These works will be carried out by applying mechanized construction methods to meet with the proposed construction period. All the heavy construction equipment required for these civil works will be provided by contractors. The availability of reliable construction equipment in Hanoi, at present, is extremely low.

2.2 Construction Plan

The construction plan of the major works for each package is as follows:-

(1) Package A1: Site Preparatory Works

Major works of this package comprise a) land preparation for the contractor's camp sites in the Yen So area, b) construction of construction/access roads in the Yen So area, and c) land preparation of spoil banks to be required for excavated materials from the Yen So Pumping Station/Regulating Reservoir, river/lake dredging sites, etc.

The proposed camp site, approximately 3 ha in extent and 100,000 m^3 in embankment volume, is situated at the western side of the Yen So Regulating Reservoir and the south of the existing road.

The planned main access/construction roads which will be required at the beginning of the main construction stage in the Yen So project area are, approximately 3.5 km in total, 2 km for widening and heightening of the existing road and 1.5 km for new construction. The estimated embankment volume is approximately 85,000 m^3 in total. These roads will be designed according to UPI's urban road planning.

The embankment work for item a) will be carried out applying a combination of a backhoe-dump truck method and a tractor drawn scraper (carry-all scraper), if scrapers are available. The embankment material will be borrowed from the proposed site of the Yen So Regulating Reservoir. The work for item b) will be carried out simultaneously by applying a conventional method with a backhoe/dozer shovel, dump truck, motor grader, compacting roller, and asphalt paving equipment. The work for item c) including access roads, riprap, and a drainage channel around the circumference of the spoil bank will be constructed at the southern side of the above camp and this area will be residential after completing the construction works.

These works will be carried out with the equipment on hand, by local contractors (government company) during the dry seasons in 1995/6 and in later 1996, and completed by December 1996, before commencing the main civil works. The proposed construction schedule is shown in Figure 2.1.

(2) Package A2: Main Civil Works

This package comprises a) construction of the Yen So Pump Station, including an Inlet Structure, Inlet Channel, Ordinary Drainage Channel, Outlet Sluice way, and an Outlet Channel, b) construction of the Yen So Regulating Reservoir including the Yen So Channel and Spoil Bank, c) Construction of the Linh Dam and Dinh Cong Lakes including the Linh Dam Channel, d) construction of Flood Gates (3 gates) and Control Gates (4 gates), e) River Improvement including the construction of bridges and culverts, f) Hydromechanical equipment including Pump Station

Equipment, Outlet Sluiceway Gates, Floodgates and Control Gates, and g) a Flood Forecasting System.

The foundation works of the pumping station comprise of foundation earth excavation, steel pipe pile driving and capping concrete. For the execution of the piling works, special consideration would be required for obtaining the steel pipe piles for the foundation and its driving rigs. During steel pipe pile driving using heavy movable diesel pile driving rigs, driving experts may be necessary. The foundation works will be commenced from the early 1997 and completed before February 1998 for the First Stage Construction, and from November 2001 and completed before February 2002 for the Second Stage Construction.

Following the steel pipe piling, construction of the sub-structure will commence from March 1997 and be completed for the installation of the pumps by the end of October 1998. All the structures in this project require foundation treatment with steel pipe piles (for Pump Station, Surge Tank and Thanh Liet Flood Gates, etc.) and concrete piles (for others) before placing concrete for the structures. After partly excavating the foundation, piling work using a movable diesel pile driving rig, capping, and base concrete placing will be carried out successively. Placing of reinforced concrete for structures will be continued using a truck crane and/or concrete pump truck. Two shift work systems will be applied for this section in the dry season. The pump installation works including electric control equipment, will be completed within 6 months by April 1999 for the First Stage Construction, and by April 2003 for the Second Stage Construction. The commissioning test will commence after completing each Stage.

The construction of a Surge Tank and Sluiceway under the Red River Dike, including excavation, foundation treatment, concrete placing, backfill and embankment, and gate installation will need to be completed within one dry season in 1997/8 for the First Stage Construction and in 2001/2 for the Second Stage Construction, using the same methods mentioned above. It may be necessary to apply a 2-shift working system during the peak time.

The construction of Inlet Structures, Inlet Channel, Ordinary Drainage Channel and Outlet Channel will be carried out by applying conventional construction methods using bulldozers, bachhoes, dump trucks, etc. within two dry seasons and completed before the pump commissioning test in May 1999.

Major works of the Yen So Regulating Reservoir and the Linh Dam Channel consist of excavation of reservoir and channels with coffering and unwatering, embankment of dikes, revetment/riprap, and the construction of 8 bridges (7 for road and 1 for railway), and 3 spillways with rubber gates.

Major works for construction of the Floodgates and Control Gates consist of excavation, foundation treatment, concrete placing for structure and gate installation with coffering and unwatering. The construction methods for these works will be similar to the above mentioned works.

The River Improvement includes excavation/dredging, embankment of dikes, revetment/riprap, construction of fall structures, road and railway bridges, box culverts, drainage and intake facilities, and environmental measures. Partial or complete coffering and unwatering is necessary for almost all the works , even if the work is done in the dry season. Excavation of rivers will be done by using hydraulic

backhoe and dump truck from landside or on working pontoon with a barge. The dredged materials from the riverbed will be utilized for land reclamation to be selected near the dredging sites. The majority of embankment materials for the Lower Kim Nguu River will be taken from the Regulating Reservoir.

The excavated and selected materials from the Regulating Reservoir, Pump Station, Channels and Rivers will be stored near the sites, or hauled directly to the backfill sites or embankment of the dikes and roads. The majority of the excavated material will be utilized for land reclamation to be proposed as residential areas in the Yen So area.

The revetment and riprap will be executed parallel to the respective embankment works. The materials, stone, sand, and gravel will be purchased from the western hilly areas about 80 - 100 km from Hanoi. Road pavement will be carried out in accordance to the standards of the Road Department. The materials will be purchased from the said places.

Major works of the Hydromechanical Equipment are to design, manufacture, transport, install and test the pumps and their related equipment and the various kinds of gates and comprises of 4 sub-packages; a) Pumping equipment including submersible motor pumps with electrical control system, valves, trash rakes with belt conveyors, stoplogs and gantry cranes for pumps and stoplogs, b) Gates with electric controlled hoists for Outlet Sluiceway, c) Rubber Gates with control equipment for the Spillways of the Regulating Reservoir, and d) Flood and Control Gates for Thanh Liet and other structures.

All the equipment and gates for the First Stage Construction will be designed and manufactured by an experienced manufacturer from January 1997 upon approval of specifications and drawings of the project. Anchors and metals to be embedded in concrete will be delivered one by one according to the civil works, and the main bodies will be delivered, installed and tested before the flood season in 1999. The equipment and gates for the Second Stage Construction will be constructed using the same procedures as the First Stage Construction, from October 2001 and completed before the flood season in 2003.

The major construction works including Pump Station, Sluiceway, Regulating Reservoir, and Hydromechanical Works of this package will be executed by a contractor selected through international competitive bidding. The remaining works will be executed by local contractors selected by local competitive bidding within the above mentioned period. The proposed construction schedule is shown in Figure 2.1.

(3) Package A3: Drainage Channel Improvement

Major works of this package comprise a) reconstruction of bridges (16 bridges) and b) reconstruction of box culverts (63 culverts) over the drainage channels of the To Lich River basin (16.4 km), Set River basin (3.7 km) and Kim Nguu River basin (10.7 km).

Initially, the contractor will prepare and submit a detailed construction schedule of bridges and box culverts in a minimum period of 6 months, to the Hanoi Traffic Police Office through the Executing Agency, to obtain approval for the temporary road closing of related routes.

The construction will be carried out by applying conventional and prevailing construction methods mentioned above, and the sub-structure of bridges and box culverts will be constructed mainly in the dry season to lessen inundation caused by construction works. The super-structure of bridges and miscellaneous works for box culverts may also be constructed in the wet season. To reduce closure period, two-shift work systems must be considered for traffic congested routes.

These works will be executed by local contractors from November 1997 and November 2001 and completed by the end of April 2000 and 2004 for the First Stage Construction and the Second Stage Construction, respectively. The proposed construction schedule is shown in Figure 2.1.

(4) Package A4: Lake Improvement

Major works of this package are a) dredging sediments in the lakes, b) bank protection using riprap, c) construction of water control structures, and d) environmental measures.

The dredging work will be carried out by applying two methods; using a pump dredger and booster except during the flood and drought season, and using a backhoe and dump truck during most of the drought season. The dredged materials will be used for land reclamation near the designated lakes. In regard to dump truck hauling, care must be taken for road traffic between the lakes and spoil banks.

These works for the First and Second Stage Construction will be executed by a local contractor from November 1997 and 2001 and will be completed by the end of April 2000 and 2004 respectively. The proposed construction schedule is shown in Figure 2.1.

(5) Package A5: Sewer Rehabilitation and Construction

The major work of this package is to rehabilitate the existing combined sewer system, including construction of additional sewer pipes and box culverts, in the West Lake Basin (80 ha), the To Lich River Basin (324 ha), the Upper Lu River Basin (215 ha), the Set River Basin (217 ha) and the Kim Nguu River Basin (374 ha).

In addition to the procedures for road traffic as described in section (3) Drainage Channel Improvement, measures must be taken for the inhabitants in the work area to obtain their cooperation.

The construction works will be carried out by applying conventional and prevailing mechanized methods used in Hanoi; cutting pavement using a concrete cutter, braking using a pneumatic hammer, excavation and loading using hydraulic backhoes and manpower, and hauling using dump truck. Following ditch excavation, precast concrete sewer pipes will be transported by a flat bed truck with crane, and laid by using its crane or the truck crane. The box culvert will be molded on site. After backfilling on the pipes and culverts, re-pavement will be completed.

These works for the First and Second Stage Construction, will be executed by local contractors from November 1997 and 2001 and completed by the end of April 2000 and 2004, respectively. The proposed construction schedule is shown in Figure 2.1.

(6) Package A6: Existing Sewer/Canal Dredging

These works will be carried out by HSDC as ordinary maintenance of the existing sewers and drainage channels, with equipment and materials to be procured from other packages in the Project.

The proposed cleaning and dredging works will commence from the first dry season in 1996/7 and completed within 3.5 years, for the urgent project area. These works will continue subsequently in other areas of Hanoi and repeat once every 3-5 years.

This contract, including technical guidance, will be executed by an international supplier from September 1996 and completed by the end of April 1998. The proposed manufacturing and delivery schedule of the equipment is shown in Figure 2.1.

The preparation of a motor pool with a maintenance and repair shop for the above equipment will be completed by HSDC before November 1996 as shown in Figure 2.1.

(7) Package B1: Supply of Equipment and Materials

The scope of work for this package as the Urgent Project, includes design, manufacture, delivery of all equipment, spare parts required for at least 3.5 years operation, materials for sewer cleaning and drainage channel dredging, and training of operators and mechanics of the Hanoi Sewerage and Drainage Company. The main equipment to be supplied are water jet cleaning trucks, vacuum trucks with dehydrator, water tankers, grab bucket excavators, dump trucks, swampdozers, etc.

Aiming for an earlier completion of cleaning and dredging works for some priority areas, a tight schedule for detailed design, tender and tender evaluation is proposed. The contract for this package will be awarded at the end of March 1996, through pre-qualification of tenderers, international competitive tender and tenders evaluation, and the equipment will be manufactured and delivered in Hanoi by the end of September 1996. One of the important contents of this package is to train operators and mechanics through initial training and intermittent on-job training for 1.5 years.

G3. Cost Estimate

3.1 Conditions of Cost estimate

The cost for the To Rich Basin Drainage Project, First Stage Construction and Second Stage Construction was estimated under the following conditions.

(1) Project Execution Method

All the project works will be executed on a contract basis. The construction equipment, materials and labors required for the works will be provided by contractors to be selected through the international or local competitive bidding.

(2) Financial Cost

The financial cost comprises the main construction cost, land acquisition and compensation cost, engineering services and administration costs, and price escalation and physical contingency. The main construction cost was estimated on an unit cost basis.

