Japan International Cooperation Agency (JICA)

Hanoi People's Committee
Socialist Republic of Vietnam

The Study on Environmental Improvement for Hanoi City in The Socialist Republic of Vietnam

Final Report

Main Report
Volume 4

The Feasibility Study for Nam Son Landfill Phase 2 & Waste Transfer System

July 20XX

Nippon Koei Co., Ltd.
EX Corporation

Japan International Cooperation Agency (JICA)

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Pre-Feasibility Study
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Nam Son Landfill Phase 2 & Waste Transfer System

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Estimate of Base Cost : As of March 1999 Price Level
Currency Exchange Rate : USD1.0 = VND13,900 = Yen 122

THE STUDY
ON
ENVIRONMENTAL IMPROVEMENT FOR HANOI CITY
IN
THE SOCIALIST REPUBLIC OF VIETNAM

FINAL REPORT

MAIN REPORT

Volume 4

Feasibility Study
For
Nam Son Landfill Phase 2 & Waste Transfer System

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ABBREVIATIONS

Government of Vietnam/Public Institutions

APNEH	:	Hanoi Association for Protection of Nature
CEETIA	:	Center for Environmental Engineering of Towns and Industrial Areas
CEST	:	Center for Environmental Science and Technology
DFP	:	Department of Finance and Pricing
DI	:	Department of Industry
DOC	:	Department of Construction
DOSTE	:	Hanoi Department of Science, Technology and Environment
EMD	:	Environmental Management Division
GOV	:	Government of Vietnam
HAPI	:	Hanoi Authority of Planning and Investment
HCAO	:	Hanoi Chief Architect's Office
HD	:	Healthcare Department
HPC	:	Hanoi People's Committee
HSDC	:	Hanoi Sewerage and Drainage Company
HT	:	Hanoi Television
MOC	:	Ministry of Construction
MOET	:	Ministry of Environment and Training
MOF	:	Ministry of Finance
MOI	:	Ministry of Industry
MOSTE	:	Ministry of Science, Technology and Environment
MPI	:	Ministry of Planning and Investment
NEA	:	National Environmental Agency
NIED	:	National Institute for Educational Development
PMB	:	Project Management Board
SC	:	Steering Committee
SCPE	:	Scientific Center for Population and Environment
TUPWS	:	Hanoi Transport and Urban Public Works Service
URENCO	:	Hanoi Urban Environment Company
VCCI	:	Vietnam Chamber of Commerce and Industry
VIWASE	:	Vietnam Consultant on Water Supply, Sanitation and Environment

International /Foreign Organizations

ADB	:	Asian Development Bank
ASEAN	:	Association of Southeast Asian Nations
CIDA	:	Canadian International Development Agency
EU	:	European Union
IBRD	:	International Bank for Reconstruction and Development (World Bank)
JICA	:	Japan International Cooperation Agency
JBIC		Japan Bank for International Cooperation
NGO	:	Non-Government Organization
OECD	:	Organization for Economic Cooperation and Development
SIDA	:	Swedish International Development Agency
The JICA Study Team	:	The JICA Team for the Study on Environmental Improvement for Hanoi City
UNDP	:	United Nations Development Program
UNICEF	:	United Nations International Children's Emergency Fund
UNIDO	:	United Nations Industrial Development Organization
WHO	:	World Health Organization

Others

BOD	:	Biochemical Oxygen Demand
C	:	Carbon
CECS	:	Center for Environmental Chemistry Studies
CEST	:	Center for Environmental Science and Technology
CH_4	:	Methane
CO_2	:	Carbon dioxide
COD	:	Chemical Oxygen Demand
CRES	:	Center for Regional and Environmental Studies
Cl	:	Chlorine
DID	:	Densely Inhabited District
DO	:	Dissolved Oxygen
EAR	:	Environmental Awareness-Raising
EARET	:	Environmental Awareness-Raising, Education and Training
EE	:	Environmental Education
EIA	:	Environmental Impact Assessment
EMP	:	Environmental Master Plan
ES	:	Executive Seminars
F/S	:	Feasibility Study
GDP	:	Gross Domestic Product

GRP	:	Gross Regional Product
H	:	Hydrogen
IUPM	:	Industrial and Urban Pollution Management
LEP	:	Law on Environmental Protection
LM	:	Laboratory and Monitoring
MEIP	:	Metropolitan Environmental Improvement Program
M/P	:	Master Plan
N	:	Nitrogen
O	:	Oxygen
ODA	:	Official Development Assistance
O&M	:	Operation & Management
SEDS	:	National Socio-Economic Development Strategy
P	:	Phosphorous
PVC	:	Polyvinyl chloride
SS	:	Suspended Solid
STW	:	Sewage Treatment Works
SWM	:	Solid Waste Management
SWS	:	Solid Waste Services
SWTC	:	Solid Waste Treatment Complex
The JICA Study	:	The Study on Environmental Improvement for Hanoi City
T-N	:	Total Nitrogen
T-P	:	Total Phosphorous
TCVN	:	Vietnam Standard
TMS	:	Time and Motion Survey
TSP	:	Total Suspended Particulate
VAT	:	Vietnam-Australia Training Project
VCEP	:	Vietnam Canada Environment Project
WSP	:	Waste Stabilization Pond

UNITS OF MEASUREMENT

T/Y	:	Tons per year
US$	:	United States Dollar
VND	:	Vietnamese Dong
dB	:	Decibel(s)
g/d	:	Grams per day
ha	:	Hectare
km^2	:	Square kilo meter
m^2	:	Square meter
m^3	:	Cubic meter
m^3/d	:	Cubic meter per day
mg/l	:	Milligram per liter
t/m^3	:	Tons per cubic meter
wt%	:	Weight percent

CHAPTER 1 INTRODUCTION

1.1 Project Components and Study Objectives

The project subject to the current pre-feasibility study has the following components:

a) construction and operation of a transfer system with a transfer station in Dong Ngac
b) construction and operation of Nam Son Landfill Phase 2

The objectives of the Study are to:

a) formulate appropriate plan for waste transfer and landfill that need to be implemented by Hanoi People's Committee (HPC) in the near future
b) examine feasibility of the project from economic, financial, social, and environmental view points

1.2 Background

In Hanoi City, the URban ENvironment COmpany (URENCO) is responsible for solid waste management for the urban districts. At present, there are seven urban districts in Hanoi City. For suburban districts (there are five currently), URENCO of each suburban district is responsible for solid waste management within respective district.

As of the beginning of 1999, URENCO collected 1,017 ton/day of solid waste and 300 ton/day of soil waste & demolition waste.

URENCO started using Tay Mo landfill in August. This landfill with an area of 5 ha is almost full now. In December 1998, Hanoi People's Committee (HPC) started construction of a self-financed landfill (Phase 1, 13.5 ha) at Nam Son commune, Soc Son suburban district. It is 50 km north of the city center of Hanoi. In June 1999, a part of Phase 1 site in Nam Son opened. As of August 1999, URENCO has transported about 50% of the collected waste to Nam Son landfill, and the remaining 50% to Tay Mo landfill site. In mid September, due to the opposition by local residents, URENCO stopped transporting waste to both those landfills, and started using Kieu Ky landfill in Gia Lam suburban district. Gia Lam suburban district planned to finish the construction of this landfill in November 1999. All demolition waste and soil waste are transported to Lam Du landfill. The landfill receives same type of waste brought by private people.

1.3 Necessity for Waste Transfer System and Nam Son Landfill Phase 2

1.3.1 Necessity for Waste Transfer System

It is not possible for URENCO to transport all collected waste to Nam Son using the existing trucks, majority of which are older than 7 years. With the use of the existing trucks, URENCO may transport only about 600 tons of solid waste daily using direct transport to Nam Son.

Under this condition, HPC has realized the necessity for a waste transfer system. The JICA Study Team considers it is rational for HPC to have a transfer system because overall cost of waste transport to Nam Son will be lower with a transfer system than the cost without one.

In general, the necessity of a transfer system depends mainly on the transport distance. It also depends on capacity of waste collection trucks. In case of small trucks with capacity of less than 3 tons, the transport distance of over 25 km may necessitate a transfer system, while in case of larger trucks, a transfer system may be economically justified if the distance is longer than 40 km.

