Table H2.1 COST BENEFIT STREAM OF URBAN DRAINAGE (TO LICH – 1ST)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit Total	B-C
1	1995	5,994		5,994	0	-5,994
2	1996	23,867		23,867	0	-23,867
3	1997	38,330		38,330	0	-38,330
4	1998	46,161		46,161	0	-46,161
5	1999	27,568	342	27,910	3,321	-24,589
6	2000	4,889	572	5,461	5,979	518
7	2001	0	1,143	1,143	12,917	11,774
8	2002	0	1,143	1,143	13,950	12,807
9	2003	0	1,143	1,143	15,066	13,923
10	2004	0	1,143	1,143	16,272	15,129
11	2005	0	1,143	1,143	17,573	16,430
12	2006	0	1,143	1,143	18,979	17,836
13	2007	0	1,143	1,143	20,498	19,355
14	2008	0	1,143	1,143	22,137	20,994
15	2009	0	1,143	1,143	23,908	22,765
16	2010	0	1,143	1,143	25,821	24,678
17	2011	0	1,143	1,143	27,887	26,744
18	2012	0	1,143	1,143	30,118	28,975
19	2013	0	1,143	1,143	32,527	31,384
20	2014	0	1,143	1,143	35,129	33,986
21	2015	0	1,143	1,143	37,940	36,797
22	2016	0	1,143	1,143	37,940	36,797
23	2017	0	1,143	1,143	37,940	36,797
24	2018	0	1,143	1,143	37,940	36,797
25	2019	0	1,143	1,143	37,940	36,797
26	2020	0	1,143	1,143	37,940	36,797
27	2021	0	1,143	1,143	37,940	36,797
28	2022	0	1,143	1,143	37,940	36,797
29	2023	0	1,143	1,143	37,940	36,797
30	2024	0	1,143	1,143	37,940	36,797
31	2025	32,478	1,143	33,621	37,940	4,319
32	2026	0	1,143	1,143	37,940	36,797
33	2027	0	1,143	1,143	37,940	36,797
34	2028	0	1,143	1,143	37,940	36,797
35	2029	0	1,143	1,143	37,940	36,797
36	2030	0	1,143	1,143	37,940	36,797
37	2031	0	1,143	1,143	37,940	36,797
38	2032	0	1,143	1,143	37,940	36,797
39	2033	0	1,143	1,143	37,940	36,797
40	2034	0	1,143	1,143	37,940	36,797
41	2035	0	1,143	1,143	37,940	36,797
42	2036	0	1,143	1,143	37,940	36,797
43	2037	0	1,143	1,143	37,940	36,797
44	2038	0	1,143	1,143	37,940	36,797
45	2039	0	1,143	1,143	37,940	36,797
46	2040	0	1,143	1,143	37,940	36,797
47	2041	0	1,143	1,143	37,940	36,797
48	2042	0	1,143	1,143	37,940	36,797
49	2043	0	1,143	1,143	37,940	36,797
50	2044	0	1,143	1,143	37,940	36,797
	Total	179,287	51,206	230,493	1,460,276	1,229,783

EIRR = 11.7%

Table H2.2 COST BENEFIT STREAM OF URBAN DRAINAGE (TO LICH - 2ND)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit Total	B-C
1	1995	0		0		0
2	1996	0		0		0
3	1997	0		0		0
4	1998	0		0		0
5	1999	0		0		0
6	2000	7,282		7,282		-7,282
7	2001	15,221		15,221		-15,221
8	2002	50,204	0	50,204	0	-50,204
9	2003	46,841	174	47,015	3,014	-44,001
10	2004	19,346	289	19,635	5,425	-14,210
11	2005	0	579	579	11,716	11,137
12	2006	0	579	579	12,653	12,074
13	2007	0	579	579	13,666	13,087
14	2008	0	579	579	14,759	14,180
15	2009	0	579	579	15,939	15,360
16	2010	0	579	579	17,215	16,636
17	2011	0	579	579	18,592	18,013
18	2012	0	579	579	20,079	19,500
19	2013	0	579	579	21,685	21,106
20	2014	0	579	579	23,420	22,841
21	2015	0	579	579	25,294	24,715
22	2016	0	579	579	25,294	24,715
23	2017	0	579	579	25,294	24,715
24	2018	0	579	579	25,294	24,715
25	2019	0	579	579	25,294	24,715
26	2020	0	579	579	25,294	24,715
27	2021	0	579	579	25,294	24,715
28	2022	0	579	579	25,294	24,715
29	2023	0	579	579	25,294	24,715
30	2024	0	579	579	25,294	24,715
31	2025	0	579	579	25,294	24,715
32	2026	0	579	579	25,294	24,715
33	2027	0	579	579	25,294	24,715
34	2028	0	579	579	25,294	24,715
35	2029	16,285	579	16,864	25,294	8,430
36	2030	0	579	579	25,294	24,715
37	2031	0	579	579	25,294	24,715
38	2032	0	579	579	25,294	24,715
39	2033	0	579	579	25,294	24,715
40	2034	0	579	579	25,294	24,715
41	2035	0	579	579	25,294	24,715
42	2036	0	579	579	25,294	24,715
43	2037	0	579	579	25,294	24,715
44	2038	0	579	579	25,294	24,715
45	2039	0	579	579	25,294	24,715
46	2040	0	579	579	25,294	24,715
47	2041	0	579	579	25,294	24,715
48	2042	0	579	579	25,294	24,715
49	2043	0	579	579	25,294	24,715
50	2044	0	579	579	25,294	24,715
	Total	155,179	23,623	178,802	936,984	758,182

EIRR = 11.4%

Table H2.3 COST BENEFIT STREAM OF URBAN DRAINAGE (NHUE – CO NHUE)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit Total	B-C
1	1995	2,784		2,784		-2,784
2	1996	1,962		1,962		-1,962
3	1997	19,356		19,356		-19,356
4	1998	20,852	0	20,852	0	-20,852
5	1999	20,892	82	20,974	79	-20,895
6	2000	7,342	136	7,478	148	-7,330
7	2001	0	273	273	326	53
8	2002	0	273	273	362	89
9	2003	0	273	273	402	129
10	2004	0	273	273	446	173
11	2005	0	273	273	495	222
12	2006	0	273	273	549	276
13	2007	0	273	273	610	337
14	2008	0	273	273	677	404
15	2009	0	273	273	751	478
16	2010	0	273	273	834	561
17	2011	0	273	273	926	653
18	2012	0	273	273	1,027	754
19	2013	0	273	273	1,140	867
20	2014	0	273	273	1,266	993
21	2015	0	273	273	1,405	1,132
22	2016	0	273	273	1,405	1,132
23	2017	0	273	273	1,405	1,132
24	2018	0	273	273	1,405	1,132
25	2019	0	273	273	1,405	1,132
26	2020	0	273	273	1,405	1,132
27	2021	0	273	273	1,405	1,132
28	2022	0	273	273	1,405	1,132
29	2023	0	273	273	1,405	1,132
30	2024	0	273	273	1,405	1,132
31	2025	6,660	273	6,933	1,405	-5,528
32	2026	0	273	273	1,405	1,132
33	2027	0	273	273	1,405	1,132
34	2028	0	273	273	1,405	1,132
35	2029	0	273	273	1,405	1,132
36	2030	0	273	273	1,405	1,132
37	2031	0	273	273	1,405	1,132
38	2032	0	273	273	1,405	1,132
39	2033	0	273	273	1,405	1,132
40	2034	0	273	273	1,405	1,132
41	2035	0	273	273	1,405	1,132
42	2036	0	273	273	1,405	1,132
43	2037	0	273	273	1,405	1,132
44	2038	0	273	273	1,405	1,132
45	2039	0	273	273	1,405	1,132
46	2040	0	273	273	1,405	1,132
47	2041	0	273	273	1,405	1,132
48	2042	0	273	273	1,405	1,132
49	2043	0	273	273	1,405	1,132
50	2044	0	273	273	1,405	1,132
	Total	79,848	12,230	92,078	52,188	-39,890

EIRR = #DIV/0!

Table H2.4 COST BENEFIT STREAM OF URBAN DRAINAGE (NHUE – MY DINH)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit Total	B-C
1	1995	1,344		1,344		-1,344
2	1996	900		900		-900
3	1997	7,812		7,812		-7,812
4	1998	8,542	0	8,542	0	-8,542
5	1999	8,937	47	8,984	499	-8,485
6	2000	7,896	80	7,976	922	-7,054
7	2001	0	159	159	2,045	1,886
8	2002	0	159	159	2,270	2,111
9	2003	0	159	159	2,474	2,315
10	2004	0	159	159	2,697	2,538
11	2005	0	159	159	2,940	2,781
12	2006	0	159	159	3,204	3,045
13	2007	0	159	159	3,493	3,334
14	2008	0	159	159	3,807	3,648
15	2009	0	159	159	4,150	3,991
16	2010	0	159	159	4,523	4,364
17	2011	0	159	159	4,930	4,771
18	2012	0	159	159	5,374	5,215
19	2013	0	159	159	5,857	5,698
20	2014	0	159	159	6,385	6,226
21	2015	0	159	159	6,959	6,800
22	2016	0	159	159	6,959	6,800
23	2017	0	159	159	6,959	6,800
24	2018	0	159	159	6,959	6,800
25	2019	0	159	159	6,959	6,800
26	2020	0	159	159	6,959	6,800
27	2021	0	159	159	6,959	6,800
28	2022	0	159	159	6,959	6,800
29	2023	0	159	159	6,959	6,800
30	2024	0	159	159	6,959	6,800
31	2025	4,776	159	4,935	6,959	2,024
32	2026	0	159	159	6,959	6,800
33	2027	0	159	159	6,959	6,800
34	2028	0	159	159	6,959	6,800
35	2029	0	159	159	6,959	6,800
36	2030	0	159	159	6,959	6,800
37	2031	0	159	159	6,959	6,800
38	2032	0	159	159	6,959	6,800
39	2033	0	159	159	6,959	6,800
40	2034	0	159	159	6,959	6,800
41	2035	0	159	159	6,959	6,800
42	2036	0	159	159	6,959	6,800
43	2037	0	159	159	6,959	6,800
44	2038	0	159	159	6,959	6,800
45	2039	0	159	159	6,959	6,800
46	2040	0	159	159	6,959	6,800
47	2041	0	159	159	6,959	6,800
48	2042	0	159	159	6,959	6,800
49	2043	0	159	159	6,959	6,800
50	2044	0	159	159	6,959	6,800
	Total	40,207	7,123	47,330	264,339	217,009

EIRR = 9.9%

Table H2.5 COST BENEFIT STREAM OF URBAN DRAINAGE (NHUE – ME TRI)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit Total	B-C
1	1995	1,895		1,895		-1,895
2	1996	1,383		1,383		-1,383
3	1997	9,285		9,285		-9,285
4	1998	10,076	0	10,076	0	-10,076
5	1999	10,338	54	10,392	514	-9,878
6	2000	9,100	90	9,190	932	-8,258
7	2001	0	179	179	2,113	1,934
8	2002	0	179	179	2,345	2,166
9	2003	0	179	179	2,603	2,424
10	2004	0	179	179	2,890	2,711
11	2005	0	179	179	3,208	3,029
12	2006	0	179	179	3,561	3,382
13	2007	0	179	179	3,952	3,773
14	2008	0	179	179	4,387	4,208
15	2009	0	179	179	4,869	4,690
16	2010	0	179	179	5,405	5,226
17	2011	0	179	179	6,000	5,821
18	2012	0	179	179	6,660	6,481
19	2013	0	179	179	7,392	7,213
20	2014	0	179	179	8,205	8,026
21	2015	0	179	179	9,108	8,929
22	2016	0	179	179	9,108	8,929
23	2017	0	179	179	9,108	8,929
24	2018	0	179	179	9,108	8,929
25	2019	0	179	179	9,108	8,929
26	2020	0	179	179	9,108	8,929
27	2021	0	179	179	9,108	8,929
28	2022	0	179	179	9,108	8,929
29	2023	0	179	179	9,108	8,929
30	2024	0	179	179	9,108	8,929
31	2025	5,252	179	5,431	9,108	3,677
32	2026	0	179	179	9,108	8,929
33	2027	0	179	179	9,108	8,929
34	2028	0	179	179	9,108	8,929
35	2029	0	179	179	9,108	8,929
36	2030	0	179	179	9,108	8,929
37	2031	0	179	179	9,108	8,929
38	2032	0	179	179	9,108	8,929
39	2033	0	179	179	9,108	8,929
40	2034	0	179	179	9,108	8,929
41	2035	0	179	179	9,108	8,929
42	2036	0	179	179	9,108	8,929
43	2037	0	179	179	9,108	8,929
44	2038	0	179	179	9,108	8,929
45	2039	0	179	179	9,108	8,929
46	2040	0	179	179	9,108	8,929
47	2041	0	179	179	9,108	8,929
48	2042	0	179	179	9,108	8,929
49	2043	0	179	179	9,108	8,929
50	2044	0	179	179	9,108	8,929
	Total	47,329	8,020	55,349	338,277	282,928