(3) Unit Prices

The unit construction costs for the major work items were prepared by referring to the prevailing construction unit prices in the Price List for Construction Materials published by Hanoi Construction Services for governmental works in Viet Nam, and to the unit construction costs for contractor systems, including direct and indirect costs, profit, etc., employed by similar projects in South-East Asian countries. The construction cost for the Project was estimated by applying the said unit costs, as shown in Table G.3.1.

The costs, including costs of construction equipment, materials and labor, both for the foreign and local currency portions were estimated in terms of US $. The ratio of the foreign and local currency components of major work items was assumed as listed in Table G.3.1.

(4) Price Level

All the direct construction costs were estimated at mid 1994 price level. The exchange rate applied for the cost estimation is as follows:

US $ 1.00 = JY 100 =VN Dong 10,800

(5) Land Acquisition and Compensation

The land needed for pumping stations, regulating reservoirs, river and channel improvement, sewer rehabilitation and construction, etc., will be acquired by the Government. Houses located on the land acquired will be compensated. Fish ponds, etc., utilized by the Project but not occupied after completion, will also be compensated. The unit costs for land acquisition and compensation were estimated as shown in Table G.3.1.

(6) Engineering Services for Detailed Design and Construction Supervision

The cost of engineering services, including detailed design (field investigation such as topographical survey, geological investigation and water quality analysis, preparation of tender documents) and construction supervision for each stage was estimated on man-month basis with direct cost, according to the implementation schedule.

(7) Administration Cost

The cost for the Project administration by the Government of Viet Nam is estimated at 3 % of the direct construction cost.

(8) Price Escalation and Physical Contingency

Price escalation is estimated by applying an annual inflation rate of 2.5 % both for the foreign and local currency portions.

Physical contingency is estimated at 10 % for the sum of civil works and 5 % for the sum of hydro-mechanical works and the supply of equipment.

(9) There may be a possibility of import taxes and other duties and taxes in the future. Hence, present cost estimate tentatively includes the allowance for such future taxation at the amount equivalent approximately to 4% of the foreign currency costs.

3.2 Financial Cost and Disbursement Schedule

(1) Financial Cost

The financial cost consists of the main construction cost, land acquisition and compensation cost, engineering services, administration cost, import tax, price escalation and physical contingency.

The estimated total financial cost is US $ 377 million, comprising the foreign currency portion of US $ 228 million and the local currency portion of US $ 149 million. Table G.3.2 shows the summary of the financial cost for the Project. Table G.3.3 shows the breakdown of the financial cost.

(2) Disbursement Schedule

The annual disbursement schedules of both the First Stage Construction and the Second Stage Construction were prepared based on Figure G2.1 proposed construction schedule and shown in Table G.3.4.

Table G1.1 (1) WORK ITEMS OF 1ST AND 2ND STAGE PROJECTS (1/2)

Items of Facilities	First Stage Project	Second Stage Project
1- Yen So Pumping Station		
(1) Pumping Station	Q = 45 m3/s	Q = 45 m3/s
(2) Inlet Structure	B = 200 m with	—
(3) Inlet Channel	L = 1,200 m	—
(4) Ordinary Drainage Channel	L = 1,900 m	—
(5) Outlet Sluiceway	A = 30 m2	A = 30 m2
(6) Outlet Channel	L = 1,600 m	—
2- Yen So Regulating Reservoir		
(1) Regulating Reservoir	A = 203ha (130ha)	—
(2) Yen So Channel	L = 3,400 m	—
(3) Spoil Bank	A = 40 ha	—
3- Linh Dam and Dinh Cong Lakes		
(1) Linh Dam Channel	L = 1,000 m	—
(2) Linh Dam Lake	—	A = 107 ha
(3) Dinh Cong Channel	—	L = 400 m
(4) Dinh Cong Lake	—	A = 25 ha
4- Floodgates and Control Gates	7 places	—
5- River Improvement		
(1) To Lich and Lower Lu River System	L = 22.1 km (Lower Lu = 3.2km) (Lower Lu = 3.2 km)	—
(2) Set and Upper Lu River System	L = 7.5 km (Upper Lu = 3.1km) (Upper Lu = 3.1 km)	—
(3) Kim Nguu River System	L = 3.4 km	—
6- Drainage Channel Improvement		
(1) To Lich and Lower Lu River Basin	Bridges/Box Culverts (21 places)	Channel Works (L = 16.4 km) & Bridge/Box Culverts (24 places)
(2) Set and Upper Lu River Basin	Bridges/Box Culverts (13 places)	Channel Works (L = 3.7 km) & Bridge/Box Culverts (2 places)
(3) Kim Nguu River Basin	Bridges/Box Culverts (20 places)	Channel Works (L = 10.7 km) & Bridge/Box Culverts (1 places)

Table G1.1 (2) WORK ITEMS OF 1ST AND 2ND STAGE PROJECTS (2/2)

Items of Facilities	First Stage Project	Second Stage Project
7- Lake Improvement		
(1) Lake Dredging	4 lakes	14 lakes
(2) Lake Conservation	Aeration in 2 lakes as a pilot project	Overall environmental measures dor 11 lakes
8- Sewer Rehabilitation and Construction		
(1) West Lake Basin	Rehabilitation	New construction
(2) To Lich River Basin	Rehabilitation	Rehabilitation/ New construction
(3) Lower Lu River Basin	—	New construction
(4) Hoang Liet Drainage Basin	—	New construction
(5) Set River Basin	Rehabilitation	New construction
(6) Upper Lu River Basin	Rehabilitation/ New construction	New construction
(7) Kim Nguu River Basin	Rehabilitation/ New construction	New construction
(8) Yen So Drainage Basin	—	New construction
9- Equipment Supply for Cleanup of Drainage Channels and Sewers	Grab bucket excavator, water jet cleaner, etc.	—

Table G3.1 UNIT PRICES FOR COST ESTIMATION (1/2)

Items Works	Unit	Unit Price (US $)				
		Foreign Currency		Local Currency		
		Unit	Ratio	Unit	Ratio	Total
A. Construction Cost						
1- Earthwork						
(1) Excavation at Yen So/Hoang Liet areas	m3	2.4	(0.80)	0.6	(0.20)	3.0
(2) Excavation along rivers/drainage channels	m3	3.4	(0.80)	0.9	(0.20)	4.3
(3) Excavation in city area lakes	m3	3.2	(0.80)	0.8	(0.20)	4.0
(4) Embankment/Backfilling	m3	4.0	(0.80)	1.0	(0.20)	5.0
2- Structural Work						
(1) Reinforced conrete	m3	132.0	(0.60)	88.0	(0.40)	220.0
(2) RC pile	m	55.0	(0.55)	45.0	(0.45)	100.0
(3) PC pile, 550 mm diameter	m	90.0	(0.55)	80.0	(0.45)	170.0
(3) Steel pile, 600 mm diameter	m	225.0	(0.90)	25.0	(0.10)	250.0
(4) Steel sheet pile	m2	207.0	(0.90)	23.0	(0.10)	230.0
(5) Revetment, 1: 0.3	m3	42.0	(0.45)	52.0	(0.55)	94.0
(6) Revetment, 1: 2.0	m2	14.0	(0.45)	17.0	(0.55)	31.0
(7) Riprap	m3	8.0	(0.80)	2.0	(0.20)	10.0
(8) Gabions for fall structure	m3	13.0	(0.90)	2.0	(0.10)	15.0
3- Composite Structures						
(1) Bridge	m2	910.0	(0.70)	390.0	(0.30)	1,300.0
(2) Bridge protection	pl.	1,400.0	(0.45)	1,705.0	(0.55)	3,100.0
(3) Box culvert	m2	540.0	(0.60)	360.0	(0.40)	900.0
(4) Railway bridge	m	10,400.0	(0.80)	2,600.0	(0.20)	13,000.0
(5) Steel gate structure	m2	20,000.0	(0.80)	5,000.0	(0.20)	25,000.0
(6) Spillway with rubber gates	m	12,000.0	(0.80)	3,000.0	(0.20)	15,000.0
(7) Control structure at outlet of city area lakes	pl.	7,000.0	(0.70)	3,000.0	(0.30)	10,000.0
(8) Pumping station	L.S.	(For the Master Plan study, the following cost curve is used)				
(9) Intake facilities	pl.	8,400.0	(0.70)	3,600.0	(0.30)	12,000.0
(10) Drainage facilities	pl.	1,200.0	(0.60)	800.0	(0.40)	2,000.0
4- Others						
(1) Land preparation	m2	2.0	(0.80)	0.5	(0.20)	2.5
(2) Environmental measures	m2	0.9	(0.30)	2.1	(0.70)	3.0

Table G3.1 UNIT PRICES FOR COST ESTIMATION (2/2)

Items of Works	Unit	Unit Price (US $)				
		Foreign Currency		Jocal Currency		Total
		Unit	Ratio	Unit	Ratio	
B. Compensation Cost						
1- Land Acquisition						
(1) Yen So/Hoang Liet areas, inside Red River dike	m2	_	(_)	25.0	(1.0)	25.0
(2) Yen So/Hoang Liet areas, outside Red River dike	m2	_	(_)	19.0	(1.0)	19.0
(3) Along rivers/drainage channels	m2	_	(_)	190.0	(1.0)	190.0
2- House Evacuation	House	_	(_)	1,300.0	(1.0)	1,300.0
3- Fishery Compensation	m2	_	(_)	0.5	(1.0)	0.5

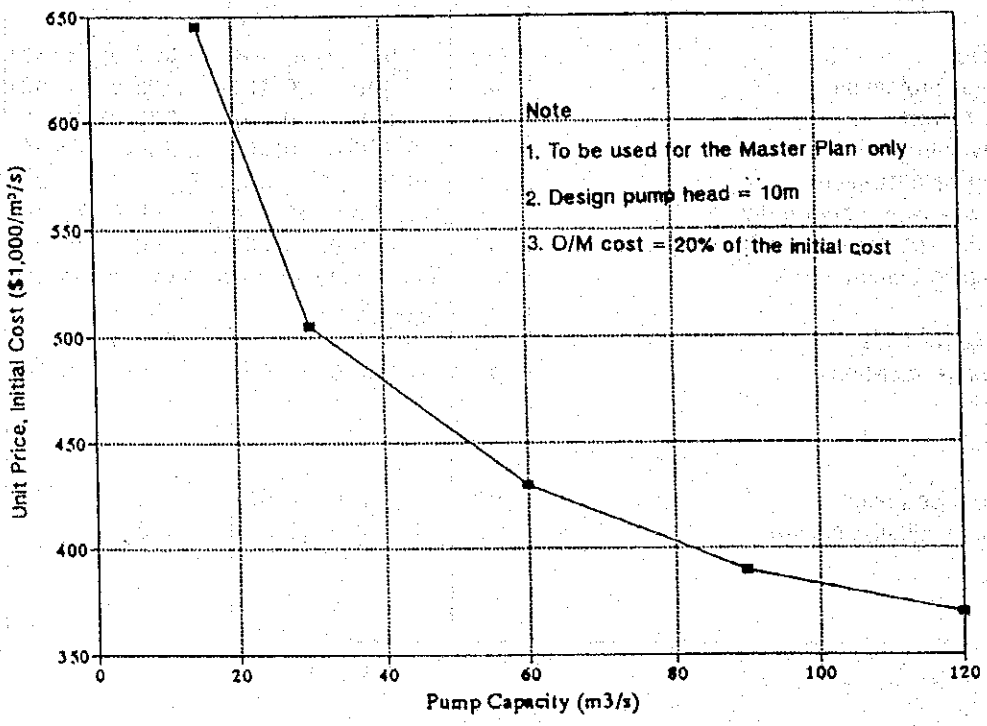


Table G3.2 FINANCIAL COST

Unit: US $ 1,000 equivalent

Item	First Stage Construction			Second Stage Construction			Total		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total
1 Construction Works	88,771	24,616	113,387	69,906	31,702	101,608	158,677	56,318	214,995
A. Construction Works	80,021	23,716	103,737	69,906	31,702	101,608	149,927	55,418	205,345
B. Procurement of Equipment & Materials	8,750	900	9,650	0	0	0	8,750	900	9,650
2 Administration Cost	0	3,401	3,401	0	3,048	3,048	0	6,449	6,449
3 Land Acquisition and Compensation Cost	0	15,180	15,180	0	20,050	20,050	0	35,230	35,230
4 Import Tax	0	3,980	3,980	0	3,282	3,282	0	7,262	7,262
5 Engineering Service	10,728	4,660	15,388	12,160	6,547	18,707	22,888	11,207	34,095
6 Price Escalation	9,140	4,356	13,496	18,945	14,273	33,218	28,085	18,629	46,714
7 Physical Contigency	9,296	5,537	14,833	9,290	7,888	17,178	18,586	13,425	32,011
Grand Total	117,935	61,730	179,665	110,301	86,790	197,091	228,236	148,520	376,756

