SURVEY DATA (2nd STUDY PERIOD)

I. Water Quality Survey

Table I.1 Location of Water Sampling and River Flow Measurement

Sample code	Sampling location
UW - 1	West lake
UW - 2	West lake
UW - 3	Truc Bach lake
UW - 4	Hoan Kiem lake
UW - 5	Bay Mau lake
UW - 6	Thu Le lake
UW - 7	Giang Vo lake
UW - 8	Buoi Slope (ToLich river)
UW - 9	Cau Moi Bridge (ToLich river)
UW - 10	To Bridge (ToLich river)
UW - 11	Xa Dan lake (Lu river)
UW - 12	Dau Bridge (Lu river)
UW - 13	Set Bridge (Set river) (Truong Dinh road)
UW - 14	Concrete Bridge(Kim Nguu river)
UW - 15	Kim Nguu Bridge (Kim nguu river)
UW - 16	Van Dien Bridge(Kim nguu river)

Table I.2 Water Quality Survey

Location of sampling points for urban water area and this signs

Sample code	Sampling location
SW - 1	Xuan Phuong Bridge (Calo river)
SW - 2	Phu Lo Bridge (Calo river)
SW - 3	Calo-Cau river junction(Cau river)
SW - 4	Da Phuc Bridge (Cau river)
SW - 5	Thuong Cat Hydrometedo logical Station (Duong river)
SW - 6	Trung Mau Pumping Station (Duong river)
SW - 7	Bat Trang Bridge(Bac Hung Hai river)
SW - 8	River junction (Bac Hung Hai river)
SW - 9	Lien Mac Dam (Nhue river)
SW - 10	Buou Bridge (Nhue river)
SW - 11	Nearby To bridge (Nhue river)
SW - 12	Lien Mac Dam (Red river)
SW - 13	Ham Tu Gate (Red river)
SW - 14	Khuyen Luong Port (Red river)

Table I.3 Results of water quality analysis
(Ha noi, 15th July 1999)

No.	Sample code	Result							Characteristic of water
		COD (mg/l)	Dilution factor	BOD_5 (mg/l)	DO (mg/l)	TSS (mg/l)	Σ N (mg/l)	Σ P (mg/l)	
1	SW1	13.6	5	3.8	5.45	53	2.5	1.11	High water level, rich in alluvium storage flow, 30.7°C
2	SW2	13.6	5	3.6	6.61	62	4.0	1.01	yellow, 32°C
3	SW3	12	5	3.2	5.58	51	4.1	0.99	Green, turbid, 30°C
4	SW4	12	5	3.0	7.14	83	1.5	1.01	High turbidity, 29°C
5	SW5	9.6	5	2.8	6.40	1395	5.0	1.83	rich in alluvium, 28°C
6	SW6	8.0	5	2.4	7.40	1595	4.0	1.77	rich in alluvium, 28°C
7	SW7	8.0	5	2.4	6.60	424	2.3	1.24	turbid, 28°C
8	SW8	16.0	5	4.5	3.64	135	2.7	0.94	black green, 30°C
9	SW9	14.4	5	4.0	8.85	67	2.5	0.87	Red, rich in alluvium, 33°C
10	SW10	13.6	5	3.6	3.20	85	2.5	1.04	Yellow, normal flow, 30°C
11	SW11	21.6	10	6.8	2.90	90	7.5	1.04	dirty, yellow red, 30°C
12	SW12	11.0	5	3.4	10.6	915	2.2	1.61	High water level, alluvium, 27°C
13	SW13	15.6	5	5.2	8.18	900	5.1	1.54	rich in alluvium, strong flow 27.5°C
14	SW14	16.4	5	5.6	10.3	900	2.8	1.91	High water level, alluvium, 27.7°C
15	UW1	25.6	10	11.0	11.3	37	5.5	0.68	Green, 34°C
16	UW2	25.6	10	13.6	9.36	42	3.0	0.75	Green 32°C
17	UW3	27.2	10	12.2	10.43	32	2.5	0.085	Green 33.7°C
18	UW4	64.0	16.66	28.6	7.20	103	2.3	0.087	Green, rich in algae . 30°C
19	UW5	29.2	10	12.8	2.2	16	2.5	0.96	dead fish, black green, 30°C
20	UW6	20.8	10	13.6	3.30	1	1.3	0.77	Green, 32.4°C
21	UW7	40.0	16.66	22.5	11.42	15	5.1	0.031	Green, dirty, rich in algae, 32.5°C
22	UW8	27.2	10	14.4	2.31	12	2.1	2.17	dirty, strong flow, 32.3°C
23	UW9	29.2	10	16.4	4.50	17	12.0	2.23	Yellow, strong flow, 28.5°C
24	UW10	32.8	10	18.0	1.50	12	15.1	2.15	dirty, strong flow, 29°C
25	UW11	25.6	10	14.4	1.50	23	11.3	2.28	black, bad odor, 29.9°C
26	UW12	30.8	10	16.6	2.80	17	22.5	2.18	Yellow, rich in alluvium, 28.8°C
27	UW13	30.8	10	17.6	1.92	16	19.0	2.23	dirty, badordor, 32.4°C
28	UW14	27.2	10	13.4	0.93	25	7.0	2.23	dirty, bad odor, 31°C
29	UW15	27.0	10	13.4	2.20	62	2.0	1.93	dirty, strong flow, 31°C
30	UW16	27.6	10	13.8	3.30	15	5.1	1.76	dirty, 31°C

Table I.4 Results of water quality analysis
(Date: 18th August 1999)

No.	Sample code	Result							Characteristic of water
		COD (mg/l)	Dilution factor	BOD_5 (mg/l)	DO (mg/l)	TSS (mg/l)	Σ N (mg/l)	Σ P (mg/l)	
1	SW1	12.8	5	4.8	6.35	39	1.80	0.725	High water level, rich in alluvium storage flow
2	SW2	13.6	5	4.8	6.42	45	3.10	0.67	yellow
3	SW3	11.2	5	3.2	6.54	30	2.40	0.58	Green, turbid
4	SW4	9.6	5	3.0	6.48	30	1.20	0.74	High turbidity
5	SW5	8.8	5	2.6	7.22	1020	2.80	0.84	rich in alluvium
6	SW6	9.6	5	2.6	7.24	1010	3.50	0.94	rich in alluvium
7	SW7	6.4	5	2.0	7.04	325	1.20	1.04	turbid
8	SW8	18.0	10	6.4	7.62	222	2.0	0.83	black green
9	SW9	16.4	10	5.8	7.65	515	1.90	0.94	Red, rich in alluvium
10	SW10	14.8	10	5.2	7.45	21	2.30	0.62	Yellow, normal flow
11	SW11	22.4	10	8.8	1.23	25	5.50	1.116	dirty, yellow red
12	SW12	12.4	5	4.8	7.42	535	1.30	0.98	High water level, alluvium
13	SW13	11.6	5	3.4	7.65	725	5.20	1.04	rich in alluvium, strong flow
14	SW14	14.8	10	5.2	7.75	960	1.80	1.26	High water level, alluvium
15	UW1	26.4	10	16.2	7.25	21	2.20	1.04	Green
16	UW2	25.6	10	16.0	6.98	40	1.80	1.116	Green
17	UW3	26.4	10	13.6	11.18	15	2.00	0.95	Green
18	UW4	59.2	25	26.8	11.50	50	1.80	0.51	Green, rich in algae
19	UW5	32.4	16.66	16.5	2.85	18	2.00	1.96	dead fish, black green
20	UW6	25.6	10	14.4	9.95	14	3.20	1.085	Green
21	UW7	46.4	25	30.2	5.50	14	6.50	1.69	Green, dirty, rich in algae
22	UW8	44.8	25	26.7	0.50	284	7.0	0.59	dirty, strong flow
23	UW9	51.2	25	34.6	0.77	47	13.10	1.88	Yellow, strong flow
24	UW10	54.2	25	34.4	0.76	29	11.50	1.34	dirty, strong flow
25	UW11	36.4	16.66	20.5	0.64	72	14.90	1.67	black, badodor
26	UW12	39.0	16.66	23.4	0.50	52	17.30	1.76	Yellow, rich in alluvium
27	UW13	42.6	25	26.8	0.38	46	15.20	1.81	dirty, badordor
28	UW14	38.0	16.66	24.8	0.56	38	7.50	1.30	dirty, bad odor
29	UW15	30.4	16.66	17.2	1.68	46	2.00	1.19	dirty, strong flow
30	UW16	30.4	16.66	16.8	0.48	47	3.10	1.34	dirty

Table I.5 Results of water quality analysis
(Date: 17th September1999)

No.	Sample code	Result							Characteristic of water
		COD (mg/l)	Dilution factor	BOD_5 (mg/l)	DO (mg/l)	TSS (mg/l)	Σ N (mg/l)	Σ P (mg/l)	
1	SW1	8.8	5	2.8	3.25	45	2.0	0.73	Red
2	SW2	10.0	5	3.4	3.6	65	2.5	0.74	Slow flow, dirty
3	SW3	8.0	5	2.8	4.5	16	2.7	0.93	t^0 = 33°C
4	SW4	9.6	5	3.0	4.7	12	1.3	0.58	Red, rich in soil, 33°C
5	SW5	5.6	5	2.0	6.3	670	3.0	0.87	Red, rich in soil
6	SW6	5.6	5	2.0	5.5	588	2.8	1.09	Red, rich in soil, 31°C
7	SW7	4.8	5	1.6	5.3	262	1.2	0.94	Red, 28, rich in soil
8	SW8	17.2	5	6.0	6.3	195	2.0	0.79	32, Mixed flow
9	SW9	14.0	5	5.0	6.5	506	2.0	0.98	Red, t^0 = 31°C
10	SW10	8.0	5	3.2	4.2	204	2.4	0.69	Red, normal flow, 29°C
11	SW11	23.6	10	7.4	3.6	135	4.5	1.04	Mixed flow, 30°C
12	SW12	9.6	5	3.2	6.6	512	1.5	0.98	Red, normal flow, 28.2°C
13	SW13	8.0	5	2.8	6.3	535	5.5	0.98	Red, normal flow, 32°C
14	SW14	8.0	5	2.8	6.3	530	2.0	0.88	Red, rich in soil
15	UW1	28.4	10	16.8	12.2	26	2.0	0.75	deep green, 32°C
16	UW2	23.2	10	14.2	10.5	22	1.7	0.65	Green, 36°C
17	UW3	25.6	10	16.0	12.4	22	2.1	0.62	deep green, 33°C
18	UW4	92.8	50	34.2	13.3	70	1.8	0.43	Green, rich in algae
19	UW5	28.8	10	16.5	2.2	13	2.0	1.24	Green, dirty and fish dead
20	UW6	28.8	10	16.5	10.2	9	2.8	0.83	Green, 34°C
21	UW7	25.6	10	14.4	15.0	8	6.5	1.73	Green, rich in algae, 32°C
22	UW8	32.0	16.66	18.0	1.3	22	6.0	1.05	narraw flow, black, dirty, 32°C
23	UW9	36.8	10	18.5	1.78	47	12.5	2.09	black, dirty
24	UW10	38.4	10	20.0	1.0	57	11.8	1.98	black, dirty, 30°C
25	UW11	35.2	10	18.5	0.78	47	15.0	1.88	black, dirty
26	UW12	41.6	25	24.7	0.68	70	17.5	1.96	black, dirty, slow flow, 29°C
27	UW13	41.6	25	25.0	0.60	81	14.5	1.44	black, dirty, 32°C
28	UW14	48.0	25	26.2	0.76	95	8.0	1.19	dirty, 31°C
29	UW15	36.8	16.66	18.4	0.82	45	2.2	0.87	dirty , 31°C
30	UW16	40.0	16.66	22.2	1.0	82	2.9	1.43	black, dirty, 31.9°C

Table I.6 Results of water quality analysis
(Date: 14th October 1999)

No.	Sample code	Result							Characteristic of water
		COD (mg/l)	Dilution factor	BOD_5 (mg/l)	DO (mg/l)	TSS (mg/l)	Σ N (mg/l)	Σ P (mg/l)	
1	SW1	16.0	5	7.2	5.82	85	2.2	0.96	Red, 29.6°C
2	SW2	20.0	5	11.4	5.84	93	2.8	0.84	Yellow, 29.7°C
3	SW3	9.6	5	3.2	7.55	22	2.0	0.83	clear, slow flow, 31°C
4	SW4	10.4	5	4.2	6.17	17	1.8	0.96	Red, 30.7°C
5	SW5	5.6	5	2.2	6.95	168	2.5	1.26	Red, rich in soil, 27°C
6	SW6	6.4	5	2.8	6.86	224	3.0	1.3	Red, rich in soil, 27°C
7	SW7	5.6	5	2.5	6.76	114	1.6	0.83	Red, rich in soil, 27.8°C
8	SW8	11.2	5	4.8	5.68	83	2.2	1.33	Plack, mixed flow, 28.2°C
9	SW9	6.4	5	3.2	7.55	184	2.2	0.78	Red, rich in soil, 27.3°C
10	SW10	8.0	5	3.85	4.26	45	2.4	0.48	Yellow, normal flow 29.1°C
11	SW11	26.0	10	8.7	1.35	32	4.4	1.09	in tensiveflow, dirty, 29.7°C
12	SW12	6.4	5	3.8	7.04	182	1.5	0.49	Red, rich in soil.27°C
13	SW13	7.2	5	4.05	6.95	158	4.2	0.49	Red, rich in soil.27.3°C
14	SW14	8.0	5	4.7	6.96	179	2.0	0.65	Red, rich in soil.27.4°C
15	UW1	25.6	10	12.4	5.25	28	2.0	0.65	Green, 28°C
16	UW2	32.0	10	15.4	7.67	97	1.8	0.62	Green, 30.5°C
17	UW3	25.6	10	16.8	8.90	27	2.0	0.61	Green, 30°C
18	UW4	108.8	50	36.8	6.8	128	2.4	0.54	Green, rich in algae, 28.5°C
19	UW5	27.2	10	10.9	6.72	14	2.7	1.25	Green, 29°C
20	UW6	28.8	10	14.0	11.7	23	2.5	0.83	Green, 30°C
21	UW7	41.6	25	19.8	16.5	19	6.0	2.23	Deep green, rich in algae,30°C
22	UW8	27.2	10	16.3	0.86	46	7.1	1.29	Black, dirty, slow flow28.5°C
23	UW9	33.6	16.66	17.2	1.35	33	11.6	1.3	dirty, slow flow Jellow 28.1°C
24	UW10	32.0	16.66	20.4	0.74	28	12.5	1.23	Black, dirty, intensive flow
25	UW11	35.2	16.66	21.8	1.46	58	15.7	2.5	black, dirty, slow flow 29°C
26	UW12	34.0	16.66	22.7	0.60	33	17.8	1.29	yellow, dirty, slow flow, 29°C
27	UW13	36.8	16.66	23.4	0.60	41	15.0	2.33	black, dirty 30.7°C
28	UW14	36.8	16.66	25.0	0.55	82	7.0	2.31	black, very dirty, adodor
29	UW15	33.6	16.66	17.6	0.93	33	2.8	1.91	Normal flow, black, dirty
30	UW16	33.4	16.66	18.2	2.73	20	2.4	1.59	intensive flow, dirty, black 29.7°C

