

Tables

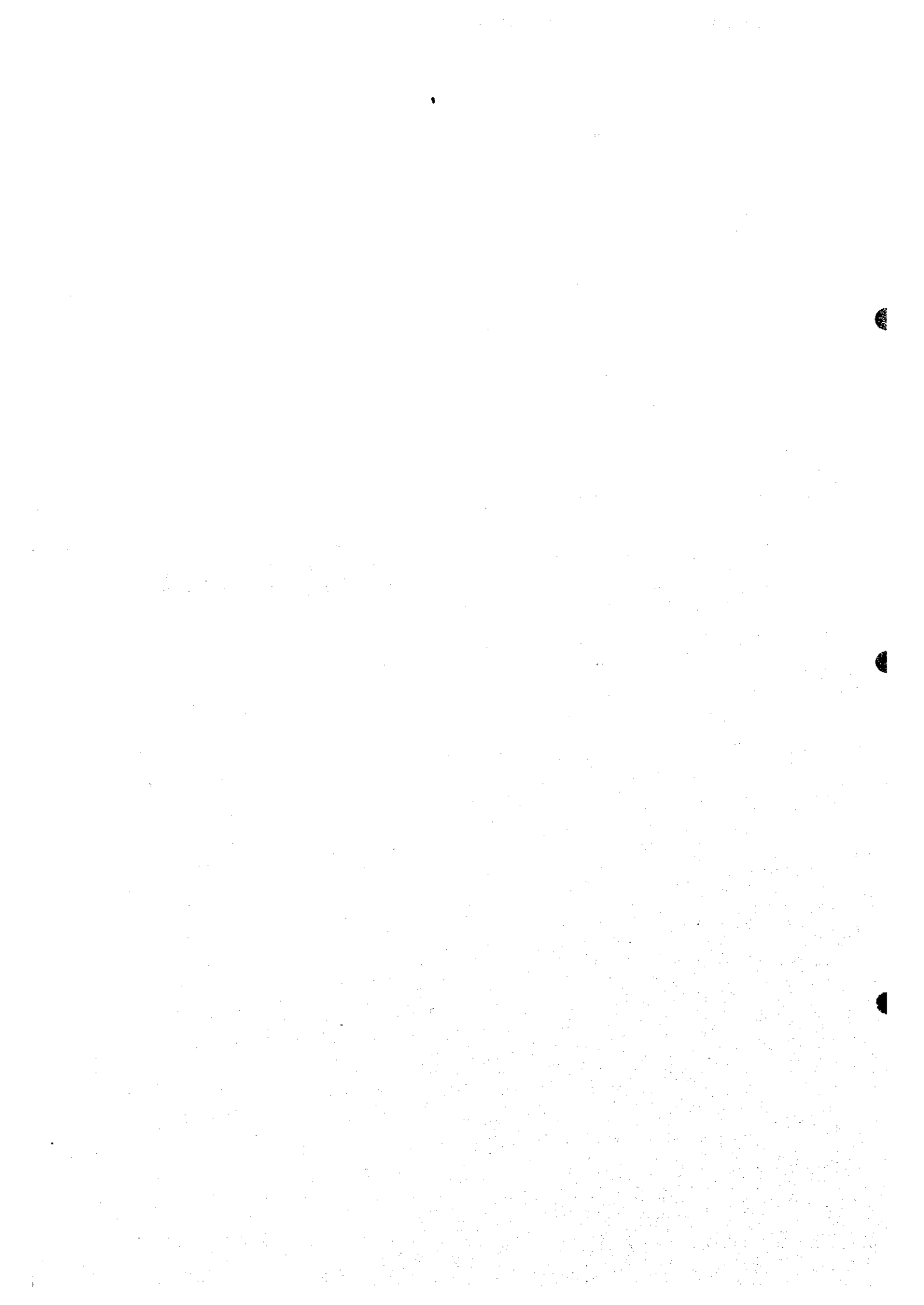


Table 2.1.1 CONVERSION FACTORS FOR ECONOMIC EVALUATION

A. Conversion Rates	Item	Rate	Remarks
1	Standard Conversion Rate (SCR)	0.96	Calculated from figures of 1992-1996 foreign trade (kg/cr to Table 2.1.2) Var:10%
2	Transfer payment (Tra-p)	0.91	
3	Opportunity Cost of Land (OC Land)	0.91	10% of vacancy of land to be assumed
4	Opportunity Cost of Labor (OC Labor)	0.97	Unemployment of 1990-96, average=3.6 %
5	Opportunity Cost of Capital (OCC)	0.12	Around 12% : NESDB Information
B. Formula of the Conversion from "Financial" to "Economic" for Local Currency Portion			
Construction Material and Equipment:			
1	Material and Equipment Cost x SCR x Tra-p	0.873	7. Building & Asset x SCR. 8. Electricity x SCR x Tra-p
(A) Skilled Labor:			
2	Labor cost x SCR x Tra-p	0.873	
(b) Unskilled Labor:			
3	Labor cost x SCR x OC Labor x Tra-p	0.842	
Land Acquisition :			
4,5	Land acquisition cost x SCR x OC Land x Tra-p	0.793	
Administration/Engineering :			
6	Administration/Engineering x SCR x Tra-p	0.873	
Physical contingency :			
	Physical contingency x SCR x Tra-p	0.873	

Table 2.1.2 STANDARD CONVERSION RATE (SCR)

	Unit: million Baht				
	1992	1993	1994	1995	Average
Export	824,644	935,862	1,137,600	1,406,311	1,412,111
Import	1,033,244	1,166,595	1,369,037	1,763,587	1,832,836
Export Duties	12	10	14	12	9
Import Duties	89,769	104,123	118,712	127,389	121,783
SCR	0.95	0.95	0.95	0.96	0.96
I+di	1,123,013	1,270,718	1,487,749	1,890,976	1,954,619
E-de	824,632	935,852	1,137,586	1,406,299	1,412,102

Source : Bank of Thailand, June, 1997.

Note : $SCR = (I+E) / ((I+di) + (E - de))$

Table 2.1.3 (1/2) CONVERSION TABLE TO THE BENEFIT OF CORRESPONDENT YEAR
(FROM 2018 FIGURE TO CORRESPONDENT YEAR)

	Growth of GDP		Growth of Agricultural Land	
	National Basis		Total of 4 Areas	
1998	1.000	0.337	1.000	0.610
1999	1.010	0.341	1.025	0.626
2000	1.055	0.356	1.051	0.641
2001	1.108	0.374	1.077	0.657
2002	1.124	0.379	1.104	0.674
2003	1.197	0.404	1.131	0.690
2004	1.275	0.430	1.160	0.708
2005	1.358	0.458	1.189	0.725
2006	1.446	0.488	1.218	0.744
2007	1.540	0.519	1.249	0.762
2008	1.640	0.553	1.280	0.781
2009	1.747	0.589	1.312	0.801
2010	1.860	0.627	1.345	0.821
2011	1.972	0.665	1.379	0.841
2012	2.090	0.705	1.413	0.862
2013	2.216	0.747	1.448	0.884
2014	2.349	0.792	1.485	0.906
2015	2.490	0.840	1.522	0.929
2016	2.639	0.890	1.560	0.952
2017	2.797	0.943	1.599	0.976
2018	2.965	1.000	1.639	1.000

Table 2.1.3 (2/2) CONVERSION TABLE TO THE BENEFIT OF CORRESPONDENT YEAR
(FROM 2005 FIGURE TO CORRESPONDING YEAR)

	Growth of Per Capita GDP(1)				Growth of Population(2)				Conversion Rate: (1)/(2)	
	BMA		Others		BMA		Others		BMA	Others
1998	1.000	0.719	1.000	0.933	1.000	0.904	1.000	0.959	0.650	0.894
1999	1.038	0.746	1.010	0.942	1.015	0.917	1.006	0.965	0.684	0.909
2000	1.077	0.775	1.020	0.951	1.029	0.930	1.012	0.971	0.721	0.923
2001	1.118	0.804	1.030	0.961	1.044	0.944	1.018	0.976	0.759	0.938
2002	1.181	0.849	1.043	0.973	1.060	0.957	1.024	0.982	0.813	0.955
2003	1.247	0.897	1.055	0.984	1.075	0.971	1.030	0.988	0.871	0.972
2004	1.317	0.947	1.068	0.996	1.091	0.986	1.037	0.994	0.933	0.990
2005	1.391	1.000	1.072	1.000	1.107	1.000	1.043	1.000	1.000	1.000
2006	1.469	1.056	1.099	1.025	1.124	1.015	1.057	1.014	1.072	1.039

Note:

(1) Growth Rate of GDP is derived from 'Growth of National Economy', Bank of Thailand 1998.

(2) Growth Rate of Agricultural Land is assumed according to change of agricultural land usage.

Table 3.2.1 RID BUDGET FOR CONSTRUCTION PROJECT

Unit : million baht

	1995	1996	1997(P)	1998(P)	Average 1995-1998	Projection of 2012	Comparison with Peak Cash Flow of Projects(M/P	Comparison with Peak Cash Flow of Projects(F/S		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Budget # 1 (Administration of Project)	4,199	4,991	3,659	3,717	4,142	19,476			7,614	
(2) Budget # 2 (Large Scale Project)	8,823	12,265	7,371	6,429	8,722	41,017	0.20		16,035	0.02
(3) Budget #3 (Medium & Small Scale Project)	2,032	3,603	3,625	4,144	3,351	15,759			6,161	
(4) Budget # 4 (Operation & Management of Project)	9,558	12,963	10,667	10,855	11,011	51,781			20,242	
(5) Budget #5 (Others)	11,563	10,999	5,292	6,020	8,469	39,825			15,569	
Total	36,175	44,821	30,614	31,165	35,694	167,859	0.05		65,620	0.005

Source : Budget of MOAC, 1995-1998, and RID

Note :

(P) : Prospected.

(2) : 11 projects as of on 1998 budget such as Pak Panang Project, Khong Ta Dan Dam Project

(3) : 49 projects as of 1998

(4) : Region No.7 (West Bank Side of the Chao Phraya River) has 23 O&M Project as of on 1998 budget.

Region No.8 (East Bank Side of the Chao Phraya) has 15 O&M Project as of on 1998 budget.

(5) : Bangkok flood protection , rural area budget, small scale irrigation project, small scale water resources development project, etc.

(7) Projection of 2012 by the nominal growth rate of GDP based on (6)

(8) Peak of Cash Flow of the Projects (8,286 million baht) at 2012 for M/P and 339 million baht at 2003 for F/S.

Table 3.2.2 LARGE SCALE PROJECT OF RID ON-GOING AS OF IN 1998 BUDGET

Project	unit : million baht	
	1998 Budget	Total Project Cost
1 Administration	1,827	-
2 Upper Mun Project	43	2,976
Project for Water Resources Development in the Foothills of Panom Dong Rek		
3 Mountain	26	1,378
4 Project for Developing and Rehabilitating the Flood-Hit Area in the South	272	2,750
5 Phra Prong Project	153	705
6 Khlong Si Yat Project	560	4,016
7 Bang Pakong Diversion & Barrage Project	551	4,320
8 Pak Phanang River Basin Development Project (Phase II)	2,043	13,380
9 Pak Phanang River Basin Development Project initiated by H.M.the King (Phase I)	296	5,099
10 Greater Mae Khlong Project (Phase III)	230	800
11 Mae Mok Project	143	450
12 Khlong Ja Dan Dam Project initiated by H.M.King	286	10,193
Total	6,430	46,067

Source : Budget of RID, 1998.

Table 3.3.1 PWD BUDGET IN THE PAST YEAR

Fiscal Year	Amount (million baht)
1995	17,295
1996	28,112
1997	37,538
1998	24,940
1999	24,725

Source : Planning Division PWD, 1998

Table 3.3.2 BUDGET APPROPRIATION BY PROGRAMMES OF
PUBLIC WORKS DEPARTMENT (PWD)

unit : million baht

Programme	Fiscal Year 1999	Total Cost of Project
I. City Planning and Basic Technical Service		
1. General Administration	85	85
2. PWD Provincial Office	280	280
3. Planning and Control of Construction	146	146
4. Electricity Supply	117	117
5. Technical Analysis and Reserches	17	17
6. Safty Standard for Petroleum and Gas	37	37
7. Training of Technition	14	14
8. Land Acquisition	2,500	2,500
9. Constuction of PDW Office Building	14	458
10. Development of Ayuttaya	100	212
11. Flood Control of Samut Prakan	113	2,928
12. Protections for Along-Rivers in Municipalities-Phase I	1,116	18,340
13. Water Supply in Municipalities	295	1,319
14. Protections for Along-Rivers in Municipalities-Phase II	64	975
15. Flood Control of Nontaburi	64	1,910
16. Improvement of Water Supply in Municipalities--Phase I	31	2,822
17. Improvement of Water Supply in Municipalities--Phase II	40	1,285
Sub-total	5,035	33,445
II. Rural Development		
1. Ground Deep Well Water	244	244
2. Water Supply Development	301	301
3. Construction of Road and Bridge	11,999	11,999
4. Maintenance of Public Utilities	1,502	1,502
5. Maintenance of Rural Road, Bridge and Dams	704	4,706
6. Rural Small Scale Water Supply	288	5,198
7. Subsidies for Local Agencies	508	508
Sub-total	15,547	24,458
III. Architecture Development for Five Provinces in South	68	1,474
IV. Urban Development		
1. Bridge Construction	834	9,940
2. Traffic and Ring Road Construction adound Chiangmai	495	3,774
3. Sanitary Facility and Road Construction in Rayong	236	956
4. Main Cities' Public Utilities Development-Phase-II	5	255
5. Construction Projects with City Planning	168	21,503
Sub-total	1,737	36,428
V. Traffic and Bridge Construction in Metropolitan Bangkok		
1. Bridge Construction- Phase-II	267	3,813
2. Bridge Construction Across the Chao Phya River-I	120	2,003
3. Road Construction around the Ring Road	1	2,287
4. Road Construction in Bangkok and its Vicinities	301	6,444
5. Bridge across the Chao Phya River and Cocection Road-II	218	12,818
6. Bridge Construction in Nontaburi	11	5,710
7. Bridge Construction in Thonburi	157	894
Sub-total	1,075	33,969
VI. Environment		
1. Waste Water Facility in Prachubkirikan-Phase-I	47	344
2. Waste Water Facility in Prachubkirikan-Phase-II	9	441
3. Waste Water Facility in High Density Population Area	1,004	10,226
4. Garbage Facilities in Communities	204	2,558
Sub-total	1,263	13,569
Ground-total	24,725	143,343

Source : Planning Division PWD, 1998.

Table 3.4.1 BUDGET APPROPRIATION BY PROGRAMMES
OF BANKOK METROPOLITAN AUTHORITY
(BMA, FISCAL YEAR 1992-1996)

Unit: million baht

Department	1992					1993					1994					1995					1996					Share in	
																										1996 (%)	
Contingent Fund	687					1,121					1,120					2,707					2,619					17.2	
Office for the Secretary to the BMA	31					44					56					68					53					0.3	
Office for the Secretary to the Governor of Bangkok	18					22					30					26					27					0.2	
Office of BMA Civil Service Commission	17					25					24					26					30					0.2	
Office of the Permanent Secretary for the BMA	308					352					393					276					266					1.7	
Department of Policy and Planning	66					90					156					89					340					2.2	
Department of Inspector General	14					16					27					21					29					0.2	
Department of Finance	280					313					404					444					498					3.3	
Department of Drainage & Sewage	941					1,003					1,111					1,508					2,875					18.9	
Department of Public Cleaning	1,133					728					781					873					858					5.6	
Department of Public Works	2,471					1,931					2,142					2,179					3,457					22.7	
Department of Education	477					472					612					655					652					4.3	
Department of Social Welfare	308					348					469					433					592					3.9	
Department of Law Enforcement	24					27					40					40					52					0.3	
Department of Health	433					595					541					599					659					4.3	
Department of Medical Service	833					1,107					1,515					1,511					1,458					9.6	
Department of Community Development	-					83					119					97					130					0.9	
Department of Traffic and Transportation	-					8,277					9,544					368					447					2.9	
Department of City Planning	-					-					-					-					107					0.7	
Total	8,045					8,194					9,424					11,921					15,202					100.0	

Source: Budget Division, Department of the Permanent Secretary for the BMA, 1998.

Table 4.1.1 FINANCIAL AND ECONOMIC COST OF ALTERNATIVE-1

Cost Evaluation (Unit : baht 1,000,000)

Distribution System Improvement - Thai (Financial)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	101	123	224
1) Material and Equipment	86	123	208
2) Skilled Labor	4	0	4
3) Unskilled Labor	11	0	11
2 Land acquisition & House R	3	0	3
3 Administration	3	0	3
4 1) Engineering service DD	1	5	6
2) Engineering service SV	1	11	13
5 Physical contingency	4	7	11
Sub-total	113	146	259
6 Price Contingency	12	14	26
Grand total	125	160	285
OM Cost			2

Distribution System Improvement - Thai (Economic)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	88	112	199
1) Material and Equipment	75	112	186
2) Skilled Labor	4	0	4
3) Unskilled Labor	10	0	10
2 Land acquisition & House Relo	2	0	2
3 Administration	2	0	2
4 1) Engineering service DD	0	5	5
2) Engineering service SV	1	10	12
5 Physical contingency	4	6	10
Sub-total	98	133	231
6 Price Contingency	0	0	0
Grand total	98	133	231
OM Cost			2

Drainage Improvement - Thai (Financial)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	2,112	2,327	4,439
1) Material and Equipment	1,837	2,327	4,163
2) Skilled Labor	92	0	92
3) Unskilled Labor	184	0	184
2 Land acquisition & House R	612	0	612
3 Administration	61	0	61
4 1) Engineering service DD	31	122	153
2) Engineering service SV	61	306	367
5 Physical contingency	245	245	490
Sub-total	3,122	3,000	6,123
6 Price Contingency	312	300	612
Grand total	3,435	3,300	6,735
OM Cost			42

Drainage Improvement - Thai (Economic)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	1,838	2,117	3,955
1) Material and Equipment	1,603	2,117	3,721
2) Skilled Labor	80	0	80
3) Unskilled Labor	155	0	155
2 Land acquisition & House Relo	456	0	456
3 Administration	53	0	53
4 1) Engineering service DD	27	111	138
2) Engineering service SV	53	279	332
5 Physical contingency	214	223	437
Sub-total	2,671	2,730	5,401
6 Price Contingency	0	0	0
Grand total	2,671	2,730	5,401
OM Cost			37

River Improvement 10 year (Chainat-Patana Thani) - Thai (Financial)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	507	602	1,109
1) Material and Equipment	432	602	1,034
2(a) Skilled Labor	40	0	40
(b) Unskilled Labor	35	0	35
2 Land acquisition	20	0	20
3 Administration	22	0	22
4 1) Engineering service DD	8	59	66
2) Engineering service SV	6	56	62
5 Physical contingency	45	60	105
Sub-total	607	776	1,384
6 Price Contingency	18	23	41
Grand total	625	800	1,425
OM Cost			34

River Improvement 10 year (Chainat-Patana Thani) - Thai (Economic)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	441	548	989
1) Material and Equipment	377	548	925
2(a) Skilled Labor	35	0	35
(b) Unskilled Labor	29	0	29
2 Land acquisition	16	0	16
3 Administration	19	0	19
4 1) Engineering service DD	7	53	60
2) Engineering service SV	5	51	56
5 Physical contingency	39	55	94
Sub-total	528	707	1,234
6 Price Contingency	0	0	0
Grand total	528	707	1,234
OM Cost		31	31

Dam Compensation Cost - Thai (Financial)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	0	0	0
1) Material and Equipment	0	0	0
2(a) Skilled Labor	0	0	0
(b) Unskilled Labor	0	0	0
2 Land acquisition	0	0	0
3 Administration	0	0	0
4 Engineering service	0	0	0
5 Physical contingency	46	0	46
Sub-total	46	0	46
6 Price Contingency	0	0	0
Grand total	46	0	46
OM Cost	451	0	451

Dam Compensation - Thai (Economic)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	0	0	0
1) Material and Equipment	0	0	0
2(a) Skilled Labor	0	0	0
(b) Unskilled Labor	0	0	0
2 Land acquisition	0	0	0
3 Administration	0	0	0
4 Engineering service	0	0	0
5 Physical contingency	40	0	40
Sub-total	40	0	40
6 Price Contingency	0	0	0
Grand total	40	0	40
OM Cost	394	0	394

Note: Physical contingency of Dam means initial cost of necessary expenses for preparation

Table 4.1.2 FINANCIAL AND ECONOMIC COST OF ALTERNATIVE-2-1

Cost Evaluation (Unit : Baht 1,000,000)

Distribution System Improvement - Thai (Financial)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	101	123	224
1) Material and Equipment	86	123	209
2) Skilled Labor	4	0	4
3) Unskilled Labor	11	0	11
2 Land acquisition & House Rsk	3	0	3
3 Administration	3	0	3
4 1) Engineering service/D/D	1	5	6
2) Engineering service/S/V	1	11	12
5 Physical contingency	4	7	11
Sub-Total	113	146	259
6 Price Contingency	12	14	26
Grand total	125	160	285
OM Cost			2

Distribution System Improvement - Thai (Economic)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	80	112	192
1) Material and Equipment	75	112	187
2) Skilled Labor	4	0	4
3) Unskilled Labor	10	0	10
2 Land acquisition & House Rsk	2	0	2
3 Administration	2	0	2
4 1) Engineering service/D/D	0	5	5
2) Engineering service/S/V	1	10	11
5 Physical contingency	4	6	10
Sub-Total	98	133	231
6 Price Contingency	0	0	0
Grand total	98	133	231
OM Cost			2

Drainage Improvement - Thai (Financial)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	2,112	2,327	4,439
1) Material and Equipment	1,837	2,327	4,164
2) Skilled Labor	92	0	92
3) Unskilled Labor	183	0	183
2 Land acquisition & House Rsk	612	0	612
3 Administration	61	0	61
4 1) Engineering service/D/D	31	132	163
2) Engineering service/S/V	61	306	367
5 Physical contingency	245	245	490
Sub-Total	3,122	3,000	6,122
6 Price Contingency	312	300	612
Grand total	3,435	3,300	6,735
OM Cost			42

Drainage Improvement - Thai (Economic)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	1,838	2,117	3,955
1) Material and Equipment	1,603	2,117	3,724
2) Skilled Labor	30	0	30
3) Unskilled Labor	135	0	135
2 Land acquisition & House Rsk	486	0	486
3 Administration	53	0	53
4 1) Engineering service/D/D	27	111	138
2) Engineering service/S/V	53	270	323
5 Physical contingency	214	223	437
Sub-Total	2,671	2,730	5,401
6 Price Contingency	0	0	0
Grand total	2,671	2,730	5,401
OM Cost			33