1.3.2 Comments on Railway Transport of Waste in Hanoi

This report focuses on the use of roads for the secondary transport of waste. Another possible way is the use of railway. The JICA Study Team considers that the road transport of waste has much more economical and operational advantages than the railway transport. Concerning railway transport of waste to Nam Son, the Study Team's comments are as follows:

a) In case of railway transport, two waste transfer facilities will be needed, i.e, one at a waste loading station to be located near waste collection area and the other at a waste unloading station (terminal) near the landfill site. Trucks will be needed to transport waste from the terminal to the landfill site.

b) Road transport of waste is an established system tested and experienced by many cities of the world, while railway transport is rare (a few cases in Europe including France, Netherlands, and Germany). In Japan, there is only one city (Kawasaki city) that has applied a railway transport of some waste to an incinerator.

c) In Japan, it is generally considered that railway transport of waste may be economically feasible if the transport distance is more than 500 km.

d) The needs for transport of waste to an incinerator exist semi-permanently as old incinerators can be replaced with new one, while the demand for transporting waste to a particular landfill site will end with the end of life of this particular

landfill site.

e) Some people consider that railway transport is environmentally sound, as it does not emit much gas emission. However, the secondary transport of waste on roads causes much less gas emission than the primary transport activity does because the secondary transport uses large capacity vehicles that results in less number of trips and less gas emission.

f) In case of Hanoi, the following factors should be considered if HPC is interested in railway transport.

- availability of land for construction of extension of railway and transfer facilities
- time needed to investigate, carry out an environment impact assessment, make plan and design, acquire necessary land, and construct facilities
- duration of Nam Son landfill operation period
- cost of design, construction and supply of all necessary equipment and facilities including transfer facilities at both ends
- cost of road transport from Nam Son railway terminal to the Nam Son Landfill site.
- cost of construction of a bride for National Road No.3 (A future extended railway to Nam Son will inevitably cross National Road No.3, and therefore, a bridge must be constructed for National Road No.3 to cross over the future railway extension line.)
- costs of compensation to local people who have to be relocated or will be affected due to construction of transfer stations and railway extension.

1.3.3 Necessity for Nam Son Landfill Phase 2

According to the feasibility study report of Nam Son Solid Waste Management Complex issued in September 1998, Nam Son Landfill Phase 1 will be full in 3 to 4 years. Planning, designing, and construction of a new landfill site usually takes a few years or more. Therefore, it is necessary for HPC to now start a study on the next Landfill phase (Phase 2).

1.3.4 Relationship between the Project and the Current JICA Study

Due to the recognition of the urgent necessity for a transfer system and Nam Son Landfill Phase 2, both HPC and the JICA have agreed that JICA Study Team should conduct a pre-feasibility for the transfer system and Nam Son Landfill Phase 2. This pre-feasibility study is conducted as a part of the current JICA Study on Environmental Improvement for Hanoi City.

1.4 Nam Son Solid Waste Management Complex Project

Nam Son Landfill Phase 2 is a part of Nam Son Solid Waste Management Complex Project (NSWMCP), which has been planned by HPC, and has the following components:

a) Landfill Phase 1 (about 13.5 ha)
b) Landfill Phase 2 (about 60 ha) (Scope of the current JICA pre-feasibility study)
c) Industrial waste treatment (5 ha)
d) Compost processing (7.5 ha)

HPC has carried out a feasibility study for NSWMCP. Each component is briefly described below:

(1) Landfill Phase 1

HPC has prepared a plan, feasibility study, and detailed design for the Nam Son Landfill Phase 1, and started the construction of the Landfill Phase 1 and expansion of the access road in December 1998. The Landfill Phase 1 construction is financed by HPC's fund. The construction cost estimated in the feasibility study is 17,847,118,000 Dong (1.28 million US$ at an exchange rate of 13,900 Dong/$), of which 2,563,750,000 Dong (0.18 million US$) is the estimated cost of relocation and compensation for the local residents. The estimated cost includes the cost of upgrading the existing access road (about 3 km) from the Route No. 35 to the landfill site.

Out of 3.5 ha of Phase 1 area, HPC prepared about 1.2 ha of landfill site, and started transporting solid waste in June 1999. HPC expects to be able to acquire the remaining land, and prepare the land for landfill by the end of 1999.

(2) Landfill Phase 2

The Landfill Phase 2 is the project for which the JICA Study Team is conducting a pre-feasibility study. The Landfill Phase 2 must be open when the Phase 1 site is full. The Landfill Phase 2 will be a sanitary landfill and satisfy all the Vietnamese standards. The following schedule is expected: design and engineering work will be completed by the end of 2000, construction will be completed by the end of 2001, the site will start receiving waste in the beginning of January 2002. The same schedule is planned for the transfer system. HPC expects that an ODA fund would be made available for the construction of the Landfill Phase 2 and the transfer system.

(3) Industrial Waste Treatment Project:

URENCO and Sumitomo Corporation plan to establish a joint venture company which will provide industrial waste collection and treatment services. A feasibility

study has already been conducted. According to URENCO, the treatment capacity of the industrial treatment facility is 50 ton/day, and in principle the 50 ton/day of industrial waste is hazardous industrial waste.

(4) Compost Processing:

URENCO has a plan to construct a new composting plant in Cau Dien (adjacent to Tay Mo landfill site) using a Spanish soft loan (US$ 4 million). The planned waste receiving capacity of the plant is 50,000 ton/year. In addition, HPC has given a American company an investment license for construction and operation of a large scale compost plant (waste receiving capacity of 250,000 ton/year) at the site of Nam Son Solid Waste Management Complex.

The JICA Study Team strongly recommends that HPC should carry out a thorough feasibility study before investing in any compost plant.

1.5 Study Method

The current pre-feasibility study includes the following activities:

a) Discussion with HPC (HPC vice chairmen, Chief Architect Office, DOSTE, TUPWS, HAPI, and URENCO)
b) Study of all relevant documents including the feasibility study of Nam Son Solid Waste Complex and the design of Landfill Phase 1. Both the study and design were conducted by HPC.
c) Topographic survey for all the sites (Nam Son Landfill Phase 2; two sites for transfer stations, i.e., Dong Ngac and Duc Giang)
d) Geological survey for Nam Son Landfill Phase 2
e) Environmental Impact Assessment (EIA) for Nam Son Landfill Phase 2
f) EIA for the Candidate Transfer Station Sites in Dong Ngac and Duc Giang
g) Socioeconomic and environmental studies for the 10 candidate locations for transfer station

CHAPTER 2 CURRENT SOLID WASTE MANAGEMENT CONDITIONS

2.1 Responsible Organization

In HPC, the Department of Transport and Public Works (TUPWS) is the main department responsible for administration of solid waste management. Chief Architect Office is responsible for planning on sites of waste management facilities. URENCO is responsible for solid waste management for the urban districts. There are 7 urban districts at present. Each of the 5 suburban districts of Hanoi has a URENCO of its own, responsible for solid waste management. URENCO of each suburban district is much smaller than URENCO.

2.2 Types and Quantities of Solid Waste Managed by URENCO and Urencos

2.2.1 Types of Waste Managed by URENCO and Urencos

URENCO and five Urencos manage the following types of waste:

a) Household waste
b) Street waste
c) Business waste excluding toxic waste
d) Hospital waste
e) Demolition waste and solid waste
f) Night soil sludge (collected only in the 7 urban districts)

2.2.2 Solid Waste Quantities Managed

As shown in the following table, the total amount of solid waste managed by URENCO, as of January 1999, is estimated to be 1,317 ton/day, of which URENCO manages 1,317 ton/day. Of 1,317 ton/day of solid waste managed by URENCO, 1,017 ton/day is domestic waste (household, street business and hospital waste) and 300 ton/day is demolition and soil waste according to the truck scale data of URENCO.

Estimated Solid Waste Quantity Managed by URENCO in Urban Hanoi

Unit: ton/day as of January 1999

	7 Urban Districts
1. Domestic waste (household, street, business, and hospital)	1,017
2. Demolition waste and soil waste	300
3. Total (1 + 2)	1,317
4. Waste Generation	1,708
5. Collection Coverage	77%

It is estimated that URENCO's waste collection coverage is about 77% assuming the generation amount is 1,708 ton/day, of which 1,319 ton/day is domestic waste and 389 ton/day is demolition and soil waste. This assumption is based on the information of URENCO.

2.3 Waste Collection and Transport

Hanoi City and probably most other cities in Vietnam dominantly apply a two-step collection/transport system comprising manual collection with handcarts, and transport with trucks. A collection worker manually collects solid waste from sources using a handcart of 450 liter capacity, and takes the waste-filled handcart to the nearest designated transfer place, typically side of street. Then, a waste collection truck arrives at the place, and mechanically lifts and empties the handcarts. A truck collects usually several to 10 handcarts from one transfer place. A truck visits a few transfer places before going to the landfill site.