EIRR = 10.0%

Table H2.6 COST BENEFIT STREAM OF URBAN DRAINAGE (NHUE - BA XA)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit Total	B-C
1	1995	797		797		-797
2	1996	489		489		-489
3	1997	5,270		5,270		-5,270
4	1998	5,807		5,807	0	-5,807
5	1999	6,337	35	6,372	266	-6,106
6	2000	5,447	59	5,506	494	-5,012
7	2001	0	118	118	1,096	978
8	2002	0	118	118	1,217	1,099
9	2003	0	118	118	1,350	1,232
10	2004	0	118	118	1,499	1,381
11	2005	0	118	118	1,664	1,546
12	2006	0	118	118	1,847	1,729
13	2007	0	118	118	2,050	1,932
14	2008	0	118	118	2,275	2,157
15	2009	0	118	118	2,526	2,408
16	2010	0	118	118	2,804	2,686
17	2011	0	118	118	3,112	2,994
18	2012	0	118	118	3,454	3,336
19	2013	0	118	118	3,834	3,716
20	2014	0	118	118	4,256	4,138
21	2015	0	118	118	4,724	4,606
22	2016	0	118	118	4,724	4,606
23	2017	0	118	118	4,724	4,606
24	2018	0	118	118	4,724	4,606
25	2019	0	118	118	4,724	4,606
26	2020	0	118	118	4,724	4,606
27	2021	0	118	118	4,724	4,606
28	2022	0	118	118	4,724	4,606
29	2023	0	118	118	4,724	4,606
30	2024	0	118	118	4,724	4,606
31	2025	3,758	118	3,876	4,724	848
32	2026	0	118	118	4,724	4,606
33	2027	0	118	118	4,724	4,606
34	2028	0	118	118	4,724	4,606
35	2029	0	118	118	4,724	4,606
36	2030	0	118	118	4,724	4,606
37	2031	0	118	118	4,724	4,606
38	2032	0	118	118	4,724	4,606
39	2033	0	118	118	4,724	4,606
40	2034	0	118	118	4,724	4,606
41	2035	0	118	118	4,724	4,606
42	2036	0	118	118	4,724	4,606
43	2037	0	118	118	4,724	4,606
44	2038	0	118	118	4,724	4,606
45	2039	0	118	118	4,724	4,606
46	2040	0	118	118	4,724	4,606
47	2041	0	118	118	4,724	4,606
48	2042	0	118	118	4,724	4,606
49	2043	0	118	118	4,724	4,606
50	2044	0	118	118	4,724	4,606
	Total	27,905	5,286	33,191	175,464	142,273

EIRR = 9.3%

Table H2.7 COST BENEFIT STREAM OF URBAN DRAINAGE PLAN (TO LICH)

(US$1,000)

No.	Year	Const. Cost		O&M Cost	Cost	Benefit			B-C
		1st Stage	2nd Stage		Total	1st Stage	2nd Stage	Total	
1	1995	5,994			5,994	0	0	0	-5,994
2	1996	23,867			23,867	0	0	0	-23,867
3	1997	38,330			38,330	0	0	0	-38,330
4	1998	46,161		0	46,161	0	0	0	-46,161
5	1999	27,568		342	27,910	3,321	0	3,321	-24,589
6	2000	4,889	7,282	572	12,743	5,979	0	5,979	-6,764
7	2001	0	15,221	1,143	16,364	12,917	0	12,917	-3,447
8	2002	0	50,204	1,143	51,347	13,950	0	13,950	-37,397
9	2003	0	46,841	1,317	48,158	15,066	3,014	18,080	-30,078
10	2004	0	19,346	1,432	20,778	16,272	5,425	21,697	919
11	2005	0	0	1,722	1,722	17,573	11,716	29,289	27,567
12	2006	0	0	1,722	1,722	18,979	12,653	31,633	29,911
13	2007	0	0	1,722	1,722	20,498	13,666	34,163	32,441
14	2008	0	0	1,722	1,722	22,137	14,759	36,896	35,174
15	2009	0	0	1,722	1,722	23,908	15,939	39,848	38,126
16	2010	0	0	1,722	1,722	25,821	17,215	43,036	41,314
17	2011	0	0	1,722	1,722	27,887	18,592	46,479	44,757
18	2012	0	0	1,722	1,722	30,118	20,079	50,197	48,475
19	2013	0	0	1,722	1,722	32,527	21,685	54,213	52,491
20	2014	0	0	1,722	1,722	35,129	23,420	58,550	56,828
21	2015	0	0	1,722	1,722	37,940	25,294	63,234	61,512
22	2016	0	0	1,722	1,722	37,940	25,294	63,234	61,512
23	2017	0	0	1,722	1,722	37,940	25,294	63,234	61,512
24	2018	0	0	1,722	1,722	37,940	25,294	63,234	61,512
25	2019	0	0	1,722	1,722	37,940	25,294	63,234	61,512
26	2020	0	0	1,722	1,722	37,940	25,294	63,234	61,512
27	2021	0	0	1,722	1,722	37,940	25,294	63,234	61,512
28	2022	0	0	1,722	1,722	37,940	25,294	63,234	61,512
29	2023	0	0	1,722	1,722	37,940	25,294	63,234	61,512
30	2024	0	0	1,722	1,722	37,940	25,294	63,234	61,512
31	2025	32,478	0	1,722	34,200	37,940	25,294	63,234	29,034
32	2026	0	0	1,722	1,722	37,940	25,294	63,234	61,512
33	2027	0	0	1,722	1,722	37,940	25,294	63,234	61,512
34	2028	0	0	1,722	1,722	37,940	25,294	63,234	61,512
35	2029	0	16,285	1,722	18,007	37,940	25,294	63,234	45,227
36	2030	0	0	1,722	1,722	37,940	25,294	63,234	61,512
37	2031	0	0	1,722	1,722	37,940	25,294	63,234	61,512
38	2032	0	0	1,722	1,722	37,940	25,294	63,234	61,512
39	2033	0	0	1,722	1,722	37,940	25,294	63,234	61,512
40	2034	0	0	1,722	1,722	37,940	25,294	63,234	61,512
41	2035	0	0	1,722	1,722	37,940	25,294	63,234	61,512
42	2036	0	0	1,722	1,722	37,940	25,294	63,234	61,512
43	2037	0	0	1,722	1,722	37,940	25,294	63,234	61,512
44	2038	0	0	1,722	1,722	37,940	25,294	63,234	61,512
45	2039	0	0	1,722	1,722	37,940	25,294	63,234	61,512
46	2040	0	0	1,722	1,722	37,940	25,294	63,234	61,512
47	2041	0	0	1,722	1,722	37,940	25,294	63,234	61,512
48	2042	0	0	1,722	1,722	37,940	25,294	63,234	61,512
49	2043	0	0	1,722	1,722	37,940	25,294	63,234	61,512
50	2044	0	0	1,722	1,722	37,940	25,294	63,234	61,512
	Total	179,287	155,179	74,829	409,295	1,460,276	936,983	2,397,259	1,987,964

EIRR = 11.6%

Table H2.8 COST BENEFIT STREAM OF URBAN DRAINAGE PLAN (NHUE RIVER)

(US$1,000)

No.	Year	Cost. Cost					O & M Cost					Total Cost	Benefit					B-C
		Co Nhue	My Dinh	Mc Tri	Ba Xa	Total	Co Nhue	My Dinh	Mc Tri	Ba Xa	Total		Co Nhue	My Dinh	Mc Tri	Ba Xa	Total	
1	1995					0					0	0					0	0
2	1996					0					0	0					0	0
3	1997					0					0	0					0	0
4	1998					0					0	0					0	0
5	1999					0					0	0					0	0
6	2000					0					0	0					0	0
7	2001					0					0	0					0	0
8	2002					0					0	0					0	0
9	2003	2,784				2,784					0	2,784					0	-2,784
10	2004	1,962				1,962					0	1,962					0	-1,962
11	2005	19,356				19,356					0	19,356					0	-19,356
12	2006	20,852	1,344	1,895		24,091	0				0	24,091	0				0	-24,091
13	2007	20,892	900	1,383		23,175	82				82	23,257	183				183	-23,074
14	2008	7,342	7,812	9,285		24,439	186				186	24,625	341				341	-24,284
15	2009	0	8,542	10,076		18,618	273	0	0		273	18,891	751	0	0		751	-18,140
16	2010	0	8,937	10,338	797	20,072	273	47	54		374	20,446	834	1,572	1,620		4,026	-16,420
17	2011	0	7,896	9,100	489	17,485	273	80	90		443	17,928	925	2,906	3,001		6,832	-11,096
18	2012	0	0	0	5,270	5,270	273	159	179		611	5,881	1,027	6,445	6,661		14,133	8,252
19	2013	0	0	0	5,807	5,807	273	159	179	0	611	6,418	1,140	7,154	7,394	0	15,688	9,270
20	2014	0	0	0	6,337	6,337	273	159	179	35	646	6,983	1,265	7,941	8,207	1,274	18,687	11,704
21	2015	0	0	0	5,447	5,447	273	159	179	59	670	6,117	1,405	8,814	9,110	2,362	21,691	15,574
22	2016	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
23	2017	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
24	2018	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
25	2019	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
26	2020	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
27	2021	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
28	2022	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
29	2023	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
30	2024	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
31	2025	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
32	2026	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
33	2027	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
34	2028	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
35	2029	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
36	2030	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
37	2031	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
38	2032	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
39	2033	6,660	0	0	0	6,660	273	159	179	118	729	7,389	1,405	8,814	9,110	4,725	24,054	16,665
40	2034	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
41	2035	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
42	2036	0	4,776	5,252	0	10,028	273	159	179	118	729	10,757	1,405	8,814	9,110	4,725	24,054	13,297
43	2037	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
44	2038	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
45	2039	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
46	2040	0	0	0	3,758	3,758	273	159	179	118	729	4,487	1,405	8,814	9,110	4,725	24,054	19,567
47	2041	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
48	2042	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
49	2043	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
50	2044	0	0	0	0	0	273	159	179	118	729	729	1,405	8,814	9,110	4,725	24,054	23,325
	Total	79,848	40,207	47,329	27,905	195,289	10,096	5,374	6,051	3,516	25,037	220,326	48,616	290,438	300,183	140,661	779,898	559,572

EIRR = 9.3%

Table H2.9 COST BENEFIT STREAM OF PROPOSED URBAN DRAINAGE PLAN

(US$1.000)

No.	Year	Cost. Cost							O & M Cost							Total Cost
		To Lich (1)	To Lich (2)	Co Nhue	My Dinh	Mc Tri	Ba Xa	Total	To Lich (1)	To Lich (2)	Co Nhue	My Dinh	Mc Tri	Ba Xa	Total	
1	1995	5,994						5,994							0	5,994
2	1996	23,867						23,867							0	23,867
3	1997	38,330						38,330							0	38,330
4	1998	46,161						46,161							0	46,161
5	1999	27,568						27,568	342						342	27,910
6	2000	4,889	7,282					12,171	572						572	12,743
7	2001		15,221					15,221	1,143						1,143	16,364
8	2002		50,204					50,204	1,143						1,143	51,347
9	2003		46,841	2,784				49,625	1,143	174					1,317	50,942
10	2004		19,346	1,962				21,308	1,143	289					1,432	22,740
11	2005			19,356				19,356	1,143	579					1,722	21,078
12	2006			20,852	1,344	1,895		24,091	1,143	579	0				1,722	25,813
13	2007			20,892	900	1,383		23,175	1,143	579	82				1,804	24,979
14	2008			7,342	7,812	9,285		24,439	1,143	579	186				1,908	26,347
15	2009			0	8,542	10,076		18,618	1,143	579	273	0	0		1,995	20,613
16	2010			0	8,937	10,338	797	20,072	1,143	579	273	47	54		2,096	22,168
17	2011			0	7,896	9,100	489	17,485	1,143	579	273	80	90		2,165	19,650
18	2012			0	0	0	5,270	5,270	1,143	579	273	159	179		2,333	7,603
19	2013			0	0	0	5,807	5,807	1,143	579	273	159	179	0	2,333	8,140
20	2014			0	0	0	6,337	6,337	1,143	579	273	159	179	35	2,368	8,705
21	2015			0	0	0	5,447	5,447	1,143	579	273	159	179	59	2,392	7,839
22	2016			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
23	2017			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
24	2018			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
25	2019			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
26	2020			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
27	2021			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
28	2022			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
29	2023			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
30	2024			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
31	2025	32,478		0	0	0	0	32,478	1,143	579	273	159	179	118	2,451	34,929
32	2026			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
33	2027			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
34	2028			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
35	2029		16,285	0	0	0	0	16,285	1,143	579	273	159	179	118	2,451	18,736
36	2030			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
37	2031			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
38	2032			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
39	2033			6,660	0	0	0	6,660	1,143	579	273	159	179	118	2,451	9,111
40	2034			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
41	2035			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
42	2036			0	4,776	5,252	0	10,028	1,143	579	273	159	179	118	2,451	12,479
43	2037			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
44	2038			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
45	2039			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
46	2040			0	0	0	3,758	3,758	1,143	579	273	159	179	118	2,451	6,209
47	2041			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
48	2042			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
49	2043			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
50	2044			0	0	0	0	0	1,143	579	273	159	179	118	2,451	2,451
	Total	179,287	155,179	79,848	40,207	47,329	27,905	529,755	51,206	23,623	10,096	5,374	6,051	3,516	99,866	629,621

(US$1,000)

Benefit							B-C
To Lich (1)	To Lich (2)	Co Nhue	My Dinh	Me Tri	Ba Xa	Total	
						0	-5,994
						0	-23,867
						0	-38,330
						0	-46,161
3,321						3,321	-24,589
5,979						5,979	-6,764
12,917						12,917	-3,447
13,950						13,950	-37,397
15,066						15,066	-35,876
16,272	3,014					19,286	-3,454
17,573	5,425					22,998	1,920
18,979	11,716	0				30,695	4,882
20,498	12,653	183				33,334	8,355
22,137	13,666	341				36,144	9,797
23,908	14,759	751	0	0		39,418	18,805
25,821	15,939	834	1,572	1,620		45,786	23,618
27,887	17,215	925	2,906	3,001		51,934	32,284
30,118	18,592	1,027	6,445	6,661	0	62,843	55,240
32,527	20,079	1,140	7,154	7,394	1,274	68,294	60,154
35,129	21,685	1,265	7,941	8,207	2,362	75,502	66,797
37,940	23,420	1,405	8,814	9,110	4,725	83,051	75,212
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	50,485
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	66,678
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	76,303
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	72,935
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	79,205
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
37,940	23,420	1,405	8,814	9,110	4,725	85,414	82,963
1,460,284	857,344	48,616	290,438	300,183	140,661	779,898	150,277