Table I.7 Results of water quality analysis
(Date: 14th November1999)

No.	Sample code	Result							Characteristic of water
		COD (mg/l)	Dilution factor	BOD_5 (mg/l)	DO (mg/l)	TSS (mg/l)	Σ N (mg/l)	Σ P (mg/l)	
1	SW1	12.0	5	4.8	6.50	32	2.30	0.74	Red, 22°C
2	SW2	10.4	5	3.6	6.48	34	2.70	0.79	Yellow,22.5°C
3	SW3	8.8	5	3.2	6.95	39	2.10	0.98	clear, slow flow, 22.6°C
4	SW4	8.0	5	3.0	7.04	17	1.60	0.74	Red, 23.9°C
5	SW5	11.5	5	4.4	7.54	725	2.30	1.50	Red, rich in soil, 22.4°C
6	SW6	8.0	5	4.0	7.28	660	3.50	1.66	Red, rich in soil, 22.8°C
7	SW7	8.8	5	3.0	7.22	208	1.80	0.77	Red, rich in soil, 21.2°C
8	SW8	9.6	5	4.2	7.14	123	2.00	1.05	Plack, mixed flow, 20.5°C
9	SW9	8.0	5	3.6	7.22	870	2.00	1.04	Red, rich in soil, 23.9°C
10	SW10	20.8	10	8.3	1.53	22	2.30	0.93	Yellow, normal flow 20°C
11	SW11	25.6	10	14.5	1.57	28	6.00	1.06	in tensiveflow, dirty, 22°C
12	SW12	12.8	5	5.7	7.65	1240	1.60	0.66	Red, rich in soil, 24.1°C
13	SW13	9.6	5	3.5	7.51	2335	5.10	0.94	Red, rich in soil, 24.4°C
14	SW14	6.4	5	2.8	7.55	505	2.30	0.77	Red, rich in soil, 22°C
15	UW1	28.8	10	14.6	9.46	30	1.90	0.94	Green, 21°C
16	UW2	24.0	10	14.4	11.5	36	1.70	0.79	Green, 22°C
17	UW3	24.0	10	15.2	8.53	37	2.30	0.88	Green, 23.6°C
18	UW4	113.6	50	38.0	7.33	140	2.00	0.94	Green, rich in algae, 20 °C
19	UW5	22.4	10	11.0	4.03	20	2.80	1.76	Green, 22.3°C
20	UW6	24.0	10	12.0	7.30	28	3.10	1.29	Green, 25.4°C
21	UW7	27.2	10	13.6	5.31	26	6.50	2.30	Deep green, rich in algae, 24.4°C
22	UW8	36.8	16.66	18.6	1.36	33	7.50	1.69	Black, dirty, slow flow, 23.9°C
23	UW9	33.6	16.66	16.9	0.90	41	13.20	1.88	dirty, slow flow Jellow, 21.8°C
24	UW10	34.0	16.66	22.1	0.80	31	12.30	1.53	Black, dirty, intensive flow 22.1°C
25	UW11	48.0	25	28.0	0.74	82	15.80	2.53	black, dirty, slow flow, 23.1 °C
26	UW12	32.0	16.66	22.4	0.90	35	18.80	1.88	yellow, dirty, slow flow, 22.3°C
27	UW13	36.4	16.66	24.2	0.68	35	16.20	2.30	black, dirty 25.6°C
28	UW14	33.6	16.66	22.8	0.64	34	8.10	0.94	black, very dirty, adodor 24.8°C
29	UW15	24.0	10	14.6	2.07	51	3.00	1.58	Normal flow, black, dirty 22.4°C
30	UW16	27.2	10	16.8	2.27	45	2.50	1.96	intensive flow, dirty, black 22.4 °C

Table I.8 Results of River Flow Rate

Measurement point	River	16th July	18th Aug.	17th Sept.	14th Oct.	4th Nov.
UW 9	To Lich River (Upper)	8.1	3.1	3.5	5.0	2.8
UW12	To Lich River (Middle)	13.7	5.8	3.1	8.8	5.9
UW10	To Lich River (Lower)	18.1	9.7	3.1	12.0	8.2
SW 11	Nhue River	54.5	27.1	25.7	31.1	28.8
UW15	Kim Nguu River (Middle)	8.9	5.5	2.6	5.2	4.2

Table I.9 River Flow Rate Calculation Sheet (Date: 16th July1999)

Character / points	Water flow rate (m^3/s)	Area of river cross section (m^2)	flow Velocity (m/s)		Depth of the river (m)		Width of the river (m)
			Average	Max	Average	Max	
UW 9	8.078	16.74	0.483	0.525	0.88	1.20	19.0
UW12	13.724	48.03	0.305	0.383	1.30	1.70	37.0
UW10	18.105	22.60	0.808	0.894	3.32	3.90	6.8
SW 11	54.487	119.86	0.455	0.525	2.71	3.70	44.2
UW15	8.888	18.40	0.483	0.547	0.75	1.15	24.5

Table I.10 River Flow Rate Calculation Sheet (Date: 18th August 1999)

Character / points	Water flow rate (m^3/s)	Area of river cross section (m^2)	flow Velocity (m/s)		Depth of the river (m)		Width of the river (m)
			Average	Max	Average	Max	
UW 9	3.096	4.275	0.724	0.79	0.29	0.40	14.5
UW12	5.776	14.32	0.403	0.54	0.52	0.75	28.5
UW10	9.650	7.48	1.290	1.43	1.17	1.45	6.4
SW 11	27.06	51.27	0.528	0.60	1.30	2.15	39.5
UW15	5.503	33.56	0.164	0.26	1.10	1.60	31.0

Table I.11 River Flow Rate Calculation Sheet (Date: 17th September 1999)

Character / points	Water flow rate (m^3/s)	Area of river cross section (m^2)	flow Velocity (m/s)		Depth of the river (m)		Width of the river (m)
			Average	Max	Average	Max	
UW 9	3.540	6.240	0.567	0.680	0.42	0.55	14.8
UW12	3.087	26.06	0.126	0.150	0.78	1.15	33.3
UW10	3.075	4.921	0.625	0.680	0.81	1.05	6.10
SW 11	25.65	38.94	0.659	0.780	1.12	1.90	34.8
UW15	2.581	20.60	0.125	0.160	0.80	1.20	25.8

Table I.12 River Flow Rate Calculation Sheet (Date: 14th October 1999)

Character / points	Water flow rate (m^3/s)	Area of river cross section (m^2)	flow Velocity (m/s)		Depth of the river (m)		Width of the river (m)
			Average	Max	Average	Max	
UW 9	5.038	5.930	0.850	0.97	0.40	0.52	15.0
UW12	8.752	20.70	0.423	0.56	0.65	0.94	32.0
UW10	12.03	11.98	1.00	1.06	1.58	2.06	7.60
SW 11	31.07	76.77	0.405	0.49	1.85	0.70	41.6
UW15	5.222	30.88	0.169	0.24	1.24	1.66	25.0

Table I.13 River Flow Rate Calculation Sheet (Date: 4th November 1999)

Character / points	Water flow rate (m^3/s)	Area of river cross section (m^2)	flow Velocity (m/s)		Depth of the river (m)		Width of the river (m)
			Average	Max	Average	Max	
UW 9	2.771	3.185	0.870	1.02	0.22	0.38	14.5
UW12	5.934	12.85	0.462	0.61	0.48	0.70	27.0
UW10	8.205	9.26	0.886	0.92	1.32	1.70	7.0
SW 11	28.80	62.68	0.459	0.51	1.57	2.30	40.0
UW15	4.156	27.29	0.152	0.22	1.09	1.56	25.0

