CHAPTER 5 WATER QUALITY IMPROVEMENT PLAN FOR LAKES AND CHANNELS

5.1 Problems Associated with Water Quality Conservation

5.1.1 Existing Environmental Condition

(1) Lakes

Table 5.1.1 and Figure 5.1.1 summarize the characteristics and locations of major lakes in the Study Area. Most lakes in the urban area of Haiphong are heavily polluted by inflow of untreated sewage. The levels of BOD are as high as 150 mg/l or higher, and have exceeded the environmental standard for surface water, TCVN 5942-1995 (25 mg/l for BOD), several times. Large fluctuations in water quality due to tidal mixing were also noted. Some lakes (e.g., Tien Nga Lake) are densely covered by water hyacinth, and exhibiting the characteristics of entrophication. The levels of nutrients are in the order of 30-50 mg/l for T-N and 1-5 mg/l for T-P. Water pollution of these lakes in the urban area must be controlled urgently. Water quality of lakes in less densely populated area, such as Do Son (e.g., Dan Tu Lake) and Kien An (e.g., Ngoc Son Lake) are better, although localized pollution is progressing.

(2) Channels

Table 5.1.2 and Figure 5.1.1 summarize the characteristics and locations of major channels in the urban area. Most channels in the urban area are heavily polluted by sewage, and the levels of many pollutants exceed the Vietnamese surface water standards. Typical ranges are BOD (50-100 mg/l), COD (100-150 mg/l), T-N (5-30 mg/l) and T-P (1-3 mg/l) depending on the tidal condition. DO level is generally low, and sediment is exhibiting anaerobic condition. Large sections of these channels are densely covered by water hyacinth. Channels in urbanized area of Do Son and Kien An are also polluted by sewage. However, the quality of water in irrigation channels in agricultural area is still relatively good compared with the quality of the channel waters in the urban areas.

5.1.2 Lake and Channel Management

(1) Functions of Lakes and Channels

Lakes and channels in the Study Area have a number of important functions as summarized below.

Functions of Lakes and Channels

Function	Remarks
Drainage	Lakes and channels play important roles in draining stormwater/sewage, and regulating the water levels.
Agriculture/ Aquaculture	Water in lakes and channels is used for irrigation, cultivation of aquatic vegetables and aquaculture.
Recreation	Lakes and channels, e.g., Quan Ngua Lake, have high recreational values.
Environment	Lakes and channels provide natural capacity to purify polluted water. Provide habitat for aquatic species

The organization responsible for the management of a given lake or channel is determined by the primary function of the lake or channel. Table below summarizes the organizations involved in management of lakes and channels.

Organizations involved in Management of Lakes and Channels

Function	Urban Districts	Other Area
Drainage	SADCO, Municipality	Local Public Works Company, Municipality
Agriculture	DARD	DARD
Recreation	Park Company	Municipality
Environment	DOSTE	DOSTE, Municipality

(2) Management Issues

Depending on the functions of lakes and channels, the management objectives are different. For example, the water level is usually kept high in an irrigation channel in order to provide sufficient irrigation water for agricultural activities. The water level of a recreational lake is also kept high for recreational and aesthetic reasons. On the other hand, the water level of a drainage channel should be kept low to enable efficient drainage of storm water.

As long as the function of a lake/channel is simple, it is relatively easy to optimize management operation. However, because most channels and lakes in Haiphong area have multiple-functionality, the responsibilities overlap, and are often not clear.

For example, An Kim Hai Channel, which was originally constructed as an irrigation channel, has been managed by DARD. However, due to the urbanization of the area, the irrigation function of the channel has diminished, and its function has shifted to wastewater drainage. Hence, the responsibility to manage An Kim Hai Channel may be transferred to SADCO. Similarly, An Bien Lake is currently managed by the Park Service for recreation, although the storm water drainage/regulating function of the lake should not be neglected.

Under the current management, the various functions of lakes and channels are not clearly defined, and there is not enough coordination among relevant organizations.

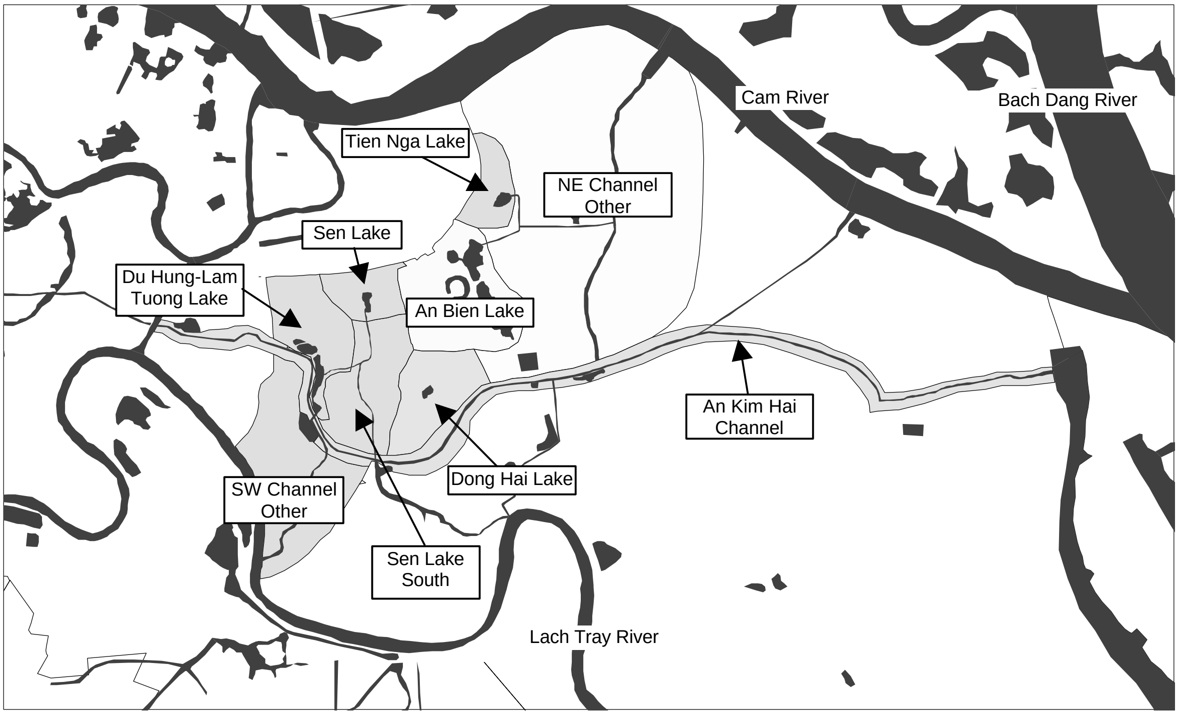
5.2 Expected Degradation of Water Quality

In order to estimate the anticipated degradation of water quality of lakes and channels in the future, pollution loads to major channels and lakes in the urban Haiphong area were analyzed. In this analysis, pollution loads from (i) domestic, (ii) industrial, (iii) commercial, (iv) livestock, and (v) non-point sources were estimated for the basins of the following channels and lakes.

Selected Channels and Lakes for Pollution Load Analysis

Channel System	Sub-basin/Lakes
NE Channel	An Bien Lake, Tien Nga Lake, other area
SW Channel	Sen Lake, Du Hang and Lam Tuong Lake, and other areas
An Kim Hai Channel	Direct catchment area of the channel and Dong Hai Lake basin

Figure below shows the locations of the selected channel and lake basins in urban Haiphong area.



Locations of Selected Channel and Lake Basins in Urban Haiphong

The details of the analysis are given in Section 10.5. The following tables summarize the anticipated pollution loads to channels and lakes in 1999, 2010 and 2020 (without Project cases).

Pollution Loads to Channels and Lakes: BOD and SS (kg/day)

Channel	Sub-basin	BOD			SS		
		1999	2010	2020	1999	2010	2020
NE Channel	An Bien-Mam Tom Lakes	1,402	1,533	1,969	1,670	1,795	2,173
		(100 %)	(109 %)	(140 %)	(100 %)	(107 %)	(130 %)
	Tien Nga Lake	459	510	516	558	610	611
		(100 %)	(111 %)	(113 %)	(100 %)	(109 %)	(110 %)
	Other	3,093	4,091	5,059	5,037	6,100	7,069
		(100 %)	(132 %)	(164 %)	(100 %)	(121 %)	(140 %)
	Total	4,954	6,134	7,544	7,265	8,505	9,854
		(100 %)	(124 %)	(152 %)	(100 %)	(117 %)	(136 %)
SW Channel	Sen Lake	598	675	802	669	749	861
		(100 %)	(113 %)	(134 %)	(100 %)	(112 %)	(129 %)
	Du Hang-Lam Tuong Lakes	1,071	1,233	1,459	1,195	1,359	1,560
		(100 %)	(115 %)	(136 %)	(100 %)	(114 %)	(131 %)
	Sen Lake South Basin	572	872	1,254	882	1,295	1,770
		(100 %)	(152 %)	(219 %)	(100 %)	(147 %)	(201 %)
	Other	194	496	753	676	937	1,154
		(100 %)	(255 %)	(388 %)	(100 %)	(139 %)	(171 %)
	Total	2,436	3,276	4,268	3,422	4,341	5,345
		(100 %)	(134 %)	(175 %)	(100 %)	(127 %)	(156 %)
An Kim Hai Channel	An Kim Hai Channel	659	1,094	1,394	1,208	1,626	1,901
		(100 %)	(166 %)	(211 %)	(100 %)	(135 %)	(157 %)
	Dong Hail Lake	400	645	977	619	841	1,133
		(100 %)	(161 %)	(244 %)	(100 %)	(136 %)	(183 %)
	Total	1,059	1,740	2,371	1,827	2,468	3,034
		(100 %)	(164 %)	(224 %)	(100 %)	(135 %)	(166 %)

Pollution Loads to Channels and Lakes: T-N and T-P (kg/day)

Channel	Sub-basin	T-N			T-P		
		1999	2010	2020	1999	2010	2020
NE Channel	An Bien-Mam Tom Lakes	277	306	395	38	44	53
		(100 %)	(110 %)	(143 %)	(100 %)	(115 %)	(137 %)
	Tien Nga Lake	90	102	104	14	15	15
		(100 %)	(113 %)	(115 %)	(100 %)	(107 %)	(111 %)
	Other	645	842	1,032	116	140	160
		(100 %)	(131 %)	(160 %)	(100 %)	(121 %)	(138 %)
	Total	1,012	1,250	1,530	168	199	227
		(100 %)	(124 %)	(151 %)	(100 %)	(118 %)	(135 %)
SW Channel	Sen Lake	121	137	162	16	17	20
		(100 %)	(112 %)	(134 %)	(100 %)	(105 %)	(127 %)
	Du Hang-Lam Tuong Lakes	218	251	295	29	34	37
		(100 %)	(115 %)	(135 %)	(100 %)	(117 %)	(129 %)
	Sen Lake South Basin	120	186	266	18	31	45
		(100 %)	(155 %)	(222 %)	(100 %)	(168 %)	(248 %)
	Other	50	109	158	11	19	26
		(100 %)	(220 %)	(318 %)	(100 %)	(176 %)	(234 %)
	Total	509	682	881	74	101	129
		(100 %)	(134 %)	(173 %)	(100 %)	(136 %)	(173%)
An Kim Hai Channel	An Kim Hai Channel	140	226	285	24	31	40
		(100 %)	(161 %)	(203 %)	(100 %)	(130 %)	(169 %)
	Dong Hail Lake	83	134	199	13	19	28
		(100 %)	(161 %)	(239 %)	(100 %)	(150 %)	(219 %)
	Total	224	360	484	36	50	68
		(100 %)	(161 %)	(216 %)	(100 %)	(137 %)	(186 %)

Unless some environmental measures are taken, the pollution loads to these lakes and channels would increase considerably in the next 20 years. The rates of increase vary from sub-basin to sub-basin. Pollution loads would increase 100 % or more in the south and east of the existing urban area (e.g., Sen Lake South Basin area, Dong Hai Lake area, west of Ngo Quyen District) where the population is expected to grow rapidly. On the other hand, pollution loads in already developed areas such as Sen Lake area and An Bien-Mam Tom Lake area, will be limited.

5.3 System and Facility Measures

5.3.1 Targets and Principles for Improvement

(1) Water Quality Target

The surface water quality standard for Vietnam is TCVN5942-1995[1]. The ultimate target is "the attainment of water quality standard by 2020".

(2) Principles

1) Environment-oriented Considerations

Among the various functions of lakes and channels, the following Section mainly focuses on the improvement of environmental and recreational conditions, including water quality, sediment quality, odor, amenity, and aesthetic aspects.

2) Coordination with Sewerage Plans

The main pollution mechanism of lakes and channels in urban Haiphong is the inflow of untreated sewage. Hence, the most effective measure to improve water quality of the lakes and channels of Haiphong will be development of the sewerage system[2], as described in Chapter 4. The measures proposed in this Section are designed to supply the sewerage plans to further improve water quality of lakes and channels.

3) Coordination with Drainage Plans

Due to the direct relationship with drainage, measures to rehabilitate drainage channels are discussed in the drainage section of the Master Plan channels including North-East Channel, South-West Channel, and An Kim Hai Channel.

5.3.2 Alternatives and Selection of the Optimum Measures

(1) General Strategies

The following table summarizes general strategies and examples of measures to control water quality of lakes and channels.

1 Ministry of Science, Technology and Environment (MOSTE) is currently reviewing the new environmental standard.

2 As assessed in Section 10.5, the proposed sewerage projects are expected to reduce pollution loads to lakes and channels by as much as 80 to nearly 100 %.

General Strategies and Facility Measures to Improve Water Quality

Strategy	Examples of Measures
Reduce external input of pollutant	sewerage, diversion, upstream retention, pre-treatment, etc.
Reduce internal source of pollutant	dredging, aeration, biological treatment, chemical control etc.
Accelerate outflow of pollutant	dilution, hydrological alteration, etc.

Source: Thomann and Mueller, 1987

(2) Selection Criteria

Considering the complex nature of the pollution problems in Haiphong and the multiple-functionality of lakes and channels, no single measure would be able to solve all water quality problems. Hence, a combination of measures was considered based on the following criteria:

- effectiveness of measure
- time required to implement the measure
- technical, financial, and institutional/organizational requirements to implement the measure
- availability of land
- existing and/or planned measures to improve water quality
- related measures proposed in other sectors of the Master Plan, including sewerage and drainage

(3) Existing Plans to Improve Water Quality of Lakes and Channels

The existing plans to improve water quality of lakes and channels are summarized in the Table below. These plans have a high possibility of being implemented, and thus are/were included in the Master Plan as given condition.

Existing Plans to Improve Water Quality of Lakes and Channels

Project Name	Components	Implementing Agency	Cost mill.US$
Vietnam Sanitation Project – Haiphong Component (1B)	- Rehabilitation of North-East and South-West drainage channels - Rehabilitation of Regulating Lakes (Thien Nga, Sen, Du Hang and Lam Tuong) - Sludge Disposal and Treatment	SADCo/ WB	0.96*
Rehabilitation of An Bien Lake and Mam Tom Lake	- Installation of sewer network around Ho An Bien and Ho Mam Tom to intercept sewage and storm water	Park Company	unknown

*: excluding land acquisition & compensation and purchase of equipment

These plans cover most of the heavily polluted lakes and channels in Le Chan and Ngo Quyen Districts. To our knowledge, there is no plan to rehabilitate the lakes and channels in Do Son and Kien An District.

(4) Selection of Optimum Measures

1) Measures to Reduced External Inflow of Pollutants

Development of the sewerage system is discussed in Chapter 4. In addition, it is recommended to construct interceptor sewer lines around lakes in the urban area. This idea was proposed in the 1B Project for Sen Lake and Tien Nga Lake, and by Park Service Company for An Bien and Mam Tom Lakes.

2) Measures to Reduce Internal Source of Pollution

Many lakes in the urban area have been heavily polluted by sewage and a thick layer of polluted sludge is deposited at the bottom of the lakes. Because bottom sludge is an important internal source of pollution, removal of deposited sludge, i.e., dredging, is desirable. Dredging will also help improve the water regulating/drainage capacities of lakes and channels.

The World Bank 1B Project has already proposed lake rehabilitation of Tien Nga Lake and Sen Lake, and reconstruction of the banks of Du Hang and Lam Tuong Lakes. Park Service also has a plan to rehabilitate Mam Tom and An Bien Lake. These projects are important for improving water quality of these lakes and were adopted to the Master Plan as they are.

If the proposed measures do not improve the water quality significantly, other measures, such as biological treatment (e.g., oyster-shell contact reactor, use of water hyacinth or duck weed, etc.) and aeration may be implemented.

3) Measures to Accelerate Outflow of Pollutant

The following three options to accelerate the outflow of pollutants from contaminated lakes and channels were compared.

Options to Accelerate Outflow of Pollutant

Option No.	Option Name	Remark
P3a	Strategic Operation of Drainage System for Water Quality Improvement	Outflow of polluted lake/channel water is accelerated by strategic operation of tidal gates and other drainage facilities
P3b	Dilution with Irrigation Water	Irrigation water from An Kim Hai Channel is used to flush out polluted lake/channel water.
P3c	Dilution with River Water	Water from Cam River or Lach Tray River is pumped in order to accelerate the outflow of polluted lake/channel water

Based on the estimated costs and advantages/disadvantages of each measure (see Table 5.3.1), "Strategic Operation of Drainage System for Water Quality Management (option P3a)" was selected as the primary option. This measure can be implemented within the general framework of drainage management with essentially no additional cost.

5.3.3 Preliminary Design and Cost Estimation for the Optimum Measures

Table 5.3.1 summarizes the environmental measures that are proposed in order to improve the water quality of lakes and channels.

(1) Construction of Interceptor Sewers around Lakes

1) Summary

Interceptor sewers (total 2.6 km) would be constructed around lakes in the urbanized area to prevent inflow of pollutants to the lakes. Although not the ultimate solution to water pollution problems, this measure can be implemented easily, and an immediate improvement in water quality can be expected.

2) Target Lakes

Based on the existing water quality, landuse, existing plans for water quality improvement, and other factors, the following lakes were selected as the target lakes.

Target Lakes for Construction of Interceptor Sewers

District	Name	Area (ha)	TCVN5942-1995
Ngo Quyen	Tien Nga Lake	2.5	not satisfied
	An Bien Lake	20	not satisfied
	Mam Tom Lake	2.1	not satisfied
Le Chan	Sen Lake	2.0	not satisfied

3) Necessity

The pollution of these lakes has already exceeded the environmental standard (TCVN5942-1995) several times. Also, these lakes are located in the urbanized area and have high recreational values. Improvement of water quality is urgently needed.

4) Project Components and Design Considerations

<u>Construction</u>: The estimated sewer length for each lake is given in the Table below. The design criteria shall be consistent with the sewerage plans[3]. The interceptor sewers shall be connected to the proposed sewer lines.

<u>O&M</u>: Regular maintenance/clean-up of the sewer lines is required.

5) Preliminary Cost Estimates

The estimated costs of the projects are given in the following Table.

[3] Intercepted wastewater must be diverted to public sewer line. The design capacity is dependent on the design of sewer network in the area. If it is difficult to control storm water, CSO control structures may be constructed around lakes.

Preliminary Cost Estimates for Construction of Interceptor Sewers

Component	Lake	Length (km)	Est. Cost*** (mill. US$)
Construction	Tien Nga Lake*	0.6	0.171
	Sen Lake*	0.4	0.100
	An Bien Lake and Mam Tom Lake**	1.6	0.458
	Sub-total	2.6	0.729
O&M (2001-2020)			0.038
Total			0.767

* : to be implemented as a part of 1B Project
** : to be implemented by Park Company
*** : direct construction cost and O&M cost
Source: Soil and Water, 1998

(2) Lake Rehabilitation Projects

1) Summary

Polluted sediment is dredged in order to reduce the release of nutrients from the sediment, and to restore regulating/drainage capacities of lakes.

2) Target Lakes

The following lakes shall be dredged soon to control water pollution problems. The decision to select these lakes was based on existing and anticipated future water/sediment qualities, recreational and environmental values of the lakes, stormwater regulating capacities, and existing plans to rehabilitate the lakes.

Target Lakes for Construction of Interceptor Sewers

District	Name	Area (ha)	Sludge Vol.* (m^3)	TCVN5942-1995
Ngo Quyen	Tien Nga Lake	2.5	15,000	not satisfied
	An Bien Lake	20	68,000	not satisfied
	Mam Tom Lake	2.1	9,000	not satisfied
Le Chan	Sen Lake	2.0	5,000	not satisfied
	Du Hang Lake	4.6	20,000	not satisfied
	Lam Tuong Lake	2.0	12,600	not satisfied

* : total sludge volume (not volume to dredge, Soil and Water, 1998)

3) Necessity

Pollution of these lakes has already exceeded the environmental standard (TCVN5942-1995) several times. Dredging is also needed to provide sufficient water regulating capacities.

4) Project Components and Design Consideration

Construction: The project components include dredging of bottom sediment, reconstruction of lakebed and bank, and construction of service roads. The volume of sediment to be dredged shall be decided based on the hydrological requirements for the drainage systems. Considering the ease of handling/transporting excavated sediment, dry excavation in the dry season is desirable. The dredged sediment shall be disposed of at the designated site in an environmentally-sound manner. Trang Cat Landfill is available for disposing of the dredged material for 1B Project. Technical details of dredging and disposal methods have been worked out in the 1B Project.

O&M: Once rehabilitated, the project requires regular maintenance of the service roads and control of illegal encroachment.

5) Preliminary Cost Estimates

The table below summarizes the estimated costs for the lake rehabilitation projects.

Preliminary Cost Estimates for Lake Rehabilitation Projects

Component	Lake	Area (ha)	Est. Cost*** (mill. US$)
Construction	Tien Nga Lake*	2.3	0.286
	An Bien Lake**	20.0	0.257
	Mam Tom Lake**	2.1	0.386
	Sen Lake*	2.0	0.136
	Du Hang and Lam Tuong Lake*	6.6	0.193
	Sub-total	33.0	1.258
O&M (2001-2020)			0.065
Total			1.323

* : to be implemented by SADCo as a part of 1B Project
** : to be implemented by Park Company
*** : direct construction cost and O&M cost
Source: Soil and Water, 1998

(3) Strategic Operation of Drainage System for Water Quality Management

1) Summary

The measure is based on strategic operation of tidal gates and pumping stations to flush polluted water out of lakes and channels. The high tidal amplitude in Haiphong provides a unique advantage to this option. Furthermore, this measure can be implemented within the general framework of drainage management with essentially no additional cost.

2) Target Lakes and Channels

The measure is applicable to all drainage systems that can be controlled by tidal gates and pumping stations.

Target Drainage System

District	Drainage System	TCVN5942-1995
Central 3 Districts	NE Channel System	not satisfied
	SW Channel System	not satisfied
	An Kim Hai Channel System	not satisfied
Kien An District	Kien An Drainage System	partially satisfied*
Do Son District	Do Son Drainage System	partially satisfied*

* : based on field observation

3) Necessity

All drainage systems in the urban area are heavily polluted, and water quality does not satisfy TCVN5942-1995.

4) Project Components and Design Consideration

Construction: None (see Chapter 3 for the rehabilitation and construction of drainage facilities)

O&M: The operation of tidal gates and pumping stations would be carefully controlled to flush out polluted water bodies and to introduce cleaner water. The quality of incoming water should be monitored.

5) Preliminary Cost Estimates

The measure can be implemented within the framework of general drainage management. No additional cost is considered here.

5.3.4 Phased Development and Disbursement Schedule

(1) Priority and Coordination with Other Projects

1) Construction of Interceptor Sewers around Lakes

The proposed measures have a high priority as temporary measures to protect the water quality of lakes and channels before the sewerage system is fully implemented. In addition, these projects have been already proposed by FINNIDA and Park Company, and can be implemented as scheduled. Hence, these measures should be implemented by 2005.

2) Lake Rehabilitation Projects

The proposed projects are essential components of 1B Project and the project proposed by Park Service Company. These projects shall be implemented as scheduled by 2005.

3) Strategic Operation of Drainage System for Water Quality Management

Development of the drainage system is a prerequisite to this measure. Hence, this measure will be fully implemented after the completion of the proposed drainage systems. Meanwhile, limited flushing can be carried out using the existing drainage systems.

(2) Implementation and Disbursement Schedule

Table 5.3.2 and Table 5.3.3 summarize the proposed implementation schedule and a preliminary disbursement plan.

5.4 Strengthening of Management and Manpower

5.4.1 Improvement of Management and Operation and Maintenance

(1) Proposed Regulations for Land, Water, and Ecological Resource use in Haiphong's Lakes, Rivers, and Channels

In Haiphong City, SADCO is responsible for managing, maintaining, protectins and developing the drainage system including rivers, lakes, and channels. This responsibility is focussed on maintaining the hydrologic function of the drainage system. There are no specific regulations for environmental protection of lakes, rivers, and streams.

It is proposed that the Haiphong People's Committee (HPPC) should prepare a decision to regulate and control all activities that use or affect Haiphong's lakes, rivers, and drainage channels . This decision should include provisions for:

- a survey and evaluation of lakes, rivers, and streams to determine the value of different ecosystems
- initial guidance on the implementation of GOV law and policy with respect to Haiphong's lakes, rivers, and streams
- planning requires to make the best use of each lake or river
- allocation of proper regulatory authority to responsible agencies

1) SADCO Responsibilities

Under these proposed regulations, SADCO will retain responsibilities for protection of the drainage system and will be given specific responsibilities and authorities for:

- managing water levels
- managing flow rates
- determining the capacity (area and volume) of lakes, rivers, streams, and ponds needed for drainage

2) Land Use Control

To prevent further degradation and to promote restoration of water bodies, the regulations will provide for specific control of:

- in-filling of water bodies
- solid waste dumping
- construction of new facilities or renovation of existing facilities or near water bodies

These land use controls will reduce the impact of land use changes on the drainage system and its flood control functions.

3) Consultation with SADCO prior to Approval

The regulations will mandate the responsibilities of planning agencies (DPI, UPI) and operating agencies (e.g. agencies under TUPWS) to consult with SADCO before approval or constructing any infrastructure or other facilities in areas deemed important for protection of the drainage system. The SADCO will assess whether or not these facilities may impair the flood control and drainage functions.

(2) Cooperation with MARD on Flood Control Measures and Water Resource Information Systems

Floodwater and wastewater from the Haiphong drainage system discharges into Cam and Tam Bac rivers under the management of MARD. The Water Resources Law (1998) assigns responsibilities to MARD for:

- approval of river basin planning and hydraulic works planning as authorized by the Government
- basic survey, inventory and evaluation of water resources
- planning, approval and supervision of the implementation of the river basin planning
- cooperation with related agencies on basic survey, inventory and evaluation of water resources
- flood prevention committees, which are responsible for guiding the flood prevention and overcoming the damage caused by floods

It is recommended that a coordination mechanism be established to develop technical agreements concerning:

- operation and management of pumping stations and floodgates
- flood prevention activities
- flood forecasting and warning systems
- collection and exchange of information and data

5.4.2 Manpower Training

In general there are two areas that need strengthening: 1) environmental monitoring; and 2) ecological management of water bodies. It is not possible to clarify recommendations for training because of the unclear responsibilities and complete absence of an integrated approach to environmental management and protection of the lakes and channels. However, one of the responsible agencies that dearly needs capacity building and training is the Haiphong DOSTE.

(1) Upgrading Capacity for Environmental Monitoring

DOSTE is mandated for environmental monitoring but lacks the capacity to conduct effective programs. Monitoring programs are needed to better assess ambient water quality and existing pollution loads in surface waters better. In addition, without effective monitoring to evaluate the achievement of environmental goals and objectives, it will not be possible to evaluate the effectiveness of improvements to sewerage and drainage. In the short term, regular routine monitoring is needed to develop a better and more accurate understanding of the existing environmental conditions and to assess seasonal changes and trends over time.

The Viet Nam Canada Environment Project is providing training and technical support to the Haiphong DOSTE's environmental monitoring programs.

