

### 3) Utility Maintenance Charge

The DQI management company maintains the water supply and sewage system and the electricity transmission system. It collects from enterprises US\$0.072 for every 1m<sup>3</sup> of water consumption and US\$0.009 for every 1kwh of electricity consumption. These rates are tentatively set, considering other cases in Viet Nam and other countries as well as keeping profitability of the project.

### 4) Administration Fee

The DQI management company collects administration fees from enterprises in the DQI. The administration fee is tentatively set at 4% of the lot price. The yearly administration fee is equal to 1.8% of the yearly value added calculated in the economic analysis.

## 7.2.3 Financial Analysis

### 1) Comparative Analysis

The financial internal rate of return (FIRR) has been calculated for two cases for fifty years for the same reason explained in the context of the economic analysis.

#### (1) Case 1

Cost items include the construction of the port and the crude oil tank. The estimated total construction cost is about US\$794 million as mentioned above. Revenue items include those arising from port operations. For this case the FIRR result is 3.42%. Calculation details are summarized in Table 7.7.

#### (2) Case 2

Cost items exclude the construction of the port and the crude oil tank. The estimation of construction costs is about US\$287 million. Revenue items exclude those arising from port operations. The resulting FIRR is 16.77%. The detailed calculation is summarized in Table 7.8.

Comparing the two cases, it can be said that the DQI project is attractive for the foreign investors, if the burden of the port and the crude oil tank construction is born by someone else. Ports and crude oil tanks are important infrastructure from the viewpoint of the national economy. Taking into consideration the result of the economic analysis, it is recommendable to construct these facilities by public fund or official development assistance (ODA) scheme.

It should be noted that these figures are attained on 100% equity. It goes without saying that how to finance the infrastructure construction is vital to the DQI construction investors.

### 2) Sensitivity Analysis

In case that some of the key prerequisites are changed to the negative side, it is examined how the FIRR of the project cash flow will change. This analysis is conducted for Case 2 above only. The results are :

- In case that the lot prices decrease by 10%, the FIRR declines to 14.33%, as summarized in Table 7.9.
- In case that the construction cost increase by 10%, the FIRR declines to 13.66% as summarized in Table 7.10.

However, it can be said that in both cases the FIRRs are still high enough to attract investors.

**Table 7.7 Financial Analysis of Dung Quat Industrial Estate (Case 1)**

Financial Analysis (Part & Oil Tank Included)

(Unit: US\$1,000)

Year	Annual/Rental Fee	Land Comp.	Cash Outflows			Cash Inflows					Net Cashflow		
			I.E. Construction	O & M Cost	Total Cost	Lot Sales	Port Charge	Sea Surface	Utility O & M	Administration	Total Revenue	Annual	Cumulative
1 1997	1	59	0	0	60	0	0	0	0	0	0	-60	-60
2 1998	36	1,455	11,979	0	13,469	0	0	0	0	0	0	-13,469	-13,530
3 1999	39	133	62,641	0	62,813	1,200	0	0	0	0	1,200	61,613	-75,143
4 2000	39	0	67,443	240	67,721	49,200	0	30	0	0	49,230	-38,491	-113,634
5 2001	104	2,731	100,503	240	103,377	0	0	0	0	0	0	-103,377	-217,011
6 2002	159	1,469	118,835	2,008	122,570	1,050	0	0	4	48	1,102	-121,469	-338,480
7 2003	169	1,268	150,779	2,085	154,301	49,050	2,600	30	3,821	2,016	57,517	-76,785	-415,264
8 2004	174	211	147,526	2,085	149,595	60,000	2,600	13	3,821	2,016	69,449	-81,547	-496,811
9 2005	174	0	57,527	8,119	65,819	60,000	5,579	0	3,887	2,058	71,324	5,504	-481,307
10 2006	169	655	19,053	12,056	31,553	0	7,942	0	10,965	4,020	22,925	-9,028	-500,315
11 2007	169	0	14344	12,198	26,731	0	8,637	0	18,378	6,420	33,915	7,204	-493,131
12 2008	169	0	14344	12,198	26,731	0	9,485	0	24,009	8,820	42,313	15,582	-477,548
13 2009	169	0	14344	12,198	26,731	0	9,706	0	24,014	8,820	42,540	15,609	-461,940
14 2010	169	0	14344	12,198	26,731	0	9,942	0	24,019	8,820	42,781	16,050	-445,890
15 2011	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-416,358
16 2012	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-386,825
17 2013	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-357,292
18 2014	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-327,759
19 2015	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-298,226
20 2016	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-268,693
21 2017	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-239,160
22 2018	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-209,627
23 2019	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-179,094
24 2020	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-149,561
25 2021	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-120,028
26 2022	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-90,495
27 2023	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-60,962
28 2024	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-31,429
29 2025	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	-2,896
30 2026	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	26,944
31 2027	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	56,378
32 2028	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	85,911
33 2029	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	115,444
34 2030	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	144,978
35 2031	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	174,511
36 2032	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	204,045
37 2033	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	233,578
38 2034	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	263,111
39 2035	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	292,645
40 2036	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	322,178
41 2037	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	351,711
42 2038	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	381,245
43 2039	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	410,778
44 2040	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	440,311
45 2041	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	469,845
46 2042	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	499,378
47 2043	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	528,911
48 2044	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	558,445
49 2045	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	587,978
50 2046	169	0	0	13,058	13,247	0	9,942	0	24,019	8,820	42,781	29,533	617,511
	8,635	8,000	793,561	545,717	1,355,914	220,500	414,203	73	978,032	160,558	1,973,426	617,512	

NPV (12%): -205,412  
 B/C (12%): 0.53  
 FRR: 3.42%

**Table 7.8 Financial Analysis of Dung Quat Industrial Estate (Case 2)**

Financial Analysis (Port & Oil Tank excluded)

Year	Cash Outflows					Cash Inflows					(Unit: US\$1,000)		
	Annual rental fee	Land Comp	LC Construction	O & M Cost	Total Cost	Lot Sales	Port Charge	Sea Surface	Utility O & M	Administration	Total Revenue	Annual	Cumulative
1 1997	0	0	0	0	0	0	0	0	0	0	0	0	0
2 1998	27	1,128	0	0	1,155	0	0	0	0	0	0	-1,155	-1,155
3 1999	30	133	6,268	0	6,431	1,200	0	0	0	0	1,200	-5,251	-6,406
4 2000	30	0	43,069	0	43,099	49,200	0	33	0	0	49,233	6,131	-275
5 2001	82	2,186	43,929	0	46,196	0	0	0	0	0	0	-46,196	-46,471
6 2002	117	1,489	35,206	197	37,008	1,050	0	0	4	48	1,102	-33,906	-82,377
7 2003	147	1,268	56,050	275	60,739	49,050	0	30	3,821	2,016	54,917	-5,822	-88,200
8 2004	147	0	63,796	275	64,218	60,000	0	13	3,821	2,016	65,849	1,632	-86,568
9 2005	147	0	31,183	4,085	35,415	60,000	0	0	3,887	2,058	65,945	30,530	-56,038
10 2006	162	655	4,709	7,743	13,309	0	0	0	10,963	4,020	14,983	1,675	-54,363
11 2007	162	0	0	7,924	8,086	0	0	0	18,878	6,420	25,298	17,212	-37,152
12 2008	162	0	0	7,924	8,086	0	0	0	24,009	8,820	32,829	24,742	-12,409
13 2009	162	0	0	7,924	8,086	0	0	0	24,014	8,820	32,834	24,747	12,336
14 2010	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	37,091
15 2011	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	61,843
16 2012	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	86,596
17 2013	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	111,349
18 2014	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	136,102
19 2015	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	160,854
20 2016	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	185,607
21 2017	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	210,360
22 2018	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	235,112
23 2019	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	259,865
24 2020	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	284,618
25 2021	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	309,370
26 2022	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	334,123
27 2023	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	358,876
28 2024	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	383,628
29 2025	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	408,381
30 2026	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	433,134
31 2027	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	457,887
32 2028	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	482,639
33 2029	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	507,392
34 2030	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	532,145
35 2031	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	556,897
36 2032	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	581,650
37 2033	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	606,403
38 2034	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	631,155
39 2035	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	655,908
40 2036	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	680,661
41 2037	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	705,414
42 2038	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	730,166
43 2039	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	754,919
44 2040	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	779,672
45 2041	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	804,424
46 2042	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	829,177
47 2043	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	853,930
48 2044	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	878,682
49 2045	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	903,435
50 2046	162	0	0	7,924	8,086	0	0	0	24,019	8,820	32,839	24,753	928,188
	7,379	6,659	287,229	329,368	631,035	220,500	0	73	978,092	360,558	1,559,229	928,188	

NPV (12%): 27,937  
 B/C (12%): 1.16  
 FIRR: 16.77%

**Table 7.9 FIRR Sensitivity Analysis on Case 2 (Port & Oil Tank Excluded, Lot Price 10% Decreased)**

Financial Analysis (Port & Oil Tank excluded, lot price 10% down)

(Unit: US\$1,000)

