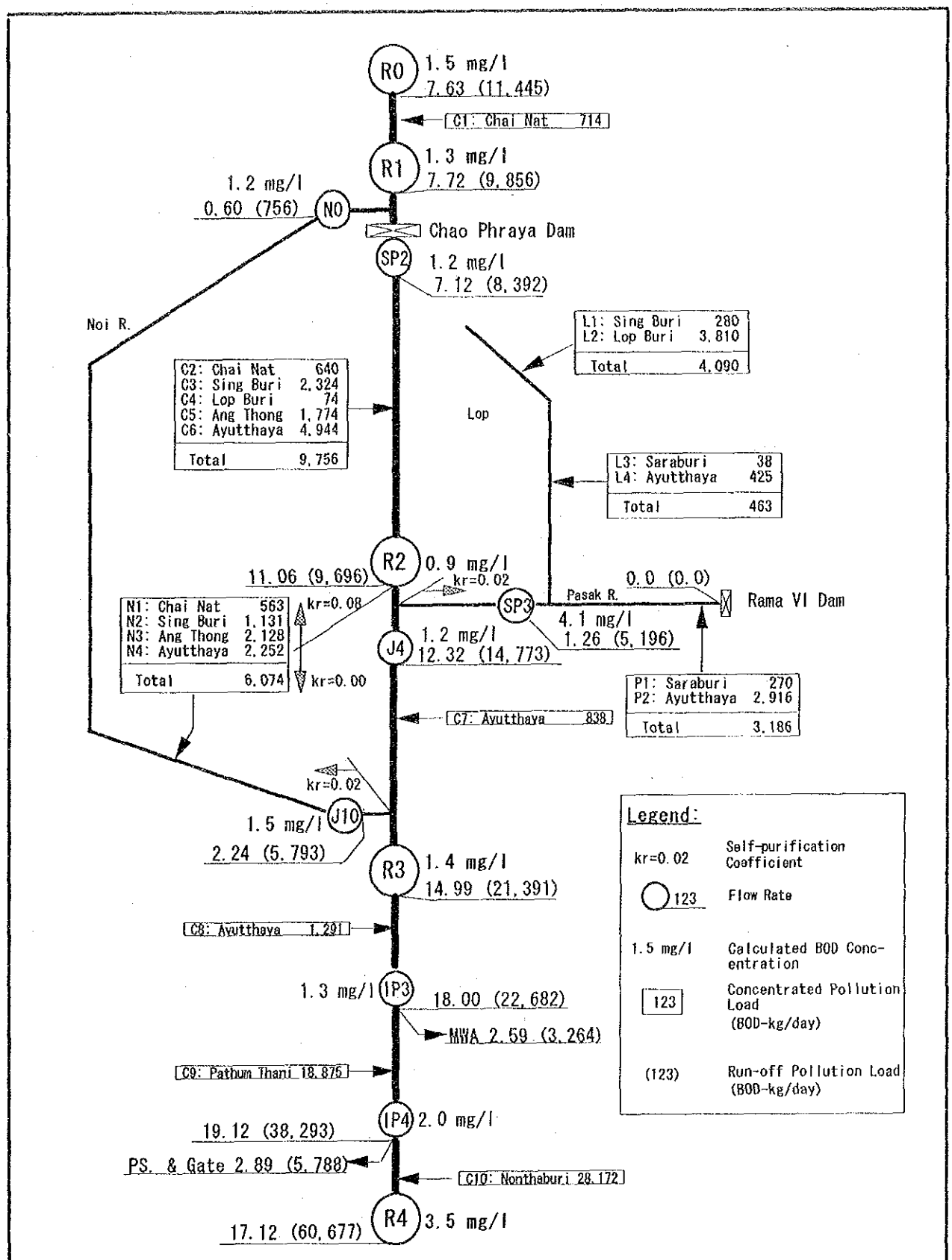

Figure 10.6.1
Future Water Pollution Analysis (1996)

STUDY ON MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT FOR LOWER CHAO PHRAYA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

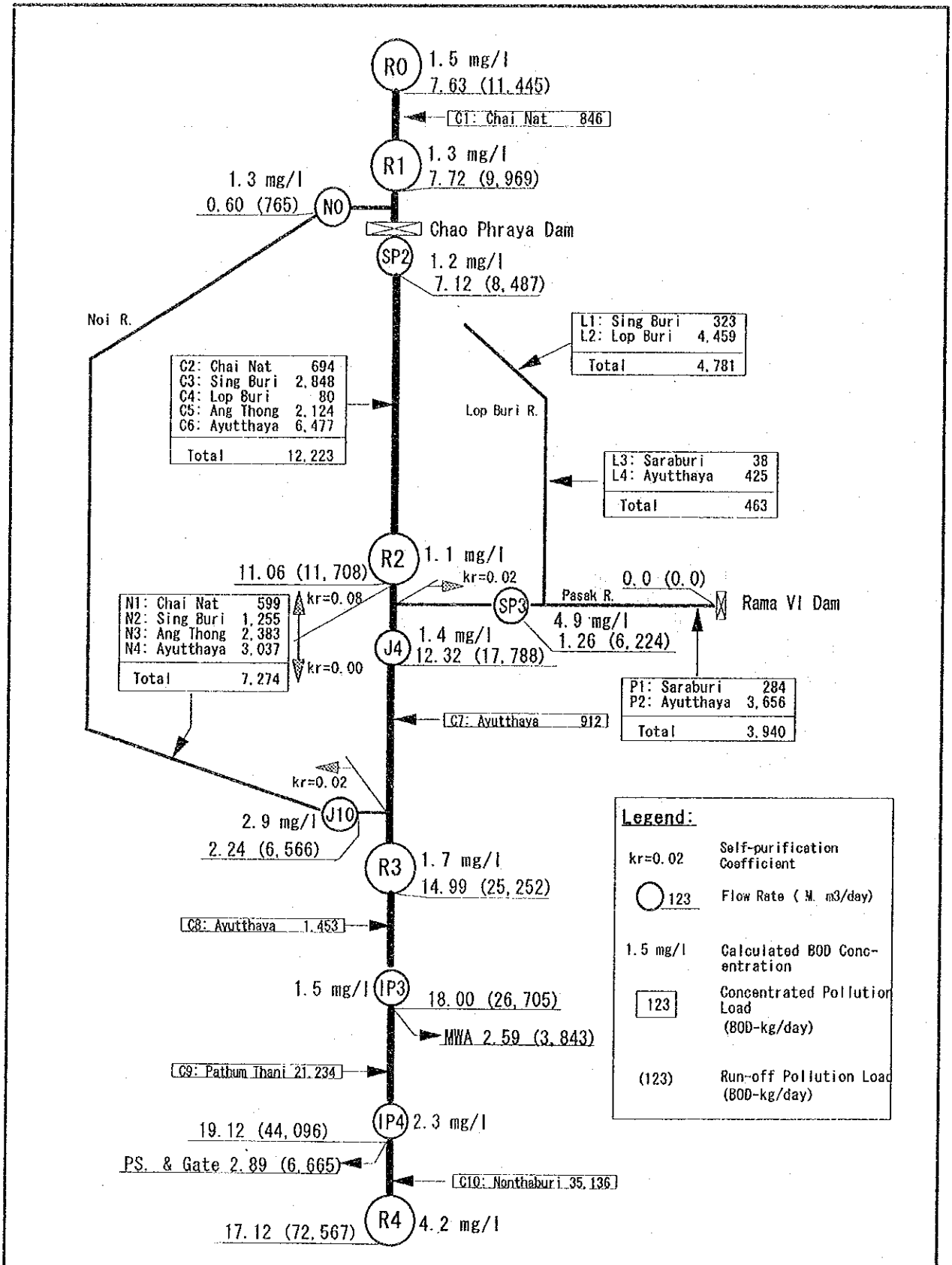

Figure 10.6.2
Future Water Pollution Analysis (2001)

STUDY ON MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT FOR LOWER CHAO PHRAYA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

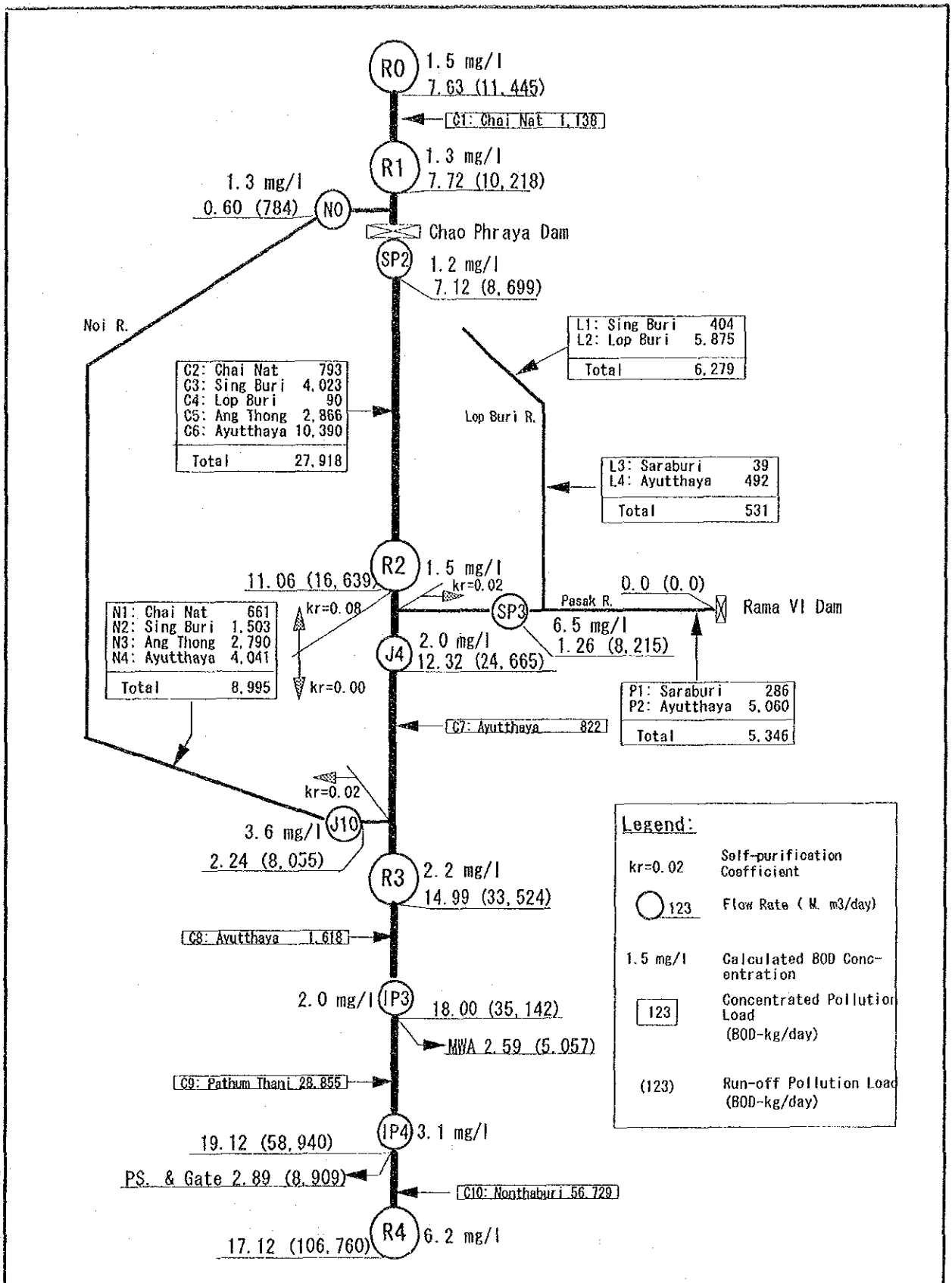

Figure 10.6.3
Future Water Pollution Analysis (2011)

STUDY ON MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT FOR LOWER CHAO PHRAYA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

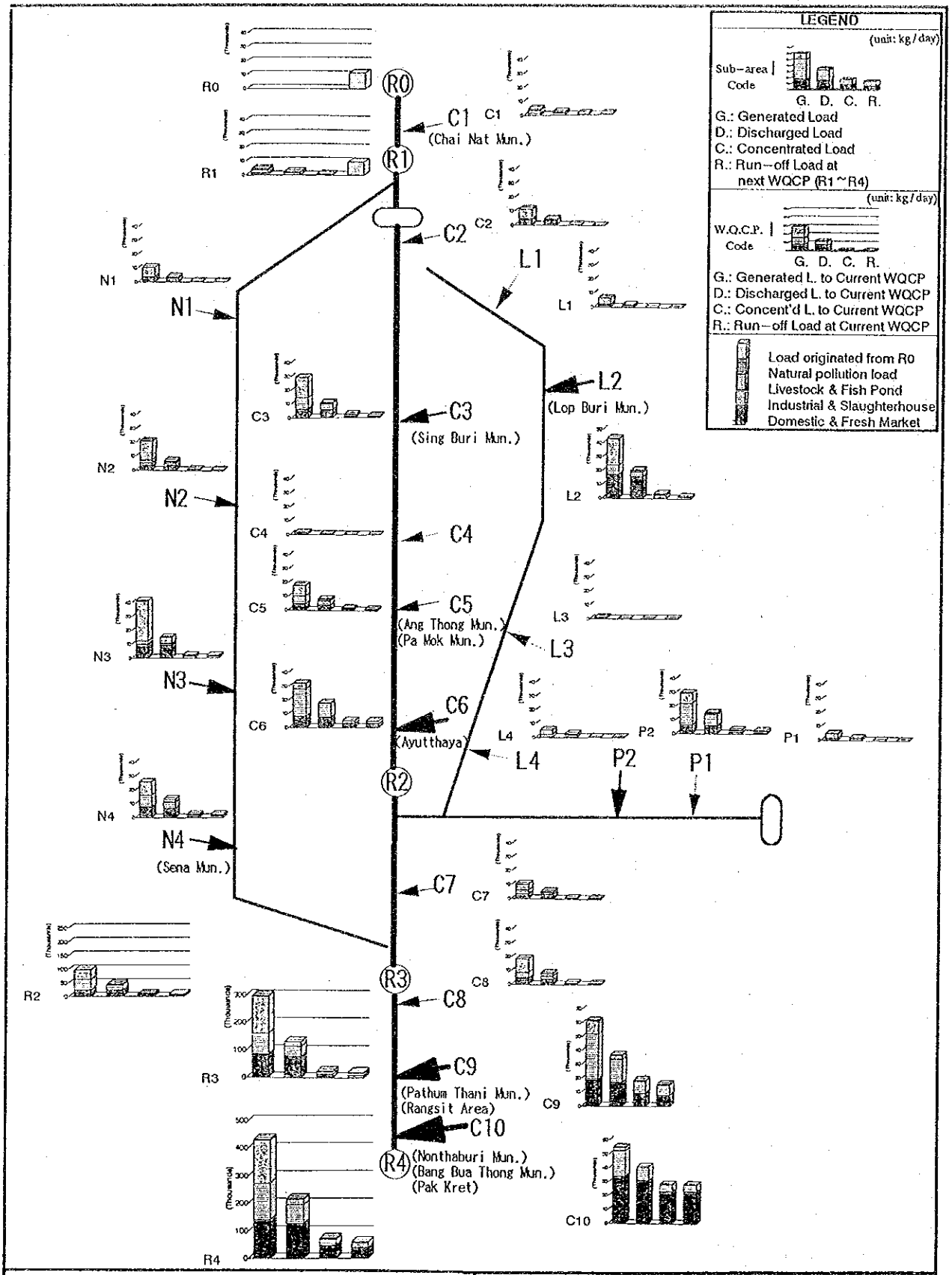

Figure 10.6.4 BOD Load by Sub-area and Run-off Load at W.Q.C.P.(1996)

