8.4 Route Plan for the Secondary Transport of Solid Waste

8.4.1 Route for the Secondary Transport

Considering the locations of the Dong Ngac transfer station and Nam Son landfill site, as well as the existing road conditions, the most economical route is the West Route, which is as follows:

Recommended West Route for the Secondary Transport

Dong Ngac transfer station – access road to be arranged – South Thang Long Highway – Thang Long Bridge – North Thang Long Highway – Route 2 – Route 35 – Bac Son – Road – Nam Son Landfill site.

Figure 8.4.1 shows the route map. Distance from Dong Ngac to Nam Son landfill site is 37.6 km as shown below.

Use of the West Route as the secondary transport route requires upgrading of Route 35, which belongs to HPC. An advantage of using the west route is that decision on the upgrading of Route 35 does not involve the government, while the upgrading of some bridges on the east route (as discussed later) will involve the government decision, which might cause a delay in the implementation of the project.

Routes from Dong Ngac Transfer Station to Nam Son

Routes	Distance (Distance from Dong Ngac)
1. Access Road from Dong Ngac transfer station to South Thang Long Highway (See Figureure8.4.3.)	0.7 km (0.7 km)
2. South thang Long Highway – Thang Long Bridge – North Thang Long Highway	15.3 km (16.0 km)
3. National Road 2	2.4 km (18.4 km)
4. Route 35	16.0 km (34.4 km)
5. Bac Son road	3.2 km (37.6 km)

8.4.2 Roads and Bridges That Need to be Strengthened on the West Route

(1) Road Capacity Required

To accommodate the secondary transport vehicles of 25 ton GVW with width of 2.5 m, length of 11.2 m and height of 3.6 m, all the roads on the route for the secondary transport from Dong Ngac to Nam Son landfill should satisfy the following road specification:

Title	
a. Load bearing capacity:	25 ton on one way
b. Road width:	9 m, i.e., Paved width 7 meter (3.5 m x 2) + compacted soil area 2 m (1 m x 2)

(2) Roads and Bridges that need to be strengthened

HPC needs to plan/construct or strengthen the following roads and bridges which exist on the route from Dong Ngac to Nam Son. Locations of these roads and bridges are shown in Figure 8.4.2.

a) Access road to Dong Ngac transfer station
b) Route 35 and Bac Son road
c) Man Tep Bridge (Upgrading is to be completed in 1999 according to HPC)
d) Kim Anh Bridge

Roads and Bridges that need to be Strengthened on the West Route

Name	Current Condition	Actions Required	Cost Assumed
1. Route 35 & Bac Son Road	HPC is currently upgrading Route 35. After the completion of the upgrading work toward the end of 1999, the bearing capacity will reach 10 ton (Grade 4) according to TUPWS.	The transfer system project includes cost of the further upgrading of the Route 35 from Grade 4 to Grade 3 to accommodate the secondary transport truck of 25 ton GVW.	Route 35 (26,350 million Dong) + Bac Son Road (4.2 billion Dong) = 30,550 million Dong = $2.198,000 (by TUPWS)
2. Man Tep bridge	Located on Route 35. The bridge is a steel structure, 19.2 m long and 4 m wide.	According to TUPWS, HPC plans to strengthen the bridge to have a capacity of H30 ton by the end of 1999.	3 b. Dong = $216,000 (by VIWASE) (not to be included)
3. Kim Anh Bridge	Located on National Road No.2. The bridge is a reinforced concrete structure, 31 m long and 7 m wide for car lanes. The existing sign board indicates the max. vehicle weight is 13 ton.	HPC should request the Ministry of Transport and Communication to upgrade this bridge.	4.17 billion Dong = $300,000 (by JICA Study Team)
4. Access Road to Dong Ngac transfer station	The existing access road to the planned Dong Ngac transfer station site is not adequate for the secondary transport vehicles in future. JICA Study Team prepared a preliminary plan of the access as shown in Figure 8.4.3.	TUPWS should prepare a final plan on the access road. At time of opening, there will be 500 round trips/day of the primary transport vehicles and 145 round trips/day of the secondary transport vehicles.	4.17 billion Dong = $300,000 (by JICA Study Team)
5. Total excluding Man Tep			38,890 million Dong = $2,798,000

Total cost of the upgrading is estimated to be $3,476,000 including costs of construction, land purchase, engineering, administration and contingency. See Tables 8.9.5 and 8.9.6 for details.

8.4.3 Alternative Route

As earlier explained, the further upgrading of the Route 35 is pre-requisite to use the proposed West Route for secondary transport of waste. The further upgrading of the Route 35 is included in the project. However, in case the Route 35 is not upgraded, the following alternative route (East Route) has to be used.

Alternative Route

Dong Ngac transfer station – access road – South Thang Long Highway – Thang Long Bridge – North Tang Long Highway – West/East Road - Phuong Trach bridge – National Road No. 3 – Route 35 – Bac Son road – Nam Son landfill (42 km in length)

The distance from Dong Ngac to Nam Son on this route is 38.6 km, 1 km longer than the West Route. In case the East Route is used, the upgrading of the following bridges are needed. The total direct investment cost of the upgrading is estimated to be $2,494,000 including costs of construction, land purchase, engineering, administration, and contingency as shown in Table 8.9.7.

Bridges that Need to be Upgraded on the Alternative East Route

Bridges	Location	Bearing capacity Indicated on Signboard	Cost of Upgrading estimated by VIWASE
1. Phuong Trach bridge	West/East Road	15 ton	3 billion Dong = $216,000
2. Cau Doi bridge	National Road No.3	10 ton	3 billion Dong = $216000
3. Tu Tao bridge	Route 35	10 ton	3 billion Dong = $216,0000
4. Road from Ne to Nam Son (a part of Route 35 (1.8 km) and Bac Son road (3.2km) = 5 km	Approach road to Nam Son	ton	6.56 billion Dong = $472,000 (4.2 billion x 5.0km/3.2km)
5. Access road to Dong Ngac			4.17 billion Dong = $300,000 (estimated by JICA Study)
6. West-east road (6.4 km)	Between North Thang Long highway & National Road 3	25 ton, width of paved area needs to be widened	8.20 Billion Dong = $590,000 (estimated by JICA Study) (Upgrading cost of Route 35: 26,350 m. Dong x 6.6km/17km x 80%)
7. Total			27.93 billion Dong = $2,010,000

Locations of the above roads and bridges are shown in Figure 8.4.2.

The road linking between and North Thang Long Highway and National Road 3 has a bearing capacity of 25 GVW trucks. However, the width of the paved area of road is less than 7 m. Therefore the paved area should be widened to 7 m if this route is used by the secondary transport trucks.

8.4.4 Cost Comparison between the West Route and East Route

The distance from Dong Ngac to Nam Son landfill site on the West Route is 37.6km, 1 km shorter than that on the East Route. Therefore the cost of the secondary transport is lower on the West Route than on the East Route. However, the investment cost of the upgrading of roads and bridges on the West Route is larger than that for the East Route. The JICA Study Team has made economic comparison between the two routes. Benefits arising from the use of the West Route are as follows:

Benefits of using the West Route

Direct benefits	1. Saving of costs of fuel 2. Saving of vehicle purchase cost 3. Saving of work time (or travel time)
Indirect benefit	4. Same kind of benefits as 1,2 and 3 that may be enjoyed by other users of the West Route instead of the East Route. 5. Same kind of benefits as 1, 2 and 3 that may be arising in case future landfill sites are located in somewhere in Soc Son district 6. Alleviation of traffic congestion in the east route 7. Alleviation of environmental pollution that may be caused due to increased traffic to local residents living along Route 3. More number of residents live along the East route than West route.

It is estimated that the direct benefit (difference in the waste transport costs between West Route instead of East Route) is about $1.3 million over the period of 30 years, while the cost difference in the upgrading roads and bridges between the West Route and East Route is about 1 million dollar (The total upgrading cost on the West Route is $3,476,000, while the total upgrading cost on the East Route is $2,494,000. ($3,476,000 - $2,494,000 = $982,000.) See Tables 8.9.5 and 8.9.6.

Assuming 1) Dong Ngac transfer system will be useful for 30 years, and 2) the indirect benefit is same as the direct benefit as in Case 2 above, aggregate value of both direct and indirect benefits is estimated to be $2,582,000 ($1,291,000 x 2), while the additional cost of upgrading of the roads and bridges on the West Route compared to that of the East Route is $982,000. The present value of $2,582,000 is identical with the additional cost of upgrading when discounted at rate of 6.1%, which is considered to have the same meaning as economic internal rate of return.

Economic Benefit Arising by Using the West Route instead of the East Route

(Costs in the table are thousand US dollar in 1999 price)

	Case 1: Indirect benefit = 0	Case 2: Indirect benefit = Direct benefit
1. Total cost saving in the secondary transport of waste during 30 years	$1,291/year	$1,291/year
2. Other benefit (saving) during 30 years	$0/year	$1,291/year
3. Total benefit (saving) during 30 years	$1,291/year	$2,582/year
4. Cost = Difference in upgrading cost between the West route and East route	$982/year	$982/year
5. Net saving = 3 – 4 at 0% discount rate	$309/year	$1,600/year
6. EIRR of the Item 3 on the Item 4	1.5 %/year	6.1 %/year

Conclusion:

It is judged that the use of West Route is more economical than the use of East Route in long term though it would require about $1 million higher investment in the upgrading of roads and bridges.

Technical Note on Possible Savings (assuming waste transfer amount = 1,600 ton/day)

1. Saving of costs of fuel = A – B = $265,578 - $258,697 = $6,881/year
   - A: Annual fuel cost for the East Route = 38.6 km/one way/trip x 2 ways x 145 trips/day x 365 days/year x 0.25 liter of fuel consumption/km x $0.26/liter = $265,578
   - B: Annual fuel cost for the West Route = 37.6 km/one way/trip x 2 ways x 145 trips/day x 365 days/year x 0.25 liter of fuel consumption/km x $0.26/liter = $258,697
2. Saving of vehicle purchase cost (in terms of depreciation cost) = A– B = $376,495 - $ 365,200 = $11,295/year
   - A: Annual depreciation cost of the secondary transport vehicles for the East Route = ($83,000/vehicle x 44 vehicles) ÷ 9.7 years = $376,495 (note: It is assumed that the useful period is about 1,000,0000 km)
   - B: Annual depreciation cost of the secondary transport vehicles = ($83,000/vehicle x 44 vehicles) ÷ 10 years = $365,200 (note: It is assumed that the useful period is about 1,000,0000 km)
3. Saving of work time = Monthly salary rate x man-months of working time saved = $60/man/month x 100.8 man-months/year = $6,048/year

   Assumptions:
   1) Salary rate = $60/man/month including allowances
   2) Difference in transport time = 20 minutes/round trip
   3) Annual difference in transport time = 20 minutes/round trip/truck x 145round trip/day in year 2004 x 365 days/year = 1,058,500 minutes/year = 17,642 man hours/year = 2,520 working days/year = 100.8 man-months/year = $6,048/year
      difference in time of transport
4. Total direct benefit = $6,881/year + $11,295/year + $6,048/year = $24,224/year when waste transfer amount is 1,600 ton/day.
5. Total direct benefit during 30 years is estimated to be $1,291,000 assuming that the benefit amounts are proportional to waste transfer amount. See Table 8.9.8.
6. the cost of upgrading of roads and bridges of the East Route = Total investment cost for the upgrading = $2,494,000 (See Table 8.9.7)
7. the cost of upgrading of roads and bridges of the East Route = Total investment cost for the upgrading = $3,476,000 (See Table 8.9.5)
8. Difference in the depreciation cost between the West and East route = 5 – 4 = $3,476,000 - $2,494,000 = $982,000

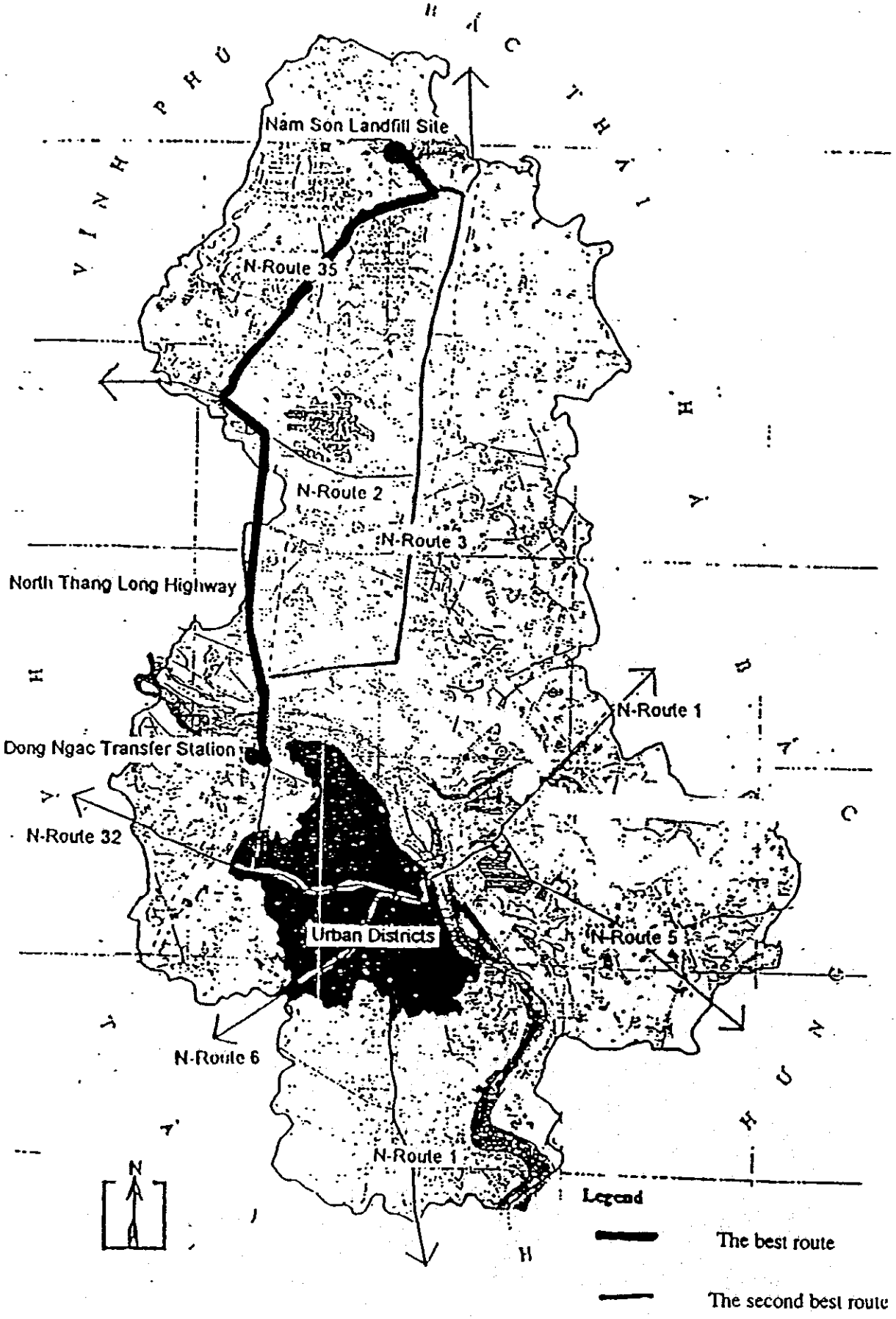


Fig. 8.4.1 Proposed Routes for the Secondary Transport
From Dong Ngac Transfer Station to Nam Son Landfill Site