Year	Annual rental fee	Land Comp	Cash Outflows			Total Cost	Lot Sales	Port Charge	Sea Surface	Cash Inflows			Total Revenue	Net Cashflow									
			I.E.	Construction	O & M Cost					Utility	O & M	Administration		Annual	Cumulative								
1 1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
2 1998	27	1,128	0	0	1,155	0	0	0	0	0	0	0	-1,155	-1,155									
3 1999	30	133	6,288	0	6,451	1,080	0	0	0	0	1,080	0	-5,371	-6,526									
4 2000	30	0	43,069	0	43,099	44,280	0	27	0	0	44,307	0	1,208	-5,318									
5 2001	62	2,188	43,929	0	46,196	0	0	0	0	0	0	0	-46,196	-51,514									
6 2002	117	1,459	35,206	197	37,068	945	0	4	43	992	992	0	-36,016	-87,530									
7 2003	147	1,268	59,050	275	60,739	44,145	0	27	3,821	1,814	49,807	0	-10,932	-98,462									
8 2004	147	0	63,796	275	64,218	54,000	0	11	3,821	1,814	59,646	0	-4,571	-103,033									
9 2005	147	0	31,185	4,085	35,415	54,000	0	0	3,887	1,852	59,739	0	24,324	-78,709									
10 2006	162	655	4,709	7,763	13,303	0	0	0	10,963	3,616	14,581	0	1,273	-77,436									
11 2007	162	0	0	7,924	8,086	0	0	0	18,878	5,778	24,656	0	16,570	-60,857									
12 2008	162	0	0	7,924	8,086	0	0	0	24,009	7,938	31,947	0	23,860	-37,006									
13 2009	162	0	0	7,924	8,086	0	0	0	24,014	7,938	31,952	0	23,865	-13,141									
14 2010	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	10,730									
15 2011	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	34,600									
16 2012	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	58,471									
17 2013	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	82,342									
18 2014	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	106,212									
19 2015	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	130,083									
20 2016	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	153,954									
21 2017	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	177,825									
22 2018	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	201,695									
23 2019	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	225,566									
24 2020	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	249,437									
25 2021	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	273,307									
26 2022	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	297,178									
27 2023	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	321,049									
28 2024	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	344,919									
29 2025	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	368,790									
30 2026	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	392,661									
31 2027	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	416,531									
32 2028	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	440,402									
33 2029	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	464,273									
34 2030	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	488,144									
35 2031	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	512,014									
36 2032	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	535,885									
37 2033	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	559,756									
38 2034	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	583,626									
39 2035	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	607,497									
40 2036	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	631,368									
41 2037	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	655,238									
42 2038	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	679,109									
43 2039	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	702,980									
44 2040	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	726,851									
45 2041	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	750,721									
46 2042	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	774,592									
47 2043	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	798,463									
48 2044	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	822,333									
49 2045	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	846,204									
50 2046	162	0	0	7,924	8,086	0	0	0	24,019	7,938	31,957	0	23,871	870,075									
7,379													6,859	287,229	929,568	631,035	138,450	0	65	978,092	924,502	1,501,110	870,075

NPV (12%): 15,211  
 B/C (12%): 1.09  
 FIRR: 14.33%

**Table 7.10 FIRR Sensitivity Analysis on Case 2 (Port & Oil Tank Excluded, Construction Cost 10% Increased)**

Financial Analysis (Port & Oil Tank excluded, construction cost 10% up)

(Unit: US\$1,000)

Year	Cash Outflows					Total Cost	Cash Inflows					Net Cashflow		
	Annual rental fee	Land Comp.	I.E. Construction	O & M Cost			Lot Sales	Port Charge	Sea Surface	Utility O & M	Administration	Total Revenue	Annual	Cumulative
1 1997	0	0	0	0	0	0	0	0	0	0	0	0	0	
2 1998	27	1,128	0	0	0	1,155	0	0	0	0	0	-1,155	-1,155	
3 1999	30	133	6317	0	0	7,080	1,200	0	0	0	1,200	-5,880	-7,035	
4 2000	30	0	47376	0	0	47,406	43,200	0	30	0	43,230	1,825	-5,211	
5 2001	82	2,186	46324	0	0	50,533	0	0	0	0	0	-50,533	-55,800	
6 2002	117	1,483	36726	217	0	40,548	1,050	0	4	48	1,102	-39,447	-95,246	
7 2003	147	1,268	64355	302	0	66,672	43,050	0	30	3,821	2,016	54,917	-11,755	-107,001
8 2004	147	0	70176	302	0	70,625	60,000	0	13	3,821	2,016	65,649	-4,775	-111,776
9 2005	147	0	34301	4,434	0	38,941	60,000	0	0	3,887	2,058	65,945	27,003	-84,773
10 2006	162	655	5178	8,561	0	14,558	0	0	0	10,963	4,020	14,983	426	-84,348
11 2007	162	0	0	8,716	0	8,879	0	0	0	18,878	6,420	25,298	16,419	-67,928
12 2008	162	0	0	8,716	0	8,879	0	0	0	24,009	8,820	32,829	23,950	-43,978
13 2009	162	0	0	8,716	0	8,879	0	0	0	24,014	8,820	32,834	23,955	-20,023
14 2010	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	5,937
15 2011	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	27,837
16 2012	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,950	51,858
17 2013	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	75,818
18 2014	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	99,778
19 2015	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	123,739
20 2016	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	147,699
21 2017	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	171,659
22 2018	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	195,619
23 2019	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	219,580
24 2020	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	243,540
25 2021	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	267,500
26 2022	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	291,461
27 2023	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	315,421
28 2024	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	339,381
29 2025	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	363,342
30 2026	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	387,302
31 2027	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	411,262
32 2028	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	435,223
33 2029	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	459,183
34 2030	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	483,143
35 2031	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	507,103
36 2032	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	531,064
37 2033	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	555,024
38 2034	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	578,984
39 2035	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	602,945
40 2036	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	626,905
41 2037	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	650,865
42 2038	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	674,826
43 2039	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	698,786
44 2040	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	722,746
45 2041	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	746,707
46 2042	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	770,667
47 2043	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	794,627
48 2044	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	818,587
49 2045	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	842,548
50 2046	162	0	0	8,716	0	8,879	0	0	0	24,019	8,820	32,839	23,960	866,508
	7,379	6,859	315,951	352,525	692,715	692,715	220,500	0	73	978,092	350,358	1,559,223	866,508	

NPV (12%): 11,417  
 B/C (12%): 1.06  
 FIRR: 13.66%

### **7.3 PROJECT JUSTIFICATION**

From the viewpoint of the national economy, the DQI project generates significant positive effects. To attract FDI, however, assistance with public funds is necessary. On the other hand, improvement is also required in investment circumstances for foreign investors.

After the project reaches full operational capacity, the following effects are expected :

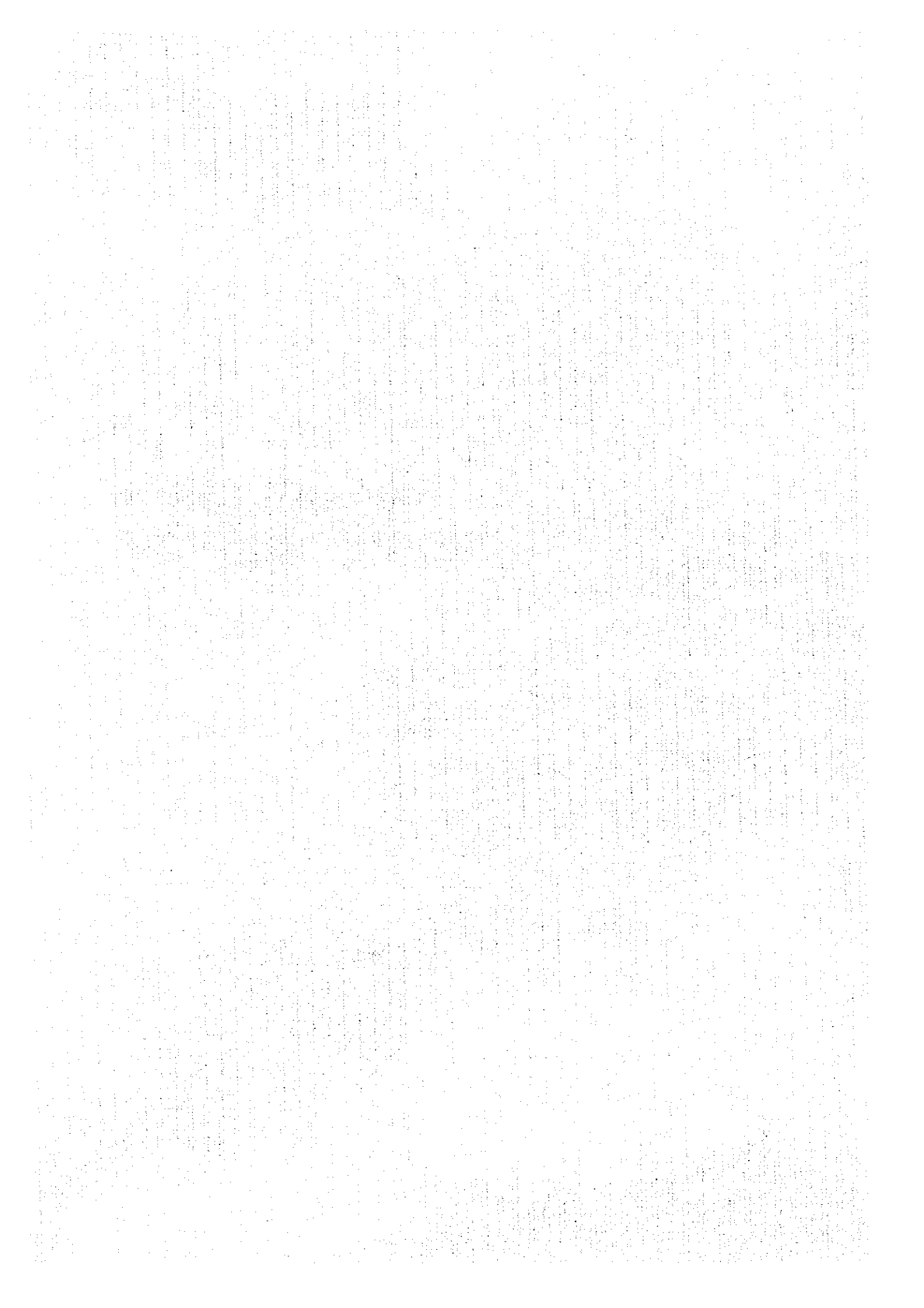
- More than US\$456 million net value added accrues every year as a result of industrial activities,
- A total of 19,400 jobs will be created by the enterprises in the DQI,
- The government receives US\$162,000 rent every year in addition to income tax,
- State of art technologies for production and modern management experiences can be acquired,
- Economic disparities of the Central Region will be mitigated, and
- Infrastructure, such as port, roads, and bridges will be beneficial not only for the enterprises in the DQI but also for the entire region.