Bang & Dike along Char Phraya River (Heightening 0.3m) - Thai (Financial)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	453	791	1,244
1) Material and Equipment	552	791	1,341
2) Skilled Labor	28	0	28
3) Unskilled Labor	74	0	74
2 Land acquisition & House Rsk	18	0	18
3 Administration	18	0	18
4 1) Engineering service/D/D	4	33	37
2) Engineering service/S/V	9	74	83
5 Physical contingency	28	44	72
Sub-Total	732	842	1,574
6 Price Contingency	75	92	167
Grand total	806	1,034	1,840
OM Cost			13

Bang & Dike along Char Phraya River (Heightening 0.3m) - Thai (Economic)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	548	720	1,268
1) Material and Equipment	482	720	1,202
2) Skilled Labor	24	0	24
3) Unskilled Labor	62	0	62
2 Land acquisition & House Rsk	15	0	15
3 Administration	16	0	16
4 1) Engineering service/D/D	3	30	33
2) Engineering service/S/V	8	67	75
5 Physical contingency	24	40	64
Sub-Total	634	838	1,472
6 Price Contingency	0	0	0
Grand total	634	838	1,472
OM Cost			12

River Improvement 10 year (Chaiwat Pahan Thani) - Thai (Financial)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	507	602	1,109
1) Material and Equipment	432	602	1,034
2(a) Skilled Labor	40	0	40
(b) Unskilled Labor	35	0	35
2 Land acquisition	20	0	20
3 Administration	22	0	22
4 1) Engineering service/D/D	8	59	66
2) Engineering service/S/V	4	56	62
5 Physical contingency	45	60	105
Sub-Total	607	776	1,384
6 Price Contingency	18	23	41
Grand total	625	800	1,425
OM Cost			34

River Improvement 10 year (Chaiwat Pahan Thani) - Thai (Economic)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	441	548	989
1) Material and Equipment	377	548	925
2(a) Skilled Labor	25	0	25
(b) Unskilled Labor	20	0	20
2 Land acquisition	16	0	16
3 Administration	19	0	19
4 1) Engineering service/D/D	7	53	60
2) Engineering service/S/V	5	51	56
5 Physical contingency	20	55	74
Sub-Total	528	707	1,234
6 Price Contingency	0	0	0
Grand total	528	707	1,234
OM Cost			32

Dam Compensation Cost - Thai (Financial)

Dam Compensation Cost - Thai (Financial)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	0	0	0
1) Material and Equipment	0	0	0
2(a) Skilled Labor	0	0	0
(b) Unskilled Labor	0	0	0
2 Land acquisition	0	0	0
3 Administration	0	0	0
4 Engineering service	0	0	0
5 Physical contingency	46	0	46
Sub-Total	46	0	46
6 Price Contingency	0	0	0
Grand total	46	0	46
OM Cost	451	0	451

Dam Compensation - Thai (Economic)

Dam Compensation - Thai (Economic)			
Classification of cost	L.C.	F.C.	Total
1 Construction cost	0	0	0
1) Material and Equipment	0	0	0
2(a) Skilled Labor	0	0	0
(b) Unskilled Labor	0	0	0
2 Land acquisition	0	0	0
3 Administration	0	0	0
4 Engineering service	0	0	0
5 Physical contingency	40	0	40
Sub-Total	40	0	40
6 Price Contingency	0	0	0
Grand total	40	0	40
OM Cost	394	0	394

Note: Physical contingency of Dam means initial cost of necessary equipment for preparation.

Table 4.1.3 FINANCIAL AND ECONOMIC COST OF ALTERNATIVE 2-2

Cost Estimate 1 (Table 4.1.1) (Financial)				Cost Estimate 1 (Table 4.1.1) (Economic)			
Classification of cost	L.C.	F.C.	Total	Classification of cost	L.C.	F.C.	Total
1 Construction cost	3,152	41,389	15,641	1 Construction cost	6,119	11,343	17,212
1) Material and Equipment	6,715	11,289	18,024	1) Material and Equipment	5,511	11,180	16,714
2) Skilled Labor	341	0	341	2) Skilled Labor	298	0	298
3) Unskilled Labor	476	0	476	3) Unskilled Labor	430	0	430
2 Land acquisition & House Rel	15,186	0	15,186	2 Land acquisition & House Rel	12,643	0	12,643
3 Administration	759	0	759	3 Administration	663	0	663
4 Engineering service D/D	10	87	97	4 Engineering service D/D	0	80	80
5 Engineering service S/V	97	875	972	5 Engineering service S/V	65	796	861
5 Physical contingency	130	221	351	5 Physical contingency	113	203	316
Sub total	22,314	13,476	36,008	Sub total	19,143	12,282	31,802
6 Price Contingency	3,508	2,811	3,221	6 Price Contingency	0	0	0
Grand total	26,824	19,195	45,028	Grand total	19,143	12,282	31,802
OM Cost			186	OM Cost			167

Distribution System Improvement (Financial)				Distribution System Improvement (Economic)			
Classification of cost	L.C.	F.C.	Total	Classification of cost	L.C.	F.C.	Total
1 Construction cost	301	123	229	1 Construction cost	88	112	199
1) Material and Equipment	84	123	208	1) Material and Equipment	79	112	186
2) Skilled Labor	4	0	4	2) Skilled Labor	4	0	4
3) Unskilled Labor	11	0	11	3) Unskilled Labor	10	0	10
2 Land acquisition & House Rel	3	0	3	2 Land acquisition & House Rel	2	0	2
3 Administration	3	0	3	3 Administration	3	0	3
4 Engineering service D/D	4	0	4	4 Engineering service D/D	0	0	0
5 Engineering service S/V	4	11	15	5 Engineering service S/V	1	10	11
5 Physical contingency	4	7	11	5 Physical contingency	4	6	10
Sub total	113	146	239	Sub total	98	113	211
6 Price Contingency	12	16	28	6 Price Contingency	0	0	0
Grand total	125	160	285	Grand total	98	113	211
OM Cost			2	OM Cost			2

Drainage Improvement (Financial)				Drainage Improvement (Economic)			
Classification of cost	L.C.	F.C.	Total	Classification of cost	L.C.	F.C.	Total
1 Construction cost	2,412	2,321	4,829	1 Construction cost	1,278	2,117	3,923
1) Material and Equipment	1,217	2,327	4,162	1) Material and Equipment	1,619	1,117	3,723
2) Skilled Labor	92	0	92	2) Skilled Labor	80	0	80
3) Unskilled Labor	104	0	104	3) Unskilled Labor	135	0	135
2 Land acquisition & House Rel	412	0	412	2 Land acquisition & House Rel	486	0	486
3 Administration	61	0	61	3 Administration	53	0	53
4 Engineering service D/D	31	121	151	4 Engineering service D/D	27	111	138
5 Engineering service S/V	61	206	267	5 Engineering service S/V	33	239	312
5 Physical contingency	245	245	490	5 Physical contingency	214	232	417
Sub total	3,122	3,990	6,129	Sub total	2,673	3,790	5,493
6 Price Contingency	312	298	612	6 Price Contingency	0	0	0
Grand total	3,439	3,286	6,725	Grand total	2,673	3,790	5,493
OM Cost			42	OM Cost			37

River Improvement 10 year (Financial)				River Improvement 10 year (Economic)			
Classification of cost	L.C.	F.C.	Total	Classification of cost	L.C.	F.C.	Total
1 Construction cost	207	492	1,109	1 Construction cost	441	548	989
1) Material and Equipment	412	642	1,054	1) Material and Equipment	373	548	925
2) Skilled Labor	40	0	40	2) Skilled Labor	19	0	19
3) Unskilled Labor	25	0	25	3) Unskilled Labor	29	0	29
2 Land acquisition	20	0	20	2 Land acquisition	16	0	16
3 Administration	22	0	22	3 Administration	19	0	19
4 Engineering service D/D	0	23	23	4 Engineering service D/D	7	33	40
5 Engineering service S/V	0	56	56	5 Engineering service S/V	5	31	36
5 Physical contingency	45	60	105	5 Physical contingency	39	33	96
Sub total	407	776	1,184	Sub total	528	707	1,234
6 Price Contingency	14	23	41	6 Price Contingency	0	0	0
Grand total	423	820	1,243	Grand total	528	707	1,234
OM Cost			34	OM Cost			31

River Improvement 15 year (Financial)				River Improvement 15 year (Economic)			
Classification of cost	L.C.	F.C.	Total	Classification of cost	L.C.	F.C.	Total
1 Construction cost	452	375	1,027	1 Construction cost	568	762	1,370
1) Material and Equipment	556	775	1,330	1) Material and Equipment	483	762	1,198
2) Skilled Labor	52	0	52	2) Skilled Labor	45	0	45
3) Unskilled Labor	45	0	45	3) Unskilled Labor	38	0	38
2 Land acquisition	26	0	26	2 Land acquisition	20	0	20
3 Administration	28	0	28	3 Administration	25	0	25
4 Engineering service D/D	10	72	82	4 Engineering service D/D	8	69	77
5 Engineering service S/V	0	71	71	5 Engineering service S/V	7	65	72
5 Physical contingency	54	76	130	5 Physical contingency	54	76	131
Sub total	782	999	1,781	Sub total	678	909	1,588
6 Price Contingency	23	36	59	6 Price Contingency	0	0	0
Grand total	805	1,035	1,840	Grand total	678	909	1,588
OM Cost			48	OM Cost			40

Dam Construction Cost (Financial)				Dam Construction (Economic)			
Classification of cost	L.C.	F.C.	Total	Classification of cost	L.C.	F.C.	Total
1 Construction cost	0	0	0	1 Construction cost	0	0	0
1) Material and Equipment	0	0	0	1) Material and Equipment	0	0	0
2) Skilled Labor	0	0	0	2) Skilled Labor	0	0	0
3) Unskilled Labor	0	0	0	3) Unskilled Labor	0	0	0
2 Land acquisition	0	0	0	2 Land acquisition	0	0	0
3 Administration	0	0	0	3 Administration	0	0	0
4 Engineering service	0	0	0	4 Engineering service	0	0	0
5 Physical contingency	46	0	46	5 Physical contingency	46	0	46
Sub total	46	0	46	Sub total	46	0	46
6 Price Contingency	0	0	0	6 Price Contingency	0	0	0
Grand total	46	0	46	Grand total	46	0	46
OM Cost			452	OM Cost			794

Note: Physical contingency of Dam means initial cost of necessary equipment for preparation.

Table 4.3.1 PROJECT EVALUATION (THAILAND)

AM-1 (excluding Dams)		Unit: million baht						
Year		Economic cost			Economic benefit			
		Construction (A)	O&M (B)	Total (C)	General etc. (D)	Agri (E)	Economic Benefit (F)	Benefit-Cost (G)
1	1998	1	0	1	0	0	0	-1
2	1999	56	0	56	0	0	0	-56
3	2000	87	0	87	0	0	0	-87
4	2001	99	0	99	0	0	0	-99
5	2002	627	0	627	0	0	0	-627
6	2003	1,199	0	1,199	0	0	0	-1,199
7	2004	1,939	0	1,939	0	0	0	-1,939
8	2005	1,602	2	1,604	78	15	93	-1,511
9	2006	765	33	798	969	49	1,018	220
10	2007	479	33	512	969	49	1,018	506
11	2008	0	70	70	1,997	177	2,174	2,104
12	2009	0	70	70	1,997	177	2,174	2,104
13	2010	0	70	70	1,997	177	2,174	2,104
14	2011	0	70	70	1,997	177	2,174	2,104
15	2012	0	70	70	1,997	177	2,174	2,104
16	2013	0	70	70	1,997	196	2,193	2,123
17	2014	0	70	70	1,997	196	2,193	2,123
18	2015	0	70	70	1,997	196	2,193	2,123
19	2016	0	70	70	1,997	196	2,193	2,123
20	2017	0	70	70	1,997	196	2,193	2,123
21	2018	0	70	70	1,997	196	2,193	2,123
22	2019	0	70	70	1,997	196	2,193	2,123
23	2020	0	70	70	1,997	196	2,193	2,123
24	2021	0	70	70	1,997	196	2,193	2,123
25	2022	0	70	70	1,997	196	2,193	2,123
26	2023	0	70	70	1,997	196	2,193	2,123
27	2024	0	70	70	1,997	196	2,193	2,123
28	2025	0	70	70	1,997	196	2,193	2,123
29	2026	0	70	70	1,997	196	2,193	2,123
30	2027	0	70	70	1,997	196	2,193	2,123
31	2028	0	70	70	1,997	196	2,193	2,123
32	2029	0	70	70	1,997	196	2,193	2,123
33	2030	0	70	70	1,997	196	2,193	2,123
34	2031	0	70	70	1,997	196	2,193	2,123
35	2032	0	70	70	1,997	196	2,193	2,123
36	2033	0	70	70	1,997	196	2,193	2,123
37	2034	0	70	70	1,997	196	2,193	2,123
38	2035	0	70	70	1,997	196	2,193	2,123
39	2036	0	70	70	1,997	196	2,193	2,123
40	2037	0	70	70	1,997	196	2,193	2,123
41	2038	0	70	70	1,997	196	2,193	2,123
42	2039	0	70	70	1,997	196	2,193	2,123
43	2040	0	70	70	1,997	196	2,193	2,123
44	2041	0	70	70	1,997	196	2,193	2,123
45	2042	0	70	70	1,997	196	2,193	2,123
46	2043	0	70	70	1,997	196	2,193	2,123
47	2044	0	70	70	1,997	196	2,193	2,123
48	2045	0	70	70	1,997	196	2,193	2,123
49	2046	0	70	70	1,997	196	2,193	2,123
50	2047	0	70	70	1,997	196	2,193	2,123
51	2048	0	70	70	1,997	196	2,193	2,123
52	2049	0	70	70	1,997	196	2,193	2,123
53	2050	0	70	70	1,997	196	2,193	2,123
54	2051	0	70	70	1,997	196	2,193	2,123
55	2052	0	70	70	1,997	196	2,193	2,123
56	2053	0	70	70	1,997	196	2,193	2,123
57	2054	0	70	70	1,997	196	2,193	2,123
58	2055	0	70	70	1,997	196	2,193	2,123
59	2056	0	70	70	1,997	196	2,193	2,123
60	2057	0	70	70	1,997	196	2,193	2,123
61	2058	0	70	70	1,997	196	2,193	2,123
62	2059	0	70	70	1,997	196	2,193	2,123
63	2060	0	70	70	1,997	196	2,193	2,123
64	2061	0	70	70	1,997	196	2,193	2,123
65	2062	0	70	70	1,997	196	2,193	2,123
66	2063	0	70	70	1,997	196	2,193	2,123
67	2064	0	70	70	1,997	196	2,193	2,123
68	2065	0	70	70	1,997	196	2,193	2,123
69	2066	0	70	70	1,997	196	2,193	2,123
70	2067	0	70	70	1,997	196	2,193	2,123
71	2068	0	70	70	1,997	196	2,193	2,123
		6,853	4,332	11,185	123,833	11,957	135,790	124,605
EIRR		21.10%						
		PV						
Discount rate(%)		BC	Cost		Benefit		NPV	
15		1.54	2,708	4,169			1,461	
12		2.00	3,298	6,588			3,291	
10		2.44	3,793	9,269			5,476	
5		4.71	5,760	26,845			21,145	
3		6.66	7,049	46,972			39,923	

Table 4.3.2 PROJECT EVALUATION (THAILAND)

		Economic cost			Economic benefit			Unit: million baht
		Construction	O&M	Total	General, etc.	Agri.	Economic Benefit	(F)/(C) Benefit-Cost
Year		(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	1998	1	0	1	0	0	0	-1
2	1999	56	0	56	0	0	0	-56
3	2000	87	0	87	0	0	0	-87
4	2001	103	0	103	0	0	0	-103
5	2002	640	0	640	0	0	0	-640
6	2003	1,216	0	1,216	0	0	0	-1,216
7	2004	2,097	0	2,097	0	0	0	-2,097
8	2005	2,109	2	2,111	78	15	93	-2,018
9	2006	1,270	33	1,303	285	48	333	-970
10	2007	768	33	801	285	48	333	-468
11	2008	0	82	82	3,037	177	3,214	3,132
12	2009	0	82	82	3,446	177	3,624	3,542
13	2010	0	82	82	3,446	177	3,624	3,542
14	2011	0	82	82	3,446	177	3,624	3,542
15	2012	0	82	82	3,446	177	3,624	3,542
16	2013	0	82	82	3,568	196	3,764	3,682
17	2014	0	82	82	3,568	196	3,764	3,682
18	2015	0	82	82	3,568	196	3,764	3,682
19	2016	0	82	82	3,568	196	3,764	3,682
20	2017	0	82	82	3,568	196	3,764	3,682
21	2018	0	82	82	3,568	196	3,764	3,682
22	2019	0	82	82	3,568	196	3,764	3,682
23	2020	0	82	82	3,568	196	3,764	3,682
24	2021	0	82	82	3,568	196	3,764	3,682
25	2022	0	82	82	3,568	196	3,764	3,682
26	2023	0	82	82	3,568	196	3,764	3,682
27	2024	0	82	82	3,568	196	3,764	3,682
28	2025	0	82	82	3,568	196	3,764	3,682
29	2026	0	82	82	3,568	196	3,764	3,682
30	2027	0	82	82	3,568	196	3,764	3,682
31	2028	0	82	82	3,568	196	3,764	3,682
32	2029	0	82	82	3,568	196	3,764	3,682
33	2030	0	82	82	3,568	196	3,764	3,682
34	2031	0	82	82	3,568	196	3,764	3,682
35	2032	0	82	82	3,568	196	3,764	3,682
36	2033	0	82	82	3,568	196	3,764	3,682
37	2034	0	82	82	3,568	196	3,764	3,682
38	2035	0	82	82	3,568	196	3,764	3,682
39	2036	0	82	82	3,568	196	3,764	3,682
40	2037	0	82	82	3,568	196	3,764	3,682
41	2038	0	82	82	3,568	196	3,764	3,682
42	2039	0	82	82	3,568	196	3,764	3,682
43	2040	0	82	82	3,568	196	3,764	3,682
44	2041	0	82	82	3,568	196	3,764	3,682
45	2042	0	82	82	3,568	196	3,764	3,682
46	2043	0	82	82	3,568	196	3,764	3,682
47	2044	0	82	82	3,568	196	3,764	3,682
48	2045	0	82	82	3,568	196	3,764	3,682
49	2046	0	82	82	3,568	196	3,764	3,682
50	2047	0	82	82	3,568	196	3,764	3,682
51	2048	0	82	82	3,568	196	3,764	3,682
52	2049	0	82	82	3,568	196	3,764	3,682
53	2050	0	82	82	3,568	196	3,764	3,682
54	2051	0	82	82	3,568	196	3,764	3,682
55	2052	0	82	82	3,568	196	3,764	3,682
56	2053	0	82	82	3,568	196	3,764	3,682
57	2054	0	82	82	3,568	196	3,764	3,682
58	2055	0	82	82	3,568	196	3,764	3,682
59	2056	0	82	82	3,568	196	3,764	3,682
60	2057	0	82	82	3,568	196	3,764	3,682
61	2058	0	82	82	3,568	196	3,764	3,682
62	2059	0	82	82	3,568	196	3,764	3,682
63	2060	0	82	82	3,568	196	3,764	3,682
64	2061	0	82	82	3,568	196	3,764	3,682
65	2062	0	82	82	3,568	196	3,764	3,682
66	2063	0	82	82	3,568	196	3,764	3,682
67	2064	0	82	82	3,568	196	3,764	3,682
68	2065	0	82	82	3,568	196	3,764	3,682
69	2066	0	82	82	3,568	196	3,764	3,682
70	2067	0	82	82	3,568	196	3,764	3,682
71	2068	0	82	82	3,568	196	3,764	3,682
		8,346	3,064	13,410	217,278	81,955	229,233	215,823
EIRR		24.02%						
				PV				
Discount rate(%)		BC	Cost		Benefit		NPV	
15		1.95	3,184		6,204		3,020	
12		2.58	3,900		10,073		6,173	
10		3.20	4,503		14,432		9,929	
5		6.41	6,825		43,725		36,901	
3		9.20	8,457		77,771		69,313	

Table 4.3.3 PROJECT EVALUATION (THAILAND)