Another collection system applied by URENCO is using communal containers. Local residents bring their waste, and put it into the communal container. A truck comes once a day to transport a waste-filled container to the landfill site. This system is used in some areas where streets are too narrow for waste collection trucks to enter, or newly inhabited places. This system is economical, but not as convenient as the other system for local residents because they have to bring waste to a container.

2.4 Treatment and Disposal

Collected waste is transported to landfill sites. In Hanoi, open dumping has been practiced.

In September 1999, URENCO stopped transporting solid waste to both Tay Mo landfill and Nam Son landfill, and started using Kieu Ky landfill in Gia Lam District. Gia Lam District administration planned to complete the construction of Kieu Ky site in November 1999, and use it for the district.

URENCO has a composting facility in Cau Dien adjacent to Tay Mo landfill site. It seems that the actual waste quantity used for compost production is a few tons per day.

HPC has installed a hospital waste treatment plant on the same site as the compost facility. HPC started a test operation of the plant in early 1999. The plant receives 3 ton/day of waste, and about 1 ton of ash is generated per day according to the specifications.

2.5 Outline of URENCO

2.5.1 Activities

URENCO activities are as follows:

a) solid waste collection, transports and disposal
b) street sweeping
c) sprinkling water on streets
d) collection and disposal of night soil sludge (According to URENCO, it collects 100 ton/day of night soil sludge out of the 300 ton/day generation.)
e) compost production
f) workshop activities including:
   - manufacturing body part of waste collection trucks based on imported chassis
   - manufacturing handcarts and containers
   - maintenance and repair of trucks, handcarts, and containers

2.5.2 Organization of URENCO

URENCO's organization comprises a headquarters and several subunits called enterprises or units. URENCO employs over 3,200 employees in total.

(1) Waste Collection Organization

As explained earlier, URENCO applies a two-step collection/transport system: manual collection with handcarts, and transport with trucks. Within URENCO, there are five enterprises responsible for manual collection of waste. These enterprises (official name is Environment Enterprise) are district-based organizations. There was a period during which these enterprises belonged to the administration of each district. The five enterprises employ 2,392 workers. Most collection workers are women.

(2) Waste Transport Organization

URENCO has four transport units responsible for waste transport with trucks. Transport Units 1 and 2 are responsible for transportation of domestic waste. Unit 3 is responsible for collection, transportation and disposal of night soil sludge. Unit 4 is responsible for collection and transport of demolition and soil waste. There are 549 employees in the four units.

Among the five Environment Enterprises, Enterprise No. 5 has some trucks to transport collected waste. This arrangement (being responsible for both manual collection and transportation with trucks) has been made as a demonstration project. URENCO thinks that the other enterprises should be responsible for both manual

collection and transportation with truck in future like Environment Enterprise No. 5.

(3) Other Organizations

URENCO has also Cau Dien Composting Enterprise (57 employees). Tay Mo landfill site is managed by Tay Mo Landfill Management Board (56 employees). Mechanical Enterprise (102 employees) is responsible for operation of workshop where they manufacture truck bodies, and repair and maintain trucks, containers, and other equipment.

2.5.3 Waste Collection and Transport

URENCO uses 140 waste transport trucks. The most dominant types of trucks are IFA MTR 92 (10 m3, 4 ton) and IF MTR 97 (6-8 m3, 3ton), both of which were made in the former East Germany. List of the waste transport trucks of URENCO is given in Table 2.5.1. Table 2.5.2 shows containers and other equipment used for waste collection.

URENCO applies two-work shifts: 1st shift from early morning until 6 PM, and 2nd shift from 6 PM – 1 AM. About 80 % of domestic waste is collected and transported during the 2nd shift to avoid rush hours. HPC's municipal regulation stipulates that waste collection and transport should not be conducted during rush hours. Table 2.5.3 shows types of trucks used by work shift. Street sweeping and collection/transportation of demolition and soil waste are carried out mainly during the 1st shift.

Each truck follows one designated waste collection route. There are 116 collection routes altogether: 30 collection routes during the 1st shift and 85 routes during the 2nd shift (see Table 2.5.4). Table 2.5.5 shows composition of employees working for the transport units by type of work.

2.5.4 Waste Disposal Methods

URENCO applies an open dumping method. Recently, in 1998, HPC installed a biological leachate treatment facility in the existing landfill in Tay Mo. It is operated on an experimental basis. Outlines of Tay Mo landfill and Lam Du landfill are shown in Tables 2.5.6 and 2.5.7.

Nam Son landfill is a sanitary landfill according to the design. However, the actual landfill's operation is not the operation of a sanitary landfill.

In the past, URENCO used mainly holes made after soil digging as landfill sites. Sizes of the past landfills ranged from 1 ha to 8 ha. Description of the past landfill sites are shown in Table 2.5.8.

In Cau Dien adjacent to Tay Mo landfill, URENCO operates a compost production plant that has been funded by UNDP. The operation started in 1991. Its design capacity is to produce compost product of 7,500 ton/year out of 30,000 m3/year of solid waste. Actual production is about 1 ton/day or so. HPC has a plan to construct another compost plant in Cau Dien. Design capacity is to produce 13,260 ton/year of compost product out of 50,000 ton/year of solid waste. Outlines of the existing and planned compost plants are shown in Tables 2.5.9 and 2.5.10 respectively.

Table 2.5.1 Waste Transport Trucks Used by URENCO

Type of vehicle	Country	Capacity	Quantity				
			Unit 1	Unit 2	Enter-prise 5	Unit 4	Total
			(a)	(b)	(c)	(d)	(a)+(b)+(c)+(d)
1. Rear-end trucks	Japan	1.8~2 tons (2.5 m^3)	6	5	0	0	11
2. Compre-ssing trucks	S. Korea	2.5 tons (3 m^3)	2	0	0	0	2
3. Compre-ssing trucks	S. Korea	5 tons (8 m^3)	2	0	0	0	2
4. KO 413	USSR	3.8~4 tons (7~8 m^3)	2	3	0	0	5
5. Sanxing	China	1.8~2 tons (3~4 m^3)	2	5	0	0	7
6. 6.Mercedez	Germany	8 tons (16 m^3)	1	0	0	0	1
7. 7.IFA MTR 92	East Ger/ URENCO	4 tons (10 m^3)	25	29	4	6	64
8. IFA MTR 97	East Ger/ URENCO	3 tons (6 ~ 8 m^3)	13	11	4	0	28
9. Container IFA	East Ger/ URENCO	4 tons (6 m^3)	0	5	0	0	5
10. Zin 130	USSR/ URENCO	3.5 tons (6 m^3)	0	18	1	5	24
11. Maz 5335	USSR/ URENCO	4 tons (8m^3)	0	2	0	0	2
TOTAL			53	78	9	11	151

Note : East Ger/URENCO means that chassis was manufactured by the former East Germany and the body by URENCO.

Table 2.5.2 Handcarts and Containers Used by URENCO

Type of Equipment	Capacity	Quantity
1. Handcarts	0.4 m^3	URENCO provides 2 handcarts per collection worker per year.
2. Communal containers	8 m^3	7
	6 m^3	30
	3 m^3	8
	total	45
3. Brooms		URENCO provides 2 brooms per collection worker per year.