Table 5.1.1 Characteristics of Major Lakes in Study Area (17/2)

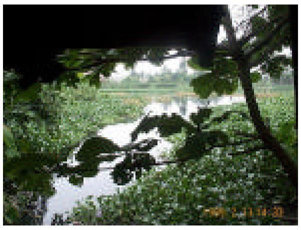
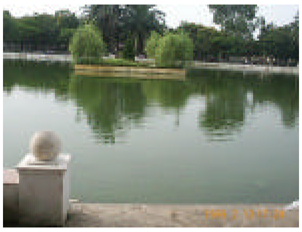
Photograph	Name	Description	Water Quality** (mg/l)	Sed. Quality** (mg/kg)
	Tien Nga Lake Area:2.5 ha Vol.*:50,750 m^3 Depth:2.3 m	Tien Nga Lake is located in the north-east of An Bien Lake, and is connected to the NE channel system. The lake is heavily polluted, and thickly covered by water hyacinth.	BOD: 138-181 COD: 224-231 SS: 98-125 T-N: 52.5-54.0 T-P: 3.8-4.2	Depth: 30cm Vol.Solid:27% T-N:2630 T-P:4340 Cd:2.2 Pb:22 Hg:0.82
	An Bien Lake Area:20 ha Vol.*:260,000m^3 Depth: 1.3m	An Bien Lake is the largest lake in the urban center, consisting of three parts, and discharges to the NE channel. It has been used for fish and shrimp farming. Currently, it is under the control of Park Company.	BOD: 49-58 COD: 96-99 SS: - T-N: 53-64 T-P: -	Depth: - Vol.Solid: - T-N: - T-P: - Cd: 16-21 Pb: 185-514 Hg: 5.8-12.5
	Quan Ngua Lake Area:2.5 ha Vol.*:43,000 m^3 Depth 1.2 m	Quan Ngua Lake is a small, circular lake next to An Bien Lake. The lake is under the control of Park Company, and has been rehabilitated recently.	No recent data available	No recent data available
	Sen Lake Area: 2.0 ha Vol.*: 20,800 m^3 Depth: 1.4 m	Sen Lake is a small, square lake in Le Chan District. It is one of the most heavily polluted lakes in the area.	BOD: 46-94 COD: 128 SS: 69-104 T-N: 31.5-33 T-P: 2.2-3.6	Depth: 60cm Vol.Solid:24% T-N:1650 T-P:2852 Cd:1.6 Pb:405 Hg:0.68
	Lam Tuong Lake Area: 2.0 ha Vol.*: 20,200 m^3 Depth: 1.1 m	Lam Tuong Lake comprises two small lakes connected with a pipe. The shore around the lake has been filled due to illegal solid waste dumping and encroaching.	BOD: 64-136 COD: 124-180 SS: 17-184 T-N: 23-43 T-P: 1.4-3.2	No recent data available
	Du Hang Lake Area: 4.6 ha Vol.*: 90,100 m^3 Depth: 1.3 m	Du Hang Lake is a long lake connected to the southern part of Lam Tuong Lake. It drains to the SW channel system, and is not connected to An Kim Hai channel.	BOD: 112-123 COD: 184-224 SS: 64-195 T-N: 40-42 T-P: 2.9-4.0	Depth: 120-160 cm Vol.Solid:14% T-N:1150 T-P:2542 Cd:6.8 Pb:250 Hg:0.49
	Thuong Ly Lake Area: 2.0 ha Vol.*: 18,000 m^3 Depth: 0.9 m	Thuong Ly Lake is located in Hong Bang District. It is connected to the canal that connect Cam River to Lach Tray River, and during high tide, river water intrudes into the lake.	BOD: 13-388 COD: 24-768 SS: 44-1610 T-N: 3.5-47 T-P: 0.4-5.5	No recent data available

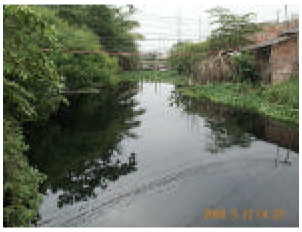
Table 5.1.1 Characteristics of Major Lakes in Study Area (18/2)

Photograph	Name	Description	Water Quality** (mg/l)	Sed. Quality** (mg/kg)
	Hanh Phuc Lake Area: approx. 1 ha	This small lake is located in a park in Kien An District.	BOD: 32-41 COD: 62-96 SS: 18-60 T-N: 2.5-7.0 T-P: 0.24-0.28	Depth: 5-10cm Vol.Solid:2.3% T-N:740 T-P:254 Cd:2.6 Pb:44 Hg:0.11
	Dan Tu Lake Area: approx. 10 ha	Dan Tu Lake is one of the large regulation lakes in Do Son.	No data available	No data available
	Ca Lake Area: approx. 4 ha	There are numerous brackish lakes in the coastal area (e.g., Do Son, Trang Cat village, Dinh Vu). These lakes are maily used for aqua-culture (fish and shrimp). The lake in the picture is one of the lakes in Dinh Vu.	BOD: 6.5-6.6 COD: 16-22 SS: 29-115 T-N: 2.5 T-P: 0.31-0.40	Depth: 40-60cm Vol.Solid:7.4% T-N:330 T-P:409 Cd:2.9 Pb:47 Hg:0.13

* : based on echo-sounding survey in 1994, Soil and Water, Vietnam Sanitation Project, F/S Background Report,1998

**: compiled from JICA Study Team, Interim Report, September, 2000, Soil and Water (1998), and other sources

Table 5.1.2 Characteristics of Major Channels in Study Area

Photo	Name	Description	Water Quality** (mg/l)	Sed. Quality** (mg/kg)
	NE Channel Length*: 6.0 km	NE (Dong Khe) Channel drains the northeast area of urbanized Haiphong, including Tien Nga Lake and An Bien Lake. It is connected to An Kim Hai Channel.	BOD: 45-99 COD: 95-144 SS: 32-97 T-N: 28-35 T-P: 2.4-3.4	Depth: 40cm Vol.Solid:10% T-N:800 T-P:854 Cd:2.5 Pb:134 Hg:0.15
	SW Channel Length*: 3.4 km	SW Channel drains the southwest area of urbanized Haiphong, including Lam Tuong Lake and Du Hang Lake.	BOD: 28-96 COD: 132-196 SS: 54-96 T-N: 3.5-34 T-P: 0.7-3.8	No recent data available
	An Kim Hai Channel Length*: 11 km	An Kim Hai Channel was originally constructed to irrigate the suburb of urban Haiphong, and is under the jurisdiction of DARD. Due to heavy pollution, however, it has not been used for irrigation.	BOD: 22-129 COD: 48-176 SS: 9-80 T-N: 2.6-11 T-P: 0.3-2.9	Depth: 80-160cm Vol.Solid:20% T-N:660-6,200 T-P:3,750-6,250 Cd:0.5-2.4 Pb:10-210 Hg:1-9.5
	South Channel in Kien An Length*: 1.6 km	There are a number of channels in Kien An area. Most of them are used mainly for irrigation. This channel in the south of Kien An drains to Da Dao River.	BOD: 36-169 COD: 96-320 SS: 36-10320 T-N: 21-28 T-P: 1.5-2.9	Depth: 60-80cm Vol.Solid:20% T-N:1,650 T-P:1,550 Cd:1.5 Pb:219 Hg:0.33
	Drainage Channel in Do Son	This channel in Do Son is used to drain storm water and sewage from relatively populated area of Do Son.	No data available	No data available
	Irrigation Channel in Minh Duc	This channel in Tam Hung Commune in Huu Nghi Village is primarily used for irrigation. Water quality is reasonably good.	BOD: 14-16 COD: 37-38 SS: 17-111 T-N: 2.0-3.5 T-P: 0.4-0.6	Depth: 100cm Vol.Solid:6% T-N:658 T-P:341 Cd:4.2 Pb:20 Hg:0.09
	Mai River in Quan Toan	Mai River is one of the interconnected rivers in Haiphong. It drains the Dong Hai area to Cam River.	BOD: 16-17 COD: 56-64 SS: 12-291 T-N: 3.0 T-P: 0.3-0.8	No data available

* : approximate length in the Study Area

Table 5.3.1 List of Possible Measures for Water Quality Improvement for Lakes and Channels

No.	Strategy	Project Name	Content/Size	Project Area			Period	Preliminary Cost Est.	Pros (○) and Cons (●)
				District	Area	Population			
P1	Reduce External Input of Pollutant	Installation of interceptor sewers around lakes (as proposed by 1B and Park Company)	Tien Nga Lake (0.6 km), An Bien and Mam Tom Lakes (1.6 km), Sen Lake (0.4 km)	Le Chan and Ngo Quyen	27 ha	Lake Basins 100,000	Total 4 years	Total 0.77 million USD	○Significant reduction of pollution loads to lakes, relatively easy implementation, immediate improvement of water quality ● Reduced water level in dry weather
P2	Reduce Internal Source of Pollution	Lake rehabilitation (as proposed by 1B and Park Company)	Tien Nga Lake (2.5 ha), Mam Tom Lake (2.5 ha), An Bien Lake (20 ha), Sen Lake (2 ha), Du Hang & Lam Tuong Lake (6.6 ha)	Le Chan and Ngo Quyen	37 ha	Lake Basins 100,000	Total 4 years	Total 1.32 million USD	○Improved drainage/regulating capacity, improvement of water quality ●sludge disposal, resettlement of affected people
P3a	Accerelate Outflow of Pollutant	Strategic Operation of Drainage System for Water Quality Management	Strategic operation of tidal gates and pumping stations to maintain reasonable level of water quality in lakes and channels.	Le Chan, Ngo Quyen, Kien An, Do Son	N/A	N/A	Total 1 year	N/A (to be implemented withing the general framework of drainage	○improvement of lake and channel water quality, limited or no additional facility needed ●close coordination with drainage program required, turbid and brackish water
P3b*		Dilution/Accelerated Outflow with Irrigation Water from West An Kim Hai Channel	Construction of channel to diver water to lake system	Le Chan and Ngo Quyen	SW Channel 500 ha	SW Channel 86,000	Total 1 year	to be estimated	○Improvement of lake and channel water quality, relatively easy implementation ● Limited discharge from An Kim Hai Channel, alterration of drainage system
P3c*		Dilution/Accelerated Outflow with River Water (Cam River and Lach Tray River)	Installation of pipeline along NE Channel (5 km, diameter 800 mm), SW Channel (4 km, diameter 600 mm), and An Kim Hai Channel (1 km, diameter 600 mm); installation of 3 pumping stations; approx. 1 m3/sec	Le Chan and Ngo Quyen	NE Channel 1440 ha; SW Channel 500 ha; An Kim Hai 420 ha	NE Channel 129,000; SW Channel 86,000; An Kim Hai 19,500	Total 5 years	Total 25 million USD	○Easy to control operation ●High initial and operation cost, turbid brackish water from Cam and Lach Tray Rivers

N/A: Not Applicable
* : optional measures

Table 5.3.2 Schedule of Measures for Water Quality Improvement of Lakes and Channels

Project	Component	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1.Construction of Interceptor Sewers																					
Tien Nga Lake	Constr.																				
	O&M																				
Sen Lake	Constr.																				
	O&M																				
An Bien & Mam Tom	Constr.																				
	O&M																				
2.Lake Rehabilitation																					
Tien Nga Lake	Constr.																				
	O&M																				
An Bien Lake	Constr.																				
	O&M																				
Mam Tom Lake	Constr.																				
	O&M																				
Sen Lake	Constr.																				
	O&M																				
Du Hang Lake & Lam Tuong Lake	Constr.																				
	O&M																				

Table 5.3.3 Disbusement Schedule of Lake Improvement Projects

Direct Construction Cost

unit: 1000US$

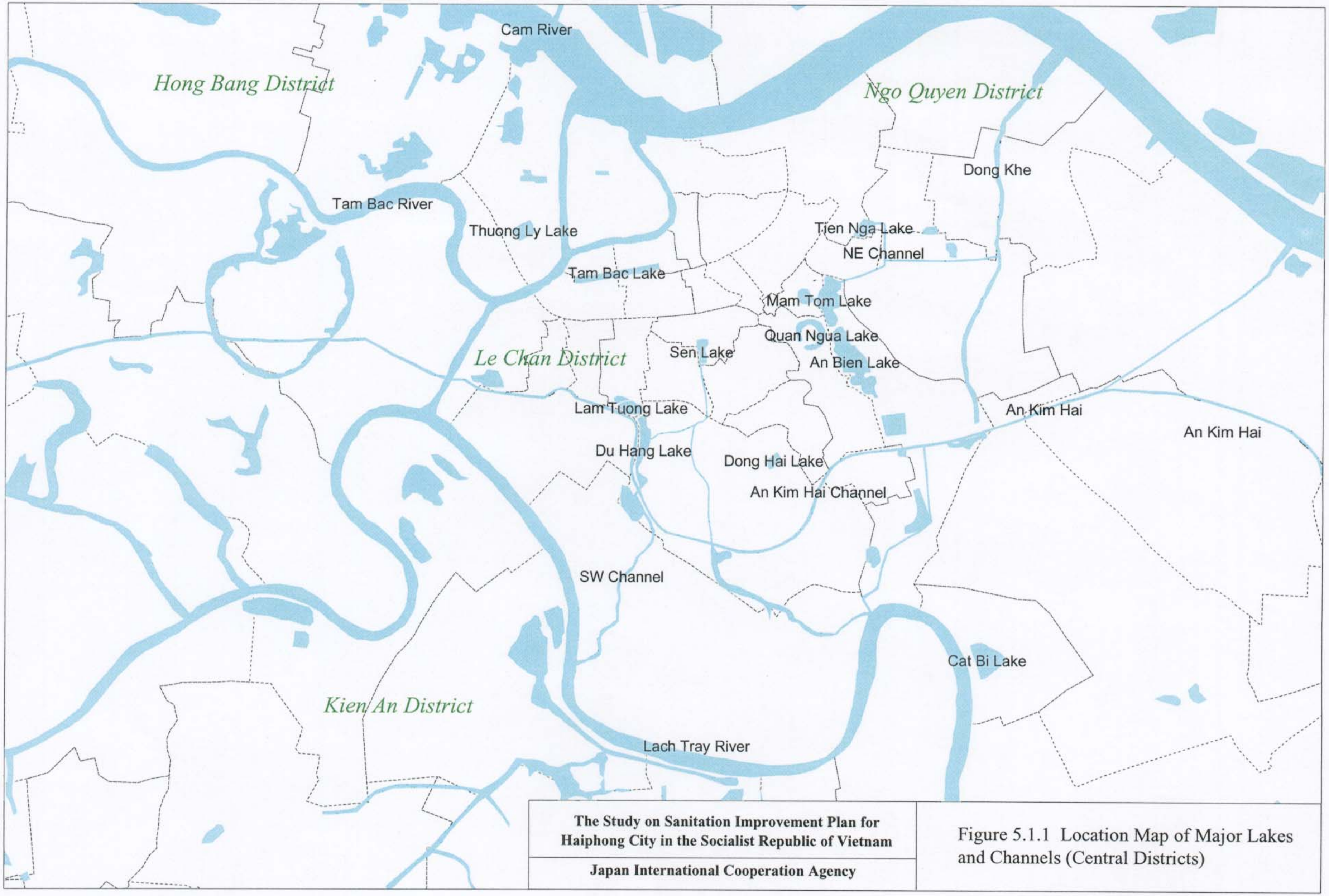
Project Component		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
1.Construction of Interceptor Sewers																						
	Tien Nga Lake	0	171	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171
	Sen Lake	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100
	An Bien & Mam Tom	0	0	229	229	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	458
	Sub-total	100	171	229	229	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	729
2.Lake Rehabilitation																						
	Tien Nga Lake	0	286	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	286
	An Bien Lake	0	0	257	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	257
	Mam Tom Lake	0	0	0	386	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	386
	Sen Lake	136	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	136
	Du Hang and Lam Tuong Lake	0	0	193	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	193
	Sub-total	136	286	450	386	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,258
Total		236	457	679	615	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,987

O&M Cost

unit: 1000US$

Project Component		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
1.Construction of Interceptor Sewers																						
	Tien Nga Lake	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	9.2
	Sen Lake	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	5.7
	An Bien & Mam Tom	0.0	0.0	0.0	0.7	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	22.7
	Sub-total	0.0	0.3	0.8	1.5	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	37.6
2.Lake Rehabilitation																						
	Tien Nga Lake	0.0	0.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	15.4
	An Bien Lake	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	13.1
	Mam Tom Lake	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	18.5
	Sen Lake	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	7.8
	Du Hang and Lam Tuong Lake	0.0	0.0	0.0	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	9.8
	Sub-total	0.0	0.4	1.3	2.6	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	64.7
Total		0.0	0.7	2.1	4.1	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	102.3

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Total Cost (Direct Construction+O&M)	236	458	681	619	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	2,089
Land Acquisition&Compensation Cost	12	46	68	62	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	188



The Study on Sanitation Improvement Plan for Haiphong City in the Socialist Republic of Vietnam

Japan International Cooperation Agency

Figure 5.1.1 Location Map of Major Lakes and Channels (Central Districts)

CHAPTER 6 IMPROVEMENT PLAN FOR SOLID WASTE MANAGEMENT

The current Study will cover all types of waste collected by Haiphong Peoples' Committee. Concerning industrial waste, facility plan is not included in the Study.

6.1 Basic Strategy for the Overall Solid Waste Management

6.1.1 Responsibilities of Waste Generators and HPPC

It is proposed that generators of industrial waste, infectious waste, demolition waste, soil waste and dredging, which are referred to as Type B solid waste, should be legally responsible for management of this waste. HPPC will be responsible for management of other kinds of waste, i.e., Type A solid waste. Proposed demarcation of responsibility is tabled below.

Waste Management Responsibility of the HPPC and Waste Generators

HPPC	Generators
Type A Solid Waste • Household waste • Street waste • Commercial waste	Type B Solid Waste Industrial waste generated from industrial process (irrespective of whether or not the waste is hazardous) • Infectious waste • Demolition waste • Soil waste • Dredging waste

Note: Commercial waste is solid waste generated from market, office, shops, restaurant, hotel, and all other non-industrial organizations.

This demarcation of waste management responsibility is rather common in industrialized countries. It is natural that industry take more responsibility in pollution control including waste management, as waste characteristics become increasingly toxic, and the generation increases.

The JICA Study Team proposes that industrial waste generators should be responsible for management of not only hazardous industrial waste but also for non-hazardous industrial waste. Reasons are given in Section 6.5 .

It is also recommended that HPPC should clearly define the waste generators' responsibility in the City Regulation.

Note:
Concerning industrial waste, the Study will concentrate on institutional aspects. Treatment methods, which have to be determined according to types of industrial waste, will not be included in the Study's scope.

6.1.2 Responsible Area of Each Waste Management Company

HPPC has three companies that provide solid waste management services, URENCO, Kien An Urban Works Company, and Do Son Public Works Company.

The JICA Study Team proposes the following areas of responsibility for each company:

Responsible Area of Each Company

Solid Waste Management Companies (URENCO)	Responsible Area
URENCO	• Hong Bang District • Le Chan • Ngo Quyen • Areas that become urban areas (URENCO will be responsible for these areas when they become urban districts.) (See the table below.)
Kien An Urban Works Company	Kien An District
Do Son Public Works Company	Do Son Town and communes located along Route No. 14.

Areas that will be Designated as Urban District
(the JICA Study Team's Estimation)

	Location	Area	Expected Timing	Projected Population in 2005
Area 1	South of Le Chan district	8.32 km^2	2003	44,282
Area 2	South of Hong Bang district	10.76 km^2	2005	24,856
Area 3	East of Ngo Quyen	37.80 km^2	2005	60,340
Total		56.88 km^2		129,478

6.1.3 Cost Recovery and Fee Collection Method

(1) Who should bear the SWM Costs?

In principle, generators of solid waste (households and commercial and industrial enterprises) should bear the solid waste management costs.

However, it is not possible for URENCO to collect the waste fees from generators of street waste (those who liter waste on streets). Streets and roads need maintenance. Street sweeping and street waste collection activities are considered part of the road maintenance work for which the road owner is responsible. It is proposed that the owner of streets or the body who are responsible for maintenance of the streets should bear the costs of street maintenance. From this point of view, it is proposed that the Haiphong City should bear the cost of street sweeping and street waste collection. For the street sweeping and street waste collection for the national roads, the City may charge the central government the costs of such service.

Who Should Pay the Waste Fees

Types of Waste	Who Should Pay the Waste Fees
1. Street waste	HPPC
2. Household waste	Household waste generators (Households)
3. Commercial and industrial waste and all other types of waste	Waste generators (Commercial and industrial enterprises)

It is reasonable for URENCO and Kien An Company and Do Son Company to recover the cost of street cleaning and street waste collection from HPPC in the form of a fee rather than a subsidy.

Based on URENCO's information, it is estimated that street sweeping and street waste collection would account for20 % of the total costs of solid waste management.

(2) Target Cost Recovery

At present, URENCO collects waste fees from the service users (citizens), and the fee revenue is equivalent to about 23 % of annual operation expenditure. It is proposed that the cost recovery through fee collection should increase in future. The proposed targets are as follows:

Target Cost Recovery through Fee Collection

At present	23 % of the annual recurring expenditures
2005	50% of the annual recurring expenditures
2010	100 % of the annual recurring expenditures
2020	100 % of the annual costs including depreciation of investment costs

(3) Fee Collection Method

1) Possible and Actual Amount of Fees Collected

It is estimated that URENCO could collect approximately VND8.4 billion per year if it collects fees from all the service recipients. However, in reality, URENCO collects only VND3.4 billion, about 40 % of this amount, as shown below.

Possible Fee Revenue and Actual Fee Revenue of URENCO

	Possible Revenue to be Collected if all service recipients pay full fees (VNDmillion per year) (a)	Actual Revenue collected by URENCO in 1998 (VNDmillion per year) (b)	Ratio (c) = (b)/(a)
Households	3,066	1,861	61 %
Small traders	952	138	15 %
Business enterprises	4,366	1,378	32 %
Total	8,384	3,377	40 %

See Tables 6.1.1 and 6.1.2 for details.

2) Reasons for Low Rate of Collection

Reasons for low rates of fee collection differ by type of service recipient.

- In case of Households

Only about 60 % of the service recipients actually pay the fees.

- In case of Households Engaged in Small Trading (Small Traders)

The City regulation stipulates that small traders should pay VND15,000 /month. However, most of them do not pay this rate, and instead pay the ordinary rate (VND1,000/month/person).

- In case of Commercial and Industrial Enterprises

It is considered that most enterprises pay waste fees. The problems is that the waste volumes shown in contracts made between URENCO and the enterprises are much less than the actual volumes of waste collected by URENCO.

Actual waste volume is 3 times larger than the contract volume according to the Waste Collection Quantity Survey and the Factory Survey conducted in May and June 2000 by the JICA Study Team.

3) Proposed Method of Fee Collection

An effective way to increase fee collection revenue is to include the fee in the water bill. The fee revenue would be easily doubled with this arrangement for the following reasons:

- Number of waste fee payers would increase. The Haiphong Water Company's service coverage is planned as follows:

	2000	2005
Le Chan	100 %	100 %
Hong Bang	42 %	94 %
Ngo Quyen	63 %	80 %

- The Water Company has a database on the number of persons in each household
- The Water Company has the best system for fee billing and collection
- The Water Company has means to force users to pay tariffs and fees

It would be necessary for URENCO to pay the Water Company a handling charge based on the amount of fee revenue collected, for example 5 % of the collected revenue. But URENCO would be able to save costs of fee collection. (URENCO has about 50 fee collectors.)

However, in the event service recipients refuse to pay the waste fee portion, water supply should not be disconnected. It should be the job of URENCO to have the recipients to pay the waste fee.

6.1.4 Strengthening of URENCO

(1) Dual Characteristics of URENCO

At present, the organization of URENCO being a municipal company, has dual characteristics. URENCO is a waste management service provider andsometimes acts as a waste administrator representing HPPC/TUPWS.

The goal of the organization as a service provider is to maximize the profit by providing customers with better service at less cost. On the other hand, the goal of a waste administrator is basically to set rules and create a business environment where the service is provided in a fair and environmentally safe manner. So these goals can sometimes conflict.

(2) URENCO as a Service Provider

It is recommended that URENCO strengthen its mission as a service provider with main objective to provide good service efficiently under the rules (regulations).

This means that URENCO should be financially and administratively autonomous. This issue is linked with future privatization and socialization.

(3) Investment Responsibility

At present URENCO is not responsible for investment in major solid waste management (SWM) facilities and equipment. But in future, URENCO should be responsible for such investments as well as planning and decisions related to the investments. The advantages of this proposal are as follows:

- URENCO will have an incentive to apply more cost-effective and sanitary methods of solid waste management leading to reduction of SWM costs
- URENCO will be able to know true costs of solid waste management that should be reflected in setting fee rates
- Independence of URENCO will be strengthened

6.1.5 Privatization and Socialization

In general, HPPC should encourage the privatization and socialization of the solid waste management service in view of benefits that would be obtained. There are different forms of privatization. The following is recommended.

- Contracting Out

Use of contractor "contracting out" is proposed for waste collection and transport and street sweeping/cleaning services. In the short term, URENCO may contract out waste collection and street sweeping service in new areas for which URENCO plans to extend such services. In the long term, HPPC may use contractors in addition to URENCO and the other two SWM companies.

- Financial and Administrative Independence of URENCO

At a certain point in time, it is recommended that URENCO become independent from HPPC. The relationship between URENCO and HPPC will change, and be based on a stricter contract basis. In the new relationship, the ultimate responsibility of fee collection should rest on HPPC. However, it is practical for HPPC to contract out the "fee collection service" to URENCO. URENCO, being a monopolistic contractor of HPPC, will be remunerated by HPPC according to the amount of work (amount of waste collected and disposed of).

Concerning Type B waste for which waste generators have waste management responsibility, URENCO will make a service contract with each waste generator.

Remarks:

- World experience shows that "the contracting out system" is successful. Under this system, the city has responsibility to collect fees, and use contractors, and remunerate them according to amount of work done.
- Experiences in some countries in the South America shows that the complete privatization of municipal solid waste management service is unsuccessful. Complete privatization means that a private company is given authorization by the city to collect both waste and fees under its own responsibility and risk.
- A complete privatization of waste service is feasible and widely practiced for non-municipal waste.

- Creation of Competition

At present, URENCO is a monopoly. Kien An Urban Works Company and Do Son Company are also monopolies in their respective areas. In future, it is recommended that HPPC deregulate the monopoly policy, selecting companies through competition. In the initial stage, URENCO will dominate the market. HPPC should take a policy to encourage other private companies to participate in the SWM service market.

It is the citizens' best interest to have "better service with less cost". This can be achieved only if the service providers are selected through competition.

- Involvement of Private Sector in Waste Treatment and Disposal

As for waste treatment and disposal, it is recommended that HPPC should consider the future possibility of involvement of private sector in these services. In Europe and Japan, an increasing number of cities apply PFI (Private Financing Initiative) for the solid waste treatment and disposal services. Under the PFI arrangement, a PFI company (or a group of companies) makes a contract with the city. The PFI company constructs and operates waste disposal facilities. The company is remunerated by the city according to amount of waste disposed of. Major advantages of PFI are: 1) the city does not have to finance investment (costs of construction of facilities), and 2) costs of waste treatment and disposal decrease with increases in efficiency.

6.1.6 Waste Collection Service Targets

(1) Waste Collection Areas

At present HPPC provides waste collection services in the 4 urban districts and Do Son Town (2 urban communes only). In future, it is proposed that HPPC provide waste collection services for the whole non-agricultural population living in urban districts or urban communes of sub-urban districts.

By 2005, it is planned that some areas adjacent to Hong Bang, Le Chan and Ngo Quyen districts will become urban districts as shown in Section 6.1.2. It is proposed that URENCO provide waste collection service for those areas by 2005.

In sub-urban districts, it is proposed that the non-agricultural population living in towns and urban communes start receiving waste collection service in 2002. In the sub-urban districts, the collection coverage should reach 50 % of the non-agricultural population by 2010, and 100 % of the non-agricultural population in 2020.

Figures 6.1.1, 6.1.2, and 6.1.3 are maps showing the proposed waste collection service areas in 2000, 2005, and 2010, respectively.

(2) Household Waste Collection Coverage

It is proposed that Haiphong People's Committee (HPPC) provide waste collection service for all non-agriculture population living in urban areas of Haiphong in principle. In the four urban districts, the 100 % coverage should be achieved by 2010 in the four urban districts; by 2012 in Do Son Town; and by 2020 in all other non-agricultural areas of other districts of Haiphong as shown below.

Household Waste Collection Service Target

(Coverage is indicated in the ratio of service recipients relative to non-agricultural population.)

	Current Coverage	Target year when 100 % coverage is achieved
URENCO Area (Hong Bang, Le Chan and Ngo Quyen Districts)	87 %	2010
Kien An Company Area (Kien An District)	85 %	2010
Do Son Company Area (Do Son Town & Communes along Route 14) 37 %	37 %	2012
Other Districts	0 %	2020

It is considered that agricultural population (those who are engaged in agriculture) can dispose of their waste by themselves because 1) waste amount is not large (128 gram/person/day, and 2) they have spaces large enough to dispose of the waste.

The annual target coverage for all areas is summarized in Table 6.1.3, and further details for each area are shown in Tables 6.1.4 – 6.1.7. Annual collection coverage targets in terms of waste quantity for each area are shown in Section 6.2.

6.1.7 System of Waste Collection/Transport and Disposal

(1) Planning Criteria

The following criteria are used for planning and selecting systems:

- For waste collection and transport
  - Sanitary conditions
  - Efficiency
- For waste disposal
  - Environmental-soundness
  - Efficiency

(2) System Options

1) Waste Collection Transport System Options

In principle, the use of waste bin system and use of vehicles with mechanical lifter satisfy both criteria of sanitation and efficiency, and therefore are recommended. This is discussed in detail in Section 6.3.2.

2) Waste Disposal System Options

(a) Cost Comparison

It is proposed that HPPC apply the sanitary landfill as major means of disposal of municipal waste because it is sanitary and economical. Costs of different disposal options can be compared in terms of unit cost needed to dispose of 1 ton of solid waste. Unit costs of different options in Vietnam are estimated as follows:

Evaluation of Solid Waste Disposal Options

Disposal System Options	In terms of Environ-mental Soundness	Unit Cost
Open dumping	Not Acceptable	US$0.5 – 1.0/ton
Sanitary landfill	Acceptable	US$2.0 – 7.0/ton
Composting + Sanitary landfill of compost rejects	Acceptable	US$4.6 – 18.6/ton
Incineration + landfill of incineration ash	Acceptable	US$58/ton at minimum
Incineration + power generation + landfill of incineration ash	Acceptable	US$64/ton at minimum

Source: Final Report on Hanoi Environmental Improvement Study, JICA

(b) Evaluation and Conclusion

In terms of unit cost, open dumping has the lower cost. However, it is not environmentally acceptable. Environmental problems with respect to open dumping are: 1) possible contamination of surface and groundwater with leachate (dirty water generated from waste deposit), 2) fires and smoke, 3) generation of rodents and flies, and 4) scattering waste and dusts to outside the site. Among the other disposal options, the sanitary landfill is the most economical, and therefore is recommended for Haiphong. .

(c) Composting

The cost of the composting option entirely depends on sales of compost. There are no cities in Vietnam where large scale composting has been feasible. The world experience shows that most composting projects (using municipal waste) have failed mainly due to inadequate demand for compost products and changes in waste quality as explained below:

- In future, it would be increasingly difficult to keep a good quality of compost due to the changes in quality of waste. Unsuitable types of waste such as metals, glass, and plastics would increase. Hazardous waste such as dry cell or some home electric appliances would also increase with economic growth
- Demand for compost product varies by season due to crop cycle, while compost production is rather constant throughout year. Long-term storage of compost will reduce its quality
- Demand for compost produced by a compost factory is limited in terms of demand area. The further the distance from the factory to users, the higher the cost of transport. It is generally observed that users would not buy products if the transport distance were longer than 30 km

The composting should be done only if and when adequate demands are firmly confirmed.

Composting may be feasible if only selected types of waste such as market waste or agricultural waste are used

(d) Incineration

Incineration is a very costly option. The cost of incineration is more than 10 times higher than the sanitary landfill option. Waste incineration is not suitable also in terms of waste calorie. Waste calorie (lower calorific value) must be a minimum 1,000 kcal/kg for waste to burn without using auxiliary fuel (heavy oil). The calorie of Haiphong waste would be less than 800 kcal/kg judging from the fact that the Hanoi waste had calorie of 721 kcal/kg in 1998. Haiphong waste calorie is lower than Hanoi waste judging from the composition of waste. According to the chemical composition analysis, Haiphong waste comprises: combustible content 30 %, water content 40 %, and ash content 30 %. Kitchen waste and ash of charcoal briquette together share more than 50 % of Haiphong waste on wet weight basis. Paper is 3.5 %, and plastics 6.1 %.

It should also be noted that a sanitary landfill is still necessary for disposal of incineration ash even if an incineration system is applied. The incineration ash is about 20 % of original waste in terms of volume, and 10 % in terms of weight.

The waste incineration with power (electricity) generation facility requires a minimum waste calorie of 1,500 kcal/kg, and therefore is not feasible either for Haiphong. If this system were applied to Haiphong, overall net cost of the option would be higher than the cost of ordinary incineration system because a large amount of fuel must be used to generate enough heat to generate electricity. See the last paragraph of Section 6.1.8 (1) for detailed explanation.

(3) Target Level of Waste Treatment and Disposal

1) Factors Affecting to the Target Setting

The following factors should be considered in setting the target level of waste treatment and disposal:

- The relevant Vietnamese laws and regulations
- Economic and financial affordability
- Natural conditions (Geographic, geological, meteorological conditions)
- Social conditions (distance of nearest houses from the facilities, population)

2) Phased Development Approach

It is proposed that HPPC should follow a phased development approach with due consideration to the economic and financial affordability. In the current study, the JICA Study Team has proposed plans and designs based on the phased development approach.

6.1.8 Resource Recovery and Waste Avoidance

(1) Introduction

In the past, in the field of solid waste management in Japan and other developed countries, the focus was on how to treat and dispose of solid waste that were discharged. The current JICA Study also focuses on waste collection/transport and treatment/disposal of waste. However, recently, in Japan and other developed countries, the focus has been shifting towards waste avoidance and resource recovery. This newer issue has become increasingly important to the societies.

In Japan and developed countries, values of used materials such as used paper, plastic and metals, had dropped so much against the value of new materials that the markets of used materials have substantially shrunk. However, like many other developing countries, Vietnam has a good system of resource recovery. Used papers, plastics, metals and glass (used bottles) are reused in the daily life or recycled through market mechanism.

In addition, there are some industrial waste materials that factories sell to other factories. Needless to say, people reuse some waste materials. Demolition waste generated in Haiphong is mainly broken bricks, and is reused as construction or filling materials.

It is desirous to maintain such existing system as long as possible. Like other markets, the recycling market has both a demand side and supply side. Shrinkage occurs on the demand side with economic development. With economic development and resulting increases in labor costs, the cost of recycling (collection, transport and processing) would increase, which leads to increases in prices of recycled materials. Prices of some recycled materials such as paper is higher than virgin paper in Japan and some other developed countries. Naturally, the people find it less attractive to use used materials that are high in price and lower in quality. In this situation, an attempt to increase supply of recycled materials without increases in demand would be a complete failure. The world experience shows a policy measure for causing increases in demand for recycled materials is crucial.

(2) Resource Recovery

Resource recovery and waste avoidance have been increasingly important in OECD countries where natural markets for recyclable materials have drastically shrunk. In many developing countries including Vietnam, recyclable material markets are still active and large. However, they may shrink with economic development as experienced by OECD countries.

With this view in mind, the JICA Study Team would like to presnet its idea on the resource recovery as follows:

- Resource recovery is most efficient and desirable when performed before materials go into waste stream
- HPPC should highly evaluate the current situation where considerable amount of useful materials is traded, reused in daily life and recycled through junk buyers and material users
- There are many cases in the world where city administration attempted recovery of useful materials from collected waste, but failed because there was not adequate demand for recovered materials
- An appropriate policy for the government and city administration would be to stimulate and increase demands for recovered materials through research and development of new ways in which recovered materials are used. Such activities should be primarily organized at the national level
- Composting
- It should be noted that composting from solid waste is theoretically desirable, but not feasible in most case in reality mainly due to insufficient and non-constant demand for the compost products as well as due to increasing proportion of hazardous/toxic elements in waste.
- Heat recovery through waste incineration
- At present, neither incineration of ordinary waste nor heat recovery through incineration is feasible. Minimum calories required are 1,000 kcal/kg for the incineration and 1,500 kcal/kg for the heat recovery through incineration, while Haiphong waste is estimated to be 700 – 800 kcal/kg.