EIRR = 10.9%

Table H2.10 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 1 - 1)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	2,249	0	2,249	0	0	0		0	-2,249
2	1996	3,373	0	3,373	0	0	0		0	-3,373
3	1997	6,746	0	6,746	0	0	0		0	-6,746
4	1998	6,746	0	6,746	0	0	0		0	-6,746
5	1999	3,374	0	3,374	0	0	0		0	-3,374
6	2000	0	419	419	41	105	14	3,620	3,780	3,361
7	2001	0	419	419	44	113	14	3,620	3,792	3,373
8	2002	0	419	419	48	122	14	3,620	3,804	3,385
9	2003	0	419	419	52	132	14	3,620	3,818	3,399
10	2004	0	419	419	56	143	14	3,620	3,833	3,414
11	2005	0	419	419	60	154	0	3,620	3,835	3,416
12	2006	0	419	419	65	167	0	3,620	3,852	3,433
13	2007	0	419	419	70	180	0	3,620	3,870	3,451
14	2008	0	419	419	76	194	0	3,620	3,890	3,471
15	2009	0	419	419	82	210	0	3,620	3,912	3,493
16	2010	0	419	419	89	227	0	0	315	-104
17	2011	0	419	419	96	245	0	0	340	-79
18	2012	0	419	419	103	264	0	0	368	-51
19	2013	0	419	419	112	286	0	0	397	-22
20	2014	0	419	419	120	308	0	0	429	10
21	2015	0	419	419	130	333	0	0	463	44
22	2016	0	419	419	130	333	0	0	463	44
23	2017	0	419	419	130	333	0	0	463	44
24	2018	0	419	419	130	333	0	0	463	44
25	2019	0	419	419	130	333	0	0	463	44
26	2020	0	419	419	130	333	0	0	463	44
27	2021	0	419	419	130	333	0	0	463	44
28	2022	0	419	419	130	333	0	0	463	44
29	2023	0	419	419	130	333	0	0	463	44
30	2024	9,200	419	9,619	130	333	0	0	463	-9,156
31	2025	0	419	419	130	333	0	0	463	44
32	2026	0	419	419	130	333	0	0	463	44
33	2027	0	419	419	130	333	0	0	463	44
34	2028	0	419	419	130	333	0	0	463	44
35	2029	0	419	419	130	333	0	0	463	44
36	2030	0	419	419	130	333	0	0	463	44
37	2031	0	419	419	130	333	0	0	463	44
38	2032	0	419	419	130	333	0	0	463	44
39	2033	0	419	419	130	333	0	0	463	44
40	2034	0	419	419	130	333	0	0	463	44
41	2035	0	419	419	130	333	0	0	463	44
42	2036	0	419	419	130	333	0	0	463	44
43	2037	0	419	419	130	333	0	0	463	44
44	2038	0	419	419	130	333	0	0	463	44
45	2039	0	419	419	130	333	0	0	463	44
46	2040	0	419	419	130	333	0	0	463	44
47	2041	0	419	419	130	333	0	0	463	44
48	2042	0	419	419	130	333	0	0	463	44
49	2043	0	419	419	130	333	0	0	463	44
50	2044	0	419	419	130	333	0	0	463	44
	Total	31,688	18,855	50,543	5,013	12,841	70	36,200	54,124	3,581

EIRR = 4.4%

Table H2.11 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 1 - 2)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	2,455	0	2,455	0	0	0		0	-2,455
2	1996	3,682	0	3,682	0	0	0		0	-3,682
3	1997	7,364	0	7,364	0	0	0		0	-7,364
4	1998	7,364	0	7,364	0	0	0		0	-7,364
5	1999	3,681	0	3,681	0	0	0		0	-3,681
6	2000	0	279	279	48	123	16	1,500	1,687	1,408
7	2001	0	279	279	52	133	16	1,500	1,701	1,422
8	2002	0	279	279	56	143	16	1,500	1,715	1,436
9	2003	0	279	279	60	155	16	1,500	1,731	1,452
10	2004	0	279	279	65	167	16	1,500	1,749	1,470
11	2005	0	279	279	71	181	0	1,500	1,751	1,472
12	2006	0	279	279	76	195	0	1,500	1,771	1,492
13	2007	0	279	279	82	211	0	1,500	1,793	1,514
14	2008	0	279	279	89	228	0	1,500	1,817	1,538
15	2009	0	279	279	96	246	0	1,500	1,842	1,563
16	2010	0	279	279	104	266	0	0	369	90
17	2011	0	279	279	112	287	0	0	399	120
18	2012	0	279	279	121	310	0	0	431	152
19	2013	0	279	279	131	335	0	0	465	186
20	2014	0	279	279	141	361	0	0	502	223
21	2015	0	279	279	152	390	0	0	542	263
22	2016	0	279	279	152	390	0	0	542	263
23	2017	0	279	279	152	390	0	0	542	263
24	2018	0	279	279	152	390	0	0	542	263
25	2019	0	279	279	152	390	0	0	542	263
26	2020	0	279	279	152	390	0	0	542	263
27	2021	0	279	279	152	390	0	0	542	263
28	2022	0	279	279	152	390	0	0	542	263
29	2023	0	279	279	152	390	0	0	542	263
30	2024	4,550	279	4,829	152	390	0	0	542	-4,287
31	2025	0	279	279	152	390	0	0	542	263
32	2026	0	279	279	152	390	0	0	542	263
33	2027	0	279	279	152	390	0	0	542	263
34	2028	0	279	279	152	390	0	0	542	263
35	2029	0	279	279	152	390	0	0	542	263
36	2030	0	279	279	152	390	0	0	542	263
37	2031	0	279	279	152	390	0	0	542	263
38	2032	0	279	279	152	390	0	0	542	263
39	2033	0	279	279	152	390	0	0	542	263
40	2034	0	279	279	152	390	0	0	542	263
41	2035	0	279	279	152	390	0	0	542	263
42	2036	0	279	279	152	390	0	0	542	263
43	2037	0	279	279	152	390	0	0	542	263
44	2038	0	279	279	152	390	0	0	542	263
45	2039	0	279	279	152	390	0	0	542	263
46	2040	0	279	279	152	390	0	0	542	263
47	2041	0	279	279	152	390	0	0	542	263
48	2042	0	279	279	152	390	0	0	542	263
49	2043	0	279	279	152	390	0	0	542	263
50	2044	0	279	279	152	390	0	0	542	263
	Total	29,096	12,555	41,651	5,864	15,040	80	15,000	35,983	-5,668

EIRR = #NUM!

Table H2.12 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 2 – 1)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	8,245	0	8,245	0	0	0		0	-8,245
2	1996	12,367	0	12,367	0	0	0		0	-12,367
3	1997	24,734	0	24,734	0	0	0		0	-24,734
4	1998	24,734	0	24,734	0	0	0		0	-24,734
5	1999	12,367	0	12,367	0	0	0		0	-12,367
6	2000	0	1,130	1,130	308	798	106	10,100	11,312	10,182
7	2001	0	1,130	1,130	333	862	106	10,100	11,400	10,270
8	2002	0	1,130	1,130	359	931	106	10,100	11,496	10,366
9	2003	0	1,130	1,130	388	1,005	106	10,100	11,599	10,469
10	2004	0	1,130	1,130	419	1,086	106	10,100	11,711	10,581
11	2005	0	1,130	1,130	453	1,173	0	10,100	11,725	10,595
12	2006	0	1,130	1,130	489	1,266	0	10,100	11,855	10,725
13	2007	0	1,130	1,130	528	1,368	0	10,100	11,995	10,865
14	2008	0	1,130	1,130	570	1,477	0	10,100	12,147	11,017
15	2009	0	1,130	1,130	616	1,595	0	10,100	12,311	11,181
16	2010	0	1,130	1,130	665	1,723	0	0	2,388	1,258
17	2011	0	1,130	1,130	718	1,861	0	0	2,579	1,449
18	2012	0	1,130	1,130	776	2,009	0	0	2,785	1,655
19	2013	0	1,130	1,130	838	2,170	0	0	3,008	1,878
20	2014	0	1,130	1,130	905	2,344	0	0	3,249	2,119
21	2015	0	1,130	1,130	977	2,531	0	0	3,508	2,378
22	2016	0	1,130	1,130	977	2,531	0	0	3,508	2,378
23	2017	0	1,130	1,130	977	2,531	0	0	3,508	2,378
24	2018	0	1,130	1,130	977	2,531	0	0	3,508	2,378
25	2019	0	1,130	1,130	977	2,531	0	0	3,508	2,378
26	2020	0	1,130	1,130	977	2,531	0	0	3,508	2,378
27	2021	0	1,130	1,130	977	2,531	0	0	3,508	2,378
28	2022	0	1,130	1,130	977	2,531	0	0	3,508	2,378
29	2023	0	1,130	1,130	977	2,531	0	0	3,508	2,378
30	2024	25,699	1,130	26,829	977	2,531	0	0	3,508	-23,321
31	2025	0	1,130	1,130	977	2,531	0	0	3,508	2,378
32	2026	0	1,130	1,130	977	2,531	0	0	3,508	2,378
33	2027	0	1,130	1,130	977	2,531	0	0	3,508	2,378
34	2028	0	1,130	1,130	977	2,531	0	0	3,508	2,378
35	2029	0	1,130	1,130	977	2,531	0	0	3,508	2,378
36	2030	0	1,130	1,130	977	2,531	0	0	3,508	2,378
37	2031	0	1,130	1,130	977	2,531	0	0	3,508	2,378
38	2032	0	1,130	1,130	977	2,531	0	0	3,508	2,378
39	2033	0	1,130	1,130	977	2,531	0	0	3,508	2,378
40	2034	0	1,130	1,130	977	2,531	0	0	3,508	2,378
41	2035	0	1,130	1,130	977	2,531	0	0	3,508	2,378
42	2036	0	1,130	1,130	977	2,531	0	0	3,508	2,378
43	2037	0	1,130	1,130	977	2,531	0	0	3,508	2,378
44	2038	0	1,130	1,130	977	2,531	0	0	3,508	2,378
45	2039	0	1,130	1,130	977	2,531	0	0	3,508	2,378
46	2040	0	1,130	1,130	977	2,531	0	0	3,508	2,378
47	2041	0	1,130	1,130	977	2,531	0	0	3,508	2,378
48	2042	0	1,130	1,130	977	2,531	0	0	3,508	2,378
49	2043	0	1,130	1,130	977	2,531	0	0	3,508	2,378
50	2044	0	1,130	1,130	977	2,531	0	0	3,508	2,378
	Total	108,146	50,850	158,996	37,673	97,598	530	101,000	236,801	77,805

EIRR = 5.7%

Table H2.13 COST BENEFIT STREAM OF WASTEWATER DIPOSAL PLAN (ZONE 2 – 2)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	5,098	0	5,098	0	0	0		0	-5,098
2	1996	7,647	0	7,647	0	0	0		0	-7,647
3	1997	15,294	0	15,294	0	0	0		0	-15,294
4	1998	15,294	0	15,294	0	0	0		0	-15,294
5	1999	7,648	0	7,648	0	0	0		0	-7,648
6	2000	0	577	577	132	342	45	2,945	3,464	2,887
7	2001	0	577	577	143	369	45	2,945	3,502	2,925
8	2002	0	577	577	154	399	45	2,945	3,543	2,966
9	2003	0	577	577	166	431	45	2,945	3,587	3,010
10	2004	0	577	577	180	465	45	2,945	3,635	3,058
11	2005	0	577	577	194	503	0	2,945	3,641	3,064
12	2006	0	577	577	209	543	0	2,945	3,697	3,120
13	2007	0	577	577	226	586	0	2,945	3,757	3,180
14	2008	0	577	577	244	633	0	2,945	3,822	3,245
15	2009	0	577	577	264	684	0	2,945	3,893	3,316
16	2010	0	577	577	285	738	0	0	1,023	446
17	2011	0	577	577	308	797	0	0	1,105	528
18	2012	0	577	577	332	861	0	0	1,194	617
19	2013	0	577	577	359	930	0	0	1,289	712
20	2014	0	577	577	388	1,005	0	0	1,392	815
21	2015	0	577	577	419	1,085	0	0	1,504	927
22	2016	0	577	577	419	1,085	0	0	1,504	927
23	2017	0	577	577	419	1,085	0	0	1,504	927
24	2018	0	577	577	419	1,085	0	0	1,504	927
25	2019	0	577	577	419	1,085	0	0	1,504	927
26	2020	0	577	577	419	1,085	0	0	1,504	927
27	2021	0	577	577	419	1,085	0	0	1,504	927
28	2022	0	577	577	419	1,085	0	0	1,504	927
29	2023	0	577	577	419	1,085	0	0	1,504	927
30	2024	12,613	577	13,190	419	1,085	0	0	1,504	-11,686
31	2025	0	577	577	419	1,085	0	0	1,504	927
32	2026	0	577	577	419	1,085	0	0	1,504	927
33	2027	0	577	577	419	1,085	0	0	1,504	927
34	2028	0	577	577	419	1,085	0	0	1,504	927
35	2029	0	577	577	419	1,085	0	0	1,504	927
36	2030	0	577	577	419	1,085	0	0	1,504	927
37	2031	0	577	577	419	1,085	0	0	1,504	927
38	2032	0	577	577	419	1,085	0	0	1,504	927
39	2033	0	577	577	419	1,085	0	0	1,504	927
40	2034	0	577	577	419	1,085	0	0	1,504	927
41	2035	0	577	577	419	1,085	0	0	1,504	927
42	2036	0	577	577	419	1,085	0	0	1,504	927
43	2037	0	577	577	419	1,085	0	0	1,504	927
44	2038	0	577	577	419	1,085	0	0	1,504	927
45	2039	0	577	577	419	1,085	0	0	1,504	927
46	2040	0	577	577	419	1,085	0	0	1,504	927
47	2041	0	577	577	419	1,085	0	0	1,504	927
48	2042	0	577	577	419	1,085	0	0	1,504	927
49	2043	0	577	577	419	1,085	0	0	1,504	927
50	2044	0	577	577	419	1,085	0	0	1,504	927
	Total	63,594	25,965	89,559	16,154	41,836	225	29,450	87,665	-1,894

EIRR = #NUM!