Table 2.5.3 Use of Waste Collection Trucks by Work Shift

Type of vehicle	Country	Capacity	Operation time					
			Unit 1		Unit 2		Enter-prise 5	
			Day time	Night time	Day time	Night time	Day time	Night time
1. Rear-end trucks	Japan	1.8~2 tons (2.5 m^3)	x	x	x	x		
2. Compre-ssing trucks	S. Korea	2.5 tons (3 m^3)	x	x				
3. Compre-ssing trucks	S. Korea	5 tons (8 m^3)	x	x				
4. KO 413	USSR	3.8~4 tons (7~8 m^3)	x		x	x		
5. Sanxing	China	1.8~2 tons (3~4 m^3)	x		x	x		
6. Mercedez	Germany	8 tons (16 m^3)	x	x				
7. IFA MTR 92	East Ger/ URENCO	4 tons (10 m^3)	x	x	x	x	x	
8. IFA MTR 97	EastGer/ URENCO	3 tons (6 ~ 8 m^3)	x	x	x	x		x
9. Container IFA	East Ger/ URENCO	4 tons (6 m^3)			x	x		
10. Zin 130	USSR/ URENCO	3.5 tons (6 m^3)				x		x
11. Maz 5335	USSR/ URENCO	4 tons (8m^3)				x		

Table 2.5.4 Number of Waste Collection Routes by Collection Area and Work Shift

Transport Unit/ Districts	Day time	Night time	Total
A. Unit 1			
A1. Ba Dinh, Cau Giay	9	13	22
A2. Hoan Kiem	5	18	23
A3. Cau Giay	2	2	4
A4. Sub total (A1+A2+A3)	16	33	49
B. Unit 2			
B1. Hai Ba Trung	5	21	26
B2. Thanh Xuan-Dong	6	28	34
B3. (B1+B2)	11	49	60
C. Enterprise 5			
C1 Tay Ho	3	4	7
D. Total	30	85	116

Table 2.5.5 Number of Employees Involved in Household Waste Transport

	Types of staff	Unit 1 (a)	Unit 2 (b)	Enter-prise 5	Total (a+b+c)
1	Administrative staffs	5	5	8	18
2	Record – keeping clerks	3	4	1	8
3	Mechanics	4	7	0	11
4	Guards	8	9	0	17
5	Drivers	59	78	9	146
6	Driver assistant	49	70	9	128
7	Collection workers	6	0	156*	162
8	Toilet cleaners	0	0	22	22
9	Receptionists	1	1	1	3
	Total (1+...+9)	135	174	206	515

* Most collection worker of the Enterprise 5 are primary collection workers.

Table 2.5.6 Outline of Tay Mo Landfill Site

Item	Content
1. Location	Tay Mo commune, To Liem suburban district (Adjacent to the composting plant)
2. Area	5 ha
3.Commencement of operation	August 1998
4. Major facilities	a. truck scale b. office c. bulldozers( ) d. lighting facilities e. occasional soil cover f. experimental leachate treatment facilities Note: The following facilities are not equipped: - waste retaining structure - gas exhaust pipes - fence
5. Experimental leachate treatment facility	There are the following two components: - anaerobic tank (biochemical treatment) - filtration layer of used bricks (physical and biochemical treatment) Treatment capacity: 200m^3/day(Max) Quality of effluent: -BOD < 50mg/L COD <100mg/L Note: Leachate coming from waste layer contains less heavy metals than the maximum set by the quality standards for effluent. This system can only treat organic matters but not heavy metals, etc.
6. Landfill operation method (including current conditions and remaining capacity)	Operation: everyday Collection vehicles directly go into the filling area. There is no daily cover and fence. Many rats are bred here and damage crops grown in the surrounding agricultural fields. There are some scavengers (20). No experts for operation of leachate treatment facility. Groundwater might have been contaminated by leachate as there is no lining at the bottom of the landfill.

Table 2.5.7 Outline of Lam Du Landfill Site for Demolition Waste and Soil Waste

Item	Content
1. Location	Lam Du, Gia Lam suburban district
2. Area	22.5 ha
3. Commencement of operation	August 1996
4. Type of waste accepted	Demolition waste (mainly broken bricks), and soil waste.
4. Users	Private persons (those who demolished houses and buildings) URENCO transport to Tay Mo landfill site, and used it as cover soil.
Landfill method applied	private persons and enterprises
Tipping fees	not charged

Table 2.5.8 Outline of Former Landfill Sites Used by URENCO

Locations	Period of Use	Area	Estimated Volume of Waste Dumped	Land use before landfill	Land use after completion of landfill
1. Thanh Cong	not available	not available	not available	not available	not available
2. Tam Hiep	1990 - Late 1992	3.5 ha	not available	holes made from digging soil for brick production	Under local manage-ment
3. Me Tri	late 1992 - July 1997	8.08 ha	2,000,000 m^3	Ponds and holes made by digging soil for brick production	None
4. Lam Du	August 1996 -	22.5 ha	1,422,000 m^3	Fish pond and cemetery	-
5. Tay Mo	July 1997 - Late 1998?	4.9 ha	636,639 m^3	Fish pond, holes made by digging soil for brick production	-

Table 2.5.9 Outline of the Existing Composting Plant

Items	Content
1. Location	Cau Dien, Tay Mo commune, Tu Liem suburban district (adjacent to the Tay Mo landfill site)
2. Area	2.2 ha
3. Commencement of operation	1991
4. Design capacity	a. Incoming waste: 30,000 m^3/year (12,000 ton/year approx.) b. Compost product: 7,500 ton/year
5. Actual performance	70 % of the design capacity according to the manager of the composting plant.
6. Fund for construction of the facility	UNDP
7. Number of employees	55

Table 2.5.10 Outline of Planned Composting Plant

Items	Contents
1. Location	Cau Dien, Tu Liem suburban district
2. Planned Commencement of operation	2000?
3. Design capacity	a. Incoming waste: 50,000 ton/year b. Compost product: 13,260 ton/year
4. Estimated Construction Cost	a. Equipment: $ 3,409,065 b. Construction: $ 469,445 c. Other capital construction works and provision: $ 121,490 d. Total (a+b+c) $ 4,000,000
5. Fund for construction of the facility	Spanish ODA: a loan (interest: 1%/year; 15 years repayment period of which the first 5 years is a grace period)
6. Proposed number of employees	50

CHAPTER 3 SELECTION OF SITES FOR TRANSFER STATION

3.1 Identification of Candidate Locations

After site identification activities carried out by both HPC and the JICA Study Team, ten candidate locations, as shown in Figure 3.1.1, have been identified for waste transfer stations. Through the evaluation and discussions with relevant authorities of HPC, two locations, Dong Ngac and Duc Giang, have been selected for which the JICA Study Team is carrying out pre-feasibility study.

Identification Process:

Before commencement of the current JICA Study, HPC identified three candidate locations, i.e., Tay Mo (existing landfill site), Lai Hoan (an agricultural land) and Tam Hiep (former dump site). Then the JICA Study Team identified five more locations, i.e. Xuan Dinh, Co Nhue, Phu Thuong, Lam Du (existing landfill site for demolition waste and soil waste), and Noi Du.

On 21 October 1998, the Project Management Board and the JICA Study Team organized a tour to candidate transfer station locations and a discussion session with the participation of representatives from the following organizations:

a) DOSTE
b) Chief Architect Office
c) TUPWS
d) HAPI
e) URENCO
f) JICA Study Team

Considering the geographic conditions of Hanoi city, JICA Study Team proposed that HPC should select two sites, one in the west and another in the east, and proposed that Xhuan Dinh in the west and Noi Du in the east would be the best selection among the eight candidate locations.

The representative of the Chief Architect Office suggested to add two more candidate locations, Dong Ngac (south west of Tang Long bridge) and Duc Giang (south of Duong river). The representative said that Dong Ngac would be better than Xuan Dinh, and Duc Giang would be better than Noi Du in terms of availability of land. So ten candidate locations were identified all together.