(3) Waste Avoidance (Reduction of Waste Generation)

With economic growth of the society, waste generation quantity will increase. In industrialized countries, a main issue is the waste avoidance (reduction of waste generation). The waste avoidance requires efforts in all sectors, i.e. consumers, producers and government. For Haiphong, the following is recommended:

- Gradual replacement of coal (briquette) with gas for cooking
- Keep the existing material reuse market as long as possible
- Promote a policy to stimulate and create the demand for reusable materials when the above market starts shrinking

- Separation of wastes (useful materials) at source before going into waste stream. Recovery of useful materials from discharged waste is not recommendable at all
- In long term, Vietnamese enterprises should apply Life Cycle Assessment (LCA) of their products as has been applied in Japan and some other countries. Products should be designed in such a way that more parts may be recovered and reused without difficulty. This practice will lead to less waste

6.2 Waste Quantity and Quality

6.2.1 Current Waste Generation and Collection Quantity

(1) Daily Quantity

Based on the waste collection quantity survey, household waste generation survey and other data obtained, it is estimated that the three companies' average waste collection quantities throughout the year, and generation in the service area are as follows:

Companies	Collection (a)	Generation (b)	Collection Ratio (c)= (a)/(b)
- URENCO	367 ton/day	484 ton/day	76 %
- Kien An Urban Works Company	61 ton/day	80 ton/day	76 %
- Do Son Public Company	44 ton/day	66 ton/day	67 %
- Total	471 ton/day	663 ton/day	71 %

(2) Waste Quantity by Waste Type

Based on the waste collection survey and data obtained, the waste collection quantities by waste types are estimated as follows:

Type of Waste	Collection	Ratio
- Household waste	218 ton/day	46 %
- Business waste	135 ton/day	29 %
- Street waste	58 ton/day	12 %
- Industrial waste	45 ton/day	10 %
- Hospital waste	5 ton/day	1 %
- Demolition waste	9 ton/day	2 %
- Total	471 ton/day	100 %

Details are shown in Table 6.2.1.

6.2.2 Projection of Future Waste Generation and Collection Targets

Future waste generation is estimated considering the population projection and economic growth forecast shown in the current report.

Target Solid Waste Collection Quantity and Collection Ratio to Generation in Haiphong

Year	URENCO		Kien An		Do Son		Other Areas (Non-Agriculture Area)		Haiphong Total	
	Collection (t/d)	Collection Ratio	Collection (t/d)	Collection Ratio	Collection (t/d)	Collection Ratio	Collection (t/d)	Collection Ratio*	Collection (t/d)	Collection Ratio
2000	367	76 %	61	76 %	44	67 %	0	0 %	471	72 %
2005	597	85 %	89	85 %	75	81 %	6	20 %	767	82 %
2010	839	95 %	132	95 %	115	91 %	18	45 %	1,104	93 %
2020	1,082	95 %	183	95 %	176	95 %	55	95 %	1,496	95 %

See Tables 6.2.2 – 6.2.6 for details.

Annual waste collection targets (ratios of waste collection amounts to generation amounts) are set based on the principles and targets shown in Section 6.1.6. The most important principle is that 100 % of non-agricultural households in Haiphong City will receive household waste collection service in future. This target will be achieved by 2010 in the 4 urban districts; by 2012 in Do Son Company's Area; and by 2020 in all the sub-urban districts.

It would not be possible for waste companies to collect 100 % of all kinds of solid waste generated in the service area even if the companies provide waste collection services for 100 % of the non-agricultural population in the service area. Some waste is reused or burned in open spaces or fed to animals or simply dumped. Maximum possible collection rate in terms of waste quantity is set at 95 %.

6.2.3 Solid Waste Quality

(1) Analyses Conducted

The JICA Study Team has carried out the waste composition analyses in May and June 2000, during which 3 samples were collected and analyzed with respect to the following:

- Bulk density on wet base
- Physical composition on wet base
- Physical composition on dry base
- Chemical composition, i.e., water, ash and combustible content

(2) Results

The results of the analyses are shown in the tables below.

"Average", "Minimum" and "Maximum" indicated in the tables are those obtained through the analyses of the 3 samplings.

1) Bulk Density

Average bulk density is 0.45, which is similar to result of the URENCO's 1997 survey.

2) Waste Composition

In the analysis of the current study results, the following two studies were used as reference, i.e. 1) URENCO's survey in 1997 indicated in a report "A Solid Waste Management Strategy for Haiphong Municipality 1998-2020" (referred to as URENCO 1997) and 2) the JICA Study Team's survey conducted in Hanoi in 1998 (referred to as Hanoi Study). The results of these two studies are shown at the end of this section. The major findings through the current analyses are summarized below:

- Residues of briquette and kitchen waste are the two dominant compositions of Haiphong waste like other cities in Vietnam
    - Share of the kitchen waste, categorized as “garbage” in this study, is about 16 %, much less than the corresponding percentages of 48 % in URENCO 1997 Study, and 42 % of Hanoi Study. There is a possibility that some kitchen waste was sorted as particle>5mm during the sorting process in the current waste composition study. It is then presumed that actual kitchen waste share is much larger than 16 %
    - Both the particle>5mm and the particle<5mm share 54 % in total, and is much greater than those found in other surveys. Majority of them may be ash or residue of the briquette used for cooking. Residue of the briquette after burning is mainly composed of solid laterite. Broken residue may be classified into the particle<5mm while the solid one into the particle>5mm. As mentioned above, the particle>5mm may include kitchen waste
- Timber and rags share 6 to 16 % in total while these components are less than 1 % in the URENCO 1997 and the Hanoi survey
- Paper content is still small in Haiphong, while plastic content is higher than expected
- Share of the glass is small because most of glass bottles are not disposed of but are reused

Bulk Density and Physical Composition on Wet Base (%)

No.	Category	Average	Min	Max
	Bulk Density (kg/L)	0.45	0.44	0.47
1	Paper	3.45	2.20	4.88
2	Garbage	16.46	14.82	18.36
3	Weave	0.95	0.36	1.56
4	Timber and rags	12.85	6.48	16.39
5	Plastics	6.10	4.02	8.64
6	Leather and rubber	0.29	0.02	0.82
7	Iron steel	0.41	0.11	0.85
8	Non-ferrous metal	0.03	0.01	0.05
9	Glass	0.29	0.17	0.47
10	Brick and Stone	4.66	2.25	6.52
11	Particle>5mm	41.16	36.85	47.98
12	Particle<5mm	13.35	9.27	17.37
	Total	100.00		

Physical Composition on Dry Base (%)

No.	Category	Average	Min	Max
1	Paper	2.70	1.29	4.13
2	Garbage	8.87	7.93	9.69
3	Weave	0.83	0.45	1.08
4	Timber and rags	9.65	4.92	13.46
5	Plastics	8.89	5.63	12.10
6	Leather and rubber	0.46	0.03	1.33
7	Iron steel	0.67	0.20	1.37
8	Non-ferrous metal	0.05	0.02	0.08
9	Glass	0.49	0.29	0.83
10	Brick and Stone	7.50	3.66	9.72
11	Particle>5mm	42.97	36.43	49.28
12	Particle<5mm	16.92	12.23	21.94
	Total	100.00		

Chemical Composition (%)

	Component	Average	Min	Max
1	Water Content	40.4	38.3	43.1
2	Ash Content	30.2	28.6	32.5
3	Combustible Cont.	29.4	28.8	30.5
	Total	100.0		

Physical Composition in the URENCO 1997 (%)

No.	Category	Percentage
1	Fruit skin and leaves	40.50
2	Paper	6.41
3	Animal bone	5.21
4	Feather	0.39
5	Animal corpse	0.25
6	Night Soil	4.27
7	Debris	2.06
8	Cloth	1.10
9	Nylon	4.21
10	Porcelain	0.47
11	Glass	0.16
12	Metal	0.22
13	Rubber, plastic	0.31
14	Wood, bamboo	0.31
15	Cinder	16.59
16	Grain<10mm	17.54
	Total	100.00

Physical Composition in the Hanoi Survey Conducted by the JICA Study Team (%)

No.	Category	Percentage
1	Kitchen waste	41.98
2	Paper	5.27
3	Plastics, rubbers	7.19
4	Bricks, stones	6.89
5	Timber, rags	1.75
6	Bones, shells	1.27
7	Metal, tin cans	0.59
8	Glass	1.42
9	Sand and dust	33.67
	Total	100.03

6.3 Municipal Waste Management Plan

6.3.1 Evaluation of the Current Conditions

(1) Institutional Aspect

1) Clarity of Solid Waste Management Responsibility

Until recently, HPPC had no regulations concerning solid waste management (SWM). HPPC has drafted a regulation on solid waste management. This regulation stipulates responsibility of each actor in SWM and penalty to be imposed, so it is a great step forward for improvement of SWM for Haiphong City. However, this regulation could be even better if it clarifies the following points:

- The responsibility for management of industrial and commercial waste
- The responsibility for management of hazardous waste

The regulation stipulates certain aspects of responsibility of the industrial and commercial waste generators (such as generators' responsibility to provide space for appropriate), but does not clarify the most fundamental issue, namely, who has the waste management responsibility.

2) Responsible Areas of SWM Companies

HPPC has 3 companies that provide solid waste management services, namely, URENCO, Kien An Urban Works Company and Do Son Public Works Company. Each company has its own area of responsibility . Allocation of responsible areas to each company is appropriate.

3) Cost Recovery

HPPC has a policy to increase the cost recovery in SWM by enhancing fee revenue. At present, URENCO's actual fee revenue is 40 % of the annual expenditures for operation and maintenance. The following are necessary for URENCO to increase the fee revenue:

- Estimate business waste collection volume accurately, and reflect accurate volume in the contracts (actual volume is 3 times larger than the contract volume on average)
- Apply fee rate (VND15,000/trader/month) stipulated by the city regulation to small traders (most traders pay by ordinary household fee rates of either VND1,000/person/month or VND500/person/month.)
- Increase number of the service recipients who pay household waste collection fees (only 60 % of the service recipients pay the fees at present.)

4) Characteristics of URENCO and Other SWM Companies

As discussed in Section 6.1.4, URENCO being a municipal company has dual characteristics or missions. URENCO acts not only as a service provider, but also acts as a waste administrator representing HPPC/TUPWS. Goal of the organization as a service provider is to maximize the profit by providing customers with better service with less cost. On the other hand, the goal of the organization as a waste administrator is basically to set rules and create a business environment where the service is provided in a fair and environmentally sound manner.

Due to this there is a limit to the efficiency of services that URENCO can provide.

(2) Waste Collection and Transport

1) Service Level

The three (3) SWM companies of HPPC provide daily collection service for majority of urban population in respective service areas. It is estimated that waste collection ratios relative to waste generation are as follows:

	Collection Ratios In terms of Waste Quantity	Population
URENCO:	76 %	85 %
Kien An Urban Works Company:	76 %	85 %
Do Son Public Works Company:	67 %	13 %

The percentages of URENCO and Kien An are similar to those of Hanoi URENCO, and are considered good.

Unserved places include 1) agricultural areas, 2) places inaccessible by collection vehicles, and 3) households who refuse waste collection service. For example, households located adjacent to rivers refuse URENCO’s service as they can easily dump waste into the rivers.

2) Waste Collection System

The dominant waste collection system applied in Haiphong comprises three activities: 1) primary collection of waste from generation sources with handcarts, 2) waste transfer from handcarts to waste collection trucks, and 3) transport of waste to landfill site. This system is very labor-intensive and is common in Vietnam and many other developing countries. There are over 60 transfer points in the 3 urban districts covered by URENCO.

In the process of waste transfer from handcarts to waste collection vehicles, handcart workers dump waste on streets, and then waste loading workers load the dumped waste into vehicles by shovel.

This process of waste transfer is inefficient and unsanitary, with the following disadvantages:

- Unhealthy to workers and neighborhood people
- Unsanitary and unsightly
- Affects traffic
- Inefficient
- Creates feeling that people can dump or liter waste on streets

3) Equipment

Most waste collection vehicles used by URECNO and the other two companies in Kien An and Do Son are old, and were purchased second hand . URENCO has 32 waste collection vehicles. They have been used for 10 years on average since they were manufactured. Of the 32 units, 28 units are second hand. Table 6.3.1 shows an inventory of vehicles used by URENCO. The following table summarizes conditions of vehicles used by the 3 companies.

Units and Conditions Waste Collection Vehicles Used in Haiphong

	Units Possessed	Ave-rage Units Used per Day	Average Period Used after Production at end of 2001	Current Condition Index Evaluated by URENCO (New vehicle = 100 %)
A. URENCO				
a. Waste Transport Vehicles				
1. Dump trucks (IFA)	15 (0)		12.6 years	56 %
2. Compactor	13 (1)		9.1 years	50 %
3. Container truck and others	4 (3)		2 years	87 %
4. Total or Average	32 (4)	25	10.2 years	57 %
b. Water Sprinkling Vehicles	4 (4)		16.3 years	59 %
c. Night Soil Collection Vehicles	5 (4)		18.4 years	45 %
URENCO Total	41 (12)			
B. Kien An Urban Works Company				
a. Dump Trucks (IFA)	5 (0)	4		
C. Do Son Public Works Company				
a. Dump Trucks (IFA)	3 (0)	3		

Note: Figures indicated in ( ) are numbers of units of new vehicles at time of purchase.

4) Expenditures

It is estimated that HPPC (3 companies) spend approximately VND17,530 million/year for solid waste management, of which 77 % is annual recurrent expenditures, and the remaining 23 % is annual depreciation cost of investment. Based on the information about cost and waste amount collected, the average unit cost of solid waste management (collection, transport, disposal) is estimated to be US$ 7.28/ton as shown in the following table.

Expenditures and Fees Collected by the 3 Companies in 1999

Unit: VNDMillion/year unless otherwise indicated

	URENCO (a)	Kien An Company (b)	Do Son Company (c)	Total (d) = a+b +c
1. Annual recurrent expenditure	12,110	900	500	13,510
2. Estimated Annual Depreciation of Investment (Investment in 1999)	3,600 (1,400)	270 (?)	150 (130)	4,020 (1,530+?)
3. Total Annual Cost (1+2)	15,710	1,170	650	17,530
4. Fee Collected	3,377	200	165	3,742
5. Cost Recovery Ratio (4/3)	21 %	22 %	25 %	21 %
6. Average Annual Waste Quantity Collected	133,773 ton/year	22,119 ton/year	16,060 ton/year	171,952 ton/year
7. Unit cost spent per ton of waste (VND/ton) (Item 3/Item 6)	VND117,438 /ton	VND52,896/ ton	VND40,473 /ton	VND101,94 7/ton
8. Unit Cost spent per of waste (US$/ton)	US$8.39/ton	US$3.78/ton	US$2.89/ton	US$7.28ton

Notes:
1. Sources of information are HPPC, URENCO, Kien Company and Do Son Company.
2. URENCO's Annual costs of depreciation of investments are estimated by the JICA Study Team based on information given by URENCO. Details are shown in Table 6.3.2.
3. Annual costs of depreciation of investments of Kien An Company and Do Son Company are estimated by applying the same ratio as URENCO's ratio (36 %) of the deprecation to the annual recurrent expenditure.

(3) Waste Disposal

1) Waste Landfill Sites

In Haiphong, the main waste disposal method is dumping at a landfill. Two landfill sites in operation now. The three districts in central area and Kien An district are using the Trang Cat landfill site. Do Son district has its own landfill site in the district. Before Kien An district started transporting their waste to Trang Cat landfill site in 1999, they had been using their own landfill site. However it was closed last year. The former lanfill site In Hong Bang district, called Thoung Ly, located near the HPURENCO's vehicle garage has not been closed with appropriate measures by HPURENCO.

Locations of the former, existing and planned landfill sites in Haiphong are shown in Figure. 6.3.1.

Medical waste and ordinary waste has not yet been collected separately in Haiphong. Therefore, there is a high risk of exposure of medical waste to landfill workers and scavengers.

Outline of Trang Cat landfill Site

Area of the site	15 ha
Height of filled layer (according to the original plan)	14 m
Volume of waste deposited	Unknown
Date of start of operation	January of 1998
Date of closure (according to the original plan)	End of 2000
Liners system	Clay liner of 25cm thickness
Leachate collection system	Collection pipes at the bottom
Leachate treatment system	Storage pond & Sedimentation pond
Gas collection & ventilation system	No
Weigh bridge	Not yet *There is a space for weighbridge, but no machine installed because of short of budget.
Fence and Gate	Concrete wall of 1.2 m height around the site. The gate has a lock.
Time of operation	24 hours
Numbers of staffs	Management: Filling work:
Heavy vehicles for filling work	2 bulldozers
Daily cover work	None
Type of waste disposed of	All kinds of solid waste including industrial, commercial and hospital waste collected, and septage
Amount of incoming waste	427 ton/day on average, of which 367 ton/day by URENCO and 60 ton/day by Kien An Company. On average, URENCO makes 98 trips/day using 25 trucks, while Kien An Company makes 16 trips using 4 trucks.

Through the site inspection and evaluation for preliminary design, the following comments can be made concerning the existing Trang Cat landfill site.

(a) Location and Condition of the Ground Base

a) Findings

- Location

The site is located at the side of Cam River that is a tidal area of Bac Bo bay. Elevation of this area ranges from 2.3 to 2.6m approximately. The top of the boundary dyke is about 5.2 to 5.5 m.

- Ground condition

According to a former geological survey report, there are three stratums in the first 20 m depth of soil in this area. The first stratum is surface soil composed of clay mud.

- Surroundings and neighbors

There are fishery ponds around the site. There are several houses located near the gate of the site.

b) Suggestions

- Flood control and high tide

The boundary dyke on the east side of the site has enough height to prevent the flood. At the high tide, there is a risk of pollution for the adjacent ponds by the discharged leachate. A careful consideration for flood and high tide is needed.

(b) Dykes/Embankments

a) Findings

- Shape and slope

The site has small dykes around the filling area. The slope of filling layer is not so steep at present. However, the stability of filled body needs to be considered if HPURENCO plans further filling.

- Permeability

No leakage was found on the west embankment. It shows the soil material of the embankment is impermeable enough to keep the leachate inside the site properly.

b) Suggestions

- Shape and slope

Because of the bad ground condition, there must be settlements of ground by the weights of embankment itself and filled waste. There is also a risk of collapse of embankment. Careful consideration will be needed for design of embankment.

- Permeability

The permeability of soil materials of existing embankments is low. Therefore, the same soil materials should be used for embankments of future landfill site.

(c) Filling Works

a) Findings

- Slope of filled waste

The slope of landfill site is 1:10 according to the plan. However at present it is almost 1:1. This is unsafe. There is a danger that the slope would collapse, and bulldozers and their operators fall. It is strongly recommended that the slope of the filled waste be reduced.

- Filling Methods

A bulldozer laterally pushes the waste after it is unloaded from collection vehicles. The bulldozer always pushes the waste toward the edge of filling area, at the top of the slope. This is dangerous and is not effective for compaction of the waste. More effective methods for filling are necessary.

- Cover soil

Some parts are covered with normal soil. However, it is not adequate in terms of volume and frequency. For prevention of vermin and pests and odor, a daily cover is recommended.

- Filling Equipment

There are two bulldozers of 5 tons. Their weights are not enough for effective compaction of filled wastes.

- Filling work strategy

There seems to be no policy and no plan with respect to filling wastes. Daily cover should be introduced. The push-up filling method is recommended in general. However the existing dykes are not strong enough. Therefore the push-up method cannot be applied.

b) Suggestions

- Shape of waste filled layer

It is recommended that a waste filling works be prepared by URENCO. The responsible personnel should understand the plan and supervise the filling workers based on it. The plan should describe or show:

  - Drawings of waste filling areas at the end of every year (in Plans and Cross sections)
  - Drawings of working roads for trucks
  - Gas ventilation pipes and collection beds

- Filling Methods

There are a few basic methods of spreading and filling the waste.

  - Push Up or Up-fill Method

- Push Down Method

The push-up filling method is recommended. However, if the dyke is not strong enough, it is impossible to apply this method.

- Cover works

The filling of the waste with daily cover forms a kind of cell of waste isolated by soil. This filling method is called “Cell Method” and is essential for the sanitary landfill. It is highly recommended for URENCO to apply the cell method .

(d) Leachate Collection and Treatment

a) Findings

- Leachate collection pipes

Leachate is collected and piped into ponds by gravity. A primary design drawing shows that the unit distance between pipes is 40m and the slope of bottom layer is 0.5 %.

- Leachate inside the waste filling area

Leachate is found beside the waste near the dyke. The table of leachate is higher than the first leachate pond’s surface. This condition reveals that clogging or breakage has occurred and prevented water flow in the pipes. The diameter of the collection pipe is 20 cm in the design drawings. It seems too small for the main collection pipes.

- Existing leachate treatment ponds

There are two ponds for leachate treatment. The first pond was planned for biological treatment and the second one for sedimentation. However ponds do not function as planned. There is no other water treatment process. This system is not effective for removal of organic matters and heavy metals. As a result, the leachate is discharged into the river without effective treatment at present.

b) Suggestions

- Leachate collection pipes

Bigger pipes should be used in the future plan. A 50cm diameter reinforced concrete pipe is recommended.

- Leachate treatment ponds

In order to use the first pond as a biological treatment pond, two aeration machines should be installed. Aeration machines of the same type as used in shrimp fishery ponds of Haiphong can be applicable. Alternatively, they could be made using propellers of ordinary boats and motors with long shafts.

If a pumping machine is available, it is recommended that two small tanks be installed besides the existing ponds as precipitation tanks. The water of first pond would be poured into the tank and mixed with lime powder for 5 minutes. The mixture would be transported to the second pond. Top water of second pond would be discharged to the drainage.

(e) Liner system

a) Findings

It was impossible to check the condition of the liner system as it is already covered by the waste fill. There is no data of permeability for actual clay liner. The clay liner was installed and compacted by manual works.

b) Suggestions

The permeability of soil materials used for existing embankments is low enough to keep the leachate inside the filling area. On the other hand, synthetic liners are expensive. Therefore, careful considerations and discussions will be needed for selection of liner system, to keep the construction cost of future landfill site affordable.

(f) Gas Collection and Ventilation

a) Findings

There is no gas collection pipe. Several fires and smoke could be observed at the site.

b) Suggestion

For the promotion of degradation of waste and prevention of casual fires, URENCO should install gas collection and ventilation wells. It is recommended that gas collection bed system be installed during the waste filling work, using gravel.

(g) Scavengers Activities

a) Findings

Many scavengers come up to collection vehicles when they dump the waste. Therefore, management of them will be necessary.

b) Suggestions

Registration of scavengers or their leaders is recommended.

URENCO should control and organize the scavengers in view of scavengers' safety and landfill work efficiency. Probably grouping of the scavengers would be needed.

3) Evaluation of Do Son Landfill Site from Technical and Sanitary Aspect

Do Son Public Works Company collects waste and transports it to their own landfill site located in Do Son Town. Characteristics of the site are outlined below:

Outline of Do Son landfill Site

Area of the site	1 ha
Height of filled layer (in plan)	10 m
Volume of the site	Unknown
Date of start of operation	September of 1998.
Date of closure (in plan)	End of 2001
Liners system	Clay liner of 25cm thickness
Leachate collection system	Gravel & Sand layer and Collection pipes at the bottom
Leachate treatment system	Storage pond & Sedimentation pond
Gas collection & ventilation system	8 vertical pipes of perforated PVC pipes are installed.
Weigh bridge	No
Fence and Gate	Concrete wall of 1.2 - 1.5m height on the one side of the site. Gate with lock.
Time of operation	24 hours
Numbers of staffs	Management: None Filling work: None
Heavy vehicles for filling work	No bulldozer and no compactor at the site. After sufficient sedimentation (land settling), bulldozer will compact waste according to the plan.
Daily cover work	No
Type of waste disposed of	All kinds of solid waste including industrial, commercial and hospital waste collected, and septage
Amount of incoming waste	Average amount of waste throughout year is 44 ton/day. Do Son Company makes 16 trips/day using 3 dump trucks. In high season from May – September, average waste increases to 50 ton/day.

Most of the findings and suggestions are almost same as those for Trang Cat landfill site. However there are two major differences:

- There are many gas ventilation pipes installed at Do Son landfill site
  =>Careful filling works are necessary
- The height of boundary dyke, about 2 m now, is not enough . It should be higher than 5 m, in order to protect the site from flooding and high tides
  =>Higher and stronger dykes are necessary

(4) Recycling in Haiphong

The JICA Study Team has conducted a recycling materials market survey in October and November 2000 in Haiphong. The survey covered the following items:

- Paper
- Plastics
- Metals

- Glasses
- Food and others

Based on the survey, the current conditions of recycling and its market in Haiphong are described as follows.

1) Players of Markets

Recyclable materials market consists of the following players:

- Generators of recyclable materials
- Traders of different levels
    - Primary collector (junk buyer, scavenger)
    - Secondary trader
    - Final trader
- End users

Primary traders do not necessarily sell materials to the secondary traders. There are cases where the primary traders sell materials to final traders or even to the end users.

Inter-provincial trade of recycling materials is common. Some items such as used paper are sold to end users (paper manufacturers) located not only inside Haiphong City but also to those located outside Haiphong City. On the other hand, Haiphong end users of some materials including used plastics purchase materials from not only Haiphong but also from neighborhood provinces.

2) Quantity of Recyclable Materials Collected in Haiphong

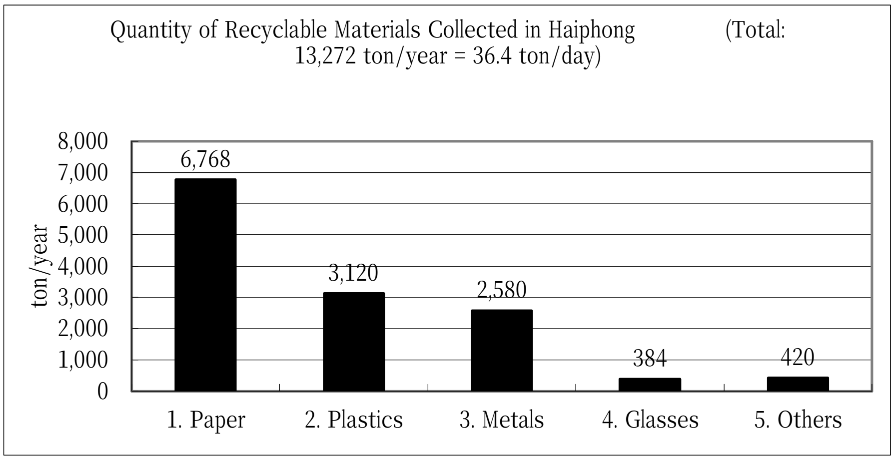
Total quantity of recyclable materials collected and traded in Haiphong is estimated to be 13,272 ton/year or 36.4 ton/day on average. This corresponds to about 7.7 % of the total waste amount (471 ton/day) collected by the 3 solid waste management companies, URENCO, Kien An Urban Works Company and Do Son Public Works Company.

The three major recycling materials in terms of trading quantity (weight) are paper (51 %), plastic (24 %), and metals (19 %).

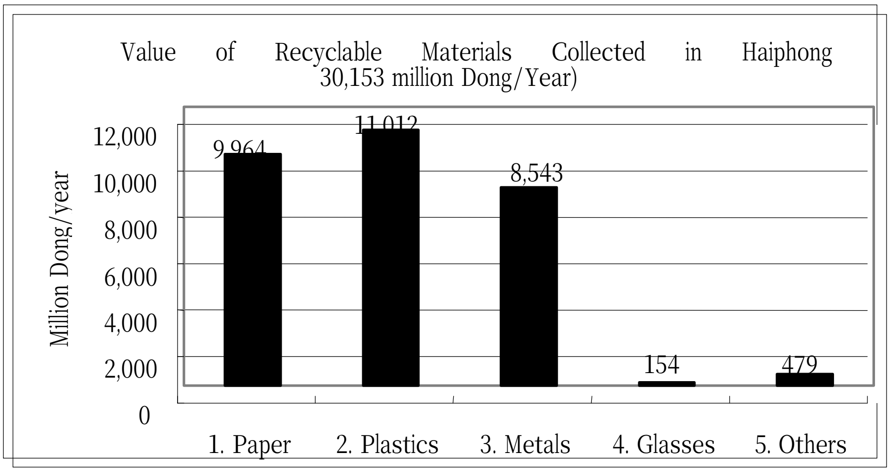
Total value of the recyclable materials collected and traded in Haiphong is estimated to be about VND30 billion (approximately US$2.1 million) per year. In terms of trading value (Dong), plastic has the largest share (37 %), followed by paper (33 %), and metals (28 %). See the table and charts below.

Quantity and Value of Recyclable Materials Collected and Traded in Haiphong

Kinds of Materials	Quantity of Materials Collected and Traded in Haiphong (Ton/year)	Value of Materials Collected and Traded in Haiphong Million (VNDmillion/year)
1. Paper	6,768 (51 %)	9,964 (33 %)
2. Plastics	3,120 (24 %)	11,012 (37 %)
3. Metals	2,580 (19 %)	8,543 (28 %)
4. Glasses	384 (3 %)	154 (1 %)
5. Others	420 (3 %)	479 (2 %)
6. Total	13,272 (100 %)	30,153 (100 %)
7. Total on Daily Base	36.4 ton/day	VND83 million/day



Note: Major items of "Others" are food, shoes, and duck's feather.



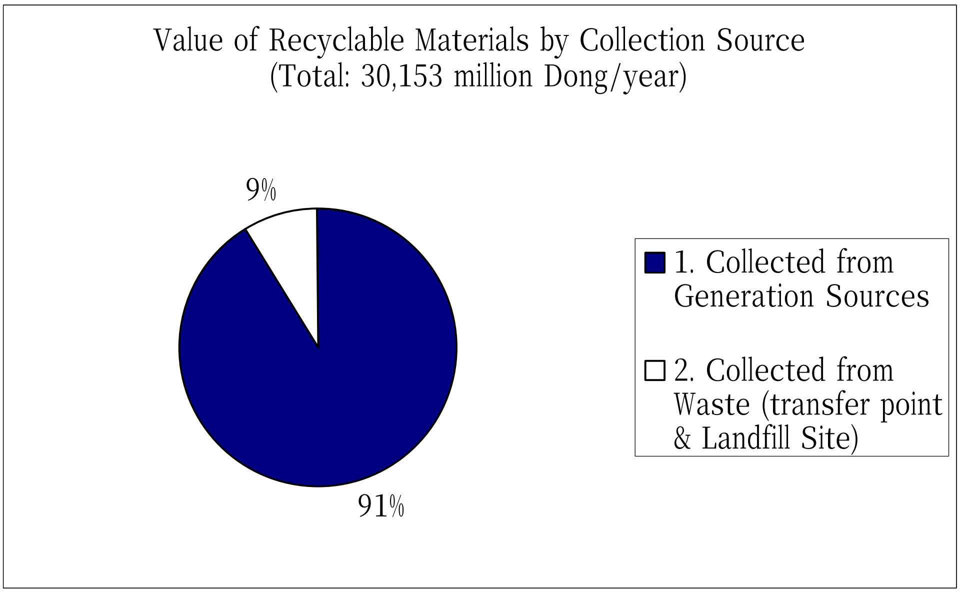
Though not covered by the survey, some farmers use night soil, and sometime purchase it from URENCO, which collect it. Night soil collected by URENCO has decreased in recent years due to the implementation of a program to replace latrine toilets with septic tanks. So far one-third of the latrine toilets have been replaced with septic tanks.

In addition, there are industrial waste materials that are either internally reused/reprocessed inside the factories or sold to other factories as industrial inputs without going through any traders. Amount of such industrial waste materials is roughly estimated to be about 50 ton/day through the two factory surveys conducted by the JICA Study Team in 2000.

Furthermore, it is quite common for Haiphong's citizens, like people of other cities in Vietnam, to reuse bottles or newspapers.

3) Distinction between Materials Recovered from Generation Sources and Those Recovered/scavenged from Waste

Materials collected from the generation sources before being discharged as waste is much more significant than those recovered/scavenged from waste. In terms of quantity, the former shares 88 %, and the latter shares 12 %. In terms of value, the former shares 91 %, and the latter shares 9 % as shown in the following chart.



In case of the latter, materials are recovered/scavenged from two different types of places, waste transfer points and the landfill site. It is mainly URENCO workers who recover materials at the transfer points, while it is scavengers who scavenge materials from the landfill site.