## **CHAPTER 8**

### **ORGANIZATIONAL AND FINANCING ASPECTS**





## CHAPTER 8 ORGANIZATIONAL AND FINANCING ASPECTS

### 8.1 CONCEPTIONAL UNCERTAINTIES

The preceding discussion of the DQI development had to make certain assumption in order to set the frame for EIRR and FIRR calculation. However, the reality is that many even basic features have not yet been decided. Those major basic features are :

- The final implementation organization for the DQI and the organization's functional responsibilities and legal status
- The final timing for implementation of the first oil refinery and the refinery's final technical lay out (this refers in particular to question whether refinery output can be utilized as input into petrochemical industry)
- The final timing for implementation of the ship repair & breaking and steel scrap & recycling mill (which may be subject to the results and recommendation of the on-going steel mill feasibility study), and
- Financing options, in particular as they refer to the financing role of the Central Government (development budget), potential ODA sources and private sector parties.

Hence, it would be misleading to present here a complete concept, since that would have to be based on too many uncertainties and assumptions. What can and should be done, however, is to highlight important aspects of the key features and point at important implications.

### 8.2 ORGANIZATIONAL ASPECTS

The DQI is a project of national importance and implications and this aspect should be reflected in the way the implementation agency will be set up. Industrial estates are presently falling under the authority of Provincial People's Committees. However, as outlined in other parts of the master plan, it should be considered to establish a two tier hierarchical system that is :

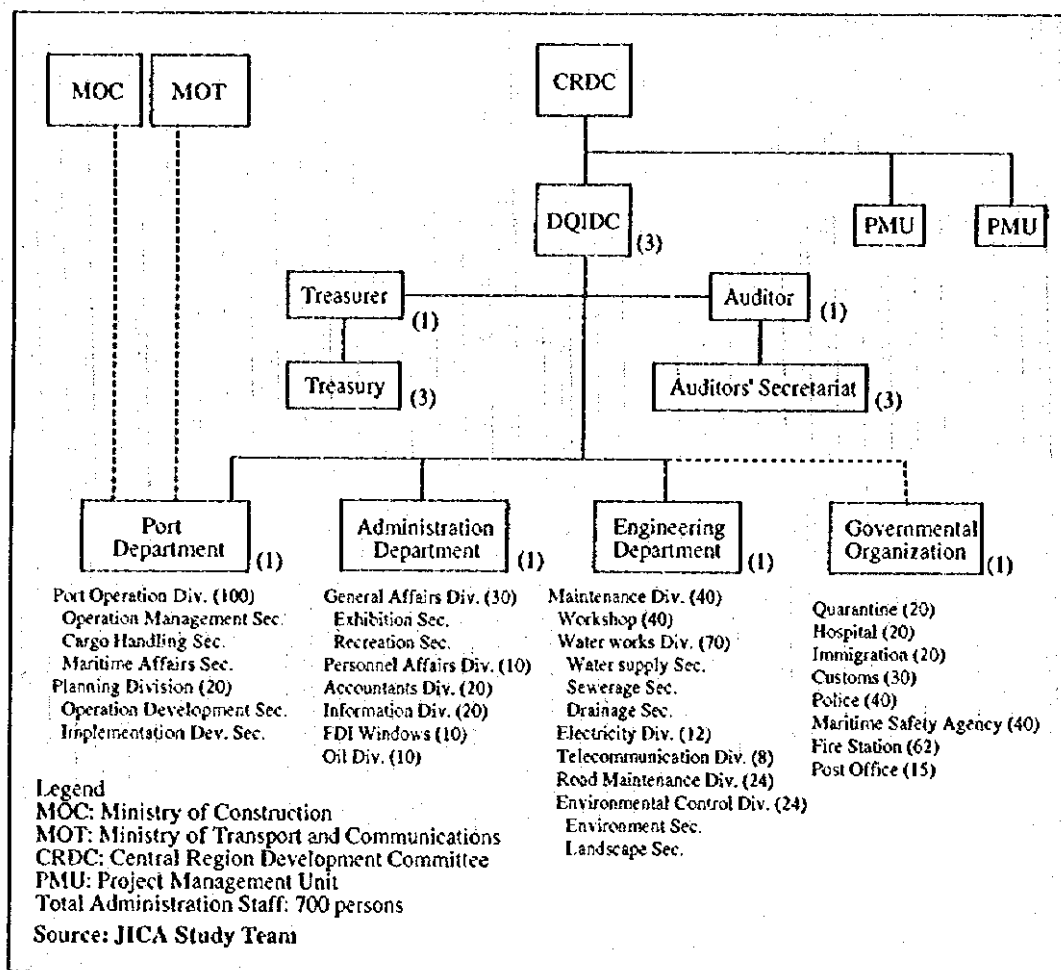
- The Central Region Development Committee or CRDC as a first tier organization. The CRDC would be a single distinct legal entity with the principal function of infrastructure project implementation in the Central Region, with the exception of the DQI construction. In this context, it would be important that CRDC be empowered to serve as a management channel for ODA funds (the agency, to which the GOV lends an ODA loan)
- The Dung Quat Industrial Estate Development Corporation or DQIDC as a second tier organization. The DQIDC would, in principle, be an operation and maintenance organization with a separate and distinct legal identity. However, it would also be responsible for the construction of the industrial estate itself
- The relations between the CRDC and the DQIDC would not be limited to cross memberships in the management boards, but CRDC would also participate in the equity of DQIDC either in cash or kind.

Functional responsibilities between the CRDC, DQIDC, Provincial Governments and technical line ministries may be summarized as follows :

- The CRDC in cooperation and coordination with the Binh Son District Peoples' Committee and the relevant technical line ministries will be responsible for implementing the facilities outside of the DQI. Prime responsibility for construction rests with the CRDC
- After completion of the construction work, the People's Committee of Binh Son District will be responsible for the management, operation and maintenance of the facilities
- The DQIDC in cooperation and coordination with the Binh Son District Peoples' Committee and the relevant technical line ministries will be responsible for implementing the facilities inside of the DQI, with the exception of the port. Prime responsibility for construction rests with the DQIDC
- After completion of the construction work, the DQIDC will be responsible for the management, operation and maintenance of the facilities
- Management, operation and maintenance of the port will rest with Ministry of Construction (MOC) and Ministry of Transport and Communications (MOT). DQIDC will be charged for use of the specialized port facilities.

Figure 8.1 depicts such a potential set up.

**Figure 8.1 Organization Chart for Dung Quat Industrial Estate**



### 8.3 DEVELOPMENT COST COMPARISON

The financial analysis assumed a lot rental fee of US\$ 30/m<sup>2</sup>. This fee structure assumes that investment cost for the DQI excludes the combined investment cost for the harbor and power station or the combined investment cost for the harbor, power station and national oil tanks as shown in Table 8.1.

**Table 8.1 Development Cost Comparison (1,262 ha DQI)**

Alternative I	Alternative II	Alternative III	Alternative IV	Alternative V
All Investment Cost Included in DQIDC	Alternative I without Cost Power Sta.	Alternative I without Cost Power Sta. & Harbor	Alternative I without Cost Power Sta. & Harbor & Oil Tanks	Alternative I without Cost Power Sta. & Harbor & Oil Tanks
Total Cost : US\$ 1,105,561,360	Total Cost : US\$ 793,561,360	Total Cost : US\$ 328,129,360	Total Cost : US\$ 280,129,360	Total Cost : US\$ 592,129,360
PER ha US\$ 876,039	PER ha US\$ 628,812	PER ha US\$ 260,007	PER ha US\$ 221,972	PER ha US\$ 469,199
PER sq.m. US\$ 88	PER sq.m. US\$ 63	PER sq.m. US\$ 26	PER sq.m. US\$ 22	PER sq.m. US\$ 47

Source : JICA study team.

Also, one would need to establish, whether the gross margin of US\$4 and US8, respectively, would be sufficient to make a reasonable contribution to the implementation organizations cash-flow.

It is obvious from the comparison that the lot rental fee would have to be substantially higher, if alternatives I, II or V are going to be implemented under DQIDC.

### 8.4 FINANCING ISSUES

As has been discussed before, a financing plan can only be prepared once all major DQI project features are decided upon. However, it is useful to obtain a feeling for orders of magnitude under an assumed scenario.

The outline of this "get things moving" or base scenario are :

- The planning horizon is up to the year 2000 only
- The GOV covers from the development budget phase 1 of the harbor development, including harbor land and surface acquisition and compensation at about US\$ 9.4 million as well as harbor development estimated at US\$ 24.0 million
- The GOV covers from the development budget the following works outside the industrial estate : temporary work at US\$ 14.77 million, land acquisition and compensation at US\$ 2.02 million, road and green belt development estimated at 33.42 million, bridges at US\$ 107.83 million, electricity wiring at US\$ 15.0 million and telecommunication lines estimated at 0.30 million
- An ODA loan is secured for water supply and sanitation outside the industrial estate estimated at 141.04 million and 72.95 million, respectively

- The DQIDC covers inside the industrial estate land acquisition and compensation at US \$ 13.47 million, road and green belt investment at US\$ 33.42 million, electricity wiring and telecommunication lines estimated at 6.01 million and construction of the administration building estimated at US\$ 0.8 million.