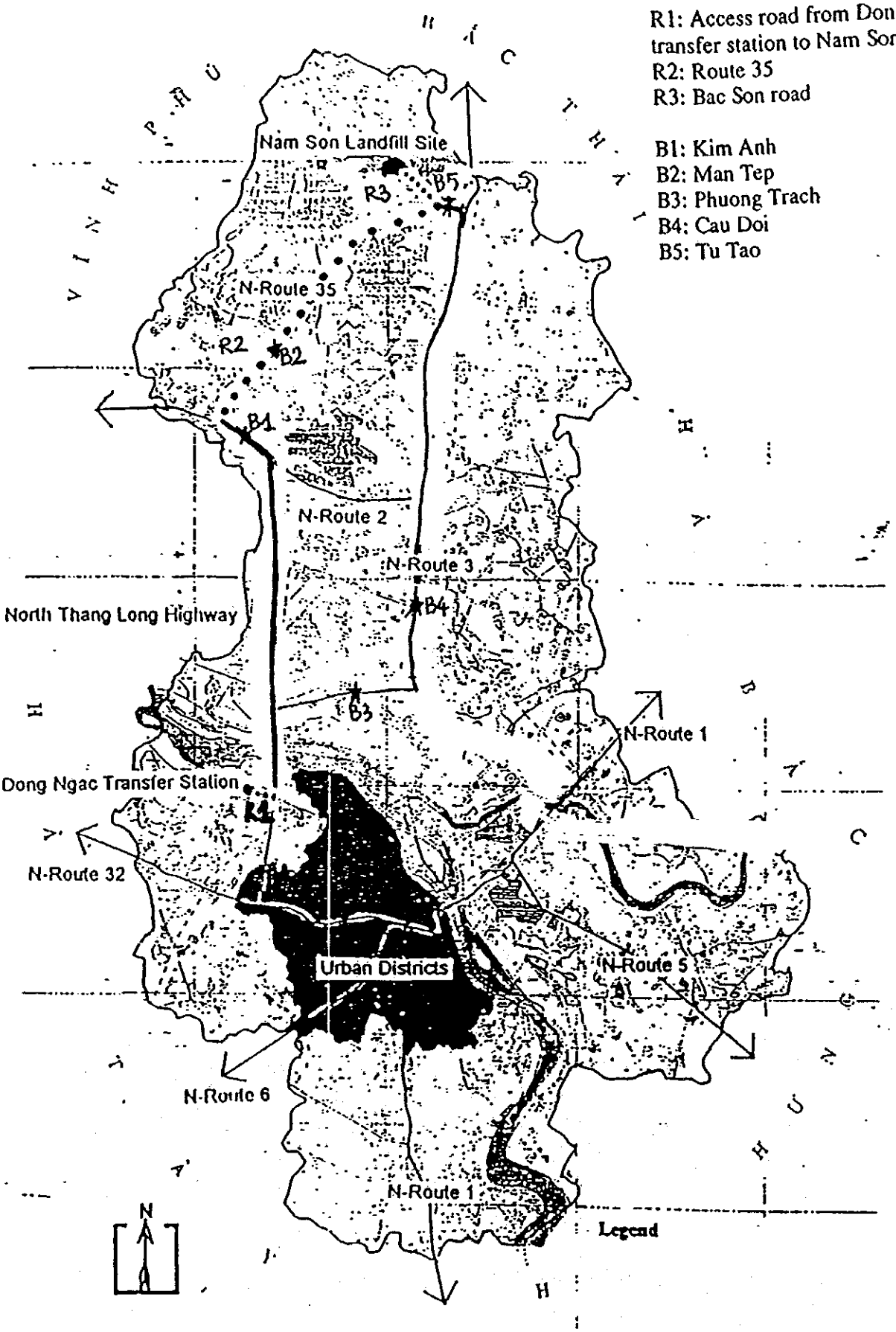


Fig 8.4.2 Existing Roads and Bridges that Need to be Upgraded for Secondary Transport of Waste

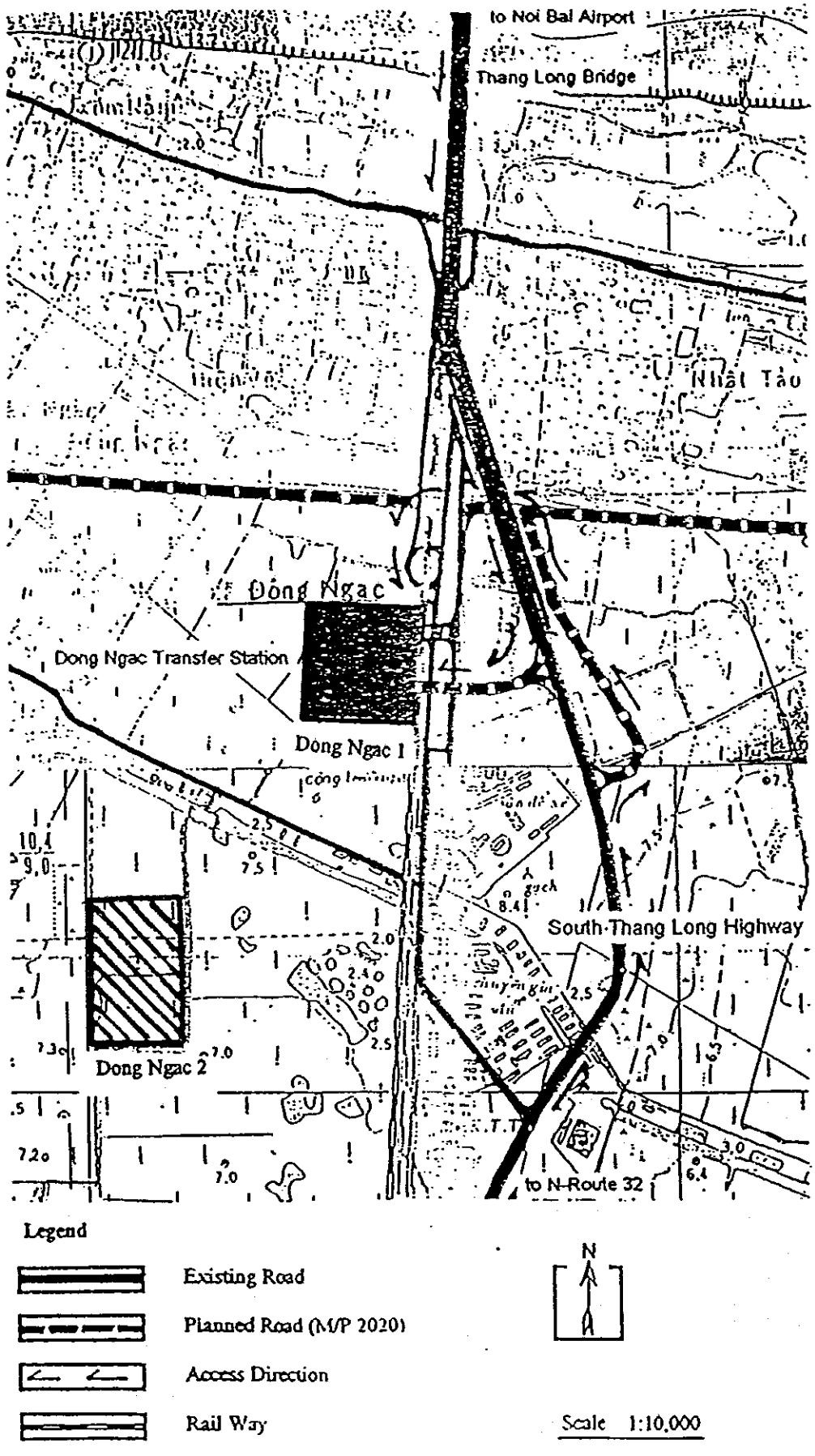


Fig. 8.4.3 Proposed Access Roads to Dong Ngac Transfer Station

8.5 Preliminary Design of Transfer Station

8.5.1 Design Conditions

A proposed layout plan of a transfer station, shown in Figure 8.5.1, has been prepared based on :

a) use of the proposed Dong Ngac area as a transfer station site, and
b) application of Option A2 (non-compaction storage load type).

The site layout reflects the results of geographic survey of the site conducted by the JICA Study Team. The layout design reflects also the following consideration and conditions.

a) The planning and design policy set out in Section 8.2.

b) The Number of loading lanes is decided based upon the truck trip data of the truck scale recorded at the Tay Mo landfill. (See the note below.)

c) On the site of transfer station, the traffic flow of the primary transport vehicles and that of the secondary transport vehicles are separated from each other as much as possible.

d) For loading waste into secondary transport vehicles, A2 Option, i.e., a combination of both the direct-load (waste is discharged directly into secondary transport vehicle) and the storage-load (waste is discharged onto unloading platform, then a wheel loader pushes waste into the secondary transport vehicles) is proposed.

Technical note on number of lanes: The required number of lanes (proposed to be 6) is calculated based on number of the primary waste collection trucks arriving at the transfer station during peak hour. Basic idea is that number of the lanes should be adequate so that primary transport trucks arriving at the transfer station do not have to wait for unloading waste even during peak hour. Required number of lanes are estimated to be 6 based on the following conditions:

a) Each lane can handle 15 primary collection vehicles per hour.

b) Maximum number of primary trucks arriving at the transfer station is calculated based on URENCO's trip record. (Maximum number of trucks arriving at Tay Mo landfill site was 45. Considering future increases in waste collection amount, maximum number of trucks arriving at the site is assumed to be 80% more than the current number, i.e. 45 trucks/hour x 1.8 = 81 trucks/hour.)

c) Number of lanes needed to handle 81 trucks/hour is calculated to be 5.6 lanes (81 trucks/hour ÷ 15 trucks/lane/hour = 5.4 lanes) So, 6 lanes are planned.

8.5.2 Facilities Provided at Transfer Station

Major components of the transfer station are shown in the following table.

Major Components of Transfer Station

Function	Remarks
Waste transfer structure	a. Elevated platform with concrete floor for waste unloading b. Leachate collection and storage facilities will be provided c. .A complete roof and walls will be provided. b. Incoming and outgoing slopes at both end of the platform
Office Building	a. Include the space for the chief and his staffs b. Locker and rest room c. Storage e. Toilet and bath
Workshop	b. Equipped with a set of equipment for daily maintenance of - the secondary transport vehicles - Wheel loaders a. Include the following vehicles - 2 Pickup trucks
Weighing Bridge	a. Install two units of weigh bridge with a maximum capacity of 10 ton b. Control booth equipped with an automatic recording system
Water Supply	a. Either piped water or underground water (Water will be used for office, workshop and truck washing pond.)
Vehicle Washing Pool	a. A shallow pool is provided to wash the secondary transport vehicles and wheel loaders
Parking Lot	a. Space for secondary transport vehicles, wheel loaders and vehicles of employers and visitors
Guard man Booth	a. All vehicles that enter into the transfer station are checked by security guards.
Gate and fence	a. Fence is provided around site of transfer station.
Miscellaneous	a. Fire fighting equipment. b. Lighting c. Signboard
Deodorization	a. This is optional. Inclusion of this system should be examined at the time of basic design.

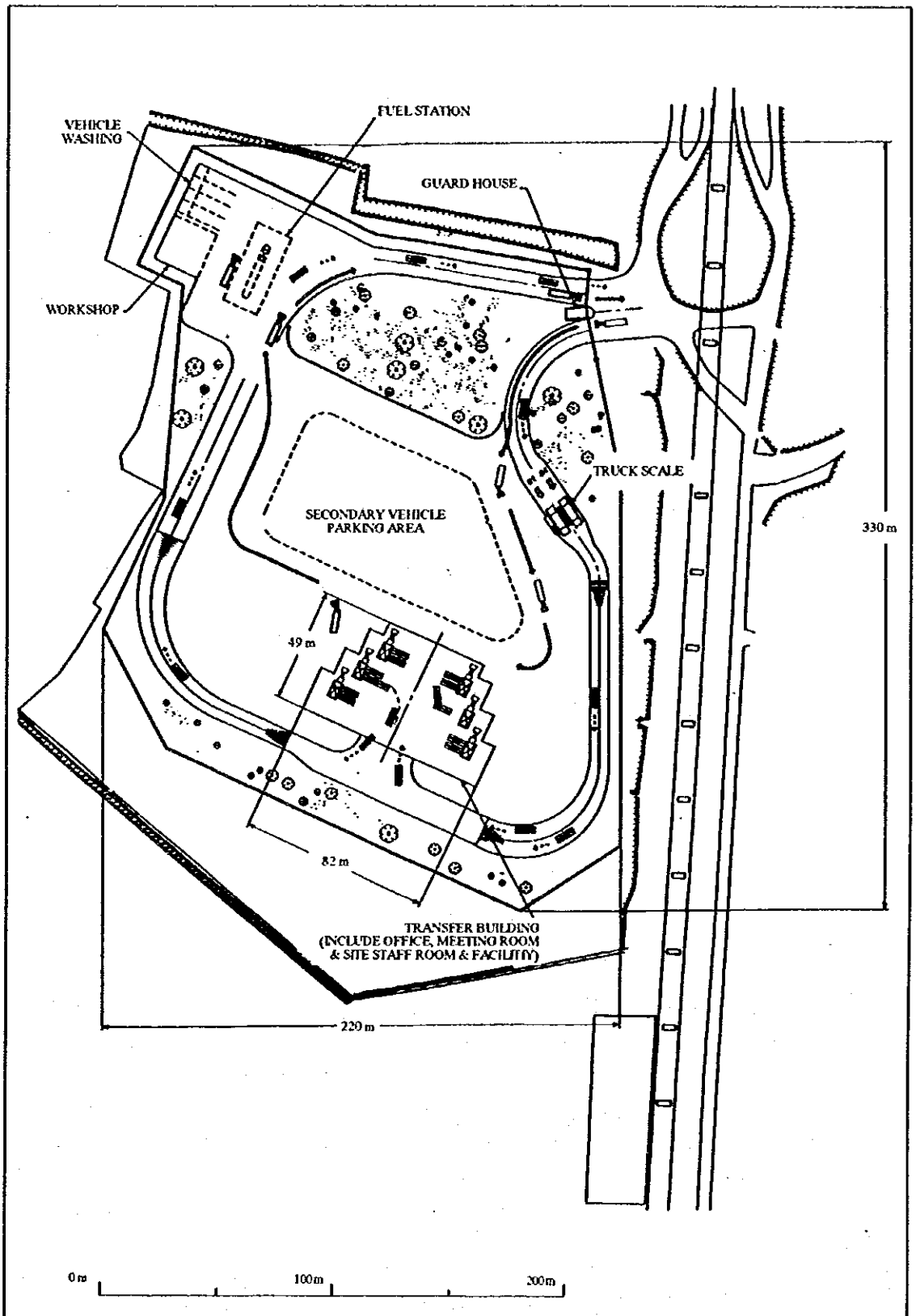


Fig 8.5.1 | **Layout of Dong Ngac Transfer Station**

8.6 Operation Plan

8.6.1 Time required for One round trip

The following time requirement is assumed:

Time Requirement

a. Loading time	25 minutes
b. Travelling time from Dong Ngac transfer station to Nam Son landfill site	70 minutes
c. Dumping time	15 minutes
d. Travelling time form Nam Son to Dong Ngac transfer station	70 minutes
e. Total	180 minutes (3 hours)

8.6.2 Time Schedule

The following schedule is proposed based on the time schedule of the primary collection. Considering the time requirement for trips, four round trips per day is proposed per vehicle.