STUDY ON MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT FOR LOWER CHAO PHRAYA RIVER BASIN

JAPAN INTERNATIONAL COOPERATION AGENCY

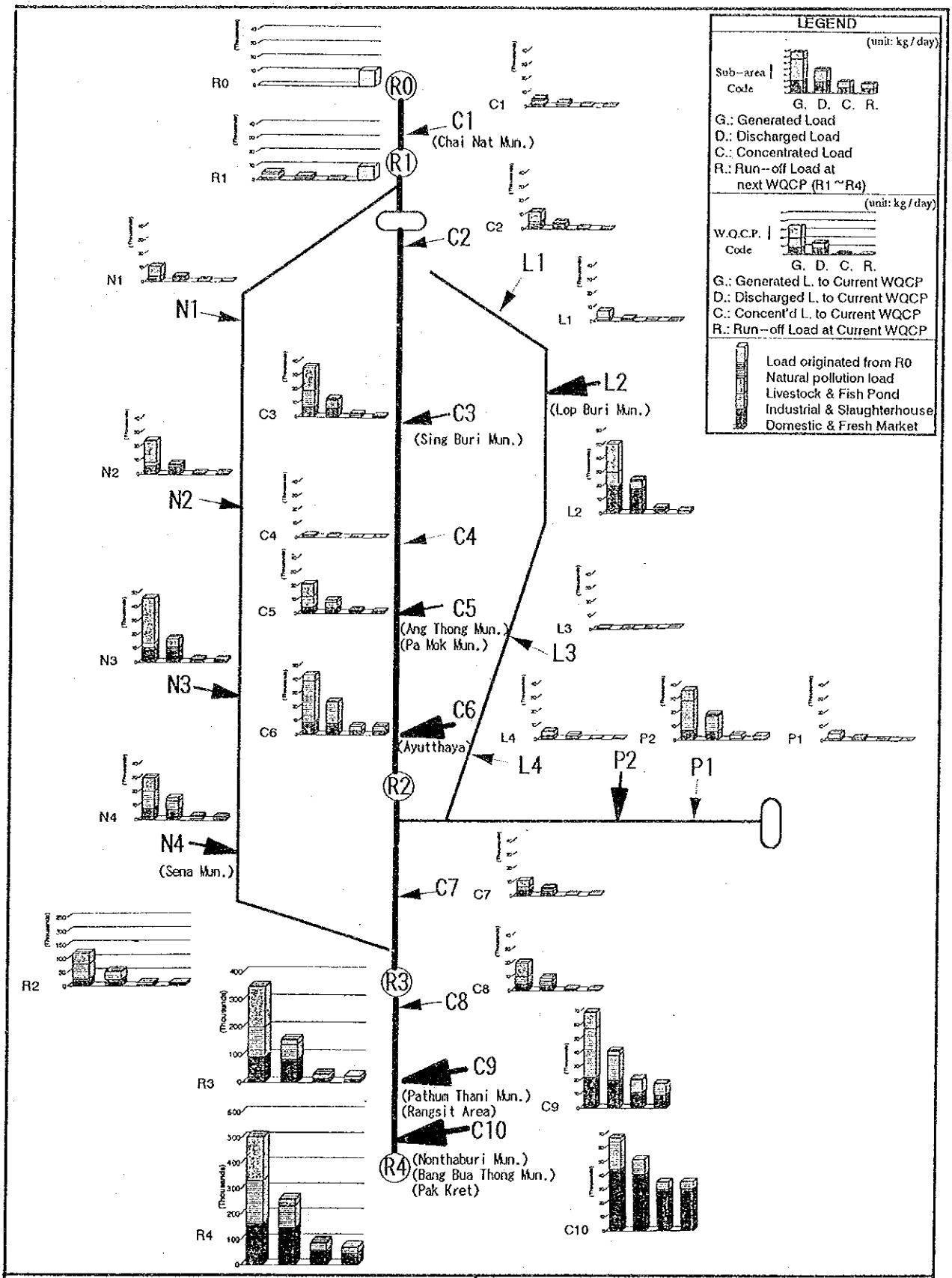

Figure 10.6.5 BOD Load by Sub-area and Run-off Load at W.Q.C.P.(2001)

STUDY ON MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT FOR LOWER CHAO PHRAYA RIVER BASIN

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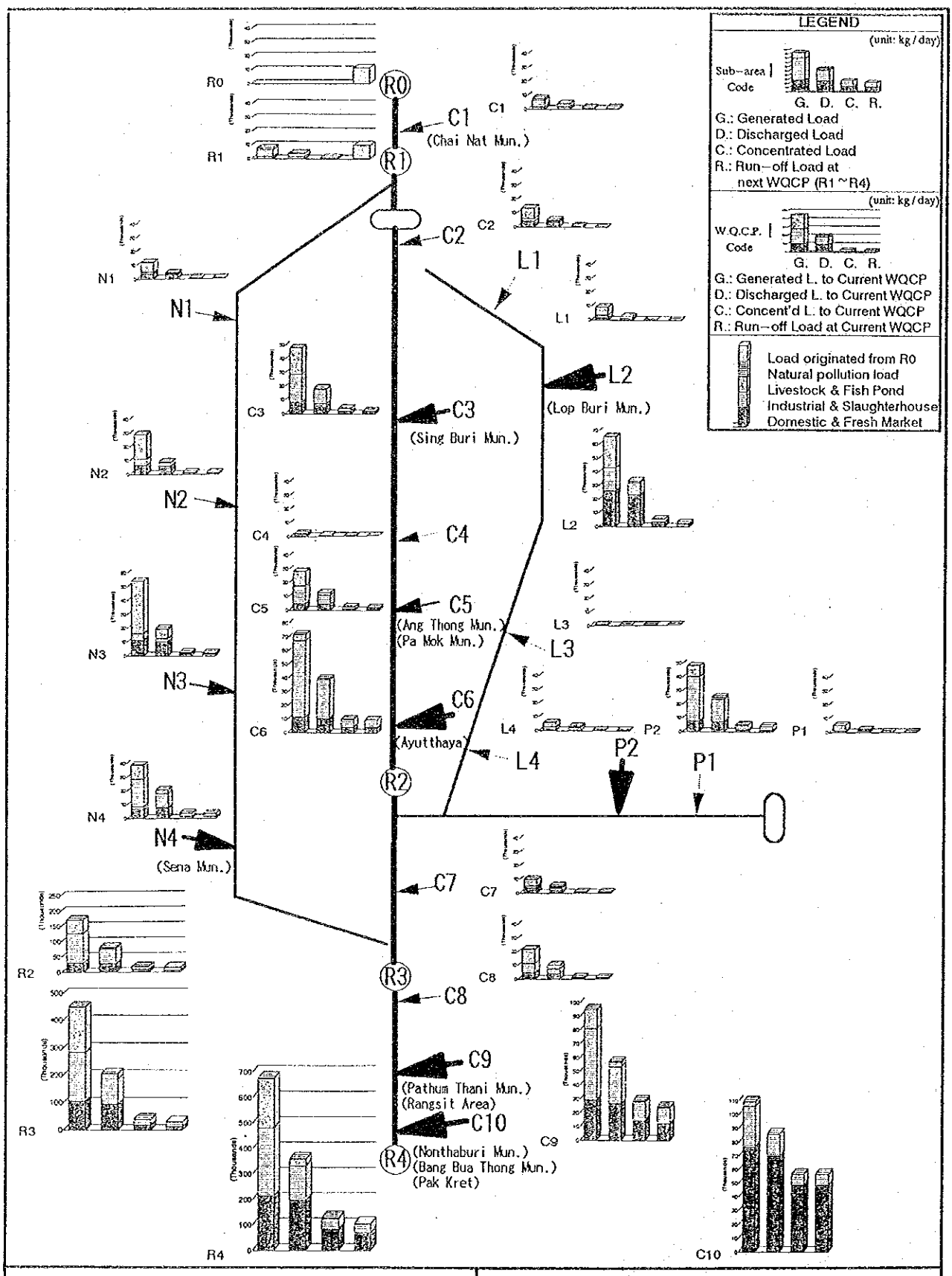

Figure 10.6.6 BOD Load by Sub-area and Run-off Load at W.Q.C.P.(2011)

STUDY ON MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT FOR LOWER CHAO PHRAYA RIVER BASIN

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Table 10.6.4 Summary of Future Water Pollution Analysis

Water Q'ty Check Point	Location	Env. Std. (mg/l)	Calculation Result 1996	2001	2011
R1	Chao Phraya R., before diversion to Noi R.	1.5	1.3	1.3	1.3
R2	Chao Phraya R., before confluence of Pasak R.	1.5	0.9	1.1	1.5
R3	Chao Phraya R., after confluence of Noi R.	2.0	1.4	1.7	2.2
R4	Chao Phraya R., Nonthaburi	2.0	3.5	4.2	6.2
SP2	Chao Phraya R., Chai Nat Dam	1.5	1.2	1.2	1.2
N0	Noi R., after diversion from Chao Phraya R.	-	1.2	1.3	1.3
SP3	Pasak R., before confluence of Chao Phraya R.	-	4.1	4.9	6.5
J4	Chao Phraya R., after confluence of Pasak R.	2.0	1.2	1.4	2.0
J10	Noi R., before confluence of Chao Phraya R.	-	1.5	2.9	3.6
IP3	Chao Phraya R., before intake of MWA	2.0	1.3	1.5	2.0
IP4	Chao Phraya R., before intake of irrigation.	2.0	2.0	2.3	3.1

Following findings are derived from the table:

- Water quality at R4 exceeds the environmental water quality standard from the year 1996 up to final target year.

- Water quality at R3 exceeds the environmental water quality standard in the final target year.

- Water quality of Pasak river at the confluence of Chao Phraya river (SP3) exceeds 2.0 mg/l from the year 1996.

- Water quality of Noi river at the confluence of Chao Phraya river (J10) exceeds 2.0 mg/l from the year 2001.

- At the intake point of MWA, water quality is less than 2.0 mg/l through target years.

CHAPTER 11

POLLUTION LOAD TO BE REDUCED BY POLLUTION SOURCE

CHAPTER 11 POLLUTION LOAD TO BE REDUCED BY POLLUTION SOURCE

11.1 General

Pollution load to be reduced by target year at each water quality checking point is calculated comparing the run-off load with allowable pollution load.

The allowable pollution load by different pollution source at each water quality checking point can be determined in proportion to the composition of their present run-off load. This is directly related to the urgent need to reduce pollution load at present because water quality at some portions of the subject basin is already critical and has to meet the water quality standards. The allocation of pollution load to be reduced by concerned pollution sources will be made considering the different countermeasures against respective sources: sewerage systems and sanitation improvement for domestic wastewater and fresh market, effluent control regulations for industrial wastewater and slaughterhouse, and effluent control/improvement of breeding method for livestock and fishpond. Figure 11.1.1 shows the manner of calculation for allowable pollution load by pollution source.