Alt-2-2 (excluding Dams)		Unit: million baht						
Economic cost			Economic benefit					
Year	Construction (A)	O&M (B)	Total (C)	General etc. (D)	Agri (E)	Economic Benefit (F)	(F/C) Benefit-Cost (G)	
1	1998	15	0	15	0	0	0	-15
2	1999	56	0	56	0	0	0	-56
3	2000	87	0	87	0	0	0	-87
4	2001	104	0	104	0	0	0	-104
5	2002	653	0	653	0	0	0	-653
6	2003	1,225	0	1,225	0	0	0	-1,225
7	2004	1,948	0	1,948	0	0	0	-1,948
8	2005	2,636	2	2,638	78	15	93	-2,545
9	2006	1,799	33	1,832	285	48	333	-1,499
10	2007	1,513	33	1,546	285	48	333	-1,213
11	2008	1,034	70	1,104	1,313	232	1,545	441
12	2009	2,245	70	2,315	1,313	232	1,545	-770
13	2010	2,422	70	2,492	1,313	232	1,545	-947
14	2011	4,169	70	4,239	1,313	232	1,545	-2,694
15	2012	6,120	70	6,190	1,313	232	1,545	-4,645
16	2013	6,109	70	6,178	1,313	232	1,545	-4,633
17	2014	2,303	70	2,373	4,634	201	4,835	2,462
18	2015	1,955	70	2,025	4,634	201	4,835	2,810
19	2016	2,193	70	2,263	4,634	201	4,835	2,572
20	2017	799	237	1,036	5,529	224	5,752	4,716
21	2018	472	237	709	5,851	229	6,092	5,383
22	2019	0	280	280	5,851	227	6,078	5,798
23	2020	0	280	280	5,851	227	6,078	5,798
24	2021	0	280	280	5,851	227	6,078	5,798
25	2022	0	280	280	5,851	227	6,078	5,798
26	2023	0	280	280	5,851	227	6,078	5,798
27	2024	0	280	280	5,851	227	6,078	5,798
28	2025	0	280	280	5,851	227	6,078	5,798
29	2026	0	280	280	5,851	227	6,078	5,798
30	2027	0	280	280	5,851	227	6,078	5,798
31	2028	0	280	280	5,851	227	6,078	5,798
32	2029	0	280	280	5,851	227	6,078	5,798
33	2030	0	280	280	5,851	227	6,078	5,798
34	2031	0	280	280	5,851	227	6,078	5,798
35	2032	0	280	280	5,851	227	6,078	5,798
36	2033	0	280	280	5,851	227	6,078	5,798
37	2034	0	280	280	5,851	227	6,078	5,798
38	2035	0	280	280	5,851	227	6,078	5,798
39	2036	0	280	280	5,851	227	6,078	5,798
40	2037	0	280	280	5,851	227	6,078	5,798
41	2038	0	280	280	5,851	227	6,078	5,798
42	2039	0	280	280	5,851	227	6,078	5,798
43	2040	0	280	280	5,851	227	6,078	5,798
44	2041	0	280	280	5,851	227	6,078	5,798
45	2042	0	280	280	5,851	227	6,078	5,798
46	2043	0	280	280	5,851	227	6,078	5,798
47	2044	0	280	280	5,851	227	6,078	5,798
48	2045	0	280	280	5,851	227	6,078	5,798
49	2046	0	280	280	5,851	227	6,078	5,798
50	2047	0	280	280	5,851	227	6,078	5,798
51	2048	0	280	280	5,851	227	6,078	5,798
52	2049	0	280	280	5,851	227	6,078	5,798
53	2050	0	280	280	5,851	227	6,078	5,798
54	2051	0	280	280	5,851	227	6,078	5,798
55	2052	0	280	280	5,851	227	6,078	5,798
56	2053	0	280	280	5,851	227	6,078	5,798
57	2054	0	280	280	5,851	227	6,078	5,798
58	2055	0	280	280	5,851	227	6,078	5,798
59	2056	0	280	280	5,851	227	6,078	5,798
60	2057	0	280	280	5,851	227	6,078	5,798
61	2058	0	280	280	5,851	227	6,078	5,798
62	2059	0	280	280	5,851	227	6,078	5,798
63	2060	0	280	280	5,851	227	6,078	5,798
64	2061	0	280	280	5,851	227	6,078	5,798
65	2062	0	280	280	5,851	227	6,078	5,798
66	2063	0	280	280	5,851	227	6,078	5,798
67	2064	0	280	280	5,851	227	6,078	5,798
68	2065	0	280	280	5,851	227	6,078	5,798
69	2066	0	280	280	5,851	227	6,078	5,798
70	2067	0	280	280	5,851	227	6,078	5,798
71	2068	0	280	280	5,851	227	6,078	5,798
		39,856	15,166	55,022	326,370	13,908	340,277	285,256
EIRR		12.01%						
		PV						
Discount rate(%)		B/C	Cost	Benefit	NPV			
15		0.77	7,362	5,658	-1,703			
12		1.00	10,030	10,036	6			
10		1.23	12,513	15,345	2,832			
5		2.37	23,407	55,511	32,104			
3		3.36	31,534	105,851	74,317			

Table 4.3.4 PROJECT EVALUATION (THAILAND)

Alt-1 (Including Dams)		Unit: million baht						
Year	Economic cost			Economic benefit				
	Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	Economic Benefit (F)	(F)-(C) Benefit-Cost (G)	
1	1998	15	0	15	0	0	0	-15
2	1999	66	0	66	0	0	0	-66
3	2000	97	0	97	0	0	0	-97
4	2001	96	45	141	142	28	170	29
5	2002	623	45	668	142	28	170	-498
6	2003	1,199	45	1,244	142	28	170	-1,074
7	2004	1,939	45	1,984	142	28	170	-1,814
8	2005	1,602	47	1,649	220	43	263	-1,386
9	2006	765	83	848	1,616	81	1,697	849
10	2007	484	83	567	1,616	81	1,697	1,130
11	2008	5	120	125	2,644	265	2,909	2,784
12	2009	0	120	120	2,679	267	2,946	2,826
13	2010	0	120	120	2,679	267	2,946	2,826
14	2011	5	120	125	2,679	267	2,946	2,821
15	2012	5	120	125	2,679	267	2,946	2,821
16	2013	0	464	464	2,989	279	3,268	2,804
17	2014	0	464	464	2,989	279	3,268	2,804
18	2015	0	464	464	2,989	279	3,268	2,804
19	2016	0	464	464	2,989	279	3,268	2,804
20	2017	0	464	464	2,989	279	3,268	2,804
21	2018	0	464	464	2,989	279	3,268	2,804
22	2019	0	464	464	2,989	279	3,268	2,804
23	2020	0	464	464	2,989	279	3,268	2,804
24	2021	0	464	464	2,989	279	3,268	2,804
25	2022	0	464	464	2,989	279	3,268	2,804
26	2023	0	464	464	2,989	279	3,268	2,804
27	2024	0	464	464	2,989	279	3,268	2,804
28	2025	0	464	464	2,989	279	3,268	2,804
29	2026	0	464	464	2,989	279	3,268	2,804
30	2027	0	464	464	2,989	279	3,268	2,804
31	2028	0	464	464	2,989	279	3,268	2,804
32	2029	0	464	464	2,989	279	3,268	2,804
33	2030	0	464	464	2,989	279	3,268	2,804
34	2031	0	464	464	2,989	279	3,268	2,804
35	2032	0	464	464	2,989	279	3,268	2,804
36	2033	0	464	464	2,989	279	3,268	2,804
37	2034	0	464	464	2,989	279	3,268	2,804
38	2035	0	464	464	2,989	279	3,268	2,804
39	2036	0	464	464	2,989	279	3,268	2,804
40	2037	0	464	464	2,989	279	3,268	2,804
41	2038	0	464	464	2,989	279	3,268	2,804
42	2039	0	464	464	2,989	279	3,268	2,804
43	2040	0	464	464	2,989	279	3,268	2,804
44	2041	0	464	464	2,989	279	3,268	2,804
45	2042	0	464	464	2,989	279	3,268	2,804
46	2043	0	464	464	2,989	279	3,268	2,804
47	2044	0	464	464	2,989	279	3,268	2,804
48	2045	0	464	464	2,989	279	3,268	2,804
49	2046	0	464	464	2,989	279	3,268	2,804
50	2047	0	464	464	2,989	279	3,268	2,804
51	2048	0	464	464	2,989	279	3,268	2,804
52	2049	0	464	464	2,989	279	3,268	2,804
53	2050	0	464	464	2,989	279	3,268	2,804
54	2051	0	464	464	2,989	279	3,268	2,804
55	2052	0	464	464	2,989	279	3,268	2,804
56	2053	0	464	464	2,989	279	3,268	2,804
57	2054	0	464	464	2,989	279	3,268	2,804
58	2055	0	464	464	2,989	279	3,268	2,804
59	2056	0	464	464	2,989	279	3,268	2,804
60	2057	0	464	464	2,989	279	3,268	2,804
61	2058	0	464	464	2,989	279	3,268	2,804
62	2059	0	464	464	2,989	279	3,268	2,804
63	2060	0	464	464	2,989	279	3,268	2,804
64	2061	0	464	464	2,989	279	3,268	2,804
65	2062	0	464	464	2,989	279	3,268	2,804
66	2063	0	464	464	2,989	279	3,268	2,804
67	2064	0	464	464	2,989	279	3,268	2,804
68	2065	0	464	464	2,989	279	3,268	2,804
69	2066	0	464	464	2,989	279	3,268	2,804
70	2067	0	464	464	2,989	279	3,268	2,804
71	2068	0	464	464	2,989	279	3,268	2,804
		6,900	26,971	33,871	184,764	17,274	202,038	168,167
EIRR		28.81%						
				PV				
Discount rate(%)		BC	Cost		Benefit	NPV		
15		1.99	3,224		6,416	3,192		
12		2.42	4,132		10,007	5,875		
10		2.79	5,004		13,950	8,976		
5		4.13	9,644		40,036	30,392		
3		4.83	14,342		69,925	55,582		

Table 4.3.5 PROJECT EVALUATION (THAILAND)

Alt. 2.1 (Including Dams)				Unit: million baht				
Year	Economic cost			Economic benefit			Benefit-Cost (F/C)	
	Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	Economic Benefit (F)		
1	1998	15	0	15	0	0	-15	
2	1999	66	0	66	0	0	-66	
3	2000	97	0	97	0	0	-97	
4	2001	100	45	145	142	28	28	
5	2002	636	45	681	142	28	-511	
6	2003	1,216	45	1,261	142	28	-1,091	
7	2004	2,097	45	2,142	142	28	-1,972	
8	2005	2,109	47	2,156	220	43	-1,893	
9	2006	1,270	83	1,353	932	80	-341	
10	2007	773	83	856	932	80	156	
11	2008	5	132	137	4,215	267	4,482	
12	2009	0	132	132	4,250	266	4,516	
13	2010	0	132	132	4,250	266	4,516	
14	2011	5	132	137	4,250	266	4,379	
15	2012	5	132	137	4,250	266	4,379	
16	2013	0	476	476	4,560	278	4,838	
17	2014	0	476	476	4,560	278	4,838	
18	2015	0	476	476	4,560	278	4,838	
19	2016	0	476	476	4,560	278	4,838	
20	2017	0	476	476	4,560	278	4,838	
21	2018	0	476	476	4,560	278	4,838	
22	2019	0	476	476	4,560	278	4,838	
23	2020	0	476	476	4,560	278	4,838	
24	2021	0	476	476	4,560	278	4,838	
25	2022	0	476	476	4,560	278	4,838	
26	2023	0	476	476	4,560	278	4,838	
27	2024	0	476	476	4,560	278	4,838	
28	2025	0	476	476	4,560	278	4,838	
29	2026	0	476	476	4,560	278	4,838	
30	2027	0	476	476	4,560	278	4,838	
31	2028	0	476	476	4,560	278	4,838	
32	2029	0	476	476	4,560	278	4,838	
33	2030	0	476	476	4,560	278	4,838	
34	2031	0	476	476	4,560	278	4,838	
35	2032	0	476	476	4,560	278	4,838	
36	2033	0	476	476	4,560	278	4,838	
37	2034	0	476	476	4,560	278	4,838	
38	2035	0	476	476	4,560	278	4,838	
39	2035	0	476	476	4,560	278	4,838	
40	2037	0	476	476	4,560	278	4,838	
41	2038	0	476	476	4,560	278	4,838	
42	2039	0	476	476	4,560	278	4,838	
43	2040	0	476	476	4,560	278	4,838	
44	2041	0	476	476	4,560	278	4,838	
45	2042	0	476	476	4,560	278	4,838	
46	2043	0	476	476	4,560	278	4,838	
47	2044	0	476	476	4,560	278	4,838	
48	2045	0	476	476	4,560	278	4,838	
49	2046	0	476	476	4,560	278	4,838	
50	2047	0	476	476	4,560	278	4,838	
51	2048	0	476	476	4,560	278	4,838	
52	2049	0	476	476	4,560	278	4,838	
53	2050	0	476	476	4,560	278	4,838	
54	2051	0	476	476	4,560	278	4,838	
55	2052	0	476	476	4,560	278	4,838	
56	2053	0	476	476	4,560	278	4,838	
57	2054	0	476	476	4,560	278	4,838	
58	2055	0	476	476	4,560	278	4,838	
59	2056	0	476	476	4,560	278	4,838	
60	2057	0	476	476	4,560	278	4,838	
61	2058	0	476	476	4,560	278	4,838	
62	2059	0	476	476	4,560	278	4,838	
63	2060	0	476	476	4,560	278	4,838	
64	2061	0	476	476	4,560	278	4,838	
65	2062	0	476	476	4,560	278	4,838	
66	2063	0	476	476	4,560	278	4,838	
67	2064	0	476	476	4,560	278	4,838	
68	2065	0	476	476	4,560	278	4,838	
69	2066	0	476	476	4,560	278	4,838	
70	2067	0	476	476	4,560	278	4,838	
71	2068	0	476	476	4,560	278	4,838	
		8,393	21,703	36,096	279,227	17,214	296,441	260,345
		IRR		30.63%				
				PV				
		Discount rate(%)	BC	Cost	Benefit	NPV		
		15	2.33	3,700	8,640	4,939		
		12	2.90	4,735	13,749	9,014		
		10	3.41	5,713	19,461	13,748		
		5	5.34	10,769	57,470	46,701		
		3	6.44	15,751	101,416	85,665		

Table 4.3.6 PROJECT EVALUATION (THAILAND)

Alt-2.2 (Including Dams)				Unit: million baht				
Economic cost			Economic benefit					
Year	Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri (E)	Tot Economic Benefit (F)	(F)-(C) Benefit-Cost (G)	
1	1998	15	0	15	0	0	0	-15
2	1999	66	0	66	0	0	0	-66
3	2000	97	0	97	0	0	0	-97
4	2001	101	45	146	142	28	170	24
5	2002	649	45	694	142	28	170	-524
6	2003	1,225	45	1,270	142	28	170	-1,100
7	2004	1,948	45	1,993	142	28	170	-1,823
8	2005	2,635	47	2,683	220	43	263	-2,420
9	2006	1,799	83	1,882	932	80	1,012	-870
10	2007	1,518	83	1,601	932	80	1,012	-589
11	2008	1,039	120	1,159	1,960	264	2,224	1,065
12	2009	2,245	120	2,365	1,995	266	2,261	-104
13	2010	2,422	120	2,542	1,995	266	2,261	-281
14	2011	4,174	120	4,294	1,995	266	2,261	-2,033
15	2012	5,392	120	5,512	1,995	266	2,261	-3,251
16	2013	6,109	464	6,572	2,305	278	2,583	-3,989
17	2014	2,313	464	2,777	4,739	219	4,958	2,181
18	2015	1,962	464	2,426	4,739	219	4,958	2,532
19	2016	2,352	464	2,816	5,218	213	5,431	2,615
20	2017	1,082	631	1,713	5,529	224	5,752	4,039
21	2018	753	631	1,384	6,043	257	6,300	4,916
22	2019	0	671	671	6,043	257	6,300	5,629
23	2020	0	671	671	6,043	257	6,300	5,629
24	2021	0	671	671	6,043	257	6,300	5,629
25	2022	0	671	671	6,043	257	6,300	5,629
26	2023	0	671	671	6,043	257	6,300	5,629
27	2024	0	671	671	6,043	257	6,300	5,629
28	2025	0	671	671	6,043	257	6,300	5,629
29	2026	0	671	671	6,043	257	6,300	5,629
30	2027	0	671	671	6,043	257	6,300	5,629
31	2028	0	671	671	6,043	257	6,300	5,629
32	2029	0	671	671	6,043	257	6,300	5,629
33	2030	0	671	671	6,043	257	6,300	5,629
34	2031	0	671	671	6,043	257	6,300	5,629
35	2032	0	671	671	6,043	257	6,300	5,629
36	2033	0	671	671	6,043	257	6,300	5,629
37	2034	0	671	671	6,043	257	6,300	5,629
38	2035	0	671	671	6,043	257	6,300	5,629
39	2036	0	671	671	6,043	257	6,300	5,629
40	2037	0	671	671	6,043	257	6,300	5,629
41	2038	0	671	671	6,043	257	6,300	5,629
42	2039	0	671	671	6,043	257	6,300	5,629
43	2040	0	671	671	6,043	257	6,300	5,629
44	2041	0	671	671	6,043	257	6,300	5,629
45	2042	0	671	671	6,043	257	6,300	5,629
46	2043	0	671	671	6,043	257	6,300	5,629
47	2044	0	671	671	6,043	257	6,300	5,629
48	2045	0	671	671	6,043	257	6,300	5,629
49	2046	0	671	671	6,043	257	6,300	5,629
50	2047	0	671	671	6,043	257	6,300	5,629
51	2048	0	671	671	6,043	257	6,300	5,629
52	2049	0	671	671	6,043	257	6,300	5,629
53	2050	0	671	671	6,043	257	6,300	5,629
54	2051	0	671	671	6,043	257	6,300	5,629
55	2052	0	671	671	6,043	257	6,300	5,629
56	2053	0	671	671	6,043	257	6,300	5,629
57	2054	0	671	671	6,043	257	6,300	5,629
58	2055	0	671	671	6,043	257	6,300	5,629
59	2056	0	671	671	6,043	257	6,300	5,629
60	2057	0	671	671	6,043	257	6,300	5,629
61	2058	0	671	671	6,043	257	6,300	5,629
62	2059	0	671	671	6,043	257	6,300	5,629
63	2060	0	671	671	6,043	257	6,300	5,629
64	2061	0	671	671	6,043	257	6,300	5,629
65	2062	0	671	671	6,043	257	6,300	5,629
66	2063	0	671	671	6,043	257	6,300	5,629
67	2064	0	671	671	6,043	257	6,300	5,629
68	2065	0	671	671	6,043	257	6,300	5,629
69	2066	0	671	671	6,043	257	6,300	5,629
70	2067	0	671	671	6,043	257	6,300	5,629
71	2068	0	671	671	6,043	257	6,300	5,629
		39,896	37,655	77,550	343,314	15,903	359,217	281,667
EIRR		13.79%						
				PV				
Discount rate(%)		B/C	Cost	Benefit	NPV			
15		0.93	7,819	7,243	-576			
12		1.13	10,792	12,219	1,427			
10		1.33	13,641	18,108	4,468			
5		2.25	27,243	61,228	33,985			
3		2.95	38,710	114,318	75,608			

Table 4.3.7 PROJECT EVALUATION (GHANA)

Distribution System Improvement				Unit: million bsh				
Economic cost			Economic benefit					
Year	Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	Economic Benefit (F)	(F)-(C) Benefit-Cost (G)	
1	1998	1	0	1	0	0	-1	
2	1999	3	0	3	0	0	-3	
3	2000	2	0	2	0	0	-2	
4	2001	45	0	45	0	0	-45	
5	2002	45	0	46	0	0	-46	
6	2003	68	0	68	0	0	-68	
7	2004	67	0	67	0	0	-67	
8	2005	0	2	2	78	15	93	
9	2006	0	2	2	78	15	93	
10	2007	0	2	2	78	15	93	
11	2008	0	2	2	78	15	93	
12	2009	0	2	2	78	15	93	
13	2010	0	2	2	78	15	93	
14	2011	0	2	2	78	15	93	
15	2012	0	2	2	78	15	93	
16	2013	0	2	2	78	15	93	
17	2014	0	2	2	78	15	93	
18	2015	0	2	2	78	15	93	
19	2016	0	2	2	78	15	93	
20	2017	0	2	2	78	15	93	
21	2018	0	2	2	78	15	93	
22	2019	0	2	2	78	15	93	
23	2020	0	2	2	78	15	93	
24	2021	0	2	2	78	15	93	
25	2022	0	2	2	78	15	93	
26	2023	0	2	2	78	15	93	
27	2024	0	2	2	78	15	93	
28	2025	0	2	2	78	15	93	
29	2026	0	2	2	78	15	93	
30	2027	0	2	2	78	15	93	
31	2028	0	2	2	78	15	93	
32	2029	0	2	2	78	15	93	
33	2030	0	2	2	78	15	93	
34	2031	0	2	2	78	15	93	
35	2032	0	2	2	78	15	93	
36	2033	0	2	2	78	15	93	
37	2034	0	2	2	78	15	93	
38	2035	0	2	2	78	15	93	
39	2036	0	2	2	78	15	93	
40	2037	0	2	2	78	15	93	
41	2038	0	2	2	78	15	93	
42	2039	0	2	2	78	15	93	
43	2040	0	2	2	78	15	93	
44	2041	0	2	2	78	15	93	
45	2042	0	2	2	78	15	93	
46	2043	0	2	2	78	15	93	
47	2044	0	2	2	78	15	93	
48	2045	0	2	2	78	15	93	
49	2046	0	2	2	78	15	93	
50	2047	0	2	2	78	15	93	
51	2048	0	2	2	78	15	93	
52	2049	0	2	2	78	15	93	
53	2050	0	2	2	78	15	93	
54	2051	0	2	2	78	15	93	
55	2052	0	2	2	78	15	93	
56	2053	0	2	2	78	15	93	
57	2054	0	2	2	78	15	93	
58	2055	0	2	2	78	15	93	
59	2056	0	2	2	78	15	93	
60	2057	0	2	2	78	15	93	
61	2058	0	2	2	78	15	93	
62	2059	0	2	2	78	15	93	
63	2060	0	2	2	78	15	93	
64	2061	0	2	2	78	15	93	
65	2062	0	2	2	78	15	93	
66	2063	0	2	2	78	15	93	
67	2064	0	2	2	78	15	93	
68	2065	0	2	2	78	15	93	
69	2066	0	2	2	78	15	93	
70	2067	0	2	2	78	15	93	
71	2068	0	2	2	78	15	93	
		231	122	353	4,992	960	5,952	5,599
EIRR		27.10%						
				PV				
Discount rate(%)	BC	Cost		Benefit		NPV		
15	2.09	112		233		121		
12	2.68	131		350		220		
10	3.26	146		476		330		
5	6.26	202		1,264		1,062		
3	8.93	240		2,140		1,901		

Table 4.3.8 PROJECT EVALUATION (THAILAND)