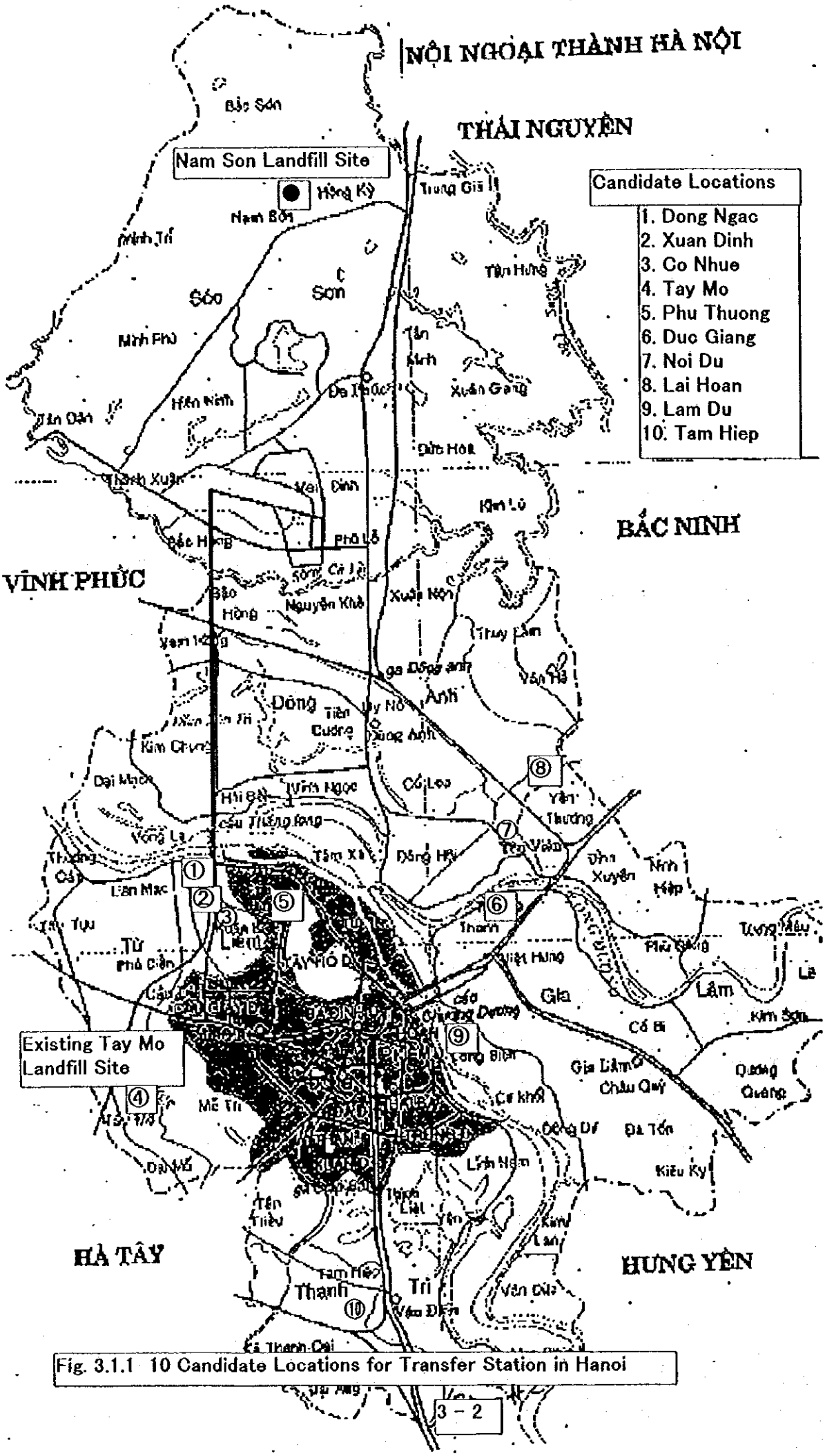

Fig. 3.1.1 10 Candidate Locations for Transfer Station in Hanoi

3.2 Characteristics of the 10 Candidate Locations

Table 3.2.1 summarizes characteristics of each location including distance from the city center (Hoan Kiem district) and to the planned Nam Son landfill site, land use and access road conditions.

There are five candidate locations (Dong Ngac, Xuan Dinh, Co Nhue, Tay Mo and Phu Thuong) in the west part of Hanoi city, four candidate locations (Duc Giang, Noi Du, Lai Hoang and Lam Du) in the east, and one in the south (Tam Hiep).

Distance from the city center:

The nearest location to the city center is the Lam Du (4.4 km from the city center), the most distant location is Lai Hoang (17 km).

Land Use:

There are no local residents living in any of the candidate locations. Out of the 10, 8 candidate sites are agricultural fields. The remaining two locations are non-agricultural sites. They are Tay Mo (existing landfill site), and Lam Du (existing landfill for demolition waste and soil waste). In Co Nhue, there is a company's un-used dormitory building surrounded by agricultural field.

Access:

Of the 10 candidate locations, Lai Hoang is the only location that is not accessible by a car. A new 2.4 km long access road needs to be constructed if this site is to be used as a transfer station. All other 9 sites are accessible by a car.

Land Availability:

It was found during the course of the study that Lam Du is not available for a transfer station. Lam Du site is located within the dike system of Red River. The Authority of Flood Control and Dike Management, which is under the Ministry of Agriculture, stated that no structure should be constructed within the dike system according to the Vietnamese law because structures may affect water flow of Red river when floods occur. (Affected water flow may damage the dike system.) Tay Mo site has been currently used as landfill site by URENCO, and is therefore available as a transfer station. Concerning the remaining 8 sites, there are no specific organizations or individuals which are explicitly against the use of the land as a transfer station. The land may be available for a transfer station through the ordinary land acquisition procedure as applied for other public works such as road construction.

Table 3.2.1 Characteristics of 10 Candidate Sites of Transfer Station

Location	Distance (km)		Availa-	Land use		Access to trunk road			Site Characteristics	Comments
	to CBD	Nam Son	ble Area (ha)	Site	Surroundings	Width	Pave	Length		
WEST 1. Dong Ngac	12.8	37.6	+ 25 ha	Paddy field.	Paddy field. Vegetable field	5~6m	crude	0.5km	1) South of theThang Long bridge. 2) 300 m from the highway. 3) Water intake points (5 wells) are proposed by the JICA water supply 4) Existing access way (300 m) to the highway needs improvement.	*Chief Architect Office recommend the site. *Best among the candidate in the west.
2. Xuan Dinh	11.5	38.6	+ 5 ha	Paddy field.	Railway Highway	12m	fine	0km	1) Locates between the highway & railway, south of T/L bridge 2) The land is categorized as paddy field (4) 3) Easy access because the site is on the side of the highway.	*Land acquisition may not be difficult. *Construction of fly-over is needed to avoid interference with highway traffic.
3. Co Nhue	11.2	38.9	3 ha	Unused house	Paddy field. Drainage	12m	fine	0km	1) The land locates on the side of the highway in the south of T/L bridge 2) Easy access because the site is just on the side of the highway. 3) There is a dormitory house (not used yet) owned by Transport Company 118.	*Highway interchange area according to M/P *Adjacent to planned diplomatic colony. *Construction of fly-over is needed to avoid interference with highway traffic.
4. Tay Mo	14.4	43.6	4ha	Existing land fill site	Paddy field. Public use	5~6m	crude	3.2km	1) Most distant to the city center among the candidate sites of the west. 2) Existing access road of 3.2km to Cau Dien bridge should be widened, or, at least 1.3km new access will be needed to Highway to Hoa Lac city. 3) Land acquisition is readily available.	*Not good as future T/S in terms of the long distance to the city center and need for construction/widening of access roads.
5. Phu Thuong	11.6	42.3	+ 10 ha	Fish pond Agricultural field	Agricultural fld. Near by dike, planned bridge	5.5m	crude	0.7km	1) The existing road (0.7 km) between the site and Thang Long bridge should be widened. (At present, it takes about 20 minutes for a car to pass.) 2) Construction of a planned bridge will shorten distance to Nam Son to 36.1 km.	*The land may not be available as it has been awarded to a business group to use it as development site of new business center.
EAST 6. Duc Giang	10.7	39.9	+ 50 ha	Vegetable field.	Paddy field. Vegetable field. chemical plant	7m	fine	2km	1) Located in the south of the southern dike of Duong river. 2) Large area (over 50 ha) 3) Access is easy from Duong bridge 4) Future industrial area according to M/P2020	*Chief Architect's Office recommend the site. *More advantageous than Noi Du in terms of nearness to the collection area and land availability.
7. Noi Du	13.3	35.2	+ 50 ha	Swamp Paddy field.	Route3 Livestock auction market	8m	fair	0km	1) Site can be either side of the Route 3. 2) Easy access as the site faces the Route 3. 3) The south side of Route 3 is swamp. North side is paddy field.	* Less advantageous than Duc Giang.
8. Lai Hoang	17.0	36.3	3ha	Paddy field.	Paddy field. Railway	3m	no	2.4km	1) Far from the collection area. 2) At present, it is not accessible by a truck. An access road of 2.4 km to Route 3 needs to be constructed.	*Not suitable as T/S site in terms of location and necessity for a new access road.
9. Lam Du	4.4	46.0	21ha	Pond, Demolition waste landfill site	Residential Warehouse Vegetable field.	6.4m	crude	0.6km	1) The best site because it is the nearest to the city center. 2) Inside the dike system, and flood area 3) Water intake points locate nearby.	*Ministry of Agriculture says the land is not obtainable for T/S because the laws say no structure may be constructed within the dike system.
SOUTH 10. Tam Hiep	13.3	61.2	2ha	Vegetable field. Seedling field.	Cemetery Pond	2.7m	no	0.5km	1) Very far to Nam Son. 2) Access road (at least 600m) needs to be constructed.	* Not suitable as T/S site in terms of location.