Table G 3.3 BREAKDOWN OF FINANCIAL COST

	Item	Unit	Whole Project						1st Stage Project				2nd Stage Project			
			Work Quantity	Unit Co: ($) F.C.	Unit Co: ($) L.C.	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total	Work Quantity	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total	Work Quantity	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total
A	CONSTRUCTION WORKS TOTAL					189,655	71,879	261,534		95,539	28,696	124,236		94,116	43,183	137,298
	- Base Cost:					149,930	55,418	205,348		80,023	23,717	103,739		69,907	31,701	101,608
	- Price Escallation:					24,229	9,960	34,188		7,839	2,401	10,240		16,390	7,559	23,949
	- Physical Contingency:					15,496	6,502	21,998		7,678	2,579	10,257		7,819	3,923	11,741
A1	Package A1 : Site Preparatory Works					604	231	836		604	231	836				
	- Base Cost:					523	200	723		523	200	723				
	- Excavation	m3	100,000	2.4	0.6	240	60	300	100,000	240	60	300	0			
	- Camp site - land preparation	m2	35,000	2.0	0.5	70	18	88	35,000	70	18	88	0			
	- Spoil bank - land preparation	m2	50,000	2.0	0.5	100	25	125	50,000	100	25	125	0			
	- Access road rehabilitation and upgrading	m2	22,000	4.0	4.0	88	88	176	22,000	88	88	176	0			
	- Miscellaneous works	5%				25	10	34		25	10	34				
	- Price Escalation for A1:					27	10	37		27	10	37				
	- Physical Contingency for A1:					55	21	76		55	21	76				
A2	Package A2 : Main Civil Works					113,252	24,824	138,075		80,590	20,750	101,340		32,661	4,074	36,735
	- Base Cost:					92,679	20,268	112,947		67,828	17,240	85,068		24,851	3,028	27,879
0-	General Installations (15% of Civil Works Cost)	LS				7,036	2,543	9,578		5,910	2,156	8,066		1,125	387	1,512
1-	Yen So Pumping Station					13,213	5,811	19,024		9,291	4,215	13,505		3,922	1,596	5,519
	(1) Pumping Station-Civil Works					7,041	2,703	9,744		3,821	1,539	5,360		3,220	1,164	4,384
	- Steel pipe piles, 600mm dia. x 38 m	m	13,300	225.0	25.0	2,993	333	3,325	6,840	1,539	171	1,710	6,460	1,454	162	1,615
	- Steel sheet piles	m2	1,200	207.0	23.0	248	28	276	600	124	14	138	600	124	14	138
	- PC piles 550 mm dia. x 23m	m	6,900	90.0	80.0	621	552	1,173	4,600	414	368	782	2,300	207	184	391
	- Reinforced concrete	m3	17,300	132.0	88.0	2,284	1,522	3,806	9,500	1,254	836	2,090	7,800	1,030	686	1,716
	- Others	LS	1			560	140	700	0.55	308	77	385	0.45	252	63	315
	- Miscellaneous works	5%				335	129	464		182	73	255		153	55	209
	(2) Inlet Structure					921	514	1,435		921	514	1,435	0			
	- Reinforced concrete	m3	2,000	132.0	88.0	264	176	440	2000	264	176	440	0			
	- PC piles 550 mm dia. x 23m	m	3,500	90.0	80.0	315	280	595	3500	315	280	595	0			
	- Steel sheet piles	m2	1,440	207.0	23.0	298	33	331	1440	298	33	331	0			
	- Miscellaneous works	5%				44	24	68		44	24	68	0			
	(3) Inlet Channel, 1,200 m					1,211	704	1,914		1,211	704	1,914				
	- Excavation	m3	230,000	2.4	0.6	552	138	690	230,000	552	138	690	0			
	- Embankement	m3	16,000	4.0	1.0	64	16	80	16,000	64	16	80	0			
	- Revetment (1 : 2.0)	m2	26,000	14.0	17.0	364	442	806	26,000	364	442	806	0			
	- Bridge, 1pl.	m2	190	910.0	390.0	173	74	247	190	173	74	247	0			
	- Miscellaneous works	5%				58	34	91		58	34	91				
	(4) Ordinary Drainage Channel, 1,900m					578	256	834		578	256	834				
	- Excavation	m3	63,000	2.4	0.6	151	38	189	63,000	151	38	189	0			
	- Embankement	m3	13,000	4.0	1.0	52	13	65	13,000	52	13	65	0			
	- Revetment (1 : 2.0)	m2	4,000	14.0	17.0	56	68	124	4,000	56	68	124	0			
	- Bridges, 2pl.	m2	320	910.0	390.0	291	125	416	320	291	125	416	0			
	- Miscellaneous works	5%				28	12	40		28	12	40				
	(5) Outlet Sluiceway - Civil Works					1,419	874	2,293		717	442	1,158		708	432	1,135
	- Reinforced concrete	m3	9300	132.0	88.0	1,228	818	2,046	4700	620	414	1,034	4,600	607	405	1,012
	- Steel sheet piles	m2	600	207.0	23.0	124	14	138	300	62	7	69	300	62	7	69
	- Miscellaneous works 5%	5%				68	42	109		34	21	55		33	21	54

Table G 3.3 BREAKDOWN OF FINANCIAL COST

	Item	Unit	Whole Project						1st Stage Project				2nd Stage Project			
			Work Quantity	Unit Cost ($) F.C.	Unit Cost ($) L.C.	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total	Work Quantity	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total	Work Quantity	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total
	(6) Outlet Channel, 1,600m					2,044	761	2,805		2,044	761	2,805				
	- Excavation	m3	290,000	2.4	0.6	696	174	870	290,000	696	174	870	0			
	- Embankment	m3	210,000	4.0	1.0	840	210	1,050	210,000	840	210	1,050	0			
	- Revetment (1 : 2.0)	m2	15,000	14.0	17.0	210	255	465	15,000	210	255	465	0			
	- Bridge, 1pl.	m2	220	910.0	390.0	200	86	286	220	200	86	286	0			
	- Miscellaneous works 5%	5%				97	36	134		97	36	134				
2-	Yen So Regulating Reservoir					15,014	4,137	19,151		15,014	4,137	19,151				
	(1) Regulating Reservoir, 203 ha					11,811	3,112	14,923		11,811	3,112	14,923				
	- Excavation	m3	3,130,000	2.4	0.6	7,512	1,878	9,390	3,130,000	7,512	1,878	9,390	0			
	- Riprap	m3	26,000	8.0	2.0	208	52	260	26,000	208	52	260	0			
	- Spillways with rubber gates, 3 pl.	m	165	12,000.0	3,000.0	1,980	495	2,475	165	1,980	495	2,475	0			
	- Bridges, 2 pl.	m2	840	910.0	390.0	764	328	1,092	840	764	328	1,092	0			
	- Intake Facilities	pl.	10	8,400.0	3,600.0	84	36	120	10	84	36	120	0			
	- Land Preparation	m2	350,000	2.0	0.5	700	175	875	350,000	700	175	875	0			
	- Miscellaneous works	5%				562	148	711		562	148	711				
	(2) Yen So Channel, 18 ha, 3,400m					1,838	684	2,522		1,838	684	2,522				
	- Excavation	m3	200,000	2.4	0.6	480	120	600	200,000	480	120	600	0			
	- Embankment	m3	110,000	4.0	1.0	440	110	550	110,000	440	110	550	0			
	- Revetment (1 : 2.0)	m2	6,000	14.0	17.0	84	102	186	6,000	84	102	186	0			
	- Bridges, 4 pl.	m2	820	910.0	390.0	746	320	1,066	820	746	320	1,066	0			
	- Miscellaneous works	5%				88	33	120		88	33	120				
	(3) Spoil Bank, 40 ha, 3,000m					1,365	341	1,706		1,365	341	1,706				
	- Riprap	m3	50,000	8.0	2.0	400	100	500	50,000	400	100	500	0			
	- Land Preparation	m2	450,000	2.0	0.5	900	225	1,125	450,000	900	225	1,125	0			
	- Miscellaneous works	5%				65	16	81		65	16	81				
3-	Linh Dam and Dinh Cong Lakes					5,161	1,605	6,766		1,581	623	2,204		3,581	982	4,562
	(1) Linh Dam Channel, 1,000 m					1,581	623	2,204		1,581	623	2,204				
	- Excavation	m3	58,000	2.4	0.6	139	35	174	58,000	139	35	174	0			
	- Embankment	m3	6,000	4.0	1.0	24	6	30	6,000	24	6	30	0			
	- Revetment (1 : 2.0)	m2	2,000	14.0	17.0	28	34	62	2,000	28	34	62	0			
	- Railway Bridge,1pl.	m	24	10,400.0	2,600.0	250	62	312	24	250	62	312	0			
	- Bridges, 2 pl.	m2	1,170	910.0	390.0	1,065	456	1,521	1,170	1,065	456	1,521	0			
	- Miscellaneous works	5%				75	30	105		75	30	105				
	(2) Linh Dam Lake, 107 ha					2,658	690	3,348						2,658	690	3,348
	- Excavation	m3	1,030,000	2.4	0.6	2,472	618	3,090	0				1,030,000	2,472	618	3,090
	- Connecting Culverts, 10 pl.	m2	110	540.0	360.0	59	40	99	0				110	59	40	99
	- Miscellaneous works	5%				127	33	159						127	33	159
	(3) Dinh Cong Channel, 400 m					301	129	429						301	129	429
	- Excavation	m3	23,000	2.4	0.6	55	14	69	0				23,000	55	14	69
	- Embankment	m3	2,000	4.0	1.0	8	2	10	0				2,000	8	2	10
	- Revetment (1 : 2.0)	m2	1,000	14.0	17.0	14	17	31	0				1,000	14	17	31
	- Bridges, 2 pl.	m2	230	910.0	390.0	209	90	299	0				230	209	90	299
	- Miscellaneous works	5%				14	6	20						14	6	20
	(4) Dinh Cong Lake, 25 ha					622	163	784						622	163	784
	- Excavation	m3	240,000	2.4	0.6	576	144	720	0				240,000	576	144	720
	- Connecting Culverts, 3 pl.	m2	30	540.0	360.0	16	11	27	0				30	16	11	27
	- Miscellaneous works	5%				30	8	37						30	8	37
4-	Floodgates and Control Gates - Civil Works					3,591	898	4,489		3,591	898	4,489				