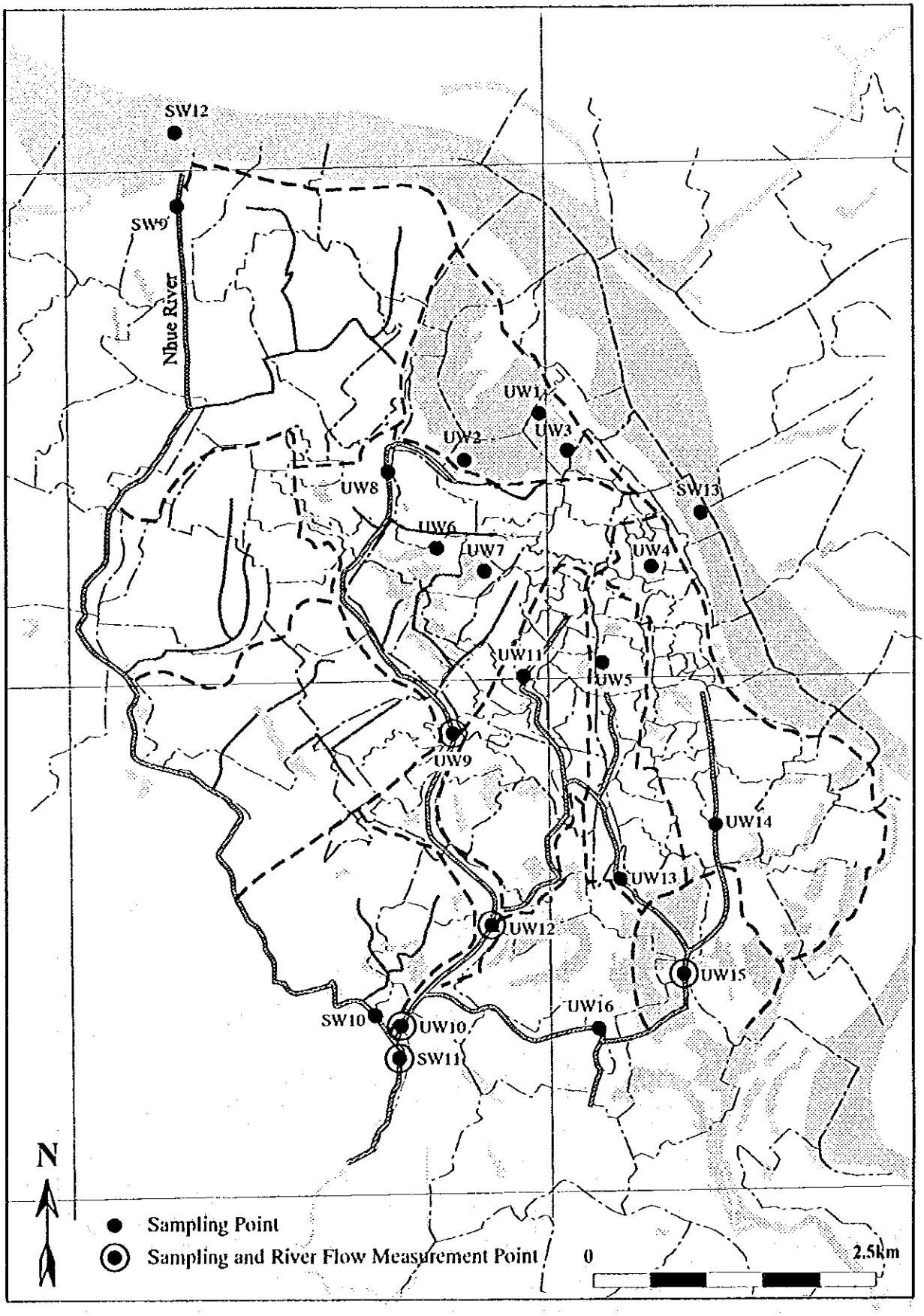


Figure I.1 Water Sampling Points and River Flow Measurement Points

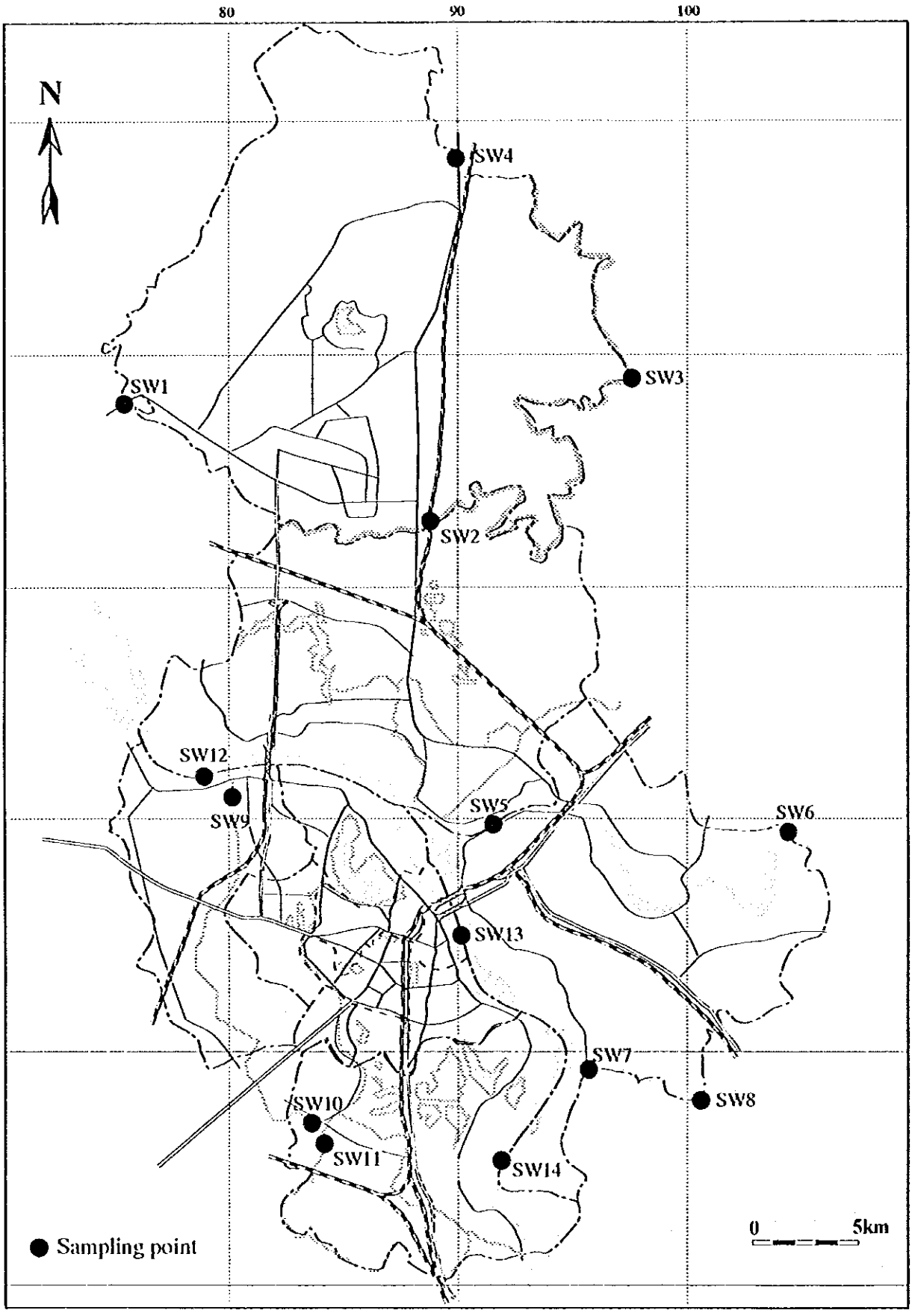


Figure 1.2 Water Sampling Points

J. Air Quality Survey

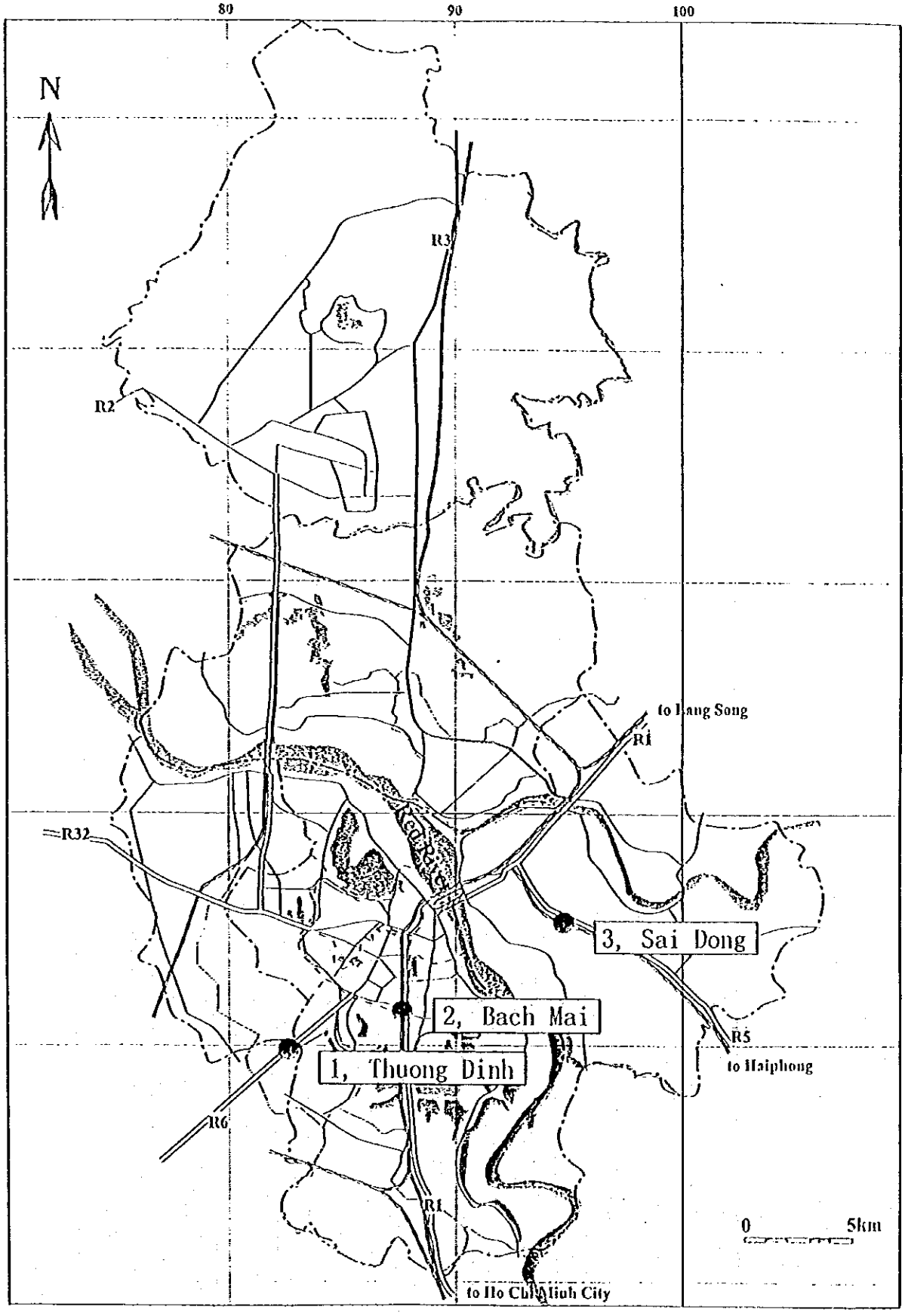


Figure J.1 Air Sampling Points

Table J.1 AVERAGING AMBIENT AIR QUALITY IN HANOI UNIVERSITY .THUONG DINH AREA

Date: 21 July, 1999

Anal parameter / duration	CO (mg/m^3)		SO_2 (mg/m^3)		Lead dust (mg/m^3)	NO_2 (mg/m^3) Method 3	NO_x (mg/m^3)	
	Method 1	Method 4	Method 2	Method 4			Method 3	Method 4
7^h — 8^h	2.97	2.52	0.013	0.020	0.0013	0.009	0.009	0.011
9h	2.30	2.49	0.009	0.017	0.0018	0.009	0.009	0.012
10h	0.34	0.20	0.008	0.015	0.0010	0.004	0.004	0.006
11h	0.22	0.20	0.008	0.015	0.0006	0.003	0.003	0.005
12h	0.26	0.22	0.008	0.016	0.0009	0.002	0.002	0.005
13h	0.27	0.85	0.008	0.015	0.0008	0.002	0.002	0.005
14h	0.37	0.25	0.009	0.017	0.0010	0.002	0.002	0.004
15h	0.39	0.40	0.009	0.017	0.0025	0.002	0.002	0.003
16h	1.03	1.57	0.012	0.014	0.0015	0.004	0.004	0.005
17h	2.00	2.41	0.016	0.016	0.0010	0.006	0.006	0.007
18h	2.31	2.50	0.016	0.016	0.0033	0.009	0.009	0.011
19h	2.18	2.40	0.014	0.018	0.0038	0.016	0.016	0.021
20h	1.92	2.00	0.026	0.025	0.0029	0.012	0.012	0.018
21h	1.67	-	0.014	0.018	0.0009	0.008	0.008	0.010
22h	0.94	-	0.01	0.010	0.0008	0.006	0.006	0.008

Method 1: CO: IR infrared radiation method
Method 2 : SO_2: Ultraviolet (UV) fluorescence spectrofotometer method
Method 3: NO_x: Chemilluminiscence detector method
Method 4 : Using Absorption by pump and identification by spectpholometer method

Table J.2 AVERAGING AMBIENT AIR QUALITY IN BACH MAI HOSPITAL. BACH MAI AREA

Date: 22 July, 1999
Per 1^{hr} — Averaging time measurement

Anal parameter / duration	CO (mg/m^3)		SO_2 (mg/m^3)		Lead dust (mg/m^3)	NO_2 (mg/m^3) Method 3	NO_x (mg/m^3)	
	Method 1	Method 4	Method 2	Method 4			Method 3	Method 4
7^h — 8^h	5.88	4.56	0.015	0.020	0.0015	0.002	0.002	0.013
9h	2.99	2.61	0.016	0.021	0.0010	0.01	0.012	0.020
10h	1.57	2.14	0.011	0.015	0.0008	0.007	0.012	0.020
11h	1.37	1.20	0.011	0.015	0.0008	0.006	0.012	0.021
12h	0.95	0.60	0.014	0.016	0.0009	0.005	0.007	0.010
13h	2.01	1.32	0.016	0.019	0.0010	0.006	0.008	0.010
14h	1.22	0.90	0.016	0.019	0.0006	0.005	0.007	0.010
15h	1.53	1.67	0.015	0.017	0.0007	0.005	0.006	0.007
16h	1.07	1.31	0.013	0.015	0.0010	0.005	0.006	0.008
17h	1.02	1.22	0.014	0.017	0.0020	0.005	0.006	0.008
18h	1.8	2.18	0.015	0.018	0.0027	0.005	0.006	0.007
19h	1.82	2.45	0.016	0.019	0.0035	0.007	0.009	0.011
20h	2.63	2.94	0.017	0.021	0.0020	0.01	0.011	0.013
21h	2.54	-	0.017	0.004	0.0010	0.007	0.007	raining
22h	0.38	-	0.005	-	0.0005	0.004	0.004	raining

Table J.3 AVERAGING AMBIENT AIR QUALITY IN MENTAL HOSPITAL . SAI DONG AREA

Date: 23 July, 1999
Per 1^{hr} — Averaging time measurement

Anai parameter / duration	CO (mg/m^3)		SO_2 (mg/m^3)		Lead dust (mg/m^3)	NO_2 (mg/m^3) Method 3	NO_x (mg/m^3)	
	Method 1	Method 4	Method 2	Method 4			Method 3	Method 4
7^h — 8^h	1.17	1.40	0.006	0.009	0.0010	0.004	0.004	0.008
9h	0.37	1.20	0.006	0.010	0.0015	0.003	0.003	0.007
10h	0.1	0. 12	0.007	0.012	0.0010	0.005	0.005	0.012
11h	0.46	0.54	0.007	0.012	0.0018	0.004	0.004	0.007
12h	0.34	0.47	0.007	0.013	0.0010	0.003	0.003	0.007
13h	0.26	0.23	0.008	0.015	0.0015	0.002	0.002	0.008
14h	0.23	0.24	0.01	0.024	0.0010	0.002	0.002	0.006
15h	0.19	0.21	0.011	0.025	0.0008	0.002	0.002	0.005
16h	0.11	0.15	0.01	0.023	0.0010	0.003	0.003	0.007
17h	0.03	0.08	0.009	0.014	0.0010	0.003	0.003	0.009
18h	0.01	0.06	0.007	0.012	0.0009	0.003	0.003	0.009
19h	0.04	0.05	0.007	0.012	0.0005*	0.002	0.002	0.012
20h	0.01	-	0.006	-	0.0004	0.002	0.002	raining
21h	0.02	-	0.006	-	0.0004	0.001	0.001	raining
22h	0.01	-	0.005	-	0.0004	0.001	0.001	raining

* Raining

K. Present Environmental and Social Conditions of Dong Ngac and Duc Giang Candidate Solid Waste Transfer Stations

3.2 PRESENT CONDITIONS OF THE ENVIRONMENTAL QUALITY

The documentation and database of the environmental present conditions of the study area are not so much, because the study areas are of the suburban districts of Hanoi City. These areas are characterized by rural so their environmental characteristics are quite different with those of Hanoi inner.

For overcoming this situation, the EIA Implementation Agency carried out therefore the surveys accorded to technical specification specified by JICA Study Team for two areas.

Normally, before carrying out the surveys, the EIA Implementation Agency coordinated with the Project Management Board must contact with the project study area authority in order them (local authority) to allow the surveys. At Duc Giang area, all surveys were very well performed with agreement of the local authority. But at Dong Ngac area, the local authority did not allow any survey on their land. For overcoming this difficulty the EIA Implementation Agency decided to survey stealthily at Dong Ngac. Moreover, all other base data related to Dong Ngac had been also collected from the other sources.

The surveys were implemented on date 27-28 for Dong Ngac Area and 30-31 for Duc Giang Area, on July 1999.

According to the EIA framework of the MOSTE and the Technical specifications of EIA framework prepared by JICA Study Team, the following detailed topics are considered to assess the environmental impacts on:

1. Air quality
2. Noise
3. Surface and underground water quality
4. Ecology
5. Economy-Culture-Sociology and Road Access

3.2.1 Present conditions of air quality (AQ)

3.2.1.1 Air emission sources

An area of 5 ha of two study areas is taken in surveying accorded to the proposed project description.

A. Dong Ngac Area

Surrounding the study area there is the current paddy fields. The nearest residential (about 200m) are some households of which the main living fuel used is the natural gas and electricity. Hence, the current exhausted vehicles passing the transportation roads are the main source of air emission.

At present, according to the data surveyed by CERECE dated August 1999, the following sources are considered as the present sources of the air pollution

- Transportation: the total length of different kinds of road is classified as following:
  - 1100 m - Urban asphalt road.
  - 900m- Inter-commune asphalt road.
  - 1000m-Inter-community road (concrete road)

  Because of near the sand exploring positions of Red River, the traffic volume of 1100m of urban asphalt road is quite dense in day and night.
- Domestic air waste

No industry, as well as any household air emission is found in here.

B. Duc Giang Area

Surrounding the study area there is the current paddy fields. The nearest residential (about 200m) is some household of which the main living fuel used is the electricity, fire wood, vegetable rubbish and rice straw etc. According to the data surveyed of CERECE and the distance from the residential to proposed transfer station, the air emission from households is not significant. Hence, the current exhausted vehicles passing the transportation roads are the main source of air emission.

At present, according to the data surveyed by CERECE dated August 1999, the following sources are considered as the present sources of the air pollution

- Transportation: the total length of different kinds of road is classified as following:
  - 1600 m - National road asphalt.
  - 1600m - Railway
  - 900m- Inter-commune road asphalt.
  - 1500m-Inter-community road (brick or concrete road)
  - 1400m - Duong River Dyke road asphalt.

The National Road No.1 is being the most important road of Hanoi to Northern provinces so there is quite high traffic volume. (Please sees the table 3.2.1.14). And the traffic vehicle exhaust is considered as the potential air emission in here.

3.2.1.2 Observing network stations

The sampling and measuring network for air pollution is arranged through the stations representing for the whole activity of the proposed project. The principle to place the monitoring station is based on the following characteristics and factors of the study area:

1. Topography

2. Climate (focussed on the wind direction and velocity)
3. Residential: Present residential and residential after the project operation
4. Detailed proposed items of the project.