CBD: Central Business District

3.3 Criteria for Site Selection

3.3.1 Economic Cost - Fundamental Criterion

The most important and fundamental criterion is the lowest transport cost. This is because the objective of having a waste transfer system is to minimize overall cost of transporting waste from collection areas to a final disposal site. Whole meaning of a transfer will be lost if overall transport cost with a transfer system turned out higher than the cost without a transfer system. The overall transport cost mainly consists of 1) cost of primary transport from waste collection areas to a transfer station, and 2) cost of secondary transport from a transfer station to a final disposal site. The source of cost reduction with a transfer system is an increase of the transport efficiency by using secondary transport vehicles larger in capacity than primary transport vehicles.

Main factors that affect the overall costs are:

a) distance of transfer station from waste collection areas
b) accessibility or conditions of roads to transfer station
c) land availability and acquisition cost

(1) Distance of transfer station from waste collection area

The distance of a transfer station from waste collection areas is the most important factor that affects the overall transport cost. In general, the nearer the transfer station to collection areas, the lower the overall transport cost is.

(2) Accessibility or conditions of roads to transfer station

For example, in case of Lai Hoan, one of the 10 candidate sites, there is no access road to the location. Construction of a 2.4 km new road for vehicles is required if HPC uses this location as a transfer station. Obviously, the construction of such a new road will be very costly, perhaps more costly than a transfer station.

Roads from a transfer station to Nam Son landfill should be in good condition because the secondary transport vehicles are large. The secondary transport vehicles may be of 35 ton gross vehicle weight. If road conditions do not allow large vehicles to pass, smaller vehicles must be used, which would reduce efficiency of the secondary transport, which then results in higher costs.

(3) Land availability and acquisition cost

Transfer stations can be constructed only on land that is available for this purpose. Some land may not be used for a transfer station due to some restrictions associated

with 1) laws and regulations, 2) conflict with other development plans, and 3) military objectives.

Lam Du (existing landfill site for demolition waste), one of the 10 candidate sites, actually is the nearest to collection areas, and the best. However, the site is not available because of the Vietnamese laws, which prohibit construction of any structure within the dike system of Red River.

All the candidate sites except for Lam Du and Tay Mo are on agricultural land where there are no houses located. The cost of land acquisition may not differ extremely by site.

3.3.2 Environmental and other criteria

The following problems may occur in connection with waste transfer system. Some of the problems may be eliminated or reduced by appropriate design.

a) bad smell generated from solid waste transported
b) contamination of soil or groundwater with leachate (dirty water) that may be generated from waste dumped.
c) noise of trucks driving in and out of transfer station
d) additional traffic load that may be added to some congested roads

(1) Bad smell generated from solid waste transported

Intensity of smell depends on distance from source, waste conditions, and wind direction. Waste smell may reach a few hundred meters from the source. Proposed waste transfer station is planned in such a way as to reduce the impact of bad smell by 1) transporting all waste within 24 hours from transfer station to Nam Son, and 2) considering wind directions.

(2) Contamination of soil or groundwater with leachate

The proposed transfer stations are planned in such a way as to minimize this impact by 1) providing concrete floor in places wherever waste contacts ground, and leachate collection and storage facility, and 2) transporting collected leachate by lorry to a leachate treatment facility in Nam Son.

(3) Noise of Trucks Driving In and Out of Transfer Station

Judging from estimated average waste volume of 1,208 ton/day at the time of commencement of operation in the beginning of 2002, there will be about 300 round trips of the primary transport trucks per day, and 75 round trips of the secondary transport vehicles per day. Mitigation measures include 1) siting transfer stations at some distance from residential houses, and 2) reducing speed of vehicles.

(4) Additional traffic load that may be added to some congested roads

This problem may occur when primary transport vehicles pass the east bridges of the Red River (Chuong Duong Bridge) and a bridge (Cau Duong Bridge) over Duong River, a branch of the Red River as these bridges are congested from time to time. However this problem may not be significant. In principle, URENCO's primary transport vehicles are not operated during rush hours. Number of trips to be made by the secondary transport trucks is 75 trips/day, which is small relative to the existing traffic volume that may be of thousands of vehicles per day.

3.4 Site Evaluation and Selection

3.4.1 Evaluation Process

The key questions regarding the transfer system to be answered is where, how many, and when to provide transfer stations. The answer is directly connected to the objective of the transfer system, that is to minimize the overall cost of waste transport from collection areas to the planned landfill in Nam Son. JICA Study Team's answer is given in Item (5) of Section 3.4.2.

We will select suitable locations of transfer station through the following practical approach:

a) Comparison of options in terms of costs of overall transport
b) Elimination of some candidate sites due to some critical reasons
c) Consideration of non-costs aspects

3.4.2 Comparison of Options in terms of Overall Transport Costs

(1) Introduction

Table 3.4.1 presents comparison of overall transport costs by locations of transfer station. The overall transport cost consist of the primary transport cost and the secondary transport cost. The table lists the 12 cases including 10 candidate locations, no transfer station case (direct transport case), and the case where 2 locations, i.e., Dong Ngac and Duc Giang are developed.

The major assumption is that the transport costs depend largely on the transport distance. Costs are estimated based on application of the most economical transfer system as recommended in Chapter 8. After estimating overall transport cost for each case, the costs were converted into indices with the estimated cost of waste transport from collection areas to Tay Mo in the year 2002 being 100.

(2) Cost Comparison Result

Lam Du site (existing landfill site for demolition waste and soil waste) will offer the lowest overall transport cost. The cost index of Lam Du is 90.9, which is strikingly low. However, as explained earlier, the Authority of Dike Management and Flood Control will not permit HPC to use this location as a waste transfer station.

Co Nhue (Cost index: 107.5) is the second, and Xuan Dinh (109.0) is the third lowest. Dong Ngac (115.7) and Duc Giang (117.3), which have been selected jointly by HPC and the JICA Study Team during the 1st study mission in 1998, are fourth and fifth. Phu Thuong (122.4) is the sixth. Tay Mo (130.3) (existing landfill site) is the seventh. Noi Du (141.0) is the eighth, Tam Hiep (141.4) is the ninth. Lai Hoan (172.6) is the most costly among the 10 candidate locations.

An important result is that the case of no transfer station (direct transport to Nam Son) is more costlier than any other cases with transfer station. The cost index of the direct transport case is 242.1. One point difference in the cost indices represents $45,400/year.

All 10 candidate locations will require some costs for providing access. In particular, Lai Hoan needs construction of a new 2.4 km long road. Provision of access will take different forms including road widening, new road construction, fly-over bridge construction, adjustment with some other roads, land purchase, and removal of some houses if necessary. Costs of provision of access can be roughly estimated only after preparing access plan for each location. Access plan of some locations will partly depend on road development plan in the surrounding areas.

(3) Major Assumptions

Transport costs for each case are estimated based on the following major assumptions:

1) Transport cost will largely depend on the transport distance in long term.
   a) Long term cost elasticity to primary transport distance:
      0.8 except the case of direct transport to Nam Son
      0.7 in case of the direct transport to Nam Son
   b) Long term cost elasticity to secondary transport distance: 0.8
2) In the long term, transport costs significantly depend on transport distance and time, which then is affected by traffic congestion and bad road conditions. Transport distance for each case will be adjusted in case of passing congested or bad roads. Adjusted length will be used as a base of cost calculation. Particular adjustments of transport lengths are as follows.

a) 15% is added to the length of transport passing Chuong Duong bridge due to congestion.
b) 15% is added to length of transport passing Cau Duong bridge due to congestion.
c) 10% is added to transport length from the city center to Phu Thuong, and 20% is added to length of transport from Phu Thuong to Nam Son due to poor road conditions.
d) 20% is added to the length of transport from Lai Hoan to Nam Son due to bad access condition.
e) 12% is added to the length of transport to and from Tam Hiep due to poor access.

3) Base cost of primary transport in 2004 with a transfer station in Tay Mo is $6,017,000/year. See below for calculation.

4) Base cost of the secondary transport in 2004 with a transfer station in Dong Ngac is $ 1,434,000/year. See below for calculation.