Proposed Time Schedule for the Secondary Transport Vehicles

	Trip	Start of Loading into Secondary Transport truck	Departure from Transfer Station	Arrival at Nam Son	Departure from Nam Son	Arrival at Transfer Station
1st shift	1st trip	17:00	17:25	18:35	18:50	20:00
	2nd trip	20:00	20:25	21:35	21:50	23:00
2nd shift	3rd trip	23:00	23:25	00:35	00:50	02:00
	4th trip	02:00	02:25	03:35	03:50	05:00

8.6.3 Vehicle Operation on Site

(1) Primary Transport Vehicle

The primary transport vehicles, at first, pass through the gate, and are checked by guard man. Then, they stop at a weighbridge for measurement of their payload. After that they go up the slope, and reach an elevated platform that has a height of about 4 to 5 m from the ground. On the platform, there are instructors who guide the drivers which lanes to go for unloading and how to unload their waste: direct-loading into secondary transport vehicle through an opening or unload on the platform. After having unloaded waste, they go down the other slope and leave the site.

(2) Secondary transport vehicle

The secondary transport vehicles also pass through the gate. They are checked by a guard man. They go to waste loading points (under the loading holes of the

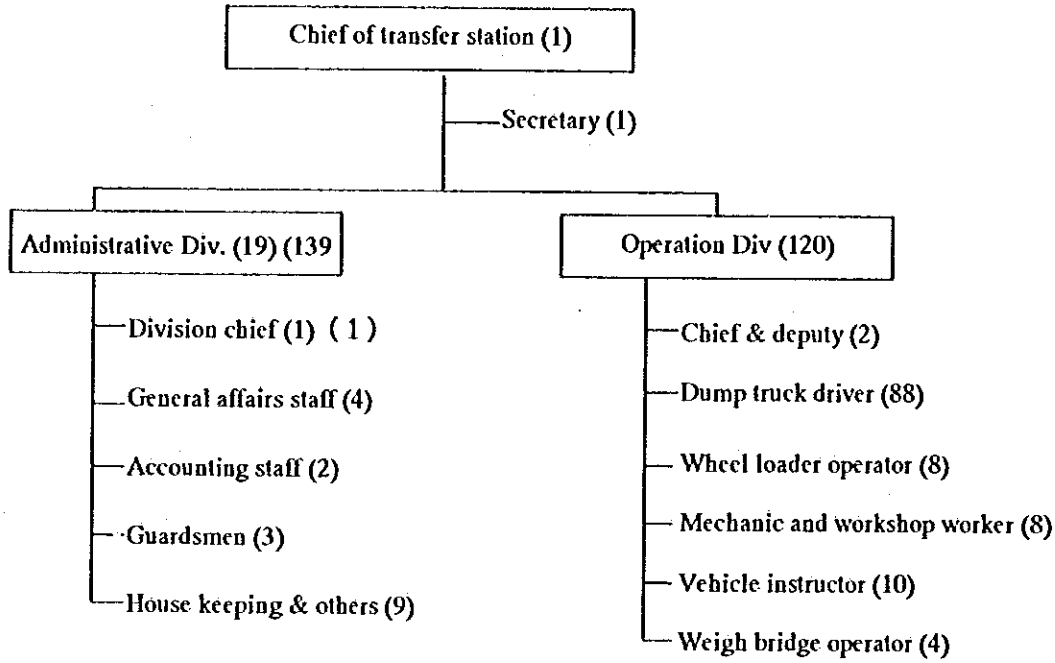
elevated platform) where they receive waste through the loading holes. When the secondary transport vehicles are full, they leave.

(3) Wheel loader

The wheel loaders push unloaded waste to the loading holes on the elevated platform. If scavengers recover materials, the operators of wheel loaders wait until their activities finish. After materials are recovered, wheel loaders push the remaining waste into the secondary transport vehicle through the loading holes.

8.7 Organizational Arrangement

The proposed organization for transfer system is shown in the following figure.



Note: Figures in parenthesis are proposed number of employees.

Proposed Organization of Dong Ngac Transfer Station

Under the chief of transfer station the organization is divided into two divisions, an administrative division and an operation division. A total of 141 employees may be needed to operate the planned transfer station and the secondary transport vehicles. Operation division will operate 365 days/year in two shifts/day.

8.8 Project Implementation Schedule

8.8.1 Project Implementation Schedule

It is proposed that HPC should make arrangements so that it will start operation of the planned transfer system and Nam Son Landfill Phase 2 in January 2004. A proposed time schedule is shown in Table 8.8.1.

The schedule is very tight so HPC's prompt action is required to meet the schedule.

8.8.2 Equipment Procurement Schedule

It is planned that HPC will procure all necessary facilities and equipment in 2003 so that the transfer system will start operation in the beginning of 2004. Vehicles purchased in 2003 will have the capacity of transferring 1,600 ton/day of solid waste, which is a little more than the waste transfer amount (1,586 ton/day) estimated in the beginning of 2006. Table 8.8.2 shows number of vehicles required to meet the demand for each year.

8.8.3 Project Period

It is planned that the operation period of Nam Son Landfill Phase 2 site will be from the beginning of 2004 until the end of 2016. The planned transfer system will be operated during this period at least. In case a future landfill site is located in Soc Son district, the planned transfer system can be used even after the Nam Son Landfill Phase 2 site is closed.

In order to open the transfer system in the beginning of 2004, the engineering service (design) should be carried out in 2002, and the major supply and construction should be completed by the end of 2003.

Table 8.8.1 Project Schedule

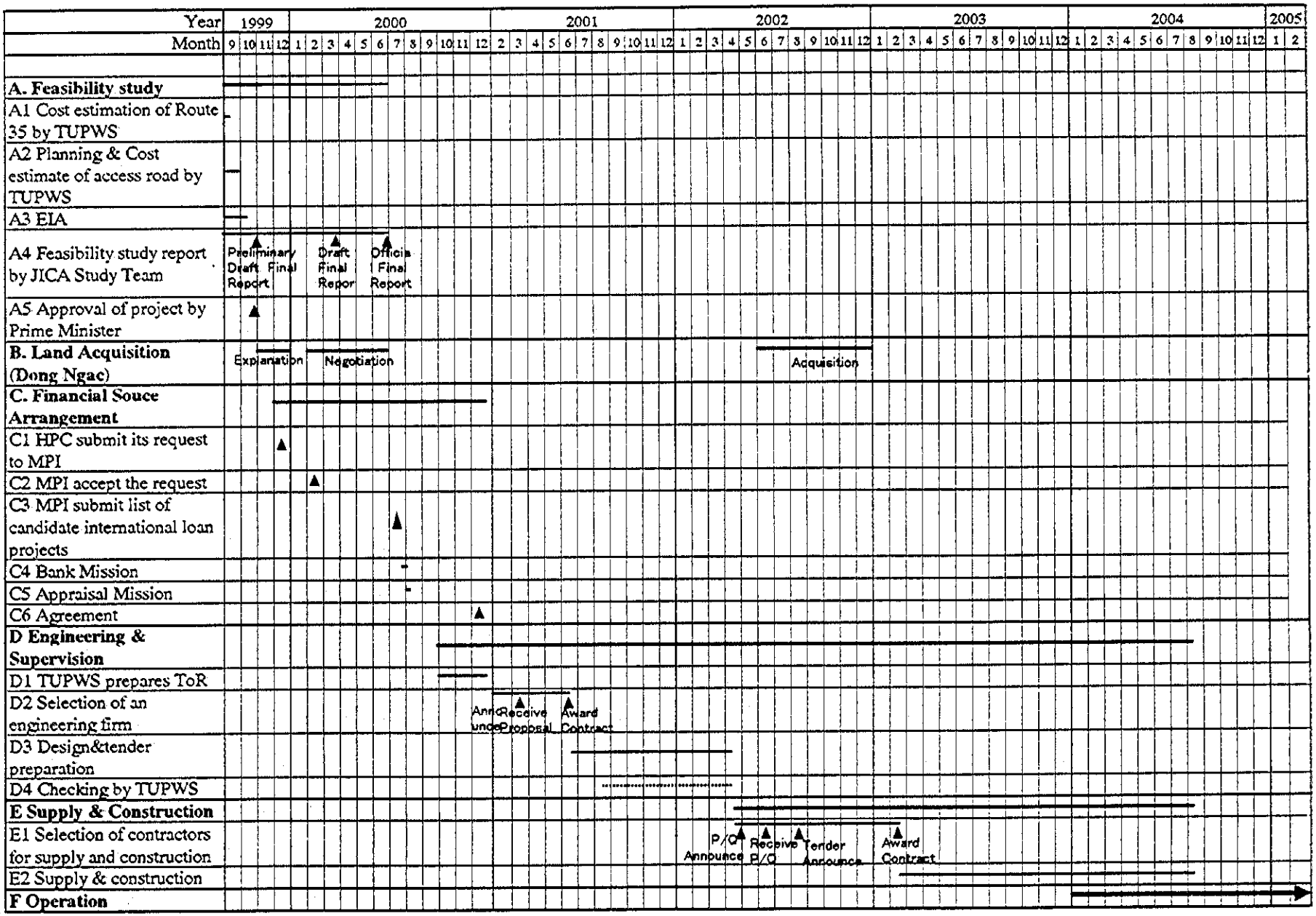


Table 8.8.2 Annual Vehicle Requirement

		Dump Truck			Wheel Loaders			Tank Lorry		
Year	Waste Transfer Amount (t/d)	New Purchase	Discarded	Quantity Required	New Purchase	Discarded	Quantity Required	New Purchase	Discarded	Quantity Required
2003		44	0		3	0		1	0	
2004	1,386	0	0	44	0	0	3	0	0	1
2005	1,507	3	0	44	0	0	3	0	0	1
2006	1,586	2	0	47	0	0	3	1	0	1
2007	1,695	3	0	49	1	0	3	0	0	2
2008	1,787	3	0	52	0	0	4	0	0	2
2009	1,884	0	0	55	0	0	4	0	0	2
2010	1,985	3	0	55	0	0	4	0	0	2
2011	2,011	2	0	58	0	0	4	0	0	2
2012	2,094	2	0	60	0	0	4	0	0	2
2013	2,181	3	0	62	0	0	4	0	0	2
2014	2,271	45	44	65	4	3	4	1	1	2
2015	2,364	3	0	66	0	0	5	0	0	2
2016	2,407	6	3	69	0	0	5	0	0	2
2017	2,507	5	2	72	0	0	5	1	1	2
2018	2,611	6	3	75	1	1	5	0	0	2
2019	2,719	6	3	78	0	0	5	0	0	2
2020	2,832	3	0	81	1	0	5	0	0	2
2021	2950			84			6			2
2022	3072									

8.9 Estimated Project Cost

8.9.1 Transfer System

(1) Expenditures

As shown in the table below, total cost of investment and operation/maintenance of the planned transfer system during the period 2002 – 2016 is estimated to be about US $35 million in 1999 price including administrative cost and 10% contingency. The investment cost and operation/maintenance are estimated to be $22 million and $13 million, respectively.

Summary of Project Expenditures

	Total	Contingency (10% of a) = b	Total including contingency a + b = c
1. Initial investment (2002 –2003)	11,862,000	1,186,000	13,048,000
2. Subsequent investment (2004 – 2016)	8,155,000	816,000	8,971,000
3. Total investment (1 + 2)	20,017,000	2,002,000	22,019,000
4. Operation & maintenance (2004 – 2016)	11,585,000	1,159,000	12,744,000
5. Administration cost for the Initial investment	356,000	36,000	392,000
6. Total (3 + 4+ 5)	31,958,000	3,196,000	35,154,000

Annual investment expenditures and annual operation/maintenance expenditures are shown in Table 8.9.1. Details and annual investment expenditures are shown in Table 8.9.2.

(2) Phased Investments

Initial investment will be made in 2002 and 2003. In 2002, engineering (design) service will be provided. In 2003, supply and construction will take place. The initial investment aims at building a capacity to transfer 1,600 ton/day of solid waste. Of the total investment of $22 million during 2002 - 2016, the amount of the initial investment during the two years 2002 – 2003 is estimated to be $13.4 million.

Subsequent investments will be made for purchasing additional equipment needed to increase waste transfer capacity in accordance with future increases in waste transfer amount.

(3) Operation and Maintenance Costs

Details of annual operation and maintenance expenditures are shown in Table 8.9.3. Annual operation and maintenance cost in the first year of operation in 2004 is estimated to be about $0.73 million including 10% contingency. Items of the operation and maintenance costs are 1) fuel for the secondary transport vehicles (39%), 2) maintenance cost of the vehicles (34%), and salaries of the employees (19%), electricity (3%), building maintenance cost (3%), water (2 %). Annual cost of operation and maintenance will increase largely in proportion to amount of waste transfer.

(4) Project Cost on Depreciation Base

The following table shows the project costs estimated on depreciation base with recognition that some investment expenditures are not depreciated during the planned project period from 2002 – 2016. Of the $22 million of the total investment during 2002 – 2016, $14.2 million is depreciated during the same period. Adding the total operation and maintenance cost during the project period ($12.7 million) and administration cost of $0.4 million amounts to the total project cost of $27.3 million on depreciation basis during 2002 – 2016. Table 8.9.4 shows details of the annual costs on depreciation base.

Summary of Project Cost on Depreciation Base

	Total	Contingency (10% of a) = b	Total including contingency a + b = c	Unit Cost ($/ton)
1. Investment Cost Depreciated during 2002 –2016	13,276,000	1,328,000	14,604,000	1.59
2. Operation & maintenance (2004 – 2016)	11,585,000	1,159,000	12,744,000	1.39
3. Total (1+ 3 + 4)	24,861,000	2,486,000	27,347,000	2.98

(5) Project Cost on Depreciation Base

Based on the costs shown in the above table and estimated cumulative waste transfer amount, the total unit cost of waste transfer is estimated to be $2.98/ton, of which $1.59/ton is for investment and the remaining $1.39 is for operation and maintenance.