Table H2.14 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 3)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	9,065	0	9,065	0	0	0		0	-9,065
2	1996	13,597	0	13,597	0	0	0		0	-13,597
3	1997	27,195	0	27,195	0	0	0		0	-27,195
4	1998	27,195	0	27,195	0	0	0		0	-27,195
5	1999	13,596	0	13,596	0	0	0		0	-13,596
6	2000	0	1,198	1,198	305	788	105	14,300	15,498	14,300
7	2001	0	1,198	1,198	329	851	105	14,300	15,585	14,387
8	2002	0	1,198	1,198	356	919	105	14,300	15,680	14,482
9	2003	0	1,198	1,198	384	993	105	14,300	15,782	14,584
10	2004	0	1,198	1,198	415	1,072	105	14,300	15,892	14,694
11	2005	0	1,198	1,198	448	1,158	0	14,300	15,906	14,708
12	2006	0	1,198	1,198	484	1,250	0	14,300	16,034	14,836
13	2007	0	1,198	1,198	523	1,350	0	14,300	16,173	14,975
14	2008	0	1,198	1,198	565	1,459	0	14,300	16,323	15,125
15	2009	0	1,198	1,198	610	1,575	0	14,300	16,485	15,287
16	2010	0	1,198	1,198	658	1,701	0	0	2,360	1,162
17	2011	0	1,198	1,198	711	1,837	0	0	2,548	1,350
18	2012	0	1,198	1,198	768	1,984	0	0	2,752	1,554
19	2013	0	1,198	1,198	829	2,143	0	0	2,973	1,775
20	2014	0	1,198	1,198	896	2,315	0	0	3,210	2,012
21	2015	0	1,198	1,198	968	2,500	0	0	3,467	2,269
22	2016	0	1,198	1,198	968	2,500	0	0	3,468	2,270
23	2017	0	1,198	1,198	968	2,500	0	0	3,468	2,270
24	2018	0	1,198	1,198	968	2,500	0	0	3,468	2,270
25	2019	0	1,198	1,198	968	2,500	0	0	3,468	2,270
26	2020	0	1,198	1,198	968	2,500	0	0	3,468	2,270
27	2021	0	1,198	1,198	968	2,500	0	0	3,468	2,270
28	2022	0	1,198	1,198	968	2,500	0	0	3,468	2,270
29	2023	0	1,198	1,198	968	2,500	0	0	3,468	2,270
30	2024	25,736	1,198	26,934	968	2,500	0	0	3,468	-23,466
31	2025	0	1,198	1,198	968	2,500	0	0	3,468	2,270
32	2026	0	1,198	1,198	968	2,500	0	0	3,468	2,270
33	2027	0	1,198	1,198	968	2,500	0	0	3,468	2,270
34	2028	0	1,198	1,198	968	2,500	0	0	3,468	2,270
35	2029	0	1,198	1,198	968	2,500	0	0	3,468	2,270
36	2030	0	1,198	1,198	968	2,500	0	0	3,468	2,270
37	2031	0	1,198	1,198	968	2,500	0	0	3,468	2,270
38	2032	0	1,198	1,198	968	2,500	0	0	3,468	2,270
39	2033	0	1,198	1,198	968	2,500	0	0	3,468	2,270
40	2034	0	1,198	1,198	968	2,500	0	0	3,468	2,270
41	2035	0	1,198	1,198	968	2,500	0	0	3,468	2,270
42	2036	0	1,198	1,198	968	2,500	0	0	3,468	2,270
43	2037	0	1,198	1,198	968	2,500	0	0	3,468	2,270
44	2038	0	1,198	1,198	968	2,500	0	0	3,468	2,270
45	2039	0	1,198	1,198	968	2,500	0	0	3,468	2,270
46	2040	0	1,198	1,198	968	2,500	0	0	3,468	2,270
47	2041	0	1,198	1,198	968	2,500	0	0	3,468	2,270
48	2042	0	1,198	1,198	968	2,500	0	0	3,468	2,270
49	2043	0	1,198	1,198	968	2,500	0	0	3,468	2,270
50	2044	0	1,198	1,198	968	2,500	0	0	3,468	2,270
	Total	116,384	53,910	170,294	37,321	96,396	325	143,000	277,241	106,947

EIRR = 8.2%

Table H2.15 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 4)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	5,517	0	5,517	0	0	0		0	-5,517
2	1996	8,275	0	8,275	0	0	0		0	-8,275
3	1997	16,550	0	16,550	0	0	0		0	-16,550
4	1998	16,550	0	16,550	0	0	0		0	-16,550
5	1999	8,273	0	8,273	0	0	0		0	-8,273
6	2000	0	900	900	194	500	67	7,960	8,721	7,821
7	2001	0	900	900	210	540	67	7,960	8,777	7,877
8	2002	0	900	900	226	583	67	7,960	8,836	7,936
9	2003	0	900	900	244	630	67	7,960	8,901	8,001
10	2004	0	900	900	264	680	67	7,960	8,971	8,071
11	2005	0	900	900	285	735	0	7,960	8,980	8,080
12	2006	0	900	900	308	793	0	7,960	9,061	8,161
13	2007	0	900	900	332	857	0	7,960	9,149	8,249
14	2008	0	900	900	359	925	0	7,960	9,245	8,345
15	2009	0	900	900	388	1,000	0	7,960	9,347	8,447
16	2010	0	900	900	419	1,079	0	0	1,498	598
17	2011	0	900	900	452	1,166	0	0	1,618	718
18	2012	0	900	900	489	1,259	0	0	1,748	848
19	2013	0	900	900	528	1,360	0	0	1,887	987
20	2014	0	900	900	570	1,469	0	0	2,038	1,138
21	2015	0	900	900	615	1,586	0	0	2,201	1,301
22	2016	0	900	900	615	1,586	0	0	2,201	1,301
23	2017	0	900	900	615	1,586	0	0	2,201	1,301
24	2018	0	900	900	615	1,586	0	0	2,201	1,301
25	2019	0	900	900	615	1,586	0	0	2,201	1,301
26	2020	0	900	900	615	1,586	0	0	2,201	1,301
27	2021	0	900	900	615	1,586	0	0	2,201	1,301
28	2022	0	900	900	615	1,586	0	0	2,201	1,301
29	2023	0	900	900	615	1,586	0	0	2,201	1,301
30	2024	18,441	900	19,341	615	1,586	0	0	2,201	-17,140
31	2025	0	900	900	615	1,586	0	0	2,201	1,301
32	2026	0	900	900	615	1,586	0	0	2,201	1,301
33	2027	0	900	900	615	1,586	0	0	2,201	1,301
34	2028	0	900	900	615	1,586	0	0	2,201	1,301
35	2029	0	900	900	615	1,586	0	0	2,201	1,301
36	2030	0	900	900	615	1,586	0	0	2,201	1,301
37	2031	0	900	900	615	1,586	0	0	2,201	1,301
38	2032	0	900	900	615	1,586	0	0	2,201	1,301
39	2033	0	900	900	615	1,586	0	0	2,201	1,301
40	2034	0	900	900	615	1,586	0	0	2,201	1,301
41	2035	0	900	900	615	1,586	0	0	2,201	1,301
42	2036	0	900	900	615	1,586	0	0	2,201	1,301
43	2037	0	900	900	615	1,586	0	0	2,201	1,301
44	2038	0	900	900	615	1,586	0	0	2,201	1,301
45	2039	0	900	900	615	1,586	0	0	2,201	1,301
46	2040	0	900	900	615	1,586	0	0	2,201	1,301
47	2041	0	900	900	615	1,586	0	0	2,201	1,301
48	2042	0	900	900	615	1,586	0	0	2,201	1,301
49	2043	0	900	900	615	1,586	0	0	2,201	1,301
50	2044	0	900	900	615	1,586	0	0	2,201	1,301
	Total	73,606	40,500	114,106	23,718	61,156	335	79,600	164,809	50,703

EIRR = 6.7%

Table H2.16 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 5)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	11,154	0	11,154	0	0	0		0	-11,154
2	1996	16,731	0	16,731	0	0	0		0	-16,731
3	1997	33,462	0	33,462	0	0	0		0	-33,462
4	1998	33,462	0	33,462	0	0	0		0	-33,462
5	1999	16,733	0	16,733	0	0	0		0	-16,733
6	2000	0	1,082	1,082	249	641	85	10,240	11,215	10,133
7	2001	0	1,082	1,082	269	692	85	10,240	11,286	10,204
8	2002	0	1,082	1,082	290	748	85	10,240	11,363	10,281
9	2003	0	1,082	1,082	314	807	85	10,240	11,446	10,364
10	2004	0	1,082	1,082	339	872	85	10,240	11,536	10,454
11	2005	0	1,082	1,082	366	942	0	10,240	11,548	10,466
12	2006	0	1,082	1,082	395	1,017	0	10,240	11,652	10,570
13	2007	0	1,082	1,082	427	1,099	0	10,240	11,765	10,683
14	2008	0	1,082	1,082	461	1,186	0	10,240	11,887	10,805
15	2009	0	1,082	1,082	498	1,281	0	10,240	12,019	10,937
16	2010	0	1,082	1,082	538	1,384	0	0	1,921	839
17	2011	0	1,082	1,082	581	1,495	0	0	2,075	993
18	2012	0	1,082	1,082	627	1,614	0	0	2,241	1,159
19	2013	0	1,082	1,082	677	1,743	0	0	2,420	1,338
20	2014	0	1,082	1,082	731	1,883	0	0	2,614	1,532
21	2015	0	1,082	1,082	790	2,033	0	0	2,823	1,741
22	2016	0	1,082	1,082	790	2,033	0	0	2,823	1,741
23	2017	0	1,082	1,082	790	2,033	0	0	2,823	1,741
24	2018	0	1,082	1,082	790	2,033	0	0	2,823	1,741
25	2019	0	1,082	1,082	790	2,033	0	0	2,823	1,741
26	2020	0	1,082	1,082	790	2,033	0	0	2,823	1,741
27	2021	0	1,082	1,082	790	2,033	0	0	2,823	1,741
28	2022	0	1,082	1,082	790	2,033	0	0	2,823	1,741
29	2023	0	1,082	1,082	790	2,033	0	0	2,823	1,741
30	2024	21,606	1,082	22,688	790	2,033	0	0	2,823	-19,865
31	2025	0	1,082	1,082	790	2,033	0	0	2,823	1,741
32	2026	0	1,082	1,082	790	2,033	0	0	2,823	1,741
33	2027	0	1,082	1,082	790	2,033	0	0	2,823	1,741
34	2028	0	1,082	1,082	790	2,033	0	0	2,823	1,741
35	2029	0	1,082	1,082	790	2,033	0	0	2,823	1,741
36	2030	0	1,082	1,082	790	2,033	0	0	2,823	1,741
37	2031	0	1,082	1,082	790	2,033	0	0	2,823	1,741
38	2032	0	1,082	1,082	790	2,033	0	0	2,823	1,741
39	2033	0	1,082	1,082	790	2,033	0	0	2,823	1,741
40	2034	0	1,082	1,082	790	2,033	0	0	2,823	1,741
41	2035	0	1,082	1,082	790	2,033	0	0	2,823	1,741
42	2036	0	1,082	1,082	790	2,033	0	0	2,823	1,741
43	2037	0	1,082	1,082	790	2,033	0	0	2,823	1,741
44	2038	0	1,082	1,082	790	2,033	0	0	2,823	1,741
45	2039	0	1,082	1,082	790	2,033	0	0	2,823	1,741
46	2040	0	1,082	1,082	790	2,033	0	0	2,823	1,741
47	2041	0	1,082	1,082	790	2,033	0	0	2,823	1,741
48	2042	0	1,082	1,082	790	2,033	0	0	2,823	1,741
49	2043	0	1,082	1,082	790	2,033	0	0	2,823	1,741
50	2044	0	1,082	1,082	790	2,033	0	0	2,823	1,741
	Total	133,148	48,690	181,838	30,461	78,395	425	102,400	211,681	29,843