Table G 3.3 BREAKDOWN OF FINANCIAL COST

	Item	Unit	Whole Project						1st Stage Project				2nd Stage Project			
			Work Quantity	Unit Cost ($)		Amount ($1,000)			Work Quantity	Amount ($1,000)			Work Quantity	Amount ($1,000)		
				F.C.	L.C.	F.C.	L.C.	Total		F.C.	L.C.	Total		F.C.	L.C.	Total
	(1) Thanh Liet Floodgate	m2	170	12,000.0	3,000.0	2,040	510	2,550	170	2,040	510	2,550	0			
	(2) Hoa Binh Floodgate	m2	20	12,000.0	3,000.0	240	60	300	20	240	60	300	0			
	(3) Van Dien Floodgate	m2	20	12,000.0	3,000.0	240	60	300	20	240	60	300	0			
	(4) West Lake Control Gate (A)	m2	30	12,000.0	3,000.0	360	90	450	30	360	90	450	0			
	(5) West Lake Control Gate (B)	m2	15	12,000.0	3,000.0	180	45	225	15	180	45	225	0			
	(6) Lu River Control Gate	m2	15	12,000.0	3,000.0	180	45	225	15	180	45	225	0			
	(7) Nghia Do Control Gate	m2	15	12,000.0	3,000.0	180	45	225	15	180	45	225	0			
	(8) Miscellaneous works for above	5%				171	43	214		171	43	214				
5-	River Improvement					9,926	4,500	14,426		9,926	4,500	14,426				
	(1) Lower Kim Ngau, To Lich and Lower Lu Rivers, and Thanh Liet Channel, 22.1 km					6,200	2,699	8,899		6,200	2,699	8,899				
	- Excavation	m3	800,000	3.4	0.9	2,720	720	3,440	800,000	2,720	720	3,440	0			
	- Embankment	m3	240,000	4.0	1.0	960	240	1,200	240,000	960	240	1,200	0			
	- Revetment (1 : 2.0)	m2	3,800	14.0	17.0	53	65	118	3,800	53	65	118	0			
	- Revetment (1 : 0.3) with Handrailing	m3	9,000	42.0	52.0	378	468	846	9,000	378	468	846	0			
	- Riprap	m3	4,600	8.0	2.0	37	9	46	4,600	37	9	46	0			
	- Fall Structure, Gabion	m3	100	13.0	2.0	1		2	100	1		2	0			
	- Railway Bridge, 1pl	m	40	10,400.0	2,600.0	416	104	520	40	416	104	520	0			
	- Bridges, 5pl.	m2	630	910.0	390.0	573	246	819	630	573	246	819	0			
	- Bridge Protection	pl.	45	1,400.0	1,700.0	63	77	140	45	63	77	140	0			
	- Box Culverts, 11 pl.	m2	270	540.0	360.0	146	97	243	270	146	97	243	0			
	- Drainage Facilities	pl.	170	1,200.0	800.0	204	136	340	170	204	136	340	0			
	- Intake Facilities	pl.	26	8,400.0	3,600.0	218	94	312	26	218	94	312	0			
	- Environmental Measures	m2	150,000	0.9	2.1	135	315	450	150,000	135	315	450	0			
	- Miscellaneous works	5%				295	129	424		295	129	424				
	(2) Set and Upper Lu Rivers, and Lu - Set Floodway, 7.5 km					2,895	1,404	4,299		2,895	1,404	4,299				
	- Excavation	m3	180,000	3.4	0.9	612	162	774	180,000	612	162	774	0			
	- Embankment	m3	60,000	4.0	1.0	240	60	300	60,000	240	60	300	0			
	- Revetment (1 : 2.0)	m2	5,000	14.0	17.0	70	85	155	5,000	70	85	155	0			
	- Revetment (1 : 0.3) with Handrailing	m3	3,000	42.0	52.0	126	156	282	3,000	126	156	282	0			
	- Riprap	m3	1,500	8.0	2.0	12	3	15	1,500	12	3	15	0			
	- Fall Structure, Gabion	m3	120	13.0	2.0	2		2	120	2		2	0			
	- Railway Bridge, 1pl.	m	25	10,400.0	2,600.0	260	65	325	25	260	65	325	0			
	- Bridges, 7 pl.	m2	1,100	910.0	390.0	1,001	429	1,430	1,100	1,001	429	1,430	0			
	- Bridge Protection	pl.	5	1,400.0	1,700.0	7	9	16	5	7	9	16	0			
	- Box Culvert,1 pl.	m2	500	540.0	360.0	270	180	450	500	270	180	450	0			
	- Drainage Facilities	pl.	65	1,200.0	800.0	78	52	130	65	78	52	130	0			
	- Intake Facilities	pl.	3	8,400.0	3,600.0	25	11	36	3	25	11	36	0			
	- Environmental Measures	m2	60,000	0.9	2.1	54	126	180	60,000	54	126	180	0			
	- Miscellaneous works	5%				138	67	205		138	67	205				
	(3) Upper Kim Ngau River, 3.4 km					832	397	1,229		832	397	1,229				
	- Excavation	m3	126,000	3.4	0.9	428	113	542	126,000	428	113	542	0			
	- Embankment	m3	20,000	4.0	1.0	80	20	100	20,000	80	20	100	0			
	- Revetment (1 : 2.0)	m2	1,300	14.0	17.0	18	22	40	1,300	18	22	40	0			
	- Revetment (1 : 0.3) with Handrailing	m3	800	42.0	52.0	34	42	75	800	34	42	75	0			
	- Riprap	m3	500	8.0	2.0	4	1	5	500	4	1	5	0			
	- Fall Structure, Gabion	m3	15	13.0	2.0				15				0			
	- Bridges, 3 pl.	m2	150	910.0	390.0	137	59	195	150	137	59	195	0			
	- Bridge Protection	pl.	16	1,400.0	1,700.0	22	27	50	16	22	27	50	0			
	- Drainage Facilities	pl.	17	1,200.0	800.0	20	14	34	17	20	14	34	0			
	- Intake Facilities	pl.	2	8,400.0	3,600.0	17	7	24	2	17	7	24	0			
	- Environmental Measures	m2	35,000	0.9	2.1	32	74	105	35,000	32	74	105	0			
	- Miscellaneous works	5%				40	19	59		40	19	59				

Table G 3.3 BREAKDOWN OF FINANCIAL COST

	Item	Unit	Whole Project						1st Stage Project				2nd Stage Project			
			Work Quantity	Unit Cost ($) F.C.	Unit Cost ($) L.C.	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total	Work Quantity	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total	Work Quantity	Amount ($1,000) F.C.	Amount ($1,000) L.C.	Amount ($1,000) Total
6-	Hydromechanical Equipment					38,388	725	39,113		22,166	662	22,827		16,223	63	16,286
	(1) Pump Station Mechanical/electrical works					35,490		35,490		19,520		19,520		15,971		15,971
	- Pump station equipment	L.S.				33,800		33,800	55%	18,590		18,590	0.45	15,210		15,210
	- Miscellaneous works	5%				1,690		1,690	55%	930		930	0.45	761		761
	(2) Outlet Sluiceway Gate					504	126	630		252	63	315	0	252	63	315
	- Supply and installation of gates	m2	60	8,000.0	2,000.0	480	120	600	30	240	60	300	30	240	60	300
	- Miscellaneous works	5%				24	6	30		12	3	15		12	3	15
	(3) Floodgates and Control Gates - Metal Works					2,394	599	2,993		2,394	599	2,993				
	- Thanh Liet Floodgate	m2	170	8,000.0	2,000.0	1,360	340	1,700	170	1,360	340	1,700	0			
	- Hoa Binh Floodgate	m2	20	8,000.0	2,000.0	160	40	200	20	160	40	200	0			
	- Van Dien Floodgate	m2	20	8,000.0	2,000.0	160	40	200	20	160	40	200	0			
	- West Lake Control Gate (A)	m2	30	8,000.0	2,000.0	240	60	300	30	240	60	300	0			
	- West Lake Control Gate (B)	m2	15	8,000.0	2,000.0	120	30	150	15	120	30	150	0			
	- Lu River Control Gate	m2	15	8,000.0	2,000.0	120	30	150	15	120	30	150	0			
	- Nghia Do Control Gate	m2	15	8,000.0	2,000.0	120	30	150	15	120	30	150	0			
	- Miscellaneous works	5%				114	29	143		114	29	143				
7-	Installation of Flood Forecasting System	LS				350	50	400		350	50	400				
	- Price Escalation for A2:					12,022	2,332	14,354		6,443	1,654	8,097		5,579	678	6,257
	- Physical Contingency A2:					8,551	2,224	10,774		6,319	1,856	8,175		2,232	367	2,599
A3	Package A3: Bridges on Drainage Channels (1st Stage)					17,451	12,313	29,764		3,620	1,971	5,591		13,831	10,342	24,173
	(Drainage Channel Improvement in 2nd Stage)															
	- Base Cost:					13,085	9,186	22,271		2,944	1,603	4,548		10,140	7,582	17,723
	(1) To Lich and Lower Lu River Basins, and Hoang Liet Drainage Basin, 16.4 km					8,658	6,005	14,662		2,003	976	2,979		6,655	5,029	11,684
	- Excavation	m3	350,000	3.4	0.9	1,190	315	1,505	0				350,000	1,190	315	1,505
	- Embankment	m3	140,000	4.0	1.0	560	140	700	0				140,000	560	140	700
	- Revetment (1 : 2.0)	m2	4,800	14.0	17.0	67	82	149	0				4,800	67	82	149
	- Revetment (1 : 0.3) with handrailing	m3	62,000	42.0	52.0	2,604	3,224	5,828	0				62,000	2,604	3,224	5,828
	- Fall Structure	m3	260	13.0	2.0	3	1	4	0				260	3	1	4
	- Bridges, 16 pl.	m2	2,800	910.0	390.0	2,548	1,092	3,640	1,580	1,438	616	2,054	1,220	1,110	476	1,586
	- Bridge Protection	pl.	35	1,400.0	1,700.0	49	60	109	0				35	49	60	109
	- Box Culverts, 29 pl.	m2	2,100	540.0	360.0	1,134	756	1,890	870	470	313	783	1,230	664	443	1,107
	- Drainage Facilities	pl.	40	1,200.0	800.0	48	32	80	0				40	48	32	80
	- Intake Facilities	pl.	5	8,400.0	3,600.0	42	18	60	0				5	42	18	60
	- Miscellaneous works	5%				412	286	698		95	46	142		317	239	556
	(2) Set and Upper Lu River Basins, 3.7 km					1,928	1,393	3,321		238	159	397		1,690	1,234	2,924
	- Excavation	m3	130,000	3.4	0.9	442	117	559	0				130,000	442	117	559
	- Embankment	m3	50,000	4.0	1.0	200	50	250	0				50,000	200	50	250
	- Revetment (1 : 0.3) with handrailing	m3	17,000	42.0	52.0	714	884	1,598	0				17,000	714	884	1,598
	- Fall Structure	m3	50	13.0	2.0	1		1	0				50	1		1
	- Bridge,1 pl.	m2	200	910.0	390.0	182	78	260	0				200	182	78	260
	- Bridge Protection	pl.	4	1,400.0	1,700.0	6	7	12	0				4	6	7	12
	- Box Culverts, 14 pl.	m2	450	540.0	360.0	243	162	405	420	227	151	378	30	16	11	27
	- Drainage Facilities	pl.	27	1,200.0	800.0	32	22	54	0				27	32	22	54
	- Intake Facilities	pl.	2	8,400.0	3,600.0	17	7	24	0				2	17	7	24
	- Miscellaneous works	5%				92	66	158		11	8	19		80	59	139
	(3) Kim Ngua River Basin, 10.7km					2,499	1,788	4,287		703	469	1,172		1,795	1,320	3,115
	- Excavation	m3	140,000	3.4	0.9	476	126	602	0				140,000	476	126	602