Under this scenario and assuming that financing would be raised in 1997 total financing volume would amount to US\$ 474.43 million in 1996 prices or US\$ 512.38 million employing a 8% increase rate, which reflects price contingencies and inflation.

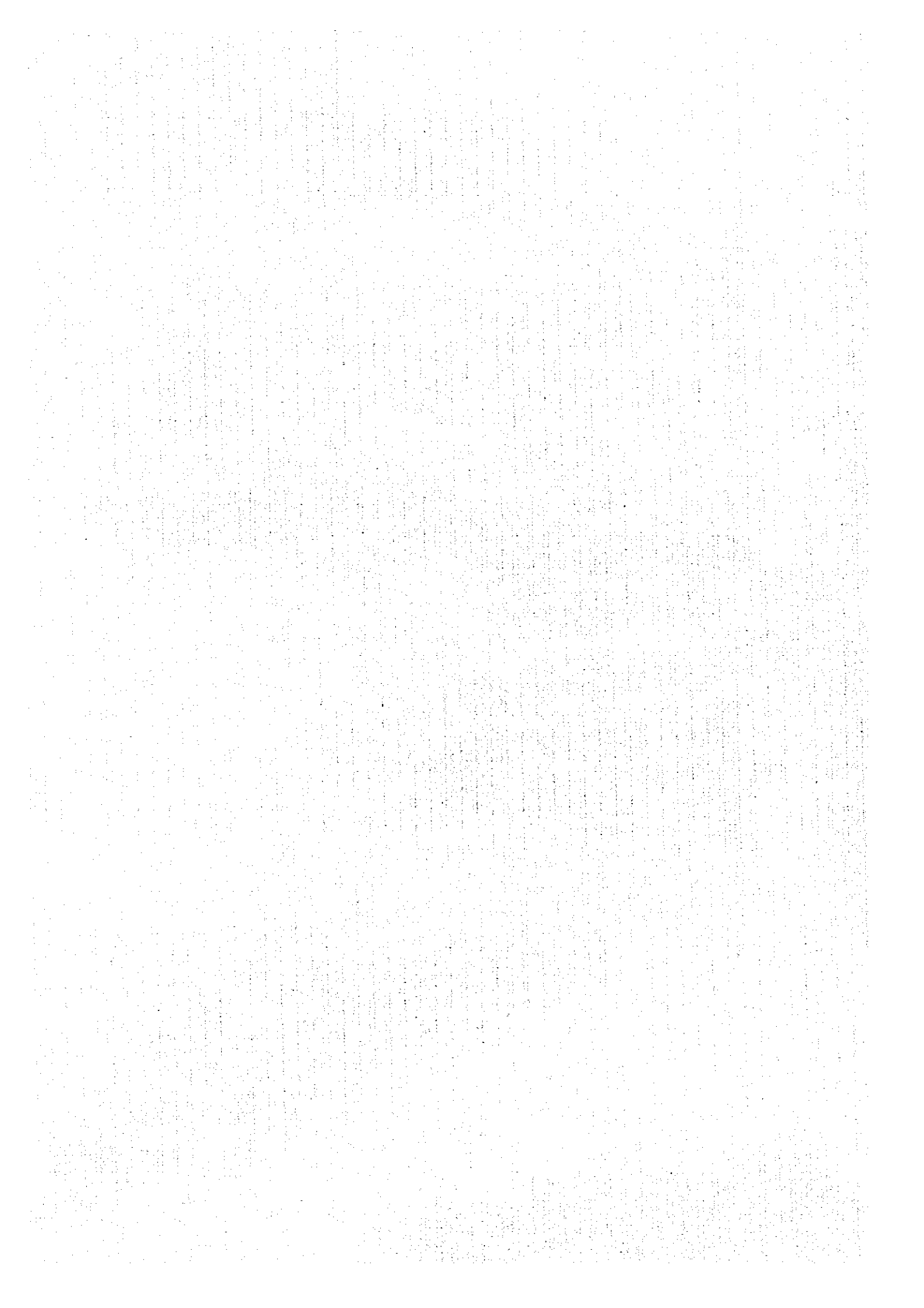
Under this scenario financing would be :

- From the GOV development budget US\$ 189.58 million or say US\$ 190 million, equivalent to about 37% of the total
- From an ODA loan some US\$ 215.20 million or say US\$ 215 million, equivalent to about 42% of the total, and
- From the GOV development budget and/or bonds some US\$ 107.60 million say US\$ 108 million, equivalent to about 21% of the total. However, if bonds are to be involved, this would require essential policy adjustment measures in the financial market.

Under this scenario the ratio of domestic to foreign financing would be roughly 58% to 42%. Likewise, the power station inside the industrial estate would have to be constructed under a BOT scheme.

## **CHAPTER 9**

### **INITIAL ENVIRONMENTAL EXAMINATION**



# CHAPTER 9 INITIAL ENVIRONMENTAL EXAMINATION

## 9.1 THE STUDY ITEMS ON INITIAL ENVIRONMENTAL EXAMINATION (IEE)

The IEE examines the environmental items that may be affected by project implementation not only in the project area, but also in surrounding area that may be directly or indirectly affected during the construction and operation stages. The screening and scoping for the environmental items of IEE for this project have been carried out. The results are shown in Table 9.1. The twenty environmental items are selected to implement initial environmental examination by taking into consideration of the environmental items and activities which may cause impacts. In the case of this project, three environmental items are not necessary to be examined because of the reasons as shown in Table 9.2.

**Table 9.1 The Relationship of Activities and Environmental Items**

Major Facilities / Activities	Industry					
	Construction Stage		Operation Stage			
	Land Acquisition and Reclamation	Operation of Construction Equipment	Spatial Occupancy	Operation of Vehicles	Operation and Maintenance of Facilities	Accumulation of People and Goods
<b>Social Environment</b>						
1 Resettlement	⊙					⊙
2 Economic Activities			○			
3 Traffic and Public Facilities				○		
4 Split of Communities			○			
5 Cultural Properties	⊙			○		○
6 Water Rights /Rights of Common	⊙		⊙			
7 Public Health Condition						
8 Waste	○				○	○
9 Hazards ( Risk )	○			○	○	
<b>Natural Environment</b>						
10 Topography and Geology	○					
11 Soil Erosion	○					
12 Groundwater						
13 Hydrological Situation	○					
14 Coastal Zone	○				○	
15 Flora and Fauna	⊙	○	○	○	○	
16 Meteorology	○					
17 Aesthetics			○			
<b>Pollution</b>						
18 Air Pollution		○		⊙	⊙	
19 Water Pollution	○			○	⊙	
20 Soil Contamination					○	
21 Noise and Vibration		○		○	○	
22 Land Subsidence						
23 Offensive Odor					○	

Note: ⊙: The environmental items to which special attention has to be paid. They might cause serious impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.  
 ○: The environmental items which may have a significant impact depending on the scale of the project and site conditions.  
 No mark: The environmental items requiring no impact assessment since the anticipated impacts are, in general, not significant.



**Table 9.2 Reason to be not Examined as Environmental Item**

<b>Environmental Item</b>	<b>Reason to be not examined</b>
Public Health Condition	This project is road one, so that it is not expected that the generation of garbage and the increase of vermin may not affect the deterioration of public health and sanitary conditions.
Groundwater	This project has no large-scale reclamation, so that it is not expected that the change of distribution of groundwater may not occur.
Land Subsidence	This project has no large-scale reclamation, so that it is not expected that the deformation of land and land subsidence may not occur.

## **9.2 THE FORECAST AND EVALUATION**

The detail location and design of facilities, and construction plan will be conducted at the Feasibility Study (F/S) or Detail Design (D/D) stage. Therefore, the general description of the forecast and evaluation will be carried out, and the examination of the necessity of Environmental Impact Assessment (EIA) also carried out in this section.

### **9.2.1 Impact at Construction Stage**

#### **1) Impact by Reclamation**

##### **(1) Impact to Social Environment**

###### **a) Impact by Resettlement**

The resettlement may cause by land acquisition and transfer of rights of residence and land ownership for industrial complex. It may conduct the impacts such as: 1) the loss of living foundation of inhabitants to be resettled, 2) the social and cultural inadaptability to the new resettlement site, 3) the conflict between permanent residents and resettlers over social and economic burden, and 4) the deterioration of living standard after resettlement in case of the poor compensation system or the status of illegal occupants. It may affect the significant impact in case of: 1) the existence of the inhabitants who live on the special environmental resources of the project site, such as fishery ground and agricultural land, 2) the existence of the inhabitants who are currently well-off, 3) no favorable resettlement site in the surrounding area, and 4) the existence of the racial or tribal problems. It is expected that the problems on resettlement may become much significant, because it will be many resettlers. Therefore, the establishment of the countermeasures and the implementation of an EIA on the impact by resettlement due to land acquisition at construction stage are required.

###### **b) Impact to Cultural Properties**

The damage to and loss of the value of cultural properties such as churches, temples, shrines and archaeological remains and other cultural properties may cause by the land acquisition. It may conduct the impacts such as: 1) the damage to tourism business opportunities which depend on cultural properties, and 2) the aggravation of inhabitants' feeling caused by the loss of precious cultural properties in the area. It may affect the significant impact in case of: 1) the existence of the cultural properties which are recognized officially, historically and culturally important from a global viewpoints or unique to the area, 2) the existence of the cultural properties with longer and valuable histories, and 3) the existence of the buildings and other facilities in unique communities. At present, it is not clear that there are some cultural properties in and around the site. If some cultural properties will be confirmed, it is required to implement some countermeasures. And also, the implementation of an EIA on the impact to cultural properties due to land acquisition at construction stage is required.