6.3.2 Plan for Waste Collection and Transport

(1) Improvement Needs and Recommended Measures and System

1) Improvement Needs

The waste collection and transport system in Haiphong needs improvement in the following aspects:

- Sanitary condition
- Efficiency

2) Proposed Measures and System

Based on the above improvement needs, the following measures are recommended:

- Change from the "Open system" to a "Closed System" where waste will not contact the ground
- Gradual shift from the double handling system to a single handling system

At present, waste collected by handcarts is taken to transfer points (typically roadsides), and waste is dumped on the ground for transfer from handcarts to a waste collection vehicle. During the process of waste transfer, the waste contacts the ground, and are visible by people. This is an open system. On the other hand, in a closed system, once waste is collected by handcart or vehicle, the waste will not touch the ground until it is disposed of at a landfill site.

The application of the following system is vital to implement the above measures effectively:

- Use of vehicles equipped with mechanical lifter (hydraulic equipment) for loading waste into vehicles
- Gradual shift from handcart collection system to a new collection system with use of bins (mini-containers) at fixed points

Improvement Needs, Proposed Measures and Systems

<table>
<tr><th>Improvement Aspects</th><th>Recommended Measures</th><th>Recommended System</th></tr>
<tr><td>Sanitary condition</td><td>Change from the "Open system" to a "Closed System" where waste will not contact the ground.</td><td rowspan="2">The following systems will contribute to the improvement of both sanitary conditions and efficiency:
• Use of vehicles equipped with mechanical lifter (hydraulic equipment) for loading waste into vehicles
• Gradual shift from handcart collection system to a new collection system with use of bins (mini-containers) at fixed points</td></tr>
<tr><td>Efficiency</td><td>Gradual shift from the double handling system to the single handling system.</td></tr>
</table>

3) Key Element for Successful Implementation of the Proposed System

Use of vehicles equipped with mechanical lifter can be implemented only if some funds are available. However, the shift from the handcart collection system to a new collection system with use of bins at fixed points requires citizens' cooperation. It is the citizens who bring waste to the bins placed at fixed points, and put waste in the bins. The citizens' cooperation in this action is the key element for successful implementation of the proposed new system. Implementation of a pilot project as explained later is necessary.

(2) Evaluation of System Options

1) System Options

The above recommendation is presented as results of the evaluation of the proposed and existing systems as shown below.

System Option 1: Single handling system with use of bins at fixed points and mechanical lifter (Recommended)

System Option 2: FINNIDA system (use of a hooklift truck and 12 m3 containers)

System Option 3: Dominant existing system (primary collection and no mechanical lifter for waste transfer from handcart to vehicle

2) Evaluation Criteria

The following two criteria are used for evaluation of the system options:

- Sanitary conditions
- Efficiency

3) Evaluation

(a) Sanitary Conditions

System Option 1 No waste will contact with ground during waste transfer because waste put into bins by residents will be directly and mechanically put into the vehicle. Sanitary level is high.

System Option2 In this system, majority (about two thirds) of waste collected by handcarts can be put directly into a 12 m3 container. Sanitary level is better than the existing system (System Option 3).

Remark: A worker can unload waste from handcart inside the container. However, when about two thirds of the space of the container is filled, the entrance door of the container has to be closed. Then subsequent handcart operators dump waste on the ground beside the container.

System Option 3 — Waste collected by handcarts is dumped on ground (streets) for transfer. Some waste is scattered to neighborhood during transfer. Sanitary condition is bad.

Result of Evaluation of the System Options in terms of Sanitary Conditions

	System Option 1 Single Handling System (Recommended)	System Option 2 FINNIDA system	System Option 3 Dominant existing system
Sanitary condition	A	B	C

A: Very Good B: Good C: Bad

(b) Efficiency

System Option 1 — Very efficient because this system does not require primary collection. The manpower requirement is the least among the options.

System Option2 — Much more efficient than the existing dominant system (Option 3) because one truck with a hooklift can daily carry as many as 6 large containers (12 m3) filled with waste.

System Option 3 — Not efficient. Under this system, one vehicle makes only about 3 trips per day because it takes as long as one hour for loading (transferring) waste from handcarts to a truck.

Result of Evaluation of the System Options in terms of Efficiency
Case 1: At Current Salary Level

	System Option 1 Single Handling System (Recommended)	System Option 2 FINNIDA System	System Option 3 Dominant Existing System
Unit cost needed to collect & transport one ton of waste	US$2.76/ton	US$2.81/ton	US$3.89/ton
Cost Indicator (Option 3 = 100)	71	72	100
Evaluation	A	A	C

Relative Efficiency:
A: very high B: high C: low

Result of Evaluation of the System Options in terms of Efficiency
Case 2: When Salary level is doubled

	System Option 1 Single Handling System (Recommended)	System Option 2 FINNIDA System	System Option 3 Dominant Existing System
Unit cost needed to collect & transport one ton of waste	US$3.10/ton	US$4.52/ton	US$6.14/ton
Cost Indicator Option 3 of Case 1 = 100 (Option 3 of Case 2 = 100)	80 (50)	116 (74)	158 (100)
Evaluation	A	B	C

Relative Efficiency:
A: very high B: high C: low

Assumptions and details of the estimated costs are shown in Tables 6.3.3 and 6.3.4.

As can be seen from the above two tables, the differences in the unit costs between the options are larger as salaries of workers increase. System Option 1 requires only about 50 % of the cost of System Option 3 when the salary of worker is doubled. Needless to say, the salary of workers will increase faster than the cost of equipment as result of economic growth.

(c) Conclusion

Evaluation results are summarized as follows:

Evaluation Criteria	System Option 1 Single Handling System (Recommended)	System Option 2 FINNIDA System	System Option 3 Dominant Existing System
Sanitary Conditions	A	B	C
Efficiency	A	B	C
Overall Evaluation	A	B	C

The conclusion is that System Option 1 is the best.

There are some other benefits arising by applying System Option 1, which intensively use waste bins:

- Citizens can discharge waste into the nearest waste bins at any time. This is convenient to the citizens. Under the existing handcart collection system, the citizens have to bring waste to a handcart only when it arrives
- The above benefit (convenience) to the citizens will reduce possibility of dumping their waste on streets before arrival of handcart. This implies that streets can be cleaner with less dumping of waste
- The System Option 1 intensively uses waste bins of standardized capacity such as 240 liter or 660 liter. Because of the use of such standardized bins, it is easy for URENCO to measure exact volume of waste collected from

business enterprises. Measurement of the exact waste collection volume is an important step towards increases in fee revenue

These benefits further strengthen the conclusion that the System Option 1 is the best.

(3) Recommended Waste Collection System

1) System Elements

The System Option 1 comprises the following elements and actions:

- Bins are placed at fixed points near the waste generation sources. The capacity of bins would range from 120 liter to 1,000 liter
- Waste generators (citizens) bring solid waste, and put it into the bins
- A waste collection vehicle arrives at the locations where a bin is placed or a place as close to the bin as possible. A worker (truck assistant) moves the waste-filled bin to the vehicle, and lifts the bin and loads waste into the vehicle by operating a mechanical lifter attached at the rear end of the vehicle

2) Recommended Waste Collection System

As result of the evaluation, the System Option 1 (collection with bins = no primary collection system) is the best, and therefore Haiphong City should dominantly apply the System Option 1 at places wherever possible. Specification (type and capacity) of bins and locations of bins differ by area conditions such as accessibility by waste collection vehicle, availability of space for placing bins, and acceptability of bins by local residents. These conditions depend mainly on types of waste generation places.

The JICA Study Team proposes the following systems according to types of places and waste.

Proposed Waste Collection Systems according to Types of Places and Waste

Type of Place	Specification of Bins to be Used	Locations of Bins	Remark	Efficiency
1. Market	Type A (see table below)	Entrance area and inside the markets	Who put waste into bins? There are two ways. First, market shop persons can bring waste, and put it into the bin. Second, a worker employed by the market can collect waste by pushing the bin-cart, and visiting shops inside the market.	Very high
2. Business enterprises	A or B depending on waste amount	Entrance area or inside the premises.	Frequency of waste collection should be reduced to twice or once a week. Bin should be large enough for storage of waste generated during 3 days or 1 week.	Very high
3. Hospital waste	Type B	Specified place	Use vehicles specialized in collection of only hospital waste.	High
4.1 Household Type 1: Government apartment buildings	B or A in principle.	Places adjacent to the building, and accessible by vehicle	240-liter bin (Type B) will serve 200 persons if the bin is emptied every day. In places where a waste collection vehicle cannot come closer to the bins, a collection worker will push bin to the vehicle.	Very high
4.2 Household Type 2: Individual houses along streets	B	Street side (pavement)	One bin is placed every 20 – 40 m on the roadside. On both sides of the roads, bins should be placed in a staggered manner like teeth of a saw.	High
4.3 Household Type 3: Places where any type of bins cannot be placed	Primary collection using handcarts	No place. In reality, there are not many places where no bins can be placed.	It may be worthwhile for URENCO to try an alternative collection system in narrow streets as a pilot project, i.e. to use a very small vehicle with capacity of 500 kg or so. Waste collection workers will load collected household waste and put directly into the vehicle. Then, at some points, waste will be transferred from this small vehicle to a larger vehicle.	Low
5. Busy streets and parks	Type B	Places where there are many pedestrians.	People put waste into the bins.	Very high
6. For sweeping of streets where bins are placed.			Sweeping workers put sweeping waste into 240-liter bins placed on street sides.	Higher than Item 7.
7. For sweeping of streets where no bins are placed.	Sweepers use bin-cart (Type A) as mobile cart.		Sweepers put sweeping waste into the bin cart that they push.	Lower than Item 6.
8. Demolition waste	No handcarts or bins are used.		Use kipper truck or multi-lift container with a grab-crane.	Higher than a system using hand-carts

Types of Bins to be Used

Type	Description
A	Bin-cart. Bin part is made of plastic with capacity of either 660 or 1,000 liter. Cart has 3 wheels. In Ho Chi Minh City and Da Nang, this type of bin-cart is proved to be more convenient and easier to handle than the traditional handcart. The bin-cart can be used either as fixed-point mini-container or mobile handcart.
B	240 liter plastic bin with 2 wheels

(4) Pilot Project for Implementation of the Proposed Collection System

1) Necessity for the Pilot Project

As earlier mentioned, key element for successful implementation of the proposed collection system is the citizens' cooperation. Under the proposed system, the citizens are required to bring waste to the nearest waste bins, and put waste in the bins.

It is sensible to implement the proposed system in some communes as a pilot project before citywide application.

2) Objectives of the Pilot Project

The prime objective of the pilot project is to see if the proposed system is applicable in reality. Through the implementation of the pilot project, it is also expected that both the city side and the citizens will learn and become accustomed to the new system. The city side will learn the following:

- how to communicate with citizens
- where to put bins
- what types of bins are suitable
- how many bins are required under certain collection frequency
- frequency of emptying bins
- how to prevent bins from being stolen or damaged by people
- how to clean bins and who should clean the bins
- possibility that bin users pay for the bin
- how fast people accustom to the new system
- How to transfer redundant workers to somewhere else

3) Selection of the Places for Pilot Project

It is sensible to implement the pilot project at places where the implementation is likely to be successful. Probably, the proposed system is the most well suited and received by the markets. The second easiest would be some enterprises. The last is the household people. Among the households, the proposed system would be most well suited to the apartment buildings. As conclusion, the pilot project for the introduction of the new collection system would be carried out in the following places:

- A market
- Some enterprises (factories)
- Government apartment buildings

After implementation of the pilot project in these types of places, the city will implement it at the following types of places:

- Houses located along main streets
- Houses located in places where collection vehicles cannot enter

4) Ownership of Waste Bins

In the pilot project, the city has to provide the bins. However, it is preferable that the users of the bins pay for the bins to keep them clean and sanitary for long time. It is relatively easy to ask markets and enterprises to purchase the bins. Households in the apartment buildings may find it better for them to purchase bins if appropriate incentives are provided. Individual households would not be interested in buying the bins. However, it is preferable that one household within a group of households takes responsibility for keeping the bins clean and sanitary. An idea is that the city provides an incentive such as reduction of waste collection fees for those who take such responsibility of bin cleaning. This aspect should also be studied during the pilot project.

5) Period of the Implementation Project

It would take a year to carry out the pilot project at all places mentioned above. Needless to say, the pilot project will become a regular practice if it is successful.

6) Collection Workers

The proposed system requires much less number of collection workers as compared to the existing system. The following policy is recommended:

- The city will not recruit new collection workers (Number of workers will decrease as some workers retire.)
- Workers who are made redundant will be 1) assigned with other job such as street sweeping or 2) transferred to other areas where the city starts new collection services
- Control the speed of application of the proposed new system so as not to necessitate dismissal of workers

(5) Long Term Implementation Schedule of the Proposed Single Handling System

There will be the following 3 different types of waste collection in future:

- Street sweeping and collection using brooms and handcarts
- The existing waste collection system with primary collection using handcarts
- The proposed single handling system where citizens will bring waste into nearest bins placed at fixed locations, and waste filled bins will be emptied directly into waste collection vehicles using lifter

A proposed time schedule for application of the proposed single handling system without primary collection is shown in the table below. The percentages in the table indicate waste quantity to be collected by each system. The proposed system will gradually increase. Targets with respect to speed of expansion of the proposed system are proposed as follows: 35 % in terms of ratio of waste collected by the proposed system to total waste amount collected, and 60 % in 2010, and 80 % in 2014 and thereafter

Proposed Time Schedule for Application of the Proposed Single Handling System

Year	Waste Amount to be Collected by URENCO (ton/day)	**Waste Collected by Proposed Single Handling System**	Waste Collected by Existing System with Primary Collection	Street Waste
2000	367	**0 %**	88 %	12 %
2001	381	**0 %**	88 %	12 %
2002	395	**5 %**	83 %	12 %
2003	446	**10 %**	78 %	12 %
2004	464	**15 %**	73 %	12 %
2005	597	**35%**	54 %	11 %
2006	660	**40 %**	49 %	11 %
2007	707	**45 %**	44 %	11 %
2008	749	**50 %**	39 %	11 %
2009	793	**55 %**	34 %	11 %
2010	839	**60 %**	30 %	10 %
2011	862	**65 %**	25 %	10 %
2012	885	**70 %**	20 %	10 %
2013	908	**75 %**	15 %	10 %
2014	932	**80 %**	10 %	10 %
2015	955	**80 %**	11 %	9 %
2016	979	**80 %**	11 %	9 %
2017	1,004	**80 %**	11 %	9 %
2018	1,030	**80 %**	11 %	9 %
2019	1,056	**80 %**	11 %	9 %
2020	1,082	**80 %**	12 %	8 %

Street waste will decrease in terms of share due to decreases in waste littering by the citizens.

(6) Equipment Procurement Plan

Based on the plan shown above, annual procurement plan of equipment (waste collection vehicles and waste bins) were prepared for each company, i.e., URENCO, Kien An Company and Do Son Company. It is planned that in 2004 the three companies will substantially replace the existing old vehicles with new ones.

In estimating quantity of waste collection vehicles and waste bins, the following assumptions were used:

- Required capacity of waste collection vehicles is set at 5 % more than the target average daily waste collection quantity before 2003, and 10 % in and after 2004
- Average amount of waste transported: 12.25 ton/vehicle/day (3.5 ton/trip x 3.5 trips/vehicle/day)
- Average amount of waste put in a waste bin: 0.16 ton (400 liter) per bin per day
- Use period of equipment
    - Vehicle: 10 years
    - Bin: 3 years

Estimated numbers of waste collection trucks needed for collecting target waste collection amounts are shown in the following table.

Estimated Number of Waste Collection Vehicles Needed

Year	URENCO (a)	Kien An Company (b)	Do Son Company (c)	Total (d) = a+b+c
2001	33	6	5	44
2002	34	6	6	46
2003	39	7	6	52
2004	42	8	6	56
2005	54	8	8	70
2006	60	9	9	78
2007	64	10	10	84
2008	68	11	11	90
2009	72	12	12	96
2010	76	12	13	101
2011	78	13	13	104
2012	80	13	14	107
2013	82	14	15	111
2014	84	14	15	113
2015	86	15	16	117
2016	88	15	17	120
2017	91	15	17	123
2018	93	16	18	127
2019	95	16	18	129
2020	98	17	19	134

Required numbers of bins and handcarts as well as purchase quantities by types of equipment are shown in Tables 6.3.9 – 6.3.12.

(7) Cost Estimation

Estimated total costs (investment + recurring costs) required by the 3 companies to provide waste collection and transport service are shown in the following table.

Estimated Total Costs (Investment + Recurring Costs) Required for Waste Collection and Transport Services by the 3 Companies during 2001 –2020

Unit: US$1,000 in 2000 Price

	URENCO (a)	Kien An Company (b)	Do Son Company (c)	Total (d) = a + b + c
a. Investment	15,977	2,645	2,602	21,225
b. Recurring Cost	40,729	6,619	6,038	53,386
c. Total (a+b)	56,706	9,264	8,640	74,611

Note: It is assumed that salaries of employees will increases by 4 % annually.

Tables 6.3.5 – 6.3.8 shows detailed costs of each companies and total of the 3 companies. Tables 6.3.9 – 6.3.12 shows estimated quantities of equipment needed or purchased and other details on which quantities and costs are estimated.

6.3.3 General Plan for Waste Treatment and Disposal

(1) Options for Waste Treatment and Disposal

There are several methods of ordinary municipal waste disposal.

- Landfill
- Composting
- Incineration
- Combination of these methods

Most popular method is the landfill. There are different levels and types of landfill. Open dumping is commonly practiced in many cities in developing countries. The sanitary landfill is very different from open dumping. It needs a leachate treatment facility and leachate collection system, liner, gas collection system, and careful filling work based on a site management plan. This is the first step to appropriate solid waste disposal. Most advanced nations still use this system.

Composting is effective for organic waste treatment. This is one of the good methods for resource recovery from waste. However it needs control of quality of waste to be accepted. For example, separation of inorganic matters from organic is essential. Compost will be produced every day throughout year. However, demand for compost is rather season specific. Therefore it needs a storage yard. Even with application of composting, a landfill site is needed to dispose of compost reject, which is normally as much as 50 % of the waste brought into a compost plant.

Composting should not be applied unless adequate demand for compost is confirmed.

Incineration is also popular in advanced countries. Because this method can reduce a volume of waste to be landfilled and recover the heat, it is popular in Japan, the Netherlands, Germany, and some other European countries. However this process generates trace hazardous substances such as dioxins. Therefore very advanced gas cleaner system and careful operation for incineration temperature control are essential. Waste incineration is expensive, normally ten times higher than the sanitary landfill. The incineration also require high waste calorie of at least 1,000 kcal/kg (lower calorific value) in order that waste can be incinerated without using fuel.

As conclusion, the sanitary landfill is the best for Haiphong because it is environmentally sound and most economical.

Comments from the JICA Study Team on co-disposal of solid waste and septage and compost using septage and market waste are described below.

Comments on
1) Co-disposal of solid waste and septage, and
2) Compost using septage and market waste

1. Co-disposal of solid wastes and septage

At the Trang Cat area, there is a plan of septage treatment facility by SADCO. For saving the costs and lands, a possibility of co-disposal of solid wastes and septage should be considered. Co-disposal of septage and collected waste has the following benefits and disadvantages:

Benefits:

- Saving the space for disposal because the sludge easily fills the vacant space of filled wastes
- Promotion of biodegradation by good moisture controls, especially in dry season.
- Saving the space and costs for leachate treatment facilities

Disadvantage:

- Bad conditions for filling works of solid waste, if there is no filling strategy
- Prevention of air invasion into the filled wastes, which prevents the aerobic decomposition
- Collapse of filled waste and sludge, if there is no cares for stability of waste layer

From the aspects of landfill site management, this co-disposal plan does not seem appropriate for the near future. In Europe, USA, and Japan, many landfill sites accept the sludge from wastewater treatment facility. However there are strict rules for water content of sludge and filling works. Some nations have a criterion for the maximum ratio of the amount of sludge to that of waste to be accepted. There has been several tragic accidents caused by sludge collapse in the past. Unfortunately there has not been good filling work plans established yet in Viet Nam. Therefore, the Vietnamese cities should have good skills of filling works first. If they have sufficient experiences and skills, they will be able to manage this co-disposal. It might become feasible in five years after the new landfill site operation starts. For the period after the year of 2010, the possibility of co-disposal would be considerable.

2. Composting using septage and market waste
There is also composting facility plan in Trang Cat area. Based on the analysis of composition of waste collected by HPURENCO, it is not feasible to make compost from collected wastes. The waste contains many inorganic matters such as ash of charcoal and many plastic films and bags. It is very hard to separate the plastic films from the waste once mixed. Therefore, it would not be effective to produce compost from waste collected by HPURENCO. In the case there is still a possibility of composting using market waste. The market waste contains much organic matters such as pieces of vegetables and meats. However organic content is too much. Therefore, the compost production by mixing of market waste and septage may be technically feasible.
A big problem is storage of compost product. Compost is a very good soil conditioner and fertilizer. However farmers do not use compost every day, only several times in a year. Therefore, storage yards with roof are needed. Some composting factories have open storage yards for storage of composts. However the climate conditions of Vietnam with high temperatures, strong sunlight, and much rainfall, would reduce nutrient contents of composts in open storage. Open storage of compost in Vietnam is not effective.
Above all, the feasibility of compost crucially depends on such factors as 1) compost prices, 2) quality, 3) transport distance from buyers to sellers, 4) as well as agricultural conditions of the area. In any case large scale composting would not be feasible in Haiphong judging from experiences in other cities in Vietnam and the rest of the world.

If the septage contains some hazardous substances like heavy metals, the compost will not be used. Occurrence of only one accident might be enough for farmers to decide not to use the compost. Composition of septage should be analyzed and confirmed.

(2) Planning and Design Policy

Landfill site facilities were designed from the aspect of BATNEEC (Best Available Technique Not Entailing Excessive Cost), affordability and self-sufficiency.

(3) General Plan for Construction of Sanitary Landfill sites in Haiphong City

1) Location and Condition of Ground Base

Haiphong City is very flat with few mountains. Therefore, most of landfill sites would be constructed on flat area. In order to construct the landfill sites, the following issues should be considered and checked:

- Site should be inside an appropriate dike to protect the area from floods and high tide
- Characteristics of soilshould be checked, i.e. permeability, consolidation, thickness of clay, groundwater table height and so on
- Access road condition and traffic condition for waste transportation from collection area

2) Dykes/Embankments

Embankments are essential to support the filled waste body. First layer embankment is very important. It should have enough strength to support the filled body and low permeability to prevent a leakage of leachate. Slopes of embankments depend on the characteristics of ground soil.

In order to get larger filling capacity for waste, a landfill site should be filled up higher. It is very difficult to support the waste body without surrounding embankments. There might be a risk of collapse of waste, if the height of waste body is more than 10 m. Therefore, additional embankments of higher levels need to be constructed on top of the first embankment. These embankments are also useful to compact the waste effectively, because the embankments can support the waste during filling works.

The Joint Circular issued by MOSTE and MoC on 18 January 2001 requires that ground of landfill sites should have adequate loading capacity, and specifies that it should be 1kg/cm^2 or more. To comply with the Circular, surcharge is recommended. Details are shown in the Feasibility Study Section 4.2.3.

3) Liner system

Haiphong City has rich resources of clay. If the ground has appropriate permeability, natural clay liner system is preferable. Synthetic liner system is very expensive.

The Joint Circular, issued by Ministry of Science, Technology and Environment (MOSTE) and Ministry of Construction (MoC) on 18 January 2001, requires the synthetic membrane liners be installed on compacted clay.

For Phase 3 Trang Cat Landfill Site, it is planned that a 1.5 mm thick synthetic membrane be installed to conform with the Joint Circular.

It is very difficult to install a synthetic liner at unconsolidated ground. Therefore, a surcharge method will be applied for reinforcement and improvement on the ground of waste filling fields. By this improvement, the permeability of ground soil for filling fields will be reduced below 10^{-7}cm/s.

4) Leachate Collection system

Leachate collection pipes will be installed. Collected leachate will be pumped into the ponds through pipes. Maintenance of leachate collection pipes is easier than that of underground pipes. However, pumping needs electricity that cost money.

There are several patterns of leachate collection pipe networks as follows:

- Single Line Type
- Parallel Lines Type
- Fish Bone Type
- Ladder Type

To collect the leachate effectively in a flat place like Trang Cat area, the Ladder Type is preferable. Consideration is also needed for the consolidation of clay mud layer of the ground. Total settling of the ground in the long term at this area is estimated to be almost 1m by former geological survey reports. A gradient of collection pipes will be hard to be maintained for long time after completion of the construction because the settling occurs unevenly in the filling area. Therefore, it is preferable to use gravel or broken bricks for leachate collection pipe that is to be installed on the liner protection layer with pipes in a ladder pattern. Carpet layer pattern is also available but not feasible.

Proposed specification of the leachate collection system is as follows:

(a) Basic Structure: Perforated Synthetic Pipes + Collection Layer/Bed

(b) Sizes

- Diameter of Collection Pipes: 0.5 m for main lines & 0.2 m for branch lines
- Thickness of Leachate Collection Layer/Bed: 0.3 - 0.5m
- Unit space between pipes: 40m
- A slope of bottom layer is 0.5-1.0 %.

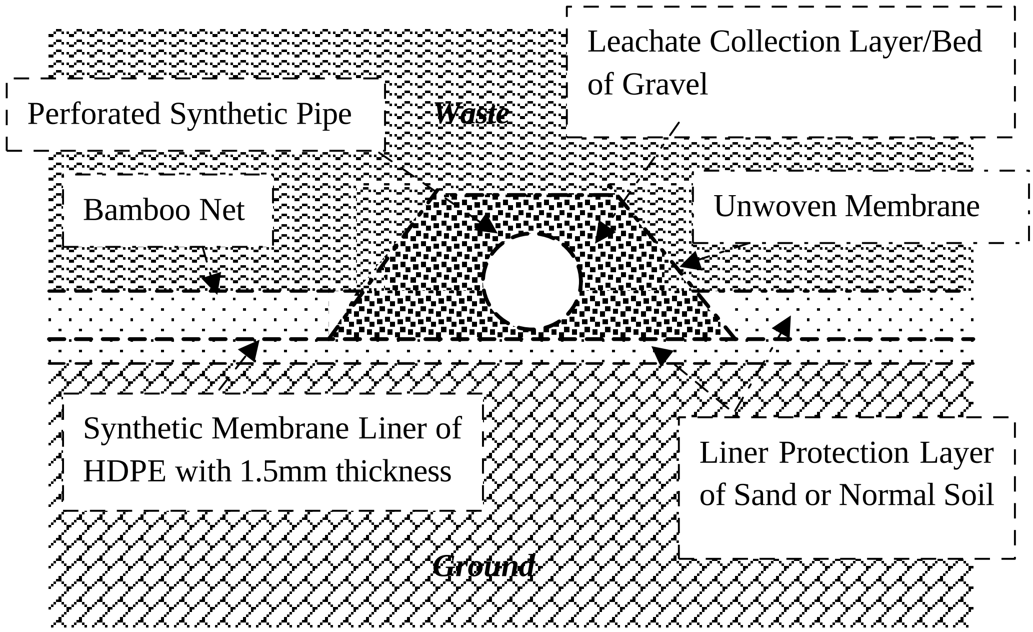
(c) Materials

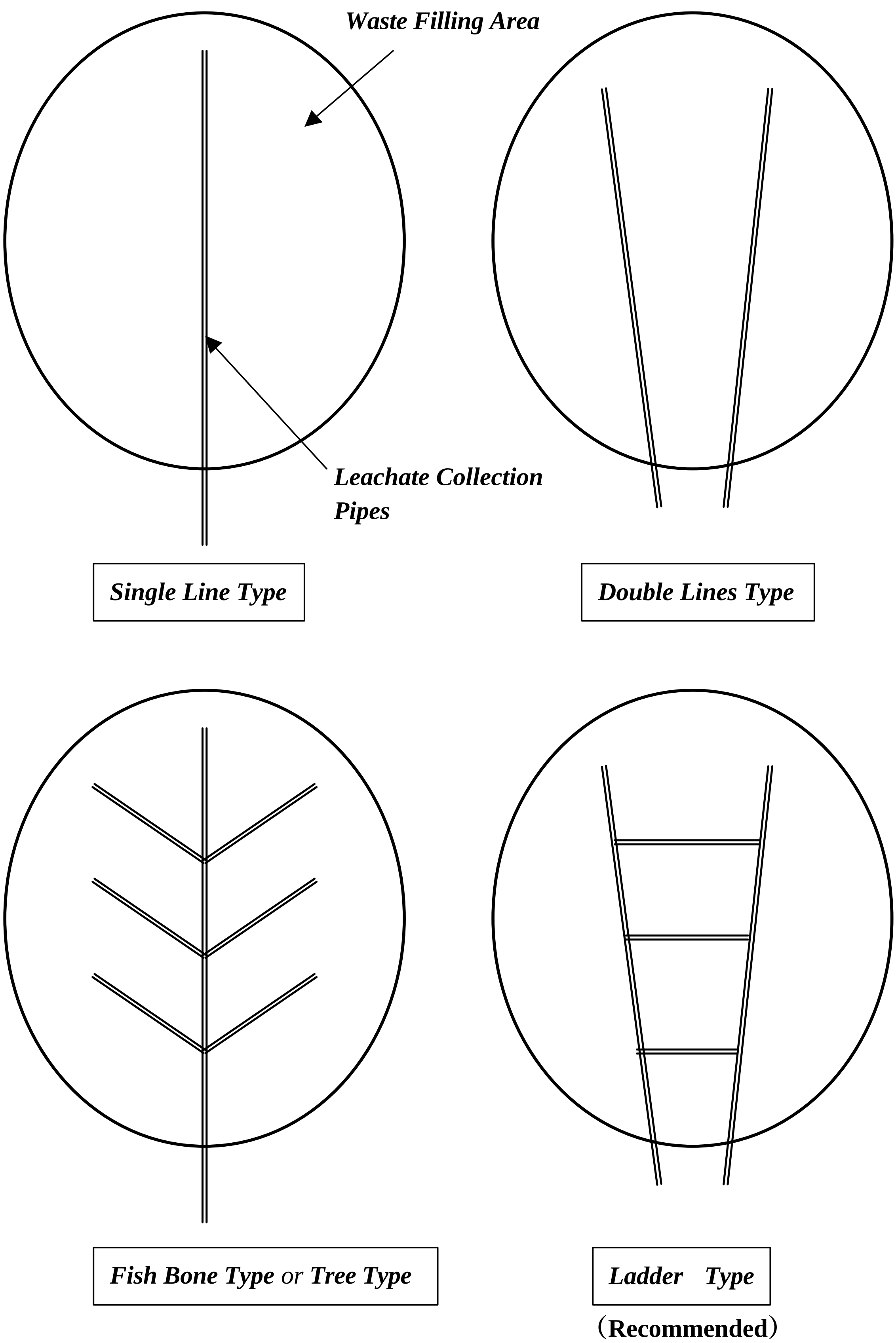
Collection Pipes:

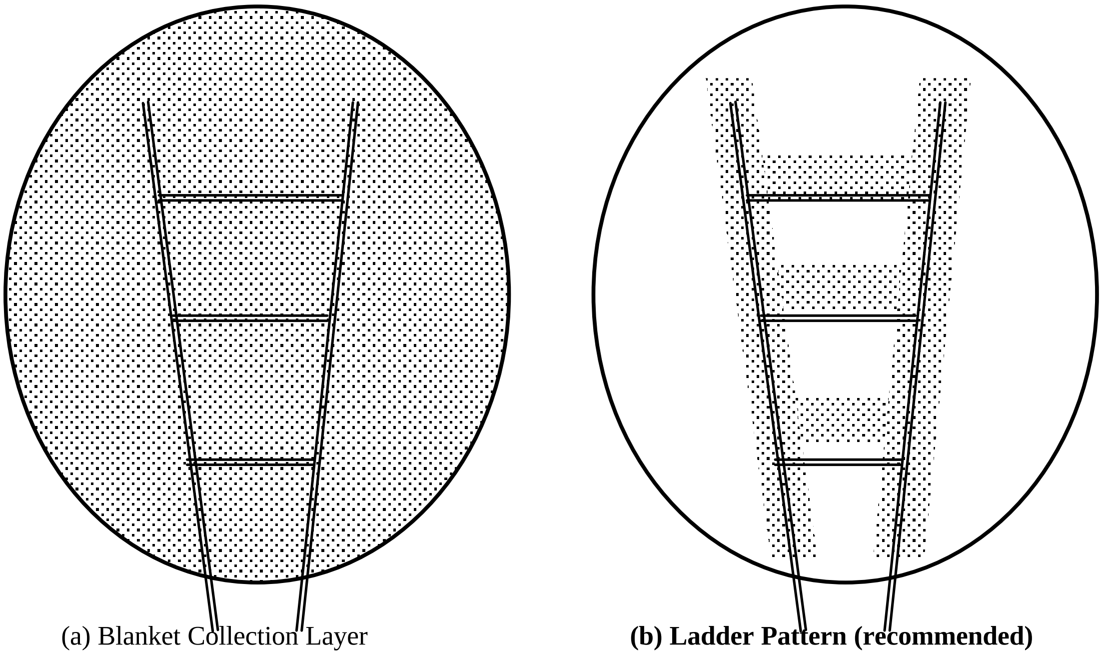
- Main pipes: Reinforced concrete pipe
- Branch pipes: HDPE (High Density Polyethylene) or PVC (Polyvinyl chloride) or PP (Polypropylene)
- Leachate Collection Layer: gravels of 100 - 200mm

(d) Design of Liner System

Design of liner system and leachate collection system is shown in cross-section below.