Table G 3.3 BREAKDOWN OF FINANCIAL COST

	Item	Unit	Whole Project						1st Stage Project				2nd Stage Project			
			Work Quantity	Unit Cost ($)		Amount ($1,000)			Work Quantity	Amount ($1,000)			Work Quantity	Amount ($1,000)		
				F.C.	L.C.	F.C.	L.C.	Total		F.C.	L.C.	Total		F.C.	L.C.	Total
	- Embankment	m3	50,000	4.0	1.0	200	50	250	0				50,000	200	50	250
	- Revetment (1 : 2.0)	m2	2,900	14.0	17.0	41	49	90	0				2,900	41	49	90
	- Revetment (1 : 0.3) with handrailing	m3	16,200	42.0	52.0	680	842	1,523	0				16,200	680	842	1,523
	- Fall Structure	m3	150	13.0	2.0	2		2	0				150	2		2
	- Bridge Protection	pl.	7	1,400.0	1,700.0	10	12	22	0				7	10	12	22
	- Box Culverts, 2 1pl.	m2	1,300	540.0	360.0	702	468	1,170	1,240	670	446	1,116	60	32	22	54
	- Drainage Facilities	pl.	140	1,200.0	800.0	168	112	280	0				140	168	112	280
	- Intake Facilities	pl.	12	8,400.0	3,600.0	101	43	144	0				12	101	43	144
	- Miscellaneous works	5%				119	85	204		33	22	56		85	63	148
	- Price Escalation for A3:					2,780	2,008	4,788		347	189	535		2,433	1,819	4,253
	- Physical Contingency for A3:					1,586	1,119	2,706		329	179	508		1,257	940	2,198
A4	Package A4 : Lake Improvement					11,318	3,159	14,477		3,322	810	4,132		7,996	2,349	10,344
	- Base Cost:					8,569	2,382	10,952		2,707	660	3,367		5,862	1,722	7,584
	(1) Lake Dredging, 4 lakes, in 1st Stage					2,392	660	3,052		2,392	660	3,052				
	- Excavation	m3	650,000	3.2	0.8	2,080	520	2,600	650,000	2,080	520	2,600	0			
	- Riprap	m3	18,000	8.0	2.0	144	36	180	18,000	144	36	180	0			
	- Control Structure	pl.	4	7,000.0	3,000.0	28	12	40	4	28	12	40	0			
	- Environmental Measures	m2	29,000	0.9	2.1	26	61	87	29,000	26	61	87	0			
	- Miscellaneous works	5%				114	31	145		114	31	145				
	(2) Lake Dredging, 14 lakes, in 2nd Stage					4,850	1,390	6,240						4,850	1,390	6,240
	- Excavation	m3	1,270,000	3.2	0.8	4,064	1,016	5,080	0				1,270,000	4,064	1,016	5,080
	- Riprap	m3	48,000	8.0	2.0	384	96	480	0				48,000	384	96	480
	- Control Structure	pl.	14	7,000.0	3,000.0	98	42	140	0				14	98	42	140
	- Environmental Measures	m2	81,000	0.9	2.1	73	170	243	0				81,000	73	170	243
	- Miscellaneous works	5%				231	66	297						231	66	297
	(3) Lake Conservation, 11lakes					1,327	332	1,659		315		315		1,012	332	1,344
	- Excavation	m3	240,000	3.2	0.8	768	192	960	0				240,000	768	192	960
	- Riprap	m3	20,000	8.0	2.0	160	40	200	0				20,000	160	40	200
	- Environmental Measures	m2	40,000	0.9	2.1	36	84	120	0				40,000	36	84	120
	- Aeration	L.S.				300		300		300		300				
	- Miscellaneous works	5%				63	16	79		15		15		48	16	64
	- Price Escalation for A4:					1,720	489	2,209		313	76	389		1,407	413	1,820
	- Physical Contingency for A4:					1,029	287	1,316		302	74	376		727	214	940
A5	Package A5 : Sewer Rehabilitation and Construction					47,030	31,352	78,382		7,402	4,934	12,336		39,628	26,418	66,046
	- Base Cost:					35,074	23,381	58,456		6,020	4,013	10,033		29,054	19,369	48,423
	(1) West Lake Basin					1,649	1,099	2,748		202	134	336		1,447	965	2,412
	- Rehabilitation of Existing Systems	L.S.				192	128	320		192	128	320				
	- Construction of New Systems	L.S.				1,378	919	2,297						1,378	919	2,297
	- Miscellaneous works	5%				79	52	131		10	6	16		69	46	115
	(2) To Lich River Basin					10,154	6,769	16,923		996	664	1,660		9,157	6,105	15,262
	- Rehabilitation of Existing Systems	L.S.				2,613	1,742	4,355		949	633	1,581		1,664	1,110	2,774
	- Sewer Construction on Existing Open Channels	L.S.				1,242	828	2,070						1,242	828	2,070
	- Construction of New Systems	L.S.				5,815	3,877	9,692						5,815	3,877	9,692
	- Miscellaneous works	5%				484	322	806		47	32	79		436	291	727
	(3) Lower Lu River Basin					1,735	1,156	2,891						1,735	1,156	2,891
	- Construction of New Systems	L.S.				1,652	1,101	2,753						1,652	1,101	2,753
	- Miscellaneous works	5%				83	55	138						83	55	138

Table G 3.3 BREAKDOWN OF FINANCIAL COST

	Item	Unit	Whole Project						1st Stage Project				2nd Stage Project			
			Work Quantity	Unit Cost ($)		Amount ($1,000)			Work Quantity	Amount ($1,000)			Work Quantity	Amount ($1,000)		
				F.C.	L.C.	F.C.	L.C.	Total		F.C.	L.C.	Total		F.C.	L.C.	Total
	(4) Hoang Liet Drainage Basin					3,101	2,066	5,167						3,101	2,066	5,167
	- Construction of New Systems	L.S.				2,953	1,968	4,921						2,953	1,968	4,921
	- Miscellaneous works	5%				148	98	246						148	98	246
	(5) Set River Basin					4,535	3,022	7,557		771	513	1,284		3,764	2,508	6,273
	- Rehabilitation of Existing Systems	L.S.				734	489	1,223		734	489	1,223				
	- Sewer Construction on Existing Open Channels	L.S.				659	439	1,098						659	439	1,098
	- Construction of New Systems	L.S.				2,926	1,950	4,876						2,926	1,950	4,876
	- Miscellaneous works	5%				216	144	360		37	24	61		179	119	299
	(6) Upper Lu River Basin					3,575	2,385	5,960		1,590	1,059	2,649		1,986	1,325	3,311
	- Rehabilitation of Existing Systems	L.S.				812	541	1,353		812	541	1,353				
	- Sewer Construction on Existing Open Channels	L.S.				702	468	1,170		702	468	1,170				
	- Construction of New Systems	L.S.				1,891	1,262	3,153						1,891	1,262	3,153
	- Miscellaneous works	5%				170	114	284		76	50	126		95	63	158
	(7) Kim Ngau River Basin					10,144	6,762	16,906		2,462	1,641	4,103		7,682	5,121	12,803
	- Rehabilitation of Existing Systems	L.S.				2,102	1,401	3,503		2,102	1,401	3,503				
	- Sewer Construction on Existing Open Channels	L.S.				612	408	1,020		243	162	405		369	246	615
	- Construction of New Systems	L.S.				6,947	4,631	11,578						6,947	4,631	11,578
	- Miscellaneous works	5%				483	322	805		117	78	195		366	244	610
	(8) Yen So Drainage Basin					183	122	305						183	122	305
	- Construction of New Systems	L.S.				174	116	290						174	116	290
	- Miscellaneous works	5%				9	6	15						9	6	15
	- Price Escalation for A5:					7,680	5,120	12,800		709	472	1,181		6,971	4,648	11,619
	- Physical Contingency for A5:					4,275	2,850	7,126		673	449	1,121		3,603	2,402	6,004
B	PROCUREMENT OF EQUIPMENT & MATERIALS					9,653	1,026	10,679		9,653	1,026	10,679				
	- Base Cost:					8,750	900	9,650		8,750	900	9,650				
	- Price Escalation:					443	78	521		443	78	521				
	- Physical Contingency:					460	49	509		460	49	509				
B1	Package B1 : Dredging Equipment and Materials					9,653	1,026	10,679		9,653	1,026	10,679				
	- Base Cost:	LS				8,750	900	9,650		8,750	900	9,650				
	1) Procurement of Equipment including guidance	LS				8,750	100	8,850		8,750	100	8,850				
	2) Procurement of Materials (fuel, etc)	LS					800	800			800	800				
	- Price Escalation for B1:					443	78	521		443	78	521				
	- Physical Contingency for B1: (chui !)					460	49	509		460	49	509				
C	ADMINISTRATION COST [3 % of above]						8,164	8,164			4,067	4,067			4,097	4,097
	- Base Cost:						6,450	6,450			3,402	3,402			3,048	3,048
	- Price Escalation:						972	972			295	295			676	676
	- Physical Contingency:						742	742			370	370			372	372
D	LAND ACQUISITION AND COMPENSATION COST					#REF!	#REF!	#REF!			17,688	17,688		#REF!	26,349	26,349
	- Base Cost:						35,230	35,230			15,181	15,181			20,049	20,049
	- Price Escalation:						4,805	4,805			900	900			3,905	3,905

Table G 3.3 BREAKDOWN OF FINANCIAL COST

	Item	Unit	Whole Project						1st Stage Project				2nd Stage Project			
			Work Quantity	Unit Cost ($)		Amount ($1,000)			Work Quantity	Amount ($1,000)			Work Quantity	Amount ($1,000)		
				F.C.	L.C.	F.C.	L.C.	Total		F.C.	L.C.	Total		F.C.	L.C.	Total
	- Physical Contingency:						4,003	4,003			1,608	1,608			2,395	2,395
1-	Land Acquisition						32,080	32,080			14,030	14,030			18,050	18,050
	(1) In Yen So / Hoang Liet Area						9,280	9,280			9,280	9,280				
	- Inside Red River Dike	m2	242,000	0.0	25.0		6,050	6,050	242,000		6,050	6,050	0			
	- Outside Red River Dike	m2	170,000	0.0	19.0		3,230	3,230	170,000		3,230	3,230	0			
	(2) Along Rivers	m2	10,000	0.0	190.0		1,900	1,900	10,000		1,900	1,900	0			
	(3) Along Drainage Channels	m2	95,000	0.0	190.0		18,050	18,050	0				95,000		18,050	18,050
	(4) At Bridge/Box Culvert Site in Drainage Channels	m2	15,000	0.0	190.0		2,850	2,850	15,000		2,850	2,850	0			
2-	House Evacuation						1,840	1,840			501	501			1,339	1,339
	(1) In Yen So / Hoang Liet Area	House	5	0.0	1,300.0		7	7	5		7	7	0			
	(2) Along Rivers	House	250	0.0	1,300.0		325	325	250		325	325	0			
	(3) Along Drainage Channels	House	1,030	0.0	1,300.0		1,339	1,339	0				1,030		1,339	1,339
	(4) At Bridge/Box Culvert Site in Drainage Channels	House	130	0.0	1,300.0		169	169	130		169	169	0			
3-	Fishery Compensation						1,310	1,310			650	650			660	660
	(1) Yen So Regulating Reservoir	m2	1,300,000	0.0	0.5		650	650	1,300,000		650	650	0			
	(2) Linh Dam Lake	m2	1,070,000	0.0	0.5		535	535	0				1,070,000		535	535
	(3) Dinh Cong Lake	m2	250,000	0.0	0.5		125	125	0				250,000		125	125
E	IMPORT DUTY						9,225	9,225			4,780	4,780			4,444	4,444
	- Base Cost:						7,263	7,263			3,980	3,980			3,283	3,283
	- Price Escalation:						1,123	1,123			366	366			758	758
	- Physical Contingency : (chenul !)						839	839			435	435			404	404
F	ENGINEERING SERVICE COST	L.S.				28,928	14,187	43,115		12,744	5,472	18,216		16,184	8,715	24,899
	- Base Cost:					22,886	11,206	34,092		10,727	4,659	15,386		12,159	6,547	18,706
	- Price Escalation:					3,413	1,691	5,104		859	315	1,174		2,554	1,375	3,930
	- Physical Contingency:					2,630	1,290	3,920		1,159	497	1,656		1,471	792	2,264
	Grand Total (A+B+C+D+E+F)															
	- Base cost:					181,565	116,466	298,032		99,499	51,838	151,338		82,066	64,628	146,694
	- Price Escalation :					28,085	18,628	46,713		9,140	4,355	13,495		18,944	14,273	33,217
	- Physical Contingency:					18,586	13,424	32,010		9,296	5,537	14,833		9,290	7,887	17,177
	- Total:					228,236	148,519	376,755		117,936	61,730	179,666		110,300	86,788	197,088