Table 8.9.1 Annual Expenditures for the Transfer System

Unit: US dollar in 1999 price

Year	Total Investment	Total Operation & Maintenance	Administration cost for Initial investment	Total Cost	Contingency	Total including contingency
a	b	c	d	e	f	g
				b+c+d	e*10%	e+f
2002	628,000	0	177,930	806,330	80,633	886,963
2003	11,234,000	0	177,930	11,411,530	1,141,153	12,552,683
2004	0	660,698	0	660,698	66,070	726,768
2005	273,000	711,475	0	984,475	98,448	1,082,923
2006	392,000	744,627	0	1,136,627	113,663	1,250,290
2007	273,000	790,368	0	1,063,368	106,337	1,169,705
2008	455,000	828,976	0	1,283,976	128,398	1,412,373
2009	0	869,681	0	869,681	86,968	956,649
2010	273,000	912,065	0	1,185,065	118,507	1,303,572
2011	182,000	922,976	0	1,104,976	110,498	1,215,474
2012	182,000	957,807	0	1,139,807	113,981	1,253,787
2013	273,000	994,316	0	1,267,316	126,732	1,394,047
2014	4,851,000	1,032,084	0	5,883,084	588,308	6,471,392
2015	455,000	1,071,111	0	1,526,111	152,611	1,678,722
2016	546,000	1,089,156	0	1,635,156	163,516	1,798,671
2017	665,000	1,131,120	0	1,796,120	179,612	1,975,732
2018	546,000	1,174,763	0	1,720,763	172,076	1,892,839
2019	728,000	1,220,085	0	1,948,085	194,808	2,142,893
2020	273,000	1,267,505	0	1,540,505	154,050	1,694,555
A. Total 2002-2003	11,862,000	,000	356,000	12,218,000	1,222,000	13,440,000
B. Total 2004-2017	8,820,000	12,716,000	,000	21,536,000	2,154,000	23,690,000
C. Total 2002-2017 (A+B)	20,682,000	12,716,000	356,000	33,754,000	3,375,000	37,130,000
D. Cost Not Depreciated during 2002-2017	6,639,000	,000	,000	6,639,000	664,000	7,303,000
E. Total Cost 2002-2017 (C-D)	14,043,000	12,716,000	356,000	27,115,000	2,712,000	29,827,000

Table 8.9.2 Annual Investment for the Transfer Sytem

Unit: US dollar in 1999 price

		Engineering	Civil & Building Works					Transfer Vehicles & Equipment					Admini-stration Cost for Initial Investment in 2002 &	Total including Administrative cost	Contin-gency (10%)	Total Including Contin-gency
Year	Land Purchase	Engineering	Transfer Station including Training Costs	Access Road (included in the Road	Weigh bridge	Workshop Equipment	Total	Dump Truck	Wheel Loader	Tank Lorry	Subtotal	Total	3% of m	m + n	10% of m	m+n
							d+e+f+g				I+j+k	b+c+h+l				
a	b	c	d	e	f	g	h	I	j	k	l	m	n	o	n	o
Unit Price	200,000	714,000	5,922,000	0	33,000	200,000		91,000	182,000	210,000			356,000			
2002	200,000	428,400	0	0	0	0	0	0	0	0	0	628,000	178,000	806,000	81,000	887,000
2003	0	285,600	5,922,000	0	66,000	200,000	6,188,000	4,004,000	546,000	210,000	4,760,000	11,234,000	178,000	11,412,000	1,141,000	12,553,000
2004	0	0	0	0	0	0	0	0	0	0	0	,000		,000	,000	,000
2005	0	0	0	0	0	0	0	273,000	0	0	273,000	273,000	,000	273,000	27,000	300,000
2006	0	0	0	0	0	0	0	182,000	0	210,000	392,000	392,000	,000	392,000	39,000	431,000
2007	0	0	0	0	0	0	0	273,000	0	0	273,000	273,000	,000	273,000	27,000	300,000
2008	0	0	0	0	0	0	0	273,000	182,000	0	455,000	455,000	,000	455,000	46,000	501,000
2009	0	0	0	0	0	0	0	0	0	0	0	,000	,000	,000	,000	,000
2010	0	0	0	0	0	0	0	273,000	0	0	273,000	273,000	,000	273,000	27,000	300,000
2011	0	0	0	0	0	0	0	182,000	0	0	182,000	182,000	,000	182,000	18,000	200,000
2012	0	0	0	0	0	0	0	182,000	0	0	182,000	182,000	,000	182,000	18,000	200,000
2013	0	0	0	0	0	0	0	273,000	0	0	273,000	273,000	,000	273,000	27,000	300,000
2014	0	0	0	0	0	0	0	4,095,000	546,000	210,000	4,851,000	4,851,000	,000	4,851,000	485,000	5,336,000
2015	0	0	0	0	0	0	0	273,000	182,000	0	455,000	455,000	,000	455,000	46,000	501,000
2016	0	0	0	0	0	0	0	546,000	0	0	546,000	546,000	,000	546,000	55,000	601,000
2017	0	0	0	0	0	0	0	455,000	0	210,000	665,000	665,000	,000	665,000	67,000	732,000
2018	0	0	0	0	0	0	0	546,000	0	0	546,000	546,000	,000	546,000	55,000	601,000
2019	0	0	0	0	0	0	0	546,000	182,000	0	728,000	728,000	,000	728,000	73,000	801,000
2020	0	0	0	0	0	0	0	273,000	0	0	273,000	273,000	,000	273,000	27,000	300,000
A. Total 2002-2003	200,000	714,000	5,922,000	,000	66,000	200,000	6,188,000	4,004,000	546,000	210,000	4,760,000	11,862,000	356,000	12,218,000	1,222,000	13,440,000
B. Total 2004-2017	,000	,000	,000	,000	,000	,000	,000	7,280,000	910,000	630,000	8,820,000	8,820,000	,000	8,820,000	882,000	9,702,000
C. Total 2002-2017 (A+B)	200,000	714,000	5,922,000	,000	66,000	200,000	6,188,000	11,284,000	1,456,000	840,000	13,580,000	20,682,000	356,000	21,038,000	2,104,000	23,142,000
F. Contingency	20,000	71,000	592,000	,000	7,000	20,000	619,000	1,128,000	146,000	84,000	1,358,000	2,068,000	36,000	2,104,000		
G. Total including contingency	220,000	785,000	6,514,000	,000	73,000	220,000	6,807,000	12,412,000	1,602,000	924,000	14,938,000	22,750,000	391,000	23,142,000		

Table 8.9.3 Annual Operation and Maintenance Costs for the Transfer System

Unit: US dollar in 1999 price

Year	Waste Transfer Amount (t/d)	Electricity	Water	Salary of Mana-gers	Salary of other employees	Fuel for Vehicle	Mainte-nance Cost for Vehicle	Mainte-nance cost for building, etc.	Total	Contin-gency	Total including contingency
a	b	c	d	e	f	g	h	I	j	k	l
	Unit Cost	$0.4/kwh	$2.5/cum	$167/ person/ month	$75/ person/ month	$0.26/ liter	5% of initial	2.5% of initial	(c+d+e+f+g +h+I)	10% of j	j +k
2004	1,386	16,856	12,647	8,000	106,809	239,148	206,168	71,070	660,698	66,070	726,768
2005	1,507	18,328	13,751	8,000	116,133	260,026	224,166	71,070	711,475	71,148	782,623
2006	1,586	19,289	14,472	8,000	122,221	273,657	235,918	71,070	744,627	74,463	819,090
2007	1,695	20,614	15,467	8,000	130,621	292,465	252,131	71,070	790,368	79,037	869,405
2008	1,787	21,733	16,306	8,000	137,711	308,339	265,816	71,070	828,976	82,898	911,873
2009	1,884	22,913	17,192	8,000	145,186	325,076	280,245	71,070	869,681	86,968	956,649
2010	1,985	24,141	18,113	8,000	152,969	342,503	295,269	71,070	912,065	91,207	1,003,272
2011	2,011	24,458	18,350	8,000	154,973	346,989	299,136	71,070	922,976	92,298	1,015,274
2012	2,094	25,467	19,108	8,000	161,369	361,311	311,483	71,070	957,807	95,781	1,053,587
2013	2,181	26,525	19,902	8,000	168,073	376,322	324,424	71,070	994,316	99,432	1,093,747
2014	2,271	27,620	20,723	8,000	175,009	391,851	337,811	71,070	1,032,084	103,208	1,135,292
2015	2,364	28,751	21,572	8,000	182,176	407,898	351,645	71,070	1,071,111	107,111	1,178,222
2016	2,407	29,274	21,964	8,000	185,489	415,317	358,041	71,070	1,089,156	108,916	1,198,071
2017	2,507	30,490	22,876	8,000	193,196	432,572	372,916	71,070	1,131,120	113,112	1,244,232
2018	2,611	31,755	23,825	8,000	201,210	450,517	388,386	71,070	1,174,763	117,476	1,292,239
2019	2,719	33,068	24,811	8,000	209,533	469,152	404,451	71,070	1,220,085	122,008	1,342,093
2020	2,832	34,442	25,842	8,000	218,241	488,649	421,260	71,070	1,267,505	126,750	1,394,255
Total 2004-2017		336,458	252,443	112,000	2,131,934	4,773,475	4,115,169	994,980	12,716,459	1,271,646	13,988,105
Share of each cost item		3%	2%	1%	17%	38%	32%	8%	100%		

Note: It is assumed that annual cost of operation and maintenance will increase in proportion to waste increase except for total salary of managers and maintenance cost of building, etc.

Table 8.9.4 Annual Cost for the Transfer System on Depreciation Base

Unit: US dollar in 1999 price

	Depreciation			Operation & Maintenance	Admini-stration cost for the Initial investment in 2002 & 2003	Total (Depreciation +O/M + Admi.)	Contingency (10% of Item g)	Total including Contingency
Year	Civil & building works	Equipment	Subtotal					
a	b	c	d = b+c	e	f	g = d+e+f	h	I = g + h
2002	21,420	0	21,420	0	177,930	199,350	19,935	219,285
2003	334,950	476,000	810,950	0	177,930	988,880	98,888	1,087,767
2004	334,950	476,000	810,950	660,698	0	1,471,647	147,165	1,618,812
2005	334,950	503,300	838,250	711,475	0	1,549,725	154,972	1,704,697
2006	334,950	542,500	877,450	744,627	0	1,622,076	162,208	1,784,284
2007	334,950	569,800	904,750	790,368	0	1,695,118	169,512	1,864,630
2008	334,950	615,300	950,250	828,976	0	1,779,225	177,923	1,957,148
2009	334,950	615,300	950,250	869,681	0	1,819,931	181,993	2,001,924
2010	334,950	642,600	977,550	912,065	0	1,889,615	188,961	2,078,576
2011	334,950	660,800	995,750	922,976	0	1,918,726	191,873	2,110,598
2012	334,950	679,000	1,013,950	957,807	0	1,971,756	197,176	2,168,932
2013	334,950	230,300	565,250	994,316	0	1,559,565	155,957	1,715,522
2014	334,950	715,400	1,050,350	1,032,084	0	2,082,433	208,243	2,290,677
2015	334,950	733,600	1,068,550	1,071,111	0	2,139,660	213,966	2,353,626
2016	334,950	749,000	1,083,950	1,089,156	0	2,173,105	217,311	2,390,416
2017	334,950	788,200	1,123,150	1,131,120	0	2,254,270	225,427	2,479,696
2018	334,950	797,300	1,132,250	1,174,763	0	2,307,013	230,701	2,537,714
2019	334,950	870,100	1,205,050	1,220,085	0	2,425,134	242,513	2,667,648
2020	334,950	870,100	1,205,050	1,267,505	0	2,472,554	247,255	2,719,810
A. Total 2002-2017	5,045,663	8,997,100	14,042,763	12,716,459	355,860	27,115,081	2,711,508	29,826,590
B.Contingency (10% of A)	504,566	899,710	1,404,276	1,271,646	35,586	2,711,508		
C. Total (A+B)	5,550,229	9,896,810	15,447,039	13,988,105	391,446	29,826,590		

Table 8.9.5 Cost of Upgrading or Construction of Roads and Bridges for the Secondary Transport on the West Route

Unit: US dollar in 1999 price

	Land acquisition (for access road to Dong Ngac)	Engi-neering in 2002	Construc-tion in 2003	Total	Cost of Administ-ration in 2002 & 2003	Total	Contin-gency	Total including contin-gency	Cost Not allocated to the Project	Cost Allocated to the Project	Cost Depreci-ated during 2004 – 2016
		10% of d		b+c+d	3% of e	e+f	10% of g	f+g	50% of h	h–i	
a	b	c	d	e	f	g	h	h	i	j	k
1. Upgrading of Route 35 & Bac Son Road	0	220,000	2,198,000	2,418,000	73,000	2,490,000	249,000	2,739,000	1,370,000	1,370,000	959,000
2. Kim Anh Bridge	0	30,000	300,000	330,000	10,000	340,000	34,000	374,000	187,000	187,000	131,000
3. Access road to Dong Ngac	100,000	20,000	200,000	320,000	10,000	330,000	33,000	363,000	181,000	181,000	88,000
4. Total	100,000	270,000	2,698,000	3,068,000	92,000	3,160,000	316,000	3,476,000	1,738,000	1,738,000	1,178,000
5. Contingency	10,000	27,000	270,000	307,000	9,000	316,000					
6. Total including contingency	110,000	297,000	2,968,000	3,374,000	101,000	3,476,000					
7. Cost Not allocated to the Project (50%)	55,000	148,000	1,484,000	1,687,000	51,000	1,738,000					
8. Cost Allocated to the Project (50%)	55,000	148,000	1,484,000	1,687,000	51,000	1,738,000					
9. Cost Depreciated during 2004 – 2016	,000	104,000	1,039,000	1,143,000	35,000	1,178,000					

Table 8.9.6 Annual Investment Cost for Upgrading or Construction of Roads & Bridges for the Secondary Transport on the West Route

Unit: US dollar in 1999 price

	Land acquisition (for access road to Dong Ngac)	Engi-neering in 2002	Construc-tion in 2003	Total	Cost of Administ-ration in 2002 & 2003	Total	Contin-gency	Total including contin-gency
		10% of d		b+c+d	3% of e	e+f	10% of g	f+g
a	b	c	d	e	f	g	h	h
2002	100,000	161,871	0	261,871	46,014	307,885	30,788	338,673
2003	0	107,914	2,697,842	2,805,755	46,014	2,851,770	285,177	3,136,947
4. Total	100,000	269,784	2,697,842	3,067,626	92,029	3,159,655	315,965	3,475,620
5. Contingency	10,000	26,978	269,784	306,763	9,203	315,965		
6. Total including contingency	110,000	296,763	2,967,626	3,374,388	101,232	3,475,620		

Table 8.9.7 Cost of Upgrading or Construction of Roads and Bridges for the Secondary Transport on the East Route

Unit: US dollar in 1999 price

	Land acquisition (for access road to Dong Ngac)	Engi-neering in 2002	Construc-tion in 2003	Total	Cost of Administ-ration in 2002 & 2003	Total	Contin-gency	Total including contin-gency	Cost Not allocated to the Project	Cost Allocated to the Project	Cost Depreci-ated during 2003 - 2016
		10% of d		b+c+d	3% of e	e+f	10% of g	f+g	50% of h	h-i	
a	b	c	d	e	f	g	h	h	i	j	k
1. Upgrading of Phuong Trach bridge	0	22,000	216,000	238,000	7,000	245,000	24,000	269,000	135,000	135,000	94,000
2. Cau Doi bridge	0	22,000	216,000	238,000	7,000	245,000	24,000	269,000	135,000	135,000	94,000
3. Tu Tao bridge	0	22,000	216,000	238,000	7,000	245,000	24,000	269,000	135,000	135,000	94,000
4. Road from Ni to Nam Son 8a part of Route 35 (1.8 km) and Bac Son road (3.2 km)	0	47,000	472,000	519,000	16,000	535,000	53,000	588,000	294,000	294,000	206,000
5. Road linkinng Thang Long highway & Route 3	0	59,000	590,000	649,000	19,000	668,000					
6. Access road to Dong Ngac	100,000	20,000	200,000	320,000	10,000	330,000	33,000	363,000	181,000	181,000	88,000
7. Total	100,000	191,000	1,910,000	2,201,000	66,000	2,267,000	227,000	2,494,000	1,247,000	1,247,000	834,000
8. Contingency	10,000	19,000	191,000	220,000	7,000	227,000					
9. Total including contingency	110,000	210,000	2,101,000	2,421,000	73,000	2,494,000					
10. Cost Not allocated to the Project (50%)	55,000	105,000	1,051,000	1,211,000	36,000	1,247,000					
11. Cost Allocated to the Project (50%)	55,000	105,000	1,051,000	1,211,000	36,000	1,247,000					
12. Cost Depreciated during 2004 - 2016	,000	74,000	735,000	809,000	25,000	834,000					

Note:
It is assumed that the useful period of the roads and bridges is 20 years, and the Planned operation period of the project is 13 years from 2004 - 2016.

CHAPTER 9 FINANCIAL PLAN

9.1 Project Expenditures and Costs

This section shows both cash expenditures and costs arising in connection with the project. They are estimated in US dollars of early 1999.

9.1.1 Project Expenditure and Cost

(1) Project Cash Expenditures

Estimated project cash expenditures are summarized in Table 9.1.1. The total project expenditures from 2002 to 2035 amount to $119 million, of which $78.4 million for Nam Son Landfill Phase 2, and $40.6 million for the transfer system and upgrading of roads and bridges. . Of the $119 million project expenditure, about $65.7 million is for investments, and the remaining $53.3 million for operation and maintenance.

It should be noted that Nam Son Landfill Phase 2 will be filled with waste in the beginning of 2018, but leachate will continue to be generated and needs to be treated until 2035. Annual cost of the post-closure treatment of leachate during 2018 - 2035 is estimated to be about $0.78 million/year.