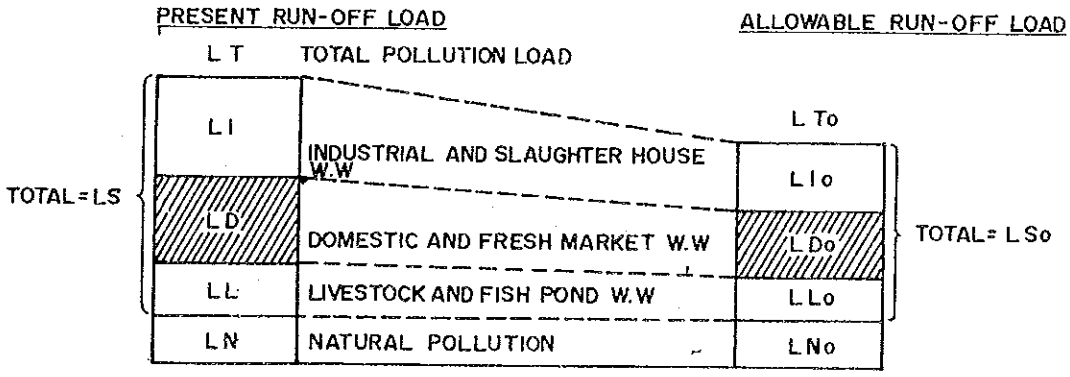


Figure 11.1.1 Manner of Calculation for Allowable Pollution Load by Pollution Source

In Figure 11.1.1, the allowable load by source is expressed as follows:

$$LI_0 = LS_0 \times LI/LS$$
$$LD_0 = LS_0 \times LD/LS$$
$$LC_0 = LS_0 \times LC/LS$$
$$LN_0 = LN$$

11.2 Allowable Pollution Load by Pollution Source at Respective Water Quality Checking Points

Allowable pollution load at each checking point is calculated using environmental standards and established flow rates. The composition of the present run-off load by pollution source at each water quality checking point was studied to come up with the percentages for allocation of total allowable load as indicated in Table 11.2.1. The following are conditions/assumptions in order to arrive at allowable pollution load by pollution source as shown in Table 11.2.2.

Table 11.2.1 Compositon of Present Run-off BOD Load by Pollution Source Category

Water Quality Checking Point	Pollution Load Remaining Ratio by Sub-area		BOD Load Source Category	W.Q.C.P. Concent'd BOD Load (kg/day)	Run-off BOD Load from Upstream (kg/day)	W.Q.C.P. Run-off BOD Load (kg/day)	Total Run-off BOD Load (kg/day)	Composition of Run-off BOD Load	
	Sub-area	PLRR						Total*4 (%)	WQCP*5 (%)
R1	R0	0.808	A	464	–	396	396	4.1	78.7
	C1	0.652	B	117	–	100	100	1.0	19.9
			C	9	–	7	7	0.1	1.4
			D	26	–	22	22	0.2	–
			R0	11,445	9,248 *1	–	9,248	94.6	–
			Total	12,061	9,248	525	9,773	100.0	100.0
R2	R1	0.116	A	4,857	46	3,610	3,656	51.6	64.0
	C2	0.292	B	2,382	12	1,853	1,865	26.3	32.9
	C3	0.479	C	297	1	177	178	2.5	3.1
	C4	0.604	D	554	3	313	316	4.5	–
	C5	0.685	R0	–	1,073	–	1,073	15.1	–
	C6	0.962	Total	8,090	1,135	5,953	7,088	100.0	100.0
(Pasak)	P1	0.766	A	1,067	–	884	884	40.8	45.5
	P2	0.838	B	1,142	–	957	957	44.2	49.2
			C	128	–	104	104	4.8	5.3
			D	270	–	220	220	10.2	–
			Total	2,607	–	2,165	2,165	100.0	100.0
(Lop Buri)	L1	0.383	A	2,775	–	1,480	1,480	68.1	78.8
	L2	0.499	B	565	–	292	292	13.4	15.6
	L3	0.611	C	186	–	105	105	4.8	5.6
	L4	0.911	D	541	–	298	298	13.7	–
			Total	4,067	–	2,175	2,175	100.0	100.0
(Noi)	N0	0.556	A	3,220	32 *2	2,293	2,325	47.5	65.8
	N1	0.598	B	980	8 *2	731	739	15.1	21.0
	N2	0.646	C	646	1 *2	458	459	9.4	13.2
	N3	0.706	D	894	2 *2	624	626	12.8	–
	N4	0.786	R0	–	743 *2	–	743	15.2	–
			Total	5,740	786	4,106	4,892	100.0	100.0
R3	R2	1.000	A	377	8,345 *3	377	8,722	51.0	57.3
	C7	1.000	B	232	3,853 *3	232	4,085	23.9	35.3
			C	49	845 *3	49	894	5.2	7.4
			D	114	1,459 *3	114	1,573	9.2	–
			R0	–	1,816 *3	–	1,816	10.6	–
			Total	772	16,318	772	17,090	99.9	100.0
R4	R3	0.721	A	28,014	6,288	26,358	32,646	65.9	72.5
	C8	0.721	B	10,787	2,945	9,473	12,418	25.1	26.0
	C9	0.817	C	653	645	533	1,178	2.4	1.5
	C10	1.000	D	1,001	1,134	845	1,979	4.0	–
			R0	–	1,309	–	1,309	2.6	–
			Total	40,455	12,321	37,209	49,530	100.0	100.0

Note:

*1: Pollution load originated from the river flow at R0 was included in the calculation.
However, it has no effect on the calculation result of the run-off BOD load composition.

*2: Diversion to Noi river from downstream of R1 (1.53 M m3/d).
(R1 Runoff Load) x (PLRR from R1 to diversion point 0.987) x (1.53/10.45) x 0.556

*3: R2 + (Pasak R.) + (Lop Buri R.) + (Noi R.)

*4: Percentage in total run-off load

*5: Percentage of A, B, C for run-off load in the section

BOD Load Source Category:

A: Domestic + Fresh Market wastewater
B: Factory + Slaughterhouse wastewater
C: Livestock + Fish Pond wastewater
D: Natural Pollution – Fixed Pollution Load
R0: Run-off Load originated from R0

Table 11.2.2 Allowable Pollution Load by Source Category

Water Quality Checking Point	Flow Rate (Million m3/day)	Water Quality Standard (BOD–mg/l)	Allowable Run–off Pollution Load (BOD–kg/d)	Pollution Load Source Category	Present Run–off P.L. Composition (%)	Allowable Run–off Pollution Load (BOD–kg/d)
R1	7.72	1.5	/ 2,310 | \ 22 *1 9,248 *2 11,580	A B C D R0 Total	78.7 19.9 1.4 – – 100.0	1,818 460 32 22 9,248 11,580
R2	11.06	1.5	/ 14,931 | \ 316 *1 1,343 *2 16,590	A B C D R1 Total	64.0 32.9 3.1 – – 100.0	9,556 4,912 463 316 1,343 16,590
R3	14.99	2.0	/ 10,874 | \ 1,573 *1 17,533 *3 29,980	A B C D R2 Total	57.3 35.3 7.4 – – 100.0	6,231 3,839 805 1,573 17,533 29,980
R4	17.12	2.0	/ 10,645 | \ 1,979 *1 21,616 *2 34,240	A B C D R3 Total	72.5 26.0 1.5 – – 100.0	7,718 2,768 160 1,979 21,616 34,240

Pollution Load Source Category:
A: Domestic + Fresh Market wastewater
B: Factory + Slaughterhouse wastewater
C: Livestock + Fish Pond wastewater
D: Natural Pollution – *1; Fixed Pollution Load
R0–R3: Run–off Load originated from upstream water quality checking point
– *2; Run–off Pollution Load x Pollution Load Remaining Ratio
– *3; Run–off Pollution Load x Pollution Load Remaining Ratio (R2, N0)

- Flow rate: Study results in sub-section 9.5.2
- Remaining ratio after purification:
  Assumed values shown in Table 11.2.3 (self-purification coefficients recommended in sub-section 9.5.3 were adopted)
- Outflow of pollution load:
  Reduction in proportion to diversion rate
- Natural pollution load: The load is deducted from allowable pollution load at respective checking point
- Run-off pollution load from upstream checking point to study checking point: Allowable pollution load at the checking point

11.3 Pollution Load to be Reduced by Pollution Source by Water Quality Checking Point

Based on the allowable pollution load by pollution source, the required pollution load to be reduced by pollution source at each water quality checking point was calculated as summarized in Tables 11.3.1 to 11.3.3. In this calculation, the allowable pollution load was employed as the run-off load from the water quality checking point upstream of the study point, and the pollution load remaining ratios presented in Table 11.3.4 (self-purification coefficients recommended in sub-section 9.5.3 were adopted) were employed.

Details of calculation are presented in Supporting Report 11.3.
The following are major findings on the reduction requirements from the study on different pollution sources.

- Category A: Domestic and fresh market
  The section R3-R4(R4 basin) needs to reduce pollution load from the year 1996 through the final target year. R2-R3 section(R3 basin) needs to reduce pollution load in the year 2011.

- Category B: Factory and slaughterhouse
  Only the section R3-R4 needs to reduce pollution load starting from the year 1996. However, it will be extended to section R2-R3 in 2001 and further up to section R1-R2 in 2011.

Table 11.2.3 Present Pollution Load Remainig Ratio by Sub-area

Section	Pollution Load Remaining Ratio
R1	
R0 – R1:	0.808
C1 – R1:	0.852
R2	
R1 – R2:	0.116 = 0.262 x { 1 – (1.53 / 10.45) } x [1 – { 4.3 / (10.45 – 1.53) }] diversion to Noi R. storage by Chao Phraya Dam
C2 – R2:	0.292
C3 – R2:	0.479
C4 – R2:	0.604
C5 – R2:	0.685
C6 – R2:	0.962
R3	
R2 – R3:	1.000
C7 – R3:	1.000
L1 – R3:	0.383
L2 – R3:	0.499
L3 – R3:	0.811
L4 – R3:	0.911
P1 – R3:	0.766
P2 – R3:	0.838
N0 – R3:	0.556 = 0.643 x { 1 – (0.70 / 5.17) } diversion by P.S. & Gate
N1 – R3:	0.598 = 0.692 x { 1 – (0.70 / 5.17) }
N2 – R3:	0.646 = 0.747 x { 1 – (0.70 / 5.17) }
N3 – R3:	0.706 = 0.817 x { 1 – (0.70 / 5.17) }
N4 – R3:	0.786 = 0.909 x { 1 – (0.70 / 5.17) }
R4	
R3 – R4:	0.721 = 1.000 x { 1 – (2.59 / 22.08) } x { 1 – (4.25 / 23.18) } diversion by MWA diversion by P.S. & Gate
C8 – R4:	0.721 = 1.000 x { 1 – (2.59 / 22.08) } x { 1 – (4.25 / 23.18) }
C9 – R4:	0.817 = 1.000 x { 1 – (4.25 / 23.18) } diversion by P.S. & Gate
C10 – R4:	1.000

Note: Pollution load remaining ratios presented in Table 10.6.1 were employed in principal. Those values were computed adopting the self-purification coefficient recommended in sub-section 9.5.3.

Table 11.3.1 Required Pollution Load Reduction (Category A)

1996

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduction
R1	508	433	1,818	-1,385
R2	5,413	4,077	9,556	-5,479
R3	7,939	5,738	6,231	-493
R4	32,995	31,442	7,718	23,724

2001

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduc'n
R1	553	471	1,818	-1,347
R2	6,157	4,686	9,556	-4,870
R3	8,662	6,236	6,231	5
R4	41,150	39,353	7,718	31,635

2011

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduc'n
R1	653	556	1,818	-1,262
R2	7,962	6,187	9,556	-3,369
R3	10,185	7,282	6,231	1,051
R4	63,451	61,168	7,718	53,450

Table 11.3.2 Required Pollution Load Reduction (Category B)

1996

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduction
R1	172	147	460	-313
R2	3,480	2,731	4,912	-2,181
R3	4,032	3,193	3,839	-646
R4	13,554	12,171	2,768	9,403

2001

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduction
R1	260	221	460	-239
R2	5,174	4,082	4,912	-830
R3	5,593	4,391	3,839	552
R4	14,775	13,254	2,768	10,486

2011

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduction
R1	452	385	460	-75
R2	9,271	7,418	4,912	2,506
R3	8,421	6,486	3,839	2,647
R4	21,719	19,510	2,768	16,742

Table 11.3.3 Required Pollution Load reduction (Category C)

1996

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduction
R1	8	7	32	-25
R2	309	194	463	-269
R3	1,161	924	805	119
R4	788	660	160	500

2001

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduction
R1	8	7	32	-25
R2	336	219	463	-244
R3	1,332	1,072	805	267
R4	897	751	160	591

2011

Water Quality Checking Point	Concentrated BOD Load (kg/day)	Run-off BOD Load (kg/day)	Allowable Pollution Load (kg/day)	Required Run-off Load Reduction
R1	8	6	32	-26
R2	374	252	463	-211
R3	1,547	1,259	805	454
R4	1,031	863	160	703

Table 11.3.4 Pollution Load Remainig Ratio by Sub-area in the Future

Section	Pollution Load Remaining Ratio
R1	
R0 – R1:	0.808
C1 – R1:	0.852
R2	
R1 – R2:	0.242 = 0.262 x { 1 – (0.60 / 7.72) } (diversion to Noi R.)
C2 – R2:	0.292
C3 – R2:	0.479
C4 – R2:	0.604
C5 – R2:	0.685
C6 – R2:	0.962
R3	
R2 – R3:	1.000
C7 – R3:	1.000
L1 – R3:	0.383
L2 – R3:	0.499
L3 – R3:	0.811
L4 – R3:	0.911
P1 – R3:	0.766
P2 – R3:	0.838
N0 – R3:	0.643
N1 – R3:	0.692
N2 – R3:	0.747
N3 – R3:	0.817
N4 – R3:	0.909
R4	
R3 – R4:	0.727 = 1.000 x { 1 – (2.59 / 18.00) } x { 1 – (2.89 / 19.12) } (diversion by MWA; diversion by P.S. & Gate)
C8 – R4:	0.727 = 1.000 x { 1 – (2.59 / 18.00) } x { 1 – (2.89 / 19.12) }
C9 – R4:	0.849 = 1.000 x { 1 – (2.89 / 19.12) } (diversion by P.S. & Gate)
C10 – R4:	1.000

Note: Pollution load remaining ratios presented in Table 10.6.1 were employed in principal. Those values were computed adopting the self-purification coefficient recommended in sub-section 9.5.3.

- Category C: Livestock and fish pond

  The sections R2-R3 and R3-R4 are required to reduce pollution load starting from 1996.