The selected observing stations to take and measure the air quality are presented in Figure 3.3(a), 3.3(b) and Table 3.2.1.1.

Table 3.2.1.1
Selected stations for monitoring air pollution at Dong Ngac

No	Present	Future
Station 1	On the local way under Thang Long Bridge parallel with the railway	At Eastern direction of transfer station, distant 100m
Station 2	Next to the road that connects the high way to go to Chem	At southwestern direction of transfer station, distant 250m at which will be affected by project operation when the NorthEastern wind blows.
Station 3	At commune healthcare station	At Western direction of transfer station, distant 150m at which will be affected by project operation when the Eastern winds blow.
Station 4	At the residential	At Northern direction of transfer station, distant 150m at which will be affected by project operation when the Southern winds blows.
Station 5	T-junct of high way to Dong Ngac commune	Road on which the solid waste transportation trucks pass
Station 6	On the high way North Thang Long-Noi Bai	High way North Thang Long - Noi Bai

Note: Traffic volume observations were implemented for station 1, 5 and 6, but no air quality observations implemented for station 5 and 6

Selected stations for monitoring air pollution at Duc Giang

No	Present	Future
Station 1	Dyke Guard box No 6 of Duong Dyke	At Northern direction of transfer station, distant 200m
Station 2	At the residential of Thanh Am village	At Eastern direction of transfer station, distant 200m
Station 3	At the residential of Duc Hoa village	At Western direction of transfer station, distant 300m
Station 4	At the residential of Thanh Am village	At SouthEastern direction of transfer station, distant 500m
Station 5	T-junct of National road 1A to Thanh Am Village	Road on which the solid waste transportation trucks pass

Note: Traffic volume observations were implemented for station 1 and 5, but no air quality observations implemented for station 5.

Figure 3.3(a)
Map of Air quality observing positions (Dong Ngac)

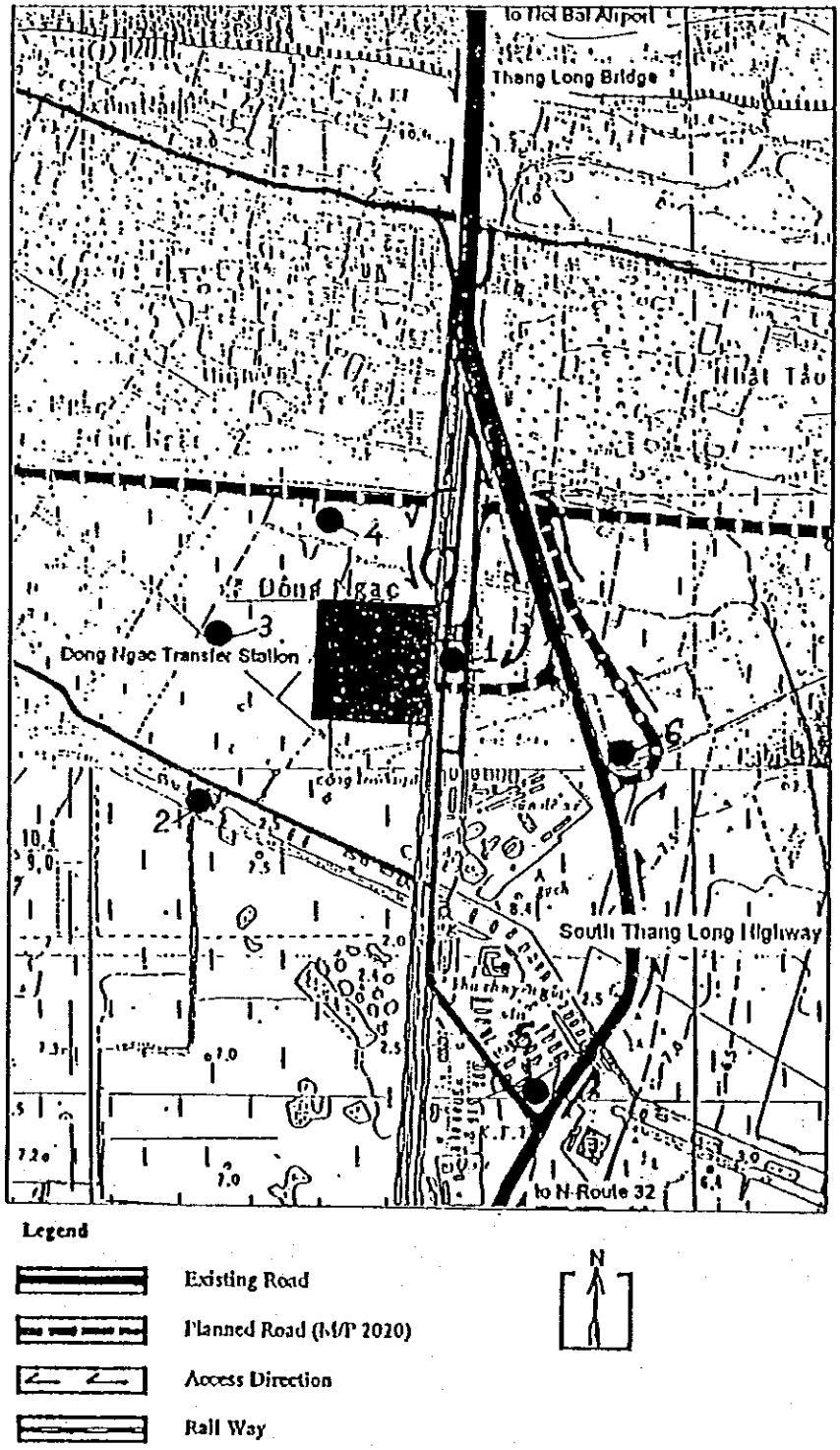
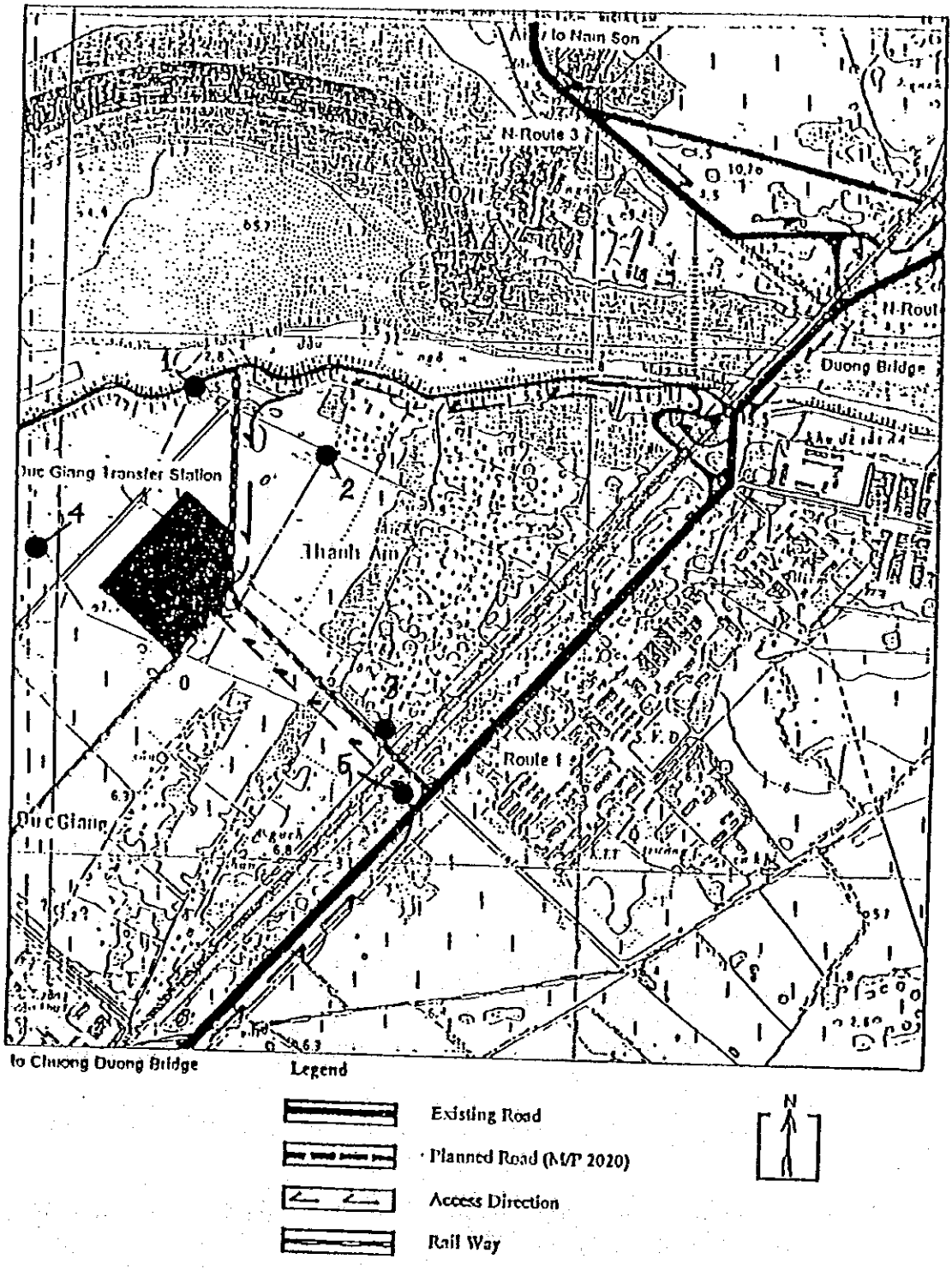


Figure 3.3(b)
Map of Air quality observing positions (Duc Giang)



Air quality information taking methodology in the survey

The ambient air quality information was divided into 4 continuous observations in 24 hours per day and night. So, for each station, 4 samples will be taken. The monitoring observations are differently taken accordance with the daytime and night. The daytime is counted from 7h AM to 7h PM, the nighttime from 7h PM to 7h AM of the next morning. This rule is considered to coincide to the meteorological monitoring observations.

The technical sampling and analyzing of the air samples are carried out in compliance with Vietnam Standards (TCVN) and International Standards.

3.2.1.3 Assessment methodology

The EIA methodology for air pollution is to measure and monitor (observe) the present condition of the ambient air quality in order to collect the necessary information based on the selected observing network stations for the whole area. The following basis are used to assess the air quality of an area or region:

A. The air quality parameters used to assess according to Standards of Vietnam.

The main ambient air quality parameters

- The gaseous substances in the ambient air: SO_2; NO_2; CO.
- The most gaseous substance will be generated in the transfer station such as: H_2S.
- The particulate matters: Total suspended particulate matters (TSP)
- Heavy metals in the ambient air: Pb in TSP

B. Measurement and analysis methodology

The measurement and analysis methods used in this report are carried out in compliance with TCVN and International Standards:

- TCVN - 1995 and if the TCVN lacks the field measurement and analysis methods will be carried out in compliance with APHA (American Public Health Association)
- Methods of Air Sampling and Analysis - Second edition do APHA-USA (American Public Health Association).

Detailed air quality samples were carried out in compliance with the standards as bellows:

1. Sampling and analyzing SO_2 concentration under TCVN 5971-1995. Tetrachloromercurate (TCM)/ Pararosaniline method.
2. Measuring the CO concentration under method No-128. Method of Air Sampling and Analysis - Second edition. APHA-USA.

3. Sampling and analyzing the NO_2 concentration under method No-406 (Saltzmann method). No-128. Method of Air Sampling and Analysis - Second edition. APHA-USA.
4. Sampling and analyzing the H_2S concentration under method No-701. Method of Air Sampling and Analysis - Second edition. APHA-USA.
5. Sampling and analyzing the TSP content under method TCVN-5067-1995 and No.501 (Hi-Vol)- Method of Air Sampling and Analysis - Second edition. APHA- USA.
6. Sampling and analyzing the Pb in TSP concentration under method No.315. Method of Air Sampling and Analysis - Second edition. APHA-USA.

C. Equipment used in measuring and analyzing

- Measuring instrument for CO in ambient air: Carbon Monoxide Analyzer ML9832, MONITOR LAB - USA.
- TSP sampler: High Volume Air Sampler - SIBATA - Japan.
- Analytical balance: Mettler Analytical balance (accuracy: 10^{-4} g).
- Air sampler - DESAGA 212 - Germany.
- Mini air samplers- SIBATA- Japan
- Spectrophotometer: Spectronic 2D -USA
- Analyzing Pb in TSP: Atomic Absorption System: AA-6501S, Shimadzu-Japan.

D. Ambient Air Quality Standard

Table 3.2.1.2
Allowable values of Ambient Air Quality

Unit: mg/m³

No	Parameters	1hr-average time	8hr-average time	24hr-average time	TCVN -1995
1	CO	40	10	5	TCVN-5937
2	NO_2	0.4	-	0,1	TCVN-5937
3	SO_2	0.5	-	0.3	TCVN-5937
4	H_2S	0.008	-	0.008	TCVN-5938
4	Pb in TSP	-	-	0,005	TCVN-5937
6	TSP	0.3	-	0.2	TCVN-5937

The measured or analyzed parameters on site will be used to assess the air quality in compliance with above ambient air quality standards.