EIRR = 1.9%

Table H2.17 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 6 - 1)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	4,424	0	4,424	0	0	0		0	-4,424
2	1996	6,636	0	6,636	0	0	0		0	-6,636
3	1997	13,271	0	13,271	0	0	0		0	-13,271
4	1998	13,271	0	13,271	0	0	0		0	-13,271
5	1999	6,637	0	6,637	0	0	0		0	-6,637
6	2000	0	517	517	117	302	40	4,075	4,534	4,017
7	2001	0	517	517	126	326	40	4,075	4,568	4,051
8	2002	0	517	517	136	352	40	4,075	4,604	4,087
9	2003	0	517	517	147	380	40	4,075	4,643	4,126
10	2004	0	517	517	159	411	40	4,075	4,685	4,168
11	2005	0	517	517	172	444	0	4,075	4,691	4,174
12	2006	0	517	517	186	479	0	4,075	4,740	4,223
13	2007	0	517	517	201	518	0	4,075	4,793	4,276
14	2008	0	517	517	217	559	0	4,075	4,851	4,334
15	2009	0	517	517	234	604	0	4,075	4,913	4,396
16	2010	0	517	517	253	652	0	0	905	388
17	2011	0	517	517	273	704	0	0	977	460
18	2012	0	517	517	295	760	0	0	1,055	538
19	2013	0	517	517	318	821	0	0	1,140	623
20	2014	0	517	517	344	887	0	0	1,231	714
21	2015	0	517	517	371	958	0	0	1,329	812
22	2016	0	517	517	371	958	0	0	1,329	812
23	2017	0	517	517	371	958	0	0	1,329	812
24	2018	0	517	517	371	958	0	0	1,329	812
25	2019	0	517	517	371	958	0	0	1,329	812
26	2020	0	517	517	371	958	0	0	1,329	812
27	2021	0	517	517	371	958	0	0	1,329	812
28	2022	0	517	517	371	958	0	0	1,329	812
29	2023	0	517	517	371	958	0	0	1,329	812
30	2024	11,227	517	11,744	371	958	0	0	1,329	-10,415
31	2025	0	517	517	371	958	0	0	1,329	812
32	2026	0	517	517	371	958	0	0	1,329	812
33	2027	0	517	517	371	958	0	0	1,329	812
34	2028	0	517	517	371	958	0	0	1,329	812
35	2029	0	517	517	371	958	0	0	1,329	812
36	2030	0	517	517	371	958	0	0	1,329	812
37	2031	0	517	517	371	958	0	0	1,329	812
38	2032	0	517	517	371	958	0	0	1,329	812
39	2033	0	517	517	371	958	0	0	1,329	812
40	2034	0	517	517	371	958	0	0	1,329	812
41	2035	0	517	517	371	958	0	0	1,329	812
42	2036	0	517	517	371	958	0	0	1,329	812
43	2037	0	517	517	371	958	0	0	1,329	812
44	2038	0	517	517	371	958	0	0	1,329	812
45	2039	0	517	517	371	958	0	0	1,329	812
46	2040	0	517	517	371	958	0	0	1,329	812
47	2041	0	517	517	371	958	0	0	1,329	812
48	2042	0	517	517	371	958	0	0	1,329	812
49	2043	0	517	517	371	958	0	0	1,329	812
50	2044	0	517	517	371	958	0	0	1,329	812
	Total	55,466	23,265	78,731	14,307	36,940	200	40,750	92,197	13,466

EIRR = 2.1%

Table H2.18 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 6 – 2)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	8,850	0	8,850	0	0	0		0	-8,850
2	1996	13,275	0	13,275	0	0	0		0	-13,275
3	1997	26,549	0	26,549	0	0	0		0	-26,549
4	1998	26,549	0	26,549	0	0	0		0	-26,549
5	1999	13,275	0	13,275	0	0	0		0	-13,275
6	2000	0	799	799	183	473	63	8,020	8,739	7,940
7	2001	0	799	799	198	511	63	8,020	8,791	7,992
8	2002	0	799	799	213	552	63	8,020	8,848	8,049
9	2003	0	799	799	231	596	63	8,020	8,909	8,110
10	2004	0	799	799	249	644	63	8,020	8,975	8,176
11	2005	0	799	799	269	695	0	8,020	8,984	8,185
12	2006	0	799	799	290	751	0	8,020	9,061	8,262
13	2007	0	799	799	314	811	0	8,020	9,144	8,345
14	2008	0	799	799	339	875	0	8,020	9,234	8,435
15	2009	0	799	799	366	946	0	8,020	9,331	8,532
16	2010	0	799	799	395	1,021	0	0	1,416	617
17	2011	0	799	799	427	1,103	0	0	1,530	731
18	2012	0	799	799	461	1,191	0	0	1,652	853
19	2013	0	799	799	498	1,286	0	0	1,784	985
20	2014	0	799	799	538	1,389	0	0	1,927	1,128
21	2015	0	799	799	581	1,500	0	0	2,081	1,282
22	2016	0	799	799	581	1,500	0	0	2,081	1,282
23	2017	0	799	799	581	1,500	0	0	2,081	1,282
24	2018	0	799	799	581	1,500	0	0	2,081	1,282
25	2019	0	799	799	581	1,500	0	0	2,081	1,282
26	2020	0	799	799	581	1,500	0	0	2,081	1,282
27	2021	0	799	799	581	1,500	0	0	2,081	1,282
28	2022	0	799	799	581	1,500	0	0	2,081	1,282
29	2023	0	799	799	581	1,500	0	0	2,081	1,282
30	2024	15,917	799	16,716	581	1,500	0	0	2,081	-14,635
31	2025	0	799	799	581	1,500	0	0	2,081	1,282
32	2026	0	799	799	581	1,500	0	0	2,081	1,282
33	2027	0	799	799	581	1,500	0	0	2,081	1,282
34	2028	0	799	799	581	1,500	0	0	2,081	1,282
35	2029	0	799	799	581	1,500	0	0	2,081	1,282
36	2030	0	799	799	581	1,500	0	0	2,081	1,282
37	2031	0	799	799	581	1,500	0	0	2,081	1,282
38	2032	0	799	799	581	1,500	0	0	2,081	1,282
39	2033	0	799	799	581	1,500	0	0	2,081	1,282
40	2034	0	799	799	581	1,500	0	0	2,081	1,282
41	2035	0	799	799	581	1,500	0	0	2,081	1,282
42	2036	0	799	799	581	1,500	0	0	2,081	1,282
43	2037	0	799	799	581	1,500	0	0	2,081	1,282
44	2038	0	799	799	581	1,500	0	0	2,081	1,282
45	2039	0	799	799	581	1,500	0	0	2,081	1,282
46	2040	0	799	799	581	1,500	0	0	2,081	1,282
47	2041	0	799	799	581	1,500	0	0	2,081	1,282
48	2042	0	799	799	581	1,500	0	0	2,081	1,282
49	2043	0	799	799	581	1,500	0	0	2,081	1,282
50	2044	0	799	799	581	1,500	0	0	2,081	1,282
	Total	104,415	35,955	140,370	22,398	57,843	315	80,200	160,757	20,387

EIRR = 1.7%

Table H2.19 COST BENEFIT STREAM OF WASTEWATER DISPOSAL PLAN (ZONE 7)

(US$1,000)

No.	Year	Const. Cost	O&M Cost	Cost Total	Benefit					B-C
					Disease Reduction	Tourism Promotion	Groundwater Improvement	Land Value Increase	Total	
1	1995	1,910	0	1,910	0	0	0		0	-1,910
2	1996	2,864	0	2,864	0	0	0		0	-2,864
3	1997	5,729	0	5,729	0	0	0		0	-5,729
4	1998	5,729	0	5,729	0	0	0		0	-5,729
5	1999	2,866	0	2,866	0	0	0		0	-2,866
6	2000	0	1,136	1,136	50	129	17	395	591	-545
7	2001	0	1,136	1,136	54	139	17	395	605	-531
8	2002	0	1,136	1,136	58	150	17	395	621	-515
9	2003	0	1,136	1,136	63	163	17	395	637	-499
10	2004	0	1,136	1,136	68	176	17	395	656	-480
11	2005	0	1,136	1,136	73	190	0	395	658	-478
12	2006	0	1,136	1,136	79	205	0	395	679	-457
13	2007	0	1,136	1,136	86	221	0	395	702	-434
14	2008	0	1,136	1,136	93	239	0	395	726	-410
15	2009	0	1,136	1,136	100	258	0	395	753	-383
16	2010	0	1,136	1,136	108	279	0	0	386	-750
17	2011	0	1,136	1,136	117	301	0	0	417	-719
18	2012	0	1,136	1,136	126	325	0	0	451	-685
19	2013	0	1,136	1,136	136	351	0	0	487	-649
20	2014	0	1,136	1,136	147	379	0	0	526	-610
21	2015	0	1,136	1,136	159	409	0	0	568	-568
22	2016	0	1,136	1,136	159	409	0	0	568	-568
23	2017	0	1,136	1,136	159	409	0	0	568	-568
24	2018	0	1,136	1,136	159	409	0	0	568	-568
25	2019	0	1,136	1,136	159	409	0	0	568	-568
26	2020	0	1,136	1,136	159	409	0	0	568	-568
27	2021	0	1,136	1,136	159	409	0	0	568	-568
28	2022	0	1,136	1,136	159	409	0	0	568	-568
29	2023	0	1,136	1,136	159	409	0	0	568	-568
30	2024	12,076	1,136	13,212	159	409	0	0	568	-12,644
31	2025	0	1,136	1,136	159	409	0	0	568	-568
32	2026	0	1,136	1,136	159	409	0	0	568	-568
33	2027	0	1,136	1,136	159	409	0	0	568	-568
34	2028	0	1,136	1,136	159	409	0	0	568	-568
35	2029	0	1,136	1,136	159	409	0	0	568	-568
36	2030	0	1,136	1,136	159	409	0	0	568	-568
37	2031	0	1,136	1,136	159	409	0	0	568	-568
38	2032	0	1,136	1,136	159	409	0	0	568	-568
39	2033	0	1,136	1,136	159	409	0	0	568	-568
40	2034	0	1,136	1,136	159	409	0	0	568	-568
41	2035	0	1,136	1,136	159	409	0	0	568	-568
42	2036	0	1,136	1,136	159	409	0	0	568	-568
43	2037	0	1,136	1,136	159	409	0	0	568	-568
44	2038	0	1,136	1,136	159	409	0	0	568	-568
45	2039	0	1,136	1,136	159	409	0	0	568	-568
46	2040	0	1,136	1,136	159	409	0	0	568	-568
47	2041	0	1,136	1,136	159	409	0	0	568	-568
48	2042	0	1,136	1,136	159	409	0	0	568	-568
49	2043	0	1,136	1,136	159	409	0	0	568	-568
50	2044	0	1,136	1,136	159	409	0	0	568	-568
	Total	31,174	51,120	82,294	6,127	15,773	85	3,950	25,935	-56,359

EIRR = #DIV/0!

Table H2.20 COST BENEFIT STREAM OF PROPOSED WASTEWATER DISPOSAL PLAN

(US$1,000)

No.	Year	Cost. Cost								O & M Cost						O & M Cost		Total Cost
		Zone 2 -1	Zone 4	Zone 3	Zone 2 - 2	Zone 6 - 1	Zone 5	Zone 6 - 2	Total	Zone 2 -1	Zone 4	Zone 3	Zone 2 - 2	Zone 6 - 1	Zone 5	Zone 6 - 2	Total	
1	1995								0								0	0
2	1996	1,134	584						1,718								0	1,718
3	1997	1,134	3,845						4,979								0	4,979
4	1998	1,870	3,845	360					6,075								0	6,075
5	1999	1,909	740	1,619					4,268								0	4,268
6	2000	1,174	248	360					1,782								0	1,782
7	2001	21,415	248	2,720					24,383								0	24,383
8	2002	21,415	2,665	2,720					26,800								0	26,800
9	2003	23,743	2,665	360					26,768								0	26,768
10	2004	8,653	3,275	1,619					13,547								0	13,547
11	2005		17,473	1,650					19,123	1,130							1,130	20,253
12	2006		17,473	392		189			18,054	1,130							1,130	19,184
13	2007		2,104	23,678	314	189			26,285	1,130							1,130	27,415
14	2008			23,678	1,607	189			25,474	1,130	900						2,030	27,504
15	2009			23,678	334	1,110			25,122	1,130	900						2,030	27,152
16	2010			7,814	13,942	1,121			22,877	1,130	900						2,030	24,907
17	2011				13,942	200	601		14,743	1,130	900	1,198					3,228	17,971
18	2012				13,942	11,893	2,923		28,758	1,130	900	1,198					3,228	31,986
19	2013				6,900	11,893	2,966	469	22,228	1,130	900	1,198					3,228	25,456
20	2014					11,893	644	2,312	14,849	1,130	900	1,198	577				3,805	18,654
21	2015					5,562	29,289	2,328	37,179	1,130	900	1,198	577				3,805	40,984
22	2016						29,289	485	29,774	1,130	900	1,198	577	517			4,322	34,096
23	2017						29,289	23,019	52,308	1,130	900	1,198	577	517			4,322	56,630
24	2018						16,541	23,019	39,560	1,130	900	1,198	577	517			4,322	43,882
25	2019							23,019	23,019	1,130	900	1,198	577	517	1,082		5,404	28,423
26	2020							13,847	13,847	1,130	900	1,198	577	517	1,082		5,404	19,251
27	2021								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
28	2022								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
29	2023								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
30	2024								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
31	2025								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
32	2026								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
33	2027								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
34	2028								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
35	2029	25,699							25,699	1,130	900	1,198	577	517	1,082	799	6,203	31,902
36	2030								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
37	2031								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
38	2032		18,441						18,441	1,130	900	1,198	577	517	1,082	799	6,203	24,644
39	2033								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
40	2034								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
41	2035			25,736					25,736	1,130	900	1,198	577	517	1,082	799	6,203	31,939
42	2036								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
43	2037								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
44	2038				12,613				12,613	1,130	900	1,198	577	517	1,082	799	6,203	18,816
45	2039								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
46	2040					11,227			11,227	1,130	900	1,198	577	517	1,082	799	6,203	17,430
47	2041								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
48	2042								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
49	2043						21,606		21,606	1,130	900	1,198	577	517	1,082	799	6,203	27,809
50	2044								0	1,130	900	1,198	577	517	1,082	799	6,203	6,203
	Total	108,146	73,606	116,384	63,594	55,466	133,148	88,498	638,842	45,200	33,300	40,732	17,887	14,993	28,132	19,176	199,420	838,262

(US$1,000)