11.4 Pollution Load to be Reduced at Respective Sub-area by Pollution Source

Required amount of pollution load to be reduced at respective checking points as reflected in Section 11.2 was broken down into related pollution load inflow points or sub-area.

Table 11.4.1 shows the present share of run-off pollution load for each sub-area at each water quality checking point. Using these percentages, the allowable pollution load at the checking points were allocated to sub-areas by pollution source as shown in Table 11.4.2. Required reduction amount of run-off load can be obtained by subtracting the allowable load from run-off pollution load of respective sub-areas. Table 11.4.2 presents the results of the calculations on P3 and R4 points(domestic pollution load). More than half of the pollution load in Category A discharged in section R3-R4 shall be reduced throuth the future to achieve the environmental water quality standard. However, among the related sub-areas in the section, the required reduction amount of discharged pollution load of the sub-area C8, the part of Ayutthaya province, is around 15-16% of the projected load through out the future.

Table 11.4.3 presents the results of the same calculation for Category B. in the section R1-R2. In this calculation, the required reduction amount of pollution load in section R3-R4 will be increased up to more than 86 % of the projected discharged load in the year 2011.

Table 11.4.4 presents the calculation results for Category C. As a result, the required reduction amount of pollution load in the section R3-R4 will be increased up to more than 80% of the projected discharged load. Not only in the section R3-R4 but in upper section of R2-R3 pollution reduction is necessary to attain the environmental quality standard.

Table 11.4.1 Present Share of Run-off Pollution Load by Each Sub-area

Water Quality Check. Point	Sub-area Code	Pollution Load Remain'g Ratio	Category A							Category B					Category C					Category D		
			Domestic			Fresh Market	Conc'd L. Sub-total	Run-off Load	Share (%)	Factory	S.H.	Conc'd L. Sub-total	Run-off Load	Share (%)	Live-stock	Fish Pond	Conc'd L. Sub-total	Run-off Load	Share (%)	Natural Pollution	Run-off Load	Share (%)
			Urban	S.urban	Rural																	
R1	C1	0.852	394	0	50	20	464	395	100.0	115	2	117	100	100.0	8	1	9	8	100.0	26	22	100.0
R2	C2	0.292	0	60	290	0	350	102	2.8	66	0	66	19	1.0	43	5	47	14	7.9	144	42	13.4
	C3	0.479	619	152	358	20	1,149	550	15.2	582	1	582	279	15.0	103	3	106	51	28.8	185	89	28.4
	C4	0.604	0	0	42	0	42	25	0.7	0	0	0	0	0.0	6	0	6	4	2.3	22	13	4.2
	C5	0.685	557	125	204	40	926	634	17.6	404	3	407	279	15.1	87	3	90	62	35.0	94	64	20.5
	C6	0.962	2,142	0	228	20	2,390	2,299	63.7	1,320	7	1,326	1,276	68.9	44	4	48	46	26.0	109	105	33.5
	Total	-	3,318	337	1,122	80	4,857	3,610	100.0	2,371	11	2,382	1,853	100.0	283	14	297	177	100.0	554	313	100.0
R3	C7	1.000	0	128	249	0	377	377	7.0	232	0	232	232	10.0	46	2	49	49	6.2	114	114	8.4
	N1	0.692	0	61	253	0	314	217	4.0	37	0	37	26	1.1	42	6	48	33	4.2	142	98	7.2
	N2	0.747	0	356	298	0	655	489	9.1	134	0	134	100	4.3	96	5	101	75	9.5	172	128	9.5
	N3	0.817	0	386	700	0	1,085	886	16.4	171	0	171	140	6.0	327	9	337	275	35.0	351	287	21.2
	N4	0.909	133	739	274	20	1,166	1,060	19.7	639	0	639	581	25.0	93	68	161	146	18.6	229	208	15.4
	N ST.	-	133	1,542	1,525	20	3,220	2,652	49.2	980	0	980	847	36.4	558	88	646	529	67.3	894	721	53.3
	P1	0.766	0	0	131	0	131	100	1.9	0	0	0	0	0.0	47	0	47	36	4.6	80	61	4.5
	P2	0.838	216	356	344	20	936	784	14.5	1,141	1	1,142	957	41.1	77	4	81	68	8.6	190	159	11.7
	P ST.	-	216	356	475	20	1,067	884	16.4	1,141	1	1,142	957	41.1	125	4	128	104	13.2	270	220	16.2
	L1	0.383	0	0	106	0	106	41	0.8	65	0	65	25	1.0	30	1	31	12	1.5	54	21	1.6
	L2	0.499	1,081	258	1,046	20	2,405	1,200	22.2	454	3	457	228	9.8	109	6	115	57	7.2	403	201	14.9
	L3	0.811	0	0	16	0	16	13	0.2	0	0	0	0	0.0	8	0	8	6	0.8	13	11	0.8
	L4	0.911	0	122	127	0	249	227	4.2	43	0	43	39	1.7	29	4	33	30	3.8	71	65	4.8
	L ST.	-	1,081	380	1,294	20	2,775	1,481	27.4	562	3	565	292	12.5	175	11	186	105	13.3	541	298	22.1
	Total	-	1,429	2,406	3,543	60	7,438	5,394	100.0	2,915	4	2,919	2,328	100.0	905	105	1,009	787	100.0	1,819	1,353	100.0
R4	C8	0.727	0	38	367	0	405	294	1.1	354	0	354	257	2.7	98	56	154	112	20.4	241	175	20.3
	C9	0.849	6,504	498	1,390	36	8,429	7,156	26.9	6,589	53	6,642	5,639	58.2	288	131	419	356	65.0	486	413	47.9
	C10	1.000	18,167	0	904	108	19,180	19,180	72.0	3,775	17	3,792	3,792	39.1	40	40	80	80	14.6	274	274	31.8
	Total	-	24,672	536	2,662	144	28,014	26,630	100.0	10,717	70	10,787	9,688	100.0	425	228	653	548	100.0	1,001	862	100.0

Table 11.4.2 Alloaction of Required Pollution Load Reduction (Category A)

1996

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R4	C8	3,910	412	0.727	300	1.1	85	215	296	0.5	591	15.1
	C9	17,084	9,543	0.849	8,102	26.9	2,076	6,026	7,098	0.9	7,886	46.2
	C10	30,905	23,041	1.000	23,041	72.0	5,557	17,484	17,484	0.9	19,427	62.9
	Total	51,899	32,996	0.953	31,443	100.0	7,718	23,725	24,877	–	27,905	53.8

2001

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R4	C8	4,041	426	0.727	310	1.1	85	225	309	0.5	619	15.3
	C9	19,951	11,129	0.849	9,449	26.9	2,076	7,373	8,684	0.9	9,649	48.4
	C10	40,676	29,595	1.000	29,595	72.0	5,557	24,038	24,038	0.9	26,709	65.7
	Total	64,668	41,150	0.956	39,354	100.0	7,718	31,636	33,032	–	36,977	57.2

* : (Allowable Run-off Load at R4, 7,718) x Present Share
** : (Required Run-off Load Reduction) / (Pollution Load Remaining Ratio)
***: (Required Concentrated Load Reduction) / (Concentration Rate)

Table 11.4.2 Alloaction of Required Pollution Load Reduction (Category A) (cont'd)

2011

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R3	C7	3,576	487	1.000	487	7.0	436	51	51	0.5	102	2.9
	N1	3,232	362	0.692	251	4.0	249	2	3	0.5	6	0.2
	N2	6,263	861	0.747	643	9.1	567	76	102	0.5	203	3.2
	N3	10,393	1,299	0.817	1,062	16.4	1,022	40	49	0.5	98	0.9
	N4	7,969	1,529	0.909	1,390	19.7	1,228	162	178	0.5	356	4.5
	P1	1,170	117	0.766	90	1.9	118	–	–	0.5	–	–
	P2	7,095	1,398	0.838	1,171	14.5	903	268	320	0.5	640	9.0
	L1	1,327	133	0.383	51	0.8	50	1	3	0.5	5	0.4
	L2	23,420	3,650	0.499	1,821	22.2	1,383	438	878	0.5	1,756	7.5
	L3	113	11	0.811	9	0.2	12	–	–	0.5	–	–
	L4	2,301	339	0.911	309	4.2	262	47	52	0.5	103	4.5
	Total	66,859	10,185	0.715	7,284	100.0	6,231	1,085	1,635	–	3,269	4.9
R4	C8	4,151	440	0.727	320	1.1	85	235	323	0.5	646	15.6
	C9	26,465	14,322	0.849	12,159	26.9	2,076	10,083	11,876	0.9	13,196	49.9
	C10	70,077	48,689	1.000	48,689	72.0	5,557	43,132	43,132	0.9	47,924	68.4
	Total	100,693	63,451	0.964	61,168	100.0	7,718	53,450	55,332	–	61,767	61.3

* : (Allowable Run-off Load at R3, 6,231) x Present Share
: (Allowable Run-off Load at R4, 7,718) x Present Share
** : (Required Run-off Load Reduction) / (Pollution Load Remaining Ratio)
***: (Required Concentrated Load Reduction) / (Concentration Rate)

Table 11.4.3 Alloaction of Required Pollution Load Reduction (Category B)

1996

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R4	C8	2,262	452	0.727	329	2.7	75	254	349	0.2	1,747	77.2
	C9	16,676	8,338	0.849	7,079	58.2	1,611	5,468	6,441	0.5	12,881	77.2
	C10	9,527	4,764	1.000	4,764	39.1	1,082	3,682	3,682	0.5	7,364	77.3
	Total	28,465	13,554	0.898	12,172	100.0	2,768	9,404	10,472	–	21,992	77.3

2001

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R3	C7	1,478	296	1.000	296	10.0	384	–	–	0.2	–	–
	N1	362	72	0.692	50	1.1	42	8	12	0.2	58	16.0
	N2	1,340	268	0.747	200	4.3	165	35	47	0.2	234	17.5
	N3	1,535	307	0.817	251	6.0	230	21	26	0.2	129	8.4
	N4	6,332	1,266	0.909	1,151	25.0	960	191	210	0.2	1,051	16.6
	P1	0	0	0.766	0	0.0	0	–	–	0.2	–	–
	P2	11,022	2,204	0.838	1,847	41.1	1,578	269	321	0.2	1,605	14.6
	L1	651	130	0.383	50	1.0	38	12	31	0.2	157	24.1
	L2	4,972	994	0.499	496	9.8	376	120	240	0.2	1,202	24.2
	L3	0	0	0.811	0	0.0	0	–	–	0.2	–	–
	L4	273	55	0.911	50	1.7	65	–	–	0.2	–	–
	Total	27,965	5,593	0.785	4,391	100.0	3,839	656	887	–	4,435	15.9
R4	C8	2,873	575	0.727	418	2.7	75	343	472	0.2	2,359	82.1
	C9	18,072	9,036	0.849	7,672	58.2	1,611	6,061	7,139	0.5	14,278	79.0
	C10	10,329	5,165	1.000	5,165	39.1	1,082	4,083	4,083	0.5	8,166	79.1
	Total	31,274	14,776	0.897	13,255	100.0	2,768	10,487	11,694	–	24,803	79.3

* : (Allowable Run-off Load at R3, 3,839) x Present Share
: (Allowable Run-off Load at R4, 2,768) x Present Share

** : (Required Run-off Load Reduction) / (Pollution Load Remaining Ratio)

***: (Required Concentrated Load Reduction) / (Concentration Rate)

Table 11.4.3 Alloaction of Required Pollution Load Reduction (Category B) (cont'd)

2011

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R2	C2	1,034	207	0.292	60	1.0	49	11	38	0.2	188	18.2
	C3	10,337	2,067	0.479	990	15.0	737	253	528	0.2	2,641	25.5
	C4	0	0	0.604	0	0.0	0	–	–	0.2	–	–
	C5	6,558	1,312	0.685	899	15.1	742	157	229	0.2	1,146	17.5
	C6	28,427	5,685	0.962	5,469	68.9	3,384	2,085	2,167	0.2	10,837	38.1
	Total	46,356	9,271	0.800	7,418	100.0	4,912	2,506	2,962	–	14,812	32.0
R3	C7	656	131	1.000	131	10.0	384	–	–	0.2	–	–
	N1	578	116	0.692	80	1.1	42	38	55	0.2	275	47.5
	N2	2,071	414	0.747	309	4.3	165	144	193	0.2	964	46.5
	N3	2,275	455	0.817	372	6.0	230	142	174	0.2	869	38.2
	N4	10,189	2,038	0.909	1,852	25.0	960	892	981	0.2	4,906	48.2
	P1	0	0	0.766	0	0.0	0	–	–	0.2	–	–
	P2	16,610	3,322	0.838	2,784	41.1	1,578	1,206	1,439	0.2	7,196	43.3
	L1	1,006	201	0.383	77	1.0	38	39	102	0.2	509	50.6
	L2	8,600	1,720	0.499	858	9.8	376	482	966	0.2	4,830	56.2
	L3	0	0	0.811	0	0.0	0	–	–	0.2	–	–
	L4	121	24	0.911	22	1.7	65	–	–	0.2	–	–
	Total	42,106	8,421	0.770	6,485	100.0	3,839	2,943	3,910	–	19,548	46.4
R4	C8	3,470	694	0.727	505	2.7	75	430	591	0.2	2,955	85.2
	C9	26,747	13,374	0.849	11,355	58.2	1,611	9,744	11,477	0.5	22,954	85.8
	C10	15,302	7,651	1.000	7,651	39.1	1,082	6,569	6,569	0.5	13,138	85.9
	Total	45,519	21,719	0.898	19,511	100.0	2,768	16,743	18,637	–	39,047	85.8

* : (Allowable Run-off Load at R2, 4,912) x Present Share
: (Allowable Run-off Load at R3, 3,839) x Present Share
: (Allowable Run-off Load at R4, 2,768) x Present Share
** : (Required Run-off Load Reduction) / (Pollution Load Remaining Ratio)
***: (Required Concentrated Load Reduction) / (Concentration Rate)