Waste Filling Area
Leachate Collection Pipes
Single Line Type
Double Lines Type
Fish Bone Type or Tree Type
Ladder Type
(Recommended)



(a) Blanket Collection Layer **(b) Ladder Pattern (recommended)**

Shaded area indicates leachate collection beds

Plans of Patterns of leachate collection bed (made of gravel)

5) Leachate Treatment

In Haiphong City, it is easy to get lime powder. From the aspects of affordability and easiness to maintain, the precipitation process with lime powders is recommended.

Leachate Collection

↓

Mixing Pond of Lime Powder

↓

Precipitation Pond

↓

Aeration Pond

↓

(Aqueous Plant Pond)

↓

Discharge to the open water body

Circulation of treated water from aeration pond and precipitation pond into the filled waste body is also recommended.

Functions of each process are described below.

(a) Mixing/Precipitation Pond

Precipitation ponds are two small ponds for mixing of leachate and cohesive agent, and are used for sedimentation of cohesion matter. The two ponds have to be used periodically; therefore there should be a gate or a valve to change the water flows.

The process is shown below.

Periodical Use of Two Precipitation Ponds

Pond A	Pond B
(a) Filling with water from aeration pond (b) Adding lime powder (c) Mixing for 30 minutes (Flocculation) (d) Stop mixing and left still for 1 hour (precipitation) (e) Discharge the top water into sedimentation pond without disturbing the flocculation (g) Remove the precipitate sludge	Start of same action of (a) in Pond A

One is used for mixing and precipitation, and the other one is being filled with the leachate at same time. In this pond, it is suggested that the lime be used as a cohesive agent. The lime powder is added at a ratio of 1000 - 1300 mg/L of leachate, and mixing continues for 30 minutes. After mixing stops, precipitation will occur. For removal of SS and another flocculation, the pond has to be left without disturbing. After precipitation of 1 hour, most of SS (Suspended Solids) and flocculation will sink to the bottom. The cleaner water body can be separated from precipitates by discharge of the top water.

The functions of these ponds are as follows:

- Making flocculation from suspended solid and other contents in leachate
- Separation of flocculation and water by precipitation

By addition of lime, pH of leachate turns to alkali side. Therefore, some solved heavy metals cannot be kept in the solution phase, and solidify. There will be also a change in surface electronic conditions of fine particles. Therefore some fine particles begin to concentrate and form bigger particles.

The complex phenomenon of those reactions and other will promote the flocculation.

The leachate always contains NH_4^+ (ammonium ion). NH_4^+ cannot exist as ion form in strong alkali condition. The change of pH to alkali side promotes the gasfication of NH_4^+.

NH_4^+ in the leachate becomes gaseous NH_3 and is released to the air. This process is called "Ammonia Stripping" and is well known as the removal process of Nitrogen in water phase. Addition of limes does not form a strong alkali condition, but is still effective for Ammonia Stripping. There might be odor plume that contains much ammonia formed in the t Precipitation Pond. High concentration of ammonia irritates human eyes, nose, and skin. Therefore, operator and owner of leachate treatment facility will need to pay attention to ammonia gas, from the aspects of occupational safety and prevention of odor complained by the neighborhoods.

The efficiency of removal of SS and other matters in precipitation pond depends on the characteristics of leachate and lime and the time of mixing and sedimentation. Most SS will be removed to less than 200 mg/L. A great change of waters shown by its color. However the leachate into the aeration pond looks black before the treatment, the color of treated water of precipitation pond (TWPP) turns brown or gray.

(b) Sedimentation Pond

After the treatment of precipitation pond, the top water will be conducted into the sedimentation pond. In this pond, the retained flocculation, which could not sink in the precipitation pond, sinks. This pond works as the control pond for final discharge.

Periodical clean up of sediments is necessary.

(c) Aeration Pond

In this pond, the plan uses a surface aeration machines. This aeration machine is mainly composed of a motor and propeller , and is jointed to a floating body or boat. If there is a shaft long enough, the propeller will be driven by the motor fixed at the edge of the pond's dyke. For affordability, using a machine similar to those used in the fish/shrimp breeding ponds is suggested.

These machines mix surface water with air, and cause vertical circulation of water in the pond. The surface water plume, which is rich in oxygen, will flow down to the bottom at the end of pond and then the bottom plume of less oxygen flows up to the water surface. Therefore, whole water body would contain more oxygen, promoting biological decomposition by he microorganisms.

The aeration pond causes the oxygen content to increase in leachate and promotes biological decomposition of organic matters in leachate. The level of decomposition of organic matters depends on the characteristics of leachate and a retention time in the pond. It also contributes to the neutralization of treated water of precipitation pond, which is alkali.

The depth of water table in this pond should be less than 3m. If it was more than 5m, the oxygen absorption would not be effective. If this aeration process works well, the color of water would turn to dark brown.

If the amount of leachate generation is small versuscapacity of pond, periodical aeration should be applied for saving electric power consumption. Periodical aeration has two phases of biodegradation: An anaerobic decomposition promotes the production of ammonia from nitrates and nitrite. This is known as "Ammonia Stripping" reaction at the mixing of lime and wastewater to remove ammonia solved in water to air.

(d) Circulation of Treated Water from Precipitation Pond

The pH of treated water of precipitation pond (TWPP) would still be alkali. Some of TWPP is useful for stabilization of filled waste body and circulated TWAP. It is also effective for ammonia gasification from the liquids on the surface of wastes. Sometimes there happens to be rapid and much production of ammonia gas by the direct pouring of TWPP into the waste. Therefore the same attention is necessary as precipitation pond. It is recommended to mix TWAP with TWPP before pouring into the circulation bed.

(e) Circulation of Treated Water from Aeration Pond

The circulation beds function to pour the circulated leachate into the filled waste effectively and collect gas.

The aeration pond will not be able to remove the organic matters of leachate completely. There are many microorganisms in the filled waste body. Therefore the treated water of aeration pond (TWAP) will be poured into the waste layer. The decomposition of organic matters of both leachate and waste will be promoted. From the experiences in Malaysia, China and other countries, the water quality of leachate will be better after 6 months operation of circulation. If it works well, the organic matter content (BOD) might be less than 200 mg/L. If the circulation continues persistently, the BOD will be less than 100.

This circulation promotes the decomposition of filled waste especially in dry season, because of moisture control by pouring leachate.

Structure of circulation beds is shown in item 8) in this section.

(f) Additional Pond/Wetlands for Further Biological Treatment

The discharge from sedimentation pond contains less concentration of pollutants. However, there will be still some Nitrogen and Phosphate in the discharged water. If there is some area near the discharge channel, it is recommended that small ponds or artificial wetlands be installed there. It is recommended that in this pond or wetlands, aqueous plants, like water hyacinth, should be brought in from other wetlands and planted there.

These aqueous plants are good at absorbing nutrient matters like N, P and organic matters for their growth. By the periodical removal of these plants from pond/wetland, nutrients and organic matters are removed from discharged water. By using the cultivated plants to feed the pigs, cows, and so on, it contributes to resource recovery. Therefore, the controlled cultivation of these plants functions as removal of nutrients from discharge water.

(g) Overviews of the Leachate Treatment Facility

From the aspects of characters of pollutants, the functions of each process are summarized in the table.

Expected Characters of Waste Water at Each Process and Their Function

Pollutants / Process	Organic Matters	Suspended Solids (SS)	Heavy Metals	Nitrogen & Phosphate	Notes
1. Precipitation Ponds	Some Organic Matters will be caught by forming flocculation	Good Cohesion & Precipitation: SS < 300 mg/L	Good Cohesion & Precipitation: Most of Heavy Metals turn to be SS	Some NH_4^+ become gaseous NH_3 and released to air NH_4^+ < 150 mg/L	Care for reaction of Ammonia Stripping during the mixing of lime & precipitation
2. Sedimentation Pond	No big removal but slight removal by biodegradation	Good Sedimentation: SS < 50 -100 mg/L	Basically no change	Hopefully T-N < 150 mg/L	
3. Aeration Pond	Good Aeration: BOD < 600 mg/L Poor Aeration: BOD < 1000 mg/L	Some SS turn to be ?	Some Metals turn to be SS	Some N, P will be consumed by the biodegradation of Organic Matters	Periodical Aeration is applicable for small leachate generation
4. Circulation of TWAP*	Good Circulation for more than 6 months: BOD < 400 mg/L After 1 year: BOD <100-200 mg/L	Some SS will be caught in the filled waste layer	Some Metals will be caught in the filled waste layer.	Same as above	Leachate circulation flow rate should be well controlled.
5. Circulation of TWPP**	Some Organic Matters will caught in the filled waste layer	Some SS will be caught in the filled waste layer	Some Metals of the liquids on the waste surface & flocculation will turn to be SS	Good Circulation for more than 6 months: T-N < 200 mg/L	Leachate circulation flow rate should be well controlled.
6. Additional Pond/ Wetlands	Some Organic Matters will be removed by plants	Some SS will be filtered by plants body and roots	Some Metals will be absorbed by plants	Controlled Cultivation of Aqueous Plants will remove N, P, etc.	Periodical removal of plants is necessary

(*): Treated Water from Aeration Pond (**): Treated Water from Precipitation Pond

6) Gas Collection and Ventilation System

Gas ventilation pipes (in vertical) and gas collection bed of gravel or broken bricks (in lateral) will be applied. For the promotion of degradation of waste and prevention of casual fires, the following systems are:

- One vertical pipe will be installed in every square of 4 0m x 40 m
- Lateral gas collection beds will be installed every layer of 5 m height

7) Filling Work

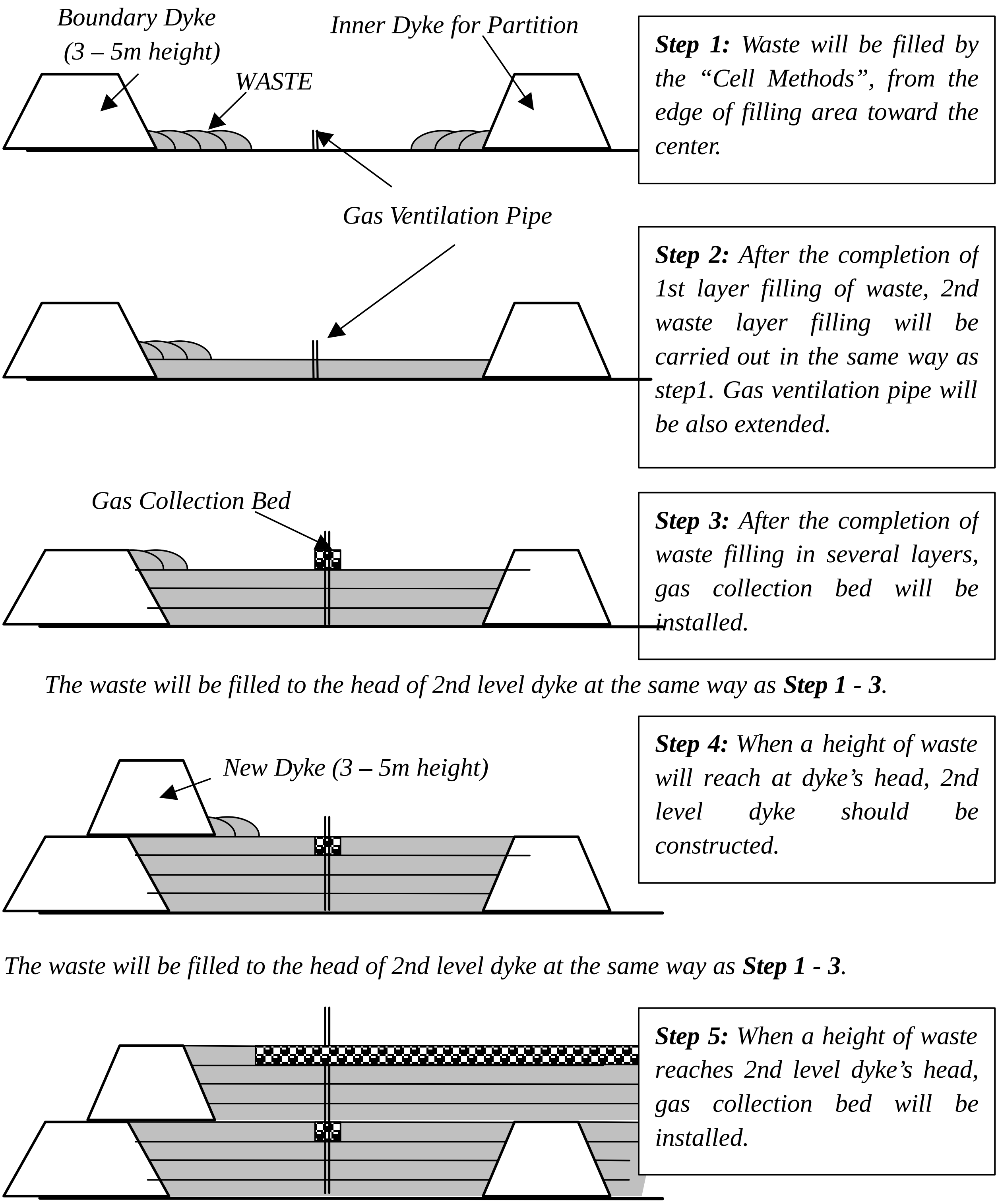
Effective filling work plan/strategy must be established at first. “Push-up” method is recommended.

It is planned that two bulldozers of 10 -15 tons will be used. Daily cover is recommended. A ratio of cover soil to filled waste will be 10cm: 1 m of thickness. However, at present, it is ambiguous whether adequate cover soil materials will be supplied at low price or not. Therefore, it is assumed there are no problems in procurement of soil material for cost estimation at this time.

8) Harmonization of Filling Work and Gas Collection/Ventilation

The gas collection system comprises gas collection beds and vertical ventilation. A gas collection bed is a filling layer of gravel. It is preferable to install a perforated synthetic pipe. Vertical ventilation system is a perforated pipe surrounded by gravel.

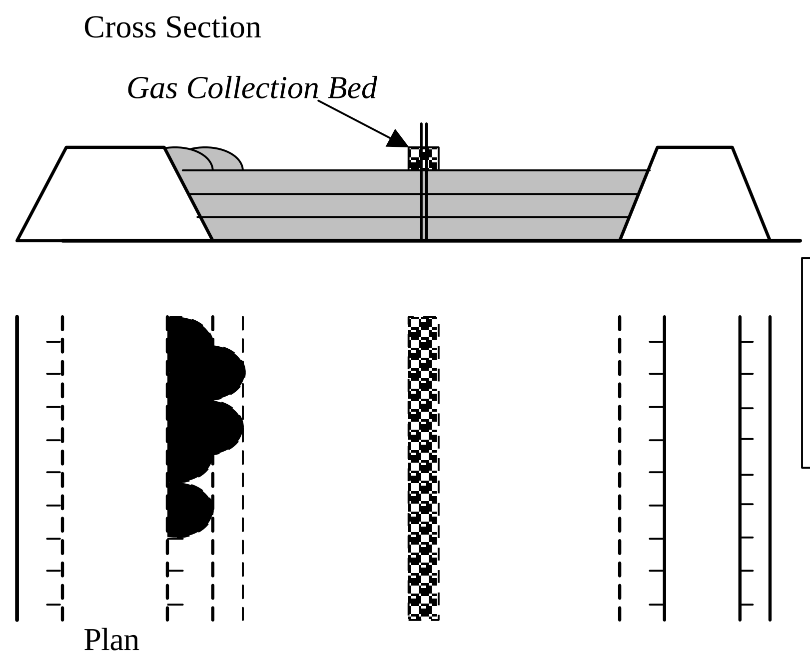
Gas collection beds will be installed every 5m in height. The beds will be located within a space of 40 m at the same level. The beds will be located perpendicular to the bed that is one level lower.



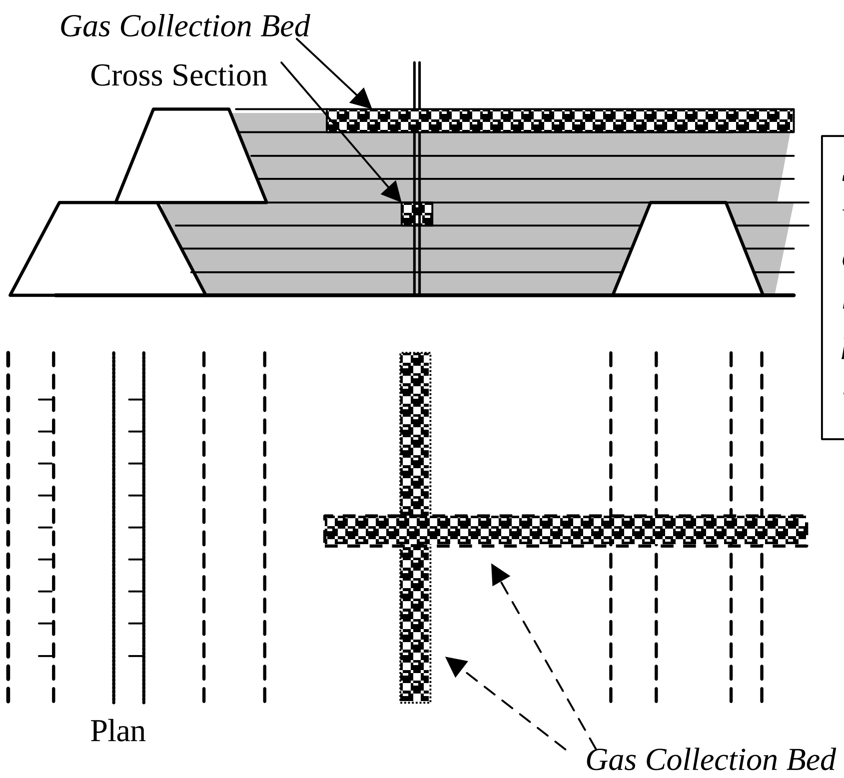
Note: Figures above are not shown in correct scale and shape.

Appropriate Process of Waste Filling Works in Cross-section

Cross Sections & Plans for Several States of Filling Works



Step 3: *After the completion of waste filling in several layers, gas collection bed will be installed.*



Step 5: *When a height of waste reaches 2nd level dyke's head, gas collection bed will be installed perpendicular to the first layer gas collection bed.*

Appropriate Process of Waste Filling Works

9) Cover and Filling Equipment

Daily cover is recommended. At lease weekly cover should be applied.

Considering breakdowns and repairs, three bulldozers (15 ton/each) and one compactor will be procured. Of the three bulldozers, two must be always operational.

10) Management Office

There will be a site office with a telephone.

11) Scavengers Activities

Scavengers' activities should be well managed and controlled.

12) Operation and Maintenance

(a) Records of Waste Accepted

There should be a weighbridge at the landfill site to collect data on collect waste. This data would be useful and necessary for proper management of the landfill site and improvement of waste collection services. A typical procedure for recording and reporting is shown below.

a) Collection Vehicle Arrives at the Site

A waste collection vehicle should go to the weighbridge, and the weight of waste transported is measured, and recorded either manually or, if computerized, automatically. The following types of data should also be recorded:

- Time of arrival at the site
- The vehicle number
- Driver's name
- Total weight of vehicle with waste before unloading

b) Collection Vehicle Goes to the Landfill Area and Unloads the Waste

c) Collection Vehicle Goes to the Weighbridge and then Leaves the Site

After the vehicle has unloaded the waste, it should go to the weighbridge and the following data should be recorded:

- The vehicle number
- Total weight of vehicle with waste after unloading
- Time of arrival at the site

Weight of waste is the difference in the vehicle weights measured before and after unloading waste.

These figures should be summarized into daily and weekly reports. The times at which collection vehicles arrive and depart should also be recorded. We can therefore calculate the actual time of a waste collection trip, and the number of trips for each vehicle and each driver. These data are useful to formulate a collection vehicle management plan and to monitor drivers' health.

(b) Filling Work

a) Shape of Waste Filled Layer

It is recommend that the waste filling work plan should be prepared by URENCO. The responsible personnel should understand the plan and supervise the filling workers based on it. The plan should describe or show:

- Drawings of waste filling areas at the end of every year (in Plans and Cross sections)
- Drawings showing access roads for trucks
- Gas ventilation pipes and collection beds

b) Filling Methods

There are a few basic methods of spreading and filling the waste:

- + Push Up or Up-fill Method
- + Push Down Method

The push-up filling method is recommended. However, if the dyke is not strong enough, it is impossible to apply this method.

c) Cover Works

The "Cell Method" and a daily cover should be applied. A daily cover needs soil storage near the site.

(c) Leachate Control

In order to prevent environmental pollution, appropriate management of the leachate treatment facility is essential. For proper management, we recommend the following items:

- Environmental monitoring (See item (e) Monitoring)
- Facility monitoring

In order to monitor the condition of treated water, analysis of treated water quality is necessary. But analysis of water quality for a full set of water standards is costly. However, the color of effluents in rivers where treated water is discharged should be subject to daily monitoring.

(d) Vermin/Pest Control

A 10 cm thick daily cover is effective for Vermin/Pest control. If there are inadequate soil resources, it may not be possible to cover daily. In that case, the site manager should devise an alternative filling strategy. It is preferable to use a smaller area for waste filling in a day, in order to reduce the area to be covered and save volume of cover soil.

(e) Monitoring

Environmental monitoring aims at the whole media around the site, ground soil, groundwater, leachate (original and treated), landfill gas (air), and temperature. These monitoring data provide us with information on the state of degradation of the waste, and the actual pollution of the surrounding areas. Therefore, monitoring items and frequencies of monitoring are different, according to the purposes of data use.

To evaluate the state of degradation, long-term and continuous monitoring data are required. To understand changes in the state of degradation, simple measurement data are useful, because they can be collected more frequently by simple methods than by laboratory analysis. When degradation is very active, data on water and gas vary considerably. However, when degradation is slowing down, the data will tend to be more stable.

To identify pollution caused by landfill operation, laboratory analysis is necessary. The analysis must be made four times a year. Due to budget constraints, frequency of monitoring by the laboratory analysis is limited as it is expensive. Combination of laboratory analysis and on-site measurement by URENCO is recommended. For the on-site measurement, simple measurement methods with testing papers, detecting tubes, portable gas meter, etc., are preferable.

6.3.4 Specific Plan and Strategy for Landfill Disposal

(1) Landfill Plan for the Central Three Urban Districts

1) General Trang Cat Site Development Plan

In 1997, HPPC obtained the Prime Minister’s approval for the use of the Trang Cat site (60 ha) that is located in Trang Cat Commune in An Hai Suburban District. Since the beginning of 1998, HPPC has been using the existing landfill site (referred to as Phase 1 site with an area of 5 ha). This site is outside to the north of the area of 60 ha approved by the Prime Minister. The conditions of this landfill site are outlined in Section 6.3.1. HPPC plans to close Phase 1 site in the middle of 2001. Upon closure of Phase 1 site, HPPC will start using Phase 2 site (11ha) that is located adjacent to the area for

World Bank's 1B project (Septage treatment site). Construction of Phase 2 landfill site started in early 2001. It is planned that the existing leachate treatment ponds of Phase 1 site will be used for Phase 2 l and fill site as well.

HPPC is going to use a part of Trang Cat site for septage treatment. The treatment site is 17 ha, and located between Phase 1 site and Phase 2 site. The construction of the treatment facility will start in 2001 according to the plan of 1B sewage project that is going to be funded by the World Bank. The western bank road of the area approved by Prime Minister will be improved by 1B project as well as by Phase 2 landfill site construction. This improvement works will not reach to the Phase 3 landfill site.

It is the Phase 3 landfill site (33 ha) that is subject to the feasibility study by the JICA Study Team. The planned service period of Phase 3 landfill site is approximately 10 years from the beginning of 2005 till the end of 2014.

The whole Trang Cat site (60 ha) will be used for two landfills (Phases 2 & 3) and the septage treatment plant(1B project).

The JICA Study Team recommends that HPPC construct Phase 4 site to receive waste from 2015. Phase 4 site should have an area of 20 ha at least that is needed to receive waste from the beginning of 2015 till the end of 2020. Phase 4 site will be outside the land of 60 ha, but adjacent to Phase 3 site.

Trang Cat site development schedule is summarized as follows:

- Phase 1 (5 ha: outside the land of 60 ha approved by PM): beginning of 1998 – mid 2001
- Phase 2 (11 ha): mid 2001 – end of 2004
- Septage treatment (17 ha) under 1B sewage project
- Phase 3 (32.7ha): beginning of 2005 – end of 2014
- Phase 4 (20 ha at least, outside the site of 60 ha): beginning of 2015 –

Trang Cat Site location and its site allocation plan by projects are shown in Figure. 6.3.1 and 6.3.2, respectively.

Phase 3 Landfill Site Plan:

The JICA Study Team has carried out a feasibility study for Phase 3 Landfill Site. It is planned that there will be two landfill sites. One site (27 ha) will receive non-hazardous waste. Industrial waste will not be accepted irrespective of whether it is hazardous or non hazardous. The other site (2 ha) will receive hospital waste incineration residue. The layout plan of Phase 3 site is shown in Figure. 6.3.3.

2) Proposed System and Preliminary Design for Trang Cat Phase 3 Landfill Site

(a) Location and Condition of the Ground Base

The new landfill site will be located at the side of Cam River and it is tidal area of Bac Bo bay. The elevation of this area ranges from 2.3 to 2.6 m. The site should be protected by a 5m high dike against the highest tide for return period of 10 years.

There are three stratums in the first 20 m of the ground soil in this area. Main stratum is clay mud. Therefore, there will be consolidation for heavy weight loads. So for construction of dykes, careful attention is necessary.

(b) Dykes/Embankments

The existing landfill site has small dykes around the filling area. The slope of filling layer is planned to be 1:2. For the effective filling works, we recommend the "Push Up" method (See Item (g)). This method needs a dyke strong enough to hold the waste and heavy vehicles during spreading and compaction works.

Basic specifications of dykes as follows:

- Ordinary soil will be used for dykes of waste filling area
- A slope of dykes will be 1:3 for outside and 1:2 or 1:3 for inside

The Joint Circular issued by MOSTE and MoC on 18 January 2001 requires that ground of landfill sites should have adequate loading capacity, and specifies that it should be 1kg/cm^2 or more. To comply with the Circular, surcharge is recommended. Details are shown in the Feasibility Study Section 4.2.3.

(c) Liner System

In addition to the natural clay liner, 1.5 mm thick artificial liner will be applied to comply with the Joint Circular issued by MOSTE and MoC on 18 January 2001.

(d) Leachate Collection System

Ladder type system is applied, because it is very flat area.

Several pumping pits with manhole will be installed around the waste filling area.

Leachate will be pumped up to the treatment ponds.

Pumps will be located on the top of pumping pit's cover.

(e) Leachate Treatment

a) Leachate Treatment Capacity Required

The treatment facility should have a treatment capacity of 80 m^3 per hour. Assumptions and calculations are shown below.

b) Treatment Process

c) Gas Collection and Ventilation

Installation of gas ventilation pipes (in vertical) and gas collection bed of gravel or broken bricks (in lateral) is proposed. For the promotion of degradation of waste and prevention of casual fires, we recommend the following system:

- one vertical pipe will be installed in every square of 40 m x 40 m
- lateral gas collection beds will be installed every layer of 5 m height

3) Basic Conditions of the Site

For the design and cost estimation of the Trang Cat Phase 3 Landfill site, we use the following conditions.

(a) Year of Start to Accept the Waste at the Site

In the year of 2005, the site will start receiving waste:

- Engineering work will be carried out in 2003
- Construction work will start at the beginning of 2004 for two years

(b) Location and Area

The site will be located next to the Trang Cat Phase 2 Landfill site, which will be constructed by HPPC, and start operation in 2001.

The area for the Phases 3 Landfill Site is 33ha. It is a part of area approved by Prime Minister.

The area is currently used as fishery ponds.

(c) Shape of the Filled Body and the Site

a) Height

The height of the site will be 15m. It seems possible to fill the waste higher. But the ground condition is so weak. Higher filling of waste would cause a big settlement and this would damage the liner, leachate collection system, and embankments.

b) Slope of Dyke

1:2.0

c) Catwalk

Catwalk of 2.5m width will be installed in every 5m height)

(d) Bulk Density of Filled Waste

It is assumed that bulk density of waste is 0.8 ton/m^3 right after landfilling.

At the time of unloading wastes from collection vehicles, the bulk density of waste seems to be 0.5 - 0.6 ton/m^3. The density will finally increase to 0.9 - 1.0 ton/m^3 after solid waste has been completely decomposed. There will be

(e) Porosity of Filled Waste

The porosity of waste is assumed to be 0.5.

(f) Rainfall

For an annual rainfall, 1800 mm/y will be applied.

(g) Discharging Point and Method for Treated Water

The treated water will be transported to the Cam River through pipelines over the boundary dykes by pump.

For prevention of pollution of fishery/shrimp breeding pond adjacent to the landfill site, transmitting the treated water to the river directly by pipe is planned. The treated water will be pumped up from the treatment ponds.

If and when the area of Cam river between main lands and Dinh Vu Island will be closed as a lake or pond according to the city development plan, this discharge point will have to be moved to a point in the open sea in order to avoid the eutrophication and another pollution in the newly formed lake. The length of extension of pipe is about 1km.

(h) Capacity of the Phase 3 Landfill site and Phase 4 Landfill site

It is estimated that the planned Phase 3 Landfill Site has capacity of receiving solid waste until the end of 2014.

Target year of the Master Plan for Sanitation Improvement Plan for Haiphong City is 2020. Therefore, another landfill site (Phase 4 landfill site) is necessary to dispose of solid waste sanitarily until the end of 2020. Necessary area for Phase 4 landfill site will be 20 ha, based on the estimation assuming the same height and embankment system as for Phase 3 site.

It is recommended that another 20 ha of the southern area adjacent to the Phase 3 landfill site be acquired for Phase 4.

Planned Waste Quantity Received from Three Urban Districts after 2005

Year A	Collection (ton/day) b	Annul Collection (ton/year) c = b x 365 or 366 /year	Cumulative Disposal Quantity from 3 Urban Districts at Year End (ton) D
2000	367	133,773	0
2001	381	139,227	0
2002	395	144,263	0
2003	446	162,831	0
2004	464	169,644	0
2005	597	217,870	217,870
2006	660	241,061	458,931
2007	707	258,224	717,156
2008	749	274,185	991,341
2009	793	289,418	1,280,759
2010	839	306,203	1,586,962
2011	862	314,546	1,901,508
2012	885	323,912	2,225,421
2013	908	331,555	2,556,976
2014	932	340,030	2,897,006
2015	955	348,507	3,245,513
2016	979	358,465	3,603,978
2017	1,004	366,617	3,970,596
2018	1,030	375,905	4,346,500
2019	1,056	385,350	4,731,850
2020	1,082	396,039	5,127,889

4) Operation and Maintenance

Refer to Section 6.3.3 Item (2) 12) for operation and maintenance of Trang Cat Phase 3 Landfill Site.

5) Land Acquisition Plan for Future Landfill Sites

The total area approved by the Prime Minister is 60 ha. HPPC's land use plan for the area is shown below, and in Fig. 6.3.2. The area along the bank has been already approved for HPPC by the Prime Minister.

Table State of land use plan in Trang Cat area, approved by PM

Projects	**Area** (ha)
Septage Treatment Site by SADCO (1B project)	16
Next Landfill Site (Phase 2) by URENCO	11
Phase 3 landfill site by URENCO	33
Total	60

The JICA Study Team has carried out a feasibility study for the Phase 3 landfill site.