3.2.1.4 Results of the air quality survey

A. Dong Ngac Area

A.(a) Results of the vehicle counted in the investigation

Table 3.2.1.3
Average Vehicle Traffic Volume at station 1 (Dong Ngac)

	24 hours traffic count				
	1:00 to 7:00	7:00 to 13:00	13:00 to 19:00	19:00 to 1:00	Total
Trucks	42	74	74	36	225
Buses	0	0	0	0	0
P. Cars	18	65	73	12	168
Trailer Cong Nong		2	0		2
Motorcycle	245	329	270	113	956
Container Truck	0	0	0		0

Table 3.2.1.4
Average Vehicle Traffic Volume at station 5 (Dong Ngac)

Vehicle Type	24 hours traffic count				
	1:00 to 7:00	7:00 to 13:00	13:00 to 19:00	19:00 to 1:00	Total
Trucks	59	81	76	356	571
Buses	5	17	17	1	40
Cars	14	49	51	15	128
Trailer Cong Nong	4	7	2	1	14
Motorcycle	251	506	462	281	1,500
Container Truck					

Table 3.2.1.5
Average Vehicle Traffic Volume at station 6 (High Way - Dong Ngac)

Vehicle Type	24 hours traffic count				
	1:00 to 7:00	7:00 to 13:00	13:00 to 19:00	19:00 to 1:00	Total
Trucks	77	144	124	72	417
Buses	35	56	64	11	166
Cars	143	319	293	132	886
Trailer Cong Nong	5	8	12	13	38
Motorcycle	847	1,252	984	453	3,536
Container Truck					

A.(b) Gaseous substances

Table 3.2.1.6
Average SO_2 concentration per day (Dong Ngac)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.0127	0.0109	0.0115	0.0092	0.0111	0.0154	0.0008
K2	0.0078	0.0064	0.0020	0.0088	0.0063	0.0095	0.0012
K3	0.0041	0.0043	0.0055	0.0086	0.0056	0.0112	0.0007
K4	0.0042	0.0054	0.0071	0.0066	0.0053	0.0112	0.0012

Table 3.2.1.7
Average NO_2 concentration per day (Dong Ngac)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.0118	0.0121	0.0140	0.0075	0.0113	0.0178	0.0006
K2	0.0058	0.0048	0.0057	0.0042	0.0051	0.0064	0.0036
K3	0.0034	0.0029	0.0049	0.0027	0.0035	0.0083	0.0019
K4	0.0036	0.0030	0.0057	0.0036	0.0045	0.0079	0.0022

Table 3.2.1.8
Average H_2S concentration per day (Dong Ngac)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.0022	0.0023	0.0033	0.0024	0.0025	0.0034	0.0020
K2	0.0017	0.0025	0.0021	0.0023	0.0022	0.0032	0.0014
K3	0.0018	0.0015	0.0013	0.0014	0.0015	0.0022	0.0006
K4	0.0011	0.0014	0.0026	0.0015	0.0017	0.0034	0.0008

Table 3.2.1.9
Average CO concentration per day (Dong Ngac)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.8860	1.1340	1.6440	2.8710	1.6337	3.7700	0.8050
K2	0.3150	0.2000	0.2530	0.2560	0.2560	0.3650	0.1400
K3	1.4380	1.850	1.2650	2.034	1.6470	3.5320	0.1670
K4	0.4440	1.252	1.3410	0.4490	0.8840	1.8250	0.0980

Table 3.2.1.10
Average TSP concentration per day (Dong Ngac)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.5800	0.7850	3.3400	1.2350	1.9850	3.7300	1.0200
K2	0.10900	0.1780	0.2260	0.1060	0.1540	0.2470	0.0980
K3	0.10400	0.2260	0.2330	0.1410	0.1760	0.3120	0.0980
K4	.01040	0.1360	0.1400	0.1090	0.1220	0.1520	0.0980

Table 3.2.1.11
Average Pb in TSP concentration per day (Dong Ngac)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.00025	0.00016	0.00012	0.00021	0.00019	0.00030	0.00012
K2	0.00021	0.00020	0.00030	0.0002	0.00020	0.00030	0.00010
K3	0.00018	0.00027	0.00024	0.00023	0.00023	0.00030	0.000122
K4	0.00019	0.00026	0.00023	0.00023	0.00023	0.00030	0.00013

A.(c) Assessment of the existing air quality

(i) Gaseous Substances

(a) SO_2 Parameter

The monitored value varied from 0.7μg/m^3 – 15.4μg/m^3 during all a day (day and night). The allowable value is 0.300mg/m^3 (300μg/m^3). This indicates that the collected values of SO_2 during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(b) NO_2 Parameter

The monitored value varied from 1.9μg/m3 – 17.8μg/m3 for all a day (day and night). The allowable value is 0.100mg/m3 (100 μg/m3). This indicates that the collected values of NO2 during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(c) CO Parameter

The monitored value varied from 0.098mg/m3- 3.77 mg/m3 for all a day (day and night). The allowable value is 5mg/m3. This indicates that the collected values of CO during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(d) H_2S Parameter

The monitored value varied from 0.6µg/m3-3.4 µg/m3 for all a day (day and night). The allowable value is 8 µg/m3. This indicates that the collected values of H2S during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(ii) Particulate Matters

(a) Total suspended particulate matter (TSP)

The monitored value varied from 0.098mg/m3- 3.77 mg/m3 for all a day (day and night). The allowable value is 0.200mg/m3.

Comparing between the monitoring stations, only a station (K1) showed the observed TSP concentration was higher 7 times than the allowable value, the rest of observed stations gave the values ver low, more lower than the allowable value from 1.5 to 2 times. The reason of high TSP concentration monitored at station K1 is caused by the sand exploring activity. At this station the TSP concentration difference between day and night was not significantly changed.

At the all monitoring stations, the TSP concentration showed the stability in value for the all observations, this leads to the comment that no much change was recorded in the TSP emission of the both sources residential and transportation activity for day and night.

Table 3.2.1.12
Average TSP concentration at day and night of monitoring stations (Dong Ngac)

Unit: mg/m3

Station	Day	Night	Average
K1	2.563	1.408	1.985
K2	0.166	0.166	0.154
K3	0.230	0.123	0.176
K4	0.138	0.107	0.152

(b) Heavy metal in TSP

According to the Standard of Vietnam TCVN 5937-1995 the heavy metal in TSP was stipulating for only Pb, therefore the Pb concentration in TSP was samples and analyzed.

(c) Pb in TSP Parameter

The monitored value varied from 0.13µg/m^3- 0.30µg/m^3 for all a day (day and night). The allowable value is 5.00 µg/m^3. This indicates that the collected values of Pb in taken TSP samples during the survey (2 day = 48 hours continuously) were being lower than allowable value. In the practice, the main pollution source of Pb in air quality is the traffic vehicle of which

the traffic volume counted in the study area was not dense leading the low Pb concentration.

B. Duc Giang Area

B.(a) Results of the vehicle counted in the investigation

Table 3.2.1.13
Average Vehicle Traffic Volume at station 4 (Duc Giang)

Vehicle Type	24 hours traffic count				
	1:00 to 7:00	7:00 to 13:00	13:00 to 19:00	19:00 to 1:00	Total
Trucks	1	-	-	-	1
Buses	0	0	0	0	0
Cars	1	3	3	1	7
Trailer Cong Nong	1	5	3	2	11
Motorcycle	26	83	56	13	178
Container Truck					

Table 3.2.1.14
Average Vehicle Traffic Volume at station 5 (NR. No1A-Duc Giang)

Vehicle Type	24 hours traffic count				
	1:00 to 7:00	7:00 to 13:00	13:00 to 19:00	19:00 to 1:00	Total
Trucks	101	272	261	143	777
Buses	38	147	87	15	287
Cars	47	147	170	66	430
Trailer Cong Nong	101	29	27	4	161
Motorcycle	1.284	2.330	2.409	66	6.088
Container Truck					

B.(b) Gaseous Substances

Table 3.2.1.15
Average SO_2 concentration per day

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.0060	0.0080	0.0050	0.00055	0.0008	0.0052	0.0011
K2	0.0035	0.0018	0.0019	0.0017	0.0022	0.0045	0.0010
K3	0.0019	0.0018	0.0020	0.0020	0.0019	0.0038	0.0003
K4	0.0012	0.0015	0.0003	0.0035	0.0016	0.0059	0.0008

Table 3.2.1.16
Average NO_2 concentration per day

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.0020	0.0015	0.0029	0.0016	0.0020	0.0042	0.00052
K2	0.0012	0.0010	0.0029	0.0030	0.0025	0.0042	0.0005
K3	0.0025	0.0018	0.0015	0.0030	0.0022	0.0040	0.0005
K4	0.0024	0.0022	0.0023	0.0024	0.0023	0.0046	0.0003

Table 3.2.1.17
Average H_2S concentration per day

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.0012	0.0015	0.0019	0.0016	0.0015.5	0.0031	0.0008
K2	0.0007	0.0012	0.0007	0.0007	0.0008	0.0015	0.0004
K3	0.0008	0.0010	0.0012	0.0012	0.0011	0.0018	0.0006
K4	0.0007	0.0006	0.0008	0.0007	0.0007	0.0009	0.0005

Table 3.2.1.18
Average CO concentration per day

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.189	0.141	0.4390	0.1450	0.228	2.7440	0.0070
K2	0.954	3.0161	1.1135	2.321	1.582	3.016	0.7860
K3	3.803	1.2510	2.3337	3.775	3.066	6.376	1.0620
K4	1.462		1.016	1.164	1.192	1.810	0.9060

Table 3.2.1.19
Average TSP concentration per day (Duc Giang)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.1350	0.1250	0.1490	0.1220	0.1330	0.1950	0.1060
K2	0.1350	0.1240	0.1370	0.1090	0.1260	0.1670	0.1030
K3	0.0880	0.0840	0.088	0.0830	0.086	0.0880	0.0830
K4	0.1070	0.1230	0.1310	0.1020	0.1160	0.1430	0.1050

Table 3.2.1.20
Average Pb in TSP concentration per day (Duc Giang)

Unit: mg/m3

Station	Obs 1	Obs 2	Obs 3	Obs 4	Mean	Max	Min
K1	0.00015	0.00015	0.00025	0.00025	0.00020	0.0003	0.00010
K2	0.00020	0.00020	0.00025	0.00015	0.00020	0.00030	0.00010
K3	0.00023	0.00024	0.00022	0.00026	0.00024	0.00036	0.00014
K4	0.00013	0.00015	0.00014	0.00012	0.00014	0.00018	0.00005

B.(c) Assessment of existing air quality

(i) Gaseous substances

(a) SO_2 Parameter

The monitored value varied from 0.3µg/m^3 – 5.9µg/m^3 during all a day (day and night). The allowable value is 0.300mg/m^3 (300µg/m^3). This indicates that the collected values of SO_2 during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(b) NO2 Parameter

The monitored value varied from 0.3µg/m3 – 4.6µg/m3 during all a day (day and night). The allowable value is 0.100mg/m3 (100µg/m3). This indicates that the collected values of NO2 during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(c) CO Parameter

The monitored value varied from 0.007mg/m^3- 6.37 mg/m^3 during all a day (day and night). The allowable value is 5mg/m^3. This indicates that the collected values of CO during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(d) H2S Parameter

The monitored value varied from 0.4µg/m^3-3.1µg/m^3 during all a day (day and night). The allowable value is 8 µg/m^3. This indicates that the collected values of CO during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

(ii) Particulate Matters

(a) Total Suspended Particulate Matter - TSP

The monitored value varied from 0.083mg/m3- 0.195 mg/m3 for all a day (day and night). The allowable value is 0.200mg/m3.

Table 3.2.1.21
Average TSP concentration at day and night of monitoring stations (Duc Giang)

Unit: mg/m^3

Station	Day	Night	Daily average
K1	0.137	0.129	0.133
K2	0.130	0.122	0.126
K3	0.088	0.84	0.86
K4	0.127	0.105	0.116

(b) Pb concentration in TSP

The monitored value varied from 0.05µg/m^3- 0.36µg/m^3, during all a day (day and night). The allowable value is 5µg/m^3. This indicates that the collected values of CO during the survey (2 day = 48 hours continuously) were quite stable in numerical value and also were being lower than allowable value.

C. General Assessment of air quality for both areas

C.(a) Dong Ngac Area

At most monitoring stations, the measured gaseous substances were being lower than the allowable value, therefore the conclusion that could be drew out for both areas is the clean of air quality. Through TSP results of both areas, the measured TSP concentrations at the whole observing network indicate that at the station nearby transportation road, the TSP had sometime exceeded 12 times (station K1, Dong Ngac Area at 2nd obs on 27/7/1999) higher than the allowable value. The interesting thing in here is that the Pb in TSP is very low. So we can recognize that the dust swept away by road activity (bad road quality, and vehicle) may cause the high TSP concentration in the air.

C.(b) Duc Giang Area

Comparing with the measured gaseous substances at Dong Ngac, the gas concentrations in here were till lower. The main reason causes the low concentration is that the present study area is quite far from the transportation roads. The counted traffic vehicles illustrate this comment.

D. Conclusion

In compliance with the TCVN 5937, 5938-1995 the existing air quality of both areas is quite clean. The measured concentration difference on the numerical value of the two areas is not so much.

3.2.2 Present conditions of Noise and Vibration Level (NVL)

3.2.2.1 Methodology

The methodology is used to evaluate the impact of noise from the transportation system for transfer stations in Duc Giang and Dong Ngac area involving measurement of current noise levels. Results are compared with Vietnamese Government guidelines and standard.

3.2.2.2 Measurement of Noise Level

Sound intensity is a function of amplitude and frequency. Within the range of human hearing, high frequency noises are generally perceived as being louder than low frequency noises. To compensate for the differences in perception based on sound frequency, a standard weighting system has been developed to describe different types of noise. There are three categories: A, B and C but standards for traffic noise usually are established by category A. The readings taken have been recorded in Decibels (dBA).

3.2.2.3 Method of Sound and Vibration Level Measurement

The purpose of the noise measurement was to determine the exiting noise levels along the streets within urban areas. The exiting noise level was monitored for a weekday continuously at each location.

The practice of measurement was according to International Standards Organization (ISO) recommendations that microphones be set 1.2 meters above the ground level and in distance 3-4 meters from edge of the road. Measurement should be made at a point more than 2 meter away from any reflective object, and other procedures.

Noise levels were surveyed two times of every hour, each time in 10 minutes for L_{50} and L_{eq}. The duration for monitoring was 24 hours continuously . Day and night sound levels are measured to characterize the average sound level that is perceived by people in residential areas throughout the day and night.

Hourly noise levels were measured in dBA by an Integrating sound level meter, Model NL - 04 – RION Manufacturer, Japan.

Vibration Levels: Vibration monitoring was complied with the Institution of Road/Highway and Transportation's Traffic impact assessment guidelines.

At each monitoring point, vibration levels were measured continuously 24 hours; two recorded data have been collected every hour. Each data has been observed for 10 minutes with 100 times of reading. From 100 readings, a mean value of velocity of vibration (V_{10}) and mean of vibration acceleration level (A_{10}) were obtained with a probability of 90 % (90 % reading values lower than above reading values) . From basic parameters, equivalent vibration level L_{V10} and L_{A10} were determined to compare with permissible values.

Vibration levels were measured by a Multipurpose Vibration Meter, Model VM-80, made by RION Company-Japan .

3.2.2.4 Monitoring Locations

The criteria for selecting monitoring locations were conducted together with air quality monitoring points. At each site, two monitoring stations of noise levels (O) and vibration levels

(R) were indicated in which:

- One was along the proposed access roads - O1 and R1
- One was at the residential area which located close to the transfer station site – O2 and R2

The locations for monitoring of noise and vibration levels are shown in figures 3.4(a), 3.4(b)

3.2.2.5 Monitored Parameters

Noise Levels: The following parameters were measured in order to achieve the objective of monitoring exiting conditions:

(a) Median of noise level (L_{50}) and equivalent sound level (L_{eq}) were surveyed, in order to assess its impacts based upon a generally accepted standards

(b) Day-sound level (L_d) - sound level averaged by survey noise levels of morning (from 6:00 -8:00), mid-day (from 11:00-13:00) and evening (from 16:00 - 18:00) - sound level (L_n) - sound level averaged by survey noise levels of mid-night from 22:00 - 24:00)

Vibration levels: The following parameters were measured in order to achieve the objective of monitoring exiting conditions:

- Average RMS velocity of vibration (10^{-3}cm/s) and
- RMS Acceleration (10^{-3}m/s^2).