Table G3.4 (1) DISBURSEMENT SCHEDULE FOR FIRST STAGE CONSTRUCTION

Unit: US $ 1,000 equivalent

ITEM	FIRST STAGE CONSTRUCTION			1995			1996			1997			1998			1999			2000		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C	L.C.	Total
1 Construction Works	88,771	24,616	113,387	52	20	72	15,951	2,144	18,095	23,885	6,844	30,729	30,402	8,624	39,026	16,660	5,917	22,577	1,821	1,067	2,888
A. Construction Works	80,021	23,716	103,737	52	20	72	7,201	1,884	9,085	23,885	6,604	30,489	30,402	8,384	38,786	16,660	5,757	22,417	1,821	1,067	2,888
B. Procurement of Equipment & Materials	8,750	900	9,650	0	0	0	8,750	260	9,010	0	240	240	0	240	240	0	160	160	0	0	0
2 Administration Cost	0	3,401	3,401	0	340	340	0	510	510	0	1,021	1,021	0	850	850	0	510	510	0	170	170
3 Land Acquisition and Compensation Cost	0	15,180	15,180	0	2,396	2,396	0	6,666	6,666	0	4,925	4,925	0	1,193	1,193	0	0	0	0	0	0
4 Import Tax	0	3,979	3,979	0	112	112	0	699	699	0	1,041	1,041	0	1,284	1,284	0	731	731	0	112	112
5 Engineering Service	10,728	4,660	15,388	2,748	1,886	4,634	1,518	644	2,162	2,143	634	2,777	1,705	624	2,329	1,625	608	2,233	989	264	1,253
6 Price Escalation	9,140	4,356	13,496	70	119	189	884	540	1,424	2,001	1,112	3,113	3,333	1,306	4,639	2,403	1,021	3,424	449	258	707
7 Physical Contigency	9,296	5,537	14,833	287	487	774	1,265	1,103	2,368	2,552	1,531	4,083	3,004	1,362	4,366	1,862	867	2,729	326	187	513
Total	117,935	61,729	179,664	3,157	5,360	8,517	19,618	12,306	31,924	30,581	17,108	47,689	38,444	15,243	53,687	22,550	9,654	32,204	3,585	2,058	5,643

Table G3.4(2) DISBURSEMENT SCHEDULE FOR SECOND STAGE CONSTRUCTION

Unit: US $ 1,000 equivalent

ITEM	SECOND STAGE CONSTRUCTION			2000			2001			2002			2003			2004		
	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C.	L.C.	Total	F.C	L.C.	Total
1 Construction Works	69,906	31,702	101,608	0	0	0	6,875	3,135	10,010	27,708	10,226	37,934	25,726	12,434	38,160	9,597	5,907	15,504
A. Construction Works	69,906	31,702	101,608	0	0	0	6,875	3,135	10,010	27,708	10,226	37,934	25,726	12,434	38,160	9,597	5,907	15,504
B. Procurement of Equipment & Materials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2 Administration Cost	0	3,048	3,048	0	305	305	0	610	610	0	914	914	0	914	914	0	305	305
3 Land Acquisition and Compensation Cost	0	20,050	20,050	0	4,010	4,010	0	8,020	8,020	0	8,020	8,020	0	0	0	0	0	0
4 Import Tax	0	3,282	3,282	0	146	146	0	347	347	0	1,263	1,263	0	1,103	1,103	0	423	423
4 Engineering Service	12,160	6,547	18,707	3,648	1,964	5,612	1,216	655	1,871	3,648	1,964	5,612	2,432	1,309	3,741	1,216	655	1,871
5 Price Escalation	18,945	14,273	33,218	583	1,026	1,609	1,637	2,441	4,078	6,898	4,906	11,804	6,862	3,879	10,741	2,965	2,021	4,986
6 Physical Contigency	9,290	7,888	17,178	423	745	1,168	950	1,538	2,488	3,362	2,735	6,097	3,200	1,946	5,146	1,355	924	2,279
Total	110,301	86,790	197,091	4,654	8,196	12,850	10,678	16,746	27,424	41,616	30,028	71,644	38,220	21,585	59,805	15,133	10,235	25,368

Fig. G1.1 OVERALL IMPLEMENTATION SCHEDULE

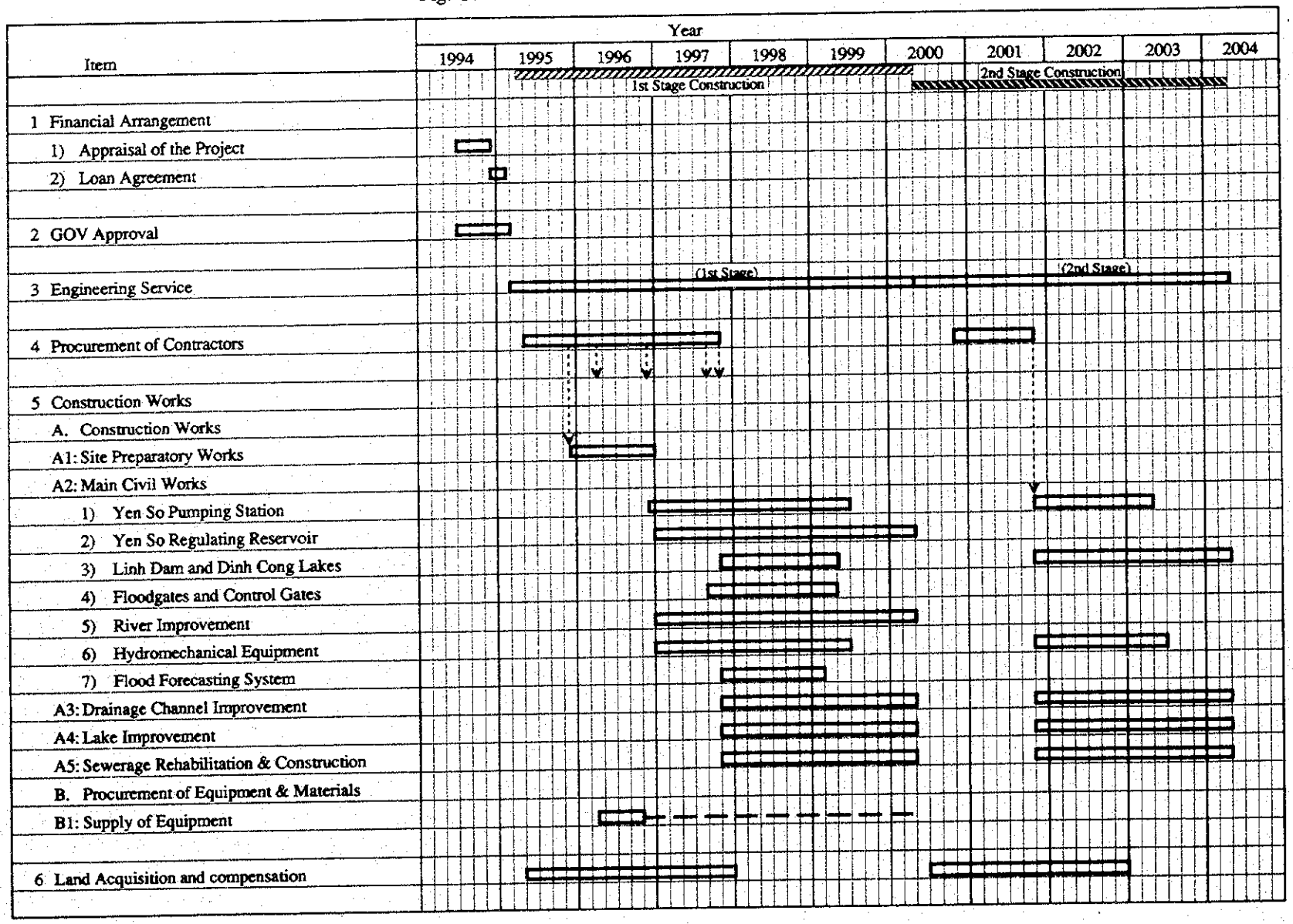
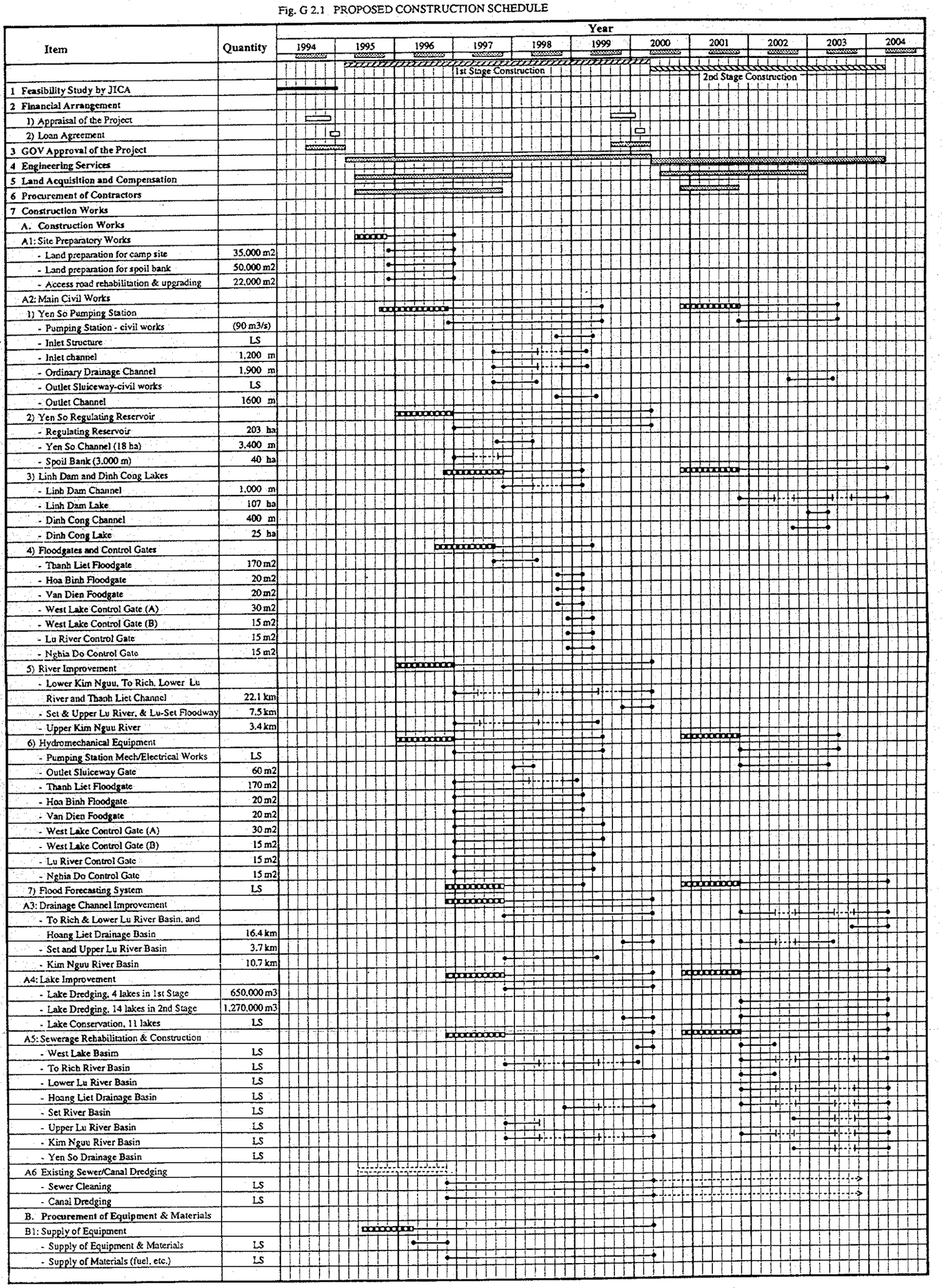