Drainage System Improvement			Unit: million baht					
Economic cost			Economic benefit					
Year	Construction (A)	O&M (B)	Total (C)	Benefit (F/B/C)			Benefit-Cost (G)	
				General, etc. (D)	Agri. (E)	Economic Benefit (F)		
1	1998	0	0	0	0	0	0	
2	1999	41	0	41	0	0	-41	
3	2000	55	0	55	0	0	-55	
4	2001	28	0	28	0	0	-28	
5	2002	287	0	287	0	0	-287	
6	2003	833	0	833	0	0	-833	
7	2004	1,579	0	1,579	0	0	-1,579	
8	2005	1,316	0	1,316	0	0	-1,316	
9	2006	765	0	765	0	0	-765	
10	2007	493	0	493	0	0	-493	
11	2008	0	37	37	1,028	184	1,212	
12	2009	0	37	37	1,028	184	1,212	
13	2010	0	37	37	1,028	184	1,212	
14	2011	0	37	37	1,028	184	1,212	
15	2012	0	37	37	1,028	184	1,212	
16	2013	0	37	37	1,028	184	1,212	
17	2014	0	37	37	1,028	184	1,212	
18	2015	0	37	37	1,028	184	1,212	
19	2016	0	37	37	1,028	184	1,212	
20	2017	0	37	37	1,028	184	1,212	
21	2018	0	37	37	1,028	184	1,212	
22	2019	0	37	37	1,028	184	1,212	
23	2020	0	37	37	1,028	184	1,212	
24	2021	0	37	37	1,028	184	1,212	
25	2022	0	37	37	1,028	184	1,212	
26	2023	0	37	37	1,028	184	1,212	
27	2024	0	37	37	1,028	184	1,212	
28	2025	0	37	37	1,028	184	1,212	
29	2026	0	37	37	1,028	184	1,212	
30	2027	0	37	37	1,028	184	1,212	
31	2028	0	37	37	1,028	184	1,212	
32	2029	0	37	37	1,028	184	1,212	
33	2030	0	37	37	1,028	184	1,212	
34	2031	0	37	37	1,028	184	1,212	
35	2032	0	37	37	1,028	184	1,212	
36	2033	0	37	37	1,028	184	1,212	
37	2034	0	37	37	1,028	184	1,212	
38	2035	0	37	37	1,028	184	1,212	
39	2036	0	37	37	1,028	184	1,212	
40	2037	0	37	37	1,028	184	1,212	
41	2038	0	37	37	1,028	184	1,212	
42	2039	0	37	37	1,028	184	1,212	
43	2040	0	37	37	1,028	184	1,212	
44	2041	0	37	37	1,028	184	1,212	
45	2042	0	37	37	1,028	184	1,212	
46	2043	0	37	37	1,028	184	1,212	
47	2044	0	37	37	1,028	184	1,212	
48	2045	0	37	37	1,028	184	1,212	
49	2046	0	37	37	1,028	184	1,212	
50	2047	0	37	37	1,028	184	1,212	
51	2048	0	37	37	1,028	184	1,212	
52	2049	0	37	37	1,028	184	1,212	
53	2050	0	37	37	1,028	184	1,212	
54	2051	0	37	37	1,028	184	1,212	
55	2052	0	37	37	1,028	184	1,212	
56	2053	0	37	37	1,028	184	1,212	
57	2054	0	37	37	1,028	184	1,212	
58	2055	0	37	37	1,028	184	1,212	
59	2056	0	37	37	1,028	184	1,212	
60	2057	0	37	37	1,028	184	1,212	
61	2058	0	37	37	1,028	184	1,212	
62	2059	0	37	37	1,028	184	1,212	
63	2060	0	37	37	1,028	184	1,212	
64	2061	0	37	37	1,028	184	1,212	
65	2062	0	37	37	1,028	184	1,212	
66	2063	0	37	37	1,028	184	1,212	
67	2064	0	37	37	1,028	184	1,212	
68	2065	0	37	37	1,028	184	1,212	
69	2066	0	37	37	1,028	184	1,212	
70	2067	0	37	37	1,028	184	1,212	
71	2068	0	37	37	1,028	184	1,212	
		5,402	2,257	2,659	62,708	11,224	73,932	66,273
ERR		14.91%						
		PV						
Discount rate(%)	B/C	Cost		Benefit		NPV		
15	0.99	2,012		1,997		-15		
12	1.32	2,457		3,249		792		
10	1.65	2,826		4,659		1,832		
5	3.36	4,198		14,123		9,925		
3	4.92	5,106		25,108		20,002		

Table 4.3.9 PROJECT EVALUATION (THAILAND)

Year		Economic cost			Economic benefit				Unit: million baht
		Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	tu Economic Benefit (F)	(F)/(C) Benefit-Cost (G)	
1	1998	0	0	0	0	0	0	0	
2	1999	0	0	0	0	0	0	0	
3	2000	0	0	0	0	0	0	0	
4	2001	4	0	4	0	0	0	-4	
5	2002	13	0	13	0	0	0	-13	
6	2003	17	0	17	0	0	0	-17	
7	2004	158	0	158	0	0	0	-158	
8	2005	507	0	507	0	0	0	-507	
9	2006	505	0	505	0	0	0	-505	
10	2007	289	0	289	0	0	0	-289	
11	2008	0	12	12	2,255	3	2,258	2,246	
12	2009	0	12	12	2,255	3	2,258	2,246	
13	2010	0	12	12	2,255	3	2,258	2,246	
14	2011	0	12	12	2,255	3	2,258	2,246	
15	2012	0	12	12	2,255	3	2,258	2,246	
16	2013	0	12	12	2,255	3	2,258	2,246	
17	2014	0	12	12	2,255	3	2,258	2,246	
18	2015	0	12	12	2,255	3	2,258	2,246	
19	2016	0	12	12	2,255	3	2,258	2,246	
20	2017	0	12	12	2,255	3	2,258	2,246	
21	2018	0	12	12	2,255	3	2,258	2,246	
22	2019	0	12	12	2,255	3	2,258	2,246	
23	2020	0	12	12	2,255	3	2,258	2,246	
24	2021	0	12	12	2,255	3	2,258	2,246	
25	2022	0	12	12	2,255	3	2,258	2,246	
26	2023	0	12	12	2,255	3	2,258	2,246	
27	2024	0	12	12	2,255	3	2,258	2,246	
28	2025	0	12	12	2,255	3	2,258	2,246	
29	2026	0	12	12	2,255	3	2,258	2,246	
30	2027	0	12	12	2,255	3	2,258	2,246	
31	2028	0	12	12	2,255	3	2,258	2,246	
32	2029	0	12	12	2,255	3	2,258	2,246	
33	2030	0	12	12	2,255	3	2,258	2,246	
34	2031	0	12	12	2,255	3	2,258	2,246	
35	2032	0	12	12	2,255	3	2,258	2,246	
36	2033	0	12	12	2,255	3	2,258	2,246	
37	2034	0	12	12	2,255	3	2,258	2,246	
38	2035	0	12	12	2,255	3	2,258	2,246	
39	2036	0	12	12	2,255	3	2,258	2,246	
40	2037	0	12	12	2,255	3	2,258	2,246	
41	2038	0	12	12	2,255	3	2,258	2,246	
42	2039	0	12	12	2,255	3	2,258	2,246	
43	2040	0	12	12	2,255	3	2,258	2,246	
44	2041	0	12	12	2,255	3	2,258	2,246	
45	2042	0	12	12	2,255	3	2,258	2,246	
46	2043	0	12	12	2,255	3	2,258	2,246	
47	2044	0	12	12	2,255	3	2,258	2,246	
48	2045	0	12	12	2,255	3	2,258	2,246	
49	2046	0	12	12	2,255	3	2,258	2,246	
50	2047	0	12	12	2,255	3	2,258	2,246	
51	2048	0	12	12	2,255	3	2,258	2,246	
52	2049	0	12	12	2,255	3	2,258	2,246	
53	2050	0	12	12	2,255	3	2,258	2,246	
54	2051	0	12	12	2,255	3	2,258	2,246	
55	2052	0	12	12	2,255	3	2,258	2,246	
56	2053	0	12	12	2,255	3	2,258	2,246	
57	2054	0	12	12	2,255	3	2,258	2,246	
58	2055	0	12	12	2,255	3	2,258	2,246	
59	2056	0	12	12	2,255	3	2,258	2,246	
60	2057	0	12	12	2,255	3	2,258	2,246	
61	2058	0	12	12	2,255	3	2,258	2,246	
62	2059	0	12	12	2,255	3	2,258	2,246	
63	2060	0	12	12	2,255	3	2,258	2,246	
64	2061	0	12	12	2,255	3	2,258	2,246	
65	2062	0	12	12	2,255	3	2,258	2,246	
66	2063	0	12	12	2,255	3	2,258	2,246	
67	2064	0	12	12	2,255	3	2,258	2,246	
68	2065	0	12	12	2,255	3	2,258	2,246	
69	2066	0	12	12	2,255	3	2,258	2,246	
70	2067	0	12	12	2,255	3	2,258	2,246	
71	2068	0	12	12	2,255	3	2,258	2,246	
		1,493	732	2,225	137,555	183	137,738	135,513	
EIRR		63.75%							
		PV							
Discount rate(%)		F/C	Cost		Benefit		NPV		
15		7.81	476	3,720			3,244		
12		10.05	602	6,052			5,450		
10		12.23	710	8,680			7,970		
5		23.40	1,124	26,311			25,186		
3		33.21	1,468	46,776			45,368		

Table 4.3.10 PROJECT EVALUATION (THAILAND)

River Improvement 1		Unit: million baht						
Economic cost			Economic benefit				(F)-(C)	
Year		Construction (A)	O&M (B)	Total (C)	Economic benefit		Benefit- Cost (G)	
					General etc. (D)	Agri. (E)		Tu Economic Benefit (F)
1	1998	0	0	0	0	0	0	
2	1999	12	0	12	0	0	-12	
3	2000	30	0	30	0	0	-30	
4	2001	26	0	26	0	0	-26	
5	2002	294	0	294	0	0	-294	
6	2003	293	0	293	0	0	-293	
7	2004	293	0	293	0	0	-293	
8	2005	286	0	286	0	0	-286	
9	2006	0	31	31	207	33	209	
10	2007	0	31	31	207	33	209	
11	2008	0	31	31	207	33	209	
12	2009	0	31	31	207	33	209	
13	2010	0	31	31	207	33	209	
14	2011	0	31	31	207	33	209	
15	2012	0	31	31	207	33	209	
16	2013	0	31	31	207	33	209	
17	2014	0	31	31	207	33	209	
18	2015	0	31	31	207	33	209	
19	2016	0	31	31	207	33	209	
20	2017	0	31	31	207	33	209	
21	2018	0	31	31	207	33	209	
22	2019	0	31	31	207	33	209	
23	2020	0	31	31	207	33	209	
24	2021	0	31	31	207	33	209	
25	2022	0	31	31	207	33	209	
26	2023	0	31	31	207	33	209	
27	2024	0	31	31	207	33	209	
28	2025	0	31	31	207	33	209	
29	2026	0	31	31	207	33	209	
30	2027	0	31	31	207	33	209	
31	2028	0	31	31	207	33	209	
32	2029	0	31	31	207	33	209	
33	2030	0	31	31	207	33	209	
34	2031	0	31	31	207	33	209	
35	2032	0	31	31	207	33	209	
36	2033	0	31	31	207	33	209	
37	2034	0	31	31	207	33	209	
38	2035	0	31	31	207	33	209	
39	2036	0	31	31	207	33	209	
40	2037	0	31	31	207	33	209	
41	2038	0	31	31	207	33	209	
42	2039	0	31	31	207	33	209	
43	2040	0	31	31	207	33	209	
44	2041	0	31	31	207	33	209	
45	2042	0	31	31	207	33	209	
46	2043	0	31	31	207	33	209	
47	2044	0	31	31	207	33	209	
48	2045	0	31	31	207	33	209	
49	2046	0	31	31	207	33	209	
50	2047	0	31	31	207	33	209	
51	2048	0	31	31	207	33	209	
52	2049	0	31	31	207	33	209	
53	2050	0	31	31	207	33	209	
54	2051	0	31	31	207	33	209	
55	2052	0	31	31	207	33	209	
56	2053	0	31	31	207	33	209	
57	2054	0	31	31	207	33	209	
58	2055	0	31	31	207	33	209	
59	2056	0	31	31	207	33	209	
60	2057	0	31	31	207	33	209	
61	2058	0	31	31	207	33	209	
62	2059	0	31	31	207	33	209	
63	2060	0	31	31	207	33	209	
64	2061	0	31	31	207	33	209	
65	2062	0	31	31	207	33	209	
66	2063	0	31	31	207	33	209	
67	2064	0	31	31	207	33	209	
68	2065	0	31	31	207	33	209	
69	2066	0	31	31	207	33	209	
70	2067	0	31	31	207	33	209	
71	2068	0	31	31	207	33	209	
		1,234	4,953	3,187	13,041	2,079	15,120	11,933
FIRR		13.47%						
				PV				
Discount rate(%)		BC	Cost		Benefit	NPV		
15		0.89	588		523	-65		
12		1.13	715		807	92		
10		1.35	826		1,117	291		
5		2.37	1,309		3,099	1,789		
3		3.11	1,714		5,334	3,620		

Table 4.3.11 PROJECT EVALUATION (THAILAND)

River Improvement 2		Unit: million baht						
Year		Economic cost			Economic benefit			
		Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri (E)	tu Economic Benefit (F)	(F)-(C) Benefit- Cost (G)
1	1998	0	0	0	0	0	0	0
2	1999	0	0	0	0	0	0	0
3	2000	0	0	0	0	0	0	0
4	2001	0	0	0	0	0	0	0
5	2002	0	0	0	0	0	0	0
6	2003	0	0	0	0	0	0	0
7	2004	0	0	0	0	0	0	0
8	2005	0	0	0	0	0	0	0
9	2006	0	0	0	0	0	0	0
10	2007	0	0	0	0	0	0	0
11	2008	0	0	0	0	0	0	0
12	2009	0	0	0	0	0	0	0
13	2010	0	0	0	0	0	0	0
14	2011	0	0	0	0	0	0	0
15	2012	0	0	0	0	0	0	0
16	2013	0	0	0	0	0	0	0
17	2014	31	0	31	0	0	0	-31
18	2015	35	0	35	0	0	0	-35
19	2016	425	0	425	0	0	0	-425
20	2017	682	0	682	0	0	0	-682
21	2018	414	0	414	0	0	0	-414
22	2019	0	40	40	-16,052	84	-15,968	-16,008
23	2020	0	40	40	-16,052	84	-15,968	-16,008
24	2021	0	40	40	-16,052	84	-15,968	-16,008
25	2022	0	40	40	-16,052	84	-15,968	-16,008
26	2023	0	40	40	-16,052	84	-15,968	-16,008
27	2024	0	40	40	-16,052	84	-15,968	-16,008
28	2025	0	40	40	-16,052	84	-15,968	-16,008
29	2026	0	40	40	-16,052	84	-15,968	-16,008
30	2027	0	40	40	-16,052	84	-15,968	-16,008
31	2028	0	40	40	-16,052	84	-15,968	-16,008
32	2029	0	40	40	-16,052	84	-15,968	-16,008
33	2030	0	40	40	-16,052	84	-15,968	-16,008
34	2031	0	40	40	-16,052	84	-15,968	-16,008
35	2032	0	40	40	-16,052	84	-15,968	-16,008
36	2033	0	40	40	-16,052	84	-15,968	-16,008
37	2034	0	40	40	-16,052	84	-15,968	-16,008
38	2035	0	40	40	-16,052	84	-15,968	-16,008
39	2036	0	40	40	-16,052	84	-15,968	-16,008
40	2037	0	40	40	-16,052	84	-15,968	-16,008
41	2038	0	40	40	-16,052	84	-15,968	-16,008
42	2039	0	40	40	-16,052	84	-15,968	-16,008
43	2040	0	40	40	-16,052	84	-15,968	-16,008
44	2041	0	40	40	-16,052	84	-15,968	-16,008
45	2042	0	40	40	-16,052	84	-15,968	-16,008
46	2043	0	40	40	-16,052	84	-15,968	-16,008
47	2044	0	40	40	-16,052	84	-15,968	-16,008
48	2045	0	40	40	-16,052	84	-15,968	-16,008
49	2046	0	40	40	-16,052	84	-15,968	-16,008
50	2047	0	40	40	-16,052	84	-15,968	-16,008
51	2048	0	40	40	-16,052	84	-15,968	-16,008
52	2049	0	40	40	-16,052	84	-15,968	-16,008
53	2050	0	40	40	-16,052	84	-15,968	-16,008
54	2051	0	40	40	-16,052	84	-15,968	-16,008
55	2052	0	40	40	-16,052	84	-15,968	-16,008
56	2053	0	40	40	-16,052	84	-15,968	-16,008
57	2054	0	40	40	-16,052	84	-15,968	-16,008
58	2055	0	40	40	-16,052	84	-15,968	-16,008
59	2056	0	40	40	-16,052	84	-15,968	-16,008
60	2057	0	40	40	-16,052	84	-15,968	-16,008
61	2058	0	40	40	-16,052	84	-15,968	-16,008
62	2059	0	40	40	-16,052	84	-15,968	-16,008
63	2060	0	40	40	-16,052	84	-15,968	-16,008
64	2061	0	40	40	-16,052	84	-15,968	-16,008
65	2062	0	40	40	-16,052	84	-15,968	-16,008
66	2063	0	40	40	-16,052	84	-15,968	-16,008
67	2064	0	40	40	-16,052	84	-15,968	-16,008
68	2065	0	40	40	-16,052	84	-15,968	-16,008
69	2066	0	40	40	-16,052	84	-15,968	-16,008
70	2067	0	40	40	-16,052	84	-15,968	-16,008
71	2068	0	40	40	-16,052	84	-15,968	-16,008
		1,587	2,000	3,587	-802,600	4,200	-798,400	-801,987
FIRR		NUM!						
		PV						
Discount rate(%)	B/C	Cost		Benefit		NPV		
15	-49.83	113	-5651			-5764		
12	-61.93	198	-12274			-12472		
10	-73.06	293	-21394			-21687		
5	-121.10	864	-104636			-105500		
3	-153.90	1,435	-220854			-222289		

Table 4.3.12 PROJECT EVALUATION (THAILAND)

Division Channel (800m x 1,100 m ³ /s)		Unit: million baht						
Economic cost			Economic benefit				Benefit-Cost	
Year	Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	Economic Benefit (F)		
1	1998	0	0	0	0	0	0	
2	1999	0	0	0	0	0	0	
3	2000	0	0	0	0	0	0	
4	2001	4	0	4	0	0	-4	
5	2002	26	0	26	0	0	-26	
6	2003	26	0	26	0	0	-26	
7	2004	9	0	9	0	0	-9	
8	2005	1,034	0	1,034	0	0	-1,034	
9	2006	1,034	0	1,034	0	0	-1,034	
10	2007	1,034	0	1,034	0	0	-1,034	
11	2008	1,034	0	1,034	0	0	-1,034	
12	2009	2,245	0	2,245	0	0	-2,245	
13	2010	2,422	0	2,422	0	0	-2,422	
14	2011	4,169	0	4,169	0	0	-4,169	
15	2012	6,120	0	6,120	0	0	-6,120	
16	2013	6,109	0	6,109	0	0	-6,109	
17	2014	2,282	0	2,282	4,168	130	4,298	
18	2015	1,927	0	1,927	4,168	130	4,298	
19	2016	1,927	0	1,927	4,168	130	4,298	
20	2017	0	167	167	5,395	154	5,549	
21	2018	0	167	167	5,395	154	5,549	
22	2019	0	167	167	5,395	154	5,549	
23	2020	0	167	167	5,395	154	5,549	
24	2021	0	167	167	5,395	154	5,549	
25	2022	0	167	167	5,395	154	5,549	
26	2023	0	167	167	5,395	154	5,549	
27	2024	0	167	167	5,395	154	5,549	
28	2025	0	167	167	5,395	154	5,549	
29	2026	0	167	167	5,395	154	5,549	
30	2027	0	167	167	5,395	154	5,549	
31	2028	0	167	167	5,395	154	5,549	
32	2029	0	167	167	5,395	154	5,549	
33	2030	0	167	167	5,395	154	5,549	
34	2031	0	167	167	5,395	154	5,549	
35	2032	0	167	167	5,395	154	5,549	
36	2033	0	167	167	5,395	154	5,549	
37	2034	0	167	167	5,395	154	5,549	
38	2035	0	167	167	5,395	154	5,549	
39	2036	0	167	167	5,395	154	5,549	
40	2037	0	167	167	5,395	154	5,549	
41	2038	0	167	167	5,395	154	5,549	
42	2039	0	167	167	5,395	154	5,549	
43	2040	0	167	167	5,395	154	5,549	
44	2041	0	167	167	5,395	154	5,549	
45	2042	0	167	167	5,395	154	5,549	
46	2043	0	167	167	5,395	154	5,549	
47	2044	0	167	167	5,395	154	5,549	
48	2045	0	167	167	5,395	154	5,549	
49	2046	0	167	167	5,395	154	5,549	
50	2047	0	167	167	5,395	154	5,549	
51	2048	0	167	167	5,395	154	5,549	
52	2049	0	167	167	5,395	154	5,549	
53	2050	0	167	167	5,395	154	5,549	
54	2051	0	167	167	5,395	154	5,549	
55	2052	0	167	167	5,395	154	5,549	
56	2053	0	167	167	5,395	154	5,549	
57	2054	0	167	167	5,395	154	5,549	
58	2055	0	167	167	5,395	154	5,549	
59	2056	0	167	167	5,395	154	5,549	
60	2057	0	167	167	5,395	154	5,549	
61	2058	0	167	167	5,395	154	5,549	
62	2059	0	167	167	5,395	154	5,549	
63	2060	0	167	167	5,395	154	5,549	
64	2061	0	167	167	5,395	154	5,549	
65	2062	0	167	167	5,395	154	5,549	
66	2063	0	167	167	5,395	154	5,549	
67	2064	0	167	167	5,395	154	5,549	
68	2065	0	167	167	5,395	154	5,549	
69	2066	0	167	167	5,395	154	5,549	
70	2067	0	167	167	5,395	154	5,549	
71	2068	0	167	167	5,395	154	5,549	
		31,402	8,684	40,086	293,044	8,398	301,442	261,356
EIRR		12.74%						
				PV				
Discount rate(%)		BC	Cost		Benefit	NPV		
15		0.81	4,529		3,646	-883		
12		1.08	6,522		7,038	516		
10		1.35	8,414		11,335	2,921		
5		2.72	16,814		45,807	28,992		
3		3.93	22,999		90,380	67,380		

Table 4.3.13 PROJECT EVALUATION (THAILAND)