3.2.2.6 Monitoring Results

A. Noise Level

A.(a) Results

The average value of the monitored noise levels is summarized in Table 3.2.1 and they were recorded more detailed in *Appendix A* . Vietnamese Noise level standards for commercial and residential areas near the routes are 70dbA at the time from 6h to 18h; 70 dbA - from 18h to 22h and 50dbA - from 22h to 6h AM (Table 3.2.2). Existing noise levels along the routes varied primarily depending on proximity to traffic volume, type of vehicles, existing routes and residential areas .

Figure 3.4(a)
Locations for monitoring of Noise and Vibration in Dong Ngac Site

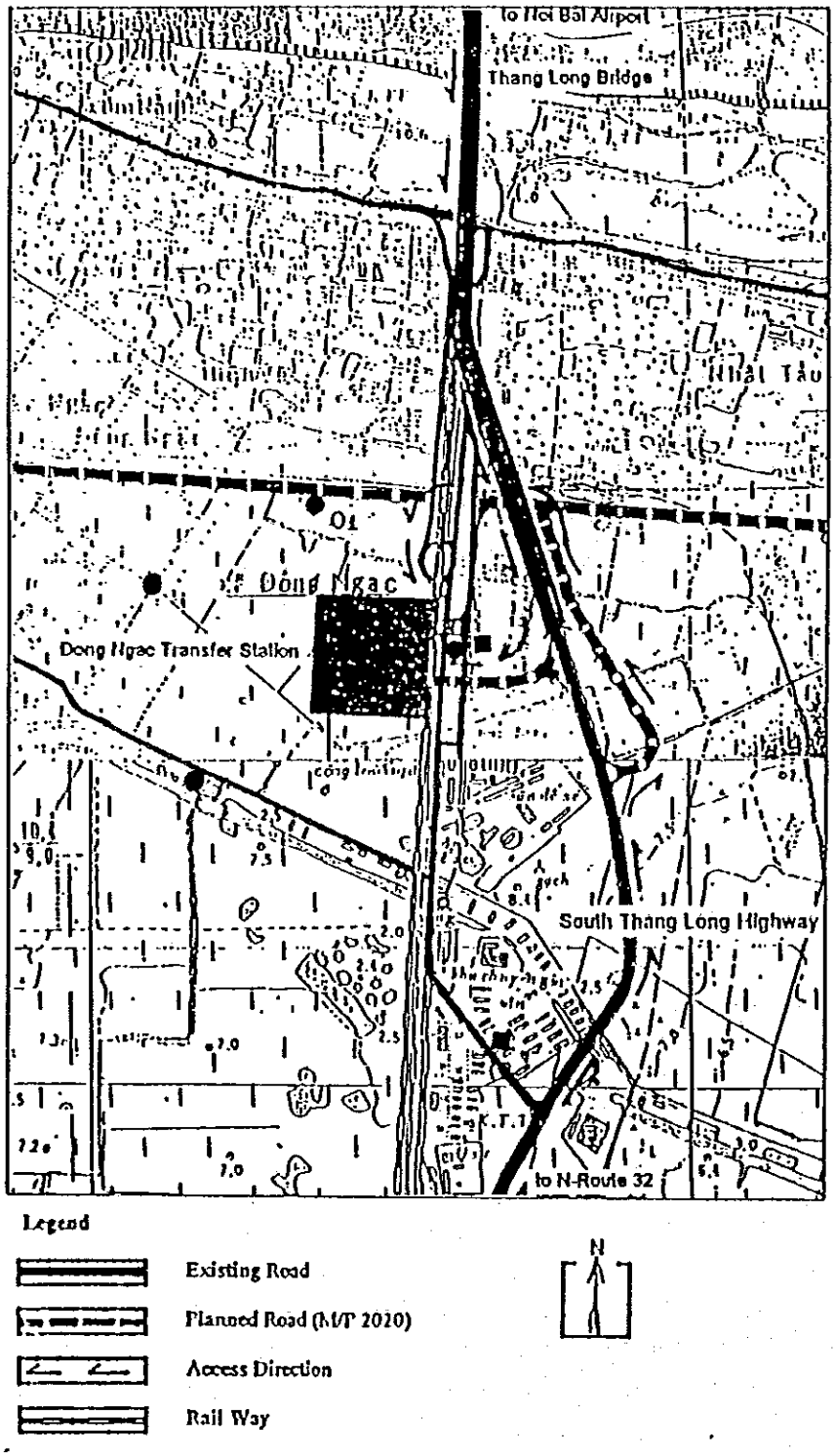


Figure 3.4(b)
Locations for monitoring of Noise and Vibration in Duc Giang Site

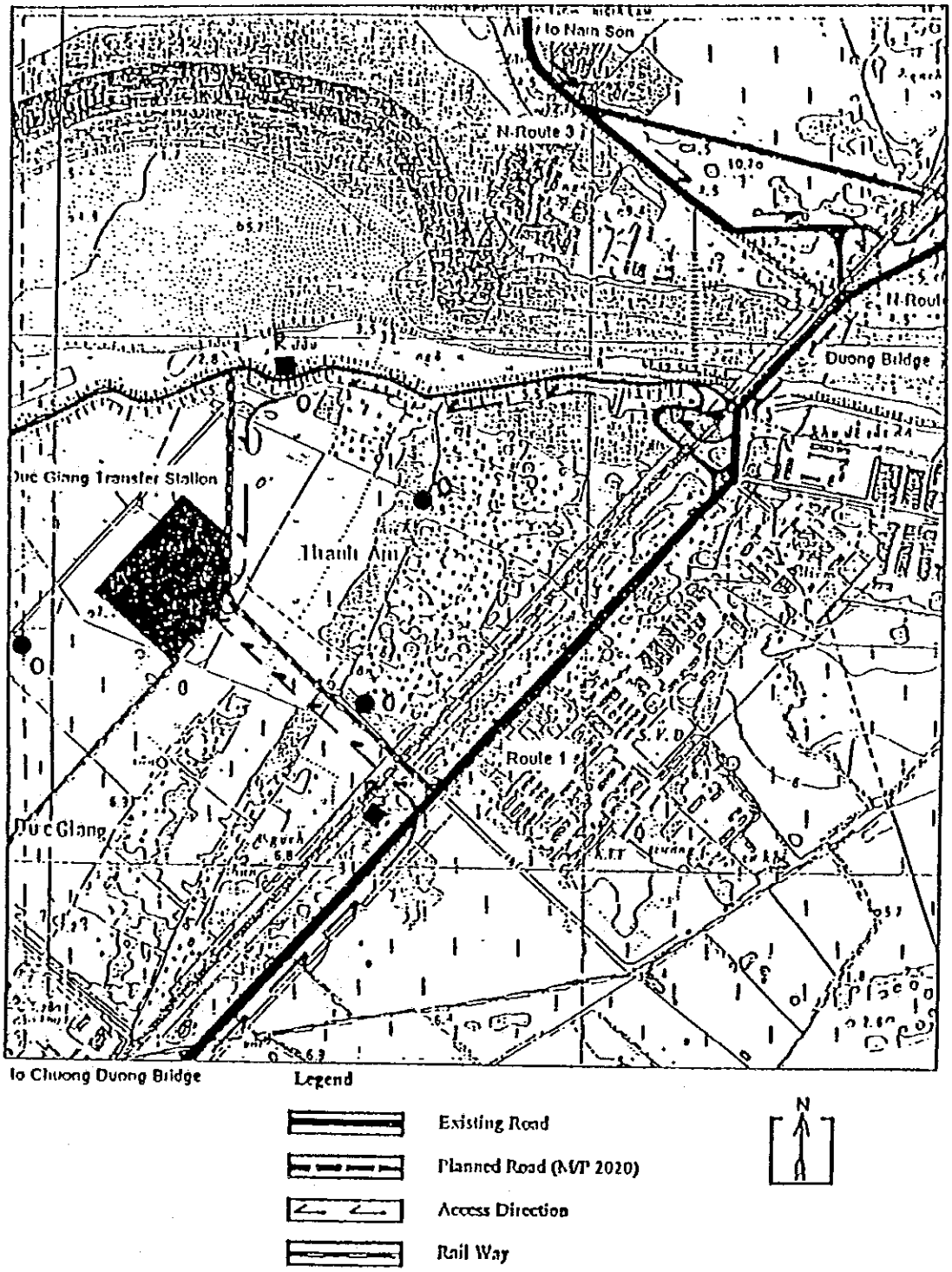


Table 3.2.2.1
Average values of Noise Level (dBA) at monitoring locations

Monitoring Location	Sampling Time	Noise Levels (dB_A)		
		L_{Aeq}	L_{Amax}	L_{50}
Dong Ngac O1	Average – Day time (6:00 – 18:00)	60.0	81.3	52.1
	Average - Evening time (18:00 – 22:00)	61.9	83.2	55.3
	Average – Night time (22:00 – 6:00)	48.9	62.6	44.4
Dong Ngac O2	Average – Day time (6:00 – 18:00)	59.9	81.5	50.4
	Average – Evening time (18:00 – 22:00)	58.1	78.6	51.6
	Average – Night time (22:00 – 6:00)	53.5	70.1	51.0
Duc Giang O1	Average – Day time (6:00 – 18:00)	59.2	80.0	51.5
	Average - Evening time (18:00 – 22:00)	60.8	80.7	54.0
	Average – Night time (22:00 – 6:00)	51.9	68.5	47.7
Duc Giang O2	Average – Day time (6:00 – 18:00)	59.0	81.3	48.5
	Average – Evening time (18:00 – 22:00)	55.4	77.9	52.8
	Average – Night time (22:00 – 6:00)	48.9	65.1	45.7

Table 3.2.2.2
Maximum Permissible Noise Levels in Public and Residential Areas - dB(A) - Vietnamese Standard TCVN 5949-1995

N°	Period of time			
	Area	From 6:00 – 18:00	From 18:00 – 22:00	From 22:00 – 6:00
1	Quiet areas: Hospitals Libraries Sanatorium Kindergartens, schools	50	45	40
2	Residential area: Hotel, administration offices Houses, apartment houses, etc.	60	55	45
3	Commercial and service areas and mix	70	70	50
4	Small industrial factories intermingling in residential areas	75	70	50

A.(b) Comments

In accordance with TCVN 5949 – 1995, from the monitored results, several findings are as follows:

In Dong Ngac Site - at Monitoring Point O1:

- From 6:00 – 18:00 : Noise levels were meet the permissible values .
- From 18:00 – 22:00 : Noise levels were higher than the permissible values at a value of 6.9 dB_A.
- From 22:00 – 6:00 : Noise levels were higher than the permissible values at a value of 3.9 dB_A.

In Dong Ngac Site - at Monitoring Point O2:

- From 6:00 – 18:00 : Noise levels were meet the permissible values
- From 18:00 – 22:00 : Noise levels were higher than the permissible values at a value of 3.1 dBA.
- From 22:00 – 6:00 : Noise levels were higher than the permissible values at a value of 8.5 dBA.

In Duc Giang Site - at Monitoring Point O1:

- From 6:00 – 18:00 : Noise levels were meet the permissible values

- From 18:00 – 22:00 : Noise levels were higher than the permissible values at a value of 5.8 dBA.
- From 22:00 – 6:00 : Noise levels were higher than the permissible values at a value of 6.9 dBA.

In Duc Giang Site - at Monitoring Point O2:

- From 6:00 – 18:00 : Noise levels were meet the permissible values
- From 18:00 – 22:00 : Noise levels were higher than the permissible values at a value of 0.5 dBA.
- From 22:00 – 6:00 : Noise levels were higher than the permissible values at a value of 3.9 dB_A.

During the day time, the noise level at four monitoring points in two proposed solid waste transfer station sites were lower than the permissible values or some times meet the permissible values as per TCVN 5949 – 1995.

During the evening and nighttime, noise levels were founded higher than the permissible values but not much. It may be caused by the vehicles along the roads or it may be caused by the activities of the residential areas

B. Vibration Levels

Results and Comment

Since there are no specific standard in Vietnam for evaluation of vibration induced by traffic, that some available the following standards and documents are considered:

(a) The Degree N°- 175/CP at 18th October 1994 by the Government of Vietnam for implementation of the Law on environmental protection, Annex N3- Permissible levels of vibration (Table 3.2.2.3);

(b) Adapted from DIN (1970): Allowable vibration levels for buildings (Table 3.2.2.4).

Table 3.2.2.3
Permissible Levels of Vibration

Areas	Permissible rectification acceleration (m/s^2)		Permissible linear acceleration (m/s^2)
	Vertical vibration	Horizontal vibration	
Quiet areas (hospital. school.library)	0.540	0.380	-
II. Residential....	0.270	0.190	-
Commercial, near main route, market place.....	0.081	0.057	0.066
Light industrial. domestic craft.....	0.054	0.038	0.045

Source : (By the Annex N°3 of the Degree N°175/CP at the 18th October 1994 by the Government of Vietnam)

Table 3.2.2.4
Allowable Vibration Levels for Buildings

Assessment Levels	Peak Particle Velocity (mm/s)	Effect on Buildings
I	2	No damage
II	5	Possibility of plaster cracks
III	10	Probable damage to load bearing units
IV	20 - 40	Damage to load bearing units

Source: Adapted from DIN, 1970

The vibration monitoring results are summarized in Table 3.2.2.5 and presented in more detail in Appendix A.

Table 3.2.2.5
Mean Value of Vibration Levels at Monitored Locations

Monitoring Locations	RMS Velocity		RMS Acceleration	
	V_{to} ($\times 10^{-3}$ cm/s)	L_{vto} (dB)	A_{to} ($\times 10^{-3}$ m/s^2)	L_{vto} (dB)
Dong Ngac R1	70	70.3	11	59.0
Dong Ngac R2	84	72.2	11	57.8
Duc Giang R1	80	71.3	12	59.2
Duc Giang R2	83	70.7	12	59.0
Permissible Value (DIN 4150)	190 - 270	85	-	-

The monitoring results showed that the vibration levels at all monitored locations were lower than permissible values in accordance with DIN 4150 Standards.