#### c) Impact to Water Rights /Rights of Common

The obstruction of fishing rights in rivers, water rights and land use rights may cause by: 1) the occupancy of arable land and forests for this project, and 2) the obstruction or alteration of fishing grounds. It may conduct the impacts such as: 1) the effect to fishery due to the occupancy of the fishing ground. The magnitude of the impact depends on the scale of change of waterway. It may affect the significant impact in case of: 1) the existence of the old communities likely to have common forests or land, and 2) the existence of the water intake facilities, navigation facilities and charcoal-burner sheds which has water rights or land use rights. This project site is relatively large area. Therefore, the countermeasures such as the establishment of sufficient compensation are required. And also the implementation of an EIA on the impact to water rights and rights of common due to land acquisition at construction stage is required.

#### d) Impact by Waste

The generation of demolition waste, debris, and logs may cause by reclamation. It may conduct the impacts such as the diminution of aesthetic values, the change of vegetation, and the soil contamination and water pollution by the exposed waste. The waste will cause impacts on aquatic life and birds affected by water pollution caused by inflow of waste into the rivers, lakes, ponds, canals, and sea, and the aggravation of environmental impacts due to inadequate and illegal disposal. This project will occur a mount of waste, therefore, the countermeasures such as the adequate management plan, and implementation of an EIA on the impact by waste due to reclamation at construction stage are required.

#### e) Impact by Hazards (Risk)

The increase in risk of landslides, cave-ins and accidents may cause by the cut and fill and land reclamation. It may conduct the impacts such as: 1) the change of the balance of the soil and creation of land cave-ins or upheavals by large-scale cutting, and 2) the damage to land and houses and the occurrence of threat the lives of inhabitants by landslides and similar failures. It may affect the significant impact in case of: 1) the high probability of landslide in the steep hills of soft soil with high porosity, and 2) the intense rain in a short time period. This project site has some hills and sandy soils. Therefore the detail studies on 1) topography and geology, 2) meteorology, and 3) the case study of past natural disasters are required, and also the implementation of an EIA on the impact by hazards (risk) due to reclamation at construction stage is required.

### (2) Impact to Natural Environment

#### a) Impact to Topography and Geology

The change of valuable topography and geology, and the change of the coastlines may cause by excavation and land reclamation, and coastal erosion or sand accumulation. It may conduct the impacts such as the occurrence of landslides or soil erosion. It may affect the significant impact in case of: 1) the existence of important topography and or geology, 2) the existence of fishing industry, 3) the existence of steep hills of soft soil with high porosity, and 4) the existence of areas which have rainfall of high intensity. Therefore the detail studies on 1) topography and geology, 2) meteorology, and 3) land use are required, and also the implementation of an EIA on the impact to topography and geology due to reclamation at construction stage is required.

#### b) Impact by Soil Erosion

The topsoil erosion by rainfall may cause by: 1) the exposure of topsoil caused by land reclamation or removal of vegetation, and 2) the rainfall and flood during construction. It may conduct the impacts such as: 1) the impact to the growth of plants and animals, agriculture and forestry by the loss of topsoil by surface runoff or wind, 2) the creation of water turbidity, impact to aquatic life, and river discharge in downstream areas caused by sediment, 3) water

suspension caused by washing out of the topsoil by rain, 4) the effect on the transparency of sea water in the coastal zone by washed out topsoil, and 5) the malfunction of water intake facilities and interruption of river transportation caused by the rise of the riverbed elevation. It may affect the significant impact in case of: 1) the existence of steep topography with sandy soil, 2) the heavy or intense rainfall, or strong wind, and 3) the existence of scarce vegetation coverage. Therefore the detail studies on 1) soil, topography and geology, 2) meteorology, and 3) land use are required, and also the implementation of an EIA on the impact by soil erosion due to reclamation at construction stage is required.

#### c) Impact to Hydrological Situation

The changes of river discharge and riverbed condition may cause by the change of runoff coefficient caused by the facility construction and decrease of vegetation due to land reclamation work, and the effects on lake and river systems by increased drainage due to increased amount of water use. It may conduct the impacts such as: 1) the increase in peak discharge of flood, a decrease in flood discharge capacity due to the cross sectional change of the river, and the shortening of the flood peak reaching time, which will increase flood damage, and 2) the inundation of the lake shore due to the rise of the lake water level, which may affect the inhabitants' living, and the fishery and tourism industries. It may affect the significant impact in case of: 1) housing and public facilities facing lakes and rivers tend to receive more serious effects, 2) areas that use the lakes and rivers for tourism or fishery, and 3) the effect to valuable aquatic life. Therefore the detail studies on 1) water supply and sewerage improvement plan, 2) water use and watershed use in the surrounding area, and 3) valuable aquatic life are required, and also the implementation of an EIA on the impact to hydrological situation due to reclamation at construction stage is required.

#### d) Impact to Coastal Zone

The coastal erosion and change of vegetation may cause by: 1) the change of the littoral current and coastline as a result of reclamation work in the coastal zone and the construction of port and harbor facilities including jetties, and 2) the change of sediment transportation and flow conditions due to reclamation. It may conduct the impacts such as: 1) loss of coastal vegetation, and the change of water depths and receded coastlines caused by coastal erosion and sand deposition zones, and 2) the effect on marine resources by the warm water discharge from thermal power plant. The fishery and tourism may be affected significantly. It may affect the significant impact in case of: 1) the existence of valuable natural environment, such as mangrove forests and coral reefs, 2) the existence of favorable industrial conditions, such as good fishing grounds, 3) the existence of tourism that uses the coastal zone as a tourist attraction, and 4) the existence of the area tends to suffer from natural disasters, such as high waves. The coastal area has vulnerable ecosystem, and many typhoon attack this area every year. It is expected that the impact to coastal zone may become significant. Therefore, the establishment of the countermeasures, such as: 1) the examination of the contents of the plan, 2) the construction of breakwaters, 3) the provision of beach nourishment, 4) the compensation for fishery, and the detail studies on: 1) valuable natural environment, such as mangroves and coral reefs, 2) fisheries, 3) industries that utilize the coastal zone, and 4) disasters such as high waves are required. And also the implementation of an EIA on the impact to coastal zone due to reclamation at construction stage is required.

#### e) Impact to Flora and Fauna

The obstruction of breeding and extinction of species caused by change of habitat condition may cause by the removal of vegetation and extinction of habitats of animals due to the construction of facilities. It may conduct the impacts such as: 1) a decrease in useful creatures for human activities or extinction of valuable species, 2) the threat on livelihood of people, including the hunting of animals and collection of forest products, 3) the decrease of the recreational value, and 4) the decrease of natural enemies and extinction of other species resulting in an outbreak of other animals, pests and harmful insects. It may affect the significant impact in case of: 1) the existence of the vulnerable ecosystem, such as primary

forests and swamp forests, 2) the existence of the species peculiar to the region, 3) the existence of many people who make their living by hunting and use of animals such as fishermen, 4) the existence of the endangered or rare species listed in the red data books by the International Union for Conservation of Nature and Natural Resources (IUCN), and 5) the existence of the bilateral and multilateral conventions on wildlife. It is expected that the impact to flora and fauna may become significant. Therefore the detail studies: 1) existing vegetation, topography and geology, 2) distribution of animals, 3) affiliation of conventions concerning wildlife protection, 4) livelihood of inhabitants are required, and also the establishment of the countermeasures and the implementation of an EIA on the impact to flora and fauna due to reclamation at construction stage are required.

#### f) Impact to Meteorology

The changes of temperature, precipitation, wind, humidity, evapotranspiration, etc. may cause by: 1) the change of topography and large-scale clear-cutting for facility construction, and 2) appearance of high-rise buildings, elevated bridges and large-scale pavement. It may conduct the impacts such as: 1) the change of hydrological condition and micro-climate, 2) the effect on farming especially weather-sensitive crops, and 3) the effect on the people, including pedestrians and residents, in the area when there is a large change in the wind condition. It may affect the significant impact in case of: 1) large-scale clear-cutting or topographical changes, 2) the existence of major agricultural industry in the area, 3) the existence of water-sensitive vegetation, and 4) the construction of high-rise buildings. It is expected that the impact to meteorology may become significant. Therefore, the establishment of the countermeasures, such as: 1) the examination of the contents of the plan, and 2) compensation for the damage, and the detail studies on: 1) meteorology, 2) the condition of agriculture and forestry, and 3) vegetation are required. And also the implementation of an EIA on the impact to meteorology due to reclamation at construction stage is required.

### (3) Impact by Pollution

#### a) Impact by Water Pollution

The pollution by inflow of silt, sand and effluent into rivers, groundwater and sea may cause by the erosion caused by the change of vegetation and topography. It may conduct the impacts such as the effect on aquatic life by turbid water, especially suspended solids (SS). It may affect the significant impact in case of: 1) the existence of the water used by habitants or businesses in the downstream area, and 2) the existence of important aquatic species. Turbid water will cause significant impact, especially during heavy rains in the rainy season. Therefore, the establishment of the countermeasures and the implementation of an EIA on the impact by water pollution due to reclamation at construction stage are required.