Table 11.4.4 Allocation of Required Pollution Load Reduction (Category C)

1996

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R3	C7	635	64	1.000	64	6.2	50	14	14	0.1	140	22.0
	N1	463	46	0.692	32	4.2	34	–	–	0.1	–	–
	N2	765	77	0.747	57	9.5	76	–	–	0.1	–	–
	N3	4,278	428	0.817	350	35.0	282	68	83	0.1	832	19.5
	N4	1,914	191	0.909	174	18.6	150	24	26	0.1	264	13.8
	P1	622	62	0.766	48	4.6	37	11	14	0.1	144	23.1
	P2	1,059	106	0.838	89	8.6	69	20	24	0.1	239	22.5
	L1	232	23	0.383	9	1.5	12	–	–	0.1	–	–
	L2	1,125	113	0.499	56	7.2	58	–	–	0.1	–	–
	L3	100	10	0.811	8	0.8	6	2	2	0.1	25	24.7
	L4	417	42	0.911	38	3.8	31	7	8	0.1	77	18.4
	Total	11,610	1,161	0.797	925	100.0	805	146	172	–	1,720	14.8
R4	C8	1,859	186	0.727	135	20.4	33	102	140	0.1	1,403	75.5
	C9	2,542	508	0.849	432	65.0	104	328	386	0.2	1,932	76.0
	C10	466	93	1.000	93	14.6	23	70	70	0.2	350	75.1
	Total	4,867	787	0.838	660	100.0	160	500	597	–	3,685	75.7

* : (Allowable Run-off Load at R3, 805) x Present Share
: (Allowable Run-off Load at R4, 160) x Present Share
** : (Required Run-off Load Reduction) / (Pollution Load Remaining Ratio)
***: (Required Concentrated Load Reduction) / (Concentration Rate)

Table 11.4.4 Allocation of Required Pollution Load Reduction (Category C) (cont'd)

2001

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R3	C7	755	76	1.000	76	6.2	50	26	26	0.1	260	34.4
	N1	447	45	0.692	31	4.2	34	–	–	0.1	–	–
	N2	648	65	0.747	48	9.5	76	–	–	0.1	–	–
	N3	5,407	541	0.817	442	35.0	282	160	196	0.1	1,958	36.2
	N4	2,156	216	0.909	196	18.6	150	46	51	0.1	506	23.5
	P1	744	74	0.766	57	4.6	37	20	26	0.1	261	35.1
	P2	1,260	126	0.838	106	8.6	69	37	44	0.1	442	35.0
	L1	195	20	0.383	7	1.5	12	–	–	0.1	–	–
	L2	1,091	109	0.499	54	7.2	58	–	–	0.1	–	–
	L3	120	12	0.811	10	0.8	6	4	5	0.1	49	41.1
	L4	492	49	0.911	45	3.8	31	14	15	0.1	154	31.2
	Total	13,315	1,332	0.805	1,072	100.0	805	307	363	–	3,630	27.3
R4	C8	2,114	211	0.727	153	20.4	33	120	165	0.1	1,651	78.1
	C9	2,914	583	0.849	495	65.0	104	391	461	0.2	2,303	79.0
	C10	514	103	1.000	103	14.6	23	80	80	0.2	400	77.8
	Total	5,542	897	0.837	751	100.0	160	591	706	–	4,353	78.6

* : (Allowable Run-off Load at R3, 805) x Present Share
: (Allowable Run-off Load at R4, 160) x Present Share
**: (Required Run-off Load Reduction) / (Pollution Load Remaining Ratio)
***: (Required Concentrated Load Reduction) / (Concentration Rate)

Table 11.4.4 Allocation of Required Pollution Load Reduction (Category C) (cont'd)

2011

Water Quality Check. Point	Sub-area Code	Sub-area Discharged BOD Load (kg/day)	Sub-area Concent'd BOD Load (kg/day)	Pollution Load Remaining Ratio	Sub-area Run-off BOD Load (kg/day)	Run-off P. Load Present Share (%)	Sub-area Allowable Run-off Load *	Required Run-off Load Reduction	Required Concent'd Load Reduction**	Concen-tration Ratio	Required Discharged Load Reduction***	Ratio to Discharged Load (%)
R3	C7	902	90	1.000	90	6.2	50	40	40	0.1	400	44.3
	N1	415	42	0.692	29	4.2	34	–	–	0.1	–	–
	N2	551	55	0.747	41	9.5	76	–	–	0.1	–	–
	N3	6,841	684	0.817	559	35.0	282	277	339	0.1	3,390	49.6
	N4	2,452	245	0.909	223	18.6	150	73	80	0.1	803	32.8
	P1	892	89	0.766	68	4.6	37	31	40	0.1	405	45.4
	P2	1,506	151	0.838	126	8.6	69	57	68	0.1	680	45.2
	L1	164	16	0.383	6	1.5	12	–	–	0.1	–	–
	L2	1,023	102	0.499	51	7.2	58	–	–	0.1	–	–
	L3	144	14	0.811	12	0.8	6	6	7	0.1	74	51.4
	L4	583	58	0.911	53	3.8	31	22	24	0.1	241	41.4
	Total	15,473	1,547	0.813	1,258	100.0	805	506	599	–	5,994	38.7
R4	C8	2,425	243	0.727	177	20.4	33	144	198	0.1	1,981	81.7
	C9	3,366	673	0.849	571	65.0	104	467	550	0.2	2,750	81.7
	C10	576	115	1.000	115	14.6	23	92	92	0.2	460	79.9
	Total	6,367	1,031	0.837	863	100.0	160	703	840	–	5,191	81.5

* : (Allowable Run-off Load at R3, 805) x Present Share
: (Allowable Run-off Load at R4, 160) x Present Share
** : (Required Run-off Load Reduction) / (Pollution Load Remaining Ratio)
***: (Required Concentrated Load Reduction) / (Concentration Rate)

CHAPTER 12

RECOMMENDATIONS ON THE REDUCTION OF POLLUTION LOAD

CHAPTER 12 RECOMMENDATIONS ON THE REDUCTION OF POLLUTION LOAD

12.1 General

Countermeasures for conservation of water quality in the public water body are recommended under the principle that reduction of pollution load required shall be done by respective pollution sources responsible in proportion to their contribution to the pollution.

Those pollution loads caused by domestic wastewater shall be reduced in provision of public sewerage systems, while others be done by responsible contributors. The combination of appropriate countermeasures not only by the public sewerage systems but also by various measures including effluent control to other pollution sources enables the water quality environment to preserve on a required level.

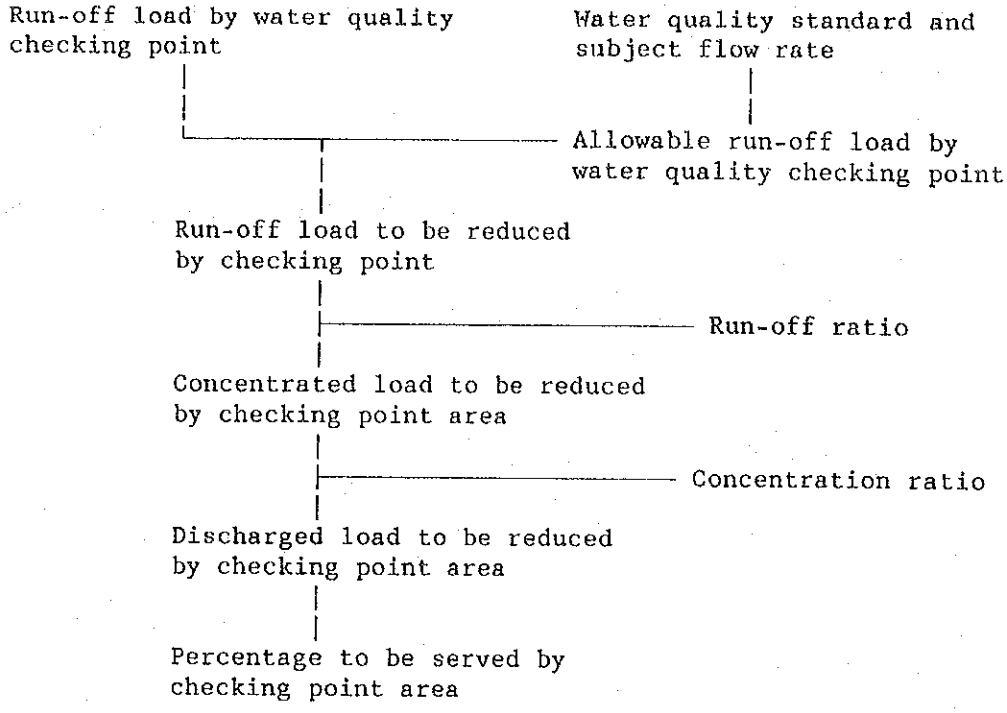
Recommendations on the countermeasures in the context as mentioned above are included in this section.

12.2 Domestic Wastewater

The area to be served by sewerage system is estimated to achieve water quality standards with reference to required reduction of domestic pollution load including that from fresh market. The reduction load is under the responsibility of domestic pollution source for conservation of water quality in the public water body. However, a combined collection and treatment of industrial and livestock wastewater with domestic wastewater in the planning of sewerage facilities may be determined from various aspects.

The calculation procedure to come up with service area is shown in Figure 12.2.1.

Potential areas to be served are assumed to be municipalities and sanitary districts including eight (8) subject areas for this sewerage master planning. Low population density areas such as rural communities are regarded to be out of sewerage service area.



Note : 1) Run-off load is limited to that caused by domestic wastewater.
2) Calculation along the flow is made for established target years.
3) Service percentage required for each municipality is the maximum one among calculated areas by water quality checking point.

Figure 12.2.1 Flow Chart to Calculate Service Area

Table 12.2.1 presents required percentage to be served for the related seven (7) municipalities and sanitary districts located within the sections R2-R3 and R3-R4 areas. These municipalities and sanitary districts are; Muang Pathum Thani Municipality, Khlong Luang SD., Prachatipat SD. and Khu Kot SD for sub-area C9, and Municipalities of Muang Nonthaburi, Bang Bua Thong and Pak Kret for sub-area C10.

As the calculation results, the subject municipality and SDs in sub-area C9 shall be fully covered immediately by sewerage system, and around 96% of population in the subject municipalities and SDs in sub-area C10 shall be covered in 1996, while 100% in 2001. In 2011, however, it would be difficult to reduce pollution load within the sub-areas in the section R3-R4. In view of the study approach/accuracy, it may be concluded that sewerage systems covering above mentioned areas are immediate requisites enabling the conservation of the water quality through the final target year more or less on a required level. At the same time it may say that reduction of the load in other sub-areas upstream of the section may be necessary to achieve the

Table 12.2.1 Reduction of Domestic Wastewater Pollution Load by Sewerage System

1996

Water Quality Check Point	Sub-area Code	Required Run-off Load Reduction	Ramified * Required Run-off L. Reduction	Municipality / Sanitary District (Rangsit Area) within Sub-area	Population in 1996	Gene'd BOD Load w/o S.S. (kg/day)	Disc'd BOD Load w/o S.S. (kg/day)	Run-off BOD Load w/o S.S. (kg/d)	Sewerage Service Coverage %	Disc'd BOD Load w/S.S. Covered by S.S.	Disc'd BOD Load w/S.S. Not-covered	Disc'd BOD Load w/S.S. Total	Concent'n Ratio Covered by S.S.	Concent'n Ratio Not-covered	Concent'd BOD Load w/S.S. Covered by S.S.	Concent'd BOD Load w/S.S. Not-covered	Concent'd BOD Load w/S.S. Total	Pollution Load Remain'g Ratio	Run-off BOD Load w/S.S. Covered by S.S.	Run-off BOD Load w/S.S. Not-covered	Run-off BOD Load w/S.S. Total	Run-off Load Reduction by S.S.
	C8	215	215	Pra Intharacha	4,031	227	205	74	100.00%	23	0	23	1.00	0.50	23	0	23	0.727	16	0	16	58
	C9	6,026	930	M. Pathum Thani	21,104	1,391	1,275	974	100.00%	139	0	139	1.00	0.90	139	0	139	0.849	118	0	118	856
			2,152	Khlong Luang	51,816	3,233	2,948	2,253	100.00%	323	0	323	1.00	0.90	323	0	323	0.849	275	0	275	1,978
R4			1,785	Prachatipat	42,986	2,682	2,446	1,869	100.00%	268	0	268	1.00	0.90	268	0	268	0.849	228	0	228	1,641
			1,159	Khu Kot	27,922	1,742	1,589	1,214	100.00%	174	0	174	1.00	0.90	174	0	174	0.849	148	0	148	1,066
	C10	17,464	9,842	M. Nonthaburi	231,409	14,764	13,491	12,142	95.67%	1,412	585	1,997	1.00	0.90	1,412	526	1,939	1.000	1,412	526	1,939	10,203
			2,237	Bang Bua Thong	52,607	3,356	3,067	2,760	95.67%	321	133	454	1.00	0.90	321	120	441	1.000	321	120	441	2,320
			5,404	Pak Kret	127,064	8,107	7,408	6,667	95.67%	776	321	1,097	1.00	0.90	776	289	1,064	1.000	775	289	1,064	5,603
	Total	23,725	23,725		554,908	35,276	32,224	27,879	–	3,414	1,039	4,452	–	–	3,414	935	4,349	–	3,277	935	4,212	23,725