The JICA Study Team recommends that HPPC will acquire 20 ha at least for the Phase 4 landfill site adjacent to the Phase 3 site.

(2) Waste Disposal Plan for Kien An District

1) Future Landfill Site Location Plan

The following landfill site location plan is proposed for Kien An.

Future Landfill Site Plan for Kien An Urban District

Period	Proposed Location
1. – End of 2004	Trang Cat Phase 1 and 2 Landfill Sites
2. Beginning of 2005 – end of 2011	A landfill site in Truong Son Commune near on the foot of Mount Mam Bong in An Lao Suburban District
3. Beginning of 2012 – beyond 2020	A landfill site in Chien Thang Commune near Khue Ferry inside the Van Uc River Dyke in An Lao Suburban District.

The Trang Cat landfill (Phase 2) site will start operation in 2001 and will accept the waste from Kien An district. However, it is not effective because the transportation distance is very long and collection vehicles should pass through the center of city, which might adversely affect the traffic condition.

The Trang Cat landfill site (Phase 2) is planned to be used until the end of 2004. After this period, Kien An district should have its own landfill site in or near the district.

According to the UPI of HPPC, a landfill site will be secured for both Kien An Urban District and An Lao Suburban District, at the foot of Mount Mam Bong, in Xuan Son village, Truong Son Commune, An Lao District, and this location is mentioned in the Haiphong City Master Plan 2020.

The location identified by UPI is near to both centers of the two districts, i.e. 7 km from Kien An District center, and 2 km from An Lao District center. Disadvantage of this site is that its area is rather small – maybe about 10 ha.. This area is unique in a sense that one side of the site is a mountain. However, there is a possibility that cost of construction of landfill site may be lowered by using this geographic characteristic, i.e. to use the mountain as a part of waste retaining structure. It is also convenient to transport the waste from An Lao district.

The area along the road from Kien An to An Lao will be developed in near future. It is very difficult to expand landfill site near the developed area. It is recommended that HPPC will construct a larger landfill site, for the use by Kien An after finishing Truong Son landfill site, in Chien Than commune in An Hai District as explained below.

As a future landfill site for two suburban districts of Tien Lang and Vinh Bao, UPI has identified a place inside the Dyke System of Van Uc River (0.5 km from the Dyke entrance that is 0.5 km from Khue Ferry) in Chien Thang commune, An Hai District. The JICA Study Team considers that this site is not feasible for the two suburban districts because the site is too far from the two districts, and it is not easy to transport waste across Van Uc River as there is no bridge. Furthermore, it is not difficult for the two very rural districts to find landfill sites inside each district.

The JICA Study Team considers that this site would be a good candidate landfill site for Kien An in future after using up the first site (in Truong Son commune) that is adjacent to the mountain. The advantage of using this site (inside the dyke of Van Uc River) is that the transport distance from Kien An District center is not long (9 km), and the land is very large, and seems to be available without special difficulty.

2) Proposed System and Preliminary Design of a Landfill Site in Trung Son Commune

(a) Geographic and Geological Conditions

There is a mountain on the north side of this site. It is useful for supporting the filled waste body, because the height of mountain is more than 20m. However, aging and erosion on the surface of mountain were found, and it shows that a risk of percolation of leachate is high. The soil/rock character survey is essential for this mountain. There are also cracks in the rock. Therefore, this mountainside might need a liner of natural clays.

(b) Dykes/Embankments

The ground condition seems not to be so weak like Trang Cat area. But careful checking and consideration of ground conditions is essential.

Basic specifications of dykes are as follows:

- Ordinary soil will be used for dykes of waste filling area
- A slope of dykes will be 1:3 for outside and 1:2 or 1:3 for inside
- Height of Dike: 3 m height/layer x 3 layers

(c) Liner System

Natural clay liner will be applied if there is clay stratum with adequate thickness and permeability.

(d) Leachate Collection System

a) Basic Structure: Perforated Synthetic Pipes + Collection Layer/Bed

b) Sizes

- Diameter of Collection Pipes: 0.5 m for main lines & 0.2 m for branch lines
- Thickness of Leachate Collection Layer/Bed: 0.3 - 0.5 m

- Unit space between pipes: 40 m

3) Land Area Required for Landfill

(a) Area Needed for 16 Years from 2005 – 2020

As shown in the table below, total waste collection quantity of Kien An District during 16 years from the beginning of the 2005 till the end of 2020 is estimated to be 825,796 ton. Total area required for landfill during the 16 years is estimated to be about 13.5 ha as shown below.

Calculation:

825,796 [ton] / 0.8 [ton/m^3] = 1,033,495 [m^3]

Necessary area for new landfill site is calculated as follows.

1,033,495 [m^3] / 9 [m] / ((100-15)/100) = 135,097 [m^2] = 13.5 ha

Assumptions:

1. Bulk density of waste in the landfill site is 0.8 ton/ m^3 landfill site

2. Ratio of dyke and cover soil volume to waste volume is 15: 85.

(b) Area Needed for 7 Years from 2005 – 2011

It is very roughly estimated that a landfill site in Truong Son Commune will have an area of 10 ha. Of the area of 10 ha, it is estimated that Kien An District will use 4.8 ha during 7 years from the beginning of 2005 till the end of 2011. See the calculation below. The remaining area (10ha – 4.8ha = 5.2 ha) will be used by An Lao Suburban District.

This site is only 2 km from An Lao District center, and therefore, it is very advantageous for An Lao District to use this area as landfill site. Probably An Lao District can use the site at least until 2020 starting from 2005.

Calculation:

293,144 [ton] / 0.8 [ton/m^3] = 366,430 [m^3]

Necessary area for new landfill site is calculated as follows.

366,430 [m^3] / 9 [m] / ((100-15)/100) = 47,899 [m^2] = 4.8 ha

(c) Area Needed for 7 Years from 2011 – 2020

During 9 years from the beginning of 2012 till the end of 2020, landfill area needed is estimated to be 8.7 ha as calculated below.

Calculation:

x – y = 13.5 ha – 4.8 ha = 8.7 ha

Where,

x: Total area needed during 2005 – 2020 (13.5 ha)

y: Area needed during the first 7 years from the beginning of 2005 till the end of 2011 (4.8 ha)

It is very likely that area much larger than 8.7 ha would be available in Chien Thang Commune.

Waste to be collected during the period of 2000-2020 in Kien An district

Year	Collection (ton/day)	Annul Collection (ton/year)	Cumulative Disposal Quantity at Year End (ton)
2000	61	22,180	0
2001	65	23,690	0
2002	69	25,272	0
2003	74	26,912	0
2004	78	28,690	0
2005	89	32,326	32,326
2006	99	36,237	68,563
2007	108	39,300	107,863
2008	115	42,224	150,087
2009	123	45,073	195,161
2010	132	48,113	243,274
2011	137	49,870	293,144
2012	142	51,800	344,943
2013	147	53,476	398,420
2014	152	55,327	453,746
2015	157	57,136	510,883
2016	162	59,181	570,064
2017	167	60,938	631,002
2018	172	62,891	693,892
2019	178	64,878	758,771
2020	183	67,025	825,796

(3) Waste Disposal Plan for Do Son District

The Do Son Public Works Company has a plan to extend the landfill area next to the existing one. It is very feasible. But there are several issues to be considered carefully. The major issue is the existing boundary dyke which is next to the river. Its elevation of 2m above the water table appears to be too low to prevent flooding. In the most serious case of highest water, it will require more than 4 m height. Therefore, amendment work will be necessary. But, there should be enough budget to construct the dykes.

1) Proposed System and Preliminary Design

The Do Son landfill (Phase 2) site should have the same structure as the landfill site of Kien An District.

2) Necessary Capacity of Waste for Phase 2 Landfill Site

(a) Landfill Area Needed during 2003 - 2020

The existing Do Son landfill (Phase 1) site will be filled up in 2002. The amount of waste to be collected during 18 years from 2003 till the end of 2020 is estimated to be 804,704 ton. Using the same assumption as Kien An landfill sites, area required for landfill during this period is estimated to be 13.1 ha as shown below.

Calculation:

804,074 [ton] / 0.8 [ton/m^3] = 1,005,093 [m^3]

Necessary area for the landfill site is calculated as follows.

1,005,093 [m^3] / 9 [m] / ((100-15)/100) = 131,384 [m^2] = 13.1 ha

(b) Future Landfill Sites

There is a space of 3ha adjacent to the existing landfill site that has been identified as next site. If this area is used for Phase 2, it can be used for 6.25 years starting from the beginning of 2003 till end of the first quarter in 2009. It is estimated that the 3 ha site will have capacity of receiving 183,600 ton as shown below.

Calculation:

30,000 [m^2] x 9 [m] x (100 – 15)/100 = 229,500 [m^3]

The amount of waste to be accepted in this site is:

229,500 [m^3] x 0.8 [ton/m^3] = 183,600 [ton]

Note : As shown in the table below, cumulative amount of waste to be collected for 6 years from the beginning of 2003 till the end of 2008 is 174,623 ton.

It is necessary for Do Son to acquire additional land of 10.1 ha (13.1 ha- 3 ha) that will be needed from the beginning of the second quarter of 2009 till the end of 2020.

Waste to be collected in Do Son Town and Area along Route 14

Year	Collection (ton/day)	Annul Collection (ton/year)	Cumulative Disposal Quantity at Year End (ton)
2000	44	16,104	0
2001	55	20,111	0
2002	60	21,781	0
2003	64	23,534	23,534
2004	70	25,443	48,976
2005	75	27,467	76,443
2006	82	29,909	106,352
2007	89	32,613	138,965
2008	97	35,658	174,623
2009	106	38,713	213,336
2010	115	42,039	255,375
2011	124	45,172	300,547
2012	132	48,131	348,678
2013	137	49,894	398,573
2014	142	51,827	450,400
2015	147	53,762	504,162
2016	153	55,912	560,074
2017	158	57,798	617,872
2018	164	59,879	677,751
2019	170	62,004	739,755
2020	176	64,319	804,074

(4) Comments on the Future Landfill sites Identified by UPI

Urban Planning Unit of Haiphong City (UPI) has identified future landfill sites for all the districts of Haiphong. It seems that the selection is based on the consideration that there should be a landfill site for each district in principle. According to UPI, these locations are shown in the final version of Haiphong City Master Plan 2020.

The JICA Study Team has visited all the locations identified by UPI. Descriptions of each site are shown in Table 6.3.13. The JICA Study Team considers that some of the locations identified by UPI as future landfill sites are not suitable due to such factors as difficult access, long transport distance, and high cost of waste transportation. Comments are summarized as follows:

1) Planned Landfill Site for Thuy Nguyen District

Location: Outside the Dyke System of Bach Dang River, Gia Minh Commune, Thuy Nguyen District

Comment:

This site is 12 km from Thuy Nui Doi (Nguyen District Center), and 15 km from Minh Duc. The transport of waste from the two centers would be costly because the transportation will require the following:

- Widening and strengthening of three bridges including one floating bridge
- Pavement of 3 km of access road

It is very likely that some other sites near the two centers of the districts may be found at places much nearer to the centers because the district is rural.

2) Planned Landfill Site for Tien Lang and Vinh Bao Suburban Districts

Location: A place inside the Dyke System of Van Uc River (0.5 km from the Dyke entrance that is 0.5 km from Khue ferry) in Chien Thang commune, An Hai District

Comment:

The most serious disadvantage of this site is the poor accessibility from Tien Lang and Vinh Bao Districts. Crossing of Van Uc River would be difficult as there is no bridge over the river. In future, even if a bridge is provided, the location is still not suitable because it is very likely that the two districts can find landfill sites within each district.

3) Planned Landfill Site for Kien Thuy District

Location: A place inside the Van Uc Dyke System, 1.5 km to the west of the Dyke entrance, Do Day, Bang La Village, Doan Xa Commune, Kien Thuy District.

Comment:

This site identified by UPI is good in terms of large area, and land acquisition. However, the site is 15 km from Nui Doi, Kien Thuy District Center. Considering level of development of the district, it is more feasible that each local center (large village) acquire a small landfill site nearby each local center. This would not be difficult as the district is still very rural.

(5) Strategy Concerning Landfill Sites for Sub-Urban Districts

1) Factors to be Considered

In identifying locations of future landfill sites, the following factors should be considered:

- Transport mode (handcart or vehicle)
- Distance from waste collection area
- Waste disposal amount and landfill area requirement

2) Transport Mode and Distance

In Haiphong, only areas where suburban districts provide waste collection service is district centers. Waste collection services in the centers have started a few years ago. A dominant collection method is to use handcarts. To use truck is rather rare. At present, the suburban districts use some places, with an area of less than 1 ha, located within 1 km as dumping site. It is not feasible to transport waste 2 km or more by handcarts. Therefore, if the handcart collection is applied, a landfill site should be located within 2 km from collection area.

3) Waste Disposal Amount and Landfill Area Requirement

In general, the larger the waste disposal amount, the greater the area of landfill site required. And, it is inevitable that a large landfill site will become far from waste collection area because it is difficult to acquire land of large area nearby population centers. At present, daily waste collection amounts in each local center in suburban districts typically range from a few cubic meters to 20 cubic meters, and the maximum would be 40 m^3.

It is roughly estimated that a landfill site with an area of 1 ha could be used for 5 years if it daily receives 20 m^3 of waste on average. In rural districts, it would not be too difficult to get a land of 1 ha at places not far from the population center.

As far as the districts apply handcart waste collection as dominant collection method, a landfill site must not be far from collection area. And it is economical to use a small site near collection area. A larger site at more distant places should be considered when the district starts using trucks for waste collection.

(6) Plan for Post-Closure Landfill Management for the Existing Landfill Site and the Former Landfill Sites

1) Background

After the landfill site has been fully utilized, there are still some risks of environmental hazards and pollution, because of rich organic matter, heavy metals, and another pollutants in the filled waste layer and leachate. Landfill gas will also continue to be a problem.

In this document, we use the following definitions for the closure, post-closure and complete closure of the landfill site.

(a) (Physical) Closure

When the landfill site is full of waste, and can accept no more, and the whole area of waste is covered with soil, the site is said to be "(physically) closed". At this time, the condition of the site is "(physical) closure"

(b) Post-closure Site

When the landfill site has been physically closed, it is called a "post-closure site". The owner should take care of the post-closure site and continue maintenance work, including operation of the leachate treatment facility.

(c) Complete Closure

This applies when the filled waste is very degraded and inactive enough that there seems to be no risk of environmental hazards from the site. The owner has no obligation to take care of the site after complete closure. It is then time to finish all the post-closure site management activities (aftercare), including operation of the leachate treatment facility.

Decomposition of organic matter takes a long time. For example, in some rehabilitation sites in Japan, waste remains fresh and not decomposed, and newspapers almost 20 years old can still be read. The decomposition process is not homogeneous, but heterogeneous. Therefore some parts of the waste layer are fully decomposed while others are not decomposed at all.

While organic matter is decomposing, heavy metals dissolve in the percolated water and leachate and mix with organic acid, and other pollutants that also react with various other waste materials, soil particles, water and gas. These chemical reactions reduce the organic matters in waste and produce by-products such as leachate and gas. Therefore some materials are removed from the waste body and waste structures become weakened. Subsidence is caused by these mechanisms.

The risks on post-closure landfill sites are as follows:

- Collapse/Landslide
- Subsidence
- Fire
- Gas explosion
- Surface soil contamination
- Leakage of leachate (Soil/Groundwater pollution)
- Surface water pollution
- Landfill gas migration over the boundary
- Polluted air exposure

2) Purpose of Post-closure Management

Purposes of post-closure are as follows:

- To prevent environmental hazards and pollution by proper maintenance and operation of the facilities
- To promote the decomposition and stabilization of the waste body by proper maintenance and operation of the facilities
- To collect information about changes in the condition of the waste body through post-closure monitoring. This information will be useful for rehabilitation in the future

3) Aftercare for Landfill

For post-closure management, aftercare should be carried out at the site. Facilities and equipment requiring aftercare are as follows:

- Final cover
- Surface drainage system (Cut-off drainage)
- Leachate collection and treatment facility

- Gas collection and treatment facilities
- Monitoring facilities (Groundwater monitoring wells and discharged water sampling points)

4) Post-closure Management for an Existing Landfill Site in Trang Cat

There should be a final cover and gas collection pipes. The gas collection bed should be installed at the middle layer of waste.

5) Post-closure Management for the Former Thuong Ly Site

There should be a final cover and gas collection pipes/beds. During the site inspection, about 10 people was excavating the filled layer. In order to prevent accidents, access into the site should be controlled. It is ambiguous whether there is groundwater pollution or not. It is better to collect the leachate inside the site and treat them.

6.4 Hospital Waste Management Plan

6.4.1 Institution on the Hospital Waste Management

(1) Classification of Health-care facilities in Haiphong

At the national level, the Ministry of Health is in charge of health-care administration.

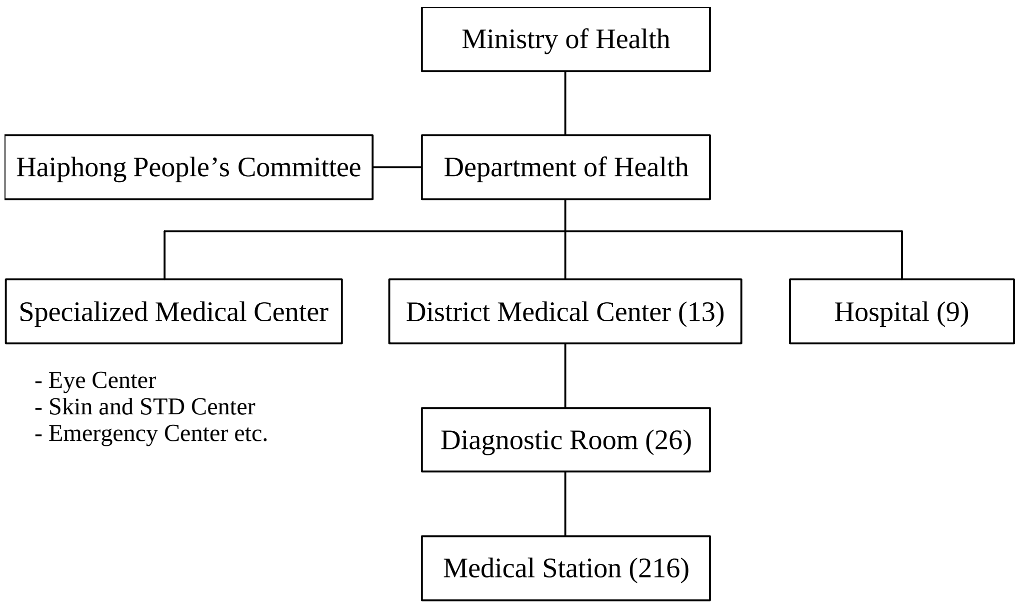
At the city level, the Department of Health (DoH), under the Haiphong city people's Committee, is responsible for all aspects of health-care administration including hospital management. DoH establishes hospitals and other health-care facilities and controls them.

Health-care facilities under control of DoH in Haiphong city are classified into the following 4 categories:

- Hospital (Benh Vien in Vietnamese)
- Medical Center (Trung Tam Y Te)
- Diagnostic Room (Phong Kham)
- Medical Station (for each commune) (Tram Y Te Xa, Phuong.)

A figure below shows the DoH's administration system of health-care facilities.

This chart is prepared by the Study Team based on the DoH's information. Figures in the parenthesis are the number of the facility.



Health-care facilities and the related administrations in Haiphong

In addition to these facilities under control of DoH, there are three hospitals, which belong to the other ministries.

Hospitals belonging to the Other Ministries

Name of the hospitals	Controlling Ministry	Number of Beds
Hospital for Communication and Transportation Industry	Ministry of Communication and Transport	75
Orthopedic and Rehabilitation Center	Ministry of Labor, War-Invalid and Social Affairs	80
Army Hospital No. 203	Ministry of Defense	75 (estimated)

Note; The number of beds in the Army Hospital No. 203 is estimated by the Study Team

Number of health-care facilities and beds in Haiphong City are summarized in the table below. Number of beds is 3,730 including 230 beds in the Hospital for Communication and Transportation Industry, the Orthopedic and Rehabilitation Center and the Army Hospital No.203.

(2) Legal Responsibility of Hospital Waste Management

The Ministry of Health issued “Regulation on Hospital Waste Management” in 1999, No. 2575/1999/QD-BYT. This Regulation defines legal responsibility of the hospital waste management as follows:

- The hospital shall have the responsibility to keep good management of hospital waste (the articles 3 and 5)
- The hospital can contract out the transportation and disposal to the organizations whose operation is authorized by competent environmental agencies (the article 15)

The regulation refers to the separation of medical waste from domestic waste and proper storage in an isolated storage room in Articles 12 and 14.

As this regulations is applied to all the hospitals and other health-care organizations in the country (Article 2), not only the hospitals and the medical centers under the Department of Health of Haiphong but also the hospitals under other ministries or the army should follow the regulation.

According to Article 15, the URENCO can be a contractor who provide services of collection, treatment and disposal of hospital waste as far as the URENCO has proper knowledge and technical skill which can fulfill the below requirements:

- Collection services by special vehicles with trained staff
- Treatment with complete disinfection, for example, by incineration
- Safe disposal of residue after treatment

Based on the Regulation, hospitals are responsible for bearing all costs of hospital waste management. In case of the hospitals under control of the Department of Health, the HPPC would finally bear the cost as it controls budget of the hospitals. However, it is better that the hospitals directly pay the costs (or fees) to a service contractor because it gives an incentive to reduce waste quantity as well as the cost.

(3) Definition of Waste

Hospitals generate two types of waste, that is, domestic waste and medical waste. In the Master Plan, "Hospital Waste" means "all the waste generated in the hospital" which can be classified into two types as shown below. In addition there is expired medicine which is a kind of medical waste but its amount is small.

Hospital waste
= All the waste
from hospital

- Domestic waste = Non-hazardous waste from hospital
- Medical waste = Hazardous waste from hospital including infectious, sharp one or surgically removed human organs and tissues
  Example: Injection needles and syringes after use, blooded cotton and bandages

The Hospital Waste Management Regulation defines the categorization of the hospital waste as shown in the table below.

Categorization by Vietnamese Hospital Waste Management Regulation

Category	Sub-category	Description
Clinical waste	Group A: Infectious waste	Materials absorbed with blood, human body liquid, and other excreta from patients such as bandages, cotton, gloves, plaster cast, cloth materials, artificial anal sacs, blood transfusion ducts, fistulas, strings, and bags for drained liquids.
	Group B: Sharps and pointed articles	Syringes and injection needles, blades and handles of operation knives, operation nails, saws, shards of glass, and every material that can cut or pierce, infectious or not infectious.
	Group C: Highly infectious waste from laboratories	Gloves, glass slides, test tubes, post-biopsy/test/cultivated human removed organs, blood containing bags, etc.
	Group D: Pharmaceutical waste	i) pharmaceutical products that are outdated, infectious, overturned, or out of need. ii) pharmaceutical products that poison cells.
	Group E: Human and animal tissues and organs	All tissues of the body (infectious or not); organs, limbs, placenta, fetus, animal corpse.
Radioactive waste	Solid radioactive waste	Materials used for tests, diagnosis, and treatment such as injection needles, syringes, protection glasses, absorbing paper, disinfectant swabs, test tubes, containers of radioactive substances
	Liquid radioactive waste	Solutions with radioactive substances created in the course of diagnosis and treatment such as patients' urine and excreta, and water that has been used for washing containers and tools contaminated with radioactive substances, etc.
	Gaseous radioactive waste	Gases used for clinical activities such as ^{133}Xe, and the gases emitted from warehouses of radioactive substances, etc.
Chemical waste	Non-hazardous chemical	Sugar, fat acids, some kinds of organic and inorganic salts
	Hazardous chemical	Formaldehyde, photochemicals, solvents, ethylene oxide, combined chemicals, etc.
Pressurized containers		Pressurized containers of oxygen, CO_2 and others.
Domestic waste	Waste not contaminated with harmful substances	Newspapers, documents, wrapping materials, carton boxes, plastic bags, film envelopes, food packing materials, food waste from patients, flowers and garbage collected from the floors.
	Out-door waste	Leaves and waste from out-door areas

For reference, WHO's categorization of health-care waste is shown in the table below. WHO uses "health-care waste" as its terminology indicating hospital waste.

Categorization of Health-care Waste by WHO

Category	Description	Examples
Infectious waste	Waste suspected to contain pathogens	Laboratory cultures; waste from isolation wards; tissues (swabs), materials or equipment that have been in contact with infected patients; excreta
Pathological waste	Human tissues or fluids	Body parts; blood and other body fluids; fetuses
Sharps	Sharp waste	Needles; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste	Waste containing pharmaceuticals	Pharmaceuticals that are expired of no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substances with genotoxic properties	Waste containing cystostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances	Laboratory reagents; film developer; disinfactants that are expired or no longer needed; solvents
Heavy metal waste	Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers		Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances	Unused liquids from radiotherapy of laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radio nuclides; sealed sources

Source: "Safe management of wastes from health-care activities", WHO, 1999

6.4.2 Evaluation of Current Conditions

(1) Current Problems

Current practice of hospital waste collection is illustrated in Figure 6.4.1. Typical problems of current hospital waste management occur both on the side of hospitals and of URENCO or other waste collectors.

1) Problems on the Hospital Side

[Problem 1] Remix of the infectious waste with non-hazardous waste in the hospitals.

Medical waste is generated mainly at medical examination rooms and treatment rooms, and partly at the patient wards when medical treatment is given there. At the moment of treatment and examination, medical doctors or nurses put the medical waste separately into thin plastic bags in waste boxes. Currently the separate disposal of the medical waste is practiced in the treatment and examination room. However, these medical waste, though once separated, is brought to the solid waste stockyard in the hospitals and there mixed with the non-hazardous domestic waste , because there is no other storeroom exclusively for the medical waste.

As a result, remixing the waste discourages doctors and nurses to separate the medical waste.

2) Problems on the Waste Collectors Side

[Problem 2] Exposure to the dust of the infectious waste during loading them onto the trucks

At present, URENCO workers scoop the mixture of medical waste and domestic waste, which is dumped in the waste stockyard by hand shovels and loaded up onto dump trucks. This work diffuses dust of the waste including the infectious one, and the workers are exposed to it. Even the workers may inhale the dust.

Two routes of infection are considered. They are contagious and air-borne infection. The former may occur by contacting medical waste directly, while the latter by inhaling dust of the medical waste during the loading. As injection needles contaminated with blood are contained in the waste, being pricked or pierced by them accidentally imposes high risk of hematogenous infection (infection via-blood)

[Problem 3] Contacting injection needles and syringes possibly infectious

The injection syringes are made of polyethylene, and infusion bags and tubes are made of PVC (polyvinyl chloride). Scavengers pick them up to sell as secondary plastic material. Even the injection needles are collected as they take small pieces of plastic at the bottoms of the needles. The scavengers enter into the waste stockyards when it is unlocked for the waste collection. Some scavengers wear the uniform of URENCO and it is difficult to identify that they are the scavengers.

It is suspected that the needles collected are also used by drug addicts. There are some hundreds of the drug addicts in the urban districts. The principal reason of the high ratio of HIV carriers in Haiphong (31.9 to 100,000 people, according to the Health Statistics 1998) is infection among the addicts by using injection needles and syringes in turn.

Examples of Infections caused by exposure to Health-care waste

Contagious diseases: AIDS (Acquired Immune Deficiency Syndrome), Viral hepatitis B, Viral hepatitis C, Septicaemia by *Staphylococcus spp*.

Air-borne Infection: Tuberculosis, Measles.

Source; “Safe management of wastes from health-care activities”, WHO, 1999

(2) Current Quantity of Hospital Waste

The Study Team interviewed and surveyed 18 hospitals and medical centers located in the urban district of Haiphong, namely, Hong Bang, Le Chan, Ngo Quyen and Kien An. In addition, the Team visited two district medical centers in An Hai and Thuy Nguyen for reference. Based on answers from 13 facilities concerning waste generation quantity and number of beds, unit generation quantity of the medical and domestic waste per bed a day was calculated as follows. If the hospitals answered the quantity not in weight but in volume, the volume was converted to the weight by applying the density indicated in the table. As the hospital's answers have certain range, upper mean and lower mean were calculated among upper and lower answers, respectively. They are shown as a range of unit generation in the table.

Waste category	Range of unit generation (kg/bed/day)	Density applied*
Medical waste	0.25 – 0.35	0.14
Domestic waste	1.23 – 1.42	0.40

The density of 0.14 of medical waste is quoted from "Project of investment for construction of hospital waste incinerators in Haiphong city" prepared by the URENCO in 1997 as the proposal to install a hospital waste incinerator. 0.40 of domestic waste is assumed based on the results of waste quality analysis conducted by the JICA Study Team. The bulk density obtained from the analysis was 0.45 but in case of hospital waste it contains less sand and stone and more paper. Therefore 0.40 is applied.

Among the range of unit generation quantity, upper mean was adopted for calculation of the total generation quantity of hospital waste, because it is more secure to plan the capacity of the treatment facility enough to cover maximum generation. Total quantity of hospital waste generated by the hospitals located in the urban districts in Haiphong is estimated below.

Waste category	Total generation Quantity (kg/day)
Medical waste	968
Domestic waste	3,926

The estimation can be summarized as follows.

Medical waste: 1 ton/day

Domestic waste: 4 tons/day

Total: 5 tons/day

6.4.3 Scope of the Hospital Waste Management Plan

Among the health-care facilities in Haiphong, the hospitals and the medical centers have beds while the diagnostic rooms and the medical stations do not. Major hospitals and medical centers are located in the urban districts such as Hong Bang, Le Chan, Ngo Quyen and Kien An.

Hospitals and medical centers subject to the Hospital Waste Management Plan are those located in Hong Bang, Le Chan, Ngo Quyen, Kien An and Do Son. With respect to the number of beds, 2,765 beds* among 3,730, accounting 74 % of the beds belong to these major hospitals and medical centers in the urban districts and Do Son. The management of the waste from these major hospitals is emphasized in the Master Plan

Number of Health-care Facilities in Haiphong in 1998

Type of Facilities	Total Facilities	No. of Beds	Subjected Facilities
Hospital (under the DoH)	9	2,250	6
Medical Center	13	1,255	9
Diagnostic Room	26	-	-
Medical Station	216	-	-
Other Hospitals	3	225	3
Total	264	3,730	18

Source; Department of Health

6.4.4 Waste Subject to the Plan

The waste subject to the Plan is limited to the medical waste as illustrated in the section 6.4.1.

The quantity of the medical waste in future may increase, though the number of the hospitals and the medical centers will not increase much. Factors contributing to increases in the medical waste quantity would be as follow:

- Population increase
- Increasing patients and visitors to the hospital as the living standard rises and health-care services extends

As the sanitary condition is improved, outbreaks of diseases will be decreased. On the other hand, as the economic standard grows, people can afford to buy the medical services, which may increase the number of visitors to the hospital and the medical waste generation. Thus, the growth of the living standard can be increasing factor as well as decreasing factor, and it is difficult to quantify the effect of such ambivalent factors.

In this plan, future amount of the medical waste is estimated according to only the population increase. As the patients and visitors to the hospital are not only the residents in the urban districts but all the citizens in Haiphong, population growth in whole Haiphong city is adopted to this estimation

The generation quantity of the medical waste in 2020 will be 1.3 ton/day at maximum.

	Population		Medical Waste Quantity
Year	Number	Growth (%)	(ton/day)
1999	1,677,465	100.0	0.968
2005	1,797,542	107.2	1.038
2010	1,909,322	113.8	1.102
2015	2,015,649	120.2	1.164
2020	2,120,692	126.4	1.224

Improvement Plan of the hospital waste management is illustrated in Figure 6.4.2. Principally, the medical waste is separated from the domestic waste in hospital, and transported by URENCO to a treatment facility. Therefore, both hospitals and URENCO share the main role in the Improvement Plan.

6.4.5 In-hospital Management Plan

First step is an improvement of in-hospital management. Hospital staff is the main actor of this plan, while the Department of Health should support them.

(1) Objectives

- Complete separation of the medical waste from others
- Isolation of the medical waste by putting into exclusive bags and boxes
- Separated and isolated storage of the medical waste in a specialized storeroom

(2) Proposed Activities

1) Installing Plastic Bags and Carton Boxes for Medical Waste

Plastic bags and carton boxes to put the medical waste are needed. Necessary numbers and categories of the bags or boxes should be installed in the treatment rooms, examination rooms and other rooms generating medical waste. They also should be installed in the patient wards if the medical waste is generated there. Color of the plastic bags and boxes are defined in the article 10 of the Hospital Waste Management Regulation according to the contents as follows. Standard specification of the bags and boxes are defined in the regulation. A carton box is recommended because it is cheap in cost and incinerable, because the bags and cartons are never opened if once it is closed or packed to keep complete isolation of the waste from other people's contact.