## 2) Impact by Operation of Construction Equipment

### (1) Impact to Natural Environment

#### a) Impact to Flora and Fauna

The obstruction of breeding and extinction of species caused by change of habitat condition may cause by the generation of exhaust gas and noise from construction equipment and vehicles. The impacts which may conduct, and the significant impact case are same as impact to flora and fauna due to reclamation at construction stage. It is expected that the impact to flora and fauna may become significant. Therefore the detail studies are required, and also the establishment of the countermeasures and the implementation of an EIA on the impact to flora and fauna due to operation of construction equipment at construction stage are required.

## **(2) Impact by Pollution**

### **a) Impact by Air Pollution**

The pollution caused by exhaust gas, toxic gas and dust from construction equipment and vehicles may cause by earthwork. The impact will be greater during the dry season. It may conduct the impacts such as the impacts to the health of people, plants and animals. It may affect the significant impact in case of the existence of densely housing area. The material transportation such as dump trucks especially transportation of borrow soil is carried out by using the roads around the existing road or temporary construction roads. The traffic volumes of the material transportation of this project will be relatively large, therefore, the countermeasures such as the establishment of adequate construction management plan are required. And the implementation of an EIA on the impact by air pollution due to operation of construction equipment at construction stage is required.

### **b) Impact by Noise and Vibration**

The noise and vibration may cause by the operation of construction equipment and vehicles for construction and detonations. It may conduct the impacts such as: 1) the effect on hospitals and schools by noise, and the disturbance of sleep by vehicles operating at night at high populated area, 2) the obstruction of breeding of cattle and dispersion of wildlife, and 3) the cracks in buildings on soft ground caused by vibration. It may affect the significant impact in case of: 1) the existence of the facilities which require calm circumstance, or densely populated areas, 2) the existence of the important cattle industry, 3) the existence of the habitats of valuable wildlife, and 4) the existence of the weak ground such as filled land or clayey soil layer. Therefore, the countermeasures are required, and also the implementation of an EIA on the impact by noise and vibration due to operation of construction equipment at construction stage is required.

## **9.2.2 Impact at Operation Stage**

### **1) Impact by Spatial Occupancy**

#### **(1) Impact to Social Environment**

##### **a) Impact to Economic Activities**

The loss of bases of economic activities, such as land, and change to the economic structure may cause by: 1) the loss of arable land and forests, and 2) the land reclamation and change in land use. It may conduct the impacts such as: 1) the effects on the regional economy because of a decrease in agriculture, forestry and fishery production due to loss of arable land, forests and fishery ground, change of population distribution caused by alternate land use, and 2) the inconvenience in accessing between both sides of the facilities. It may affect the significant impact in case of the effect of relocation on the local economy and employment for important industries. Therefore, the countermeasures are required, and also the implementation of an EIA on the impact to economic activities due to spatial occupation at operation stage is required.

##### **b) Impact by Split of Communities**

The split of communities may cause by: 1) the interruption of existing route by the construction of facilities, and 2) the interruption of traffic of inhabitants and commercial distribution. It may conduct the impacts such as: 1) the inconvenience in daily activities of inhabitants and effect on economic activities, and 2) the creation of detached territories or isolated areas. It may affect the significant impact in case of: 1) the appearance of isolated, and 2) the existence of the communities having long existing customs or traditions and tightly united in their social activities. Therefore, the countermeasures are required, and also the implementation of an EIA on the impact by split of communities due to spatial occupation at operation stage is required.

## **(2) Impact to Natural Environment**

### **a) Impact to Flora and Fauna**

The obstruction of breeding and extinction of species caused by change of habitat condition may cause by the disruption of migratory routes and habitats of animals by the existence of facilities. The impacts which may conduct, and the significant impact case are same as impact to flora and fauna due to reclamation at construction stage. This project site is located at coastal area, these impacts will cause the decrease or extinction in biomes of seaweed, fish, benthos and birds, because of the diminution or extinction of habitats, the deterioration of habitat conditions caused by vegetation and substrate changes. The vegetation of the sites will be removed, and it may bring about the loss of animal habitats. The migratory routes and habitat areas could be disturbed by the spatial occupancy. It is expected that the impact to flora and fauna may become significant. Therefore the detail studies are required, and also the establishment of the countermeasures and the implementation of an EIA on the impact to flora and fauna due to spatial occupation at operation stage are required.

### **b) Impact to Aesthetics**

The change of topography and vegetation by land reclamation, and the deterioration of aesthetic harmony may cause by the appearance of new and different facilities and structures such as industrial facilities, road and the operation vehicles, and air pollution, especially by dust, and water pollution. It may conduct the impacts such as: 1) the damage to the value of the scenery by the change of landscape which may have cultural values or close relationship with the life of local people, especially religious importance, and 2) the damage to tourism and local people's life. It may affect the significant impact in case of the existence of the landscape that has cultural values from an international viewpoint. Therefore the detail studies are required, and also the establishment of the countermeasures and the implementation of an EIA on the impact to aesthetics due to spatial occupation at operation stage are required.

## **2) Impact by Operation of Vehicles**

### **(1) Impact to Social Environment**

#### **a) Impact to Traffic and Public Facilities**

Impacts on schools, hospitals and present traffic conditions, such as increased traffic congestion and accidents may cause by: 1) the replacement of transport means by the existence of facilities, and 2) the emergence and increase of vehicular traffic. It may conduct the impacts such as: 1) the depression or extinction of the existing traffic and transport facilities owing to the emergence of mass transport introduced by the facilities, 2) the increase in traffic accidents, traffic jams and other traffic problems caused by an increase in traffic, and 3) the effect of noise caused by vehicles on schools, hospitals, religious spots and other public facilities. It may affect the significant impact in case of: 1) the effects on the local traffic and transport facility conditions along the access roads to the existing route, and 2) the existence of schools, hospitals, religious spots and other public facilities in the area. Therefore, the countermeasures such as: 1) the examination of the project contents, 2) the rehabilitation of the existing traffic system, 3) the installation of traffic safety facilities, and 4) the environmental protection measures for public facilities, and traffic safety education and training for local people, are required. Therefore the implementation of an EIA on the impact to traffic and public facilities due to operation of vehicles at operation stage is required.

#### **b) Impact to Cultural Properties**

The damage to and loss of the value of cultural properties such as churches, temples, shrines and archaeological remains and other cultural assets may cause by the noise and air pollution caused by vehicles. The impacts which may conduct, and the significant impact case are same

as impact to cultural properties due to reclamation at construction stage. At present, it is not clear that there are some cultural properties in and around the site. If some cultural properties will be confirm, it is required to implement some countermeasures. Therefore, the implementation of an EIA on the impact to cultural properties due to operation of vehicles at operation stage is required.

#### c) Impact by Hazards (Risk)

The increase in danger may cause by accident of ships and natural disasters. It may conduct the impacts such as: 1) marine pollution due to accidents involving hazardous substances and the destruction of port facilities, and 2) loss of human life and damage to inhabitants' livelihood such as production activities, houses, food collection, etc.. It may affect the significant impact in case of the existence of facilities having a high possibility of exploding or releasing hazardous substances. It is expected that the impact by hazards (risk) may become much significant. Therefore, the establishment of the countermeasures, such as: 1) the examination of the contents of the plan, 2) the site selection considering the potential of natural disasters, such as earthquakes and typhoons, 3) the installation of a safety system that would minimize the damage to the storage facilities of hazardous materials, and 4) the provision of safety education to facility workers are required, and the detail studies on: 1) the location of underwater facilities, 2) the meteorological and marine conditions, 2) laws and regulations on handling and storing hazardous materials, and 4) case studies of past natural disasters are required. And also the implementation of an EIA on the impact by hazards (risk) due to operation of vehicles at operation stage is required.

### (2) Impact to Natural Environment

#### a) Impact to Flora and Fauna

The obstruction of breeding and extinction of species caused by change of habitat condition may cause by the generation of exhaust gas and noise from running vehicles. The impacts which may conduct, and the significant impact case are same as impact to flora and fauna due to reclamation at construction stage. It is expected that the impact to flora and fauna may become significant. Therefore the detail studies: 1) existing vegetation, topography and geology, 2) distribution of animals, 3) affiliation of conventions concerning wildlife protection, and 4) livelihood of inhabitants are required, and also the establishment of the countermeasures and the implementation of an EIA on the impact to flora and fauna due to operation of vehicles at operation stage are required.

### (3) Impact by Pollution

#### a) Impact by Air Pollution

The pollution caused by exhaust gas and toxic gas may cause by exhaust gas from running vehicles. The impact will be greater during the dry season. It may conduct the impacts such as the impacts to the health of people, plants and animals along the route by exhaust gas and dust. It may affect the significant impact in case of: 1) the existence of densely housing area, 2) the occurrence of the significant increases of a number of vehicles, and 3) the existence of the large gradient of slope which concentration of exhaust gas from running vehicles will be higher. The traffic volumes introduced by this project will become large, therefore the establishment of the countermeasures and the implementation of an EIA on the impact by air pollution due to the operation of vehicles at operation stage are required.

#### b) Impact by Water Pollution

The pollution by inflow of silt, sand and effluent into rivers and groundwater may cause by the use of herbicides to the roadbed, flush out of dust and oil on the road surface during rain. It may conduct the impacts such as the contamination of water by herbicides would affect the

aquatic life and the health of inhabitants who use the water. It may affect the significant impact in case of: 1) the existence of the water used by habitants or businesses in the downstream area, and 2) the existence of important aquatic species. Therefore, the countermeasures are required. The implementation of these countermeasures can protect the impact by water pollution, therefore the implementation of an EIA on the impact to traffic and public facilities due to operation of vehicles at operation stage is not required.