2001

Water Quality Check Point	Sub-area Code	Required Run-off Load Reduction	Ramified * Required Run-off L. Reduction	Municipality / Sanitary District (Rangsit Area) within Sub-area	Population in 2001	Gene'd BOD Load w/o S.S. (kg/day)	Disc'd BOD Load w/o S.S. (kg/day)	Run-off BOD Load w/o S.S. (kg/d)	Sewerage Service Coverage %	Disc'd BOD Load w/S.S. Covered by S.S.	Disc'd BOD Load w/S.S. Not-covered	Disc'd BOD Load w/S.S. Total	Concent'n Ratio Covered by S.S.	Concent'n Ratio Not-covered	Concent'd BOD Load w/S.S. Covered by S.S.	Concent'd BOD Load w/S.S. Not-covered	Concent'd BOD Load w/S.S. Total	Pollution Load Remain'g Ratio	Run-off BOD Load w/S.S. Covered by S.S.	Run-off BOD Load w/S.S. Not-covered	Run-off BOD Load w/S.S. Total	Run-off Load Reduction by S.S.
	C8	225	225	Pra Intharacha	4,248	243	220	80	100.00%	24	0	24	1.00	0.50	24	0	24	0.727	16	0	16	62
	C9	7,373	1,170	M. Pathum Thani	24,910	1,669	1,532	1,171	100.00%	167	0	167	1.00	0.90	167	0	167	0.849	142	0	142	1,029
			2,575	Khlong Luang	56,947	3,664	3,371	2,576	100.00%	368	0	368	1.00	0.90	368	0	368	0.849	313	0	313	2,263
R4			2,219	Prachatipat	49,075	3,175	2,905	2,220	100.00%	318	0	318	1.00	0.90	318	0	318	0.849	270	0	270	1,950
			1,409	Khu Kot	31,170	2,017	1,845	1,410	100.00%	202	0	202	1.00	0.90	202	0	202	0.849	171	0	171	1,239
	C10	24,038	14,049	M. Nonthaburi	296,470	19,478	17,847	15,063	100.00%	1,948	0	1,948	1.00	0.90	1,948	0	1,948	1.000	1,948	0	1,948	14,115
			2,862	Bang Bua Thong	60,396	3,968	3,636	3,272	100.00%	397	0	397	1.00	0.90	397	0	397	1.000	397	0	397	2,875
			7,127	Pak Kret	150,402	9,881	9,054	8,149	100.00%	988	0	988	1.00	0.90	988	0	988	1.000	988	0	988	7,161
	Total	31,636	31,636		669,370	43,673	40,191	34,860	–	4,387	0	4,387	–	–	4,387	0	4,387	–	4,228	0	4,228	30,632

Note: Assumed BOD removal ratio by sewerage system: 90%
Required pollution load reduction for sub-area is further allocated to municipalities and S.Ds in proportion to the run-off load amount originated from those sub-areas.
Deficit of load reduction in sub-areas C8 and C9 is allocated to sub-area C10.

Table 12.2.1 Reduction of Domestic Wastewater Pollution Load by Sewerage System (cont'd)

2011

Water Quality Check Point	Sub-area Code	Required Run-off Load Reduction	Ramified * Required Run-off L. Reduction	Municipality / Sanitary District (Rangsit Area) within Sub-area	Population In 2011	Gene'd BOD Load w/o S.S. (kg/day)	Disc'd BOD Load w/o S.S. (kg/day)	Run-off BOD Load w/o S.S. (kg/d)	Sewerage Service Coverage %	Disc'd BOD Load w/S.S. Covered by S.S.	Disc'd BOD Load w/S.S. Not-covered	Disc'd BOD Load w/S.S. Total	Concent'n Ratio Covered by S.S.	Concent'n Ratio Not-covered	Concent'd BOD Load w/S.S. Covered by S.S.	Concent'd BOD Load w/S.S. Not-covered	Concent'd BOD Load w/S.S. Total	Pollution Load Remain'g Ratio	Run-off BOD Load w/S.S. Covered by S.S.	Run-off BOD Load w/S.S. Not-covered	Run-off BOD Load w/S.S. Total	Run-off Load Reduction by S.S.
	C7	51	51	Ban Len	19,190	1,146	1,040	520	12.58%	14	909	924	1.00	0.50	14	455	469	1.000	14	455	469	51
				Ban Sang	4,595	274	249	125	–	0	249	249	1.00	0.50	0	125	125	1.000	0	125	125	0
	N1	2	2	Prake Sriracha	7,184	429	389	135	1.90%	1	382	383	1.00	0.50	1	191	192	0.692	1	132	133	2
	N2	76	76	Sing	27,059	1,615	1,467	548	17.79%	29	1,206	1,234	1.00	0.50	29	603	632	0.747	21	450	472	76
				Thon Samo	12,592	752	682	255	–	0	682	682	1.00	0.50	0	341	341	0.747	0	255	255	0
				Pho Sang Kho	3,698	221	200	75	–	0	200	200	1.00	0.50	0	100	100	0.747	0	75	75	0
	N3	40	40	Pho Thong	6,428	384	348	142	38.05%	14	223	237	1.00	0.50	14	111	125	0.817	11	91	102	40
				San Chao Rong T.	18,475	1,103	1,001	409	–	0	1,001	1,001	1.00	0.50	0	501	501	0.817	0	409	409	0
				Bang Chak	9,356	559	507	207	–	0	507	507	1.00	0.50	0	254	254	0.817	0	207	207	0
				Samko	10,260	613	556	227	–	0	556	556	1.00	0.50	0	278	278	0.817	0	227	227	0
				Sawaenga	3,485	208	189	77	–	0	189	189	1.00	0.50	0	94	94	0.817	0	77	77	0
R3	N4	162	162	Sena (Mun.)	7,790	502	460	209	99.25%	50	3	53	1.00	0.50	50	2	52	0.909	45	2	47	162
				Chao Chet	18,831	1,124	1,021	464	–	0	1,021	1,021	1.00	0.50	0	510	510	0.909	0	464	464	0
				Bang Sai	5,764	344	312	142	–	0	312	312	1.00	0.50	0	156	156	0.909	0	142	142	0
				Bang Shai	15,732	939	853	388	–	0	853	853	1.00	0.50	0	426	426	0.909	0	388	388	0
				Bang Ban	16,271	971	882	401	–	0	882	882	1.00	0.50	0	441	441	0.909	0	401	401	0
				Phak Hai	15,517	926	841	382	–	0	841	841	1.00	0.50	0	421	421	0.909	0	382	382	0
				Lad Chad	12,244	731	664	302	–	0	664	664	1.00	0.50	0	332	332	0.909	0	302	302	0
				Hua Wiang	13,762	822	746	339	–	0	746	746	1.00	0.50	0	373	373	0.909	0	339	339	0
	P2	268	268	T. Wat Sing (Mun.)	15,519	926	841	352	97.53%	90	21	111	1.00	0.50	90	10	101	0.838	76	9	84	268
				Ayothaya	12,780	763	693	290	–	0	693	693	1.00	0.50	0	346	346	0.838	0	290	290	0
				Tha Luang	19,061	1,138	1,033	433	–	0	1,033	1,033	1.00	0.50	0	517	517	0.838	0	433	433	0
				Nakhong Luang	8,532	509	462	194	–	0	462	462	1.00	0.50	0	231	231	0.838	0	194	194	0
	L1	1	1	–	–	–	–	–	–	–	–	–	1.00	0.50	–	–	–	0.383	–	–	–	–
	L2	438	438	M. Lop Buri (Mun.)	49,320	3,181	2,910	726	77.21%	246	663	909	1.00	0.50	246	332	577	0.499	123	165	288	438
				Khok Toom	18,792	1,122	1,019	254	–	0	1,019	1,019	1.00	0.50	0	509	509	0.499	0	254	254	0
				Tha Wung	2,167	129	117	29	–	0	117	117	1.00	0.50	0	59	59	0.499	0	29	29	0
				Tha Khlong	2,587	154	140	35	–	0	140	140	1.00	0.50	0	70	70	0.499	0	35	35	0
	L4	47	47	Bang Pahan	14,524	867	787	359	16.61%	15	655	669	1.00	0.50	15	327	342	0.911	13	298	312	47
				Ban Phraek	2,395	143	130	59	–	0	130	130	1.00	0.50	0	65	65	0.911	0	59	59	0
				Maha Rat	3,151	188	171	78	–	0	171	171	1.00	0.50	0	85	85	0.911	0	76	76	0
	Total	1,085	1,085		377,061	22,785	20,711	8,155	–	458	16,530	16,989	–	–	458	8,265	8,723	–	305	5,766	7,071	1,084
	C8	235	235	Pra Intharacha	4,248	243	220	80	100.00%	24	0	24	1.00	0.50	24	0	24	0.727	18	0	18	62
	C9	10,083	1,702	M. Pathum Thani	32,521	2,247	2,068	1,580	100.00%	225	0	225	1.00	0.90	225	0	225	0.849	191	0	191	1,390
			3,420	Khlong Luang	65,353	4,516	4,156	3,176	100.00%	452	0	452	1.00	0.90	452	0	452	0.849	383	0	383	2,793
R4			3,060	Prachatipat	58,478	4,041	3,719	2,842	100.00%	404	0	404	1.00	0.90	404	0	404	0.849	343	0	343	2,499
			1,901	Khu Kot	36,326	2,510	2,310	1,765	100.00%	251	0	251	1.00	0.90	251	0	251	0.849	213	0	213	1,552
	C10	43,132	27,014	M. Nonthaburi	486,610	33,625	30,948	27,854	100.00%	3,362	0	3,362	1.00	0.90	3,362	0	3,362	1.000	3,362	0	3,362	24,491
			4,419	Bang Bua Thong	79,604	5,501	5,063	4,557	100.00%	550	0	550	1.00	0.90	550	0	550	1.000	550	0	550	4,006
			11,699	Pak Kret	210,727	14,561	13,402	12,062	100.00%	1,456	0	1,456	1.00	0.90	1,456	0	1,456	1.000	1,456	0	1,456	10,606
	Total	53,450	53,450		969,619	67,001	61,668	53,836	–	6,700	0	6,700	–	–	6,700	0	6,700	–	6,499	0	6,499	47,337

Note: Assumed BOD removal ratio by sewerage system: 90%

Required pollution load reduction for sub-area is further allocated to municipalities and S.Ds in proportion to the run-off load amount originated from those sub-areas.

standard. Improvement of toilet facilities in the rural area and preparation of small scale communal wastewater treatment facility for clustered community in the rural area may be alternative countermeasures.

Introduction of advanced wastewater treatment process for better treatment efficiency is another countermeasure for such a case. It would not be a practical solution in the concerned areas because of high capital and operation & maintenance cost.

12.3 Industrial and Slaughterhouse Wastewater

Reduction of pollution load caused by industrial and slaughterhouse wastewater shall be done in provision of more stringent effluent control. Required run-off load to be reduced at each water quality checking point is the basis for calculation of effluent control requirements. If the control of water quality by the effluent regulations is not practical, review of future frame values is another alternative to meet required reduction of the pollution load. Figure 12.3.1 shows concept of pollution load reduction.

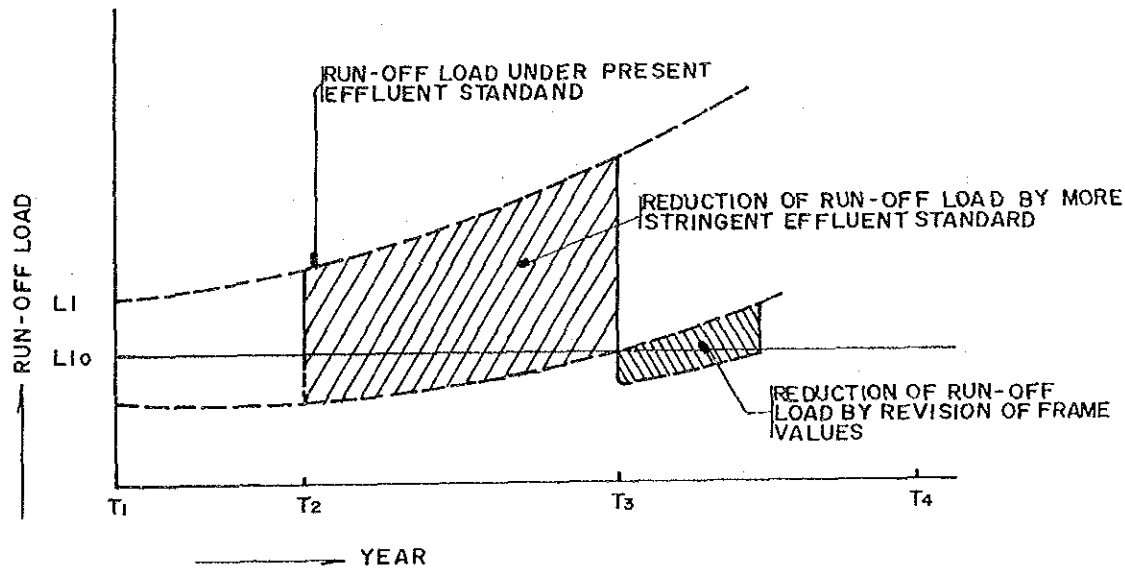


Figure 12.3.1 Conceptual Reduction of Pollution Load

As shown in Table 11.4.3, required reduction percentages of pollution load are 77 % in the year 1966, 79 % in 2001, and 86 % in 2011 to the sub-areas in the section R3-R4, while additional reduction of pollution load is