Fig. G 2.1 PROPOSED CONSTRUCTION SCHEDULE

Item	Quantity
1 Feasibility Study by JICA	
2 Financial Arrangement	
1) Appraisal of the Project	
2) Loan Agreement	
3 GOV Approval of the Project	
4 Engineering Services	
5 Land Acquisition and Compensation	
6 Procurement of Contractors	
7 Construction Works	
A. Construction Works	
A1: Site Preparatory Works	
- Land preparation for camp site	35,000 m2
- Land preparation for spoil bank	50,000 m2
- Access road rehabilitation & upgrading	22,000 m2
A2: Main Civil Works	
1) Yen So Pumping Station	
- Pumping Station - civil works	(90 m3/s)
- Inlet Structure	LS
- Inlet channel	1,200 m
- Ordinary Drainage Channel	1,900 m
- Outlet Sluiceway-civil works	LS
- Outlet Channel	1600 m
2) Yen So Regulating Reservoir	
- Regulating Reservoir	203 ha
- Yen So Channel (18 ha)	3,400 m
- Spoil Bank (3,000 m)	40 ha
3) Linh Dam and Dinh Cong Lakes	
- Linh Dam Channel	1,000 m
- Linh Dam Lake	107 ha
- Dinh Cong Channel	400 m
- Dinh Cong Lake	25 ha
4) Floodgates and Control Gates	
- Thanh Liet Floodgate	170 m2
- Hoa Binh Floodgate	20 m2
- Van Dien Foodgate	20 m2
- West Lake Control Gate (A)	30 m2
- West Lake Control Gate (B)	15 m2
- Lu River Control Gate	15 m2
- Nghia Do Control Gate	15 m2
5) River Improvement	
- Lower Kim Nguu, To Rich, Lower Lu River and Thanh Liet Channel	22.1 km
- Set & Upper Lu River, & Lu-Set Floodway	7.5 km
- Upper Kim Nguu River	3.4 km
6) Hydromechanical Equipment	
- Pumping Station Mech/Electrical Works	LS
- Outlet Sluiceway Gate	60 m2
- Thanh Liet Floodgate	170 m2
- Hoa Binh Floodgate	20 m2
- Van Dien Foodgate	20 m2
- West Lake Control Gate (A)	30 m2
- West Lake Control Gate (B)	15 m2
- Lu River Control Gate	15 m2
- Nghia Do Control Gate	15 m2
7) Flood Forecasting System	LS
A3: Drainage Channel Improvement	
- To Rich & Lower Lu River Basin, and Hoang Liet Drainage Basin	16.4 km
- Set and Upper Lu River Basin	3.7 km
- Kim Nguu River Basin	10.7 km
A4: Lake Improvement	
- Lake Dredging, 4 lakes in 1st Stage	650,000 m3
- Lake Dredging, 14 lakes in 2nd Stage	1,270,000 m3
- Lake Conservation, 11 lakes	LS
A5: Sewerage Rehabilitation & Construction	
- West Lake Basim	LS
- To Rich River Basin	LS
- Lower Lu River Basin	LS
- Hoang Liet Drainage Basin	LS
- Set River Basin	LS
- Upper Lu River Basin	LS
- Kim Nguu River Basin	LS
- Yen So Drainage Basin	LS
A6 Existing Sewer/Canal Dredging	
- Sewer Cleaning	LS
- Canal Dredging	LS
B. Procurement of Equipment & Materials	
B1: Supply of Equipment	
- Supply of Equipment & Materials	LS
- Supply of Materials (fuel, etc.)	LS



: Feasibility Study (JICA)
: Financial arrangement
: Procurement of contractors
: Activity by GOV / Consultant
: Preparatory works by HSDC
: Works by contractors

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

APPENDIX (H)

PROJECT EVALUATION

FEBRUARY 1995

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

APPENDIX (H)
PROJECT EVALUATION

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H1. GENERAL

Economic and financial evaluation is conducted both for the urban drainage plan and the wastewater disposal plan. For the estimate of economic benefit, reduction of flood damage is evaluated for the urban drainage plan, while quantifiable benefits such as reduction of disease contraction, tourism promotion, groundwater quality improvement, and land value increases are estimated for the wastewater disposal plan.

Construction cost, operation and maintenance cost, and replacement cost are estimated at mid 1994 price levels. All the costs are estimated, excluding price contingency and transfer payments such as import and other related taxes.

The Economic Internal Rate of Return (EIRR) is calculated for the selected urban drainage plan and wastewater disposal plan on the basis of the estimated economic benefit and cost.

For the financial analysis, a fund requirement is estimated for implementing the selected projects up to year 2020, which is evaluated from the view point of the government budget and national economy. An appropriate sewer charge is also studied in due consideration of the required operation and maintenance cost and affordability of the residents.

H2. ECONOMIC EVALUATION

2.1 Urban Drainage Plan

2.1.1 Economic Benefit

Economic benefits expected from the urban drainage plan are the mitigation of flood damage and the contribution to environmental improvement. However, only the reduction of flood damage is estimated for this economic study. To achieve this, the direct damage of residential properties, household goods, shops, merchandise, public/government buildings, factories, and agricultural production is based on the study on damage potential and flood frequency and by applying the damage ratio.

Indirect damage is also taken into account, which includes damage to transportation, communication, and loss of income for factory owners and employees. The indirect damage is estimated by evaluating the loss of regional products in the Study Area.

The expected damage reduction is calculated by estimating the difference between the average annual flood damage without-the-project and with-the-project. After implementation of the drainage plan, the Study Area will be free from floods with a return period of 10-year or less. The estimated economic benefits both for the To Lich River basin and the Nhue River basin are presented below (details of the benefit estimate are presented in Appendix D - Drainage Plan):

(US$ 1,000)

Plans	Economic Benefit
To Lich River Basin	
- 1st Stage	7,537
- 2nd Stage	5,026
(Sub-total)	(12,563)
Nhue River Basin	
- Co Nhue	157
- My Dinh	985
- Me Tri	1,018
- Ba Xa	528
(Sub-total)	(2,688)
Total	15,251

The above estimate is expected to increase at 8 % per annum and 11 % per annum for the To Lich River and Nhue River basins, respectively, which correspond to the future economic growth in the region. (In due consideration of the rapid urbanization of the area, a higher growth rate is applied for the Nhue River basin.)

2.1.2 Economic Cost

The economic costs of the urban drainage plans are calculated by applying the following economic costs per m^2 for land acquisition and compensation, as in the table presented below:

Land Acquisition	Financial Cost	Economic Cost
Fishpond	US$ 25 /m^2	US$ 0.80/m^2
Farmland	US$ 19 /m^2	US$ 0.65/m^2
Land along rivers/channels	US$ 190 /m^2	0

Compensation	Financial Cost	Economic Cost
Fishery	US$ 0.5/m^2	US$ 0.14/m^2

Note : The economic costs are estimated on the basis of the net production values during the project life of 50 years.

(US$ 1,000)

Plans	Economic Cost
To Lich River Basin	
- 1st Stage	146,809
- 2nd Stage	138,894
(Sub-total)	(285,703)
Nhue River Basin	
- Co Nhue	73,188
- My Dinh	35,430
- Me Tri	42,076
- Ba Xa	24,147
(Sub-total)	(174,841)
Total	460,544

2.1.3 Economic Evaluation

(1) Comparison of Development Plans

On the basis of the estimated economic construction cost, operation and maintenance cost (O/M cost), and estimated economic benefit, the Economic Internal Rate of Returns (EIRR) are calculated for the various development plans. For the calculation, the urban drainage plans are assumed to be completed within 6 years, in principle. The calculated EIRRS are presented below:

Urban Drainage Plans	EIRR (%)
To Lich River Basin	(11.6)
- 1st Stage	11.7
- 2nd Stage	11.4
Nhue River Basin	(9.3)
- Co Nhue	*
- My Dinh	11.1
- Me Tri	10.0
- Ba Xa	9.3

* EIRR is not calculated since the benefit could not cover the project economic cost.

As indicated above, the To Lich River basin drainage plans both for the 1st stage and the 2nd stage have high economic rate of returns, and are economically justified. In the Nhue River basin, My Dinh, Me Tri, and Ba Xa show reasonable returns though Co Nhue does not produce any justifiable benefit. (Cost benefit streams of the development plans are presented in Tables H2.1 to H2.8.)

(2) Economic Feasibility of the Proposed Urban Drainage Plan

As indicated in the EIRRs, the To Lich River basin drainage plan is selected as the first priority scheme, and is planned to be implemented during 1995 – 2004 (1st stage from 1995 – 2000 and 2nd stage from 2000 – 2004). The implementation of the Nhue River basin drainage plan will be realized later during 2000 – 2015. The construction of the Nhue River basin drainage plan will commence from upstream to downstream (starting from Co Nhue to My Dinh, Me Tri, and Ba Xa) in due consideration of engineering aspects and the socio-economic location. The calculated overall EIRR is 10.9 %, which shows sufficient economic viability for the whole drainage plan. (Cost benefit stream of the proposed implementation plan is presented in Table H2.9.)

2.2 Wastewater Disposal Plan

2.2.1 Economic Benefit

In general, quantifying the economic benefit of sewerage improvement on wastewater treatment is not easy, as it is rather difficult to clearly separate the benefit of wastewater treatment from drainage improvement. However, on the basis of the simplified assumptions that only the reduction of flood damage is taken into account for drainage improvement, while other related benefits belong to wastewater treatment, the expected economic benefit is estimated in the following manner.

Through the improvement of the wastewater disposal system, the following economic benefits are expected to emerge in the region:

(1) Reduction of disease contraction;

(2) Tourism promotion (contribution to tourism increase);

(3) Improvement of groundwater quality;

(4) Land value increase;

(5) Increase of agricultural and fishery production;

(6) Improvement of living environment; and

(7) Facilitating urban development.

Among the above benefits, only the first four benefits are estimated quantitatively, while the remaining three benefits are described qualitatively.

(1) Reduction of Disease Contraction

The most common waterborne diseases in the Study Area are diarrhea and dysentery. From the available statistical data and the results of the interview survey, the actual contraction rate of these diseases and the number of patients are estimated as follows:

Disease	Actual Contraction Rate	No. of Patients in the Study Area
Diarrhea	4.0%	48,110
Dysentery	0.4%	4,810

According to the Ministry of Health information, the contraction rates of these diseases will decrease considerably up to 50 % of the current levels if the sewerage system is improved. For the estimate of economic benefit, it is assumed that the contraction rates will drop by 40 %.

Medical cost per patient is estimated at US$ 45, on the basis of the regional economic data and the results of the interview survey, which includes the income loss (US$ 15) during sick periods (7 days) and medical expenses (US$ 30).

The economic benefit expected from the reduction of the diseases in the Study Area is, thus, calculated at US$ 0.953 million in the year 1993. This benefit is expected to increase at 8 % per annum (same as the per-capita income growth rate).

(2) Tourism Promotion

In 1993, 450,000 people visited Hanoi including 300,000 foreigners. This figure is expected to grow to 1.5 million in 2000 and 3.5 million in 2010. However, this projected growth will be realized provided that the environment of Hanoi City, including the conditions of rivers, lakes and ponds, and the urban infrastructure, will be improved and well managed. In Hanoi City, ponds and lakes are very important components for tourism, and presently are being polluted by waste disposal. If the wastewater disposal is not implemented, the number of tourists will not increase as planned.

For the estimate of this effect, it is assumed that 10 % of the projected increase (105,000 tourists in 2000) will be affected by this unimproved condition, and will not be realized if the improvement works are not implemented. Average revenue per visitor is estimated at US$ 82*, about 50 % of which is considered profit or value added. The benefit from tourism in the Study Area is the loss of value added to be avoided, and is calculated at US$ 2.46 million in the year 1993. This benefit is expected to increase at 8 % per annum.

* : Master Plan to 2010, Hanoi City

(3) Improvement of Groundwater Quality

Due to the lack of or the malfunction of the drainage and sewerage facilities, groundwater is being polluted in the urban area of Hanoi City, where most people depend on the groundwater. In order to acquire safe drinking water, the residents are now constructing deep wells (30 to 40 m deep) which costs US$ 200 per well. From the interview survey, it is assumed that about 5 % of the residents in the Study Area use private and public wells. The required total construction cost of the deep wells will be US$ 2.796 million at 1994 price levels, which can be avoided if the wastewater treatment plan is implemented. It is assumed that the economic benefit or the construction cost of the deep wells is to be disbursed over a period of 5 years.