(2) Project Unit Cost

The unit project costs per ton of waste transfer and disposal are estimated by dividing the total project costs by cumulative waste amounts transferred or disposed of at the planned facilities. It should be noted that some equipment that is purchased towards the end of the operation period can be used for some other projects. Therefore, some portions of the equipment purchase costs are deducted from cash expenditures when calculating project cost. It is estimated that the unit costs of Nam Son Landfill Phase 2 and the transfer system are $6.96/ton and $2.95/ton, respectively. Major assumptions used for estimation of the project costs are as follows:

Major assumptions

a) Useful Period of Facilities and Equipment
   - Civil and building works of the transfer station: 20 years
   - Mechanical facilities and equipment including secondary transport vehicles and bulldozers: 10 years

b) Expenditures for land acquisition is not depreciated assuming that the land acquired have same values before and after the project.

c) Administrative cost is 3 % of the initial investments to be made in 2002 and 2003.

d) Contingency is 10% of the original cost.

e) Cash expenditures needed for upgrading the roads and bridges on the secondary transport route are not considered as cost of the project on depreciation base.

Table 9.1.2 shows annual project expenditures. Table 9.1.3 shows project cost estimated based on unit cost per ton and annual amount of waste managed.

Table 9.1.1 Summary of Project Expenditures and Costs

Unit: US dollar in 1999 price

a	Nam Son Phase 2 Landfill b	Transfer System c	Roads and Bridges d	Total e = b+c+d
1. Site acquisition	2,539,000	220,000	110,000	2,869,000
2. Engineering	2,260,000	785,000	297,000	3,342,000
3. Site Development	28,447,000	6,807,000	2,968,000	38,222,000
4. Equipment	4,958,000	14,938,000	0	19,896,000
5. Administration	862,000	391,000	101,000	1,354,000
6. Total Investment	39,066,000	23,141,000	3,476,000	65,683,000
7. Operation & maintenance	39,340,000	13,988,000	0	53,328,000
8. Total Project expenditures (6 + 7)	78,406,000	37,129,000	3,476,000	119,011,000
9. A part of investment expenditures Not depreciated during 2002-2018	2,869,000	7,302,000	3,476,000	13,647,000
10. Project Cost (8 - 9)	75,537,000	29,827,000	0	105,364,000
11 Unit cost per ton	6.96	2.95	0.00	9.91
12 Total amount of waste managed during 200-2018 (ton)	10,852,554	10,105,399		

Note: All the costs shown above include 10% contingency.

Table 9.1.2 Project Cash Expenditures

Unit: US dollar in 1999 price

	Nam Son Phase 2 Landfill			Transfer			Roads and Bridges			Total Project Cost		
	Investment	Operation & maintenance Cost	Total	Investment	Operation & maintenance Cost	Total	Investment	Operation & maintenance Cost	Total	Invesment	Operation & maintenance Cost	Total
a	d	e	f	g	h	i	j	k	l	j	k	l
			(d+e)			(g+h)			(j+k)			(j+k)
Year												
2002	3,480,000	0	3,480,000	886,963	0	886,963	338,673	0	338,673	4,705,636	0	4,705,636
2003	14,576,000	0	14,576,000	12,552,683	0	12,552,683	3,136,947	0	3,136,947	30,265,630	0	30,265,630
2004	4,706,000	1,198,679	5,904,679	0	726,768	726,768	0	0	0	4,706,000	1,925,447	6,631,447
2005	6,847,000	1,259,788	8,106,788	300,300	782,623	1,082,923	0	0	0	7,147,300	2,042,410	9,189,710
2006	250,000	1,465,151	1,715,151	431,200	819,090	1,250,290	0	0	0	681,200	2,284,241	2,965,441
2007	1,547,000	1,534,454	3,081,454	300,300	869,405	1,169,705	0	0	0	1,847,300	2,403,859	4,251,159
2008	89,000	1,581,379	1,670,379	500,500	911,873	1,412,373	0	0	0	589,500	2,493,253	3,082,753
2009	250,000	1,635,798	1,885,798	0	956,649	956,649	0	0	0	250,000	2,592,447	2,842,447
2010	1,547,000	1,701,362	3,248,362	300,300	1,003,272	1,303,572	0	0	0	1,847,300	2,704,634	4,551,934
2011	,000	1,726,086	1,726,086	200,200	1,015,274	1,215,474	0	0	0	200,200	2,741,359	2,941,559
2012	,000	1,769,164	1,769,164	200,200	1,053,587	1,253,787	0	0	0	200,200	2,822,751	3,022,951
2013	3,727,000	1,813,897	5,540,897	300,300	1,093,747	1,394,047	0	0	0	4,027,300	2,907,645	6,934,945
2014	,000	1,886,985	1,886,985	5,336,100	1,135,292	6,471,392	0	0	0	5,336,100	3,022,277	8,358,377
2015	,000	1,935,231	1,935,231	500,500	1,178,222	1,678,722	0	0	0	500,500	3,113,453	3,613,953
2016	1,797,000	1,968,577	3,765,577	600,600	1,198,071	1,798,671	0	0	0	2,397,600	3,166,648	5,564,248
2017	250,000	2,020,624	2,270,624	731,500	1,244,232	1,975,732	0	0	0	981,500	3,264,856	4,246,356
2018	,000	982,043	982,043	600,600	1,292,239	1,892,839	0	0	0	600,600	2,274,282	2,874,882
2019	,000	879,720	879,720	800,800	1,342,093	2,142,893	0	0	0	800,800	2,221,813	3,022,613
2020	,000	879,720	879,720	300,300	1,394,255	1,694,555	0	0	0	300,300	2,273,975	2,574,275
Total 2002-January 2018	39,066,000	23,579,000	62,645,000	23,192,000	14,096,000	37,287,000	3,476,000	,000	3,476,000	65,733,000	37,675,000	103,408,000
Total 2002-2020	35,586,000	26,239,000	61,825,000	23,956,000	18,017,000	41,973,000	3,137,000	,000	3,137,000	62,679,000	44,255,000	106,935,000

Table 9.1.3 Project Cost (Unit cost x Waste amount)

Unit: US dollar in 1999 price

	Waste Amount		Nam Son Phase 2 Landfill			Transfer			Total Project Cost		
	Disposal (ton/year)	Transfer (ton/year)	Depreciation of facilities & equipment	Operation & maintenance Cost	Total	Depreciation of facilities & equipment	Operation & maintenance Cost	Total	Depreciation of facilities & equipment	Operation & maintenance Cost	Total
a	b	c	d	e	f	g	h	i	j	k	l
					(d+e)			(g+h)			(j+k)
Unit Cost ($/ton)			3.34	3.62	6.96	1.57	1.38	2.95	4.90	5.01	9.91
Year											
2004	535,766	507,276	1,786,964	1,942,127	3,729,091	795,094	702,177	1,497,271	2,582,058	2,644,303	5,226,362
2005	579,541	550,055	1,932,969	2,100,809	4,033,778	862,145	761,392	1,623,537	2,795,114	2,862,201	5,657,315
2006	616,689	578,890	2,056,870	2,235,469	4,292,339	907,341	801,306	1,708,646	2,964,210	3,036,774	6,000,985
2007	657,706	618,675	2,193,676	2,384,153	4,577,829	969,699	856,376	1,826,075	3,163,375	3,240,530	6,403,904
2008	694,343	654,042	2,315,873	2,516,961	4,832,834	1,025,132	905,332	1,930,464	3,341,005	3,422,293	6,763,298
2009	728,898	687,660	2,431,126	2,642,221	5,073,347	1,077,825	951,866	2,029,691	3,508,950	3,594,087	7,103,037
2010	767,147	724,525	2,558,699	2,780,872	5,339,571	1,135,606	1,002,895	2,138,501	3,694,305	3,783,767	7,478,072
2011	785,450	734,015	2,619,746	2,847,219	5,466,965	1,150,480	1,016,031	2,166,512	3,770,226	3,863,251	7,633,477
2012	819,581	766,404	2,733,585	2,970,943	5,704,527	1,201,246	1,060,865	2,262,111	3,934,831	4,031,807	7,966,638
2013	850,459	796,065	2,836,573	3,082,874	5,919,447	1,247,736	1,101,922	2,349,658	4,084,310	4,184,796	8,269,105
2014	884,851	828,915	2,951,282	3,207,543	6,158,826	1,299,225	1,147,393	2,446,618	4,250,507	4,354,936	8,605,444
2015	920,568	862,860	3,070,411	3,337,016	6,407,427	1,352,429	1,194,380	2,546,809	4,422,840	4,531,396	8,954,236
2016	947,845	880,962	3,161,389	3,435,894	6,597,283	1,380,802	1,219,437	2,600,239	4,542,191	4,655,331	9,197,522
2017	983,787	915,055	3,281,268	3,566,182	6,847,450	1,434,239	1,266,629	2,700,868	4,715,507	4,832,811	9,548,317
2018	1,023,811	953,015	3,414,762	3,711,267	7,126,029	1,493,737	1,319,173	2,812,910	4,908,498	5,030,440	9,938,939
2019	1,065,389	992,435	3,553,439	3,861,985	7,415,424	1,555,523	1,373,739	2,929,262	5,108,961	5,235,724	10,344,686
2020	1,111,621	1,036,512	3,707,638	4,029,574	7,737,212	1,624,608	1,434,751	3,059,359	5,332,246	5,464,325	10,796,571
Total 2004-2018January	10,857,949	10,184,817	36,214,993	39,359,555	75,574,548	15,963,478	14,097,931	30,061,409	52,178,471	53,457,486	105,635,957
Total 2004-2020	13,973,452	13,087,361	46,606,268	50,653,109	97,259,377	20,512,868	18,115,663	38,628,531	67,119,136	68,768,772	135,887,908

Note: Depreciation includes not only those of construction and procurement costs but also engineering, administration and contingency.

9.2 Project Financing Plan

9.2.1 Initial Investment Amount

Of $65.7 million of total project investment amount, $45.8 million will be invested during 2002 – 2005. Both Nam Son Phase 2 and the transfer system will start operation in the beginning of 2004. All construction and procurement should be finished before the commencement of operation except for construction of some landfill area that will be used in subsequent years.

The following table shows coverage of the initial investments.

Works to be Covered by the Initial Investment

	Works Covered by the Initial Investment
1. Nam Son Landfill Phase 2	All common facilities such as leachate treatment facilities, and lining work and embankments on the first landfill layer for the whole area.
2. Transfer system	All facilities and equipment necessary to transfer 1,600 ton/day of waste
3. Roads and bridges	Construction of access road to Dong Ngac and upgrading of bridges and road on the route of the secondary transport that need upgrading.

Subsequent investments will cover purchase of additional equipment to increase waste transfer capacity along with increases of waste amount, and construction of embankments, etc. for the 2nd and subsequent layers of landfill.

9.2.2 Contract Package and Financing Plan

(1) Financial Resources

1) Costs to be Funded by HPC's Own funds

HPC should finance the following costs by using its own resources.

a. Operation and maintenance cost

b. Land acquisition cost including compensation paid to local residents

c. Administration costs

2) Costs to be Funded by ODA Soft Loan

It is proposed that HPC should acquire ODA funds (a soft loan) to finance the initial investments except for the above items. Subsequent investments should be financed by HPC in principle.

(2) Contract Package Plan for the Initial Investment

It is advisable for HPC to minimize the number of contracts for easier and economical management of the contracting business. The following contract package plan is proposed.

Contract Package Plan for the Initial Investment

	Nam Son Landfill Phase 2	Transfer System	Construction and Upgrading of Roads and Bridges
a. Land acquisition	HPC's arrangement		
b. Administration of contract	HPC's arrangement		
c. Engineering	Contract 1		
d. Construction	Contract 2	Contract 3	Contract 4
e. Mobile equipment	Contract 5		None

Note: Mobile equipment includes secondary transport vehicle, heavy equipment such as bulldozers and wheel loaders.

Summary of Proposed Initial Investment Sources and Amounts during 2002 – 2005

Unit: US dollar in 1999 price

	Nam Son Phase 2 Landfill	Transfer System	Roads and Bridges	Total
a	b	c	d	e = b+c+d
A. To be funded by HPC's Own Fund (1+2)				
1. Site acquisition	2,539,000	220,000	110,000	2,869,000
2. Administration	862,000	391,000	82,000	1,335,000
3. Subtotal (1 + 2)	3,401,000	611,000	192,000	4,204,000
B. to be funded by ODA Soft Loan (4+5+6)				
4. Engineering	2,260,000	785,000	237,000	3,282,000 **(Contract 1)**
5. Site Development	22,258,000 **(Contract 2)**	6,807,000 **(Contract 3)**	2,371,000 **(Contract 4)**	31,436,000
6. Equipment	1,690,000	5,236,000	0	6,926,000 **(Contract 5)**
7. Subtotal (4+5+6)	26,208,000	12,828,000	2,608,000	41,644,000
6. Total Investment (3+7)	29,609,000	13,439,000	2,800,000	45,848,000

Notes:

1. All these costs include 10% contingency.
2. Details of these investment costs are shown in the following tables:
   - Site acquisition and Administration cost: Tables 7.8.2, 7.8.6, 8.9.2 and 8.9.5
   - Contract 1: Table 7.8.2, Table 8.9.2 and Table 8.9.5
   - Contract 2: Table 7.8.2
   - Contract 3: Table 8.9.2
   - Contract 4: Table 8.9.5
   - Contract 5: Tables 7.8.2 and 8.9.2

(3) Case Study for Financing the Five Contracts

Total amount of the five contracts is estimated to be $41,644,000. It is proposed that that HPC acquire an ODA soft loan to finance the five contracts. Conditions of a possible soft loan are as follows:

Conditions of a Possible Soft Loan

	For Contract 1	For Contract 2, 3, 4 and 5	For Contract 2, 3, 4 and 5
	A	B	C = A + B
Source	Bilateral soft loan	Bilateral soft loan	
1. Interest rate	0.75 %/year	1.3 %/year	
2. Repayment period	30 years	40 years	
3. Grace period	10 years	10 years	
4. Loan Amount	$ 3,282,000	$38,362,000	$41,644,000
5. Repayment amount during the grace period	$24,615/year	$498,706/year	$523,321/year
6. Peak Repayment amount in 2012 just after the grace period	$134,015/year	$2,416,806/year	$2,550,821/year (0.70%)
7. Operation & maintenance cost in 2012			$2,822,751/year (0.77%)
8. Total annual expenditure in 2012			$5,373,572/year (1.47%)

Note:
1. Table 9.2.1 for details.
2. The percentages in the brackets show ratio of these expenditures to the projected HPC's budget, $366.48 million in 2012.

Table 9.2.1 shows annual schedule of repayments and ratios of repayment to expected income of HPC. In case HPC acquire the above loans, the repayment of the loans would not pose a serious financial burden. Total repayment amount during the first 10 years of grace period is $523,321 ($24,615 + $498,706) per year. The peak repayment amount that occurs in 11th year (2012) will be $2,550,821/year; representing 0.70% of expected HPC revenue.

Adding cost of operation and maintenance of Nam Son Phase 2 landfill and the transfer system, the total cash expenditure (repayment + O/M cost) is $5,374,000 in 2012, and represents 1.47% of expected HPC revenue. Thereafter, the corresponding ratios will decrease year by year. In 2018 when the operation period of the project is over, the corresponding ratio will be 0.84%.

These percentages are small. Therefore, the project execution with an ODA soft loan as examined here is financially feasible.