Dam Combined		Unit: million baht						
		Economic cost			Economic benefit			(B/C)
Year		Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri (E)	Economic Benefit (F)	Benefit- Cost (G)
1	1998	0	0	0	0	0	0	0
2	1999	10	0	10	0	0	0	-10
3	2000	10	0	10	0	0	0	-10
4	2001	0	45	45	142	28	170	125
5	2002	0	45	45	142	28	170	125
6	2003	0	45	45	142	28	170	125
7	2004	0	45	45	142	28	170	125
8	2005	0	45	45	142	28	170	125
9	2006	0	50	50	647	32	679	629
10	2007	5	50	55	647	32	679	624
11	2008	5	50	55	647	32	679	624
12	2009	0	50	50	682	34	716	666
13	2010	0	50	50	682	34	716	666
14	2011	5	50	55	682	34	716	661
15	2012	5	50	55	682	34	716	661
16	2013	0	394	394	992	46	1,038	644
17	2014	0	394	394	992	46	1,038	644
18	2015	0	394	394	992	46	1,038	644
19	2016	0	394	394	992	46	1,038	644
20	2017	0	394	394	992	46	1,038	644
21	2018	0	394	394	992	46	1,038	644
22	2019	0	394	394	992	46	1,038	644
23	2020	0	394	394	992	46	1,038	644
24	2021	0	394	394	992	46	1,038	644
25	2022	0	394	394	992	46	1,038	644
26	2023	0	394	394	992	46	1,038	644
27	2024	0	394	394	992	46	1,038	644
28	2025	0	394	394	992	46	1,038	644
29	2026	0	394	394	992	46	1,038	644
30	2027	0	394	394	992	46	1,038	644
31	2028	0	394	394	992	46	1,038	644
32	2029	0	394	394	992	46	1,038	644
33	2030	0	394	394	992	46	1,038	644
34	2031	0	394	394	992	46	1,038	644
35	2032	0	394	394	992	46	1,038	644
36	2033	0	394	394	992	46	1,038	644
37	2034	0	394	394	992	46	1,038	644
38	2035	0	394	394	992	46	1,038	644
39	2036	0	394	394	992	46	1,038	644
40	2037	0	394	394	992	46	1,038	644
41	2038	0	394	394	992	46	1,038	644
42	2039	0	394	394	992	46	1,038	644
43	2040	0	394	394	992	46	1,038	644
44	2041	0	394	394	992	46	1,038	644
45	2042	0	394	394	992	46	1,038	644
46	2043	0	394	394	992	46	1,038	644
47	2044	0	394	394	992	46	1,038	644
48	2045	0	394	394	992	46	1,038	644
49	2046	0	394	394	992	46	1,038	644
50	2047	0	394	394	992	46	1,038	644
51	2048	0	394	394	992	46	1,038	644
52	2049	0	394	394	992	46	1,038	644
53	2050	0	394	394	992	46	1,038	644
54	2051	0	394	394	992	46	1,038	644
55	2052	0	394	394	992	46	1,038	644
56	2053	0	394	394	992	46	1,038	644
57	2054	0	394	394	992	46	1,038	644
58	2055	0	394	394	992	46	1,038	644
59	2056	0	394	394	992	46	1,038	644
60	2057	0	394	394	992	46	1,038	644
61	2058	0	394	394	992	46	1,038	644
62	2059	0	394	394	992	46	1,038	644
63	2060	0	394	394	992	46	1,038	644
64	2061	0	394	394	992	46	1,038	644
65	2062	0	394	394	992	46	1,038	644
66	2063	0	394	394	992	46	1,038	644
67	2064	0	394	394	992	46	1,038	644
68	2065	0	394	394	992	46	1,038	644
69	2066	0	394	394	992	46	1,038	644
70	2067	0	394	394	992	46	1,038	644
71	2068	0	394	394	992	46	1,038	644
		40	22,639	22,679	60,931	2,948	63,879	41,200
IRR		268.43%						
				PV				
Discount rate(%)		BC	Cost		Benefit		NPV	
15		4.28	508		2,171		1,663	
12		3.99	826		3,298		2,471	
10		3.78	1,202		4,540		3,338	
5		3.23	3,937		12,708		8,771	
3		3.04	7,286		22,117		14,831	

Table 4.4.1 FLOW OF FINANCIAL COST FOR AIT-2-2

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Unit : million baht												
I. Structural Measures												
(1) River Improvement	1	45	45	165	318	306	306					
(2) Distribution System Improvement				56	84	83						
(3) Drainage System Improvement	15	46	61	31	360	1,049	1,975	1,645	937	497		
(4) Diversion Channel				5	29	29	10	1,352	1,352	1,352	1,352	2,958
(5) Sub-tl of (1)-(4)	16	94	109	257	791	1,467	2,291	2,997	2,309	1,949	1,352	2,958
II. Non-Structural Measure												
(6) Modification Dam Operation Rule	11	11	52	52	52	52	52	52	57	57	57	57
(7) Assumed expenditure for the year : (5) + (6)	27	105	161	309	843	1,519	2,342	3,049	2,366	2,006	1,409	3,015
Unit : million baht												
I. Structural Measures												
(1) River Improvement												
(2) Distribution System Improvement												
(3) Drainage System Improvement	3,211	5,500	8,286	8,273	3,211	2,705	2,705	2,705				
(4) Diversion Channel												
(5) Sub-tl of (1)-(4) : Grd 52,606	3,211	5,500	8,286	8,273	3,248	2,745	3,174	2,765	459			
II. Non-Structural Measure												
(6) Modification Dam Operation Rule tl : 309,826	57	57	57	451	451	451	451	451	451	451	451	451
(7) Assumed expenditure for the year : (5) + (6)	3,268	5,557	8,343	8,724	3,697	3,196	3,625	3,217	910			

Note : Construction cost from 2003 to 2016 would amount to 49,214 million baht.

Table 4.4.2 Financial Cash Flow and Loan Repayment : Alternative 2-2

Year in Order		Unit : Baht Million					
		Loan Disbursement			Repayment		
		Capital Cost	Interest	Cummulative Debt	Principal	Interest	Total
1	2003	2,953	22		0	22	22
2	2004	2,953	44		0	44	44
3	2005	2,953	66		0	66	66
4	2006	2,953	89		0	89	89
5	2007	2,953	111		0	111	111
6	2008	2,953	133		0	133	133
7	2009	2,953	155		0	155	155
8	2010	2,953	177		0	177	177
9	2011	2,953	199		0	199	199
10	2012	2,953	221		0	221	221
11	2013	0	0	29,528	984	214	1,198
12	2014	0	0	28,544	984	207	1,191
13	2015	0	0	27,560	984	199	1,184
14	2016	0	0	26,576	984	192	1,176
15	2017	0	0	25,591	984	185	1,169
16	2018	0	0	24,607	984	177	1,161
17	2019	0	0	23,623	984	170	1,154
18	2020	0	0	22,638	984	162	1,147
19	2021	0	0	21,654	984	155	1,139
20	2022	0	0	20,670	984	148	1,132
21	2023	0	0	19,686	984	140	1,125
22	2024	0	0	18,701	984	133	1,117
23	2025	0	0	17,717	984	125	1,110
24	2026	0	0	16,733	984	118	1,102
25	2027	0	0	15,748	984	111	1,095
26	2028	0	0	14,764	984	103	1,088
27	2029	0	0	13,780	984	96	1,080
28	2030	0	0	12,796	984	89	1,073
29	2031	0	0	11,811	984	81	1,065
30	2032	0	0	10,827	984	74	1,058
31	2033	0	0	9,843	984	66	1,051
32	2034	0	0	8,859	984	59	1,043
33	2035	0	0	7,874	984	52	1,036
34	2036	0	0	6,890	984	44	1,029
35	2037	0	0	5,906	984	37	1,021
36	2038	0	0	4,921	984	30	1,014
37	2039	0	0	3,937	984	22	1,006
38	2040	0	0	2,953	984	15	999
39	2041	0	0	1,969	984	7	992
40	2042	0	0	984	984	0	984
Total		29,528	1,218		29,528	4,429	33,958

Note : Condition of An International Financial Agency on Project to be ;
Interest: 0.75 % per year, Disbursement period : 40 years (including grace period of 10 years)
Loan Amount : 60 % of Financial Project Cost

Table 4.4.3 FINANCIAL CONSIDERATION OF LOAN REPAYMENT
(Comparison of Peak Repayment with the Concerned Government Expenditures)

Unit : million baht

	1994	1995	1996	1997	Average (1993-1996)	Projection (2009)	Projection (2013)
(1) Overseas Loan Repayment for Public Sector	1,943	2,029	1,845	1,024	1,710	6,281	8,590
(2) Overseas Loan Repayment for Private Sector	4,574	6,224	7,179	9,671	6,912	25,384	34,715
(3) Total Repayment	6,517	8,523	9,024	11,630	8,924	32,771	44,818
(4) Capital Expenditure of Budget	196,320	207,727	319,799	363,232	271,770	998,044	1,364,936
(5) Total Expenditure of Budget	560,000	625,000	715,000	843,200	685,800	2,518,527	3,444,416
(6) (1)/(5)x100 : (%)	0.3	0.3	0.3	0.1	0.2	0.2	0.2
(7) (2)/(5)x100 : (%)	1.2	1.4	1.3	1.4	1.3	1.3	1.3
(8) (4)/(5)x100 : (%)	35.1	33.2	44.7	43.1	39.6	39.6	39.6
(9) Peak Annual Repayment of Loan Prtion	63.7	61.0	67.0	120.8	72.3	0.6	13.9
(11) Peak/(3)x100 : (%)	19.0	14.5	13.7	10.6	13.9	0.1	2.7
(12) Peak/(4)x100 : (%)	0.63	0.60	0.39	0.34	0.46	0.00	0.09
(13) Peak/(5)x100 : (%)	0.22	0.20	0.17	0.15	0.18	0.00	0.04

Source : Quarterly Bulletin, Bank of Thailand, December, 1998, and JICA.

Thailand Budget in Brief, Fiscal Year 1997 and 1998, Bureau of Budget

Note : * Debt Coverage Ratio; the ratio of overseas loan repayment to government budget expenditure.

Projection to be done according to Assumed Growth of Nominal GDP.

Peak Annual Repayment of Loan : 35 million baht at 2009 for F/S, and 1,198 million baht at 2013 for Aht.2-2 of M/P.

Table 5.1.1 FINANCIAL AND ECONOMIC COST OF FOR PRIORITY PROJECT

Cost Evaluation (Unit : baht 1,000,000)

River Improvement 10-year (Chainat-Fathom Thani : Thai (Financial)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	507	602	1,109
1) Material and Equipment	432	602	1,034
2(a) Skilled Labor	40		40
(b) Unskilled Labor	35		35
2 Land acquisition	20		20
3 Administration	22		22
4 1) Engineering service D.D	8	59	66
2) Engineering service S.V	6	56	62
5 Physical contingency	45		105
Sub-total	607	776	1,384
6 Price Contingency	18	23	41
Grand total	625	800	1,425
OM Cost			34

River Improvement 10-year (Chainat-Fathom Thani : Thai (Economic)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	441	548	989
1) Material and Equipment	377	548	925
2(a) Skilled Labor	35	0	35
(b) Unskilled Labor	29	0	29
2 Land acquisition	16	0	16
3 Administration	19	0	19
4 1) Engineering service D.D	7	53	60
2) Engineering service S.V	5	51	56
5 Physical contingency	39	55	94
Sub-total	528	707	1,234
6 Price Contingency	0	0	0
Grand total	528	707	1,234
OM Cost		31	31

Dam Compensation Cost : Thai (Financial)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	0	0	0
1) Material and Equipment	0	0	0
2(a) Skilled Labor	0	0	0
(b) Unskilled Labor	0	0	0
2 Land acquisition	0	0	0
3 Administration	0	0	0
4 Engineering service	0	0	0
5 Physical contingency	34	0	34
Sub-total	34	0	34
6 Price Contingency	0	0	0
Grand total	34	0	34
OM Cost	80	0	80

Dam Compensation : Thai (Economic)

Classification of cost	L.C.	F.C.	Total
1 Construction cost	0	0	0
1) Material and Equipment	0	0	0
2(a) Skilled Labor	0	0	0
(b) Unskilled Labor	0	0	0
2 Land acquisition	0	0	0
3 Administration	0	0	0
4 Engineering service	0	0	0
5 Physical contingency	30	0	30
Sub-total	30	0	30
6 Price Contingency	0	0	0
Grand total	30	0	30
OM Cost	74	0	74

Note : Physical contingency of Dam means initial cost of necessary expenses for preparation.

Table 5.4.1 PROJECT EVALUATION (THAILAND)

River Improvement-1 (F/S)				Unit: million baM				
Year	Economic cost			Economic benefit				
	Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	Economic Benefit (F)	(F)-(C) Benefit-Cost (G)	
1	1998	0	0	0	0	0	0	
2	1999	12	0	12	0	0	-12	
3	2000	30	0	30	0	0	-30	
4	2001	26	0	26	0	0	-26	
5	2002	294	0	294	0	0	-294	
6	2003	293	0	293	0	0	-293	
7	2004	293	0	293	0	0	-293	
8	2005	286	0	286	0	0	-286	
9	2006	0	31	31	185	36	190	
10	2007	0	31	31	185	36	190	
11	2008	0	31	31	185	36	190	
12	2009	0	31	31	185	36	190	
13	2010	0	31	31	185	36	190	
14	2011	0	31	31	185	36	190	
15	2012	0	31	31	185	36	190	
16	2013	0	31	31	185	36	190	
17	2014	0	31	31	185	36	190	
18	2015	0	31	31	185	36	190	
19	2016	0	31	31	185	36	190	
20	2017	0	31	31	185	36	190	
21	2018	0	31	31	185	36	190	
22	2019	0	31	31	185	36	190	
23	2020	0	31	31	185	36	190	
24	2021	0	31	31	185	36	190	
25	2022	0	31	31	185	36	190	
26	2023	0	31	31	185	36	190	
27	2024	0	31	31	185	36	190	
28	2025	0	31	31	185	36	190	
29	2026	0	31	31	185	36	190	
30	2027	0	31	31	185	36	190	
31	2028	0	31	31	185	36	190	
32	2029	0	31	31	185	36	190	
33	2030	0	31	31	185	36	190	
34	2031	0	31	31	185	36	190	
35	2032	0	31	31	185	36	190	
36	2033	0	31	31	185	36	190	
37	2034	0	31	31	185	36	190	
38	2035	0	31	31	185	36	190	
39	2036	0	31	31	185	36	190	
40	2037	0	31	31	185	36	190	
41	2038	0	31	31	185	36	190	
42	2039	0	31	31	185	36	190	
43	2040	0	31	31	185	36	190	
44	2041	0	31	31	185	36	190	
45	2042	0	31	31	185	36	190	
46	2043	0	31	31	185	36	190	
47	2044	0	31	31	185	36	190	
48	2045	0	31	31	185	36	190	
49	2046	0	31	31	185	36	190	
50	2047	0	31	31	185	36	190	
51	2048	0	31	31	185	36	190	
52	2049	0	31	31	185	36	190	
53	2050	0	31	31	185	36	190	
54	2051	0	31	31	185	36	190	
55	2052	0	31	31	185	36	190	
56	2053	0	31	31	185	36	190	
57	2054	0	31	31	185	36	190	
58	2055	0	31	31	185	36	190	
59	2056	0	31	31	185	36	190	
60	2057	0	31	31	185	36	190	
61	2058	0	31	31	185	36	190	
62	2059	0	31	31	185	36	190	
63	2060	0	31	31	185	36	190	
64	2061	0	31	31	185	36	190	
65	2062	0	31	31	185	36	190	
66	2063	0	31	31	185	36	190	
67	2064	0	31	31	185	36	190	
68	2065	0	31	31	185	36	190	
69	2066	0	31	31	185	36	190	
70	2067	0	31	31	185	36	190	
71	2068	0	31	31	185	36	190	
		1,234	1,953	3,187	11,655	2,268	13,923	10,736
EIRR		12.5%						
				PV		NPV		
Discount rate(%)		BC	Cost		Benefit			
15		0.82	588		482		-106	
12		1.04	715		743		28	
10		1.24	826		1,028		202	
5		2.18	1,309		2,853		1,544	
3		2.87	1,714		4,912		3,198	

Table 5.4.2 PROJECT EVALUATION (THAILAND)

3 Dams & River Improvement (F/S)				Unit: million baht				
Economic cost			Economic benefit					
Year		Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Benefit		Benefit- Cost (G)
						Agri. (E)	Economic Benefit (F)	
1	1998	0	0	0	0	0	0	0
2	1999	27	0	27	0	0	0	-27
3	2000	45	0	45	0	0	0	-45
4	2001	26	74	100	908	130	1,038	938
5	2002	294	74	368	908	130	1,038	670
6	2003	293	74	367	908	130	1,038	671
7	2004	293	74	367	908	130	1,038	671
8	2005	286	74	360	908	130	1,038	678
9	2006	0	105	105	1,257	184	1,441	1,336
10	2007	0	105	105	1,257	184	1,441	1,336
11	2008	0	105	105	1,257	184	1,441	1,336
12	2009	0	105	105	1,257	184	1,441	1,336
13	2010	0	105	105	1,257	184	1,441	1,336
14	2011	0	105	105	1,257	184	1,441	1,336
15	2012	0	105	105	1,257	184	1,441	1,336
16	2013	0	105	105	1,257	184	1,441	1,336
17	2014	0	105	105	1,257	184	1,441	1,336
18	2015	0	105	105	1,257	184	1,441	1,336
19	2016	0	105	105	1,257	184	1,441	1,336
20	2017	0	105	105	1,257	184	1,441	1,336
21	2018	0	105	105	1,257	184	1,441	1,336
22	2019	0	105	105	1,257	184	1,441	1,336
23	2020	0	105	105	1,257	184	1,441	1,336
24	2021	0	105	105	1,257	184	1,441	1,336
25	2022	0	105	105	1,257	184	1,441	1,336
26	2023	0	105	105	1,257	184	1,441	1,336
27	2024	0	105	105	1,257	184	1,441	1,336
28	2025	0	105	105	1,257	184	1,441	1,336
29	2026	0	105	105	1,257	184	1,441	1,336
30	2027	0	105	105	1,257	184	1,441	1,336
31	2028	0	105	105	1,257	184	1,441	1,336
32	2029	0	105	105	1,257	184	1,441	1,336
33	2030	0	105	105	1,257	184	1,441	1,336
34	2031	0	105	105	1,257	184	1,441	1,336
35	2032	0	105	105	1,257	184	1,441	1,336
36	2033	0	105	105	1,257	184	1,441	1,336
37	2034	0	105	105	1,257	184	1,441	1,336
38	2035	0	105	105	1,257	184	1,441	1,336
39	2036	0	105	105	1,257	184	1,441	1,336
40	2037	0	105	105	1,257	184	1,441	1,336
41	2038	0	105	105	1,257	184	1,441	1,336
42	2039	0	105	105	1,257	184	1,441	1,336
43	2040	0	105	105	1,257	184	1,441	1,336
44	2041	0	105	105	1,257	184	1,441	1,336
45	2042	0	105	105	1,257	184	1,441	1,336
46	2043	0	105	105	1,257	184	1,441	1,336
47	2044	0	105	105	1,257	184	1,441	1,336
48	2045	0	105	105	1,257	184	1,441	1,336
49	2046	0	105	105	1,257	184	1,441	1,336
50	2047	0	105	105	1,257	184	1,441	1,336
51	2048	0	105	105	1,257	184	1,441	1,336
52	2049	0	105	105	1,257	184	1,441	1,336
53	2050	0	105	105	1,257	184	1,441	1,336
54	2051	0	105	105	1,257	184	1,441	1,336
55	2052	0	105	105	1,257	184	1,441	1,336
56	2053	0	105	105	1,257	184	1,441	1,336
57	2054	0	105	105	1,257	184	1,441	1,336
58	2055	0	105	105	1,257	184	1,441	1,336
59	2056	0	105	105	1,257	184	1,441	1,336
60	2057	0	105	105	1,257	184	1,441	1,336
61	2058	0	105	105	1,257	184	1,441	1,336
62	2059	0	105	105	1,257	184	1,441	1,336
63	2060	0	105	105	1,257	184	1,441	1,336
64	2061	0	105	105	1,257	184	1,441	1,336
65	2062	0	105	105	1,257	184	1,441	1,336
66	2063	0	105	105	1,257	184	1,441	1,336
67	2064	0	105	105	1,257	184	1,441	1,336
68	2065	0	105	105	1,257	184	1,441	1,336
69	2066	0	105	105	1,257	184	1,441	1,336
70	2067	0	105	105	1,257	184	1,441	1,336
71	2068	0	105	105	1,257	184	1,441	1,336
		1,264	6,985	8,249	83,731	12,242	95,973	87,724
EIRR		456.07%						
PV								
Discount rate(%)		BC	Cost		Benefit		NPV	
15		5.82	933		5,428		4,495	
12		6.38	1,176		7,509		6,333	
10		6.88	1,405		9,662		8,257	
5		8.76	2,568		22,486		19,919	
3		9.84	3,697		36,379		32,682	

Table 5.4.3 PROJECT EVALUATION (THAILAND)

3 Dams (US)		Unit: million baht						
		Economic cost			Economic benefit			
		Construction	O&M	Total	General, etc.	Agri.	Economic Benefit	(FRR) Benefit-Cost
Year		(A)	(B)	(C)	(D)	(E)	(F)	(G)
1	1998	0	0	0	0	0	0	0
2	1999	15	0	15	0	0	0	-15
3	2000	15	0	15	0	0	0	-15
4	2001	0	74	74	908	130	1,038	964
5	2002	0	74	74	908	130	1,038	964
6	2003	0	74	74	908	130	1,038	964
7	2004	0	74	74	908	130	1,038	964
8	2005	0	74	74	908	130	1,038	964
9	2006	0	74	74	908	130	1,038	964
10	2007	0	74	74	908	130	1,038	964
11	2008	0	74	74	908	130	1,038	964
12	2009	0	74	74	908	130	1,038	964
13	2010	0	74	74	908	130	1,038	964
14	2011	0	74	74	908	130	1,038	964
15	2012	0	74	74	908	130	1,038	964
16	2013	0	74	74	908	130	1,038	964
17	2014	0	74	74	908	130	1,038	964
18	2015	0	74	74	908	130	1,038	964
19	2016	0	74	74	908	130	1,038	964
20	2017	0	74	74	908	130	1,038	964
21	2018	0	74	74	908	130	1,038	964
22	2019	0	74	74	908	130	1,038	964
23	2020	0	74	74	908	130	1,038	964
24	2021	0	74	74	908	130	1,038	964
25	2022	0	74	74	908	130	1,038	964
26	2023	0	74	74	908	130	1,038	964
27	2024	0	74	74	908	130	1,038	964
28	2025	0	74	74	908	130	1,038	964
29	2026	0	74	74	908	130	1,038	964
30	2027	0	74	74	908	130	1,038	964
31	2028	0	74	74	908	130	1,038	964
32	2029	0	74	74	908	130	1,038	964
33	2030	0	74	74	908	130	1,038	964
34	2031	0	74	74	908	130	1,038	964
35	2032	0	74	74	908	130	1,038	964
36	2033	0	74	74	908	130	1,038	964
37	2034	0	74	74	908	130	1,038	964
38	2035	0	74	74	908	130	1,038	964
39	2036	0	74	74	908	130	1,038	964
40	2037	0	74	74	908	130	1,038	964
41	2038	0	74	74	908	130	1,038	964
42	2039	0	74	74	908	130	1,038	964
43	2040	0	74	74	908	130	1,038	964
44	2041	0	74	74	908	130	1,038	964
45	2042	0	74	74	908	130	1,038	964
46	2043	0	74	74	908	130	1,038	964
47	2044	0	74	74	908	130	1,038	964
48	2045	0	74	74	908	130	1,038	964
49	2046	0	74	74	908	130	1,038	964
50	2047	0	74	74	908	130	1,038	964
51	2048	0	74	74	908	130	1,038	964
52	2049	0	74	74	908	130	1,038	964
53	2050	0	74	74	908	130	1,038	964
54	2051	0	74	74	908	130	1,038	964
55	2052	0	74	74	908	130	1,038	964
56	2053	0	74	74	908	130	1,038	964
57	2054	0	74	74	908	130	1,038	964
58	2055	0	74	74	908	130	1,038	964
59	2056	0	74	74	908	130	1,038	964
60	2057	0	74	74	908	130	1,038	964
61	2058	0	74	74	908	130	1,038	964
62	2059	0	74	74	908	130	1,038	964
63	2060	0	74	74	908	130	1,038	964
64	2061	0	74	74	908	130	1,038	964
65	2062	0	74	74	908	130	1,038	964
66	2063	0	74	74	908	130	1,038	964
67	2064	0	74	74	908	130	1,038	964
68	2065	0	74	74	908	130	1,038	964
69	2066	0	74	74	908	130	1,038	964
70	2067	0	74	74	908	130	1,038	964
71	2068	0	74	74	908	130	1,038	964
		30	5,032	5,062	61,744	8,840	70,584	65,522
FIRR		707.88%						
		PV						
Discount rate(%)		BC	Cost		Benefit		NPV	
15		13.17	346	4,550			4,204	
12		13.34	461	6,154			5,693	
10		13.45	579	7,787			7,208	
5		13.73	1,259	17,283			16,025	
3		13.83	1,983	27,421			25,439	