**c) Impact by Noise and Vibration**

The noise and vibration may cause by the operation of vehicles. The impacts which may conduct, and the significant impact case are same as impact by noise and vibration due to operation of construction equipment at construction stage. It is expected that the impact by noise and vibration may become significant. Therefore the detail studies are required, and also the establishment of the countermeasures and the implementation of an EIA on the impact by noise and vibration due to operation of vehicles at operation stage are required.

**3) Impact by Operation and Maintenance of Facilities**

**(1) Impact to Social Environment**

**a) Impact by Waste**

The generation of general and industrial waste may cause by the operation of the facilities and the increase of economic activities. It may conduct the impacts such as the diminution of aesthetic values, the change of vegetation, and the soil contamination and water pollution by the exposed waste. The waste will cause impacts on aquatic life and birds affected by water pollution caused by inflow of waste into the rivers, lakes, ponds, canals, and sea, and the aggravation of environmental impacts due to inadequate disposal and illegal disposal. This project will occur a mount of waste, therefore, the countermeasures such as 1) the establishment of adequate waste collection system, waste treatment facilities and disposal facilities, the securing of disposal sites for waste dumps and construction waste, and 3) the publicity and promotional activities to reduce industrial waste are required, and the implementation of the detail studies on: 1) physical and chemical characteristics of the waste, 2) land ownership and land use conditions for obtaining disposal sites, and 3) laws and regulations related to solid waste management are required. And also the implementation of an EIA on the impact by waste due to operation and maintenance of facilities at operation stage is required.

**b) Impact by Hazards (Risk)**

The increase in danger from accidents may cause by: 1) the installation of hazardous material storage and handling facilities, 2) multiple effects of natural disasters which exceed the designed safety capacity of fuel storage tanks and other storage facilities for hazardous materials or port facilities, and 3) dredging of the seartransport route during maintenance. The impacts which may conduct such as: 1) marine pollution due to accidents involving hazardous substances and the destruction of port facilities, 2) loss of human life and damage to inhabitants' livelihood such as production activities, houses, food collection, etc., 3) occurrence of a large-scale disaster if hazardous material storage facilities are destroyed by a natural disaster, and 4) accidental cutting of underwater pipelines and cables during the dredging work. It may affect the significant impact in case of: 1) the existence of facilities having a high possibility of exploding or releasing hazardous substances, 2) the possibility of a disaster which the recovery would be difficult, and 3) the areas that often suffer from natural disasters. It is expected that the impact by hazards (risk) may become much significant. Therefore, the establishment of the countermeasures, such as: 1) the examination of the contents of the plan, 2) the site selection considering the potential of natural disasters, such as earthquakes and typhoons, 3) the installation of a safety system that would minimize the damage to the storage facilities of hazardous materials, 4) the provision of safety education to



facility workers, and 5) appropriate management of hazardous materials are required, and the detail studies on: 1) the location of underwater facilities, 2) the meteorological and marine conditions, 2) laws and regulations on handling and storing hazardous materials, and 4) case studies of past natural disasters are required. And also the implementation of an EIA on the impact by hazards (risk) due to operation and maintenance of facilities at operation stage is required.

## **(2) Impact to Natural Environment**

### **a) Impact to Coastal Zone**

The coastal erosion and change of vegetation may cause by the warm water discharge from thermal power plant. It may conduct the impacts such as the damage and loss of marine resources, which will affect fishery and tourism. It may affect the significant impact in case of: 1) the existence of valuable natural environment, such as mangrove forests and coral reefs, 2) the existence of favorable fishing grounds, and 3) the existence of tourism that uses the coastal zone as a tourist attraction. It is expected that the impact to coastal zone may become significant. Therefore, the establishment of the countermeasures, such as: 1) the examination of the contents of the plan, and 2) the compensation for fishery are required, and the detail studies on: 1) valuable natural environment, such as mangroves and coral reefs, 2) fisheries, and 3) industries that utilize the coastal zone are required. And also the implementation of an EIA on the impact to coastal zone due to operation and maintenance of facilities at operation stage is required.

### **b) Impact to Flora and Fauna**

The obstruction of breeding and extinction of species caused by change of habitat condition and the disruption of migratory routes may cause by the generation of exhaust gas, noise and warm water from the operation of facilities. The impacts which may conduct, and the significant impact case are same as impact to flora and fauna due to spatial occupancy at operation stage. Therefore, it is expected that the impact to flora and fauna may become significant. So that the detail studies: 1) existing vegetation, topography and geology, 2) distribution of animals, 3) affiliation of conventions concerning wildlife protection, and 4) livelihood of inhabitants are required, and also the establishment of the countermeasures and the implementation of an EIA on the impact to flora and fauna due to operation and maintenance of facilities at operation stage are required.

## **(3) Impact by Pollution**

### **a) Impact by Air Pollution**

The pollution caused by exhaust gas, toxic gas and dust may cause by the operation of facilities, and the soot and smoke from thermal power plants. The impact will be greater during the dry season. It may conduct the impacts such as: 1) the impacts to the health of people, plants and animals by exhaust gas and dust, and 2) the contribution to the global environmental problems such as acid rain by sulfur oxides and global warming by carbon dioxide. It may affect the significant impact in case of: 1) the existence of densely housing area, and 2) the occurrence of the significant increases of a mount of gas. Especially, the special attention should be paid for large pollution sources, such as thermal power plants. Therefore, the countermeasures such as: 1) the establishment of adequate operation management plan, 2) the treatment of exhaust gas emitted by various facilities are required. So that the implementation of an EIA on the impact by air pollution due to operation and maintenance of facilities at operation stage is required.

### **b) Impact by Water Pollution**

The pollution by inflow of effluent from facilities into rivers, groundwater and sea, oil spills as a result of marine operation or accidents, and sewage discharge may cause by the erosion caused by the change of vegetation and topography. It may conduct the impacts such as: 1) the

contamination of water would affect the aquatic life and the health of inhabitants who use the water, 2) the deterioration of the water quality in the rivers, lakes and sea brought about by the drainage produced by the facility operation and maintenance work, and the settlement of people, and 3) the effects on the water use by inhabitants, fishery, fish cultivation, and recreational use. It may affect the significant impact in case of: 1) the existence of the water used by habitants or businesses in the downstream area, 2) the existence of important aquatic species, and 3) the existence of enclosed water system such as lakes and ponds. Therefore, the establishment of the countermeasures such as: 1) adequate sewage treatment and waste management planning, 2) compensation to the inhabitants and industries, and 3) creation of habitats for valuable aquatic life, and the implementation of an EIA on the impact by water pollution due to operation and maintenance of facilities at operation stage are required.

#### c) Impact by Soil Contamination

The soil contamination may cause by: 1) the leakage and diffusion of dumping of ash, incombustible refuse and dust from dust collectors, 2) application of compost contaminated by heavy metals, etc., to farmlands, and 3) dispersion of disposal such as heavy metals, pesticides and toxic substances from facilities and port. It may conduct the impacts such as: 1) the contamination of solid waste disposal sites, 2) the effects to crops and affect human health by the absorption of contamination in farmland, and 3) the leakage of toxic substances with rainwater, which affect water use and the downstream water value such as drinking, agriculture and fishery. It may affect the significant impact in case of: 1) the dumping of ash and industrial waste which has high contamination risk, 2) the usage of downstream water with vigorous purpose, and 3) the usage of the compost to be used as fertilizer. The soil contamination is expected significant. Especially, the impact will increase through a process that the heavy metals in dust and the toxic chemicals are accumulated in the soil and absorbed by plants and eventually enter the water system. Therefore, the countermeasures such as: 1) prevention of toxic substances from intrusion by applying impermeable sheet or installing clay as impermeable layer, 2) prevention of leakage and intrusion by heat and light treatment, confinement in cans, concrete, etc., and 3) dust prevention by sprinkling water on the disposal, 4) no use of contaminated compost as fertilizer, and 5) restriction of land use in the proximity are required. The detail studies on: 1) topography and geology, and 2) water use and land use, and the implementation of an EIA on the impact by soil contamination due to operation and maintenance of facilities at operation stage are required.

#### d) Impact by Noise and Vibration

The noise and vibration may cause by the operation of facilities. It may conduct the impacts such as: 1) the effect on hospitals and schools by noise, and the disturbance of sleep by facilities operating at night at high populated area, 2) the obstruction of breeding of cattle and dispersion of wildlife, 3) health problems, such as sleeplessness and poor appetites, when the noise continues over a long period of time, and 4) the cracks in buildings on soft ground caused by vibration. It may affect the significant impact in case of: 1) the existence of the facilities which require calm circumstance, or densely populated areas, 2) the existence of the important cattle industry, 3) the existence of the habitats of valuable wildlife, and 4) the existence of the weak ground such as filled land or clayey soil layer. It is expected that the impact by noise and vibration may become significant. Therefore, the countermeasures such as: 1) examination of the contents of the plan, 2) examination of operation hours, 3) installation of acoustic walls and buffer zones, and 4) compensation for the impacts on the livestock, are required, and also the implementation of an EIA on the impact by noise and vibration due to operation and maintenance of facilities at operation stage is required.

#### e) Impact by Offensive Odor

The generation of offensive odor may cause by the operation of facilities such as industrial complexes, thermal power plants, sewage treatment plants, and waste disposal plants. It may conduct the impacts such as: 1) complaints from such public facilities as schools, hospitals, etc., and 2) health problems of the residents and livestock by strong hazardous materials. It

may affect the significant impact in case of the existence of factories which handle hazardous materials. Especially oil refinery plants may exhaust offensive odor, so that land use conditions around the site should be taken into consideration. And wind direction and speed will influence the areas to be affected. Therefore, the special attention should be paid for the detail studies on: 1) meteorological conditions, such as wind direction and speed, temperature gradients at high altitudes, precipitation, etc., 2) topographical information related to valleys and undulations, and 3) past complaints regarding offensive odors. And also careful examination of countermeasures such as: 1) the facility construction site and the contents of the plan, 2) the land use in surrounding area, and 3) appropriate management of hazardous materials. The implementation of an EIA on the impact by offensive odor due to operation and maintenance of facilities at operation stage is required.