Benefit								B-C
Zone 2 -1	Zone 4	Zone 3	Zone 2 - 2	Zone 6 - 1	Zone 5	Zone 6 - 2	Total	
							0	0
							0	-1,718
							0	-4,979
							0	-6,075
							0	-4,268
							0	-1,782
							0	-24,383
							0	-26,800
							0	-26,768
							0	-13,547
11,831							11,831	-8,422
11,961							11,961	-7,223
12,101							12,101	-15,314
12,253	9,245						21,498	-6,006
12,417	9,347						21,764	-5,388
12,488	9,458						21,946	-2,961
14,679	9,578	16,848					41,105	23,134
12,885	9,708	17,052					39,645	7,659
13,108	9,847	17,273					40,228	14,772
13,349	9,998	17,510	4,337				45,194	26,540
3,508	10,161	17,767	4,449				35,885	-5,999
3,508	10,161	17,768	4,449	5,404			41,290	7,194
3,508	10,161	17,768	4,449	5,404			41,290	-15,340
3,508	2,201	17,768	4,449	5,404			33,330	-10,552
3,508	2,201	17,768	4,449	5,404	13,063		46,393	17,970
3,508	2,201	17,768	4,449	5,404	13,063		46,393	27,142
3,508	2,201	3,468	4,449	5,404	13,063	10,101	42,194	35,991
3,508	2,201	3,468	4,449	5,404	13,063	10,101	42,194	35,991
3,508	2,201	3,468	4,449	5,404	13,063	10,101	42,194	35,991
3,508	2,201	3,468	1,504	5,404	13,063	10,101	39,249	33,046
3,508	2,201	3,468	1,504	5,404	13,063	10,101	39,249	33,046
3,508	2,201	3,468	1,504	1,329	13,063	10,101	35,174	28,971
3,508	2,201	3,468	1,504	1,329	13,063	10,101	35,174	28,971
3,508	2,201	3,468	1,504	1,329	13,063	10,101	35,174	28,971
3,508	2,201	3,468	1,504	1,329	2,823	10,101	24,934	-6,968
3,508	2,201	3,468	1,504	1,329	2,823	10,101	24,934	18,731
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	-7,730
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	-15,025
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	-1,902
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	-516
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	-10,895
3,508	2,201	3,468	1,504	1,329	2,823	2,081	16,914	10,711
232,312	157,091	258,522	75,962	79,291	175,798	130,144	1,109,120	270,858

EIRR= 5.2%

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Table H3.1 PROPOSED COST DISBURSEMENT SCHEDULE

(US$1,000)

		1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
I. Urban Drainage Plan	524,107	8,150	29,866	42,762	47,235	27,568	15,780	22,439	57,422	53,534	25,217	21,962	31,806	28,285	27,845	22,023	20,611	18,023	5,629	6,166	5,447						
1 To Lich River	317,409	8,150	29,866	42,762	47,235	27,568	15,780	22,439	57,422	46,841	19,346																
1st Stage	160,470	8,150	29,866	42,762	47,235	27,568	4,889																				
2nd Stage	156,939						10,891	22,439	57,422	46,841	19,346																
2 Nhue River	206,698									6,693	5,871	21,962	31,806	28,285	27,845	22,023	20,611	18,023	5,629	6,166	5,447						
Co Nhue	86,218									6,693	5,871	21,962	23,458	20,892	7,342												
My Dinh	40,950												3,000	2,556	8,916	9,645	8,937	7,896									
Me Tri	53,588												5,348	4,837	11,587	12,378	10,338	9,100									
Ba Xa	25,942																1,336	1,027	5,629	6,166	5,447						
II. Wastewater Disposal Plan	637,926		3,991	5,038	5,933	5,968	7,093	23,553	34,022	36,350	14,181	20,668	31,891	16,809	33,015	32,663	45,970	29,222	35,567	30,720	23,268	42,666	30,382	52,308	39,722	23,019	13,907
(1) 2 – 1	85,522		1,134	1,134	1,870	3,373	2,638	21,415	21,415	23,743	8,800																
(2) Zone 4	69,504		2,857	3,845	3,848	741	249	249	8,358	8,358	3,275	17,473	17,473	2,778													
(3) Zone 3	109,734					360	1,619	360	2,720	2,720	360	1,619	10,739	9,480	23,678	23,678	23,678	8,723									
(4) Zone 2 – 2	52,518													314	2,339	1,066	13,942	13,942	13,942	6,973							
(5) Zone 6 – 1	45,120												189	189	189	1,110	1,541	619	11,893	11,893	11,893	5,604					
(6) Zone 5	114,924																	601	2,923	4,576	2,254	29,289	29,289	29,289	16,703		
(7) Zone 6 – 2	89,774																			469	2,312	2,936	1,093	23,019	23,019	23,019	13,907
(8) Zone 1 – 1	26,233			59	215	1,494	2,587	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,474	1,242					
(9) Zone 1 – 2	24,990												104	662	3,423	3,423	3,423	1,951	3,423	3,423	3,423	1,735					
(10) Zone 7	19,607							55	55	55	272	102	1,912	1,912	1,912	1,912	1,912	1,912	1,912	1,912	1,912	1,860					
III. Grand Total	1,162,033	8,150	33,857	47,800	53,168	33,536	22,873	45,992	91,444	89,884	39,398	42,630	63,697	45,094	60,860	54,686	66,581	47,245	41,196	36,886	28,715	42,666	30,382	52,308	39,722	23,019	13,907

Table H3.2 BUDGET FOR CAPITAL EXPENDITURE HANOI CITY

(Billion Dong)

	1990	1991	1992	1993	1994
Capital Invest	25.2	45.7	76.2	98.6	128.4
Service	22.1	35.9	110.0	115.3	146.3
Total	47.3	81.6	186.2	213.9	274.7

Note : Figures of 1994 is estimated ones
Source : Dept. of Finance, HPC

Table H3.3 BUDGET ALLOCATION OF DIFFERENT SECTORS, HANOI CITY

(Billion Dong)

Sector	1990	1991	1992	1993	1994	Total	(%)
1. Roads	15.8	26.8	92.0	90.8	136.7	362.1	(45.1)
2. Water Supply	11.1	16.5	15.9	18.6	20.7	82.8	(10.3)
3. Drainage & Sewerage	6.8	7.9	20.9	25.8	27.5	88.0	(11.1)
4. Street Light	4.6	13.9	24.5	25.7	30.5	99.2	(12.3)
5. Solid Waste	6.0	12.4	23.1	36.5	35.5	113.5	(14.1)
6. Park	2.4	3.1	6.5	12.0	14.7	38.7	(4.8)
7. Zoo	0.6	1.1	3.3	4.5	5.6	15.1	(1.9)
8. Others	0	0	0	0	3.5	3.5	(0.4)
	47.3	81.7	186.2	213.9	274.7	803.8	(100.0)

Note : Figures of 1994 is estimated ones
Source : Dept. of Finance, HPC

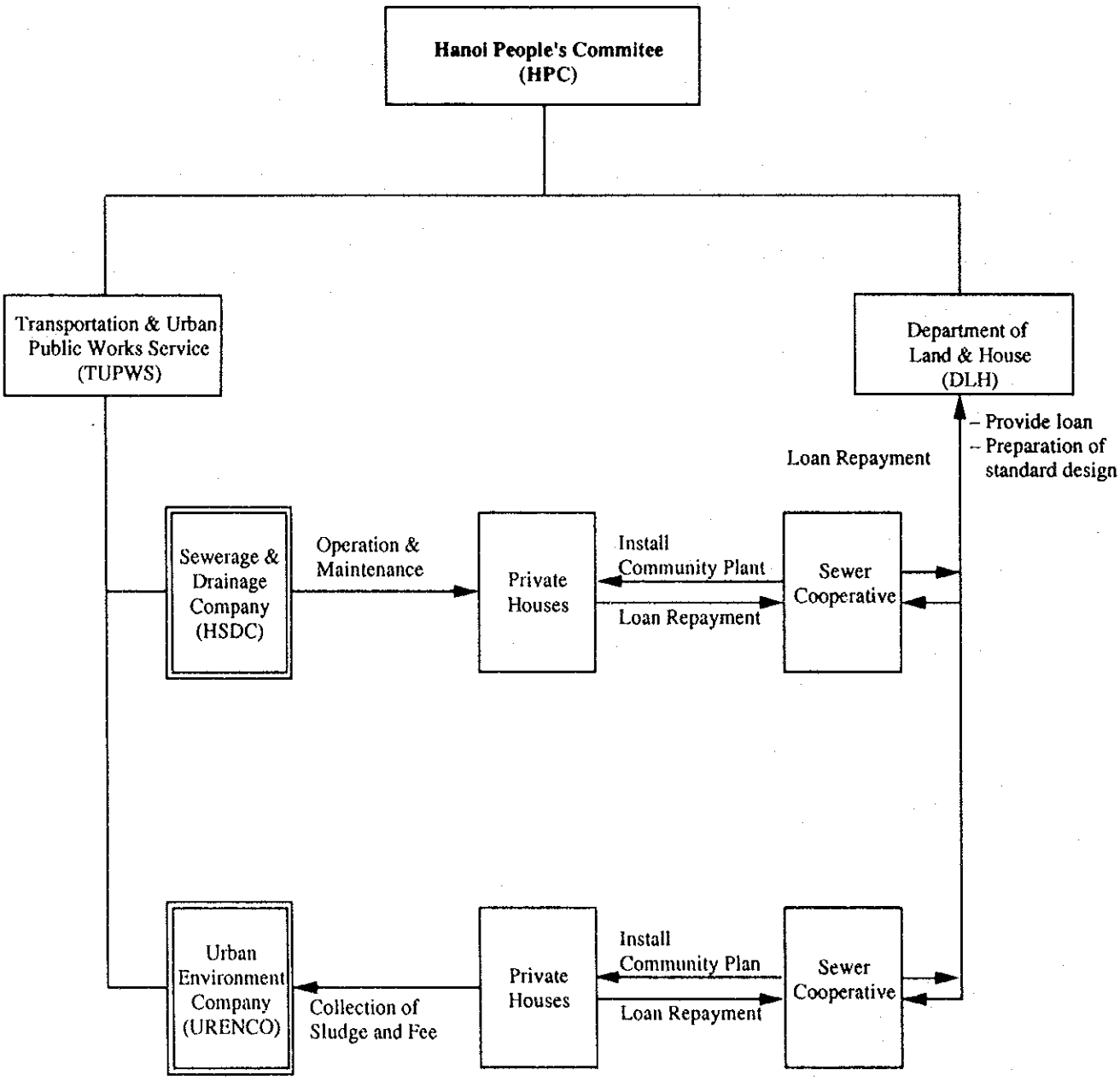
Table H3.4 PROJECTION OF CAPITAL EXPENDITURE FOR INFRASTRUCTURE

(US$ million)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1- Total National Capital Expenditure *1	3390	4220	5060	5979	7010	8220	9650	11020	12857	14920	17100	19250	21870	24570	27950	31310	34490
2- Projected Capital Expenditure on Infrastructure *1	1270	1620	1830	2140	2560	2990	3430	3790	4510	5160	5690	6350	7100	7840	8860	9730	10810
3- Capital Expenditure Allocated to Hanoi City																	
(a) %	7	7	7	7	7	10	10	10	10	10	10	10	10	10	10	10	10
(b) 2 x 3 (a)	89	113	128	150	179	299	343	379	451	516	569	635	710	784	886	973	1081
4- Capital Expenditure for Drainage & Sewerage																	
(a) %	7	7	7	7	7	10	10	10	10	10	10	10	12	12	12	12	12
(b) 3 (b) x 4 (a)	6	8	9	11	13	30	34	38	45	52	57	64	85	94	106	117	130

*1 Projection by SPC, 1994, Total Capital Expenditure includes expenditure for infrastructure, industry (power), and other sectors

Fig. H3.1 PROPOSED ORGANIZATION FOR INSTALLATION OF ON-SITE TREATMENT PLANT



THE STUDY
ON
URBAN DRAINAGE AND WASTEWATER DISPOSAL SYSTEM
IN
HANOI CITY

APPENDIX (J)

GEOTECHNICAL INVESTIGATION

FEBRUARY 1995

THE STUDY ON
URBAN DRAINAGE AND WASTEWATER DISPOSAL SYSTEM
IN
HANOI CITY

APPENDIX (J)
GEOTECHNICAL INVESTIGATION

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J1. INTRODUCTION

This Appendix (J) Geotechnical Investigation compiles all the study results in terms of the geotechnical aspects necessary for designing structures/facilities incorporated in the Master Plan and Feasibility Study. This Appendix comprises the following chapters:

(1) J2 : General Geography and Geology describes the geography of the study area, especially the creation of lakes and ponds in the area, and the geology thereof.

(2) J3 : Geotechnical Investigation Results presents the stratigraphy and soil mechanics of the subsoil in the study area based mainly on the following geotechnical investigations conducted in this study period, and further discusses some findings on the ground subsidence:

(a) Rotary boring	:	17 boreholes (433m in total)
(b) Standard penetration test	:	211 times
(c) In-situ permeability test	:	28 times
(d) Soil sampling	:	45 pieces
(e) Physical laboratory test	:	45 samples
(f) Mechanical laboratory test	:	39 samples

J2. GENERAL GEOGRAPHY AND GEOLOGY

2.1 Geography

2.1.1 Geography of Study Area

Hanoi City, the capital of Vietnam, is located approximately in the center of Northern Vietnam. The location is about 100 km upstream from the mouth of the Red River where the river, after flowing from the northwest to the southeast in the mountainous area, branches into several courses over the alluvial plain. (See Figure J2.1.)

The elevation of the study area ranges between 4 m and 15 m. The highest is the right dike of the Red River (EL. 13 m to EL. 15 m), which is followed by the Old City Area built in the northeast of the study area near the dike, with elevations between 7 m and 10 m. New city areas developing in the flange of the Old City Area have elevations from 5 m to 6 m. The lowest area lies from the south to the southwest in the study area with elevations of around 4 m. In the low-lying area, there remain topographic characteristics formed by the Red River, and the Nhue and To Lich rivers; including a number of natural levees 0.5 m to 1.0 m higher than the surrounding areas where villages have developed, old river courses generally in the form of crescent lakes, and back marches spreading behind them.

2.1.2 Creation of Lakes and Ponds

Even limiting the area over 1 ha, there are as many as 111 lakes and ponds in the total area, which represents about 16 % of the study area. These lakes and ponds might have been created by depressions, or old river courses, left by the meandering, short-cut, and bifurcation of rivers on the deltaic low-lying area. These geographic developments have formed the following four distinct types of topography in the study area:

(1) A sandbar, or a small-scale fan, formed by the Red River, with slightly higher elevations than the other areas, in the northeast where the Old City Area develops;

(2) Natural levees mainly comprising sandy material which develop along the Red River and the To Lich River with comparatively narrow widths and higher elevations;

(3) Back marshes mainly comprising clayey material which spread over the low-lying areas behind the natural levees with nearly horizontal depositions; and

(4) Existing river courses, and lakes/ponds (most of which are considered old river courses).