Table 5.4.4 PROJECT EVALUATION (THAILAND)

Dam Bhumibol (F&S)		Unit: million baht						
Economic cost			Economic benefit					
Year		Construction (A)	O&M (B)	Total (C)	Benefit			(F)-(E) Benefit-Cost (H)
					General, etc. (D)	Agri. (E)	Economic Benefit (F)	
1	1998	0	0	0	0	0	0	0
2	1999	5	0	5	0	0	0	-5
3	2000	5	0	5	0	0	0	-5
4	2001	0	20	20	53	6	59	39
5	2002	0	20	20	53	6	59	39
6	2003	0	20	20	53	6	59	39
7	2004	0	20	20	53	6	59	39
8	2005	0	20	20	53	6	59	39
9	2006	0	20	20	53	6	59	39
10	2007	0	20	20	53	6	59	39
11	2008	0	20	20	53	6	59	39
12	2009	0	20	20	53	6	59	39
13	2010	0	20	20	53	6	59	39
14	2011	0	20	20	53	6	59	39
15	2012	0	20	20	53	6	59	39
16	2013	0	20	20	53	6	59	39
17	2014	0	20	20	53	6	59	39
18	2015	0	20	20	53	6	59	39
19	2016	0	20	20	53	6	59	39
20	2017	0	20	20	53	6	59	39
21	2018	0	20	20	53	6	59	39
22	2019	0	20	20	53	6	59	39
23	2020	0	20	20	53	6	59	39
24	2021	0	20	20	53	6	59	39
25	2022	0	20	20	53	6	59	39
26	2023	0	20	20	53	6	59	39
27	2024	0	20	20	53	6	59	39
28	2025	0	20	20	53	6	59	39
29	2026	0	20	20	53	6	59	39
30	2027	0	20	20	53	6	59	39
31	2028	0	20	20	53	6	59	39
32	2029	0	20	20	53	6	59	39
33	2030	0	20	20	53	6	59	39
34	2031	0	20	20	53	6	59	39
35	2032	0	20	20	53	6	59	39
36	2033	0	20	20	53	6	59	39
37	2034	0	20	20	53	6	59	39
38	2035	0	20	20	53	6	59	39
39	2036	0	20	20	53	6	59	39
40	2037	0	20	20	53	6	59	39
41	2038	0	20	20	53	6	59	39
42	2039	0	20	20	53	6	59	39
43	2040	0	20	20	53	6	59	39
44	2041	0	20	20	53	6	59	39
45	2042	0	20	20	53	6	59	39
46	2043	0	20	20	53	6	59	39
47	2044	0	20	20	53	6	59	39
48	2045	0	20	20	53	6	59	39
49	2046	0	20	20	53	6	59	39
50	2047	0	20	20	53	6	59	39
51	2048	0	20	20	53	6	59	39
52	2049	0	20	20	53	6	59	39
53	2050	0	20	20	53	6	59	39
54	2051	0	20	20	53	6	59	39
55	2052	0	20	20	53	6	59	39
56	2053	0	20	20	53	6	59	39
57	2054	0	20	20	53	6	59	39
58	2055	0	20	20	53	6	59	39
59	2056	0	20	20	53	6	59	39
60	2057	0	20	20	53	6	59	39
61	2058	0	20	20	53	6	59	39
62	2059	0	20	20	53	6	59	39
63	2060	0	20	20	53	6	59	39
64	2061	0	20	20	53	6	59	39
65	2062	0	20	20	53	6	59	39
66	2063	0	20	20	53	6	59	39
67	2064	0	20	20	53	6	59	39
68	2065	0	20	20	53	6	59	39
69	2066	0	20	20	53	6	59	39
70	2067	0	20	20	53	6	59	39
71	2068	0	20	20	53	6	59	39
EIRR		10	1,360	1,370	3,604	468	4,012	2,642
		196.65%						
		PV						
Discount rate(%)		B.C		Cost		Benefit		NPV
15		2.73		95		259		164
12		2.77		126		350		224
10		2.80		158		443		285
5		2.87		342		982		641
3		2.90		538		1,559		1,021

Table 5.4.5 PROJECT EVALUATION (THAILAND)

Dam-Srikit (F/S)		Unit: million baht						
		Economic cost			Economic benefit			(FRC)
Year		Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	Economic Benefit (F)	Benefit- Cost (G)
1	1998	0	0	0	0	0	0	0
2	1999	5	0	5	0	0	0	-5
3	2000	5	0	5	0	0	0	-5
4	2001	0	38	38	383	41	424	386
5	2002	0	38	38	383	41	424	386
6	2003	0	38	38	383	41	424	386
7	2004	0	38	38	383	41	424	386
8	2005	0	38	38	383	41	424	386
9	2006	0	38	38	383	41	424	386
10	2007	0	38	38	383	41	424	386
11	2008	0	38	38	383	41	424	386
12	2009	0	38	38	383	41	424	386
13	2010	0	38	38	383	41	424	386
14	2011	0	38	38	383	41	424	386
15	2012	0	38	38	383	41	424	386
16	2013	0	38	38	383	41	424	386
17	2014	0	38	38	383	41	424	386
18	2015	0	38	38	383	41	424	386
19	2016	0	38	38	383	41	424	386
20	2017	0	38	38	383	41	424	386
21	2018	0	38	38	383	41	424	386
22	2019	0	38	38	383	41	424	386
23	2020	0	38	38	383	41	424	386
24	2021	0	38	38	383	41	424	386
25	2022	0	38	38	383	41	424	386
26	2023	0	38	38	383	41	424	386
27	2024	0	38	38	383	41	424	386
28	2025	0	38	38	383	41	424	386
29	2026	0	38	38	383	41	424	386
30	2027	0	38	38	383	41	424	386
31	2028	0	38	38	383	41	424	386
32	2029	0	38	38	383	41	424	386
33	2030	0	38	38	383	41	424	386
34	2031	0	38	38	383	41	424	386
35	2032	0	38	38	383	41	424	386
36	2033	0	38	38	383	41	424	386
37	2034	0	38	38	383	41	424	386
38	2035	0	38	38	383	41	424	386
39	2036	0	38	38	383	41	424	386
40	2037	0	38	38	383	41	424	386
41	2038	0	38	38	383	41	424	386
42	2039	0	38	38	383	41	424	386
43	2040	0	38	38	383	41	424	386
44	2041	0	38	38	383	41	424	386
45	2042	0	38	38	383	41	424	386
46	2043	0	38	38	383	41	424	386
47	2044	0	38	38	383	41	424	386
48	2045	0	38	38	383	41	424	386
49	2046	0	38	38	383	41	424	386
50	2047	0	38	38	383	41	424	386
51	2048	0	38	38	383	41	424	386
52	2049	0	38	38	383	41	424	386
53	2050	0	38	38	383	41	424	386
54	2051	0	38	38	383	41	424	386
55	2052	0	38	38	383	41	424	386
56	2053	0	38	38	383	41	424	386
57	2054	0	38	38	383	41	424	386
58	2055	0	38	38	383	41	424	386
59	2056	0	38	38	383	41	424	386
60	2057	0	38	38	383	41	424	386
61	2058	0	38	38	383	41	424	386
62	2059	0	38	38	383	41	424	386
63	2060	0	38	38	383	41	424	386
64	2061	0	38	38	383	41	424	386
65	2062	0	38	38	383	41	424	386
66	2063	0	38	38	383	41	424	386
67	2064	0	38	38	383	41	424	386
68	2065	0	38	38	383	41	424	386
69	2066	0	38	38	383	41	424	386
70	2067	0	38	38	383	41	424	386
71	2068	0	38	38	383	41	424	386
		10	2,584	2,594	26,044	2,788	28,832	26,238
EIRR		784.31%						
				PV				
Discount rate(%)		BC	Cost		Benefit		NPV	
15		10.70	174	1,858			1,685	
12		10.80	233	2,514			2,281	
10		10.86	293	3,181			2,888	
5		11.00	642	7,060			6,418	
3		11.06	1,013	11,201			10,188	

Table 5.4.6 PROJECT EVALUATION (THAILAND)

Dam Pasak (F/S)		Unit: million baht						
		Economic cost			Economic benefit			FJBJ Benefit- Cost (G)
Year		Construction (A)	O&M (B)	Total (C)	General, etc. (D)	Agri. (E)	Tu Economic Benefit (F)	
1	1998	0	0	0	0	0	0	0
2	1999	5	0	5	0	0	0	-5
3	2000	5	0	5	0	0	0	-5
4	2001	0	16	16	472	71	543	527
5	2002	0	16	16	472	71	543	527
6	2003	0	16	16	472	71	543	527
7	2004	0	16	16	472	71	543	527
8	2005	0	16	16	472	71	543	527
9	2006	0	16	16	472	71	543	527
10	2007	0	16	16	472	71	543	527
11	2008	0	16	16	472	71	543	527
12	2009	0	16	16	472	71	543	527
13	2010	0	16	16	472	71	543	527
14	2011	0	16	16	472	71	543	527
15	2012	0	16	16	472	71	543	527
16	2013	0	16	16	472	71	543	527
17	2014	0	16	16	472	71	543	527
18	2015	0	16	16	472	71	543	527
19	2016	0	16	16	472	71	543	527
20	2017	0	16	16	472	71	543	527
21	2018	0	16	16	472	71	543	527
22	2019	0	16	16	472	71	543	527
23	2020	0	16	16	472	71	543	527
24	2021	0	16	16	472	71	543	527
25	2022	0	16	16	472	71	543	527
26	2023	0	16	16	472	71	543	527
27	2024	0	16	16	472	71	543	527
28	2025	0	16	16	472	71	543	527
29	2026	0	16	16	472	71	543	527
30	2027	0	16	16	472	71	543	527
31	2028	0	16	16	472	71	543	527
32	2029	0	16	16	472	71	543	527
33	2030	0	16	16	472	71	543	527
34	2031	0	16	16	472	71	543	527
35	2032	0	16	16	472	71	543	527
36	2033	0	16	16	472	71	543	527
37	2034	0	16	16	472	71	543	527
38	2035	0	16	16	472	71	543	527
39	2036	0	16	16	472	71	543	527
40	2037	0	16	16	472	71	543	527
41	2038	0	16	16	472	71	543	527
42	2039	0	16	16	472	71	543	527
43	2040	0	16	16	472	71	543	527
44	2041	0	16	16	472	71	543	527
45	2042	0	16	16	472	71	543	527
46	2043	0	16	16	472	71	543	527
47	2044	0	16	16	472	71	543	527
48	2045	0	16	16	472	71	543	527
49	2046	0	16	16	472	71	543	527
50	2047	0	16	16	472	71	543	527
51	2048	0	16	16	472	71	543	527
52	2049	0	16	16	472	71	543	527
53	2050	0	16	16	472	71	543	527
54	2051	0	16	16	472	71	543	527
55	2052	0	16	16	472	71	543	527
56	2053	0	16	16	472	71	543	527
57	2054	0	16	16	472	71	543	527
58	2055	0	16	16	472	71	543	527
59	2056	0	16	16	472	71	543	527
60	2057	0	16	16	472	71	543	527
61	2058	0	16	16	472	71	543	527
62	2059	0	16	16	472	71	543	527
63	2060	0	16	16	472	71	543	527
64	2061	0	16	16	472	71	543	527
65	2062	0	16	16	472	71	543	527
66	2063	0	16	16	472	71	543	527
67	2064	0	16	16	472	71	543	527
68	2065	0	16	16	472	71	543	527
69	2066	0	16	16	472	71	543	527
70	2067	0	16	16	472	71	543	527
71	2068	0	16	16	472	71	543	527
		10	1,088	1,098	32,096	4,828	36,924	35,876
EIRR		931.50%						
				PV				
Discount rate(%)		BC	Cost		Benefit		NPV	
15		30.83	77		2,380		2,303	
12		31.44	102		3,219		3,117	
10		31.84	128		4,073		3,945	
5		32.85	275		9,041		8,766	
3		33.21	432		14,345		13,913	

Table 5.6.1 FLOW OF FINANCIAL COST FOR RIVER IMPROVEMENT (F/S)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Unit : million baht												
I. Structural Measures												
(1) River Improvement		13	33	30	340	339	330					
II. Non-Structural Measure				30								
(6) Modification Dam Operation Rule												
(7) Assumed expenditure for the year : (5) + (6)	0	13	33	60	340	339	330	0	0	0	0	0
Unit : million baht												
I. Structural Measures												
(1) River Improvement												
II. Non-Structural Measure												
(6) Modification Dam Operation Rule t.l : 309Aeat												
(7) Assumed expenditure for the year : (5) + (6)	0	0	0	0	0	0	0	0	0	0	0	0

Note : Construction cost from 1999 to 2004 would amount to 1,425 million baht.

Table 5.6.2 Financial Cash Flow and Loan Repayment : -Alternative 2-2

Year in Order		Unit : Baht Million					
		Loan Disbursement			Repayment		
		Capital Cost	Interest	Cummulative Debt	Principal	Interest	Total
1	1999	86	1		0	1	1
2	2000	86	1		0	1	1
3	2001	86	2		0	2	2
4	2002	86	3		0	3	3
5	2003	86	3		0	3	3
6	2004	86	4		0	4	4
7	2005	86	4		0	4	4
8	2006	86	5		0	5	5
9	2007	86	6		0	6	6
10	2008	86	6		0	6	6
11	2009	0	0	855	29	6	35
12	2010	0	0	827	29	6	34
13	2011	0	0	798	29	6	34
14	2012	0	0	770	29	6	34
15	2013	0	0	741	29	5	34
16	2014	0	0	713	29	5	34
17	2015	0	0	684	29	5	33
18	2016	0	0	656	29	5	33
19	2017	0	0	627	29	4	33
20	2018	0	0	599	29	4	33
21	2019	0	0	570	29	4	33
22	2020	0	0	542	29	4	32
23	2021	0	0	513	29	4	32
24	2022	0	0	485	29	3	32
25	2023	0	0	456	29	3	32
26	2024	0	0	428	29	3	31
27	2025	0	0	399	29	3	31
28	2026	0	0	371	29	3	31
29	2027	0	0	342	29	2	31
30	2028	0	0	314	29	2	31
31	2029	0	0	285	29	2	30
32	2030	0	0	257	29	2	30
33	2031	0	0	228	29	1	30
34	2032	0	0	200	29	1	30
35	2033	0	0	171	29	1	30
36	2034	0	0	143	29	1	29
37	2035	0	0	114	29	1	29
38	2036	0	0	86	29	0	29
39	2037	0	0	57	29	0	29
40	2038	0	0	29	29	0	29
Total		855	35		855	128	983

Note : Condition of An International Financial Agency on Project to be ;
 Interest : 0.75 % per year, Disbursement period : 40 years (including grace period of 10 years)
 Loan Amount : 60 % of Financial Project Cost

Table 5.7.1 EFFECTIVENESS OF PROSED MEASURES BESIDE DIRECT TANGIBLE EFFECTS

(1) Non-Structural Measures	<p>To produce the similar effects as structural measures : i.e., Mental and physical damages : to decrease the disease, injury and death, and to nourish mental anguish of the sufferers. Public health: to decrease the inflow of garbage, sewage waste water and to induce infectious disease during and after the flood. Land use : the potentiality of land use in flood prone areas would increase.</p>
(a) Modification of Dam Operation Rule	
(b) Land Use Control and Guidance	<p>The lands for agricultural , residential, commercial, industrial, institutional usages would be extended and/or developed intending to minimize the anticipated flood damages through the guidance of the hazard map. Infrastructures would also be installed in the same way. Eventually, it would contribute to produce the increase of GDP.</p>
(c) River Basin Committee	<p>To promote the efficiency of organizations and inter-organizations concerned through the coordination work-out; this measure would be expected high return effects by comparative low cost. As for the details, discussed and explained in Sector XI.</p>
(2) Structural Measures	
(a) Distribution System Improvement	<p>The better usage of agricultural land . Mental and physical damages : to decrease the disease, injury and death, and to nourish mental anguish of the sufferers. Public health: to decrease the inflow of garbage, sewage waste water and to induce infectious disease during and after the flood.</p>
(b) River Improvement	<p>The better usage of agricultural land . Mental and physical damages : to decrease the disease, injury and death, and to nourish mental anguish of the sufferers. Public health: to decrease the inflow of garbage, sewage waste water and to induce infectious disease during and after the flood. Multiplier effects of project cost investment: to bring multiplier effects to the project area and its vicinity; increase of employment opportunity, consumption increase from wages which accelerate commercial and economic activities.</p>
(c) Drainage System Improvement	<p>The better usage of agricultural land . Mental and physical damages : to decrease the disease, injury and death, and to nourish mental anguish of the sufferers. Public health: to decrease the inflow of garbage, sewage waste water and to induce infectious disease during and after the flood. Multiplier effects of project cost investment: to bring multiplier effects to the project area and its vicinity; increase of employment opportunity, consumption increase from wages which accelerate commercial and economic activities.</p>
(d) Diversion Channel	<p>Mental and physical damages : to decrease the disease, injury and death, and to nourish mental anguish of the sufferers. Public health: to decrease the inflow of garbage, sewage waste water and to induce infectious disease during and after the flood. Multiplier effects of project cost investment: to bring multiplier effects to the project area and its vicinity; increase of employment opportunity, consumption increase from wages which accelerate commercial and economic activities; compensation cost for land acquisition also brings multiplier effects. Technology transfer : technology transfer during construction, and operation and maintenance produce the human resource development. Land use : the potentiality of land use in inundated areas increase by implementation of the measure. In addition , particularly by Diversion Channel ; Usage of diverted water : for irrigation and fish farming, industrial and drink water. Water transportation : to transport cargo and inhabitants by boat. Land development by using excavated earth</p>
(e) Heightening of Flood Barrier	<p>Mental and physical damages : to decrease the disease, injury and death, and to nourish mental anguish of the sufferers. Public health: to decrease the inflow of garbage, sewage waste water and to induce infectious disease during and after the flood. Multiplier effects of project cost investment: to bring multiplier effects to the project area and its vicinity; increase of employment opportunity, consumption increase from wages which accelerate commercial and economic activities.</p>

SECTOR XIV

***ENVIRONMENTAL
CONSIDERATION***



SECTOR XIV: ENVIRONMENTAL CONSIDERATION

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- Initial Environmental Examination
- Terms of Reference for Environmental Studies



1. INTRODUCTION

1.1 PURPOSE

The Study will formulate a master plan and conduct a feasibility study, which focuses on the basic structure of flood mitigation facilities in its study. Through out this study period, environmental concern should carefully be applied. During the master plan study period, environmental and social cost of the each alternatives of flood mitigation will be compared, and then incorporated into an alternative-selecting process for the feasibility study. In this period, not only the impacts of mitigation facilities should be concerned, but also the impacts of mitigating flood of the Chao Phraya River itself. In the feasibility study, impacts, which may occur in a course of implementation of the selected alternative(s), will be assessed and the mitigation measures will also be incorporated in the Study at the same time. Diagram of conceptual study flow is shown in Fig. 1.1.

1.2 Implementation Schedule

Initial Environmental Examination (IEE), according to JICA's guideline, is to be conducted during the phase I (Master Plan Study) period. Environmental Impact Assessment (EIA) shall be conducted according to "Manual of NEB Guidelines for Preparation of Environmental Impact Evaluations", only if the selected alternative(s) by the Master Plan meet the criteria set. A tentative environmental impact study schedule is shown below.

The chart shows general implementation schedule of impact assessment study.

Month	11	12	1	2	3	4	5	6	7	8	9
The Study Stage	Master Plan					Feasibility Study					
IEE	IEE(cont'd)										
EIA	TOR Preparation					EIA study					
Work of OEPP					Approval				Approval		

1.3 Institutional Framework

An organisation, which holds the supreme authority in enhancement and conservation of environmental quality in Thailand, is National Environmental Board (NEB). NEB consists of heads of related ministries. The components of NEB are listed below.

- **Chairman:** the Prime Minister
- **First Vice Chairman:** the Deputy Prime Minister
- **Second Vice Chairman:** the Minister of Science, Technology and Environment (MOSTE)
- **Members ex officio:** the Minister of Defense, the Minister of Finance, the Minister of Agriculture and Cooperatives, the Minister of Transport and Communications, the Minister of Interior, the Minister of Education, the Minister of

Public Health, the Minister of Industry, the Secretary-General of the National Economic and Social Development Board, the Secretary General of the Board of Investment, the Director of the Bureau of the Budget

- **Members:** representatives from qualified private sector (5~8 members)
- **Member and Secretary:** the permanent secretary of the ministry of Science, Technology and Environment

According to Section 19 of Enhancement and Conservation of National Environment Quality Act B.E.2535, NEB holds the power to require government agencies, state enterprises, and other persons for submission of documents relating to the impacts on environmental quality and documents or data concerning the projects or work plans planned.