9.2.3 Justification for HPC to Acquire ODA Funds

(1) Urgency

HPC is in need of implementing the project urgently because of the following situation:

a) HPC's existing landfill site in Tay Mo is almost full, and will be closed in 1999.

b) In June 1999, HPC started using a part of Nam Son Landfill Phase 1 of which total area is 13.5 ha. Landfill Phase 1 site will be full in 4 years or so.

c) HPC need to open Landfill Phase 2 site right after the Phase 1 area is full, which is expected to happen in 2003.

d) Services for collection, transport and disposal of solid waste have to be provided every day without any interruption to maintain the city clean and sanitary. If HPC cannot open Landfill Phase 2 right after Phase 1 is full, Hanoi citizens will greatly suffer from the suspension of these services.

e) As Nam Son landfill site is 50 km from the city center, a transfer system is needed to reduce overall cost of transport of waste.

(2) Importance

The implementation of the project is simply necessary for HPC to continue waste collection, transport, and disposal under this situation. The planned project has another objective, i.e. to serve as a national model of urban and large landfill, and of efficient transfer system. Nam Son Landfill Phase 2 will be the first full-scale sanitary landfill for Vietnam.

(3) Needs for Funds

HPC is soon going to experience two big changes in solid waste management. The first is the waste transport distance to landfill will be about four times longer as HPC has chosen a landfill site in Nam Son, which implies higher costs of transport. The second is the upgrading waste disposal standard from an open dumping practice to a sanitary landfill disposal, which also implies higher costs. The simultaneous implementation of these two changes will present a big financial burden to HPC. If necessary funds are not available for both changes, HPC should delay implementation of the sanitary landfill.

Gradual Enhancement of Cost Recovery

HPC uses city's general budget to finance a dominant part (maybe about 85 %) of the solid waste management expenditures. It is proposed that HPC should gradually shift its financial source from the city's general budget to fees collected

from service users. HPC will experience this transition during the next decade. It would be difficult for HPC to implement the above two changes during the financial transition period.

(4) HPC's capacity to operate and maintain the project facilities and equipment

URENCO is responsible for solid waste management. URENCO has a high level of capacity for maintenance of waste collection vehicles. In addition, as part of its services, URENCO manufactures and builds body parts of waste collection vehicles on top of chassis imported. This proves URENCO's strong mechanical capacity. URENCO operates old collection vehicles well by repairing and maintaining them.

Table 9.2.1 Repayment Schedule of ODA Soft Loans & Ratios of Repayment to HPC's Expected Income

Unit: US dollar in 1999 price

	A Soft Loan for Contract 1				A Soft Loan for Contracts 2, 3, 4, & 5				Total				Operation & Maintenance Cost			Aggregate Financial Cost (Repayment & O/M Cost)	Percentage as of HPC Revenue
Year	Borrowing & Remaining Debt	Repayment of Principle at end of year	Payment of Interest at end of year	Total	Borrowing & Remaining Debt	Repayment of Principle at end of year	Payment of Interest at end of year	Total	Borrowing & Remaining Debt	Repayment of Principle at end of year	Payment of Interest at end of year	Total	Nam Son Phase 2 Landfill	Transfer System			
a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
				(c+d)				(g+h)				(k+l)			(n+o)		
2002	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	0	0	0	523,321	0.30%
2003	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	0	0	0	523,321	0.28%
2004	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,198,679	726,768	1,925,447	2,448,768	1.22%
2005	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,259,788	782,623	2,042,410	2,565,731	1.19%
2006	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,465,151	819,090	2,284,241	2,807,562	1.20%
2007	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,534,454	869,405	2,403,859	2,927,180	1.16%
2008	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,581,379	911,873	2,493,253	3,016,574	1.11%
2009	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,635,798	956,649	2,592,447	3,115,768	1.06%
2010	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,701,362	1,003,272	2,704,634	3,227,955	1.01%
2011	3,282,000	0	24,615	24,615	38,362,000	0	498,706	498,706	41,644,000	0	523,321	523,321	1,726,086	1,015,274	2,741,359	3,264,680	0.96%
2012	3,282,000	109,400	24,615	134,015	38,362,000	1,918,100	498,706	2,416,806	41,644,000	2,027,500	523,321	2,550,821	1,769,164	1,053,587	2,822,751	5,373,572	1.47%
2013	3,172,600	109,400	23,795	133,195	36,443,900	1,918,100	473,771	2,391,871	39,616,500	2,027,500	497,565	2,525,065	1,813,897	1,093,747	2,907,645	5,432,710	1.38%
2014	3,063,200	109,400	22,974	132,374	34,525,800	1,918,100	448,835	2,366,935	37,589,000	2,027,500	471,809	2,499,309	1,886,985	1,135,292	3,022,277	5,521,587	1.31%
2015	2,953,800	109,400	22,154	131,554	32,607,700	1,918,100	423,900	2,342,000	35,561,500	2,027,500	446,054	2,473,554	1,935,231	1,178,222	3,113,453	5,587,007	1.23%
2016	2,844,400	109,400	21,333	130,733	30,689,600	1,918,100	398,965	2,317,065	33,534,000	2,027,500	420,298	2,447,798	1,968,577	1,198,071	3,166,648	5,614,446	1.16%
2017	2,735,000	109,400	20,513	129,913	28,771,500	1,918,100	374,030	2,292,130	31,506,500	2,027,500	394,542	2,422,042	2,020,624	1,244,232	3,264,856	5,686,898	1.09%
2018	2,625,600	109,400	19,692	129,092	26,853,400	1,918,100	349,094	2,267,194	29,479,000	2,027,500	368,786	2,396,286	982,043	1,292,239	2,274,282	4,670,568	0.84%
2019	2,516,200	109,400	18,872	128,272	24,935,300	1,918,100	324,159	2,242,259	27,451,500	2,027,500	343,030	2,370,530	879,720	1,342,093	2,221,813	4,592,343	0.77%
2020	2,406,800	109,400	18,051	127,451	23,017,200	1,918,100	299,224	2,217,324	25,424,000	2,027,500	317,275	2,344,775	879,720	1,394,255	2,273,975	4,618,749	0.72%
2021	2,297,400	109,400	17,231	126,631	21,099,100	1,918,100	274,288	2,192,388	23,396,500	2,027,500	291,519	2,319,019			0	2,319,019	
2022	2,188,000	109,400	16,410	125,810	19,181,000	1,918,100	249,353	2,167,453	21,369,000	2,027,500	265,763	2,293,263			0	2,293,263	
2023	2,078,600	109,400	15,590	124,990	17,262,900	1,918,100	224,418	2,142,518	19,341,500	2,027,500	240,007	2,267,507			0	2,267,507	
2024	1,969,200	109,400	14,769	124,169	15,344,800	1,918,100	199,482	2,117,582	17,314,000	2,027,500	214,251	2,241,751			0	2,241,751	
2025	1,859,800	109,400	13,949	123,349	13,426,700	1,918,100	174,547	2,092,647	15,286,500	2,027,500	188,496	2,215,996			0	2,215,996	
2026	1,750,400	109,400	13,128	122,528	11,508,600	1,918,100	149,612	2,067,712	13,259,000	2,027,500	162,740	2,190,240			0	2,190,240	
2027	1,641,000	109,400	12,308	121,708	9,590,500	1,918,100	124,677	2,042,777	11,231,500	2,027,500	136,984	2,164,484			0	2,164,484	
2028	1,531,600	109,400	11,487	120,887	7,672,400	1,918,100	99,741	2,017,841	9,204,000	2,027,500	111,228	2,138,728			0	2,138,728	
2029	1,422,200	109,400	10,667	120,067	5,754,300	1,918,100	74,806	1,992,906	7,176,500	2,027,500	85,472	2,112,972			0	2,112,972	
2030	1,312,800	109,400	9,846	119,246	3,836,200	1,918,100	49,871	1,967,971	5,149,000	2,027,500	59,717	2,087,217			0	2,087,217	
2031	1,203,400	109,400	9,026	118,426	1,918,100	1,918,100	24,935	1,943,035	3,121,500	2,027,500	33,961	2,061,461			0	2,061,461	
2032	1,094,000	109,400	8,205	117,605	0	0	0	0	1,094,000	109,400	8,205	117,605			0	117,605	
2033	984,600	109,400	7,385	116,785	0	0	0	0	984,600	109,400	7,385	116,785			0	116,785	
2034	875,200	109,400	6,564	115,964	0	0	0	0	875,200	109,400	6,564	115,964			0	115,964	
2035	765,800	109,400	5,744	115,144	0	0	0	0	765,800	109,400	5,744	115,144			0	115,144	
2036	656,400	109,400	4,923	114,323	0	0	0	0	656,400	109,400	4,923	114,323			0	114,323	
2037	547,000	109,400	4,103	113,503	0	0	0	0	547,000	109,400	4,103	113,503			0	113,503	
2038	437,600	109,400	3,282	112,682	0	0	0	0	437,600	109,400	3,282	112,682			0	112,682	
2039	328,200	109,400	2,462	111,862	0	0	0	0	328,200	109,400	2,462	111,862			0	111,862	
2040	218,800	109,400	1,641	111,041	0	0	0	0	218,800	109,400	1,641	111,041			0	111,041	
2041	109,400	109,400	821	110,221	0	0	0	0	109,400	109,400	821	110,221			0	110,221	
2042	0	0	0	0	0	0	0	0	0	0	0	0			0	0	
Total		3,282,000	627,683	3,909,683		38,362,000	10,223,473	48,585,473	0	41,644,000	10,851,156	52,495,156		18,016,693	18,016,693	70,511,848	

9.3 Future Financial Resource Plan

9.3.1 Introduction

URENCO's operating revenues in 1997 (as estimated by Study Team/URENCO, and shown in the Progress Report Table 3.3.15) were as follows:

URENCO Operating Revenues 1997

(In million Dong)

- Transfer from Government for solid waste services	56,123	73%
- Domestic household fee	3,050	4%
- Commercial and industrial waste	5,473	7%
- Construction waste	200	0%
- Septage collection and disposal	1,074	1%
- Other sources of revenue	11,119	14%
- Total	77,227	100%*

* subject to rounding

With regard to future financial strategy, the major issue is how to reduce the dependence upon government transfers to URENCO, which currently account for over 70% of total operating revenues. The second issue is how to apportion the costs between various categories of user of the system, or beneficiary. Precise determination of the appropriate revenues to be obtained from each category of waste generator will not be possible until that is done. In practice, gradual implementation of revenue system reform is thus required.

9.3.2 Cost Allocation

For purposes of illustration, it is assumed that costs of solid waste management in Hanoi are attributable to various sources as follows:

- sweeping, collection, and disposal of street waste – 20%
- household waste – 70%
- industrial commercial and construction waste – 10%

Revenues for solid waste management services are assumed to account for 85% of total URENCO costs. "Other revenues" are defined to include septage collection and disposal, and account for the remaining 15% of total revenues).

In principle, the cost of street sweeping and associated collection and disposal costs should continue to be a municipal responsibility. Transfer of funds from HPC to URENCO should thus be seen as a payment for services rendered (i.e. a fee), rather than a subsidy. The remaining 80% of solid waste management costs

should, however, be clearly attributable to the sources concerned, and this attribution should be used as a basis for cost recovery.

9.3.3 Proposed Financing Reform

The following sets out a possible strategy for gradual implementation of financing reform, under the further assumption that the costs attributable to each source remain a constant percentage of total revenues, and in the absence of the recommendations made below by the Study Team, total revenues increase at the same rate as total SWM costs.

Because precise information about cost responsibility is not available, the above changes cannot be introduced immediately. It is therefore proposed that the existing system should be replace by one in which user charges levied directly on households and industry should ultimately finance 80% of URENCO's solid waste management costs, with the changes being introduced gradually. This could be done in two stages, the first in the year 2001, the second in the year 2006. The remaining 20% will be collected from HPC as fees for cleaning of streets of which owner is HPC or the government.

This will provide time to study the precise allocation that is to be aimed for, and to organize a public relations campaign. Design of the actual fee structure and practical methods of collecting the charges will also have to be developed. The gradual approach implied by the use of two steps is also merited on grounds of equity in case there is a shift in the burden of paying for SWM from one category of waste discharger to another.

In terms of percentages, the revenues obtained from various sources according to this plan would be as follows:

Sources of URENCO Revenue Under Proposed Financing Plan

(Unit: percentage)

Period	Subsidy From HPC	User Charges HPC (Street Waste)	User Charges Households [1]	User Charges Industry etc. [2]	Other (incl. Septage)	Total [1]
1996-2000	74	0	4	7	15	100
2001-2005	42	9	25 (30)	9 (4)	15	100
2006 onwards	0	17	60	9	15	100

Notes: 1) subject to rounding

Notes: 2) In practice, it would not be desirable to reduce the proportion of funds collected from industry in the year 2001 and then increase it again in 2006. The above suggests introducing the final percentage allocation in 2001, with corresponding reduction for households for that year.

The above indicates that in year 2001, 43% of URENCO's revenues would be in the form of user charges for solid waste management. By the year 2006 this would increase to 85% (or 100% of actual solid waste management costs).

Design of the user charge system will have to be studied: probably a fixed charge per household, possibly depending on the size of the house or other measure, plus a combination of fixed charges and volume charges or tipping fees for industrial users may be used. Considerations of equity as well as practical issues involved in actual collection of charges also arise.

On average, the financing reform measure in the early stages would be revenue-neutral, with the user charge simply substituting for general taxation. However, over time it should result in greater awareness of local environmental problems, and more responsible public and industrial attitudes toward waste and waste generation. Combined with a greater transparency about costs and revenue needs, it will also act as an incentive to URENCO to be cost-conscious and efficient, the net result should be an actual reduction in the net cost/tax burden of Hanoi's residents.

CHAPTER 10 PROJECT EVALUATION

10.1 Objective Achievement

10.1.1 Objectives of the Project

This project has the specific objectives as stated below.

a) Nam Son Landfill Phase 2: to acquire land for waste disposal, and dispose of waste in environmentally sound manner.

b) Waste Transfer System: to minimize costs of waste transport from collection areas to Nam Son landfill site

10.1.2 Evaluation of Objective Achievement

(1) Nam Son Landfill Phase 2

HPC has partly acquired Phase 1 landfill site in Nam Son, and plans to acquire the remaining site of Phase 1, and Phase 2 site in the near future. It is estimated that Phase 1 site (13.5 ha) will be used for 4 years, and 13 years for Phase 2 site. It is likely that HPC will achieve the first objective of Nam Son, i.e. to acquire land for waste disposal.

The primary objective of the waste landfill is to receive and store waste removed from the living areas, which keeps the living areas clean and sanitary even if an open dumping method is used. An open dumping landfill may cause secondary environmental pollution by contaminating surface and groundwater and generating smokes, fires and odor. Planned landfill is a sanitary landfill. As explained in Section 10.2, environmental measures are adequately incorporated and reflected in the plan and design of the Landfill Phase 2. The planned sanitary landfill will satisfy all the relevant Vietnamese standards.

(2) Waste Transfer System

As demonstrated in Chapter 3, the waste transport cost with the proposed transfer system is estimated to be slightly less than one half of the transport cost without any transfer system (direct transport system). The proposed transfer system with a transfer station in Dong Ngac is the least cost solution among the 10-sites options examined, excluding Lam Du, Co Nhue, and Xhuan Dinh.

Transfer system with one of these 3 locations used as a transfer station is more economical than the transfer system with a transfer station in Dong Ngac. However, Lam Du site is not available according to the opinion of the Ministry of Agriculture because the site is located within the dike system of Red River. HPC

judges that Co Nhu and Xhuan Dinh pose some problems, i.e. these sites can be seen by highway passengers.

Therefore, the proposed transfer system will achieve the objective of minimizing the cost of waste transport.

(3) Conclusion

The proposed project will achieve its objective if implemented as planned.

10.2 Environmental Assessment

10.2.1 Introduction

The JICA Study Team has carried out environmental impact assessment for Nam Son Landfill Phase 2 in October 1998, and for the planned Dong Ngac transfer station site in October 1999. The results of the assessment are documented in separate reports.