Table 12.3.1 Average Quality of Industrial Wastewater

Item	Unit	Year	Chai Nat C2	Sing Buri C3	Ang Thong C5	Ayutthaya C6	Ayutthaya C7	Chai Nat N1	Sing Buri N2	Ang Thong N3	Ayutthaya N4	Ayutthaya P2	Sing Buri L1	Lop Buri L2	Ayutthaya L4	Ayutthaya C8	Pathum T. C9	Nonthaburi C10
1)		1996	670	6,375	7,122	24,302	3,246	375	1,456	2,856	10,957	19,529	707	5,873	599	5,527	58,119	33,069
Industrial Wastewater	m3/day	2001	910	8,864	9,262	33,829	3,313	508	1,954	3,574	14,184	24,689	949	8,163	611	6,438	59,277	33,725
Quantity		2011	1,330	13,733	13,395	56,076	1,296	743	2,752	4,664	20,137	32,822	1,336	12,699	239	6,859	79,104	44,998
2)		1996	893	8,116	5,443	19,295	2,577	499	1,854	2,183	8,699	15,505	900	6,490	475	4,388	31,415	17,984
Generated BOD Load	kg/day	2001	1,277	11,971	7,685	29,272	2,867	714	2,639	2,965	12,273	21,363	1,281	9,737	529	5,571	33,997	19,461
		2011	2,039	20,359	12,634	55,125	1,274	1,139	4,079	4,398	19,795	32,264	1,981	16,878	235	6,742	50,436	28,864
3)		1996	1,333	1,273	764	794	794	1,331	1,273	764	794	794	1,273	1,105	793	794	541	544
Average Quality of	mg/l	2001	1,403	1,351	830	865	865	1,406	1,351	830	865	865	1,350	1,193	866	865	574	577
Generated Wastewater		2011	1,533	1,482	943	983	983	1,533	1,482	943	983	983	1,483	1,329	983	983	638	641
4)		1996	453	4,123	2,816	9,946	1,329	253	942	1,130	4,484	7,993	457	3,305	245	2,262	16,572	9,494
Discharged BOD Load	kg/day	2001	648	6,061	3,979	15,094	1,476	362	1,340	1,535	6,329	11,016	651	4,958	273	2,873	17,972	10,295
		2011	1,034	10,335	6,536	28,387	656	578	2,071	2,275	10,186	16,603	1,006	8,586	121	3,470	26,649	15,263
5)		1996	676	647	396	409	409	675	647	396	409	409	646	563	409	409	285	287
Average Quality of	mg/l	2001	712	686	430	446	446	713	686	429	446	446	686	607	447	446	303	305
Discharged Wastewater		2011	777	753	488	506	506	778	753	488	506	506	753	676	506	506	337	339
Quntity of 6)		1996	335	3,188	3,561	12,151	1,623	188	728	1,428	5,479	9,765	354	2,937	300	2,764	29,060	16,535
Industrial Wastewater	m3/day	2001	455	4,432	4,631	16,915	1,657	254	977	1,787	7,092	12,345	475	4,082	306	3,219	29,639	16,863
without Treatment		2011	665	6,867	6,698	28,039	648	372	1,376	2,332	10,069	16,411	668	6,350	120	3,430	39,552	22,499
7)		1996	447	4,058	2,722	9,648	1,289	250	927	1,092	4,350	7,753	450	3,245	238	2,194	15,708	8,992
Discharged BOD Load	kg/day	2001	639	5,986	3,843	14,636	1,434	357	1,320	1,483	6,137	10,682	641	4,869	265	2,786	15,999	9,731
without Treatment		2011	1,020	10,180	6,317	27,563	637	570	2,040	2,199	9,898	16,132	991	8,439	118	3,371	25,218	14,432
Average Quality of 8)		1996	1,333	1,273	764	794	794	1,331	1,273	764	794	794	1,273	1,105	793	794	541	544
Discharged Wastewater	mg/l	2001	1,403	1,351	830	865	865	1,406	1,351	830	865	865	1,350	1,193	866	865	574	577
without Treatment		2011	1,533	1,482	943	983	983	1,533	1,482	943	983	983	1,483	1,329	983	983	638	641
9)		1996	335	3,188	3,561	12,151	1,623	188	728	1,428	5,479	9,765	354	2,937	300	2,764	29,060	16,535
Industrial Wastewater	m3/day	2001	455	4,432	4,631	16,915	1,657	254	977	1,787	7,092	12,345	475	4,082	306	3,219	29,639	16,863
Quantity with Treatment		2011	665	6,867	6,698	28,039	648	372	1,376	2,332	10,069	16,411	668	6,350	120	3,430	39,552	22,499
10)		1996	7	66	97	299	41	4	15	39	135	241	7	60	8	68	865	502
Discharged BOD Load	kg/day	2001	10	96	137	458	45	5	21	53	193	335	11	90	9	88	974	565
with Treatment		2011	15	156	219	805	19	9	32	76	289	471	16	147	4	99	1,431	831
Average Quality of 11)		1996	14	16	34	30	30	14	16	34	30	30	15	18	31	30	52	53
Discharged Wastewater	mg/l	2001	15	16	34	30	30	14	15	34	30	30	15	18	31	30	54	55
with Treatment		2011	14	15	34	28	29	15	15	33	28	28	15	17	29	29	54	54

Ratio of Treatment: 50%

1), 2), 4): from Chapter 10

3): 2) / 1) x 10 5): 4) / 1) x 1000

6), 9): 1) x (1−0.5)

7): 2) x (1−0.5)

8): 7) / 6) x 10(10): 4) − 7)

11): 10) / 9) x 1000

Table 12.3.2 Required Percentage to be Treated

Item	Unit	Year	R1−R2 Chai Nat C2	Sing Buri C3	Ang Thong C5	Ayutthaya C6	Total	R2−R3 Ayutthaya C7	Chai Nat N1	Sing Buri N2	Ang Thong N3	Ayutthaya N4	Ayutthaya P2	Sing Buri L1	Lop Buri L2	Ayutthaya L4	Total	R3−R4 Ayutthaya C8	Pathum Thani C9	(revised)*	Nonthaburi C10	(revised)*	Total R3−R4	(revised)*
Average Quality 1)		1996	14	16	34	30	−	30	14	16	34	30	30	15	18	31	−	30	52		53		−	
of Discharged IWW	mg/l	2001	15	16	34	30	−	30	14	15	34	30	30	16	18	31	−	30	54		55		−	
with Treatment		2011	14	15	34	28	−	29	15	15	33	28	28	15	17	29	−	29	54		54		−	
IWW Quantity 2)		1996	335	3,188	3,561	12,151	19,235	1,623	188	728	1,428	5,479	9,765	354	2,937	300	22,802	2,764	29,060		16,535		48,359	
without	m3/day	2001	455	4,432	4,631	16,915	26,433	1,657	264	977	1,787	7,092	12,345	475	4,082	306	28,975	3,219	29,639		16,863		49,721	
Treatment		2011	665	6,867	6,898	28,039	42,269	648	372	1,376	2,332	10,069	16,411	668	5,350	120	36,346	3,430	39,552		22,499		65,481	
Average Quality 3)		1996	1,333	1,273	764	794	877	794	1,331	1,273	764	794	794	1,273	1,105	793	793	794	541		544		556	
of Discharged IWW	mg/l	2001	1,403	1,351	830	865	950	865	1,406	1,351	830	865	865	1,350	1,193	866	866	865	574		577		594	
without treatment		2011	1,533	1,482	943	983	1,066	983	1,533	1,482	943	983	983	1,483	1,329	983	983	983	638		641		657	
Required 4)		1996	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	1,747	12,881		7,364		21,992	
Discharged Load	kg/day	2001	−	−	−	−	−	−	58	234	129	1,051	1,605	157	1,202	−	4,436	2,359	14,278		8,166		24,803	
Reduction		2011	188	2,641	1,145	10,837	14,812	−	275	964	869	4,906	7,196	509	4,830	−	19,549	2,955	22,954		13,138		39,047	
Quality of Effluent 5)	mg/l	−	90	90	90	90	−	90	90	90	90	90	90	90	90	90	−	90	90	55	90	55	−	−
Required 6)		1996	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	2,482	26,561	26,504	16,220	15,059	47,263	44,045
IWW Quantity	m3/day	2001	−	−	−	−	−	−	44	186	174	1,356	2,071	125	1,090	−	5,045	3,044	29,500	27,511	16,788	15,644	49,312	46,199
to be Treated		2011	130	1,897	1,343	12,135	15,505	−	191	693	1,019	5,494	8,058	365	3,898	−	19,718	3,309	41,887	39,372	23,844	22,420	69,040	65,101
Required 7)		1996	−	−	−	−	−	−	−	−	−	−	−	−	−	−	−	89.8%	98.3%	91.2%	98.1%	91.1%	97.7%	91.1%
Percentage of IWW	%	2001	−	−	−	−	−	−	17.4%	19.0%	9.8%	19.1%	16.8%	26.2%	26.7%	−	17.4%	94.6%	99.5%	92.6%	99.4%	92.3%	99.2%	92.9%
to be Treated		2011	19.6%	27.6%	20.1%	43.3%	36.7%	−	51.2%	50.3%	43.7%	54.6%	49.1%	54.7%	81.4%	−	51.4%	96.5%	105.9%	99.5%	106.0%	99.6%	105.4%	99.4%
Required 8)		1996	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	94.9%	99.1%	95.5%	99.0%	95.5%	98.9%	95.5%
Percentage of IWW	%	2001	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	58.7%	59.5%	54.9%	59.6%	58.4%	63.1%	63.3%	50.0%	58.7%	97.3%	99.8%	96.4%	99.7%	96.4%	99.6%	96.6%
to be Treated		2011	59.8%	63.8%	60.0%	71.6%	68.3%	50.0%	75.6%	75.2%	71.6%	77.3%	74.6%	77.4%	80.7%	50.0%	75.7%	98.2%	103.0%	99.8%	103.0%	99.8%	102.7%	99.7%

Note:
1), 2), 3): from Table 12.3.1
4): from Table 11.4.3
5): Assumed average water quality of industrial watewater considering the industrial effluent standard
Industrial Effluent Standard: BOD 100 mg/l (Food, Tanning, Pulp), 60 mg/l (Others)
Required water quality of industrial effluent for C9 and C10
6): 4) / (3) − 5)) x 1000
7): 6) / 2) x 100, percentage in non−treated IWW.
8): Percentage in all IWW
*: In case the required effluent quality is adopted.

required to other sub-areas in the upstream of the section for the year 2011.

Since it seems to be serious for the section R2-R4, possibility of pollution load reduction in the section was studied.

Table 12.3.1 shows the calculation results of average quality of discharged wastewater with and without treatment facility. Using these data, required treatment percentage of untreated wastewater amount in provision of current effluent standard was calculated as shown in Table 12.3.2.

Based on the results of calculation, if most of untreated industrial wastewater would be treated to some extent of water quality, required reduction of pollution load would be accomplished in sections R0-R1 and R1-R2. However, required percentage to be treated in the section R3-R4 (sub-areas C9 and C10), exceeds 100 %. Under this study, an average effluent quality from treatment facility is assumed to be 90 mg/l, which was derived from industrial wastewater effluent standard - 100 mg/l for major food, tanning and pulp industries, and 60mg/l for others. Thus, more stringent effluent standard shall be introduced for sub-areas C9 and C10. Proper effluent control under the present effluent standard is also necessary covering all factories in other sub-areas to attain required reduction of pollution load.

Table 12.3.2 shows an alternative for sub-areas C9 and C10 in provision of more stringent effluent standard with 50 mg/l in average. This target concentration (50mg/l) is almost on the same level as the average effluent quality of treated industrial wastewater in Pathum Thani and Nonthaburi as shown in Table 12.3.2.

At present, DIW is implementing central wastewater treatment plant project for industrial wastewater in the Rangsit area (the part of Amphoe Khlong Luang, out of the sewerage service area of this study). Completion of the project will contribute to the requirements of pollution load reduction.

12.4 Livestock and Fish Pond Wastewater

Countermeasures to the wastewater discharged from fish pond and livestock are discussed in this section.

Generally, generated pollution load by livestock is discharged in the rural area. Thus, the amount of concentrated pollution load is limited. Furthermore, those generated by cattle is negligible as confirmed by field survey and partial discharge from pigsty is only required to be controlled by means of effluent regulations.

Wastewater from fish pond is also to be controlled by means of effluent control.

The following are the requirements to reduce pollution load in the sections R2-R3 and R3-R4. As presented in Table 11.4.4, required reduction amount of pollution load in section R3-R4 is more than 75% through the target years. Table 12.4.1 presents required percentage of wastewater treatment in assumption of effluent quality of 100 mg/l. This calculation results imply that impossibility of pollution load reduction only within the section R3-R4 and necessity of further pollution load reduction in upstream sections.

Considering the characteristics of livestock and fish pond as pollution sources, it is difficult to accomplish required drastic pollution load reduction. Relocation of the livestock from the sub-areas of the section R3-R4 to other areas including those upstream of the section may be one of the alternatives to solve this problem. Another alternative is to reduce discharged pollution load not only in the section R3-R4 but in the overall study basin. Those pollution load reduction can be accomplished by provision of wastewater treatment facilities.