(4) Explanation, Detailed Assumptions and Calculations

1) Explanation about long term transport cost elasticity to transport distance

In general, during a short period, it may be possible to do more work than usual. However, if "more work" becomes a usual amount of work, then, a new expanded arrangement has to be made to do "more work" in a usual working condition. Same thing can be said to the waste transport arrangement. When the waste transport volume increases quickly or the transport distance gets longer, transport of waste can be arranged by increases of trips or longer working hours. In this case, a proportion of actual incremental cost during a short period, could be much less than a proportion of incremental waste volume or incremental travelling distance. However, in the longer term, number of workers and maintenance facilities will gradually increase to cope with the new situation in a regular manner. The longer term transport cost elasticity to transport distance is assumed to be 0.8 based on the following conditions:

a) Much of the waste transport costs are highly related to distance traveled by vehicles. For example, fuels costs are highly co-related to the travelling distance. Life period of a vehicle is also closely co-related to cumulative travelling distance of the vehicle. Longer the travelling distance, less the number of trips (between collection areas and transfer stations), which will lead to increasing demand for more vehicles and workers in order to transport same amount of waste.

It is assumed that this portion of the cost (cost of fuels and vehicle depreciation, etc.) shares 80 % of the total cost of waste transport by trucks. And, it is assumed that the long term cost elasticity of this portion of cost is 0.85, which means that the cost will increase by 8.5 % in the long term in case travelling distance increases by 10 %.

Other costs such as general administration and garage costs are less responsive to the travelling distance. However, in the long run, increases in workers and vehicles will gradually demand a larger cost of administration and other costs.

It is assumed that this portion of the cost (cost of administration and others) shares 20 % of the total cost of waste transport. And, it is assumed that the long term cost elasticity of this portion of cost is 0.6, which means that the cost will increase by 6 % in the long term in case travelling distance increases by 10 %.

c) Based on assumptions a) and b), the cost elasticity to travelling distance on weighted average is estimated to be 0.80 by the following formula: 0.85 x 80% + 0.6 x 20% = 0.68 + 0.12 = 0.80.

d) In case of the direct transport to Nam Son, it is assumed that the following formula may be more relevant: 0.75 x 80% + 0.5 x 20% = 0.6 + 0.1 = 0.7

2) Adjustment due to traffic congestion and bad road conditions

In addition to travelling distance, travelling time is also a very important factor affecting transport efficiency, and therefore transport costs. More time spent for one trip, the less number of trips, which then will necessitate more number or vehicles and workers to do the same job. Traffic congestion happens quite often at both Chuong Duong bridge and Cau Duong bridge. The existing roads to and from Phu Thuong are poor. In particular, the road from Phu Thuong to Tang Long bridge is bad, and takes a lot of time to travel. Lai Hoan is extremely difficult to reach by a car. The 10 – 20 % adjustments shown earlier are made based on these conditions.

3) Cost of URENCO's primary transport

URENCO currently transports collected waste to Tay Mo landfill. URENCO's current cost of transporting solid waste excluding demolition/soil waste will be used as a base. It is assumed that such cost (excluding manual collection activities) will comprise of 1) 50 % of URENCO's total SWM operation costs and 2) annual depreciation of primary transport equipment. (It is assumed that the remaining 50 % of the URENCO's total SWM operation costs are used for other activities such as manual waste collection activities,

street sweeping and cleaning, collection of septage, collection of demolition waste/soil waste, and composting.) Annual depreciation cost will be measured in terms of cost of replacement of the existing vehicles. Vehicle use period is assumed to be 10 years.

a) 1998 URENCO's total SWM operation expenditure (planned budget) excluding depreciation of equipment: 74,000,000,000 Dong/year = $5,286,000/year (at 14,000 Dong/$)
b) 1998 URENCO's cost of depreciation of primary transport vehicles is assumed to be $ 960,000. ($68,600/vehicle x 140 vehicles) ÷ 10 years of use period = $960,000/year
c) 1998 URENCO's primary transport cost = 1/2a + b = ($5,286,000/year x 1/2) + $960,000/year = $2,643,000/year + $960,000/year = $3,603,000/year

Adjustment due to future increase in waste collection quantity:

a) 1998 URENCO collection quantity: 960 ton/day
b) 2005 URENCO collection quantity: 1,600 ton/day
c) Growth rate: 1,600 ton/960 ton = 167%
d) 2005 URENCO Primary transport cost = $3,603,000/year x 167% = $6,017,000

4) Cost of URENCO's secondary transport

The secondary transport cost will be calculated assuming that the most economical transfer system is used. Based on the result of the study shown in Chapter 8, unit cost of the most economical transfer system is $3/ton. Annual cost of the secondary transport is estimated to be $1,752,000/year. ($3/ton x 1,600 ton/day x 365 days/year)

(5) Special Consideration by HPC on the 3 Locations: Lam Du, Co Nhue & Xuan Dinh

Though Lam Du, Co Nhue, and Xuan Dinh are highly ranked, HPC expressed, in the process of evaluation in 1998, that they would not be suitable as transfer station locations due to some problems and concerns shown below:

Lam Du:

Lam Du (the existing landfill site for demolition waste/soil waste) is very near to the city center, and the best location that offers the lowest transport cost. However, the Authority of Dike Management and Flood Control told that there are Vietnamese laws that stipulate that no structure can be constructed within the dike system of the Red River as any structure can affect flow of water in case of flood. (Affected flow may damage the dike system.) The Authority said that because of

this reason it is difficult for the Authority to give a permission to HPC to use this location as a site for waste transfer station.

Comment by the JICA Study Team:

The cost difference between the two cases of Lam Du (1st ranked) and Dong Ngac (4th ranked) is $1,402,000/year ($7,234,000/year - $5,832,000/year) or $1,4020,000 for 10 years. This cost is the opportunity cost of selecting Dong Ngac instead of Lam Du. This cost is the cost of avoiding an increase in the risk of adverse effects on the dike system and resulting higher flood risk. A high level policy judgment should be based on the evaluation of the cost ($1,402,000/year) and the benefit (lowering of the flood risk by certain degree) associated with non-use of Lam Du location as a transfer.

The value (benefit) of lowering a flood risk is not unlimited. The value may be assessed by degree (magnitude) of risk reduction. Another thinking is that the amount ($1,402,000/year) saved by using Lam Du site can be used for strengthening the dike system to lower the risk of flood. It is rational to compare 1) magnitude of flood risk increase due to the use of Lam Du site, and 2) magnitude of flood risk reduction that is made possible by using the saved amount for the strengthening of the dike system. If the latter is larger than the former, then, Hanoi citizens will be better off by using Lam Du site as a waste transfer station, and by using the saved amount for the strengthening of the dike system.

Because there are already numerous structures (houses, etc.) constructed within the dike system, the construction of a transfer system in Lam Du will just add one more structure to already existing numerous structures. Magnitude of an increase of flood risk associated with the use of the Lam Du site as a transfer station would not be large.

Co Nhue and Xuan Dinh

Co Nhue (2^{nd} ranked) is located on the east side of the highway several hundred meters to the south of the Tang Long bridge, while Xuan Ding (3^{rd} ranked) is located near the Co Nhu, on the west side of the same highway. Concerned HPC officials posed a concern that these locations can be visually seen by highway passengers including VIPs coming from the airport.

In addition, Co Nhue has the following disadvantages. Co Nhue is a part of the planned future business center development area. There is also a possibility of conflicting with a plan of future road development around this area.

Comment by the JICA Study Team:

HPC made the above comments in 1998 before we started discussing the specifications and environmental protection measures concerning the transfer

station. Through the discussions with TUPWS on the transfer station held in 1999, it was decided that the transfer station should be a closed type with roof and walls surrounding the transfer structure. Therefore the waste and waste transfer operation cannot be seen from outside. The transfer station will be fenced, and green trees will be planned around the site. The transfer station will not present an ugly sight to the outside people.

A transfer station would require an area of only 6 ha or so, therefore, use of a land for transfer station would not affect the future business center plan.

(6) Suitable Candidate Locations

After eliminating the 3 locations, i.e., Lam Du, Co Nhue and Xuan Dinh, HPC considered that Dong Ngac (4th ranked) in the west and Du Giang (5th ranked) in the east are better and more suitable than any other remaining candidate locations. See the table below.