2.2 Geology

2.2.1 Geological History of Vietnam

The territory of Vietnam is geologically intersected by the border between the Eurasian Continent which is an old continent formed in the Pre-Cambrian Era (before 550 million years ago), and the Indochina Continent comprising deposits in the Mesozoic Era (65 million years to 250 million years ago). In both continents, scores of rows of mountain ranges were created, along with faults and folds, by several orogenic movements. Further, in the Cenozoic Era (65 million years ago to date), the lava plateau in the center to the south of Vietnam was built by the penetration of basaltic lava. In the Quaternary, deposits originating from the above base rocks have formed plains along the rivers and the sea.

2.2.2 Geology of Hanoi Area

According to a report (Geological Survey of Vietnam), the geological status in and around the study area is depicted as shown in Figures J2.2 and J2.3 (refer to Table J2.1). In the study area, the Quaternary stratum covering the base rock is generally constituted by, from top to bottom, Thai Binh (tb), Hai Hung (hh), Vinh Phuc (vp), and Hanoi (hn) formations. The characteristics of each layer are as follows:

(1) Alluvial Deposits

(a) Thai Binh : composed of sand, sandy clay, and silt lying 15 m below the ground surface.

(b) Hai Hung : comprising humic clay with depths between 5 m and 20 m.

(2) Diluvial Deposits

(a) Vinh Phuc : mainly composed of sand with depths between 15 m and 40 m.

(b) Hanoi : mainly composed of sandy gravel lying 4 m to 35 m deep.

J3. GEOTECHNICAL INVESTIGATION RESULTS

3.1 Stratigraphy

The geotechnical investigation conducted in this stage (whose locations are shown in Figure J3.1) has clarified the stratigraphy in the study area as depicted in Figure J3.2 Geotechnical Profiles. (For the boring log in each location, refer to Figure J3.3.) The clayey layers C1, C2 and C3 in Figure J3.2 generally correspond to the alluvial deposits tb1 and hh, while the layers S1, S2, S3 and S4 mainly comprise sand, among which S2, S3 and S4 correspond to the alluvial deposits tb1, tb2 and hh, and S1 corresponds to the diluvial deposit vp.

3.1.1 To Lich River

Along the To Lich river course, the clayey layers C1, C2 and C3 are thick especially around the Thanh Liet site, reaching 35 m in depth. These clayey layers are interrupted by the sandy layers S2 and S3 in places. Further, such layers are supported by the sandy layer S1 whose depth ranges from 10 m to 15 m in the stretch between West Lake and the confluence of the Lu River, and suddenly reach 30 m to 35 m in the stretch downstream of the confluence. The N-values of the above clayey and sandy layers are 6 to 11, and 16 to more than 30, respectively.

3.1.2 Kim Nguu River

Distributed along the river are the layers C1, C2, C3, S2 and S4. Among these, S4 is only found on the high water channel of the Red River, comprising newly depositing sand. The entire soil profile is represented by the clayey layers (C1, C2 and C3) with a nearly constant thickness of 35 m although sandy lenses (corresponding to S2) are sandwiched in between, for the downstream reaches. The N-values of the clayey layers are 6 to 11 (not so different from those along the To Lich river). The bearing layer S1 has not been confirmed therein.

3.1.3 Yen So Area

The following five layers, from top to bottom, appear in the Yen So area:

(1) Layer C3 : shallower than 5 m in depth

Horizontal clayey deposition including top soils.

(2) Layer C2 : under C3 and shallower than 20 m to 35 m in depth

This clayey layer contains a lot of humic materiac, sloping down to the south.

(3) Layer C1 : under C2 and shallower than approximately 40 m

This clayey layer is thicker in the north, including humic soil and sand. (The V-values of C1, C2 and C3 are 4 to 17.)

(4) Layer S2 : above 40 m in depth

This sandy layer appears in clayey layers C1 and C2 in the form of lenses.

(5) Layer S1 : deeper than 40 m in depth

This sandy layer lies with a nearly constant top elevation of -37 m, which can be assigned as the bearing layer for proposed structures (the N-values are more than 30).

3.2 Soil Mechanics

This section describes the soil mechanical characteristics of the subsoil in the study area revealed by the borings, in-situ tests, and laboratory tests in this stage. The test results are listed in Table J3.1, which are summarized in Table J3.2.

3.2.1 Earthwork

Earthwork for the proposed project will be executed in the upper portion of the clayey layers C2 and C3 comprising silt, clay, and humic material. There may be no sandy lenses interrupting this upper portion. The N-value ranges between 4 and 7, the natural water content 28 % and 37 %, the liquid limit 34 % and 45 %, the bulk density 1.80 and 1.96 kgf/cm^2, the cohesion 0.7 and 1.5 kgf/cm^2, and the sand contents 12 % and 35 %, showing rather hard properties. The permeability coefficient shows the 10 $^{-6}$ cm/sec order. Calculation indicates that the maximum possible excavation depth can be 10 m even without retaining walls, and for seepage to occur from a fishpond 5 m behind the excavation field can require more than 3 months. Judging from the above, both manual and mechanical earthworks can be applied to the proposed project without special countermeasures, and also the excavated materials can be used for embankments.

However, as observed at the excavation site in the Yen So regulating reservoir, the soil tends to be muddy through repeated loading from water after rains. This is because its liquid limit is close to its natural water content, as mentioned above. This condition may not pose a problem for manual operations, but for mechanized operations. In this case, some soil improvement should be examined for securing the traficability of heavy machinery.

3.2.2 Consolidation Settlement

The clayey layers C1, C2, and C3 may be subject to consolidation settlement. Based on the data obtained from the geotechnical investigation, and given at 5 ton/m^2 of the additional load of embankment, the final settlement is calculated at approximately 60 cm for 25 years, as presented in the table below. This settlement should be compensated by an extra embankment.

Layer	Depth (m)	Thickness (m)	Cc	Cv (cm^2/day)	Settlement (cm)	Time for Settlement (Year)
C3	0.0 ~ 4.5	4.5	0.13	70	20	2
C2	4.5 ~ 23.5	19.0	0.30	110	30	23
C1	27.2 ~ 40.8	13.6	0.16	194	8	7

3.2.3 Bearing Layer

The deepest sandy layer (S1) has N-values of more than 30, and can be the bearing layer for the structures to be proposed in the study. This layer is distributed approximately 15 m and 35 m under the ground surface respectively along the To Lich River and at the Thanh Liet weir. However, along the Kim Nguu River this layer was not confirmed. In the Yen So area, on the other hand, the surface of this layer lies at EL.-37 m with less undulation, requiring approximately 35 m of foundation piles to support the structures.

3.2.4 Permeability

The permeability of the subsoil is examined based on the data attained through the in-situ and laboratory permeability tests. The permeability coefficients of the clayey layers are the 10^{-6}cm/sec order for C2 and C3, and the 10^{-7}cm/sec order for C1, while those of the sandy layers are the order of 10^{-4} cm/sec for S1, S2 and S3, and 10^{-5} cm/sec for S4. On this condition, unless the sandy lenses exist in the upper clayey layers (C2 and C3), only a few meter's excavation, keeping the water level approximately 2 m below the ground level, should not affect the safety of the Red River levee located more than 1 km away from the excavation site. Moreover, there will be less change in the water stage of the fishponds around the Yen So reservoir site.

3.3 Ground Subsidence

The water supply for Hanoi City solely depends on groundwater. In the study area, there are two aquifers from which groundwater is abstracted: Qa and Qb corresponding to Formations Hanoi and Thai Binh, respectively. The amount of the groundwater abstraction tends to increase as follows:

Year	Volume (m^3/day)	Increasing Rate (m^3/day/year)
1970	140,000	–
1978	165,000	3,100
1985	210,000	6,400
1990	350,000	28,000
1992	411,000	30,500

Source : Water Master Plan in Hanoi City, 1993 FINIDA

This increase of abstraction volume has provoked deep concern on the ground subsidence. See Figure J3.4 and J3.5, and Figure J3.6 which show respectively the isotopic elevation lines of the aquifers, and the actual ground subsidence between 1988 and 1992. As can be seen in Figure J3.6, the areal-average ground subsidence is about 5 mm to 10 mm per annum, and large subsidence were observed at Phap Van and Ngo Si Lien where groundwater abstraction is vigorous. Such ground subsidence may, unwillingly, be accelerated with the increase of abstraction (as suggested in the table above) that will necessarily result from the expansion of the population in the Hanoi area (refer to Figure J3.7).

On a premise that the ground subsidence is likely to continue for a foreseeable future, this will have to be taken into consideration in the planning and designing of drainage structures. Some of the approaches include:

(1) To provide an extra allowance in the freeboard above the high water level (e.g., in rivers and drainage channels); and

(2) To assume extra discharge capacities for floodgates, etc.

Table J 2. 1 GEOLOGIAL COLUMN IN HANOI AREA

System	Series	Stage	Formation	Index	Column	Thickness (m)	Description
Quaternary	Holocene	Upper	Thai binh	aIV^3tb_2		5-15	The upper part is light brown clay containing fresh water mollusca shells and vegeta l remains. The lower part are cobbles, pebbles, sand mixed with little greyish yellow clayey silt.
				aIV^3tb_1		6-31	On top is clayey silt mixed with vegeta l remains of bown grey colour. Further down is clayey silt mixed with little vegetal remains. (Qb) The lowermost are small cobbles, pebbles, sand mixed with little clayey silt of light brown grey colour.
		Middle	Hai hung	$bIV^{1-2}hh$		2	Silty clay mixed with little sand of dark brown, dark grey colours, containing peat
		Lower		$mIV^{1-2}hh$		0.5- 9	Marine sediments:clay, silty clay of blue grey colour grey blue one, with some vegetal remains on the bottom.
				$lbIV^{1-2}hh$		2- 6	Silty clay, clayey sand with vegetal remained.
	Pleistocene	Upper	Vinh phuc	$lbIII^2vp_3$		3- 9	Black clay, black-brown clayey silt mixed with vegetal remains.
				$lIII^2vp_2$		2-10	White grey kaolin clay, yellow grey silty clay.
				$aIII^2vp_1$		33	Yellow sand mixed with little clay with lenses of brown yellow gravel. The lower pant is cobbles pebbles mixed little silty clay grey yellow in colour.
		Middle	Hanoi	ap, aQ II, III^2 hn		21-37	The upper part is clayey silt of yellow grey, grey brown colours containing vegetal remains. The middle part is composed of coarse sand mixed with pebbles and gravel and some small cobbles with grey bricky yellow grey brown colour. (Qa) The lowermost part is composed of cobbles, boulders, pebbles, gravel mixed with little sand.
		Lower	Le shi	aQ I-Ic		23	The upper part is clayey silt of yellow grey-dark grey colour. The middle part is sandy silt and fine sand of grey colour. The lower part is cobbles, pebbles sand mixed with little silty clay.
Neogene	Pliocene	Upper	Vinh bao	N_2vb		150	Cobbles, pebbles, conglomerate, sandstone, siltstone black tstone, claystone, cross-bedded limited dirty grey siltstone, claystone, cross-bedded

Table J3.1(1) SOIL TEST RESULTS (1/2)