12.5 Summary of Recommendations

Various countermeasures are recommended to attain the environmental standard. For the pollution load from domestic source, provision of sewerage system is one of major countermeasures. In addition, improvement of toilet facilities including septic tank in the rural area and provision of small scale communal wastewater treatment facilities for clustered communities in

Table 12.4.1 Required Percentage of Livestock Wastewater to be Treated

Item	Unit	Year	R2–R3												R3–R4			
			Ayutthaya	Chai Nat	Sing Buri	Ang Thong	Ayutthaya	Saraburi	Ayutthaya	Sing Buri	Lop Buri	Saraburi	Ayutthaya	Total	Ayutthaya	P. Thani	Nonthaburi	Total
			C7	N1	N2	N3	N4	P1	P2	L1	L2	L3	L4		C8	C9	C10	
Discharged BOD 1)		1996	612	407	716	4,184	1,233	622	1,024	226	1,061	100	379	10,564	1,298	1,887	264	3,449
Load from	kg/day	2001	732	391	599	5,313	1,475	744	1,225	189	1,027	120	454	12,269	1,553	2,259	312	4,124
Livestock		2011	879	359	502	6,747	1,771	892	1,471	158	959	144	545	14,427	1,864	2,711	374	4,949
Discharged WW 2)		1996	83	55	97	565	166	84	138	30	143	14	51	1,426	175	255	36	466
Quantity from	m3/day	2001	99	53	81	717	199	100	165	25	139	16	61	1,655	210	305	42	557
Livestock		2011	119	49	68	911	239	120	199	21	130	19	74	1,949	252	366	50	668
Required 3)		1996	140	–	–	832	264	144	239	–	–	25	77	1,721	1,403	1,932	350	3,685
Discharged Load	kg/day	2001	260	–	–	1,958	506	261	442	–	–	49	154	3,630	1,651	2,303	400	4,354
Reduction		2011	400	–	–	3,390	803	405	680	–	–	74	241	5,993	1,981	2,750	460	5,191
Quality of Effluent 4)	mg/l	–	100	100	100	100	100	100	100	100	100	100	100	–	100	100	100	–
Required 5)		1996	19	–	–	114	36	20	33	–	–	3	11	236	192	264	48	504
WW Quantity	m3/day	2001	36	–	–	268	69	36	60	–	–	7	21	497	226	315	55	596
to be Treated		2011	55	–	–	464	110	55	93	–	–	10	33	820	271	376	63	710
Required 6)		1996	23.1%	–	–	20.2%	21.8%	23.5%	23.7%	–	–	24.4%	20.7%	16.5%	109.7%	103.7%	133.0%	108.2%
Percentage of WW	%	2001	35.9%	–	–	37.4%	34.8%	35.7%	36.7%	–	–	41.9%	34.5%	30.0%	107.6%	103.3%	130.3%	107.0%
to be Treated		2011	46.0%	–	–	50.9%	46.0%	46.2%	46.8%	–	–	53.3%	44.6%	42.1%	107.6%	102.8%	125.9%	106.3%

Note: 1): from Table A10.3.37–39 2): from Table A10.3.31–33 3): from Table 11.4.4–6 4): assumption 5): 3) / (WW quality 7,404mg/l – 4)) /1,000 6): 5) / 2) x 100

the rural area are effective alternatives.
Proper effluent control under the present effluent standard is essential for pollution load reduction to the industrial wastewater. Furthermore, more stringent effluent standard shall be introduced in Pathum Thani and Nontha-buri.

Relocation of the livestock from the sub-areas of the section R3-R4 to other areas and compression of frame values are possible alternatives. Reduction of discharged pollution load not only in the section R3-R4 but in the over-all study basin by provision of wastewater treatment facilities is also required.

Table 12.5.1 presents a summarization of findings and recommendation dis-cussed in this Section.

Table 12.5.1 Findings and Recommendations for Pollution Load Reduction

Pollution Source Category	Required Discharged Load Reduction Amount and Ratio to Discharged Load by Category by Sub-area	(kg/day)	(%)	Recommendations
A Domestic and Fresh Market	**1996**			1) Provision of sewerage system in municipalities and sanitary districts within the section
	Sub-area C8 (Ayutthaya)	591	15	
	Sub-area C9 (Pathum Thani)	7,886	46	Required percentage of sewerage service coverage
	Sub-area C10 (Nonthaburi)	19,427	63	**1996**
	Section R3-R4 Total	*27,904*	*54*	Pra Intharacha Sanitary District 100.0%
				M. Pathum Thani Municipality 100.0%
	2001			Khlong Luang Sanitary District 100.0%
	Sub-area C8 (Ayutthaya)	619	15	Prachatipat Sanitary District 100.0%
	Sub-area C9 (Pathum Thani)	9,649	48	Khu Kot Sanitary District 100.0%
	Sub-area C10 (Nonthaburi)	26,079	66	Muang Nonthaburi Municipality 95.7%
	Section R3-R4 Total	*36,347*	*57*	Bang Bua Thong Municipality 95.7%
				Pak Kret Municipality 95.7%
	2011			**2001**
	Sub-area C7 (Ayutthaya)	102	3	8 Municipalities/SDs presented above 100.0%
	Sub-area N1 (Chai Nat)	6	0	**2011**
	Sub-area N2 (Sing Buri)	203	3	Ban Len Sanitary District 12.6%
	Sub-area N3 (Ang Thong)	98	1	Prake Sriracha Sanitary District 1.9%
	Sub-area N4 (Ayutthaya)	356	5	Sing Sanitary District 17.8%
	Sub-area P2 (Ayutthaya)	640	9	Pho Thong Sanitary District 36.1%
	Sub-area L1 (Sing Buri)	5	0	Sena Municipality 99.3%
	Sub-area L2 (Lop Buri)	1,756	8	Tambol Wat Sing Municipality 97.5%
	Sub-area L4 (Ayutthaya)	103	5	Muang Lop Buri Municiparity 77.2%
	Section R2-R3 Total	*3,269*	*5*	Bang Pahan Sanitary District 16.8%
				8 Municipalities/SDs presented above 100.0%
	Sub-area C8 (Ayutthaya)	646	16	
	Sub-area C9 (Pathum Thani)	13,196	50	2) Provision of sewerage systems in upstream areas
	Sub-area C10 (Nonthaburi)	47,924	68	
	Section R3-R4 Total	*61,766*	*61*	3) Improvement of toilet facilities in the rural area

Table 12.5.1 Findings and Recommendations for Pollution Load Reduction (cont'd)

Pollution Source Category	Required Discharged Load Reduction Amount and Ratio to Discharged Load by Category by Sub-area	(kg/day)	(%)	Recommendations	
B	1996			1) Proper effluent control under the present effluent quality standard	
	Sub-area C8 (Ayutthaya)	1,747	77		
Industry	Sub-area C9 (Pathum Thani)	12,881	77	Required percentage of treatment in all IWW	
and	Sub-area C10 (Nonthaburi)	7,364	77	1996	
Slaughterhouse	*Section R3-R4 Total*	*21,992*	*77*	Sub-area C8 (Ayutthaya)	94.9%
				Sub-area C9 (Pathum Thani)	99.1%
	2001			Sub-area C10 (Nonthaburi)	99.0%
	Sub-area N1 (Chai Nat)	58	16	*Section R3-R4 Total*	*98.9%*
	Sub-area N2 (Sing Buri)	234	18		
	Sub-area N3 (Ang Thong)	129	8	2001	
	Sub-area N4 (Ayutthaya)	1051	17	Sub-area N1 (Chai Nat)	58.7%
	Sub-area P2 (Ayutthaya)	1605	15	Sub-area N2 (Sing Buri)	59.5%
	Sub-area L1 (Sing Buri)	157	24	Sub-area N3 (Ang Thong)	54.9%
	Sub-area L2 (Lop Buri)	1,202	24	Sub-area N4 (Ayutthaya)	59.6%
	Section R2-R3 Total	*4,436*	*16*	Sub-area P2 (Ayutthaya)	58.4%
				Sub-area L1 (Sing Buri)	63.1%
	Sub-area C8 (Ayutthaya)	2,359	82	Sub-area L2 (Lop Buri)	63.3%
	Sub-area C9 (Pathum Thani)	14,278	79	*Section R2-R3 Total*	*58.7%*
	Sub-area C10 (Nonthaburi)	8,166	79		
	Section R3-R4 Total	*24,803*	*79*	Sub-area C8 (Ayutthaya)	97.3%
				Sub-area C9 (Pathum Thani)	99.8%
	2011			Sub-area C10 (Nonthaburi)	99.7%
	Sub-area C2 (Ayutthaya)	188	18	*Section R3-R4 Total*	*99.6%*
	Sub-area C3 (Pathum Thani)	2,641	26		
	Sub-area C5 (Nonthaburi)	1,146	18	2011	
	Sub-area C6 (Nonthaburi)	10,837	38	Sub-area C2 (Ayutthaya)	59.8%
	Section R1-R2 Total	*14,812*	*32*	Sub-area C3 (Pathum Thani)	63.8%
				Sub-area C5 (Nonthaburi)	60.0%
	Sub-area N1 (Chai Nat)	275	48	Sub-area C6 (Nonthaburi)	71.6%
	Sub-area N2 (Sing Buri)	964	47	*Section R1-R2 Total*	*68.3%*
	Sub-area N3 (Ang Thong)	869	38		
	Sub-area N4 (Ayutthaya)	4906	48	Sub-area N1 (Chai Nat)	75.6%
	Sub-area P2 (Ayutthaya)	7196	43	Sub-area N2 (Sing Buri)	75.2%
	Sub-area L1 (Sing Buri)	509	51	Sub-area N3 (Ang Thong)	71.8%
	Sub-area L2 (Lop Buri)	4,830	56	Sub-area N4 (Ayutthaya)	77.3%
	Section R2-R3 Total	*19,549*	*46*	Sub-area P2 (Ayutthaya)	74.6%
				Sub-area L1 (Sing Buri)	77.4%
	Sub-area C8 (Ayutthaya)	2,955	85	Sub-area L2 (Lop Buri)	80.7%
	Sub-area C9 (Pathum Thani)	22,954	86	*Section R2-R3 Total*	*75.7%*
	Sub-area C10 (Nonthaburi)	13,138	86		
	Section R3-R4 Total	*39,047*	*86*	Sub-area C8 (Ayutthaya)	98.2%
				Sub-area C9 (Pathum Thani)	100.0%
				Sub-area C10 (Nonthaburi)	100.0%
				Section R3-R4 Total	*100.0%*
				2) Introduction of more stringent effluent standard in Pathum Thani and Nonthaburi (55 mg/l in average BOD concentration)	
				3) Provision of centralized IWW treatment plant	

Table 12.5.1 Findings and Recommendations for Pollution Load Reduction (cont'd)

Pollution Source Category	Required Discharged Load Reduction Amount and Ratio to Discharged Load by Category by Sub-area	(kg/day)	(%)
C	1996		
	Sub-area C7 (Ayutthaya)	140	22
Livestock	Sub-area N3 (Ang Thong)	832	20
and	Sub-area N4 (Ayutthaya)	264	14
Fish Pond	Sub-area P1 (Saraburi)	144	23
	Sub-area P2 (Ayutthaya)	239	23
	Sub-area L3 (Saraburi)	25	25
	Sub-area L4 (Ayutthaya)	77	18
	Section R2-R3 Total	*1,721*	*15*
	Sub-area C8 (Ayutthaya)	1,403	76
	Sub-area C9 (Pathum Thani)	1,932	76
	Sub-area C10 (Nonthaburi)	350	75
	Section R3-R4 Total	*3,685*	*76*
	2001		
	Sub-area C7 (Ayutthaya)	260	34
	Sub-area N3 (Ang Thong)	1958	36
	Sub-area N4 (Ayutthaya)	506	24
	Sub-area P1 (Saraburi)	261	35
	Sub-area P2 (Ayutthaya)	442	35
	Sub-area L3 (Saraburi)	49	41
	Sub-area L4 (Ayutthaya)	154	31
	Section R2-R3 Total	*3,630*	*27*
	Sub-area C8 (Ayutthaya)	1,651	78
	Sub-area C9 (Pathum Thani)	2,303	79
	Sub-area C10 (Nonthaburi)	400	78
	Section R3-R4 Total	*4,354*	*79*
	2011		
	Sub-area C7 (Ayutthaya)	400	44
	Sub-area N3 (Ang Thong)	3,390	50
	Sub-area N4 (Ayutthaya)	803	33
	Sub-area P1 (Saraburi)	405	45
	Sub-area P2 (Ayutthaya)	680	45
	Sub-area L3 (Saraburi)	74	51
	Sub-area L4 (Ayutthaya)	241	41
	Section R2-R3 Total	*5,993*	*39*
	Sub-area C8 (Ayutthaya)	1,981	82
	Sub-area C9 (Pathum Thani)	2,750	82
	Sub-area C10 (Nonthaburi)	460	80
	Section R3-R4 Total	*5,191*	*82*

Recommendations	
1) Provision of treatment facility for livestock waste-water in the sections R2-R3, and R3-R4	
Required percentage of treatment in livestock WW	
1996	
Sub-area C7 (Ayutthaya)	23.1%
Sub-area N3 (Ang Thong)	20.2%
Sub-area N4 (Ayutthaya)	21.8%
Sub-area P1 (Saraburi)	23.5%
Sub-area P2 (Ayutthaya)	23.7%
Sub-area L3 (Saraburi)	24.4%
Sub-area L4 (Ayutthaya)	20.7%
Section R2-R3 Total	*16.5%*
Sub-area C8 (Ayutthaya)	100.0%
Sub-area C9 (Pathum Thani)	100.0%
Sub-area C10 (Nonthaburi)	100.0%
Section R3-R4 Total	*100.0%*
2001	
Sub-area C7 (Ayutthaya)	35.9%
Sub-area N3 (Ang Thong)	37.4%
Sub-area N4 (Ayutthaya)	34.8%
Sub-area P1 (Saraburi)	35.7%
Sub-area P2 (Ayutthaya)	36.7%
Sub-area L3 (Saraburi)	41.9%
Sub-area L4 (Ayutthaya)	34.5%
Section R2-R3 Total	*30.0%*
Sub-area C8 (Ayutthaya)	100.0%
Sub-area C9 (Pathum Thani)	100.0%
Sub-area C10 (Nonthaburi)	100.0%
Section R3-R4 Total	*100.0%*
2011	
Sub-area C7 (Ayutthaya)	46.0%
Sub-area N3 (Ang Thong)	50.9%
Sub-area N4 (Ayutthaya)	46.0%
Sub-area P1 (Saraburi)	46.2%
Sub-area P2 (Ayutthaya)	46.8%
Sub-area L3 (Saraburi)	53.3%
Sub-area L4 (Ayutthaya)	44.6%
Section R2-R3 Total	*42.1%*
Sub-area C8 (Ayutthaya)	100.0%
Sub-area C9 (Pathum Thani)	100.0%
Sub-area C10 (Nonthaburi)	100.0%
Section R3-R4 Total	*100.0%*
2) Relocation of livestock in section R3-R4 to other areas	
3) Proper effluent control by regulations