(4) Land Value Increase

The value of land is expected to increase, in general, if the sewerage is improved. This is confirmed by experience in other developing countries and by the results of the interview survey. However, there are many factors in land value increases, which include the availability of infrastructure (electricity, water supply, sewerage, and drainage), access to roads and markets, etc. For the estimate of land value increase, the following assumptions are made:

(a) Only residential land is taken into account and other lands such as governmental, public, and agricultural lands are excluded;

(b) Current values of the residential land are US$ 400/m^2 for urban and US$ 100/m^2 for suburban area;

(c) Expected increase in value is 5 % of the current land value; and

(d) Land value increase is realized over a 10-year period after completion of the wastewater treatment.

The expected land value increase in the Study Area is estimated at about US$ 465 million.

Beside the above quantified benefit, the following non-quantified benefits are expected :

Agricultural and fishery production such as crop production and fishery is expected to increase through the improvement of the sewerage system. However, in some areas, present untreated sewage provides nutrition to agricultural production and does not always cause negative impacts. It is, therefore, very difficult to quantify the net positive impact without a detailed analysis.

Improvement of the living environment is one of the most important effects of the sewerage improvement because residents will be free from odors and polluted water, and will be able to better enjoy their life. This quality improvement is rather difficult to be quantified.

Another benefit is the effect of facilitating urban development toward "Hanoi 2010 Plan". The implementation of the project will control flood and improve the sewerage system, which will result in more intensive land use and will facilitate residential, commercial, and industrial development in Hanoi City. (Part of this benefit might be included in the land value increase.)

2.2.2 Economic Cost

Economic construction cost of the wastewater disposal plan is estimated by applying the economic prices for the land acquisition and compensation as presented in Subsection 2.1.1, as follows:

(US$ 1,000)

Zones	Economic Cost
Zone 1-1	22,488
Zone 1-2	24,546
Zone 2-1	82,447
Zone 2-2	50,981
Zone 3	90,648
Zone 4	55,165
Zone 5	111,542
Zone 6-1	44,239
Zone 6-2	88,498
Zone 7	19,098
Total	589,652

2.2.3 Economic Evaluation

(1) Comparison of Development Plans

On the basis of the estimated construction cost, operation and maintenance cost (O/M cost), and estimated economic benefit, the Economic Internal Rate of Returns (EIRR) are calculated for seven various zonal development plans. For the calculation, all the development plans are assumed to be completed within 5 years. The resulting EIRRs are summarized below:

Zones	EIRR (%)
Zone 1-1	4.4
Zone 1-2	*
Zone 2-1	5.7
Zone 2-2	*
Zone 3	8.2
Zone 4	6.7
Zone 5	1.9
Zone 6-1	2.1
Zone 6-2	1.7
Zone 7	*

* EIRR is not calculated since the benefit could not cover the project economic cost.

The above results indicate that Zone 3 produces the highest return among the ten zones and Zones 4, 2-1, and 1-1 yield relatively high returns compared to Zones 5, 6-1, and 6-2. The expected benefits are lower than the project economic cost for Zones 1-2, 2-2, and 7. (Cost benefit streams of the ten plans are presented in Tables H2.10 to H2.19.)

It is noted that the comparison of EIRR between the urban drainage plan and the wastewater disposal plan cannot be made directly since the economic benefits are estimated differently.

(2) Economic Feasibility of the Proposed Wastewater Disposal Plan

In due consideration of the economic viabilities of the component projects and socio-economic aspects, the implementation plan for the wastewater disposal plan is prepared, on the basis of which overall economic evaluation for the wastewater disposal plan (excluding the on-site plants of Zones 1-1, 1-2, and 7) is conducted by calculating the EIRR. The calculated EIRR is 5.2 % as presented in Table H2.20, which shows moderate economic return on the investment compared to similar kinds of the projects.

H3. FINANCIAL EVALUATION

3.1 Required Government Investment

For the assessment of the financial viability of the Master Plan annual disbursement of the implementation cost is prepared on the assumption that all the components are to be completed by the end of 2020. The required annual investment amount both for the urban drainage and wastewater disposal during the period of 1995 – 2020 is presented in Table H3.1. As seen in the table, the total investment amount will be US$ 1,162 million during this period (26 years), which is equivalent to US$ 44.7 million per year on average.

3.2 Government Budget Analysis

3.2.1 Review of Capital Expenditure

To check the financial viability of the Master Plan, capital expenditure on the infrastructure of the national government and Hanoi City are reviewed. The national government capital expenditures during the period of 1989 – 1993 are presented in comparison with GDP as follows:

(Billion Dong)

Item	1989	1990	1991	1992	1993
National Capital Exp.	1,626	2,124	2,135	5,710	9.396
GDP	24,308	38,166	69,959	101,870	125,064
% of GDP	6.7	5.6	3.1	5.6	7.5

Source : Ministry of Finance

As shown in the above table, the capital expenditure is 3.1 to 7.5 % of the GDP with an average rate of 5.7 % during the past five years. During this period, most of the capital expenditure was directed to the development of roads and irrigation facilities. The expenditure for other sectors such as water supply, drainage, and sewerage remains low at less than 10 % of the total expenditure. Out of the national capital expenditure, about 5 to 7 % has been allocated to the infrastructure of Hanoi City. (Beside the national budget, Hanoi City provides capital expenditure from his own budget, which amounted to 214 billion Dong in 1993). About 10 % of the total budget is allocated to drainage and sewerage. The allocated budget for capital expenditure in Hanoi City is presented in Tables H3.2 and H3.3.

3.2.2 Projection of Capital Expenditure

At present, capital expenditure is barely adequate to maintain the national infrastructure. To sustain the economic growth projected in the national development plan, the capital expenditure for the improvement of basic infrastructure is to be drastically increased. In due consideration of the above, the projection of the capital expenditure on the infrastructure was made by the State Planning Committee (SPC) assuming that GDP will increase at the relatively high rate of 10 to 12 % during the

period up to 2010. The projected capital expenditure is presented in Table H3.4. (The projected expenditure includes loans from international organizations.)

Possible national capital expenditure on Hanoi infrastructure is estimated on the basis of the following assumptions:

(1) Capital expenditure to be allocated to Hanoi City is 7 to 10 % of the national expenditure; and

(2) The allocated amount for drainage and sewerage is 7 to 12 % of the Hanoi capital expenditure.

The estimated possible capital expenditure is presented in Table H3.4 and summarized below:

(US$ Million)

Item	2000	2005	2010
Capital Expenditure in Hanoi City	343	635	1,081
For Drainage and Sewerage	34	64	130

A comparison of the proposed cost disbursement with the projected capital expenditure gives the following conclusive remarks:

(1) During 1996 to 1998, the required fund will be considerably larger than the projected capital expenditure. To achieve this, 1.8 to 2.2 % of the national capital expenditure on infrastructure is to be allocated to the Hanoi drainage and sewerage sector; and

(2) After 1998, the projected government expenditure will mostly cover the required investment, except in 2002 and 2003.

The estimated figures of possible capital expenditure indicate that the proposed investment for drainage and wastewater disposal in Hanoi City can generally be financially justified. This is based on the condition that being supported by high economic growth during 1994 to 2010 will increase capital expenditure at a relatively high ratio of 13 % per annum (SPC projection).

In case a more moderate increase of the capital expenditure, say 8 % per year, is assumed, the share of Hanoi City in capital expenditure, or the investment share for drainage and sewerage, is to be raised substantially to sustain the required investment.

3.3 Finance for On - site Plant

3.3.1 Finance Plan

In Zones 1-1 and 7, on-site plants such as community plants and septic tanks will be installed because these zones are relatively sparsely populated. However, the required investment cost per family reaches US$ 1,280 and US$ 1,000 for Zone 1-1 (community plants) and Zone 7 (septic tanks), respectively, as follows:

Zone 1-1

Cost of community plants	:	US$ 9,600,000
No. of households	:	7,500
Cost per household	:	US$ 1,280

Zone 7

Cost of septic tanks	:	US$ 9,135,000
No. of households	:	9,135
Cost per household	:	US$ 1,000

In due consideration of the socio-economic situation in the region, some financial arrangement seems necessary for the successful implementation of the installation. One conceived financial arrangement is to set up a revolving fund in HPC, which might be funded by international finances or local budget allocation. Using this fund, a soft loan will be arranged for the installation of community plants and septic tanks with the following loan conditions (since the loan conditions are affected by economic situations, the figures mentioned below are indicative under the present conditions):

Coverage of Finance	:	90% of the installation cost
Interest	:	7 to 10 % per annum
Repayment Period	:	5 years after installation

The total cost for installation of the community plants and septic tanks are estimated at US$ 15.54 million. However, the required revolving fund would be about US$ 6.81 million, assuming that the repayment of the loan is to be made as scheduled and the interest covers the cost increase for future installation.

3.3.2 Organizational Set-up

For receiving and repayment of the loan and for the installation arrangement, cooperative organizations (say, sewer cooperatives) will be set up in Zone 1-1 and Zone 7. Members of the sewer cooperatives would number 200 to 300 households depending on the size of the community plants and the population densities. The loan will be provided to sewer cooperatives through the Department of Land and Housing (DLH), which is now responsible for the management of state houses and private houses, and is in charge of the maintenance of septic tanks.

By using the loan (90 %) and private contributions (10 %), the sewer cooperatives will install community plants and septic tanks in their respective areas. After installation, operation and maintenance is transferred to HSDC for the community plants and to URENCO for the septic tanks. The sewer cooperative will be responsible for the repayment of the loan after the completion of facilities.

A proposed organization for the installation, operation and maintenance of the community plants and septic tanks is presented in Figure H3.1.

3.4 O/M Cost and Sewer Charge

Investment costs, or capital costs, for urban drainage and wastewater disposal are, in principle, to be borne by the government. Even the operation and maintenance cost for the urban drainage is to be provided by the government budget as the flood control project does not produce direct cash income. In the proposed implementation plan, the O/M cost for urban drainage is estimated as follows:

2000 – 2006 : US$ 0.57 to 1.72 million per year (To Lich)
2007 – 2016 : US$ 1.80 to 2.45 million per year (To Lich plus Nhue)

According to the HSDC budget, the allocated amount for the operation and maintenance is 12.8 billion Dong (US$ 1.19 million) in 1994, while the total budget for HSDC is 16.0 billion Dong (US$ 1.48 million). In order to cover the additional O/M cost required for the urban drainage plan, the HSDC budget is to increase by 7.7 % per year in net value up to the year 2006. This increase seems quite possible in view of the projected future economic growth and the past trend of the HSDC budget (33 % of increase per year after 1992).

The O/M cost for wastewater disposal, or its part, is basically being borne by beneficiaries in most developed countries. At present, 10 % of the water charge is imposed on the beneficiaries as a sewer charge in Hanoi City. This is used for operation and maintenance of the sewer system. In this study, the sewer charge for residents, to be collected for recovering the O/M cost, is estimated based on the following assumptions:

(1) The annual O/M cost for the wastewater disposal plan excluding on-site plants (Zone 1-1, 1-2, and 7) is US$ 6,203 million.

(2) The present ratio of water charge between households and commercial/ factories ($ 0.06/m^3 for household and $ 0.3/m^3 for commercial/factory) continues in the future and the sewer charge is assessed corresponding to the water consumption.

(3) Based on the above and the projected future wastewater yield, the share of the O/M cost of the sewer charge is estimated at:

Resident shares : 31 % of O/M cost
Commercial/Factory/Public shares : 69 % of O/M cost

(4) The total population will be 1,460,900 in 2010 and the number of households will be 339,7000.

The estimated sewer charge adequate for recovering the O/M cost is $ 5.7/household per year. The estimated figure is equivalent to 0.6 % of the estimated average household income for urban residents (US$ 960/year in 1994). This indicates that the O/M cost can be reasonably recovered by the sewer charge if the above share of O/M cost can be maintained. However, the water charge per household is estimated at US$ 8.5 per year in 1994 (90 lit/day per person). The number of people in a household is 4.3, water charge is 0.06 $/$m^3$. Compared to this, the sewer charge is about 67 % of the water charge, which is considered high.