No	B.H	Sampling depth (m)	Grain size composition (%)									Physical properties								Mechanical properties					
			Cobbles	Sand fraction				Silt fraction		Clay fraction		Natural water content	Bulk density	Dry density	Specific gravity	Natural porosity coefficient	Precity ratio	Saturation degree	Permeability coefficient	Atteberg limits			Compression index	Consolidation coefficient	Compressibility coefficient a (cm²/kg) Corresponding to load P (Kg/cm²)			
				Coarse	Med	Fine														Liquid limit	Plastic limit	Plastic index					
			Grain size (mm)																							
			5-2	2-1	1.0-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	<0.005	W (%)	γ (g/cm³)	γd (g/cm³)	Δ (g/cm³)	e	n (%)	G (%)	K (cm/s)	Wc (%)	Wd (%)	I	Cc	Cv (cm²/s)	0.0-0.5	0.5-1.0	1.0-2.0	2.0-3.0
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	K1	39.5-39.7				0.4	17.6	22.0	24.0	10.0	26.0	25.1	1.94	1.551	2.69	0.734	42.3	92	6.9×10^{-7}	25.3	19.7	5.6	0.06	7.49×10^{-3}	0.134	0.032	0.018	0.015
2	"	4.0-4.2			1.1	18.0	1.9	1.0	10.0	6.0	70.0	35.1	1.84	1.362	2.72	0.997	50.0	96	1.34×10^{-7}	44.8	24.6	20.2	0.096	2.01×10^{-3}	0.084	0.064	0.029	0.028
3	"	9.8-10.0										76.0	1.44	0.848	2.58	2.154	68.3	91	3.91×10^{-4}	80.4	46.6	33.8	0.52	1.29×10^{-3}	0.184	0.132	0.156	0.149
4	"	15.9-16.1			0.1	0.7	20.2	10.0	28.0	11.0	30.0	30.3	1.81	1.389	2.69	0.937	48.4	100	1.95×10^{-5}	25.0	19.0	6.0	0.083	7.36×10^{-3}	0.096	0.040	0.025	0.017
5	"	29.8-30.0			0.1	1.3	3.1	7.0	40.5	16.0	32.0	36.0	1.73	1.272	2.72	1.138	53.2	86	6.6×10^{-6}	28.3	22.9	5.4	0.126	1.66×10^{-3}	0.066	0.052	0.038	0.032
6	K3	6.8-7.0			0.1	2.4	19.5	26.0	23.5	4.5	24.0	38.9	1.88	1.353	2.70	0.995	53.4	100	7.4×10^{-6}	34.4	23.3	11.1	0.146	1.55×10^{-3}	0.066	0.064	0.044	0.037
7	K4	7.8-8.0		0.1	0.5	0.7	6.1	29.0	28.0	6.0	30.0	31.3	1.77	1.348	2.71	1.110	59.2	84	3.79×10^{-4}	37.6	23.7	13.9	0.133	3.28×10^{-3}	0.048	0.058	0.040	0.028
8	"	15.8-16.0			2.6	21.6	35.7	10.6	18.4	7.2	3.9	25.9	1.86	1.477	2.61	0.767		100	2.67×10^{-4}									
9	K5	1.8-2.0						13.8	25.6	32.1	28.5	27.7	1.92	1.505	2.70	0.796	44.0	94	2.89×10^{-6}	33.9	21.1	12.8	0.053	3.00×10^{-3}	0.016	0.080	0.016	0.019
10	"	9.5-9.7	4.3	2.0	17.5	38.7	4.4	5.5	8.5	4.0	8.0	12.5	1.60	1.422	2.69	0.892	47.1	38	4.57×10^{-4}									
11	K6	4.0-4.2		1.0	0.5	2.0	0.5	2.0	34.0	1.3	47.0	31.8	1.92	1.457	2.70	0.853	46.0	100	1.59×10^{-7}	41.1	23.6	17.5	0.059	9.72×10^{-4}	0.046	0.046	0.014	0.073
12	"	9.8-10.0						12.6	22.3	38.4	26.7	30.3	1.89	1.450	2.70	0.862	46.3	95	6.45×10^{-8}	35.7	21.9	13.8	0.096	1.00×10^{-3}	0.052	0.028	0.029	0.079
13	K8	2.5-2.7	1.5	0.1	0.4	1.2	10.8	14.0	37.5	6.0	28.5	24.7	1.91	1.532	2.71	0.769	43.5	87	3.99×10^{-8}	27.5	17.7	9.8	0.136	6.83×10^{-3}	0.042	0.032	0.041	0.025
14	"	19.3-19.5										42.2	1.46	0.863	2.58	1.989	66.5	94	4.14×10^{-8}	45.8	24.7	21.1	0.66	2.47×10^{-3}	0.146	0.092	0.198	0.784
15	K2	3.8-4.0						8.5	30.2	21.6	39.7	45.4	1.81	1.245	2.70	1.769	54.8	100	5.07×10^{-8}	54.8	33.6	23.2	0.11	1.08×10^{-3}	0.072	0.046	0.039	0.029
16	"	7.8-8.0										85.6	1.40	0.754	2.64	2.501	71.4	90	3.16×10^{-5}	84.2	47.0	37.2	0.386	9.8×10^{-4}	0.115	0.061	0.116	0.097
17	"	23.9-24.1			5.6	20.5	23.7	10.8	15.3	2.9	6.3	24.6	1.95	1.560	2.60	0.688	40.7	100	6.85×10^{-3}									
18	"	33.4-33.6	1.7	2.0	3.0	6.2	17.1	5.8	10.0	11.0	44.0	40.2	1.49	0.930	2.65	1.849	64.9	86	2.8×10^{-4}	51.8	40.7	11.1	0.27	9.59×10^{-4}	0.137	0.063	0.081	0.065
19	K7	3.8-4.0				9.0	10.6	15.7	16.8	22.0	25.9	27.5	1.96	1.554	2.75	0.770	43.5	93	4.82×10^{-8}	34.1	20.8	13.3	0.073	1.37×10^{-3}	0.015	0.013	0.032	0.076
20	"	11.8-12.0				5.1	9.5	18.7	20.9	24.6	21.0	34.0	1.80	1.343	2.71	1.017	50.0	91	7.86×10^{-8}	33.8	22.1	11.7	0.223	8.43×10^{-3}	0.085	0.061	0.067	0.058

Table J3.1(2) SOIL TEST RESULTS (2/2)

No	B.H	Sampling depth (m)	Grain size composition (%)								Physical properties										Mechanical properties							
			Sand fraction					Silt fraction		Clay fraction	Natural water content W (%)	Bulk density γ (g/cm³)	Specific gravity Δ (g/cm³)	Natural porosity coefficient e°	Porosity ratio n (%)	Saturation degree G (%)	Permeability coefficient K (cm/s)	Atterberg limits			Compression index Cc	Consolidation coefficient Cv (cm²/s)	Compressibility coefficient a (cm²/kg) Corresponding to load P (kg/cm²)						
			Coarse		Med	Fine												Liquid limit Wc (%)	Plastic limit Wd (%)	Plastic index I			0.0-0.5	0.5-1.0	0.0-1.0	1.0-2.0	2.0-3.0	3.0-4.0
			2-1	1-0.5	0.5-0.25	0.25-0.1	0.1-0.05	0.05-0.01	0.01-0.005	<0.005																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
1	K9	3.0-3.2			9.6	4.7	11.5	12.1	29.3	33.8	31.1	1.90	2.71	0.869	46	97	1.21×10^{-4}	40.7	22.5	18.2	0.065				0.045	0.020	0.016	0.013
2	K9	9.8-10.0				4.9	11.5	30.6	29.2	23.8	46.5	1.80	2.68	1.179	54	100	6.25×10^{-7}	42.9	28.5	14.4	0.252	3.92×10^{-4}	0.122	0.094		0.076	0.068	
3	K9	33.7-33.9			2.4	7.9	12.8	25.2	27.6	24.1	44.7	1.78	2.67	1.171	54	100	3.5×10^{-7}	39.7	25.8	13.9	0.282	1.36×10^{-3}	0.114	0.096		0.085	0.075	
4	K9	38.2-38.4				27.1	39.6	19.5	9.4	4.2	32.2	1.83	2.69	0.949	49	94	8.21×10^{-7}	34.8	28.2	6.6	0.083	5.61×10^{-3}			0.092	0.025	0.018	0.012
5	K9	41.8-42.0	6.7	18.5	32.4	17.5	14.3	6.2	3.1	1.0	26.4	1.87	2.65	0.794	44	88	6.97×10^{-4}											
6	K10	5.0-5.2					11.3	28.2	30.8	29.7	51.2	1.55	2.59	1.515	60	97	9.02×10^{-4}				0.332		0.150	0.138		0.100	0.086	
7	K10	25.0-25.2		9.2	19.6	37.3	22.9	6.3	3.2	1.5	26.2	1.88	2.64	0.772	43	90	3.97×10^{-4}											
8	K10	29.8-30.0				11.2	17.5	20.6	22.8	15.1	48.8	1.75	2.69	1.279	56	100	4.2×10^{-7}	41.4	27.5	13.9	0.319	7.05×10^{-4}	0.162	0.128		0.096	0.084	
9	K10	34.8-35.0			3.2	4.5	10.8	19.5	22.4	37.6	25.9	1.88	2.72	0.826	45	85	3.5×10^{-5}	42.1	20.8	21.3	0.034	9.38×10^{-4}			0.026	0.011	0.010	0.009
10	K10	40.1-40.3			16.6	24.5	18.7	21.6	12.5	6.1	31.8	1.81	2.68	0.956	49	89	8.65×10^{-7}	33.8	27.5	6.3	0.209	1.71×10^{-3}			0.122	0.063	0.048	0.026
11	K11	2.0-2.2			6.2	11.4	19.2	18.6	21.0	23.6	31.8	1.89	2.70	0.888	47	97	3.56×10^{-7}	38.4	22.6	15.8	0.093	1.25×10^{-3}			0.065	0.028	0.019	0.013
12	K11	7.0-7.2				11.0	16.5	19.6	20.5	32.4	51.9	1.60	2.69	1.371	58	94	6.25×10^{-5}				0.329	1.78×10^{-3}	0.152	0.110		0.099	0.084	
13	K11	11.8-12.0				4.4	19.3	15.6	22.9	27.8	47.4	1.74	2.67	1.242	54	100	8.71×10^{-7}	40.5	25.8	14.7	0.279	1.76×10^{-4}	0.104	0.096		0.084	0.052	
14	K12	4.0-4.2					13.8	20.5	23.6	42.1	36.7	1.84	2.70	1.001	50	99	2.9×10^{-7}	44.0	21.9	22.7	0.120	5.61×10^{-4}			0.070	0.036	0.029	0.023
15	K12	8.2-8.4				8.5	20.3	19.5	32.1	19.6	42.3	1.87	2.67	1.102	52	100	1.05×10^{-7}	39.4	24.3	15.1	0.252		0.098	0.085		0.076	0.069	
16	K13	2.2-2.4			4.1	6.7	12.3	31.6	22.5	20.8	37.3	1.84	2.70	1.015	50	99	1.69×10^{-7}	39.5	23.5	16.0	0.193		0.095	0.092		0.058	0.051	
17	K13	9.8-10.0				6.4	15.7	24.6	29.9	23.4	45.1	1.77	2.68	1.197	54	100	5.6×10^{-8}	39.5	24.7	14.8	0.319		0.152	0.104		0.096	0.083	
18	K14	3.9-4.1					11.6	20.3	22.5	45.6	37.0	1.85	2.71	1.007	50	100	7.92×10^{-8}	44.7	23.8	20.9	0.140	9.19×10^{-4}			0.055	0.042	0.029	0.019
19	K14	9.8-10.0			21.0	30.2	32.9	5.2	3.9	1.8	25.0	1.83	2.63	0.801	44	82	5.63×10^{-4}											
20	K15	3.5-3.7				9.8	12.1	29.6	25.7	22.8	34.7	1.80	2.71	1.022	51	92	8.72×10^{-6}	38.9	22.8	16.1	0.120				0.042	0.036	0.031	0.027
21	K15	11.0-11.2			1.6	8.5	19.6	17.8	30.1	22.5	42.6	1.78	2.64	1.191	53	100	7.31×10^{-7}	38.7	25.8	12.9	0.206	5.27×10^{-4}	0.101	0.095		0.062	0.048	
22	K16	3.4-3.6				6.5	20.1	29.6	43.8		34.8	1.85	2.71	0.978	49	96	5.86×10^{-8}	41.7	20.2	21.5	0.140				0.086	0.042	0.036	0.024
23	K16	8.2-8.4			6.4	10.0	13.6	22.6	25.7	21.8	48.4	1.78	2.70	1.250	56	100	7.28×10^{-8}	45.3	28.8	16.5	0.282		0.096	0.092		0.085	0.071	
24	K17	2.7-2.9				6.4	14.2	25.6	30.5	21.3	35.4	1.82	2.70	1.015	50	94	8.21×10^{-4}	38.3	22.5	15.8	0.179	4.88×10^{-4}	0.720	0.660		0.540	0.500	
25	K17	8.8-9.0		2.1	6.1	15.2	10.4	13.2	22.8	30.2	57.6	1.80	2.69	1.360	58	100	4.55×10^{-7}	50.9	38.1	12.8	0.286		0.104	0.098		0.086	0.058	

Table J 3.2 SUMMARY OF SOIL TEST RESULTS FOR EACH LAYER

* Layer	** Area	Composition (%) Grain Size (mm) 2	0.05	0.005		Water Content (%) Liquid Limit	Natural	Plastic Limit	Bulk Density γ (g/cm³)	Specific Gravity (g/cm³)	Natural Porosity eo	Permeability Coefficient (cm/s)	Compression Index Cc	Consolidation Coefficient Cv (cm²/day)	Cohesion c (kg/cm²)	Soil Classification	Average of N-value (N/30cm)
S_4	②	2	27	43	28	28	25	10	1.91	2.71	0.77	4×10^{-5}	0.14	590		Sand-Clayey Silt	13
C_3	①	0	33	26	41	39	35	24	1.83	2.71	1.03	4×10^{-6}	0.13	190	1.5	Silt-Sandy Clay	7
	②	0	35	39	26	34	28	13	1.96	2.75	0.77	5×10^{-6}	0.07	118	1.5	Clay-Sandy Silt	7
	③	0	21	47	32	41	35	22	1.80	2.71	0.87	2×10^{-6}	0.13	70	0.7	Clay-Sandy Silt	4
	④	0	12	43	45	45	37	24	1.85	2.71	1.01	8×10^{-6}	0.14	79	1.2	Sand-Silty Clay	5
S_3	①	0	71	25	4	—	26	—	1.86	2.61	0.77	3×10^{-4}	—	—	—	Silty Sand	19
C_2	①	0	31	39	30	53	53	33	1.63	2.63	0.94	2×10^{-6}	0.30	88	1.2	Clay-Sandy Silt	6
	②	0	33	46	21	40	48	23	1.63	2.64	1.08	8×10^{-6}	0.44	220	1.0	Clay-Sandy Silt	8
	③	0	24	50	26	42	49	28	1.68	2.64	1.21	4×10^{-6}	0.30	110	0.8	Sand-Clayey Silt	4
S_2	③	0	89	9	2	—	26	—	1.85	2.64	0.79	4×10^{-4}	—	—	—	Sand	12
	④	0	89	9	2	—	25	—	1.83	2.63	0.80	6×10^{-4}	—	—	—	Sand	12
C_1	①	0	11	53	36	35	31	22	1.86	2.70	0.91	4×10^{-7}	0.08	142	1.0	Sand-Clayey Silt	11
	③	0	44	38	18	38	35	26	1.82	2.70	1.00	5×10^{-7}	0.16	194	1.7	Clay-Sandy Silt	17
S_1	①	2	58	23	17	—	19	—	1.77	2.69	0.81	3×10^{-6}	—	—	—	Clay-Silty Sand	30
	③	0	90	9	1	—	26	—	1.87	2.65	0.79	7×10^{-4}	—	—	—	Silty Sand	37

* S_4, S_3, S_2, S_1 ····· Sandy Layer , C_3, C_2, C_1 ····· Clayey Layer

** ① Along To Lich River. (B.H. No.1, 3~6) ② Along Upper Kim Nguu River. (B.H. No.7, 8) ③ Yen So Site. (B.H. No.2, 9~13, 15~17) ④ Hoang Liet Site (B.H. No.14)