They are incinerated as enclosed in the bags or boxes. Biohazard mark should be put on the bags and boxes for clinical waste.

Coloring of the Waste Bags and Boxes according to the Regulation

Yellow	Clinical waste. The bio-hazard mark should be put on the surface
Black	Chemical waste, radioactive waste, cyto-toxic waste
Green	Domestic waste

Biohazard Mark

2) Preparation of the Manual Book for proper Handling of Medical Waste in the Hospital

Though separation of the medical waste according to the category is defined in the Regulation, more practicable manual book describing the Standard Operation Procedure (SOP) of the medical waste handling should be prepared for facilitating actual practice. It should be provided at all the places where the medical waste might possibly be generated and be available for all the hospital staff to refer to it whenever necessary. The manual book should be prepared by each hospital according to the individual situation of the hospital with the participation of the doctors and nurses. DoH's advisory support is also needed.

When the manual book is completed, training and seminars should be held to disseminate the SOP among all the hospital staff.

3) Construction of the Special Storeroom Exclusively for Medical Waste

The reason why the medical waste is remixed with the domestic waste is that currently the hospital has only one waste stockyard. For the separate discharge of the medical waste from the domestic waste, waste storeroom exclusively for the medical waste is required.

The Regulation stipulates the requirement of the storeroom of the following conditions. As mentioned, the storeroom should be locked not only to prevent animals, rodents and insects but also to keep out the scavengers from picking up needles and syringes from the medical waste. The storeroom should be cleaned and sterilized by spraying isopropyl alcohol after the waste is taken out. The trained worker should be allocated to manage the storeroom.

Required Conditions of the Medical Waste Storeroom (the article 14):

- Far from the cooking places, warehouses, and paths
- There is access way to the place for waste trucks to collect the waste
- There are separate sections for medical hazardous waste and domestic waste
- There are a roof, a protection fence, door, and lock to prevent animals, rodents, and insects from coming inside
- Area of the room should be suitable to the quantity of medical waste generated
- There are washing and protection facilities for workers, and sanitation tools and chemicals
- There exists a drainage system, impermeable floor and a good ventilation system

6.4.6 Collection and Transportation Plan

URENCO is in charge of collection and transportation of the medical waste.

(1) Objectives

- To prevent workers of URENCO from being exposed to the risk of contagious or infectious diseases like AIDS
- To isolate the medical waste from all the people except for trained collectors
- To transport the medical waste in a safe condition to prevent environmental impact during transportation

(2) Proposed Activities

1) Waste Handling by the Trained Workers

Workers in charge of the medical waste collection should be trained specially and should have enough knowledge to handle the medical waste.

2) Transportation by Special Vehicles

The vehicles for the medical waste collection should be a truck with a load cabin to prevent the loaded medical waste from dropping off on the way or being exposed to sunshine and wind. Two vehicles are necessary to collect the waste from 18 hospitals and medical centers.

3) Everyday Collection

Everyday collection service is recommended, as the medical waste contains not only bacterial or viral contaminated matters but also blooded cotton and bandages and human tissues and organs. They must be properly treated before degradation. In case of bacterial contaminated matter, keeping the waste for a long time may multiply the bacteria.

4) Waste Transportation Record

To secure the proper handling and safe transportation, URENCO keeps records of collection and transportation of waste. The record should be prepared for each hospital and the date, time of collection, quantity (number of the bags and boxes), waste type and weight should be recorded. The weight should be measured by both the hospital staff and the workers of URENCO, as this is a basis for fee charge. Article 16 of the Regulation also requires the transportation record.

6.4.7 Treatment Plan

Incineration is the first candidate of good treatment for disinfection.

(1) Objectives

- Treatment of medical waste for complete disinfection, that is, complete elimination of the risk of infection to make residue after treatment possible to be landfilled
- To minimize adverse impact on the surrounding environment by the treatment process

(2) Treatment Options

There are several options to be examined including incineration. Brief explanation of these options is the followings:

- Incineration: To burn the medical waste and turn them into ash. The medical waste should be incinerated in a closed chamber, an incinerator, to prevent their embers, cinders and ashes from being blown around. Most of the bacterial and viral organisms are killed by heat and the volume of the waste can be reduced because they are turned into ash. This method consumes some fuels such as kerosene or gasoline for pre-heating of the incinerator. It also requires a technical skill in the operation
- Autoclave: It is also called as a high-pressurized steam sterilizer,which heats the medical waste up to 121 °C in the high pressure at 2.0 atmospheric pressure in a closed chamber and keep the temperature for more than 20 minutes. Most of the bacterial and viral organisms are killed by heat but the volume of the waste cannot be reduced much. This consumes a lot of electricity
- Chemical treatment: To bathe the medical waste into the sterilizing chemical agents such as alum or chlorine. A bathing pool and a wastewater treatment facility are necessary to disinfect the medical waste. This system consumes a lot of chemical agents

Advantage and Disadvantage of Treatment Options

Method	Incineration	Autoclave = high-pressurized steam sterilization	Chemical Treatment
Completeness of Disinfection	Complete disinfection during short time is possible. Completion of the disinfection can easily and visibly be confirmed as the waste changes to ash.	Complete disinfection if operated properly, but it is not so easy to confirm the completion of the disinfection	Completion of disinfection cannot be verified.
Reduction of the Waste Volume	Waste volume is remarkable reduced.	No reduction of waste volume after treatment.	No reduction of waste volume
Easy Operation	Well-trained operators are required for good operation	Slow rate of operation due to the limited capacity of the autoclave machines	Easy to operate, just only simmer the waste in the chemical agents
Environmental Impact to the Surrounding	Air pollution and dioxin but they can be controlled Ash after incineration can be landfilled.	Neither air pollution nor dioxin is generated, but offensive odor may be generated.	Neither air pollution nor dioxin is generated, but offensive odor may be generated.
Initial Cost	High	Higher (more than that of the incinerator)	Low (Less than half of that of incinerator)
Operation Cost	Middle	Higher (more than twice of that of the incinerator)	Higher (more than twice of that of the incinerator)
Total Evaluation	Good	No good	Fair

The advantage and disadvantage of each option are summarized in the table below.

In terms of the effectiveness of sterilization, incineration or autoclaving is recommended. With respect to the cost, initial investment of the incinerator is higher than that of the chemical treatment, while the operation cost of the chemical treatment is much higher than that of the incinerator. Cost of autoclaving is the highest both in initial investment and in operation. Although dioxin problem may arise by incineration, it can be controlled by installing the proper treatment facility for emission gas. Considering these advantages, incineration is recommended for the medical waste treatment for its effectiveness and cost.

(3) Specification of the Incinerator and Recommended Option

1) Capacity of the Incinerator

Future quantity of the medical waste is estimated to be 1.2 ton/day as described in Section 6.4.2. Considering the fluctuation of the quantity and the allowance, the incinerator with a capacity of 1.5 ton/day is proposed.

2) Composition of Incineration Facility

Considering high contents of plastics in the medical waste, the incinerator should have a supplementary burner and an after-burner to burn up the organic residues completely. In addition, air-pollution control equipment complying with dioxin control should be installed together.

Considering these requirements, composition of the incinerator and its attachment can be roughly described as follows.

Incinerator	Incineration chamber made of fire bricks, supplementary burner, two after burners, an oil tank, turbo-fan, filter to eliminate dust,
Emission gas cooler (for dioxin control)	Gas cooling tower, water tank with pump, cooling fan
Gas treatment equipment (for dioxin control)	Bag filter, activated carbon supplier, air compressor, stack

3) Operation

Principally, 8 hours operation a day is a routine, but additional time is needed for pre-heating, shutting-down or more volume of the waste received.

Pre-heating is indispensable to prevent dioxin generation, as the dioxin tends to be generated in temperature range of 300 to 700 °C. Therefore, temperature of more than 800 °C is required during incineration. Combustion gas must stay more than 2 seconds in the atmosphere of more than 800 °C in the secondary incineration chamber for complete combustion.

At the emission gas cooler, on the other hand, the temperature of the gas should be lower than 200 °C to prevent regeneration of dioxin.

For shutting-down, the only supplementary fuel will be incinerated for a short time after the loaded medical waste is burnt down so as to confirm the complete incineration of the medical waste, then the incineration will be stopped.

4) Environmental Measures

Proper operation can prevent generation of dioxin as well as conventional air pollutants such as SOx, NOx, and so on. Quality of emission gas needs to comply with the industrial emission standards for air quality in Vietnam, that is, Standard TCVN 5939-1995 and TCVN 5940-1995. Maximum level of the pollutants stated in TCVN 5939-1995 is shown in the table below. However the regulation of dioxin concentration is not yet established in Vietnam. Application of Japanese Standard for the small incinerator is strongly recommended.

Maximum Level to be applied to the Emission Gas

Substance	Maximum level (mg/m^3)	Regulation
Dust	400	TCVN 5940-1995
SOx	500	TCVN 5940-1995
NOx	1,000	TCVN 5940-1995
HCl	200	TCVN 5940-1995
Dioxins	Less than 5 ng-TEQ/Nm^3	*Japanese Regulation

Note: * Enforcement regulation of special law for dioxin control of Japan

6.4.8 Disposal Plan

It is recommended that the incineration ash should be disposed of at a landfill site.

In general, the ash is harmless after complete incineration and can be landfilled mixed with other waste. However, it is better to dispose of it at a designated segment in the landfill site for better control .

It is planned that Trang Cat Phase 3 landfill site will include hazardous waste landfill site that will receive the incineration ash

6.4.9 Fee Collection

(1) URENCO

URENCO currently collects the waste collection fee from the hospital, which is calculated based on the ordinary industrial waste collection fee.

When URENCO starts medical waste collection service, it should collect special fee for it separately from domestic waste collection fee. In principle, the fee rate should be high enough to cover all investment and operation costs required for collection, treatment and disposal of the medical waste.

(2) Hospital

The fee setting might seem very high for the hospitals. However, the hospitals should be responsible for proper treatment of their own medical waste, as indicated in the Hospital Waste Management Regulation No. 2575/1999/QD-BYT.

6.4.10 Development Strategy of Hospital Waste Management

For the hospitals and medical centers in other districts, it is recommendable that clusters of them have their own incinerator for medical waste in future.

The diagnostic rooms and medical stations generates no or only a small amount of hazardous medical waste because the patients of serious cases are forwarded to the medical centers or the hospitals of the upper classes which are well equipped.

Therefore, a staged plan for development of the hospital waste management facility is proposed. The table below shows a three-staged plan for development of the hospital waste management.

Development Strategy of the Hospital Waste Management

Stage	Hospitals to be subjected	Districts	Strategy of the Management Plan
1st stage	9 Hospitals 9 Medical Centers	Le Chan, Hong Bang, Ngo Quyen, Kien An, Do Son	Facility should be constructed by 2005, and the collection services should be started by URENCO.
2nd stage	1 Hospitals (Sanatorium) 8 Medical Centers	Other districts	Incinerators for the medical waste should be installed to each cluster of the hospitals and the medical centers
3rd stage	26 Diagnostic Rooms 216 Medical Stations	All districts in Hai Phong	Less potential to generate the medical waste of hazardous. It should be discharged after the sterilization

6.4.11 Wastewater Treatment in the Hospital

(1) Necessity of the Wastewater Treatment in the Hospital

Wastewater generated in the hospital may have the following hazards:

- Pathogenic bacteria and viruses
- Hazardous chemicals
- Heavy metals
- Radioactive agents

Among them, pathogenic bacteria and viruses and heavy metals are more likely to contaminate the hospital wastewater, as they are potent and may affect human health by only a small amount.

If the wastewater contaminated with pathogenic bacteria and viruses is discharged to a public accessible water body , it might cause an epidemic of water-borne diseases. Cholera, dysentery, typhoid and paratyphoid are typical water-borne diseases, but nowadays infectious diarrhea is most common among the water-borne diseases. Not only hospital wastewater but also household wastewater has this potential. Heavy metals will accumulate in the human body and cause disorder of vital functions.

Fortunately, serious epidemic of these diseases has not happened in Haiphong since the outbreak of Cholera in 1996, but infectious diarrhea and amebic dysentery are still common, especially in the suburban area. Although in this case hospital wastewater was not the cause of such diseases, it should be treated properly in order not to transmit the epidemic diseases.

Also, transmission of tuberculosis should be prevented, as Tuberculosis Hospital is located in the south of Kien An district.

(2) Regulation to be Applied

Regulation on Hospital Waste Management (No. 2575/1999/QD-BYT) refers to treatment and discharge of the wastewater of the hospital in Article 26. It states that the wastewater of the hospital can be discharged into water bodies as long as its quality conforms to the relevant standards of water quality. In other words, the regulation requires all the hospitals either to install their own wastewater treatment system or to rehabilitate it if the hospitals have a treatment system. Introduction of new equipment and technology is encouraged as far as DOSTE authorize it.

In this context, Industrial Wastewater Discharge Standards are attached to the Regulation of Hospital Waste Management as its annex. Currently, these standards are applicable to the hospital wastewater.

(3) On-going plans

Currently, some national projects on hospital wastewater treatment are in progress or in preparation for the following hospitals in Haiphong:

- Hospital for Tuberculosis and Lung Diseases (Benh Vien Lao) in Kien An
- Viet Tiep General Hospital in Le Chan
- Medical Center of Ngo Quyen, Kien An, Bin Vao and Pediatrics Hospital

Project of the Hospital for Tuberculosis and Lung Diseases is supported by the government of Austria, while that of Viet Tiep Hospital is sponsored by the central government of Vietnam. Project of the district medical centers and Pediatrics Hospital is in preparation under the National Programs for Clean Water, Environment and Sanitation, which is a governmental program nationwide.

(4) Water Quality to be Secured before Discharge

Though the regulation requires the hospital wastewater to comply with the wastewater discharge standards, the standards do not define standards for each pathogenic bacterium, but for coliforms. In the case of hospital wastewater, attention should be paid not only to coliform but also to some specific pathogenic bacteria, that is, Viblio Cholerae, Shigella spp., Entamoeba histolytica, Salmonella typhi, Salmonella paratyphi A, etc. which are the pathogens of Cholera, bacillary dysentery, amebic dysentery, typhoid and paratyphoid, respectively. Currently, such pathogenic bacteria to be controlled are not specified nor defined in the wastewater discharge standards. But it should be clearly defined in the wastewater discharge standards to be applied to the hospital wastewater. It is recommended that the hospital, which possibly discharge the wastewater contaminated with these pathogenic bacteria, should sample periodically and examine whether the bacteria exist in the wastewater.

Also the heavy metals in the wastewater should be controlled. Among cadmium, chromium, lead, manganese, mercury, nickel, tin and zinc which are regulated by the wastewater discharge standards for the industrial wastewater, mercury has a high possibility to contaminate the hospital wastewater. The best practice is not to discharge testing agents containing such heavy metals. Periodical sampling and examination is also recommended for heavy metal control.

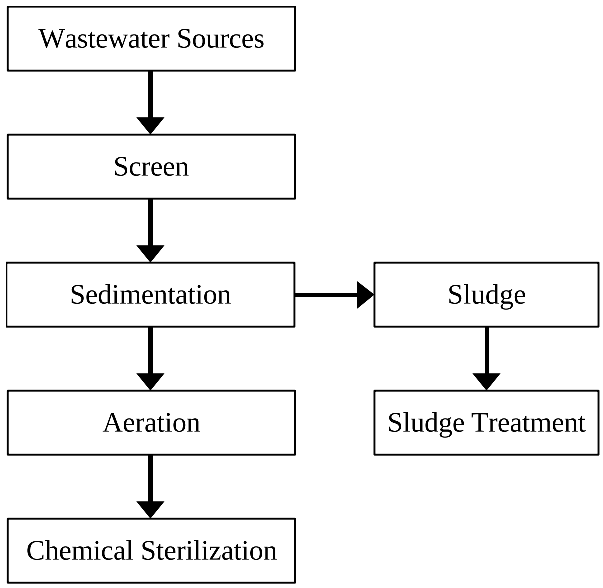
Kind of pathogenic bacteria and heavy metals depend on the specialty of the hospital and medicines of testing agents to be used. Such characteristic of the wastewater depending on the hospital should be considered when designing the wastewater treatment system in the hospital.

(5) Basic Methodology of the Treatment

Currently, some of the hospital have their own sewer network within the hospital and collect the wastewater, but others do not. For efficient treatment, the wastewater containing the pathogenic bacteria and heavy metals should be identified. Kind of pathogenic bacteria and heavy metals depend on the specialty of the hospital and medicines of testing agents to be used. Such characteristic of the wastewater depending on the hospital should be considered when the treatment system in the hospital is designed. General flow of the treatment system in the hospital can be illustrated below.

After screening, organic solid matters are removed by sedimentation. Then decomposition of the organic particles is facilitated by the aeration, and finally sterilizing chemical agents such as chlorine are injected into the tank to kill the pathogenic bacteria and viruses. Such bacterial control by the chemical agents should be implemented especially during the outbreaks of epidemic diseases.

To better control wastewater quality, it should be monitored whenever contamination is suspected.



Flowchart of the Hospital Wastewater Treatment

6.5 Industrial Waste Management Plan

In Haiphong, URENCO and Kien An Urban Works Company are the main organizations that collect and dispose of industrial waste. It is estimated that they collected about 45 ton/day of industrial waste on average in 2000. Collected waste is disposed of at Trang Cat Landfill Site.

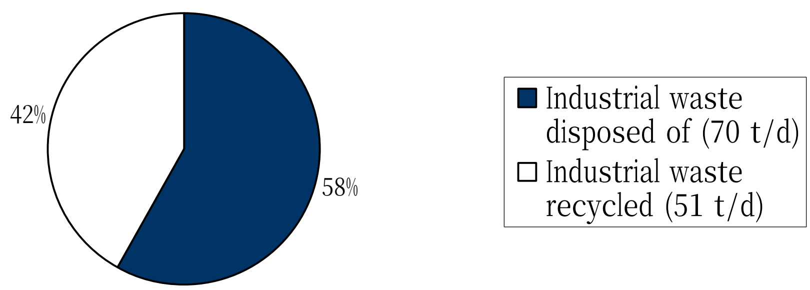
There is one private company called "Hung Tinh Company" that provides industrial waste collection and incineration services. The company incinerates mainly waste of footwear manufacturers and clothes makers. The incinerator is locally made, and is not equipped with an emission gas control system. Emission of black smoke was observed.

6.5.1 Quantity of Industrial Waste in Haiphong City

The JICA Study Team has carried out two surveys concerning industrial waste in Haiphong, i.e. the first, 100 Factory Survey was conducted during May - June 2000, and the second, Hazardous Industrial Waste Survey was conducted during October – December 2000. The results of the 100 Factory Survey is summarized in Table 6.5.1. List of factories subject to the Hazardous Industrial Waste is shown in Table 6.5.2.

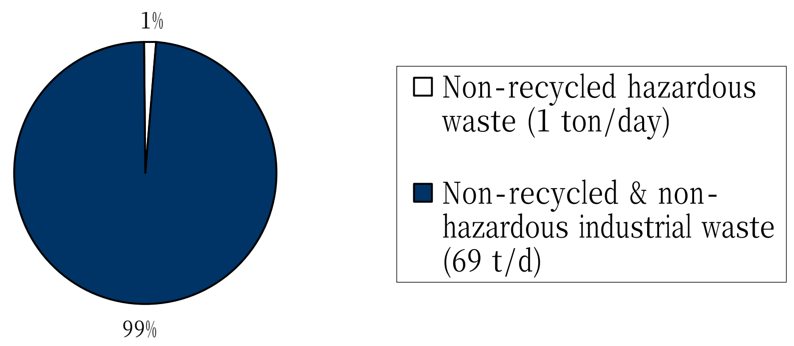
Though these two surveys covered major factories in Haiphong City, there are some factories of medium and small sizes that were not covered by the surveys. For estimation of the quantity of non-hazardous industrial waste, non-hazardous industrial waste quantity of the factories that are not covered by the two surveys is assumed to be one half of the non-hazardous industrial waste quantity of the factories that are covered by the two surveys.

Based on the two surveys and the above assumption, it is estimated that the industrial waste quantity generated in Haiphong is 121 ton per day, of which 70 ton/day (58 %) is non-recycled industrial waste disposed of as waste, and 51 ton/day (42 %) is industrial materials that are recycled either inside the factory or sold to other factories as industrial inputs.



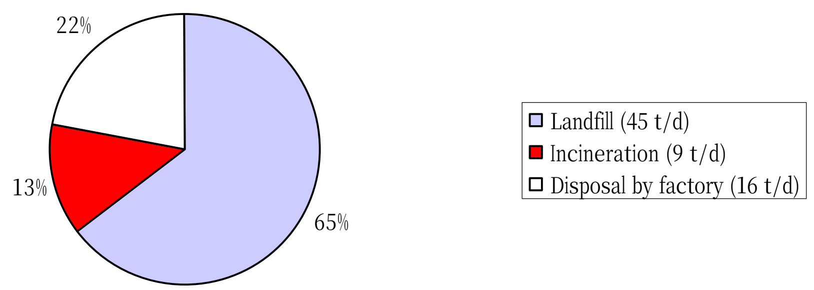
Quantity of Industrial Waste Disposed of or Recycled (Total 121 ton/day)

Of the non-recycled industrial waste, non-hazardous industrial waste generation is 69 ton/day (98.6 %) and hazardous industrial waste generation is 0.99 t/d (1.4 %).



Quantity of Non-Recycled Industrial Waste by Type (Total 70 ton/day)

Of 70 ton/day of non-recycled industrial waste, 45 ton/day (65 %) is disposed of by landfill at Trang Cat Site, 9 ton/day (13 %) by incineration (by Hung Tinh incinerator), the remaining 16 ton/day (22 %) is disposed of by factories themselves, some of which might be dumped elsewhere.



Quantity of Non-Recycled Industrial Waste by Disposal Methods

The above quantity data are summarized in the following table.

Estimated Industrial Waste Quantities in Haiphong (Unit: ton/day)

	Industrial Waste				Industrial	Total
	Landfill (1)	Incinerated (2)	Dispo-sed by Factory Itself (3)	Total = (4) = (1+2+3)	Materials Recycled (5)	(Waste + Recyclable Materials) (6) = (4 +5)
a. Hazardous waste	0.16	0.70	0.13	0.99	1.14	2.13
b. Non-hazardous waste	45.14	8.71	15.51	69.36	49.86	119.22
c. Total (a + b)	45.30	9.41	15.64	70.35	50.99	121.35

6.5.2 Hazardous Industrial Waste

(1) Hazardous Industrial Waste Survey Conducted

The JICA Study Team conducted a hazardous industrial waste survey during October to December 2000 in Haiphong. The survey objective was to prepare an inventory of hazardous industrial waste generated in Haiphong City area. The Vietnamese Hazardous Waste Regulation 155/1999 is used for definition and categorization of hazardous waste. The survey method and details are shown in the Supporting Report A.2.10 and the Data Book. The result of the survey are summarized below.

(2) Factories that Generate Hazardous Industrial Waste

There are 17 factories in Haiphong that generate hazardous industrial waste based on the Vietnamese Regulation 155/1999. Details of the 17 factories are shown in Table 6.5.3. Of the 17 factories that generate hazardous industrial waste, 13 factories either recycle or sell the generated hazardous waste or materials.

(3) Quantity of Hazardous Industrial Waste

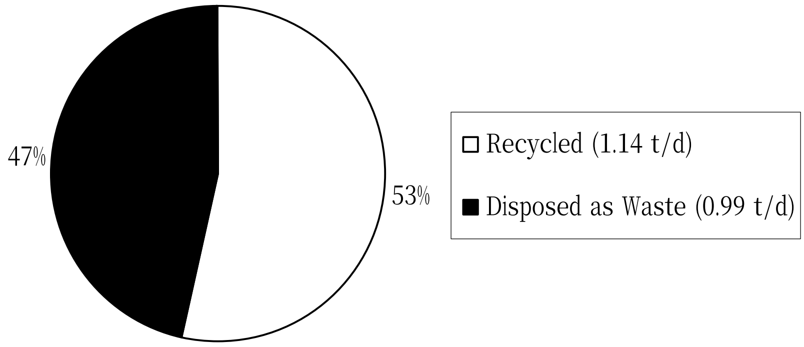
It is estimated that total generation amount of hazardous industrial waste is 778 ton/year or 2.13 ton/day on average. The inventory of the hazardous industrial waste in Haiphong is shown in Table 6.5.4.

1) Material Recycled and Waste Disposed

Of the 778 ton/year of hazardous industrial waste, as much as 415 ton/year (1.14 ton/day) that corresponds to 54 % is recycled or sold. The remaining waste 363 ton/year (0.99 ton/day) is the hazardous industrial waste that is disposed of as waste.

Hazardous Industrial Waste Recycled or Disposed as Waste

	Generation Quantity	Percent (%)
1. Recycled or Sold	1.14 ton/day	53 %
2. Disposed of as Waste	0.99 ton/day	47 %
3. Total (1+2)	2.13 ton/day	100 %



Hazardous Industrial Waste Recycled and Disposed as Waste (Total: 2.13 ton/day)

2) Types of Hazardous Industrial Waste Generated including Those Recycled

Of the 778 ton/year of hazardous industrial waste generated, waste of footwear manufactures share the largest portion, i.e. 0.67 ton/day (31.6 %), the second is waste oil or cloth containing waste oil 0.57 ton/day (27 %), the third is cement fibro board containing asbestos 0.55 ton/day (26 %). See the table below.

Hazardous Industrial Waste by Type Including That Recycled

Type of Hazardous Waste	Code by the 155/1999	Generation		Percent (%)
		Ton/year	Ton/day	
1. Leather, rubber, sponge attached with glue, generated from footwear companies	A3050	246	0.67	31.6
2. Waste oil or cloth containing waste oil	A3020	208	0.57	26.7
3. Cement fibro board containing asbestos	A2050	200	0.55	25.7
4. Coal cinder containing PbO or PbO2	A1020	50	0.14	6.4
5. Steam solvent evaporating from a paint company	A3080	40	0.11	5.1
6. Paint & liquid color powder, containers contaminated with chemicals	A4070	23	0.06	2.9
7. Phosphate salt contaminated container or materials	A3130	9	0.025	1.2
8. Plastic	A3050	2	0.007	0.3
9. Pond sludge	A1120	1	0.003	0.1
10. Total		778	2.13	100

3) Focus on Hazardous Industrial Waste that Need Close and Careful Attention

(a) Factories to be Closely Monitored

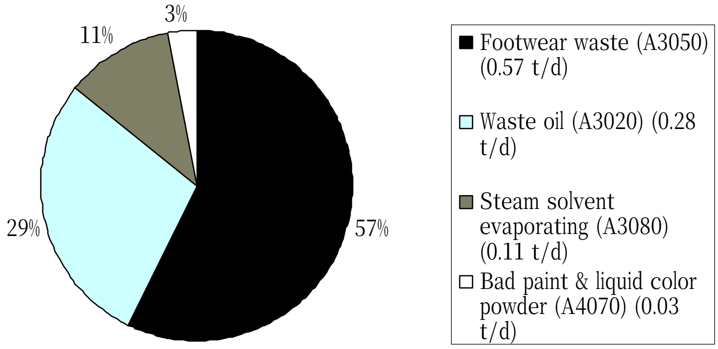
It is considered that hazardous industrial waste that is recycled does not pose environmental burdens or problems. Users of such materials are aware of their hazardous characteristics . Of the 17 factories that generate hazardous waste, 8 factories generate non-recycled hazardous industrial waste that is disposed of as waste. Total amount of such waste is 0.99 ton/day or 363 ton/year. Of the 8 factories, 4 are footwear-manufacturing companies (Foreign/Local Joint Venture). The other companies are Enamel-ware Factory, Rubber & Plastic Company, Haiphong Toaxe Factory (railroad car & spare parts manufacturer), and Haiphong Paint Company. An Inventory of Non-Recycled Hazardous Industrial Waste is shown in Table 6.5.5. These factories and their waste need to be closely monitored and controlled.

(b) Types of Non-Recycled Hazardous Industrial Waste

Of 0.99 ton/day of hazardous industrial waste disposed of as waste; 0.57 ton/day (57 %) is waste generated from footwear manufacturers (Foreign/Local Joint Venture); 0.28 ton/day (29 %) is waste oil or waste cloth containing waste oil; 0.11 ton/day (11 %) is steam solvent evaporating from a paint manufacturer; and the remaining 0.03 ton/day (3 %) is bad paint and liquid color powder.

Non-Recycled Hazardous Industrial Waste by Type

Type of Hazardous Waste	Code (by (155/1999)	Generation		Percent (%)
		(Ton/year)	(Ton/day)	
1. Leather, rubber, sponge attached with glue, generated from footwear companies	A3050	208	0.57	57
2. Waste oil or cloth containing waste oil	A3020	104	0.28	29
3. Steam solvent evaporating from a paint company	A3080	40	0.11	11
4. Bad paint and liquid color powder	A4070	11	0.03	3
5. Total (1+2+3+4)		363	0.99	100



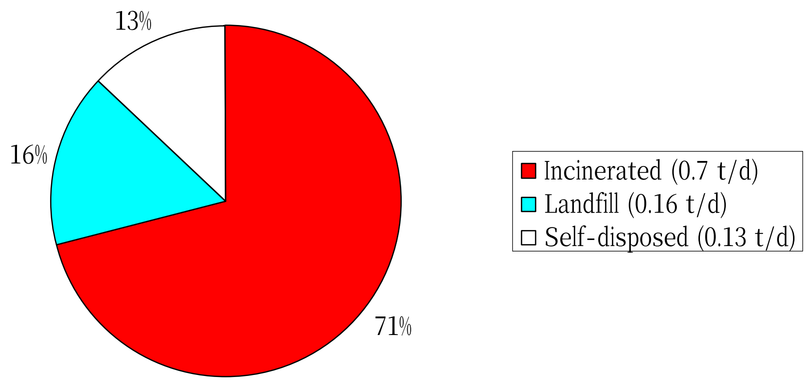
Non-Recycled Hazardous Industrial Waste by Type (Total: 0.99 ton/day)

(c) Methods of Disposal of Non-Recycled Hazardous Industrial Waste

Of the 0.99 ton/day of non-recycled hazardous industrial waste, 0.7 t/d (71 %) is incinerated at Hung Tinh incinerator (private company) located in Trang Cat Commune, 0.16 t/d (16 %) is dumped at Trang Cat Landfill Site. The remaining 0.13 t/d (13 %) is disposed of by the factories themselves.

Non-Recycled Hazardous Industrial Waste Quantity by Disposal Method (ton/day)

Disposal Method	Disposal Quantity (Ton/day)	Percent (%)
1. Incineration at Hung Tinh incinerator	0.70	70 %
2. Disposed at Trang Cat Landfill Site	0.16	16 %
3. Disposed by factory	0.13	14 %
4. Total (1+2+3)	0.99	100 %



Non-Recycled Hazardous Industrial Waste by Disposal Method (Total: 0.99 ton/day)

(4) Industrial Waste Considered as Hazardous by DOSTE

Reviewing the result of the Hazardous Industrial Waste Survey conducted by the JICA Study, Haiphong DOSTE has considered that some types of the industrial waste surveyed should be categorized as hazardous waste although they are not listed in the hazardous waste table of the Regulation 155/1999. Generation quantity of such waste is 26.2 ton/day, of which 4.4 ton/day is recycled, and the remaining 21.8 ton/day is disposed as waste. Of the 21.8 ton/day of non-recycled waste, 9.1 ton/day (42 %) is incinerated, 7 ton/day (32 %) is disposed of at landfill, and the remaining 5.7 ton/day (26 %) is disposed of by the factories themselves. See the table below.

Industrial Waste Considered as Hazardous By DOSTE
Though Not Listed in the Regulation 155/1999

Disposal Way	Generation (ton/year)	Generation (ton/day)	Percent	Percent
1. Recycled	1,614	4.42		17 %
2. Disposed as waste				
2.1 Incineration	3,332	9.13	42 %	
2.2 Landfill	2,571	7.04	32 %	
2.3 Disposal by factories themselves	2,066	5.66	26 %	
2.4 (sub total of Item 2)	7,969	21.83	100 %	83 %
3. Total (1 + 2.4)	9583	26.25		100 %

6.5.3 Projection of the Future Non-Recycled Industrial Waste Quantity

(1) Industrial Waste Generation Quantity

Future generation quantity of industrial waste is projected as follows based on the assumption that generation quantity of industrial waste will increase at the same rate as the economic growth of Haiphong City.