As it is mentioned in the Section 21 of Enhancement and Conservation of National Environment Quality Act B.E.2535, NEB may entrust the three departments under the MOSTE for operation or preparation of propositions made to the NEB. The three departments are: Office of Environmental Policy and Planning (OEPP), Pollution Control Department, and Department of Environment Quality Promotion. Among these departments, Environment Impact Evaluation Division of OEPP is designated to take in charge of environmental impact assessment process. OEPP consists of the divisions shown in Fig. 1.2.

1.4 Thailand's National Policy on Environment

(1) The 7th National 5-Years Plan

The Seventh National Economic and Social Development Plan (1992) has set three major objectives such as human resources development, raising standard of living, and environment and natural resources development. It is notable that the environmental consideration was proclaimed as one of the major objectives of the national development plan. In the plan, It states that Thailand upholds an idea of sustainable development by building consensus with regional community; keeping balance between economic growth and income distribution, industrialization and environmental quality, urbanization and support for rural population is essential. The government is now going to count on involvement of local people for natural resources management, and role of NGOs as intermediaries between the government and local people.

Towards more sustainable development, balance between the below and the right is essential	
Economic Growth	Income Distribution
Industrialization	Protection of Environmental quality
Urbanization	Support for Rural Population

(2) The Eighth National 5-Years Plan

For better quality of life of Thai people and lasting national development, *The Eighth National Economic and Development Plan (1997-2001)* set following objectives. To ensure lasting natural resource by protection and rehabilitation projects, and to protect both urban and rural environment. It concerns that Thailand had put "far more emphasis placed on expansion of economic activities than environment," thus degrading environment and overexploited natural resources. *The Eighth National Economic and Development Plan* is to set counter-balance for "ordinary ways" of development. Technically, it supports to give more opportunities for local people and the organizations to manage natural resources. It also recommends that economic instruments to be used for controlling and supervising the development practices. The Study Team is obligated to develop environmental counter measures together with local representatives, and to evaluate flood control measures from environmental point of view. A diagram of general idea of *The Eighth National Economic and Development Plan* is shown Fig. 1.3.

1.5 Legal Framework on EIA

(1) Environmental Act

In the same year, Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992) was proclaimed by repealing the Enhancement and Conservation of National Environmental Quality Act, B.E.2518 (1975), the Enhancement and Conservation of National Environmental Quality Act (No.2), B.E.2521 (1978), the Enhancement and Conservation of National Environmental Quality Act (No.2), B.E.2522 (1979). As a results of the revision of the act, NEB was strengthened (chapter I), Environmental Fund was established (Chapter II), conservation and protected areas came into sphere of central government (chapter III), and Environmental Impact Assessment process is clarified (chapter IV). In all, the central government, especially MOSTE, is strengthened ever to play major roles in environmental concerns for broader aspects.

(2) Environmental Impact Assessment

By revisioning *Enhancement and Conservation of National Environmental Quality Act B.E.2535*, as it was noted above, environmental impact assessment process is now newly affirmed. Its major procedure is as following diagram. If a project or activity is required to submit EIA report by the law, the proponent has a duty to prepare the impact assessment report at the stage of conducting a feasibility study, and submit the EIA report to Environmental Impact Assessment Division under OEPP, MOSTE for its review, and must obtain a permission by National Environmental Board (NEB) prior to construction or operation. It should also be noted that preparation of EIA report must be done by a person who is officially licensed to be a specialist in

environmental impact assessment. As of June 1993, 33 consultant firms are issued the license, which is valid for 3 or 5 years. A diagram shown below is a EIA process for a project of a government agency, or of a state enterprise or to be jointly undertaken with private enterprise which is required to be approved by the cabinet. Fig. 1.4 shows conceptual diagram of EIA procedures.

(3) Projects Required to Submit EIA

Projects or activities of government agency, state enterprise or private person which is required to prepare EIA report are specified by the Notification of the Ministry of Science, Technology and Environment by the name of the Mr. Pajitra Auctaweekul, the Minister under the *Enhancement of National Environment Quality Act B.E.2535*. The notification, shown in Table 1.1, was published in the Government Gazette Vol.109, No. 130 (October 8, 1992) and additional types of projects and activities in the Government Gazette Vol. 109, No.136 (October 22, 1992). If a planned project does not fall in any of the category listed below, even if, for extreme case, thousands of inhabitants are to be dislocated, EIA report is not necessary, according to the Director of EIA Division of OEPP.

(4) Watershed Classification and Development Restrictions

Decline of forest area has been a major concern of the public for environmental reasons and also for the watershed value. The Cabinet approved the *Classification* for watersheds of Pin and Wang rivers in 1985, and Yom and Nan in 1986. The project implementing agencies must follow the measures and recommendations of land utilisation applicable to the each watershed class. The 1:50,000 watershed maps of all the Study Area are available at Project Planning Division of the Royal Irrigation Department. Table 1.2 shows the watershed classification.

(5) Protected Land for Biological Reason

About 10% of Thailand is already declared national parks and wildlife sanctuaries to protect habitat of wildlife from development and their pressures. A map and list of national parks, wildlife sanctuaries and non-hunting areas are presented in Fig. 1.5.

2. MASTER PLAN STAGE

2.1 Objectives and Scope of IEE

Objectives of this Initial Environmental Examination (IEE) are:

- to assess probable environmental impact to be caused by proposed projects,

- to estimate for what environmental values, or categories, the Study Team should conduct environmental studies to conduct further environmental studies, and to make a term of reference (TOR) for the environmental studies, and
- to present recommendations for the feasibility study to the Team.

In planning of any project, the possible effects of the project on environmental values must be taken into account as one of the major factors of pre-feasibility process from the earliest stage of planning, according to Manual of NEB Guidelines for Preparation of Environmental Impact Evaluation. For selection and development of environmentally wholesome project plan, Initial Environmental Examination (IEE) was conducted. The main objective of IEE is to determine whether a full-scale Environmental Impact Assessment (EIA) will be needed or not in the following feasibility study, and if the conclusion is that EIA is needed, outline of farther environmental study will be prepared. Therefore this IEE was carried out only to the depth that to suffice the above stated purpose. The parameters used in this IEE are as the same parameter as the ones listed in full-scale environmental study of NEB Guidelines.

IEE is a part of a process of formulation of environmentally sound project. IEE will assess probable impacts of proposed projects, and make outline of further assessment. For those inevitable impacts expected even after the modification of original design, mitigation plans will be formulated, and for those impacts that are not mitigable, compensation plans will be formulated in feasibility study period.

In Master Plan Stage, Initial Environmental Examination (IEE) was conducted to assess the impacts of alternatives such as retarding basin, diversion channel, and construction of embankments. Organisation of IEE possessed four parts as follows:

- Description of proposed project
- Discussion of probable environmental effects
- Tabulation of Initial Evaluations
- Conclusions

The parameters used are the same as the parameters used in full-scale environmental study. The extent of work is limited to "reach a decision" to make the actual detailed evaluation for each parameter, rather than to make the actual detailed evaluation for each parameters. The IEE concluded that further environmental study is needed. Terms of reference (TOR) for the further environmental study is then prepared. The TOR included delineation of sensitive environmental aspects and an indication of extent of the work to be done, and budget which should be allocated to support sufficient level of investigation. The results of IEE were utilized to select improvements of the river embankment as the subject of feasibility study.

(1) Necessity of Governmental Review

Three major facilities are tentatively chosen as the alternatives for flood control measures being considered in the "Study on Integrated Plan for Flood Mitigation in the Chao Phraya River Basin" (the Study) from engineering stand points of view. They are river training, flood diversion channel, and retarding basin, as of December 1998. The best among these or a best combination of these measures will be selected in the Master Plan study phase, for the Feasibility Study. Except "loop-cut" in the river training measure, the rest of all *tentatively chosen* alternatives, which will be described in following pages, will be large-scale projects. Although the EIA requirement of Ministerial Decree of Ministry of Science, Technology and Environment does not state that flood control facilities are obligated to prepare EIA, the project will need environmental impact analysis and formulation of environmental countermeasures that will be incorporated into the Feasibility Study owed to their expected impacts on the sites and the surroundings. Comments of Office of Environmental Policy and Planning (OEPP) shall be obtained at each phase of study.

(2) Organization of IEE Report

This IEE report contains four major sections as follows:

- Description of proposed project and the sites

A brief description of tentatively proposed flood control measures such as river training, flood diversion channel, and retarding basin, and the site description.

- Discussion of probable environmental effects

Environment likely to be affected is discussed and evaluated according to each parameter in the Guidelines for each project. The parameters utilized for the evaluation of each facilities' environmental impacts are of following Supplemental EIS Guidelines in Manual of NEB.

Supplemental Guidelines of Highways: river training (loop-cut, widening, embankment), Diversion Channel
Supplemental Guidelines of Dams and Reservoirs: retarding basin

- *Tabulation of Initial Evaluation*
- *Summary*

(3) Description of Proposed Projects in Master Plan Stage

The brief outlines of each proposed project and the general settings of the project sites will be described in this section. A term "proposed project" used in this section refers to *only the largest outlines of projects* that are chosen at the primary stage of selecting process of the best alternative (s). The proposed

projects are river training, flood diversion channel, and retarding basin. IEE was conducted on these proposed projects.

(a) River Training

A term, river training, refers to increasing discharge capacity, cubic meter per second, of the river. By implementation of river training works, floodwater may flow downstream faster than without the project. River training generally includes heightening of the embankment, widening and shortcut of river channel, and excavation of the riverbed. For mitigating of flood damage in Bangkok and the surrounding area, all the measures above except excavation are proposed, and the location of river training works could be any stretch of the Chao Phraya river and the Tha Chin river where it is concerned effectively mitigate flood. IEE was conducted on the changes will be made by the outline of river training works. However, only minor river training works might be possible to implement for the Chao Phraya river and the Tha Chin river because confining flood water in river lines may cause flooding in cities downstream.

(b) Flood Diversion Channel

Ten flood diversion channel routes (Fig. 2.1) are proposed to divert floodwater from upstream of the Chao Phraya river, or from the major tributary, to the Gulf of Thailand. All these routes are intended to divert floodwater from the Chao Phraya river that might overflow dikes at the stretch along Bangkok, otherwise. The study is now in a selecting process of choosing the best among the alternatives. In order to minimize construction cost and social conflicts, sparsely populated area shall be chosen for the routes. Some routes will use existing irrigation canals by widening and excavating while other stretches in built-in area will be bypassed by new course to minimize number of relocation. Table 2.1 shows the estimation of construction cost, including land acquisition, and number of houses needed to be relocated for each proposed diversion routes.

(c) Retarding Basin

Retarding basin, which retains flood water for certain period and mitigate degree of severance of flood, is also a one of the alternative measures for flood control. Proposed site for the retarding basin is located in the center to upper part of the Chao Phraya delta along the Chao Phraya river. It lets flood water into the area at beginning of flood period, and cut the peak of flood flow of the Chao Phraya river, and release the stored flood water into the Chao Phraya river back again after flood peak period. Size of the proposed area is approximately 2,800 km² in where deep-water rice cultivation is dominant, and partially used for

floating rice. There are no certain flood control facilities designed yet for the retarding basin. However, this Initial Environmental Examination report will presume small regulators shall be installed and divert flood water into the retarding area. The area will hold the water for certain period of time, which is longer than what is happening naturally every year.

(4) General Description of Project Site

The Chao Phraya Delta can be divided into the three major parts, such as flood plain, new delta, and old delta (Fig. 2.2), according to Takaya (1987). There are clear differences among them in their topographies, flood damages, and ways to coop or take advantages of the Chao Phraya rivers seasonal changes. Significance of being acquainted with characteristics of the project site lies on selecting suitable flood control measure (s) for the feasibility study. It also enhances ideas that for what problems the higher priorities should be given when formulating mitigation measures and compensation measures. Present land use in each area is shown in Fig. 2.3. Natural vegetation in the lower delta is shown in Fig. 2.4.

(a) Flood Plain

Flood plain becomes a 10 to 20 km-wide floodwater path during rainy season. Floodwater is confined by natural dikes, which are about 3 to 4 m high. The water body expands, but it will not be disseminated. There are lowland behind the natural dikes in where deep-water rice or floating rice is grown.

(b) New Delta

The elevation is not more than 2 m and it is extremely flat. Floodwater dissemination and inundation occur naturally during rainy season. The depth of inundation is about 50 cm to 1 m.

(c) Old Delta

Old Delta is approximately 4 to 5 m higher than the New Delta, and not completely flat like the new delta. Floodwater usually will not flow into this area. Tall trees and natural ponds are found.

(5) Lifestyles in Delta Area

(a) Noi- Lop Buri Flood Plain

This elevation of Noi-Lop Buri flood plain is lower than its surrounding area. There are impressive number of large and tangled river lines along complex mounds and rises. The water depth of the lowland behind the natural dikes leach more than 4 m deep customarily. Single rice

cropping is still seen in this area. The life is said to be easier than Rangsit area because of easy access to water, and their houses are surrounded by trees that provide shades during dry season. Moreover, floodwater will not threaten their life during rainy season because the people are living on natural banks that are higher than flood water level. Variety of agriculture can be practiced on the natural banks. In the area behind natural banks where water depths become tremendous, floating rice is grown. Those who do not have lands on natural banks live on small mounds in the floating rice area, and since single cropping is possible in the area, they leave their home and work during off-season. During dry season, the groups of women catch fish that are captured in ponds for their food.

(b) Rangsit Area (eastside of new delta)

The topography of Rangsit area is extremely flat. All the area will be calmly inundated during rainy season by water coming from other areas and rainfall in the Rangsit area, however, without the irrigation systems, it turns out to be totally waterless land during dry season. Houses are built along khlongs for easier access for navigation and water use purposes. After construction of Chai Nat-Pasak canal and introduction of mechanized cultivation, the irrigation system of Rangsit area made intensive rice agriculture possible. Today, Rangsit area is in strong influence of Bangkok metropolitan area, and conversions of the rice field into fruit trees are commonly seen and new settlements have rapidly been developed along freeways to Bangkok. Along the coastal line of Gulf of Thailand, there are salt pans and blackish or freshwater aquaculture ponds.

(c) West Bank (west side of new delta)

During flood season, over-flown water from the right bank of Chao Phraya river below Pa Mok, 20 km upstream of Ayuthaya, flows into West Bank area. The area becomes like a shallow wet basin, whose depth is about 1.0 - 1.5 m, during wet season. There are no high natural banks as they are seen in Noi-Lop Buri Flood Plain. West Bank receives weakened-flood water. After completion of Khlong Phak Hai-Chao Ched in 1960, West Bank area is used as flood retarding basin for protection of Bangkok during flood season. Because of the flood control measure, the farmers in the West Bank area are needed shift to dry season cropping using water supplied by the irrigation system. Houses are built along khlongs in here also. Today, the land use pattern of southern half of West Bank is mostly for fruits and vegetables. The coastal area, a band of 5 - 15 km, is used for brackish water aquaculture and for salt pans.

2.2 Results of IEE

The subjects of the IEE are the three proposed flood mitigation measures such as river improvement, diversion channel, and retarding basin (these alternatives are still being modified and not the finalized ones, however, it is assumed for IEE that the largest scale of the plan will be implemented). As the result, it is found that the retarding basin plan affects the natural and social environmental values of the site significantly. The IEE also found that river improvement and diversion channel plans give significant impacts on the sites and the surroundings; however, it is also assumed that they can be either mitigated or compensated by appropriate countermeasures. Significance of probable impacts caused by the proposed flood control measures, and contents of the further studies are summarized in Table 2.1.

2.2.1 River Training

(1) Loop-cut and Widening

Impacts of loop-cut at Pra Prapadaeng, just off south of Bangkok Metropolis, are expected to be limited because of its size, 0.7 km long, and the site's sparse population density. In addition, there is a canal, Khlong Pak Lat, already existing. Houses required to be relocated will also be very limited. Widening of river will require relocations and other necessary infrastructure renovations; however, cautious studies on the existing functions should manage the impacts by either appropriate mitigations or adequate compensations.

(2) Embankment

Construction of embankment for *all* stretch of the Chao Phraya river will affect the natural and social environment significantly, some of the impacts are inevitable, and some can not be compensated fully because of its irreversible characteristics.

(a) Impacts on Physical Resource Values

Embankment will separate the Chao Phraya river and natural ecosystem along the river by shutting off natural water movements. It will alter the natural environment significantly and, further, alteration of phase of aquatic and terrestrial lives may happen.

(b) Impacts on Human Use Values

- Embankment will interrupt local navigation between the left and right banks. It eventually may separate the communities along the Chao Phraya river.
- Many existing irrigation canals need to be reworked simultaneously with the embankments. Farmers who practice subsistent farming

may be forced to support more-intensive cultivation, because of changes in water supply and drainage systems.

(c) Impacts on Quality of Life Values

- Large number of resettlement will be necessary; moreover, the residents will lose immediate access to river water.
- It may alter the natural characteristics of non-hunting areas such as Wat Tarn-En and Wat Phai Lom-Wat Umputwararan.

2.2.2 Diversion Channel

Implementation of proposed diversion channel b considered environmentally sustainable only with deliberate environmental countermeasures for resettlement, local transportation, community separation, and sedimentation problems near the outlet of the channel at coastal line.

(a) Impacts on Physical Resources Values

- A portion of silt, which has been transported down originally by the Chao Phraya river, will be diverted to the diversion channel, and will be released by the coastal town, Ban Khlong Dan. Silt may alter the coastal topography and the aquatic lives' habitats significantly. It may also give impacts on the vigorous local fishing industries.

(b) Impacts on Ecological Resources Values

- It may drain wetland's water and alter the characteristics of lower plain where important habitat of, for example, water fowls.

(c) Impacts on Human Use Values

- As the route goes through in the "mesh" of khlongs in Rangsit area the diversion channel will change navigation patterns.
- Because the embankments of diversion channel may interrupt receding water which goes back to the Chao Phraya river, prolongation of inundation may occur at some part in the vicinity of discharge channel in the end of wet season.

(d) Impacts on Quality of Life Values

- Although low-population-density areas are chosen for the proposed route of diversion channel, there is possibility of splitting communities, as it may make local residents' accesses over the diversion channel difficult.

- More than one thousand houses, built along the khlongs, are in the route of the diversion channel. Although the houses do not have to move far, large number of resettlement will be necessary.
- If large quantity of water is withdrawn from the Chao Phraya river by the diversion channel during dry period, it may accelerate salt intrusion toward upstream of the Chao Phraya river. It eventually may threat water intake of Bangkok, Sam Lac, in Pathum Thani.

2.3.3 Retarding Basin

Proposed retarding basin plan has many environmental disadvantages. Implementation of the retarding basin plan should give profound environmental impacts.

(a) Impacts on Physical Resources Values

- In the project-proposed site, highest water level during flood will be kept until the end of flood period. The natural hydrology will be altered significantly.
- At the end of flooding period, water which retained in the retarding basin will be released gradually. Turbid water will be released after the flood period for longer time than the period without the project.

(b) Impacts on Ecological Resources Values

- Gates will be installed to retain the flood water. The gates will interrupt migration of aquatic ecosystems. For some, including endangered fish species, connections of swamps and rivers are crucial for accessing their reproduction grounds.
- Aquatic ecosystem may receive impacts by flow of turbid water for longer time in downstream of retarding basin.
- Characteristics of habitats for waterfowls may be altered by prolongation of inundation, so as their reproduction cycles.

(c) Impacts on Human Use Values

- Inland navigation will be interrupted by the gates to be installed.
- Land transportation also will be disconnected for longer period of time because of inundation.
- Harvesting period of traditional-variety rice may be delayed and disabled.

- Some fish species may fail to migrate through the gates and local fish catch could be reduced.

(d) Impacts on Quality of Life Values

- Land use pattern will be restricted because of the flood retarding operations. It gives profound impacts on land values and the compensation fee will be considerable amount.
- Some existing local industry may not be suitable for longer period of submergence in floodwater. Compensation will also be needed for disabled local industries.

2.3 Terms of Reference of EIA

Objectives of IEE are to give information of environmental cost of the proposed project and to provide recommendations to the Study team. The other is to determine if this project needs to conduct further environmental survey and impact analysis. The IEE concluded, given that any of the tentatively proposed alternatives are to be implemented, it will be large-scale project, and thus EIA will be needed. The newly proclaimed Constitution also requires public consultations for large-scale project although it is not fall into the categories specified in Government Gazette No. 109, 130, and 136 (1992). During the IEE study, probable impacts are estimated, and it also studied what researches are needed for clarification of environmental impacts. Terms of Reference for Environmental Study is formulated to inform a plan for further environmental study. TOR for EIA is attached at the end of this section.

2.4 Summary

In order to enhance outcomes of the master plan, Initial Environmental Examination (IEE) was conducted. The examination results were designated to be utilised by the Study Team for selecting process of the optimum plan. Another purpose of the IEE is that IEE will decide whether further environmental studies would be necessary for an alternative, which would be chosen. Further, assumptions are made for amount of work needed during feasibility study period. At commencement of the master plan, several forms of flood mitigation measures were proposed. Alternatives that proposed at the beginning of master plan were as below.

- dam operation modification
- flood warning system
- river training (heightening and new embankment, short-cut, widening, dredging, etc.)
- diversion channel
- retarding basin

Amongst of above measures, non-structure measures, "dam operation" and "warning system" are disregarded because they are declared that they are not the subjects of

EIA, by a ministerial decree. Since final picture of flood control measures and the specifications were not foreseeable, flood mitigation measures such as river trainings, diversion channel, and artificial-retarding basin plans are selected as the subjects of IEE. Likewise the sizes (and locations) were also undecided, largest size of each structures are *hypothetically* set up for the IEE.

2.5 Findings and Recommendations

It was found that EIA would be necessary in all cases because of the scale of projects and the impacts. IEE also found that human use values and quality of life would be affected severely by construction of following: new embankment along the riversides, large-scale artificial retarding basins, and large-scale diversion channel. In all cases, appropriate environmental assessment of the project impacts would be necessary. The cost of mitigation measures and compensation fee should be integrated to the project cost, and then the optimum plan should be chosen from the alternatives. It should be noted that the IEE is conducted for hypothetical alternatives, and the results are useful only for comparison of proposed alternatives in master plan period. Specific environmental studies will assess the impacts of selected measures, and the appropriate countermeasures for negative impacts should then be formulated.