#### **4) Impact by Accumulation of People and Goods**

##### **(1) Impact to Social Environment**

###### **a) Impact to Economic Activities**

The loss of bases of economic activities, such as land, and change to the economic structure may cause by the change of industrial structure following the inflow and outflow of population and goods resulting from the facility operation. It may conduct the impacts such as: 1) the effects on the regional economy because of the change of commercial activities and job opportunities, and 2) the increase of cash income by the adoption of cash crops, malnutrition might result in self-sufficient areas, and 3) the expansion of the gap between the rich and poor caused by rise in land value around the facility. It may affect the significant impact in case of: 1) the effect on the economy caused by the inflow of people and commodities in self-sufficient areas, and 2) the effect of relocation on the local economy and employment for important industries. Therefore, the countermeasures are required, and also the implementation of an EIA on the impact to economic activities due to accumulation of people and goods at operation stage is required.

###### **b) Impact to Cultural Properties**

The damage to and loss of the value of cultural properties such as churches, temples, shrines and archaeological remains and other cultural assets may cause by the increase in traffic of people owing to the operation of facility. It may conduct the impacts such as: 1) the increase possibility of theft due to damage to or vanishing of a unique culture by the flow of different cultures and the loss of opportunity for academic research, 2) the damage to tourism business opportunities which depend on cultural properties, and 3) the aggravation of inhabitants' feeling caused by the loss of precious cultural properties in the area. It may affect the significant impact in case of: 1) the existence of the cultural properties which are recognized officially, historically and culturally important from a global viewpoints or unique to the area, 2) the existence of the cultural properties with longer and valuable histories, and 3) the existence of the buildings and other facilities in unique communities. At present, it is not clear that there are some cultural properties in and around the site. If some cultural properties will be confirm, it is required to implement some countermeasures. Therefore, the implementation of an EIA on the impact to cultural properties due to accumulation of people and goods at operation stage are required.

###### **c) Impact by Waste**

The generation of general waste may causes by the following the increase of economic activities. It may conduct the impacts such as: 1) the diminution of aesthetic values, the change of vegetation, and the pollution of soil and water by the exposed waste, and 2) the diminution of aesthetic values and the occurrence of sanitary problems by the illegally dumping. It may affect the significant impact in case of the disposal of debris at tourism area. In case there are illegal disposal, hygienic condition and aesthetic value of the area will be deteriorated, and an outbreak of pathogenic insects and animals would aggravate the sanitary conditions of the area.

The site is located at coastal are, so it is anticipated that waste water from waste will be discharged into sea. Therefore, the establishment of countermeasures such as adequate management of waste is required. And the implementation of an EIA on the impact by waste due to accumulation of people and goods at operation stage is required.

### 9.3 RECOMMENDATIONS

#### 9.3.1 Implementation of EIA

The following environmental items are required to implement an EIA.

**Table 9.3 Environmental Items to be implemented EIA**

Stage	Cause	Category	Environmental Item		
Construction Stage	Land Acquisition and Reclamation	Social Environment	Resettlement		
			Cultural Properties		
			Water Rights and Right of Common Waste		
		Natural Environment	Hazards (Risk)		
			Topography and Geology		
			Soil Erosion		
			Hydrological Situation		
			Coastal Zone		
			Flora and Fauna		
			Meteorology		
Operation of Construction Equipment		Pollution	Water Pollution		
		Natural Environment	Flora and Fauna		
			Pollution	Air Pollution	
			Noise and Vibration		
Operation Stage	Spatial Occupancy	Social Environment	Economic Activities		
			Split of Communities		
		Natural Environment	Flora and Fauna		
			Aesthetics		
			Operation of Vehicles	Social Environment	Traffic and Public Facilities
					Cultural Properties
	Operation and Maintenance of Facilities		Natural Environment	Hazards (Risk)	
				Flora and Fauna	
			Pollution	Air Pollution	
				Noise and Vibration	
				Waste	
				Hazards (Risk)	
Accumulation of People and Goods		Natural Environment	Coastal Zone		
			Flora and Fauna		
		Social Environment	Air Pollution		
			Water Pollution		
			Soil Contamination		
			Noise and Vibration		
Accumulation of People and Goods		Social Environment	Offensive Odor		
			Economic Activities		
			Cultural Properties		
			Waste		

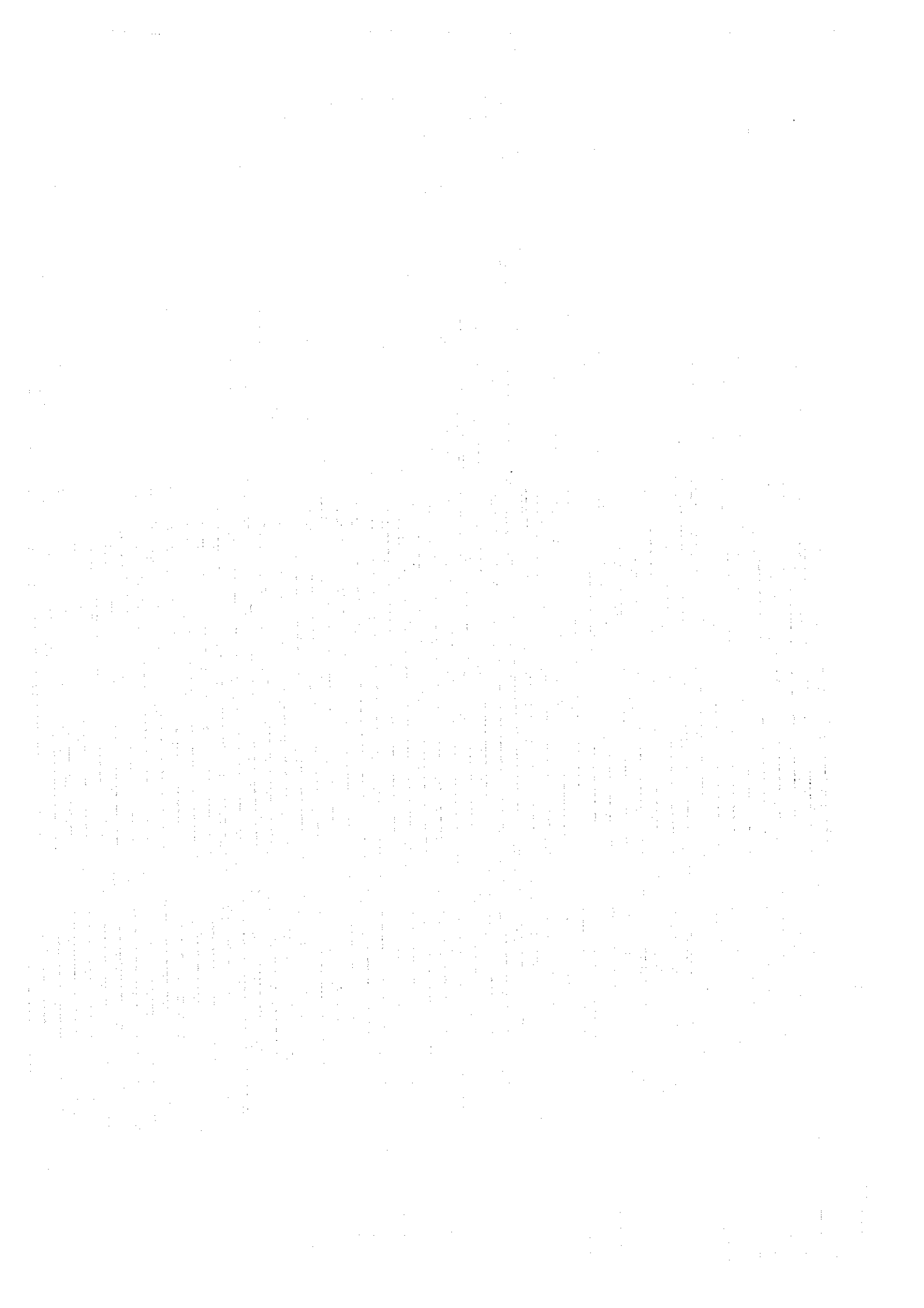
### 9.3.2 Examination of Environmental Countermeasures

The following environmental countermeasures are required to discuss at next stage such as feasibility study (F/S) or detail design (D/D).

**Table 9.4 Items for Environmental Countermeasures**

Environmental Item	Reason to be not examined
Resettlement programme	Provisions of the meetings with resettlers and necessary information Careful resettlement site selection Improvement of living and economic conditions of the resettlement site Sufficient compensation system Provisions of sufficient compensation system and the job training and guidance
Careful detail design	Careful site selection Examination of project components Establishment of proper waste collection system and disposal system Establishment of adequate drainage system Establishment of water supply and sewerage systems Establishment of traffic safety system
Construction and maintenance plan	Establishment of careful construction and maintenance plan Examination of the construction and maintenance method and schedule Establishment of temporary flood control ponds and fence to protect the muddy water Establishment of low noise and vibration construction equipment Establishment of temporary acoustic walls and buffer zone Establishment of sprinkling water system Establishment of monitoring system
Pollution control plan	Air pollution and offensive odor control plan Water pollution, soil contamination and hazardous substances control plan Noise and vibration control plan
Land use plan	Restriction of land use in the surrounding area Examination of regional development plan and city planning Water resource use plan









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