Candidate Locations Selected after Evaluation of the 10 Sites

Candidate Site (No. in brackets are those In the Location Map)	Total Transport Cost (1000$/year)	Total Cost Index	Overall Cost Ranking	Locations Considered Not Suitable By HPC in 1998	Locations Selected as Suitable Sites
1. Lam Du (East) (9)	5,832	96.9	1	√	
2. Co Nhue (West) (3)	6,748	112.1	2	√	
3. Xuan Dinh (West) (2)	6,837	113.6	3	√	
4. Dong Ngac (West) (1)	7,234	120.2	4		√
5. Dong Ngac& Duc Giang	7,360	122.3	5		√
6. Duc Giang (East) (6)	7,378	122.6	6		√
7. Phu Thuong (West) (5)	7,711	128.2	7		
8. Tay Mo (West) (4)	8,179	135.9	8		
9. Noi Du (East) (7)	8,746	145.3	9		
10. Tam Hiep (South) (10)	9,043	150.3	10		
11. Lai Hoan (East) (8)	10,693	177.7	11		
12. No Transfer Station	17,416	289.4	12		

Note: The base index (100) of the above shown indices is the estimated future (2002) cost of waste transport from the collection areas to Tay Mo.

3.4.3 Choices between One or Two Transfer Stations

(1) Principle

Locations and number of transfer stations should be decided in such a manner as to minimize the aggregate cost of waste transport comprising primary transport (from collection areas to a transfer station) and secondary transport (from a transfer station to Nam Son landfill site).

(2) Two Options

There are two main routes from the urban areas (7 urban districts) to Nam Son, i.e., a route through Tang Long Bridge (west side) and a route through Chuong Duong bridge (east side).

Dong Ngac case will use Tang Long Bridge for secondary transport, and Duc Giang case will use Chuong Duong bridge for secondary transport.

Taking into account this situation, a feasible option is either to have one transfer station in Dong Ngac (Option A) or two transfer stations in Dong Ngac and Duc Giang (Option B).

Option A: Use of 1 location in Dong Ngac only

Option B: Use of 2 locations, i.e., Dong Ngac and Duc Giang

The cost conditions of the two options are summarized in the following table:

Title

	Option A (Dong Ngac only)	Option B (Dong Ngac & Duc Giang)
1. Primary transport cost	Higher than Option B	Lower than Option A
2. Secondary transport cost	Lower than Option B	Higher than Option A
3. Total transport cost (1+2)	Do not know.	Do not know.

The primary transport cost is lower with Option A than Option B, while, the secondary transport cost is lower with Option B than Option A. Decision can be made only when we know the total cost of both primary and secondary transport.

The following table shows results of calculation of the relevant costs.

Title

Unit: US $ 1000/year in 1999 price

	Option A (Dong Ngac only)	Option B (Dong Ngac & Duc Giang)	Difference between Options B and A (Option B – Option A)
1. Primary transport cost	5,482	4,948	- 534
2. Secondary transport cost	1,752	2,412	660
3. Total transport cost (1 + 2)	7,234	7,360	126

Note: The above costs are estimated based on the estimated waste transport amount of 1,600 ton/day, which is the capacity of the transfer system planned.

Primary Transport Costs:

The reason why the primary transport cost is lower with the use of two transfer stations than the use of one transfer station is that it is possible to choose one of the two locations whichever is nearer to collection area under the case of two transfer stations. In view of the geographic configuration of the urban areas, Duc Giang (east) is more advantageous, than Dong Ngac (west), for primary transport of waste

collected from Hoan Kiem district, while Dong Ngac will be more advantageous for primary transport of waste collected from all the other 6 urban districts.

Secondary Transport Costs:

On the other hand, the total secondary transport cost will be lower in the case of one transfer station than the case of the two transfer stations because of scale of economy and avoidance of some duplications in investments. In case of two transfer stations, two sets of most things have to be provided; two managers, two garages, two systems of weigh bridge are required while one set is enough in case of one transfer station. Between the two locations of Dong Ngac and Duc Giang, Dong Ngac will offer lower secondary transport because Dong Ngac is nearer to Nam Son landfill site, and the condition of road from Dong Ngac is better than that of Duc Giang.

Total cost of transport with Option A is lower than Option B by $126,000/year as shown in the above table. Also, investment cost alone is $3.4 million lower with Option A ($13.4 million) than Option B ($16.8 million).

(3) Conclusion

Option A (to have one transfer station in Dong Ngac) is more economical than Option B (to have two transfer stations: one in Dong Ngac and one in Duc Giang). In addition, if a transfer station is provided at Duc Giang, primary waste transport trucks have to use Chuong Duong Bridge, and will aggravate traffic congestion at the bridge area where there already exists traffic congestion.

3.4.4 Recommended Strategy

The best strategy for HPC is to construct one transfer station in Dong Ngac and transport all collected waste to Dong Ngac. HPC should construct it as soon as possible after acquiring necessary fund and land.

Exact Location of Transfer Station in Dong Ngac

Availability of the land can only be confirmed when HPC actually negotiate with local residents. A specific area in Dong Ngac has been identified and suggested by this Study. However, if the identified specific area is not available, HPC should try to find other area in Dong Ngac. An alternative site (referred to as Dong Ngac II) is shown in Fig. 8.4.3. It is recommended that HPC acquire this area in case the area identified (referred to as Dong Ngac I) is not available.

As is the case with Dong Ngac I, Dong Ngac II is an agricultural field (paddy field), and there are no houses found. There would not be much difference between Dong

Ngac I and Dong Ngac II in terms of costs required for arranging access road to Dong Ngac II from the highway.

Co Nhue and Xuan Dinh

As has been shown earlier, Co Nhue and Xuan Dinh are even more economical than Dong Ngac. But in 1998, HPC considered that they are not suitable as these two sites can be seen from the highway passengers. In 1999, main specification of the transfer station was finalized. According to the agreed specification, the waste transfer structure will be provided with a roof and walls surrounding it, and therefore the highway passengers would not see the waste in the transfer station.

Another reason why HPC considers that Co Nhue is not suitable is that Co Nhue is a part of the future business center area according to the city plan 2020. However, a transfer station would occupy a land of only 6 ha or so, and therefore it would not affect the city plan.

It is advised that HPC should consider the use of one of these two locations, particularly Co Nhue, if HPC would face difficulty in obtaining land of Dong Ngac.

Lam Du

As has been already shown earlier, Lam Du is of the least cost among all the candidates identified. Overall transport cost would be minimized with selection of Lam Du. The problem is that the Ministry of Agriculture considers that the construction of a transfer station in Lam Du is against the laws which stipulate that no structures can be constructed within the dyke system of Red River. However, the real adverse effect that a transfer station gives to the stream of water is considered small, and therefore it is advised that HPC should re-consider the possibility of use of Lam Du, particularly in case HPC would face difficulty in obtaining lands (Dong Ngac, Co Nhue, Xuan Dinh) on the west route.

Table 3.4.1 Comparison of 10 Locations in terms of Distance and Transport Costs

Candidate Site (No. in brackets are those in the Location Map) a	Primary Transport Distance from City Center (km) b	Secondary Transport Distance from City Center (km) c	Adjusted Primary Transport Length d	Adjusted Secondary Transport Length e	Primary Transport Cost (1000$/year) f	Secondary Transport Cost (1000$/year) g	Total Transport Cost (1000$/year) h	Total Cost Index i	Overall Cost Ranking j
1. Lam Du (East) (9)	6	46	6.9	52.9	3,510	2,322	5,832	**96.9**	1
2. Co Nhue (West) (3)	11.2	38.9	11.2	38.9	4,947	1,800	6,748	**112.1**	2
3. Xuan Dinh (West) (2)	11.5	38.6	11.5	38.6	5,048	1,789	6,837	**113.6**	3
4. Dong Ngac (West) (1)	**12.8**	**37.6**	**12.8**	**37.6**	**5,482**	**1,752**	**7,234**	**120.2**	**4**
5. Dong Ngac & Duc Gian	(2 sites)		11.2	39.3	4,948	2,412	7,360	**122.3**	4.5
6. Duc Giang (East) (6)	10.7	39.9	12.3	45.9	5,317	2,061	7,378	**122.6**	5
7. Phu Thuong (West) (5)	11.6	42.3	12.8	50.8	5,469	2,243	7,711	**128.2**	6
8. Tay Mo (West) (4)	14.4	48.6	14.4	48.6	**6,017**	2,162	8,179	**135.9**	8
9. Noi Du (East) (7)	13.3	35.2	17.6	35.2	7,083	1,663	8,746	**145.3**	7
10.Tam Hiep (South) (10)	13.3	61.2	14.9	67.3	6,183	2,860	9,043	**150.3**	9
11. Lai Hoan (East) (8)	17.0	36.3	22.5	43.6	8,719	1,974	10,693	**177.7**	10
12. No Transfer Station	(Direct)		48.5	0	17,416	0	17,416	**289.4**	11

Note: The city center is assumed to be Hoan Kem District.