3. FEASIBILITY STUDY STAGE

3.1 Outlines of Environmental Studies in F/S Stage

Initial Environmental Examination (IEE), which was conducted during master plan period, indicated that further environmental study is necessary because of the project scale. In feasibility study period, Environmental Study was conducted to analyse natural and social impacts of the project. The objectives of the environmental study was to assess both the positive and negative impact of the project, and to feedback the results as the recommendations to the JICA Study team. This environmental study plan was formulated according to the guidelines issued by Office of Environmental Policy and Planning of Ministry of Science, Technology and Environment. Content of the environmental study covers the following aspects:

- Basic Project Features
- Existing Environmental Conditions of:
 - Meteorology
 - Hydrology
 - Water Quality
 - Aquatic Ecology
 - Terrestrial Ecology
 - Transportation
 - Land Use/ Agriculture
 - Socioeconomic
 - Compensation
 - Aesthetic and Tourism
 - Public Health
- Assessment of the Project's Impact

- Mitigation and Compensation Measures
- Monitoring Programs

3.2 Outline of Public Hearings

3.2.1 Objectives

Holding of public hearings became mandatory to the project executing agencies by the Prime Minister's decree in 1996. Hence, a number of public hearings were conducted in feasibility study period, for this study. However, the feasibility study period was more like formulation period of the optimum plan rather than finalising the structures and the specifications of the facilities. Instead, functions and the facilities for flood mitigation were proposed in this stage. They were designed:

- to inform the residents in the areas where the project is proposed;
- to obtain feedback information from concerned stakeholders;
- to consult with public about project development scheme and incorporate the public concerns into the design of flood control facilities.

3.2.2 Legal Framework

New Constitution was promulgated in 1997. In the Article 67 of Chapter 4, it affirms right of residents to receive information of public works or other plans that may give impacts, and right to express their opinions before implementation of the plan. In the same year, The *Eighth National Economic and Social Development Plan (1997-2001)* was issued. In the plan, participation of the residents is encouraged in the Chapter IV as below.

"to allow greater participation of NGOs, the private sector, communities, and the general public in the process of national development"

"Local people and community organisations should be urged to play an increasingly active role in the management of natural resources and environments".

Specific guidelines of public participation is clarified in *Guidelines for Public Participation in EIA*, issued by Office of Environmental Policy and Planning, with Office of Education and Policy, in October 1997. The guideline was formulated as an answer for Prime Minister's Decree on Public Hearings, which was declared to Ministers and Departments on February 15, 1996. The guideline states the objective as below.

"People's participation in EIA, or popularly called PPEIA, should actively be incorporated into EIA process...It has objectives to give a forum to people...that have been affected from the project to express their opinions, data presentation, arguments or recommendations involving EIA."

3.2.3 Location of Public Meetings

To cover the project site, five provincial level meetings are held and the Study team explained outlines of the flood mitigation plan. After that, nine district level meetings were held with participants from sub-districts in following locations (Fig. 4.1).

[Provinces] Lop Buri, Sing Buri, Ang Thong, Ayutthaya, Pathum Thani

[Districts] Tha Rua, Nakorn Ruang, Maha Rat, Bang Pahan, Ayutthaya, Bang Pa-In, Bang Sai, Sam Khok, Khlong Luang

3.3 Project Description

The objective of the project is to increase safety level of agricultural land in the midstream of the Chao Phraya river. In order to achieve the objective, the parts of river stretches of the Chao Phraya, Pasak, Noi, Lop Buri rivers, and major khlongs, which can not withstand flood that occur once in three years, will be upgraded. The upgrading will take forms of heightening of existing embankment with regulators at confluence with khlongs. The embankment will have. The heightening works for existing embankment, with 30 cm freeboard, will require land acquisition along the dikes according to the height necessary. The alignments are shown in SECTOR VII.

3.4 Work Plan of EIA

3.4.1 General Categories

Work plan of environmental study is formulated in accordance to the *Manual of NEB Guidelines for Preparation of Environmental Impact Evaluations*. For the environmental study for this particular project, it is envisioned that following specialised skills and knowledge will be needed:

1. E-Study management

Physical Resources

2. Hydrology
3. Water quality

Biological Resources

4. Fisheries and aquatic ecology
5. Terrestrial river line biology

Human Use Values

6. Transportation and Land Use
7. Agriculture

Quality of Life Value

8. Socioeconomic / Public consultation
9. Compensation
10. Cultural values and archaeology

11. Health Science

3.4.2 Expected Impacts and Work Tasks

(1) Physical Environment

(a) Surface Water Hydrology

Separation of rivers from khlongs may be occurred by construction of embankment and other flood mitigation facilities. Reviewing related information, analyses of data, assessment of the impacts, and recommendation to the Study Team shall be made.

(b) Surface Water Quality

Without appropriate mitigation measures for stagnation of khlongs' water, it may affect water usage of local residents, and further, may affect public health of local residents. Relevant literatures should be reviewed, field observation shall be carried out and the data shall be analyzed for future estimation of water degradation and the impacts on local public.

(c) Fluctuation of Sub-surface Water

Level of sub-surface water may rise or decline after construction of embankment. Information on existing subsurface water level will be collected, and relevant precedent cases shall be reviewed. The collected data shall be analysed for estimation of future fluctuation of the water level, the impacts, and the mitigation measures.

(2) Ecological Environment

(a) Aquatic Ecosystem, Fisheries, and Aquatic Endangered Species

Flood fisheries, which have been practiced in the Chao Phraya Basin traditionally, may receive impacts of lessened flood frequencies. Relevant literature shall be reviewed, necessary researches will be conducted and future impact assessed, then the appropriate mitigation measures shall be proposed.

(b) Terrestrial River Line Wildlife and Terrestrial Endangered Species

Waterfowls' and other terrestrial wildlife's habitat may be disturbed by construction of embankment or other form of flood control measures. Relevant literatures shall be reviewed, field research to be conducted, and impacts on wildlife and on the habitat shall be assessed; then appropriate mitigation measures shall be proposed to the Study team.

(3) Human Values

(a) Navigation (transportation)

Construction of embankment may cut off khlongs and roads, and they disrupt navigation and other means of transportation. Relevant literatures and precedent cases shall be reviewed; necessary field survey shall be conducted. Then the impacts of flood control facilities should be assessed, and for the impacts, mitigation measures shall be proposed to the Study Team as early as possible.

(b) Agriculture

Traditional agriculture practices, so-called "flood agriculture" are commonly found in the Chao Phraya River Basin. Lessening of flood frequencies may give adverse impacts on the agriculture practices for reasons that flood control may also limit water supply and soil enrichment. Construction of embankment may also interrupt irrigation canals. Reviewing existing information and field survey shall be conducted for where sufficient data are not available. Impacts on agriculture in the project site shall then be assessed for formulating mitigation plan.

(c) Land Use

The Riverside land of proposed embankment might be restricted because floodwater will probably be confined between the dikes. Land value may be changed because of the hydrological changes. Relevant-existing information shall be analysed; the impacts will be assessed; the suggestions or proposals should be formulated promptly, and to be incorporated into the flood control facilities' design.

(4) Quality of Life Values

(a) Socioeconomic Values / Public consultation

Riverside land of embankment and land in the course of embankment may need compensation. In addition, access to the river may be interrupted by the dikes; hence, the land use may receive certain degree of social changes. Relevant information, complemented by field survey, is analysed and then the impacts shall be assessed. Public consultation shall be carried out with well-experienced personnel who understand the projects and also able to communicate with local residents. Proposals or suggestion to the Study Team should be formulated promptly to be incorporated in the design of flood control facilities.

(b) Cultural and Archaeological Values

Cultural values or archaeological values may be in the course of the embankment or other flood control facilities. For the evaluations and decisions what to do with them according to the Archaeological Site and Museum Act (1961) or equivalent, relevant literature shall be reviewed and the site survey shall be conducted if necessary, and information shall be analysed and assessed.

(c) Resettlement /compensation

For the land owners and others who uses lands, which are in the course of, proposed embankment will probably need to be compensated. Reduced land value resulting from the changes in hydrology (see category, Land Use), or changes of traffic, such as interruption of navigation routes shall be assessed and suggest the Study Team the amount of compensation. The assessment shall be conducted by reviewing relevant literature and field survey, if necessary, and the collected data shall be analysed.

(d) Public Health

Indicated in "Surface Water Quality"

(e) Dedicated Area Uses

Indicated in "Aquatic Ecosystem" and "Terrestrial River Line Wildlife"

3.4.3 Management of Environmental Study

The environmental study manager is responsible for supervision of above written personnel and integration of each task to suffice the object of this environmental study.

(1) Justification of Equipment

The field researches required for the study are quantified as in the list shown below.

- •Water Quality/ Aquatic Ecology - more than 10 stations
- •Terrestrial Ecological/Wetland Survey
- •Land Use Survey
- •Compensation Survey
- •Socioeconomic Survey - more than 200 cases
- •Public Consultation- more than 10 small group meetings- more than one seminar
- •Archaeological Survey

(2) Schedule of Work

Terms of E-Study Schedule

Work Items	1998					1999		
	8	9	10	11	12	1	2	3
Surface water hydrology/Public safety		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Surface water quality/Public health		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Aquatic ecosystem, fisheries		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Terrestrial riverline wildlife		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Navigation (transportation)		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Agriculture		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Land use		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Socioeconomic values/Public consultation		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Cultural and archaeological values		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨
Resettlement/Compensation		•••••		▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨	▨▨▨▨▨

* seminar
 ** progress report submission
 *** draft final report submission
 **** final report submission

Data Collection	•••••	Mitigation and Monitoring Plan	▨▨▨▨▨
Field Research	▨▨▨▨▨	Report Making	▨▨▨▨▨
Data Analysis	▨▨▨▨▨		
Impact Estimation	▨▨▨▨▨		

The environmental study shall be started in August 1998, and be completed before March 1999. A tentative schedule is described in above. In addition to the work items, an in charging staff for the environmental study will be attended for whole study period for responding for inquiries from other organisations and supervising the each work tasks.

(3) Review Sessions

Review sessions will take a form of seminar, which the Study Team will conduct, presentation of the Study; the E-Study will be incorporated in the presentation. Inter-ministerial Steering committee, of which the representative from Office of Environmental Policy and Planning (OEPP) of the Ministry of Science, Technology and Environment is a member, will also be conducted by the Royal Irrigation Department and the Study Team. Other than the presentation, the Study team will have discussions with OEPP for receiving comments and advises for the process of Study. Local specialised personnel, conducting the environmental study, shall participate JICA seminars and other formal and informal meetings, on the request of the JICA study team, and to prepare relevant explanatory documents in relation with the environmental study.

(4) Project Reports

The E-Study report will be written in both Thai and English language as they are shown below.

- -Draft Final Report in Thai (Main report + Summary report)

- -Draft Final Report in English (Main report only)
- -Final Report in Thai and English

4. RESULTS OF ENVIRONMENTAL STUDY

4.1 Introduction

Environmental impacts of both construction and operation periods were assessed, and the results are presented in the following pages. It is essential to assess the impacts prior to implementation of plan for formulation of mitigation measures, which will be described in the following section. The predicted impacts are of *after the implementation of the mitigation plans*. Categories that used for assessment are of Manual of NEB Guidelines, namely, physical resources, biological resources, human use values, and quality of life values. Impacts may be described as the impacted area, the significance, and the duration as follows.

- • Geographic Scope: local and Regional
- • Level of Impact: high, medium, low, and no impacts
- • Duration: within construction phase, and longer than construction period

Environmental impact assessment was conducted by TEAM Consulting Engineers Co., Ltd., an authorised consulting firm by the RTG. The report is written in *Environmental Study on the Middle Chao Phraya River Improvement Project for the Study on Integrated Plan for Flood Mitigation in the Chao Phraya River Basin*, Main Report and Summary Report. Followings are the brief summary of the report.

4.2 Impacts on Physical Resources

(1) Meteorology

Such minor dike improvement will create no impact on meteorological condition.

(2) Hydrology / Flood Control

Water levels of improved river section will not be changed by flood, which is bigger than targeted scale of flood (embankment for the frequency of occurrence is once in three years, or *3-year improvement*) because floodwater will overtop the heightened embankment. However, flood, which is the same or less than the 3-year improvement, water level will rise. The average increase of water level between the dike is 0.13, 0.19, 0.15, 0.15, 0.12 m for the Chao Phraya river, Lop Buri river, Khlong Bang Kaeo, Noi river, and Khlong Bang Bal respectively. The duration of inundation will not be changed. Floodwater increase will be seen in the Chao Phraya river at Bangkok; however, it will be under the design flood level, and will not overflow the dikes.

(3) Surface Water Quality / Ground Water

Impact on water quality of surface water and groundwater is expected to be nil in operation period.

4.3 Impacts on Ecological Resources

(1) Terrestrial Ecology

There will be no impact on forestry and wildlife. Although there are three non-hunting areas, impacts are not expected because of the characteristics.

(2) Aquatic Ecology / Fisheries

Regulators will be closed during a period when the water level of inland is lower than the improved dikes. It is found that "blackfish" species migrate in a period between dry and wet season and might receive adverse impacts from the closed regulators. However, they are able to move as soon as the gates are opened when water level of river became lower than that of inland water in flooding period. Therefore, impacts on the fish species can be expected to minimal with appropriate gates operations.

4.4 Impacts on Human Use Values

(1) Land Use / Agriculture

Adverse impacts will be relatively low level because the area adjacent to the river have been flooded in almost every year for a long time. The increases in water levels are insignificant and the flooding period will be the same with prior conditions. For this aspect, extensive public hearings and surveys were conducted (refer main EIA report).

(2) Transportation

Impacts of the project are positive since it increases the height of roads and strengthens. For navigation, the project may have impacts during flood because regulators will be closed, but as soon as river water recedes, the gates will be opened. The project will provide navigation locks where they are necessary.

4.5 Impacts on Quality of Life Values

(1) Socio-economic

People living along the riverbanks (between the flood protection dikes and riverbanks) will face increased flood levels for floods of once in three years return period. However, flood water levels during bigger than that will be the same since it overtops the dikes. Social survey revealed that the people living

along the banks of the rivers are accustomed with flood situation, which occur periodically.

(2) Compensation

Some private owned lands as well as some properties have to be compensated. The exact compensation cost will be fairly set up by the compensation committee. Refer to EIA main report for the specific compensation amount.

(3) Archaeological and Historical Values

The archaeological sites which must be considered with great cares are Sam Khok ancient Kilns which have become earth piles with remnants of bricks and terracotta. The debris of artifacts, which are important archaeological evidence, might be damaged more by increased flood level; nevertheless, this impact can be mitigated with appropriate management. Other sites need cares are the ancient pagoda of early Ayuttaya period at Wat Mai Chumphon near the Pasak river in Nakorn Luang district, and ancient temples in the Ancient City of Ayutthaya in Phranakorn Si Ayuttaya district, Ayutthaya province. The increase flood level might cause some damages on the basement of the buildings. For consideration of the visual impact, since the average heightening of embankment is approximately 30 cm, the impact is considered nil.

(4) Aesthetic and Tourism

Impact of increased flood water levels and the heightening of roads on tourism are considered as nil.

(5) Public Health

Stagnation of water in tributaries may occur by shutting down the gates during flood period; however, the other time of the year, these gates will be left open so major deterioration of water quality is not expected.

4.6 Results of Public Consultation

Providing project information and opportunities of residents to express their opinions on project is assured by the Constitution, and the guidelines are applicable to this project. Above all, receiving information and needs of the residents who live in the vicinities of the project site is essential in the process of formulating effective plan. The study team conducted extensive public consultations in the project area together with informal social surveys. Venues of public consultations are shown in Fig. 4.1. Summaries of the consultations are as follows.

(1) Provincial Meetings

Consultation meetings with Governors and Heads of government offices in 5 provinces comprising Singburi, Lopburi, Ang Thong, Ayutthaya, and Pathum Thani were conducted during 10-13 November 1998. The officers of the governmental offices expressed concern on bank erosion, installation of gates, periodical river dredging, proper land use control, conflicts between canals and embankments, and conflicts between resident outside and inside of the dike. The heightening of embankment is generally supported. The comments and recommendations obtained at the meetings are presented in Table 4.1.

(2) District Level Meetings

Eight small group meetings were also conducted in the areas where the dike heightenings are proposed. Target groups of the Small group meetings comprises sub-district headsmen, village headsmen, members of sub-district administrative organisation, and villagers' representatives from concerned villages and sub-districts along the 7 water ways. The districts are Maha Rat, Bang Pahan, Tha Rua, Nakhorn Luan, Bang Ban, Bang Pain, Sam Khok, and Phranakom Si Ayutthaya in January and February, 1998. Total number of participants of 8 small meetings reached total of 600 people, 75 people per district in average. In the small group meeting, the outline of project is explained to the residents, and probable impact of due to the implementation is explained together with other alternatives. Then the residents were asked for their preferences on the alternatives. Table 4.2 shows material that was used in the small group meetings. Problems that they are chronically facing during flood are also asked. The last half of the meetings were designed for questions and presentation of opinions from the residents.

The residents were aware of the project plan because extensive social surveys were conducted before the meetings were held. Although some villagers expressed flooding are natural phenomena to the area and, and said, causing no problems to them¹, general participants agreed to heightening the roads (embankments) will be useful to some extent. The government sectors were played catalyst between the study team and the residents; the governments showed remarkably supportive attitude to the project. No objections were ever heard. However, construction of new dikes just off the river shore is opposed by the residents that great deal of relocations will be necessary.

Suggestions from the residents are provided to the study team that low lying areas can be used for retarding basins and for fishponds or water reservoirs.

¹ According to the residents, damages were insignificant, even with 2-4 m depth of flood inundation for three months in 1995, because most of rice was harvested prior to the inundation.

5. RECOMMENDATIONS

In order to assure that the impacts are well within the predicted level, all of the recommended mitigation measures needed to be implemented properly at the appropriate places and periods. The following sections of this section will present the necessary mitigation measures during construction and operation periods for the proposed projects.

5.1 Design Period (for the JICA Study team)

- Large area of low lying swamps should be set as conservation zones in order to enhance ecological habitats.
- Ditches should be dug parallel to the improved dike to collect the runoff water and avoid stagnation of water nearby the dike.
- Clearly inform the local residents about the project and the expected impacts.
- Further study to protect the communities adjacent to the river from flood related damages, such as providing efficient flood.
- Provide alternative navigation route to mitigate the inconvenience during construction of regulators at Khlong Toei, Khlong Wat Dok Mai and Khlong Bang Pho in Sam Khok district, Pathum Thani province.
- Fairly compensate for directly affected land and properties as recommended in the section of compensation in main report of EIA. The compensation cost should be accepted by the residents.
- Compensation process needs to be completed prior to the construction.
- The affected people should have proper representatives in establishing of the compensation process.
- Provide efficient social system to assist the flood-affected families during flood.
- Implement other additional flood protection measures such as drainage canals.

5.2 Construction Period (for Construction Company)

- Employ local workers to a maximum extent to alleviate conflicts between the project construction workers and the residents, and to improve economic condition.
- Concentrate construction activities close to waterways in the dry season.
- Concentrate construction activities only in daytime.

- Temporary ditch or pond should be provided at drainage channel adjacent to construction site to trap sediments prior to discharging to the receiving water body.
- Utilise soil materials from swamp and pond excavations to the maximum extent to provide additional flood absorbing and restoring capacity of the project.
- Locate construction camp at least 50 m away from waterway, and enough distance away from aesthetic sites.
- Temporary on-site wastewater treatment system (e.g. septic tank) and sufficient number of sanitary latrines (1 unit/ 15 workers) have to be provided for the construction camp.
- Prohibit that washing equipment in the river.
- Inspect machineries and equipments periodically, to prevent any oil leakage into nearby water body.
- Prohibit any waste dumping into the waterways and set up designated containers.
- Filled up soil must be graded and pressed immediately in order to minimise erosion.
- Avoid transporting construction machineries, equipments and materials during rush hours.
- Apply appropriate construction techniques and method that minimise traffic congestion
- Inform road users and people in communities nearby the construction sites about the project construction schedules and diversion routes.
- Closely co-operate with the highway police to alleviate traffic problem around the project construction site.
- Trucks with construction material should be covered with canvas to prevent dust dispersion and material falling on the roads.
- Spray water on disturbed area or dust generating area to minimise dust dispersion.
- Install warning signs for drivers entering the construction site.
- Repair any damages of infrastructures caused by the construction works immediately.
- Demolition and construction activities should be carried out in such a way that vibration arising will not affect to adjacent archaeological structures especially at Wat Chaiwatthanaram, Wat Phutthai Sawan, Ancient Portuguese village, Wat Bang Toci Klang, Wat Sing and Sam Khok Ancient Kilns.

- Should any remains or antiquities be uncovered during construction, the responsible authority, i.e., the Fine Arts Department, shall be informed immediately.
- Temporary footways should be provided to the temples/archaeologicals for access of, especially, Wat Chaiwatthanaram, Wat Shyttai Sawan, Ancient Portuguese village, Wat Bang Toei Klang, Wat Sing and Sam Khok Ancient Kilns.

5.3 Planning, Operation and Maintenance Period (for RID)

- Gates should be left open during the early periods of rainy season (breeding period) to keep continuation between river water and land sides of the dike.
- A public relation team should be established to promote the understanding on project's compensation process to the people within the project vicinities. It is recommended that the committee should consist of following persons.

Chairman of committee: Head of district

Member of committee: Water resource engineer from RID, District land officer, and Representative from the land acquisition section of RID

Secretary: Representative from the land acquisition section of RID

- The compensation committee should be responsible to the compensation price and should conduct investigations for the price determination.
- Compensation and rebuilding of the wall of Wat Bang Toei Nok must be properly managed.
- Archaeological sites such as Wat Chaiwatthanaram, Wat Phutthai, Sawan, and Sam Khok ancient kilns that are vulnerable to flood must be properly protected by directly responsible authority, such as small flood protection dikes.
- Promote deepwater rice variety in the paddy field located adjacent to the river.

5.4 Operation and Maintenance Period (for Local Government)

- Minimise the use of private land for construction purposes
- Prohibit usage of illegal fishing gears.
- Local governments should co-ordinate with local RID about gates, dam, and barrage operations during flood.
- Regularly clear up waterways prior to flood season.
- Fry and fingerlings should be stocked to gain production for local people.
- Educate local farmers to minimise use of herbicide and insecticide.
- Restrict use of pesticides and herbicides within landside of dike.

6. MONITORING PLAN

Monitoring programs to be proposed are follow up tools to ensure the effectiveness of the recommended measures. The data, which obtained from the monitoring program, will be useful for the formulation of further improvements of infrastructures in the region and provision for assistance on the households affected by flood. Recommended plans are formulated for physical resources, ecological resources, and quality of life values. Refer EIA main report for the specifications of the monitoring set-ups.