The proposed project aims at improving the efficiency of removal (transport) of solid waste from urban areas to landfill site, and upgrading the sanitary standard of landfill disposal. Thus, the project, by its objective, contributes to the improvement of the urban environment.

However, the project may cause some secondary environmental pollution if appropriate measures are not taken. This section shows what kind of environmental problems may occur if measures are not taken, and examines whether or not the planned project have adopted adequate measures in the plan and design.

10.2.2 Possible Environmental Problems and Measures Taken

The table below summarizes general environmental and social problems that may possibly arise in connection with waste disposal and transfer without proper measures.

General Environmental and Social Problems Possibly Arising in Connection with Nam Son Landfill and Waste Transfer System

Possible Environmental and Social Problems	Adverse Effects on the People and Environment
Use of the land for landfill	Relocation that impose changes of house location, occupation, and life.
Contamination of ground and surface water	- Contamination of groundwater that is used for drinking and other purposes, which in turn leads to damages to health - Damages to crops due to contamination of surface water
Generation of smoke, fires, dusts, rodents, smell (In general, these are common problems seen in open dumping sites.)	- Damages to local residents in terms of health and quality of life
Increases of traffic volume near the landfill site	- Increases of risk of traffic accidents, noise and vibration, and air pollution due to increases in gas emission.
Change of landfill site from Tay Mo to Nam Son	- Loss of scavenging jobs for the existing scavengers - Creation of scavenging jobs for new comers

10.2.3 Environmental Measures Planned for the Project

Environmental measures proposed and planned for the project are summarized in the following tables.

Environmental Measures Planned for the Nam Son Landfill Phase 2

Possible Environmental and Social Problems	Environmental Measures Planned for the Nam Son Landfill Phase 2
1. Use of the land for landfill	a. There are 161 households living in the planned landfill site of Nam Son including both Phases 1 and 2 sites. In addition, there are 170 households located along the planned access roads. b. It is expected that HPC will pay adequate compensation to local residents who have to relocate themselves or may be affected. c. Agreement by local residents is a condition to be imposed by international fund agencies that may finance the project.
2. Contamination of ground and surface water	a. The planned landfill site will be equipped with lining facilities (plastic sheets), leachate collection pipes and treatment facility as well as rainwater drainage which helps to reduce generation amount of leachate. b. The planned landfill is designed so as to satisfy all relevant Vietnamese regulations including those concerning leachate control. c. The planned landfill will be the most advanced one in Vietnam, and will serve as a national model landfill for other cities. d. Periodical environmental monitoring is proposed and planned for the project to check changes in quality of groundwater. e. In future, it is anticipated that solid waste would contain more heavy metals. Monitoring parameters should include heavy metals.

Possible Environmental and Social Problems	Environmental Measures Planned for the Nam Son Landfill Phase 2
3. Generation of smoke, fires, dusts, rodents, smell, and gases (In general, these are common problems seen in open dumping sites.)	a. These problems will be eliminated by application of daily cover soil. b. Application of daily cover soil is proposed. The project design shows appropriate method of soil covering. The project costs include costs of application of daily cover soil. c. Fence will also be provided around the site. d. Fire fighting equipment will be provided for the site. e. Gas exhaust pipes will be provided to avoid gas explosion and fires by emitting gases generated from waste deposit. f. HPC should provide the staff working on the site with adequate training on the operation of landfill. Remarks: 1. The biggest reason for local people to oppose to landfill site in Hanoi is that rats are bred in the landfill site, and eat rice before harvest. Application of daily cover soil and fence will help to eliminate rat problems. 2. Nam Son landfill site is 50 km to the north of the city center. The choice of Nam Son location itself is good in terms of minimizing number of local people who would be affected.
4. Increases of traffic volume near the landfill site	a. Because of use of large transport vehicles, trips of waste transport vehicles will be reduced to about one quarter of the trips made by the existing trucks that collect and transport waste to Tay Mo. b. HPC should make sure that drivers will use most care when driving large vehicles, particularly during nighttime. Lights of vehicles should be maintained well. HPC should provide specific training for drivers of the secondary transport trucks as they are very large. c. Because the secondary transport vehicle (large dump truck) is very heavy (25 ton including waste), the road (Route 35) should be upgraded and widened.
5. Change of landfill site from Tay Mo to Nam Son	a. Majority of scavengers currently working in Tay Mo landfill site will be obliged to change to other job. b. Since the income level of the local residents of Nam Son is low, the new landfill in Nam Son will attract some local residents into scavenging business.

HPC plans to open Nam Son Landfill Phase 1 in 1999. Landfill Phase 2 site will open when HPC closes the Phase 1 site. It is expected that HPC will solve all the social and environmental problems arising in connection with the operation of Landfill Phase 1 before opening of the Phase 2 site.

Environmental Measures Planned for the Transfer System

Possible Environmental and Social Problems	Environmental Measures Planned for the Transfer System
1. Use of the land for landfill	a. There are no houses within the planned site of Dong Ngac and Duc Giang. Farmers who are engaged in agriculture in the land will have to change land. b. There may be some local residents who may be affected by construction or arrangements of access roads to the transfer station in Dong Ngac. c. It is expected that HPC will pay adequate compensation to those who will be affected by this project.
2. Contamination of ground and surface water	a. It is the design policy of this project not to cause any contamination of ground and surface water with waste. b. Concrete floor will be provided at places wherever waste contacts ground. Leachate (water generated from waste storage) will be collected, and stored and then taken to leachate treatment facility to be provided in the Nam Son landfill site.
3. Generation of smoke, fires, dusts, rodents, smell (In general, these are common problems seen in open dumping sites.)	a. In principle, all waste transported to the transfer station will be transported to Nam Son landfill site within 24 hours after arrival. b. To reduce smell, seasonal wind directions are considered in deciding on the site location. c. To prevent waste flowing, fence will be provided around the site.
4. Increases of traffic volume near the landfill site	a. There are about 260 round trips made by URENCO's waste collection trucks between collection areas and the existing Tay Mo landfill site. Number of trips will increase as the waste collection amounts increase in future. b. At present, HPC's regulation requires that waste transport activities should be carried out during non-rush hours. The same regulation will be applied for the project. This will help to minimize the traffic problems associated with the waste collection trucks. c. The secondary transport vehicles travel between the transfer station and Nam Son landfill site. The number of the secondary transport vehicles is much less than the number of primary transport vehicles. d. HPC should provide appropriate access road in conformity with the road development plan around the planned transfer station sites.
5. Change of landfill site from Tay Mo to Nam Son	a. The planned transfer station is designed in such a manner as to physically allow scavenging activities though it is up to HPC whether or not to allow such activities.

10.2.4 Conclusions

The following conclusions can be drawn:

a) The proposed project contributes to the improvement of urban environment of Hanoi by removing solid waste efficiently, and disposes of waste in a sanitary manner.

b) Adequate environmental measures have been planned for the project in terms of:

- locations of landfill site and transfer station
- structural design of landfill and transfer station
- operation of the project

1. Therefore, the proposed project would bring about big net environmental benefits.
2. HPC should provide operation staff with adequate training for the operation of the planned landfill and transfer system.

10.3 Social Issues

Social issues considered in this section are discussed under the following headings:

- Residents affected by landfill site
- Residents affected by transfer station sites
- Employment
- Other social aspects

10.3.1 Residents Affected by Landfill Site

Residents affected by the new Nam Son landfill will include both those current residents who will have to move to other locations as well as those who live close to the site or along the access roads, whose living environment will be adversely affected by the noise, smell and congestion caused by the transport of waste to the landfill.

From this point of view, the Nam Son site is well chosen. The site, which includes areas not only in Nam Son itself, but also Hong Ky and Bac Son, only contains 161 households at present. Essentially an agricultural community, residents have annual incomes of less than US$ 100 per annum. Soil is poor and lacks irrigation.

Nevertheless, although the number of people involved is small, and the value of their land is insignificant in a financial sense, the potential social costs of the project are considerable. People's lives will be disrupted, and their modest means of livelihood destroyed as they are forced to move away from their traditional homes. Moreover, some ancestral lands and a cemetery will be lost or moved.

Social feasibility of the project requires that the views of the residents be seriously considered by the waste management planners concerning the alternatives open to them. Based upon this consultation, adequate compensation must be paid to those

who have to be resettled, as well as those whose homes are adversely affected by proximity to the new site or access roads. An adequate level of compensation must be agreed and a satisfactory mechanism created to ensure that this compensation actually reaches the residents involved.

As of November 1999, HPC will soon come to agreement with local residents concerning the compensation amount, and relocation arrangement. It is reported that total costs for compensation and relocation is about US$2.9 million, of which US$0.6 million is related to Phase 1 and US$2.3 million for Phase 2. The cost for Phase 2 is included in the project cost.

10.3.2 Residents Affected by the Transfer Station Sites

The site selected for the transfer stations (Dong Ngac) also is currently on agricultural land (mainly rice fields). This field has more than 100 ha, of which only 6 ha of land would be used for the transfer station itself. Nobody would have to be resettled as a result of developing these sites, although some tombstones might have to be relocated.

However, there will doubtless be some loss of amenity to those living close to the designated sites, due to increased traffic, noise and smell. In this regard, it should be noted that Dong Ngac was originally planned to become a residential area, while Duc Giang was planned to be used as future industrial area according to the Hanoi Urban Master Plan for 2020. However, the revised use of these areas has been agreed by the Chief Architect's Office.

Similar considerations apply to the transfer stations as to the landfill. In particular, the people whose homes are close to the proposed transfer stations or access roads should be consulted about the projects. An adequate level of compensation should be agreed for those adversely affected.

10.3.3 Employment

Solid waste management is a relatively labor-intensive activity, and the project will generate the demand for labor in both its construction as well as its operational phases. This will confer certain social benefits in a city experiencing high unemployment. Operation of the transfer system and operation of the landfill will account for about 61 and 25 man-years per year at least, respectively. In addition, construction work will create many man-years of work during the construction stage.

The impact on scavenger activities is unclear. An immediate impact of shifting the landfill site from Tay Mo to Nam Son would be that most scavengers working at

Tay Mo would have to move to Nam Son if they wished to continue this activity. It is unlikely that many would do so. This would result in unemployment of these people, but the numbers of persons involved is not known, although it is thought to be about 100. There would be a corresponding increase in scavenging at Nam Son. Because the income level of local residents of Nam Son is low, it is anticipated that many local people will be involved in scavenging activities in the Nam Son landfill site.

Officially concerned government bodies are opposed to scavenging, but in practice it is tolerated. While a socially undesirable activity in terms of the living conditions of those involved, scavenging has clear economic benefits, encouraging recycling and providing employment.

10.3.4 Other Social Aspects

On balance, the project is of course designed to provide positive social results. Although not readily quantifiable in financial or economic terms, the project will, by making it possible to remove large volumes of waste material from the city streets and residential areas, considerably enhance the general environment of the city. This will have direct impacts upon the quality of life by discouraging insects and rodents that pose threats to public health; it will also reduce smells, help to protect water supplies, reduce urban floods, and improve visual amenity in the city.

10.4 Economic Evaluation

10.4.1 General Principles

Ideally, project evaluation would be carried out by (a) determining the least cost solution and then (b) comparing economic benefits and costs, when both are measured in financial terms. In practice, however, data do not allow adequate measurement of the public health and amenity benefits of solid waste management services in financial terms.

As an alternative, project evaluation may consist of (a) determination of the cost-effective solution, including qualitative judgment about the need and appropriate level of the services provided, and (b) economic feasibility, in terms primarily of the affordability of the program. Even if a theoretically more desirable cost benefit calculation cannot be done, if these two tests are satisfied, there can be confidence that the system expansion program is justifiable.

From a national perspective, whether or not a strict cost-benefit procedure is used, the calculation should normally be independent of actual financing mechanism used, for example the possible availability of a grant or a soft loan. The reason for

this is the assumption that, in the absence of the SWM project, soft loans would be available for other purposes. There is thus an economic opportunity cost involved in using such loans for the SWM project. However, for any one beneficiary, such as URENCO or the HPC, the financing mode will be crucial in determining the net benefits or costs of a project, as they see it. In each case, economic and financial analysis should proceed in parallel with each other.

10.4.2 Least-Cost Solution

(1) General Methodology

To arrive at the least-cost solution, cost comparisons of alternative solutions have been made in comparable terms. They were compared in present value terms, at constant prices, using the same discount rates. Values have been expressed as far as possible in economic, rather than in purely financial terms. Therefore subsidies, such as the low interest content of any loan or a transfer from the national government are ignored, and total resource costs used. Any distortion in prices due to market imperfections should also be compensated for. It is not possible to avoid valuation problems entirely, even in a cost-effectiveness comparison. For example, while financial costs of relocating people living close to proposed landfill or transfer station sites must be included, they fail to capture the psychological and other social consequences involved.

In assessing whether even the cost-effective solution is itself justified, and in the absence of data on economic benefits, a qualitative judgment has to be made about the importance of the services provided, and therefore how appropriate is the standard of services supplied.

(2) Landfill

The major strategic issue is whether landfilling is the appropriate means of disposal. In fact, as in most developing country situations, there is no serious alternative in cost-effectiveness terms. The major technical alternatives, namely incineration and composting, are judged by the Study Team to be such high cost alternatives that detailed cost comparison was not required.

With regard to the landfill, the location of the site is the primary issue. However, in practice, site selection is invariably subject to serious political and social constraints. The location may in fact not be the least cost in a strict cost-benefit sense. In particular, restricting the landfill site to an area within the HCP territorial jurisdiction may be necessary in a political sense, but the constraint may mean that the least cost solution is not selected. The economic cost of such a constraint, should it exist, would be the difference between the present value of

the costs of the Nam Son scheme minus the present value of the costs of the alternative site.

It is clear that financial criteria alone do not adequately measure the true social cost of alternative locations. For example, locations closer to the city would be cheaper in terms of transport costs, but would create major amenity problems, such as noise and smell in close to residential areas. Even if the purely financial costs of resettling people forced to move from the selected site were adequate, the social costs of large scale disruption, while unquantifiable, are no doubt extremely large.

Having selected the site, it was then demonstrated that the least-cost means of achieving the given quality of service was achieved. The decision about the relatively high design standard for the site (which meets national Vietnam standard for permeability, and will achieve other objectives, such as control of rodents, smoke and smell), is considered a necessary minimum, particularly in light of the fact that groundwater in the site area is used for Hanoi water supply. The design standard itself was, therefore, also not subjected to economic analysis.

Details are described in Chapter 7.

(3) Transfer System

Strategic alternatives considered included (a) direct transport of waste to the final site as well as (b) various combinations of transfer stations at different locations.

Ten possible locations for transfer stations were identified. Sites were considered based upon several criteria, with cost criteria primarily being related to transportation, land availability, and accessibility from various parts of the city (basically east and west), and to the disposal site. Through the comparison of overall transport costs, it was found that the transfer system with Dong Ngac as a transfer station site is the most economical at present. And the combination of Dong Ngac and Duc Giang will be the most economical if and when URENCO must transport solid waste of Gia Lam in the future. The alternative cost-effective possibility, Lam Du, was rejected on environmental grounds, i.e. no structures are permitted within the Red River dike system as they may affect water flow in case of flooding.

It is estimated that the total cost of transporting solid waste from the city center to Nam Son landfill site would be around $17 million/year with no transfer system in 2006 while the cost will reduce to around $7 million with the planned transfer system.

As part of the least-cost estimation, the number and design of transportation equipment for collecting and hauling waste to the transfer stations and from the transfer stations to the final disposal site were also analyzed.

Details are described in Chapter 8.

(4) Standard of Service

As part of the cost effectiveness analysis it is necessary to make a judgment as to whether the services provided are required to address the fundamental problems caused by the generation of solid waste. Unquantifiable in strictly financial terms, these obvious costs are in the form of threats to public health and amenity, as well as potential contamination of groundwater supplies and, due to obstruction of gutters by the accumulation of garbage, urban flood damage.