3.2.3 Present conditions of water quality

3.2.3.1 Surface water quality

A. Wastewater sources

A.(a) Dong Ngac Area

The quality of surface water sources depends closely on wastewater discharged from industrial and agricultural activities and hydrological condition. Main sources of wastewater in the project area include:

- Domestic wastewater from the village, sub-village and residential community of Dong Ngac around the area.
- Wastewater from small-scale-production activities in the area.

In general, domestic wastewater from inhabitants is mainly discharged directly into rice fields, ponds or channels because no sewerage system exists in the area. Wastewater from household production activities in the area is quite small.

A.(b) Duc Giang Area

- Wastewater is mainly from domestic wastewater of residential community of Thanh Am village, sub-villages of Lo, Duc Hoa in Duc Giang town.
- Wastewater from such household production activities as making rice vermicelli, soya curd, dry pancake is not much by its manual production.

Because this is a purely agricultural area and no sewerage system exists, so domestic wastewater of this area is discharged directly into the rice fields, ponds around the area.

B. Observing network

B.(a) Principle to set the observing network

The sampling and measuring network for monitoring water quality is arranged at the sites representing spatial and time for the whole activity of the proposed project. The principle to place the monitoring positions is based on the following characteristics and factors of the study area:

- Topography
- Existing kinds of water surface
- Hydrological characteristics (water regime).
- Residential: Present residential and residential after the project operation
- Detailed positions to take samples for water quality as the following:
  + Existing irrigation and drainage channel system
  + Existing wetlands
  + Existing waste water ditches

B.(b) Location to water sampling

(i) Dong Ngac Area

Surface water sources in the studied area are selected to measure and survey the water quality as bellow:

- Irrigation channel for rice field in Dong Ngac of which the water is taken from Red River.
- Pond inside the village.
- Wastewater from sub-village No1 to rice field.

Position of points selected for surface water quality in Duc Giang to be measured and surveyed is presented in Figures 3.5(a)

(i) Duc Giang Area

Surface water sources in the studied area are selected for measuring and surveying of water quality:

- Pond N°1 in Thuong Thanh commune.
- Pond N°2 in Thuong Thanh commune.
- Irrigation channel in Thuong Thanh commune of which the water is taken from Duong River.

Position of points selected for surface water quality in Duc Giang to be measured and surveyed is presented in Figure 3.5(b)

B.(c) Survey duration

A day was spent for taking the water sample for the both areas. The detailed day was 3 August 1999 for Duc Giang, but for Dong Ngac the survey date was 16 August 1999.

B.(d) Sampling type and frequency

A composite sample was specified for each well.

The total number of composite sample was 7 samples for both areas.

B.(e) Manpower

Manpower for surface water sampling was 2 persons for each area.

C. Environmental parameters to be observed

C.(a) Environmental parameters to be observed on site

Temp, pH, Conductivity, TDS.

C.(b) Environmental parameters to be observed at laboratory

The rest of chemical and biological parameters were carried out at the lab. Please see the bellow table 3.2.3.1.

D. Measurement and analysis method

Selection of standard for surveying and analysis of water quality plays an important factor in EIA implementation. The data on water quality must reflect the current water quality in the area. Besides, the gathered data is also the initiatives for monitoring and assessing the impact of the project on water quality in the future. By means of analyzing the wastewater sources as well as analyzing development

program in the area, criteria for monitoring and assessing water quality in this report is from water quality standard "Standards of Vietnam for Environment-1995".

The measurement and analysis methods used in this report are carried out in compliance with TCVN and International Standards:

- TCVN - 1995 and if the TCVN lacks the field measurement and analysis will be carried out in compliance with American Standards
- Methods of Standards for water and waster examination (1995)

Figure 3.5(a)
Map of Surface water quality observing positions (Dong Ngac)

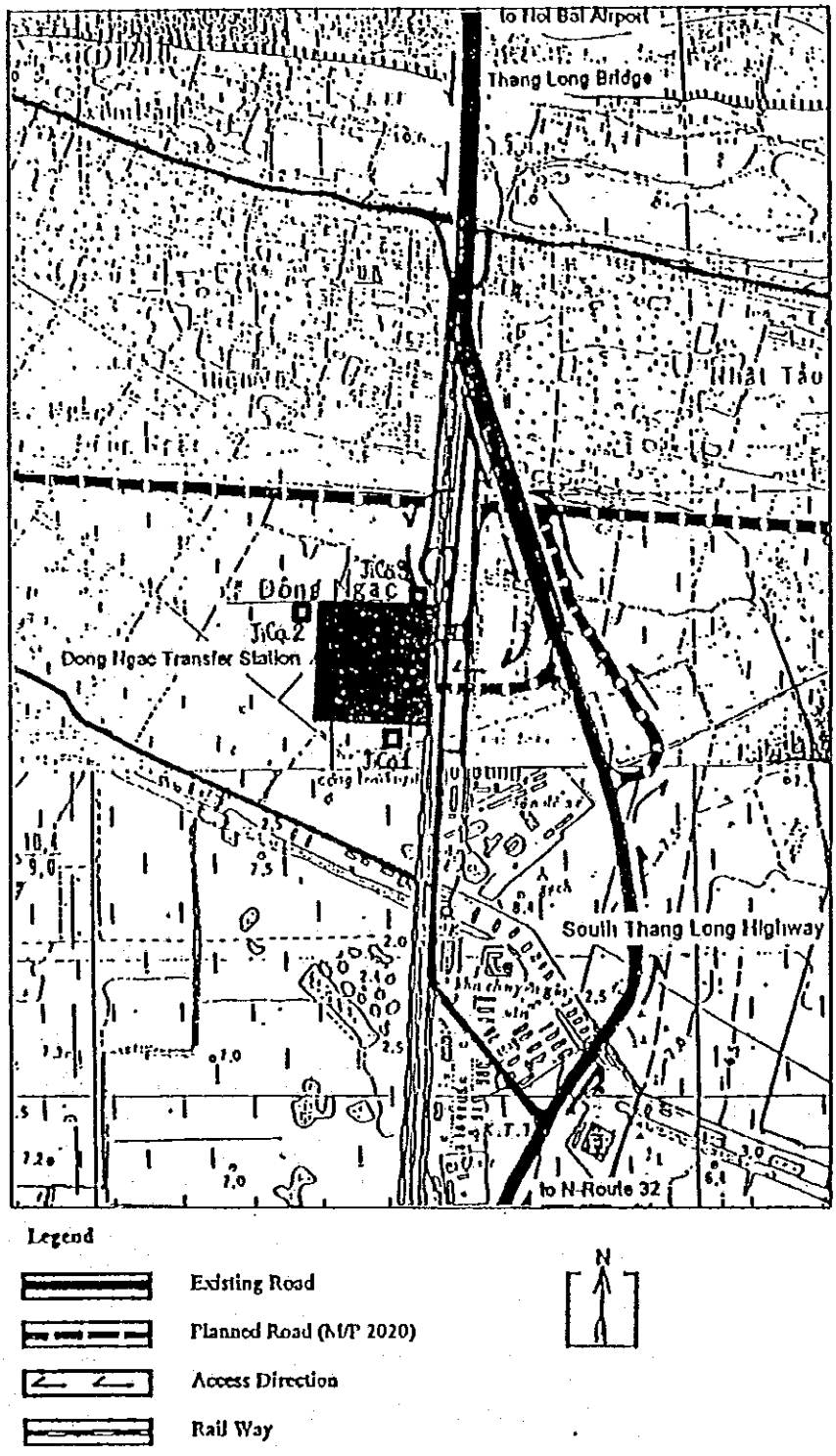


Figure 3.5(b)
Map of Surface water quality observing positions (Duc Giang)

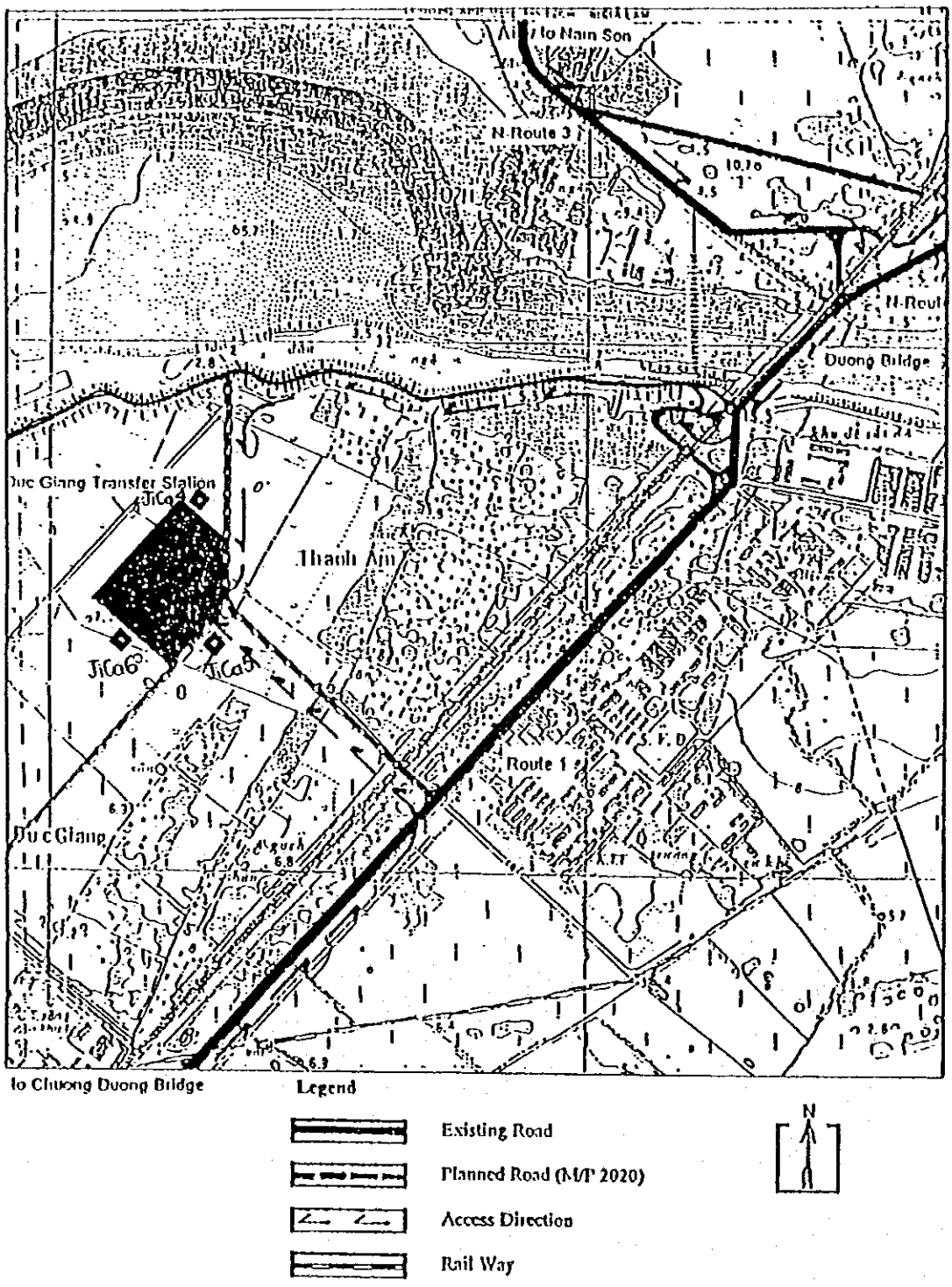


Table3.2.3.1
Analysis methods of surface water quality to be carried out

No	Parameter	Instrument	Compliance with
	• *Physical*		
1.	PH	pH Meter	ASTM-D5464
2.	t^o	Temp. Meter	Standard Method-2550
3.	TSS	Gravimetric	Standard Method-2540.D
	• *Oxygen*		
4.	DO (*)	DO Meter	Standard Method-4500-O.B Standard Method-4500-O.G
5.	BOD^5 (*)	BOD Determinator	Standard Method-5210.B
6.	COD (*)	COD Determinator	Standard Method-5220.C
	• *Chemical*		
7.	NO_2^-	Spectrophotometer	Standard Method-4500-NO_2^-.B
8.	NO_3^-	Spectrophotometer	Standard Method-4500-NO_3^-.B
9.	NH_4^+	Spectrophotometer	Standard Method-4500-NH_3.F
10.	Nitrogen Oranics	Spectrophotometer	Standard Method-4500-N_{org}
11.	Total phosphorus (*)	Spectrophotometer	Standard Method-4500-P.E
	• *Biological*		
12.	Total coliform	Coliform Determinator	Standard Method-9222-B
	• *Organic toxics*		
13.	Oil & Grease	Gravimetric	Standard Method-5520.B
14.	Total phenol	Spectrophotometer	Standard Method-5530.C
15.	Total pesticide	GC/ ECD	Standard Method-6630
	• *Inorganic toxics*		
16.	Zn	AAS	ASTM-1691-95-A
17.	Asen	AAS	ASTM-2972-93-B
18.	Cu	AAS	ASTM-1688-C
19.	Cd	AAS	ASTM-3557-95-D
20.	Hg	AAS	ASTM-3223-91
21.	Pb	AAS	ASTM-3559-95-D
22.	Mn	AAS	ASTM-858-A
23.	Phenol	Spectrophotometer	Standard Method-5536-C
24.	Total CN (*)	Spectrophotometer	Standard Method-4500.CN.C

E. Assessment methods

Method for assessing water environment quality (wastewater, natural water) is to test and monitor water quality, thus gathering the needed data on quality and quality of water subject selected. The gathered data on water quality will be compared with Vietnam 's National Standard on Environment for classification, analysis, and assessment. Such standards as TCVN 5942-1995, TCVN 5945-1995 and TCVN 5944-1995 are used to assess water quality of water subject to be surveyed and researched.

F. Results of the present condition of surface water quality

F.(a) Dong Ngac

Table 3.2.3.2
Analysis results of surface water quality in Dong Ngac.