Existing solid waste services are at an appropriate level for those currently receiving collection service from URENCO. There is an efficient street cleaning program and solid waste collection from residential areas. However, these services are restricted to the central areas of the city. Growing industrial development as well as growth of the city's population, combined with overload of the existing disposal sites requires expansion of collection service and expansion and upgrading of disposal facilities.

Essentially, the future program, of which the Nam Son Phase 2 development and the associated transfer system are integral parts, will permit the standard of service now provided to the central area of Hanoi to be continued in the future, and extended to outlying areas in an efficient manner.

10.4.3 Economic Feasibility

(1) General Principles

The Study Team assessed the economic feasibility of the Nam Son Landfill Phase 2 and transfer system project in terms of its impact upon the overall operation of URENCO in financial terms, and in light of how affordable the costs of system expansion might be for the residents of Hanoi. Indicators, based upon international experience, of the proportion of income devoted to SWM, and unit costs of SWM are used to assist in the judgment about reasonableness of expenditures and affordability.

(2) Project Costs: Nam Son Landfill Phase 2 and Transfer System

Costs of the Nam Son Landfill Phase 2 and associated transfer system project have been shown earlier in Tables 9.1.1 to 9.1.4. Table 9.1.5 shows total costs of solid waste management for the urban Hanoi including Nam Son Phase 2, the

transfer system, as well as proposed projects for improvement of primary collection and transport in addition to water sprinkling. A number of assumptions are contained in this table, including the following:

- The Nam Son landfill is expected to have a useful life of 14 years, starting from January 2004.
- Structures of the proposed Dong Ngac transfer station can be used for 20 years
- Transport and equipment has a ten year life.

For other assumptions, see Chapter 9.1.

Based upon the information contained in Chapter 9, in which investment costs are amortized, total cost of the project for the urban Hanoi over the project operation period is about US$ 100 million, of which US$ 48 million is accounted for by investment and US$ 52 million by operation and maintenance. The US$52 million include cost of leachate treatment during post closure period during 2018 – 2035. Annual project costs are as follows: $4.9 million in 2004 when the operation of the project starts, $14.3 million in 2010, and $19.0 million in 2018 when the landfill is full. Average unit cost of the project is estimated to be $9.36 per ton of waste transferred and disposed of.

(3) Affordability

The feasibility of the major increases in the costs of solid waste management (SWM) in Hanoi must be assessed in light of the affordability of this service, measured in terms of HPC's overall revenues, or of local incomes.

The 1998 SWM cost is estimated to be $6.7 million as shown in the note of the table below. This represents 0.81% of the GRP of seven urban districts, 5% of the HPC revenue. With the implementation of the proposed transfer system and Nam Son Landfill Phase 2 site, the overall SWM cost will increase to $15.04 million in 2004, year of commencement of the operation of the proposed transfer system and Nam Son Phase landfill. The corresponding ratios will then be 1.2% of the GRP, and 7.2% of the HPC revenue in 2004; 1.08% and 6.5% in 2010; and 0.82% and 5.1% in 2018 when the project ends. It should be noted that the solid waste management cost will be even higher without the proposed transfer system. See the table below. A complete annual information is shown in Table 10.4.1.

Waste Collection and Generation, URENCO Costs Including Landfill and Transfer Station Projects, and Incomes in Urban Hanoi

Unit: million US dollar in 1999 price

Year	Total Solid Waste Generated (tons/year)	Total Solid Waste Collected (tons/year)	Project Cost (Transfer & Nam Son Landfill) (US$ m.)	Other SWM Cost (Primary collection & transport (US$ m.)	Total SWM cost (US$ m.)	GRP of 7 Urban Districts of Hanoi (US$m.)	SWM Costs as % of GRP	HPC Revenue Hanoi (US$ m.)	SWM Costs as % of HPC Revenue	Unit Cost of SWM ($/ton)
a	c	c	d	e	f = d+ e	g	h = f/g	i	j = f/i	K = d/c
1998	593,490	444,935	0.00	6.70	6.70	821	0.82	133	5.0	15.3
2004	799,344	708,210	5.23	10.10	15.33	1,249	1.23	201	7.6	21.2
2010	1,061,420	1,008,495	7.48	14.32	21.80	1,973	1.10	318	6.9	17.8
2018	1,414,010	1,343,565	9.94	19.02	28.96	3,467	0.84	559	5.2	17.8
2020	1,523,292	1,447,164	10.80	20.44	31.24	3,940	0.79	644	4.9	17.8

Note 1) The waste collection amounts are estimated by the Study Team.

Note 2) URENCO's 1998's SWM cost US$ 6.70 million is estimated as follows: URENCO's 1997 annual expenditure is US$ 5.20 million (source, URENCO) with no capital investment. Assuming that 1998 expenditure is 7 % more than the 1997 amount, and also 2%/year inflation rate in dollar base, the 1998 SWM cost is estimated to be $5.68 million (in 1999 price). Then, the JICA Study Team estimates that the capital depreciation cost of waste collection trucks is 1.02 million/year in 1999 price with the following assumptions and calculation ($68,000/truck x 150 trucks ÷ 10 years depreciation period = $1.02 million/year) URENCO's total cost in 1998 is $5.68 million/year + $1.02 million/year = $ 6.70 million/year in 1999 price.

Note 3) In principle, it is assumed that to total solid waste management cost will increase in proportion to increases in waste collection amount if URENCO will not change collection system. However, it is assumed that URENCO will take some cost reduction measure such as the proposed application of single handling collection system (without using handcarts), which is estimated to result in 1 million dollar cost reduction in 2002, and such cost reduction will increase in proportion to increases in waste collection amount.

Note 4) GRP of 7 Urban Districts of Hanoi are estimated by the JICA Study Team. It is assumed that GRP of the 7 urban districts on per capita base is 1.31 times higher than the average of all 12 HPC districts.

Probably, the ratio of solid waste management cost relative to GRP of Hanoi urban districts is more relevant than the ratio to HPC revenue as it represents only a part of the total amounts collected in HPC area. The ratio of SWM cost to urban Hanoi GRP reaches 1.24% in the peak year of 2005. Judging from the experiences of other countries, it is generally considered that the SWM cost is very high if the ratio exceeds 1%. SWM costs increase roughly in proportion to increases in waste collection amount. It is assumed that URENCO's collection amount will increase by 8%/year by 2007 in which year the target waste collection ratio relative to generation reach 95%. Thereafter, collection amount will increase at lower rates in proportion to increases in waste generation amount. On these assumptions, the ratios of SWM cost will begin to drop in 2007, and will be about 1% in 2015, and 0.84% in 2018 when the project period finishes.

In summary, the net effect of:

- increases in URENCO's costs due to investment in high quality waste disposal and associated transfer system development,
- increases in per capita incomes in Hanoi, and
- a rate of increase in waste generation that is less than the rate of increase in incomes,
- and an increase in waste collection that much greater than the rate of increase in waste generated

is that SWM costs for the Hanoi urban population will rise to 1.2% at the time of commencement of the project facilities, but will then drop to about 1.08% by 2010, and 0.82% in 2018 at the end of the project period. SWM cost of Hanoi will be categorized as very high. However, the project is still affordable for HPC and Hanoi citizens.

To alleviate future increases in SWM cost, it is advisable for HPC to implement measures for increase of waste collection efficiency as proposed in Volume 3 that include 1) shift of waste collection method from double handling to a single handling system without handcarts, and 2) shift of major SWM responsibility to districts. It is estimated that implementation of these measures will lead to reduction of waste collection and transport by one third.

10.4.4 Conclusions of Economic Evaluation

In summary, the expansion plan for SWM in Hanoi, of which the Nam Son Landfill Phase 2 and associated transfer system are integral parts, appears to be an economically and financially feasible and justifiable program. Main reasons for this conclusion are as follows:

- apart from certain social and political constraints about siting, both the proposed landfill and the transfer system development plans meet cost-effectiveness criteria
- the program meets an obvious public health and amenity need
- design standards are of an appropriate level
- the future expansion plan is affordable, representing about one percent of incomes in the Hanoi urban area
- unit costs of service (measured as costs per ton of waste collected) are at an acceptable level

Table 10.4.1 Total Solid Waste Mangement Costs for Urban Hanoi (Investment Cost is estimted based on unit cost & waste amount)

Unit: US dollar in 1999 price

	Nam Son Phase 2 & Transfer System			Collection & Primary Transport & Watering, & Street sweeping			Total SWM Costs			Ratio of Total SWM Cost to HPC's Revenue	Ratio of Total SWM Cost to GRP of Urban hanoi	HPC's Revenue	Gross Regional Product Product of Urban Hanoi
	Depreciation of facilities & equipment	Operation & maintenance Cost	Total	Depreciation of facilities & equipment	Operation & maintenance Cost	Total	Depreciation of facilities & equipment	Operation & maintenance Cost	Total				
a	b	c	d	e	f	g	h	i	j	k	l	m	n
			(b + c))			(e + f)	(b + e))	(c + f)	(h + i)	(j/m)	(j/n)		
Unit Cost	4.52	4.85	9.36										
1998				1,020,000	5,680,000	6,700,000	1,020,000	5,680,000	6,700,000	5.06%	0.82%	132,485,000	821,470,000
1999				1,020,000	6,134,400	7,154,400	1,020,000	6,134,400	7,154,400	5.04%	0.81%	141,915,000	879,940,000
2000				1,659,606	6,625,152	8,284,758	1,659,606	6,625,152	8,284,758	5.43%	0.88%	152,606,000	946,230,000
2001				1,787,478	6,655,164	8,442,642	1,787,478	6,655,164	8,442,642	5.18%	0.84%	162,851,000	1,009,750,000
2002				1,930,476	6,727,577	8,658,053	1,930,476	6,727,577	8,658,053	4.95%	0.80%	175,040,000	1,085,330,000
2003				2,084,914	7,265,783	9,350,698	2,084,914	7,265,783	9,350,698	4.98%	0.80%	187,640,000	1,162,850,000
2004	2,582,058	2,644,303	5,226,362	2,257,876	7,847,046	10,104,922	4,839,934	10,491,350	15,331,284	7.62%	1.23%	201,150,000	1,248,830,000
2005	2,795,114	2,862,201	5,657,315	2,431,844	8,474,810	10,906,654	5,226,957	11,337,011	16,563,968	7.68%	1.24%	215,630,000	1,334,700,000
2006	2,964,210	3,036,774	6,000,985	2,626,391	9,152,795	11,779,186	5,590,602	12,189,569	17,780,171	7.63%	1.23%	233,100,000	1,445,170,000
2007	3,163,375	3,240,530	6,403,904	2,788,267	9,691,936	12,480,203	5,951,642	12,932,466	18,884,108	7.49%	1.21%	251,980,000	1,564,620,000
2008	3,341,005	3,422,293	6,763,298	2,931,788	10,116,827	13,048,614	6,272,793	13,539,120	19,811,912	7.27%	1.17%	272,390,000	1,688,600,000
2009	3,508,950	3,594,087	7,103,037	3,065,873	10,587,821	13,653,694	6,574,823	14,181,908	20,756,731	7.05%	1.14%	294,460,000	1,822,570,000
2010	3,694,305	3,783,767	7,478,072	3,214,874	11,102,389	14,317,263	6,909,179	14,886,156	21,795,335	6.85%	1.10%	318,310,000	1,973,340,000
2011	3,770,226	3,863,251	7,633,477	3,332,217	11,486,251	14,818,468	7,102,443	15,349,501	22,451,945	6.57%	1.06%	341,540,000	2,118,680,000
2012	3,934,831	4,031,807	7,966,638	3,463,306	11,883,085	15,346,390	7,398,136	15,914,892	23,313,028	6.36%	1.05%	366,480,000	2,215,870,000
2013	4,084,310	4,184,796	8,269,105	3,579,908	12,316,817	15,896,726	7,664,218	16,501,613	24,165,831	6.15%	1.03%	393,230,000	2,337,790,000
2014	4,250,507	4,354,936	8,605,444	3,710,575	12,766,381	16,476,956	7,961,082	17,121,317	25,082,400	5.94%	1.02%	421,930,000	2,452,580,000
2015	4,422,840	4,531,396	8,954,236	3,846,011	13,232,354	17,078,365	8,268,851	17,763,750	26,032,601	5.75%	0.99%	452,740,000	2,638,500,000
2016	4,542,191	4,655,331	9,197,522	3,997,312	13,715,335	17,712,647	8,539,503	18,370,666	26,910,169	5.54%	0.92%	485,780,000	2,910,460,000
2017	4,715,507	4,832,811	9,548,317	4,131,894	14,215,945	18,347,838	8,847,400	19,048,755	27,896,156	5.35%	0.87%	521,250,000	3,207,190,000
2018	4,908,498	5,030,440	9,938,939	4,282,708	14,734,827	19,017,534	9,191,206	19,765,267	28,956,473	5.18%	0.84%	559,300,000	3,440,640,000
2019	5,108,961	5,235,724	10,344,686	4,439,026	15,272,648	19,711,674	9,547,988	20,508,372	30,056,360	5.01%	0.81%	600,130,000	3,691,090,000
2020	5,332,246	5,464,325	10,796,571	4,613,657	15,830,099	20,443,756	9,945,903	21,294,424	31,240,327	4.85%	0.79%	643,940,000	3,939,550,000
Total 2004 – 2018	56,677,928	58,068,723	114,746,651	49,660,843	171,324,617	220,985,460	106,338,770	229,393,340	335,732,111	6.30%	1.04%	5,329,270,000	32,399,540,000
Total 1998 – 2020	67,119,136	68,768,772	135,887,908	68,216,000	241,515,441	309,731,441	135,335,136	310,284,214	445,619,350	5.92%	0.97%	7,525,877,000	45,935,750,000

10.5 Conclusions

Conclusions can be drawn as follows.

a) The planned project, development of a waste transfer system and Nam Son Landfill Phase 2, must be implemented urgently so as not suspend HPC's solid waste management services in the following situation:
   - the existing landfill site in Tay Mo will be full, and closed in 1999,
   - the planned Nam Son new landfill site is located 50 km away from the city center (main waste collection areas), and
   - Nam Son Landfill Phase 1 site which will be open in 1999 will be full in four years after commencement of operation.
   - Preparation of the planned project will take a few years before implementation

b) The planned project is designed in such a manner as to:
   a. Satisfy future service demand for waste transport and disposal in Hanoi
   b. Satisfy all the relevant Vietnamese laws
   c. Be environmentally sound in terms of avoidance of the secondary environmental pollution by taking adequate pollution control measures. (The primary objective of the project is to improve the urban environment of Hanoi.)
   d. Be of the least cost subject to the above a, b and c.

c) The social impacts in connection with the project is acceptably low, probably lower than any other project options by having chosen Nam Son as a landfill site, and non-inhabited Dong Ngac and Duc Giang (for future) as waste transfer station sites. There are 161 households who have to relocate due to the development of Nam Son Landfill of both Phases 1 and 2. HPC has been continuing negotiation concerning compensation with local residents who have to relocate.

d) The project is affordable for both HPC and the Hanoi citizens as demonstrated in Section 10.4.

e) URENCO, a responsible organization for solid waste management in Hanoi, will be responsible for operation of the project facilities and equipment. It is considered that URENCO has a high level capacity and skill for maintaining waste collection vehicles and other mechanical equipment judging from the fact that URENCO, at its workshop, manufactures body part of waste collection vehicles based on imported chassis, and uses very old vehicles by maintaining them.

f) As conclusion, it is judged that the project is feasible in an economic and environmental sense. Urgent implementation is needed so as not to suspend waste transport and disposal services.