N°	Parameters	Unit	Results		Permissible Limit 5942-1995
			Channel	Pond	Class B
1.	TSS	mg/L	254	18	80
2.	COD	mg/L	10	30	< 35
3.	BOD_5	mg/L	6	13	< 25
4.	NO_2^-	mg/L	0.021	1.250	0.05
5.	NO_3^-	mg/L	0.068	0.240	15
6.	NH_4^+	mg/L	0.03	1.00	1
7.	Nitrogen organic	mg/L	0.05	2.25	
8.	Total $P\text{-}PO_4^{3-}$	mg/L	0.63	2.00	
9.	Oil and Grease	µg/L	3.5	1.5	300
10.	Total coliform	MNP/100mL	12.000	8.000	10000
11.	Fecal coliform	MNP/100mL	8.000	3.200	
12.	Total Phenol	µg/L	< 0.2	0.54	20
13.	Total CN^-	µg/L	< 5	< 5	50
14.	Cu	µg/L	2	3	1000
15.	Pb	µg/L	< 0.5	< 0.5	100
16.	Zn	µg/L	< 5	< 5	2000
17.	Hg	µg/L	< 0.2	< 0.2	2
18.	As	µg/L	< 0.5	1.2	100
19.	Cd	µg/L	< 0.1	< 0.1	20
20.	Mn	µg/L	30	26	800
21.	Chlorinated pesticide	ng/L			
	Total HCB	ng/L	< 1.0	< 1.0	150000
	Lindane	ng/L	< 1.0	< 1.0	150000
	Endrine	ng/L	< 1.0	20	150000
	DDE	ng/L	< 1.0	2.0	150000

N°	Parameters	Unit	Results		Permissible Limit 5942-1995
			Channel	Pond	Class B
	DDD	ng/L	< 1.0	< 1.0	150000
	DDT	ng/L	3.0	4.0	10000
22.	Temperature	°C	27.6	33.3	
23.	pH		7.81	8.13	5.5 - 9.0
24.	Conductivity	µS/cm	143.7	643	
25	DS	mg/L	144	637	
26.	DO	mg/L	7.85	14.8	≥ 2
27.	DO	%	100	206	

The results shows that:

- Temperature: the measured water temperature varies from 27.6^{0}C to 33.3^{0}C
- pH: the measured pH varies from 7.81 to 8.13
- Dissolved oxygen: the measured DO varies from 7.85 to 14.8 mg/L.
- Biochemical oxygen demand (BOD_5): 6.0 to 13 mg/L, the result shows that at present, surface water quality in the area is clean, within the Permissible Limit of Class B and has not been under the impact of wastewater.
- Other parameters such as Nitrogen organic, Total phosphorus are low in surface water. The results show that water sources in the area have not been effected by agricultural and everyday life activities.
- The concentration of toxic heavy metals such as As, Cd, Cu, Pb, Zn, and Hg...in samples is lower than the Permissible Limit of Class B.
- The concentration of other toxic substances such as Phenol, CN^- in samples is lower than the Permissible Limit of Class B (TCVN 5942-95).
- The coliform in channel is relatively high, total coliform determined ranges from 8000 to 12.000 MPN/100ml, fecal coliform determined ranges from 3200 to 8000 MPN/100ml which shows that surface water in the area is polluted by cattle manure.
- Though the studied area is mainly rice fields the results of analyzed chlorinated pesticide show that the agricultural activities in Dong Ngac have not polluted water sources.

The analysis results show that surface water in the area is relatively clean, the majority of concentrations of analyzed parameters are lower than the Permissible Limit of Class B. But coliform pollution is determined.

F.(b) Duc Giang

Table 3.2.3.3
Analysis results of surface water quality in Duc Giang

N°	Parameters	Unit	Results			Permissible Limit Class B
			Pond N°1	Pond N°2	Channel	
1.	TSS	mg/L	10	11	41	80
2.	COD	mg/L	35	10	10	< 35
3.	BOD_5	mg/L	12	6	8	< 25
4.	NO_2^-	mg/L	0.027	0.041	0.029	0.05
5.	NO_3^-	mg/L	0.010	0.015	0.014	15
6.	NH_4^+	mg/L	0.21	0.42	0.08	1
7.	Nitrogen organic	mg/L	0.45	0.85	0.20	
8.	Total $P\text{-}PO_4^{3-}$	mg/L	0.17	0.93	0.50	
9.	Oil and Grease	µg/L	1.30	1.94	0.73	300
10.	Total coliform	MNP/100mL	1,000	1,300	1,200	10000
11.	Fecal coliform	MNP/100mL	700	650	700	
12.	Total Phenol	µg/L	3.24	< 0.2	2.23	20
13.	Total CN^-	µg/L	< 5	6	< 5	50
14.	Cu	µg/L	2	5	4	1000
15.	Pb	µg/L	< 0.5	< 0.5	< 0.5	100
16.	Zn	µg/L	< 5	< 5	< 5	2000
17.	Hg	µg/L	< 0.2	< 0.2	< 0.2	2
18.	As	µg/L	< 0.5	< 0.5	< 0.5	100
19.	Cd	µg/L	< 0.1	< 0.1	< 0.1	20
20.	Mn	µg/L	30	42	54	800
21.	Chlorinated pesticide	ng/L				
	Total HCB	ng/L	< 1.0	< 1.0	< 1.0	150000
	Lindane	ng/L	< 1.0	< 1.0	< 1.0	150000
	Endrine	ng/L	22	24	8.0	150000
	DDE	ng/L	5.0	4.0	<1.0	150000
	DDD	ng/L	< 1.0	< 1.0	< 1.0	150000
	DDT	ng/L	< 1.0	< 1.0	< 1.0	10000
22.	Temp.	°C	37.9	36.8	27.5	
23.	PH		7.92	7.95	7.14	5.5 - 9.0
24.	Conductivity	µS/cm	337	402	353	
25.	TDS	mg/L	332	395	352	
26.	DO	mg/L	9.42	8.42	2.78	≥ 2
27.	DO	%	140	125	36	

The results shows that

- Temperature: the measured water temperature varies from 27.5 to 37.9°C.
- pH: the measured pH varies from 7.14 to 7.95.
- Dissolved oxygen: the measured DO varies from 2.78 to 9.42 mg/L.
- Biochemical oxygen demand (BOD_5):6.0 to 12 mg/L, the result shows that at present, surface water quality in the area is clean, within the Permissible Limit of Class B and has not been under the impact of wastewater.
- Other parameters such as Nitrogen organic, Total phosphorus are low in surface water. The results show that water sources in the area have not been effected by agricultural and everyday life activities.
- The concentration of toxic heavy metals such as As, Cd, Cu, Pb, Zn, and Hg...in samples is lower than the Permissible Limit of Class B.
- The concentration of other toxic substances such as Phenol, CN^- in samples is lower than the Permissible Limit of Class B (TCVN 5942-95).
- The coliform in surface water is relatively high, total coliform determined ranges from 1000 to 1300 MPN/100ml, fecal coliform determined ranges from 650 to 700 MPN/100ml which shows that surface water in the area is polluted by cattle manure, but still within the Permissible Limit.
- Though the studied area is mainly rice fields the results of analyzed chlorinated pesticide show that the agricultural activities in Duc Giang have not polluted water sources.

The analysis results show that surface water in the area is relatively clean, the majority of concentrations of analyzed parameters are lower than the Permissible Limit of Class B.

3.2.3.2 Underground water quality

Underground water plays an important role in the supply of clean water for uses at present and in the future as well. The project area is relatively far away from residential area, so there's no water tube or available well there. To assess the quality of underground water in the area, water tube 15 meters in depth have been drilled (3 in Dong Ngac and 4 in Duc Giang).

A. Observing network

A.(a) Principle

Principle to drill the well is the drilled boreholes in such way to be representative for geographical main directions surrounding the area of 5 ha accorded with the North, South, East, and West

A.(b) Locations to survey

For Duc Giang area the day spent to drill four (4) wells was on 29 July 1999 according to the proposal approved by JICA. These 4 wells were drilled for 4 directions surrounding of 4 sides of the area of 5 ha

The same principle to drill wells for Dong Ngac area. But in practice, the wells drilled for Dong Ngac were only 3 less one than proposed. The day spent to drill three (3) wells was on 13 August 1999. Like mentioned in the introduction of this chapter, when the survey team came to contact with the commune authority to allow them the investigation, but the Dong Ngac authority did not allow any survey there. So the survey team had delayed the drill time and they resolved the geotechnical by stealthy drilling.

Position of points selected for underground water quality in both areas to be measured and surveyed is presented in Figures 3.2(a, g).

A.(c) Survey duration

Well drilling: the duration spent for well drilling was a day for each study area

A day was spent for taking the water sample for the both areas. The detailed day was 3 August 1999 for Duc Giang, but for Dong Ngac the survey date was 16 August 1999.

A.(d) Sampling type and frequency

A composite sample was specified for each well.

The total number of composite sample was 7 samples for both areas.

A.(e) Manpower

Manpower for surface water sampling was 2 persons for each area.

B. Environmental parameters to be observed

B.(a) Environmental parameters to be observed on site

Temp, pH, Conductivity, TDS.

B.(b) Environmental parameters to be observed at laboratory

The rest of chemical and biological parameters were carried out at the lab. Please see the bellow table 3.2.3.4.

C. Measurement and analysis methodology

The measurement and analysis methods used in this report are carried out in compliance with TCVN and International Standards:

- TCVN - 1995 and if the TCVN lacks the field measurement and analysis will be carried out in compliance with American Standards

- Methods of Standards for water and waster examination (1995)

Table 3.2.3.4
Analysis methods of underground water quality to be carried out

No	Parameter	Instrument	In Compliance with
	• *Physical*		
1.	PH	pH Meter	ASTM-D5464
2.	t°	Temp. Meter	Standard Method-2550
3.	TDS	Gravimetric	Standard Method-2540.D
	• *Chemical*		
4.	Cl^-	Titration	
5.	NO_3^-	Spectrophotometer	Standard Method-4500-NO_3^-.B
6.	NH_4^+	Spectrophotometer	Standard Method-4500-NH_3.F
7.	Nitrogen Organic	Spectrophotometer	Standard Method-4500-N_{org}
8.	SO_4^{-2}	Paqualab	Standard Method-4500-SO_4^{-2}-E
	• *Biological*		
9.	Fecal coliform	Coliform Determinator	Standard Method-9222-B
10.	Total coliform	Coliform Determinator	Standard Method-9222-B
	• *Inorganic toxics*		
11.	Zn	AAS	ASTM-1691-95-A
12.	Asen	AAS	ASTM-2972-93-B
13.	Cu	AAS	ASTM-1688-C
14.	Cd	AAS	ASTM-3557-95-D
15.	Mn	AAS	ASTM-858-A
16.	Cr (total)	AAS	ASTM-1687-92
17.	Total CN	Spectrophotometer	Standard Method-4500.CN.C

D. Assessment methods

Method for assessing water environment quality (wastewater, natural water) is to test and monitor water quality, thus gathering the needed data on quality and quality of water subject selected. The gathered data on water quality will be compared with Vietnam's National Standard on Environment for classification, analysis, and assessment. Such standards as TCVN 5944-1995 are used to assess underground water quality of water subject to be surveyed and researched.

E. Results of the present condition of underground water quality

E.(a) Dong Ngac

Table3.2.3.5
Analysis results of underground water quality in Dong Ngac.

N°	Parameters	Unit	Results			TCVN 5944-95
			BH1	BH2	BH3	
1.	NO_3^-	Mg/L	0.032	0.036	0.051	45
2.	NH_4^+	mg/L	0.05	0.08	0.12	
3.	Nitrogen organic	mg/L	0.18	0.15	0.23	
4.	SO_4^{--}	mg/L	< 3	5	5	200-400
5.	Cl^-	µg/L	2.40	1.96	2.20	200-600
6.	Total coliform	MNP/100mL	0	0	0	3
7.	Fecal coliform	MNP/100mL	0	0	0	0
8.	Total CN^-	µg/L	< 5	< 5	< 5	10
9.	Cu	µg/L	6	5	4	1000
10.	Zn	µg/L	8	28	40	5000
11.	Cr	µg/L	< 0.5	< 0.5	< 0.5	
12.	As	µg/L	< 0.5	< 0.5	< 0.5	50
13.	Cd	µg/L	< 0.1	< 0.1	< 0.1	10
14.	Mn	µg/L	630	800	690	100-500
15.	Temp.	°C	27.8	27.4	28.1	
16.	PH.		6.42	6.38	6.50	6.5-8.5
17.	Conductivity.	µS/cm	275	263	577	
18.	DS	mg/L	272	264	575	

Analysis results of underground water show that:

- The temperature in boreholes varies from 27.4 to 28.1 °C.
- The value of pH is stable from 6.38 to 6.50.
- Concentration of such substances as NH_4^+, NO_3^- in underground water is low, has no sign of pollution.
- Total coliform and fecal coliform are not determined in those boreholes.
- Concentration of such heavy metals as As, Zn, Cd, Cr... in underground water is lower than the Permissible Limit.

E.(b) Duc Giang

Table3.2.3.6
Analysis results of underground water quality in Duc Giang

N°	Parameters	Unit	Results				TCVN 5944-95
			BH1	BH2	BH3	BH4	
1.	NO_3^-	mg/L	0.009	0.051	0.036	0.027	45
2.	NH_4^+	mg/L	0.25	0.15	0.31	0.24	
3.	Nitrogen organic	mg/L	0.30	0.25	0.35	0.30	
4	SO_4^{--}	mg/L	3.0	8	< 3	5	200-400
5.	Cl^-	µg/L	1.74	1.30	2.61	1.82	200-600
6.	Total coliform	MNP/100mL	0	0	0	0	3
7.	Fecal coliform	MNP/100mL	0	0	0	0	0
8.	Total CN^-	µg/L	< 5	< 5	< 5	< 5	10
9.	Cu	µg/L	3	5	6	2	1000
10.	Zn	µg/L	< 5	< 5	< 5	< 5	5000
11.	Cr	µg/L	< 0.5	< 0.5	< 0.5	< 0.5	
12.	As	µg/L	< 0.5	< 0.5	< 0.5	< 0.5	50
13.	Cd	µg/L	< 0.1	< 0.1	< 0.1	< 0.1	10
14.	Mn	µg/L	860	760	960	830	100-500
15.	Temp.	°C	28	29	27.5	28	
16.	PH		6.92	7.15	7.14	7.08	6.5-8.5
17.	Conductivity.	µS/cm	523	309	353	320	
18.	TDS	mg/L	520	308	352	318	

Analysis results of underground water show that:

- The temperature in boreholes varies from 27.5 to 29 °C.
- The value of pH varies from 6.92 to 7.15.
- Concentration of such substances as NH_4^+, NO_3^- in underground water is low, having no sign of pollution.
- Total coliform and fecal coliform are not determined in those boreholes.
- Concentration of such heavy metals as As, Zn, Cd, Cr... in underground water are lower than the Permissible Limit (5944-1995).

The analytical results of underground water quality in 2 study areas -Dong Ngac and Duc Giang- show that the present condition of underground water in both areas have no sign of pollution.