Projection of Future Non-Recycled Industrial Waste Generation Quantity

	Hazardous Waste	Non Hazardous waste	Total
	a	b	c = a + b
2000	0.99	69.36	70.35
2005	1.19	85.09	86.28
2010	1.78	130.75	132.53
2020	3.02	212.97	215.99

Table 6.5.6 shows the projection of annual generation quantities during 2000 – 2020. Table also shows projected disposal quantities by type of industrial waste.

6.5.4 Legal and Institutional Recommendations

(1) Legal Improvement – Clearer Definition of Responsibility of the Industries for Industrial Waste Management

It is extremely important for HPPC to legally clarify who has the responsibility of industrial waste management. Both national and municipal regulations do not address this issue clearly. Concerning hazardous waste, the national regulation, 155/1999, clearly state that generators of hazardous waste is responsible for the waste management.

The JICA Study Team recommends that HPPC should legally make it clear that generators of industrial waste are responsible for management of industrial waste – both hazardous and non-hazardous waste.

The reason why waste generators should be responsible for industrial waste irrespective of whether or not it is hazardous is that it is not easy in reality to distinguish hazardous waste from non-hazardous waste although the hazardous waste management law issued in 1999 shows scientific definition of hazardous waste.

Under the situation where the city does not have an adequate monitoring and law enforcement systems, the generators of hazardous waste have incentives not to manifest generation of hazardous waste. If the industrial enterprises are held responsibility for industrial waste management irrespective of whether waste is hazardous or not hazardous, the legal responsibility of the industrial enterprises with respect to waste management can be made very clear.

On the other hand, if the industrial enterprises are responsible for management of only hazardous waste, and not responsible for non-hazardous waste, a heavy responsibility load will be put on the city administration to monitor and prove that a company is generating hazardous waste.

Remarks: It should be recognized that having waste management responsibility does not necessarily means that the enterprises having such responsibility should transport and dispose of the waste by themselves. The generators can fulfill the responsibility by using a waste management company on contract base. Management responsibility and management service provision are two different things.

(2) Involvement of Private Sector in Industrial Waste Management

An ideal situation is that licensed industrial waste management companies would be established in Haiphong, and the company would provide waste management services including collection, transport, treatment and disposal.

It is the responsibility of HPPC to create the business environment necessary and favorable for the private sector to participate in the industrial waste management business. For this purpose, key actions of HPPC are:

- Strong enforcement of the industrial waste regulation stipulating the responsibility of the industries for waste management = strong penalty for illegal dumping or those who do not comply with the regulation
- Do not regulate level of industrial waste management service fees

Hung Ting Incineration Company's service fee levels are regulated by HPPC. The incineration facility of Hung Ting Company is not adequate in terms of pollution control. Low level of service fees regulated by HPPC limits the possibility for the company to invest for improvement of the facility.

Considering immaturity of the market for the industrial waste management service in Haiphong, one option is to encourage URENCO to make a joint venture company that provides industrial waste management service, incineration treatment service in particular. In this case, HPPC may provide some financial assistance for the first few years. However, in the medium and long term, the strong legal enforcement by HPPC is more helpful for industrial waste management companies than financial assistance is.

The world experiences show that the feasibility of establishing such company largely depends on how strong the enforcement of industrial waste regulation is. If the enforcement were not adequately strong, waste generators would use cheaper and illegal ways of disposing of their industrial waste. If illegal disposal is allowed, the generators of industrial waste will never make contracts with a waste disposal company that would comply with the environmental standard at high cost. Then the industrial waste management business would not be feasible.

Therefore, HPPC (DOSTE) should strengthen the enforcement. For this purpose, the most important points are:

- the determined and resolute attitude on the part of HPPC itself against the industrial enterprises including those municipally owned. This means a change in the industrial policy
- the strengthening of the capacity of DOSTE in terms of emission monitoring, factory inspection and advising ability

(3) Industrial Waste Management at Industrial Parks

It is recommended that HPPC should clearly and legally express the following:

- Organizers of industrial parks should be responsible for planning and organizing solid waste management within the industrial parks

HPPC should require organizers to formulate and submit a plan for solid waste management in addition to business plan of the industrial parks. HPPC should then check the plans before granting a business permission to the organizer.

Of course, it is possible for the organizers to use external contractors for collection, transport and disposal of industrial waste.

(4) Comments on the Choice of Technology for Industrial Waste Treatment

1) In general, incineration is recommended as the method of treatment of hazardous waste.

2) Sanitary landfill is the most economical and recommended method of disposal of non-hazardous industrial waste.

Remark: Incineration is a costly option, a minimum US$50 dollar per ton . Hanoi URENCO has studied the possibility of application of incineration for industrial waste by establishing a joint-venture company with a foreign company. However, the company has given up the incineration option due to its high cost. The company seems to be considering application of waste solidification technology that is much less costly than incineration. Sanitary landfill for industrial waste would be much lower in cost. Unit cost would be less than US$10/ton.

3) In the United States and some other countries, some types of industrial waste such as tires are incinerated at cement kilns. This is a rather economical method. However, there are only certain types of waste

suitable for incineration at cement kilns.

4) HPPC should pay special attention to Haiphong Paint Company that generates 1) steam solvent (40 ton/year) which evaporates into air, and 2) bad paint and liquid color powder (10 ton/year) that the company stores inside the factory. They are potential hazards to public health and the environment.

6.6 Institutional Strengthening and Manpower Training for Solid Waste Management

6.6.1 Strengthening the Institutional Framework for Solid Waste Management

(1) Tariff system, Cost Recovery and Revenue Collection

URENCO is authorized by HPPC to collect a monthly service charge for its services. All revenues collected are transferred to the Department of Finance (DOF). DOF provides URENCO's full operating budget. Collected revenues represent approximately 24 % of the operating expenditure (based on 1998 data of revenues VND3,377,000,000 and expenditure of VND13,995,000,000). The shortfall in revenues results from both: 1) low collection rates from households, i.e. there are many non-paying users; and 2) the rates set for the environment charge are not sufficient to cover the current costs. It is recognized that URENCO must improve its service if it is to increase the fees that it charges.

1) Tariff to be Set to Move Towards Full Cost Recovery

As the principle of collection of an environmental charge for solid waste management services is well established, the central issue is how should URENCO move towards full cost recovery of both operating and capital costs.

Current revenue should be about 3-4 times higher to ensure cost recovery to meet URENCO full costs of operation and maintenance. And URENCO may have to try to recover capital investment costs in the future. It is generally believed that customers may not be able to afford the full cost (O&M plus capital). However, they may be able to afford to pay the O&M costs. There have already been proposals for a price increase but it has not been approved by HPPC.

A schedule for increase in rates for solid waste collection should be developed based on a financial and economic analysis of the costs. This schedule should be mandated by HPPC and be based on HPPC's proposed urban finance policy (see recommendation in section 7.3.3) to establish the principles for setting tariffs and cost recovery objectives.

2) Revenue Collection

There is a proposal for an urban fee – including water fee, sewerage and drainage fee, and solid waste. This urban fee might be collected by a single agency (e.g. the WSCO as sewerage and drainage surcharge is collected along with water bill). At present, URENCO fee collectors are going door to door to collect revenue. One new option is to adopt the "Phuong model", similar to the WSCO collection system. Decentralization of fee collection to the

Phuongs could be achieved by using the same system and people as for water fees.

However, this would only apply to households. Commercial, office, and industrial customers will be required to sign contracts with URENCO. These contracts may or may not be governed by tariffs set by GOV. If there is price deregulation of solid waste for commercial, office, and industrial enterprises, it will also be desirable to allow for competition with URENCO for the provision of these services.

(2) Business Planning to help URENCO become a Commercial and Financially Autonomous Enterprise.

URENCO's current and future business opportunities will be governed by regulation of the solid waste management services. Price increases are necessary; but price deregulation will also become necessary for non-domestic solid waste. Socialization and privatization of solid waste management services will both create opportunities and increase competition from other service providers. In the future, URENCO business will expand as demand increases due to urbanization, population growth, and more industrial and commercial users. At this point, URENCO has a comparative advantage because of its monopoly position and investment from Hai Phong City. It also controls and manages the Trang Cat Landfill.

The long term corporate strategy for URENCO appears to be development of the company so that it will be sustainable – more cost recovery – revenues to cover O&M maintenance and investment costs. As URENCO moves towards this goal, it needs to begin a rigorous strategic business planning process that helps it identify clearly:

- its current and future business opportunities
- its comparative advantage
- its assets
- its ability to attract financing
- the expected revenues and costs
- the strength of its senior management team
- the strength of its "Board of Management"
- regulatory environment for Public Utility Enterprises

This will help URENCO organize itself to achieve its social and business goals.

(3) Socialization of Solid Waste Management Services

TUPWS has been the target of administration reform of public service delivery in Hai Phong. TUPWS wishes to improve the quality of public service delivery and reduce the State budget share of the costs through socialization. Socialization means " the expansion of social involvement (e.g. companies, enterprises, organizations, mass organizations, community and individuals) in the provision of public services currently being supplied by the public sector (i.e. GOV) so as to improve the service quality for the community social and economic benefit."

The HPPC and TUPWS have not issued on policy on socialization of solid waste management services. It is premature to formulate policy, but pilot projects and other demonstrations of different models should be tested. In general, there appears to be a number of options for socialization of domestic waste (see table below). Policy and direction from TUPWS and HPPC is needed to move towards socialization. To guide policy development and the choice of appropriate demonstration projects, TUPWS should identify:

- What types of solid waste management services are candidates for socialization (i.e. separation, collection, transfer, transport, and disposal)
- What forms of socialization are appropriate for each type of solid waste management services (e.g. contracting out, privatization)

Socialization of Domestic Solid Waste

Solid Waste Management Component Domestic Solid Waste	Form of Socialization
Waste Separation at Source	• done by waste generator
Waste Collection	• contract for service to phuong level • contract for service to private sector • privatization to private sector
Street Sweeping and Street Washing	• contract for service
Waste Transport to Disposal Site	• contract for service to private sector • privatization to private sector
Waste Separation at Disposal Site	• scavengers
Operation of Disposal Site	• contract for service to private sector • complete delegation to district level of government • privatization to private sector

There are number of different examples of socialization to draw upon.

1) Quan Toan Case Study

Quan Toan phuong was selected for a case study on socialization of solid waste collection. This case is to be undertaken under the UNDP Pilot Administrative Reform Project in Hai Phong VIE/98/003. A contractor was to be selected to undertake the collection of solid waste and fee collection in the Quan Toan phuong. The fee collection revenue was to be submitted to the Department of Finance and Pricing. URENCO was to load and transport the waste to the landfill. HPPC (i.e. URENCO) was to provide handcarts to the contractor. This one year pilot project was expected to begin in September 2000.

Terms of reference for the contractor were prepared and the case study was put out to tender. TUPWS received the bids but reviewing the proposals, the bidders were unwillingly to meet the target level for total fee collection set by the Department for Finance and Pricing. URENCO had to assign one of their units to do the waste collection at the lower cost as provided by TUPWS.

There are other difficulties with socialization in this case. There is the issue of labor redundancy and transfer of workers to the private sector. In this case the URENCO workers already collecting solid waste feared that if they become part of a private sector company, they would lose their seniority and will not have job security. Revenue generation is also a problem. The government is setting the rates for collection of solid waste. New organizations cannot recover their costs at current rates.

2) Nui Deo Experience with Social of Solid Waste Management Collection

Nui Deo is the largest town in Thuy Nguyen District. It covers 103 ha and has a population of 4,115 persons in 915 households. Sanitation service was established in 1986 when the People's Committee assigned four collection teams. Current model of socialization solid waste management system was initiated by the NDPC a few years ago.

In this model, residents and enterprises have to pay a fee for services. The Unit has to collect fees and pay for their own operating and maintenance. Initial investment of VND20,000,000 included 1 small semi truck (simple Chinese tractor and a trailer with 1 cu m. capacity), handcarts to collect waste from households, uniforms and tools for workers. There are three transfer points. The average volume collected is 16 cu m/day and street sweeping is not included as part of their service.

The Unit has 15 workers – 1 manager, 1 vice manager/accountant, 2 drivers, and 11 collection workers. The worker salary is VND330,000/month. If the Unit were profitable, the salaries of the workers would be increased or the monies applied against depreciation on equipment. At present, 564 households are served by the service. Individual enterprises make contracts with the Unit and the Unit provides 1 m x .60 m x .60 m containers (costing 150,000 VND) to enterprises. Price (based on the quantity collected) for enterprises in VND20,000 – 50,000/month for households is VND5,000 – 20,000/month. The activities of the Unit are under the control of the Nui Deo People's Committee (NDPC). NDPC set prices on costs paid by residents.

The Unit receives some assistance – mainly managerial and a small amount of financial assistance from the NDPC. Unit must guarantee payment of workers salaries. There is no support from the Thuy Nguyen District PC or HPPC for the service. Thus far, sanitation has been improved and each worker is taking greater responsibility for provision of the service. While this system works within Nui Deo – it will be difficult to extend to the whole district. In any case, the district will take over waste collection responsibility in the future as a new landfill has been approved in Gia Minh – Thuy Nguyen. This landfill (est. cost VND3,700,000,000) will open in 2002 and will have a duration of 7 –10 years.

Nui Deo is a good example of socialization. The main elements are:

- Improvement in the quality of service
- The user pay directly for the service
- The provider collects the fees and pays for labor and other operating and maintenance costs
- The State does not have to provide financial assistance
- The State provides guidance and retains the regulatory responsibility and authority
- This model is not privatization

3) Privatization of Waste Collection from Ships and Port Facilities

URENCO has recently established a sea and river environment team, which will collect solid and other waste from ships and port facilities. This business unit is expected to obtain the monies directly from the waste generators to finance operations. It will require initial capital and financing from inside URENCO. Thus far, a unit price for service has been agreed upon. The unit is currently being organized with a new manager (acting) and staffed (17 hired to date). The business unit will have its own accounting systems but will be under the control of the Finance and Accounting Department of URENCO. The Finance and Accounting Department will collect the revenue based on the contracts.

At present this business unit is well within URENCO but it could be privatized in the future. Alternatively, it could be operated as a for-profit business under URENCO's PUE mandate. In the future, one can anticipate increased competition by the private sector and other agencies for the ship and port facility solid waste management business.

4) Privatization of Industrial Waste Management

URENCO has recently created an industrial waste collection team to collect industrial waste collection from enterprises, industrial zones, and hospitals.

This business unit is also being organized with a new manager and 16 people have been hired. Like the sea and environment team, it is expected to obtain monies directly for waste generators to finance operations.

At present this business unit is well within URENCO but it could be privatized in the future. Alternatively, it could be operated as a for-profit business under URENCO's PUE mandate. In the future, one can anticipate increased competition by the private sector and other agencies for the industrial waste management business.

(4) Improvement in Administrative Efficiency

In general, there are a number of improvements in administrative efficiency that need to be introduced into URENCO. The following description focuses on the institutional changes, technical assistance, and training needs.

1) Action Planning and Financial Planning

Annual corporate planning process needs to be strengthened. The next important improvement is the introduction of a performance based reporting model that is based on indicators. Each sector is to prepare plans and hold regular quarterly meetings to evaluate progress.

2) Accounting

Work on the upgrading and developing accounting systems. In general, there are a number of areas that are being worked on: 1) collection, and analysis, and production of statistics: 2) completion of the Billing, Collection, and Accounts Receivable 3) cost controls based on new developed cost indicators and cost codes; and 4) auditing procedures for the accounts.

In general, these activities involve the introduction of new computerized systems, both hardware and software. And of course, training in the use of these systems.

3) Management Information Systems

Management Information Systems may incorporate a number of existing and future systems, including: 1) an internal local area network, 2) the proposed material management system, 3) accounting systems, 4) the billing collection, and accounts receivable system, 5) proposed reporting system.

The first step is to create the basic design of the system using the basic approaches for design and development of management information systems.

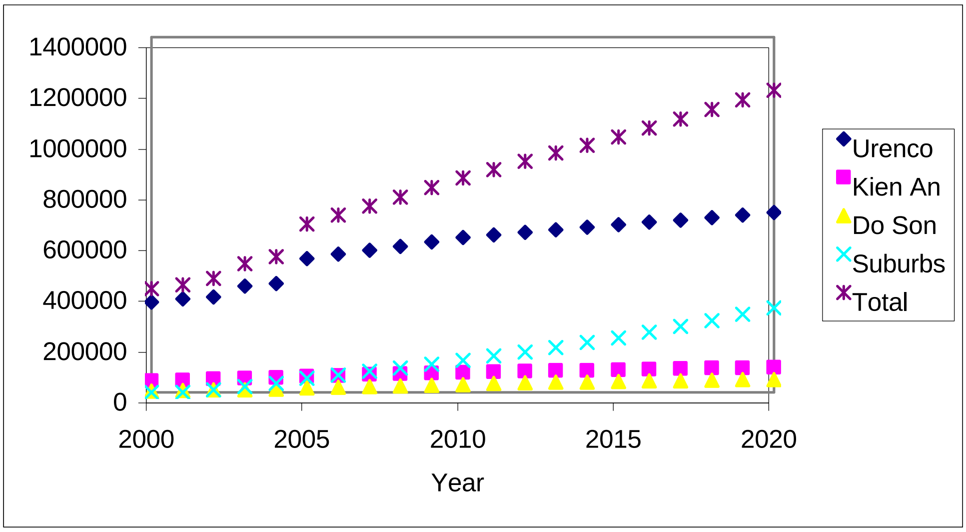
4) Material Management Systems

Better systems are required to manage the procurement process and track the use and disposal of materials. Computerization?? under development need to be completed and training in standard operating procedures undertaken.

6.6.2 Demand for Solid Waste Management Services

(1) Domestic Solid Waste

Population growth and expansion of the service area for household waste collection will increase the total population to be served to household waste collection from 408,987 people in year to 2000 to 1,191,526 people by the year 2002.



Population to be served by Household Waste Collection

6.6.3 Institutional Changes

Table below outlines the institutional changes that are associated with the implementation to the priority projects.

Institutional Changes associated with priority project on solid waste management

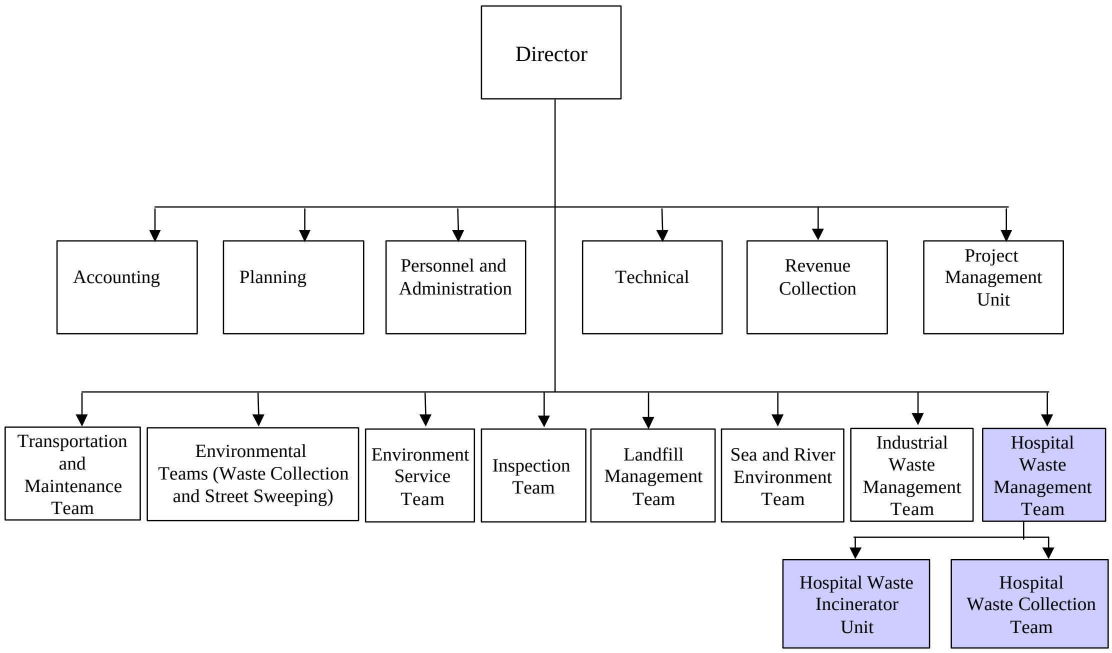
Trang Cat Landfill Phase 3	• Strengthening of the landfill team • Increase in staffing for landfill team
Improvement of Waste Collection and Transport	• Increase O&M in the transport and maintenance divisions of URENCO, Do Son Public Works Companies, and Kien An Urban Companies
Hospital Waste Collection and Transport	• Creation of Hospital Waste Management Unit in URENCO • Operation of Hospital Waste Incinerator • Collection and Transport of Hospital Waste

This assessment assumes the following organizational development schedule.

Implementation Time Schedule

Time	Organizational Development Event
2003	• Creation / Strengthening of PMU for Solid Waste Management Project (to be funded by ODA) • Strengthening of the O&M capability of Transportation and Maintenance Divisions
2004	• Creation of Hospital Waste Management Team • Further strengthening of the landfill team • Further strengthening of the PMU

The only major organizational structure change will result from the need to create a new division for hospital waste management. This new unit will have two divisions: 1) a hospital waste incinerator unit; and 2) hospital waste collection team.



Organizational Structure after the priority project on solid waste management.

6.6.4 Manpower Estimates

The priority project on solid waste management will require that new staff be recruited and trained in hospital waste management collection, operation of the incinerator, and in operation of a sanitary landfill (see table below).

Staffing Requirement of Priority Project

Overall Staffing		2005
URENCO		
Finance and Administration		4
Project Management Unit		20
Transportation and Maintenance		0
Landfill Management Team		35
Hospital Waste Management Team		19
Total URENCO		78
Do Son		5
Kien An		5
TOTAL Priority Projects		88

Hospital Waste Management	Education	2005
Manager	University	1
Head of Collection Unit	High School	1
Head of Incineration Unit	University	1
Drivers - Collection		6
Mechnical Engineers	University	1
Incinerator Operators	High School	9
Total		19

Landfill	Education	2005
Secretary	University	1
Deputy Manager	University	2
Secretary	High School	1
Chief Engineer	University	1
Truck Scale Engineer	University	1
Truck Scale Operator	High School	3
Leachate control Engineer	University	1
Chief Landfill Operator	High School	2
Leachate Facility Operator	High School	3
Heavy Equipment Operator		12
Site Workers		4
Guards		4
Total		35

The basic assumptions used to estimate manpower for the complete organization are detailed in the following table .

Assumptions used to estimate personnel requirements

Unit	2000 (estimated)	Assumptions Used to Estimate Future Staffing
Directors Office	3	Organization Size
Finance and Administration	52	• Organization size (.05 finance and administration staff / staff in all other divisions) • Increasing administrative efficiency (.05/staff to .04/staff) by 2020
Personnel and Administration (21staff)		
Accounting (10 staff)		
Planning (6 staff)		
Technical (8 staff)		
Revenue Collection (7 staff)		
Project Management Unit (8 staff)		
Transportation and Maintenance	103	• Increasing with collection area • Decreasing with increasing collection efficiency (large capacity trucks)
Environment Teams (3 teams) Solid Waste Collection	728	• Increasing with collection area • Decreasing with increasing collection efficiency (large capacity trucks
Environment Team (1 team) Nightsoil Collection	44	Phasing out over ten years
Environmental Service Team	29	Increasing with City Population
Inspection Team	16	Organization Size
Landfill Management Team	29	• Increasing with daily Collection volume
Sea and River Environment Team	17	2 % increase per year due to business growth
Industrial Waste Management Team	16	3 % increase per year due to business growth
Hospital Waste Management Team	-	To be created –
Total All Divisions	**1045**	

Based on the projections of total population served by URENCO and the assumptions on how staffing will change within each division, the projection of the staff requirements to 2020 is presented below .

Projected Changes in URENCO Staffing

	2000	2005	2010	2015	2020
Director Office	3	4	4	5	5
Finance and Administration	52	70	76	77	83
Project Management Unit	8	11	12	12	13
Inspection Team	16	22	24	25	25
Transportation and Maintenance	103	145	158	162	164
Environment Teams - Solid Waste Collection	728	1023	1119	1145	1157
Environment Teams - Nightsoil Collection	44	16	0	0	0
Environmental Service Team	29	43	50	54	58
Landfill Management Team	29	35	35	35	35
Sea and River Environment Team	17	26	32	36	40
Industrial Waste Management Team	16	26	33	39	46
Hospital Waste Management Team	0	18	18	18	18
Total	1045	1439	1561	1608	1643

The projected total staff by 2020 is 1643 in case URENCO remains the sole service provider in the service area. The staff required for domestic solid waste collection and transportation will increase due to expansion in the coverage for solid waste collection. This increase will occur even though there will be an increase in efficiency. It is assumed that by 2020, four workers will be able to do the work currently being undertaken by five. It is assumed that nightsoil collection will be phased out by 2010.

The staffing requirements for the sea and river environment team, and the industrial waste management team will grow at faster rates than the staff for domestic solid waste collection and transport.

It is assumed the staffing needs for the landfill team will be relatively constant after the Phase III landfill is constructed.

6.6.5 Human Resource Development.

(1) Training Priorities

The training activities from 1997 – 99 indicate that the priorities were academic training and upgrading of English language skills. The training and technical assistance supplied by HPWSSP focused on increasing administrative efficiency and business planning. As part this JICA study, an institutional analysis survey of URENCO was conducted. This survey identified the following training priorities in 1) finance and administration; 2) solid waste management; 3) operation and maintenance; 4) basic sanitation and management; and 5) advanced sanitation and management. (See table below). Based on the survey the top priorities are:

- financial management and investment planning
- organizing solid waste collection and treatment
- vehicle/equipment management and maintenance
- legal and regulatory framework of sanitation and environmental management in Vietnam
- solid and hazardous waste management systems

<u>Based on the results of the training survey, it is recommended that future training programs focus on more technical aspects of URENCO's operations.</u>

Training Priorities

Category	Training Priority (priorities) are ranked from 1 (highest)
Finance and Administration	1. Financial management and investment planning 2. Project planning and management 3. Procurement and contract management 4. Human resources development and how to organize training
Solid Waste Operation and Maintenance	1. Organizing solid waste collection 2. Organizing solid waste treatment 3. Landfill operations management and environmental protection 4. Solid waste treatment processes 5. Organizing solid waste separation 6. Recycling and re-use of solid waste
General Operation and Maintenance	1. Vehicle/equipment management and maintenance 2. Occupational health and safety 3. Maintenance management practices and information systems
Basic Sanitation Management	1. legal and regulatory framework of sanitation and environmental management in Vietnam 2. managing environmental information 3. urgent sanitation and environmental problems in Vietnam 4. sanitation and environmental inspection systems 4. principles of environmental monitoring 4. principles of pollution control 4. principles of environmental impact assessment 5. conflict resolution for environmental disputes 6. sanitation and environmental management administration 6. public health and sanitation promotion 6. introduction to environmental inspection 6. communication and environmental awareness
Advanced Sanitation Management	1. solid and hazardous waste management systems 2. water pollution control and treatment technologies

(2) Capacity Building for Implementation of the Priority Projects

The implementation of the priority projects in solid waste will require technical assistance and training.

1) Project Management in URENCO

URENCO has had little experience in the implementation of infrastructure projects. The PMU assembled to assist the JICA Study Team does not have the necessary experience to implement the priority project for solid waste management. For planning purposes, it should be assumed that:

- New staff with suitable qualifications will have to be recruited
- Technical assistance to facilitate the PMUs participation in the implementation of the priority project will be needed
- International advisors will need to participate directly in the bidding, procurement, and construction supervision

2) Strengthening of the Operations and Maintenance Capability of Transport and Maintenance Units of URENCO, Do Son Public Works Company, and Kien An Urban Company

Retraining and skill upgrading for maintenance staff will be needed as a result of the new vehicles and equipment that will be acquired.

3) Training and Technical Assistance in the Operation of the Sanitary Landfill

URENCO does not have the necessary trained personnel or equipment to practice proper techniques for landfill operations. Instruction in appropriate methods for placement of solid waste in the landfill and training on proper operation of the leachate collection systems is needed. A landfill expert may be needed for up to six months to train the URENCO landfill team.

4) Technical Assistance and Training for Operation of Medical Waste Incinerator

During the commission phase for medical waste incinerator, it will be essential to have technical experts to ensure that the incinerator is operating efficiently. Operating procedures and manuals must be developed to provide technical guidance for URENCO staff. The contractor should provide this technical assistance and training for the incinerator.

5) Demonstration Project and Training on In-Hospital Waste Management

A demonstration project in one or more hospitals should be undertaken to train staff and demonstrate in-hospital waste management procedures including: 1) separation of bio-medical waste from other solid waste; 2) disinfection on-site for hazardous waste (e.g. used injection needles); and 3) separate and isolated storage of bio-medical waste in special storerooms. One output of the demonstration project will be the development of a manual for proper separation, handling, storage, and disposal of bio-medical waste. Training courses should be designed and training programs with follow-up monitoring conducted for all hospitals.

(3) Basic Strategy for Human Resource Development

The basic human resource development strategy for URENCO is to:

- Strengthen the capacity of the project management unit (PMU) to ensure that it can effectively implement the capital investment projects
- Improve administrative efficiency throughout the organization
- Increase the technical competence of operations and maintenance staff to ensure sustainability of new system improvements

- Upgrade managerial skills to introduce modern management methods
- Introduce business planning methods to foster the development of the organization into an autonomous and commercially viable business entity

The following specific courses are to be developed and delivered to achieve these objectives:

Specific Courses Required

Strategic Objectives	Specific Courses
Strengthening Project Management Units	• Project management systems • Financial management (planning and budgeting • Bidding and Contract Management • Engineering skills • Foreign Languages
Improving Administrative Efficiency	• Accounting • Billing and Collection Systems • Finance and Budgeting • Management Information Systems • Personnel Management and Training • Performance monitoring • Human Resources Development
Improving Operations and Maintenance Competence	• Environment Teams (solid waste collection), Transport Team, Landfill Management Team, Sea and River Environment Team, and Industrial Waste Management Team
Upgrading of Management Skills	• Post secondary training – Master of Business Administration of Master of Public Administration or other executive programs
Business Planning	• Formal business plans designed at defining the core business • Characterizing of business opportunities – including revenue projections and cost estimates • **Planning for financing and the recruitment of staff to take advantage of the business opportunities**

Training for Operations and Maintenance

Department	Specific Courses
Environment Teams (Solid Waste Collection)	• Customer service • Waste handling
Transport Team	• Equipment operation and maintenance • Efficient loading and unloading
Landfill Management Team	• operation and maintenance of a sanitary landfill • environmental protection
Sea and River Environment Team	• Customer service • Special waste handling (e.g. oily waste) • Recognizing hazardous waste
Industrial Waste Management Team	• Customer service • Industrial waste handling • Recognizing hazardous waste • Handling hazardous waste
Hospital Waste Management Team	• Hospital waste collection and transport • operation and maintenance of medical waste incinerator • Customer service and advice to clients on proper procedures for handling and storage of hospital

(4) Training and Technical Assistance Costs

The human resource development plan has two primary components:

- An extensive program of training to be delivered to all departments and staff in URENCO. This program should begin immediately to prepare URENCO for the future
- A program of technical assistance to be provided to support the priority projects. This program includes advisors to provide technical assistance in: 1) solid waste management advisor to the PMU, 2) landfill operation and maintenance, and 3) hospital waste management

Some of the training is directly linked to the priority project implementation (e.g. training on hospital waste management, solid collection, land fill management, and project management). This training is to be supported by the technical advisors. Other training is designed to improve the administrative efficiency and business orientation of URENCO. The total cost for training is US$101,000. The total cost for technical assistance is US$525,000.

Human Resource Development Costs

I. Training	1	2	3	4	5	6
	Trainees	Course Units	Days/Unit	Trainer Days	Training Cost/Day	Total Cost
1. Directors Office						
Foreign University MBA Degree	1	1	n/a	n/a	n/a	$ 40,000
Business Planning	3	3	10	30	100	$ 3,000
2. Finance and Administration						
Improving Administrative Efficiency	20	7	10	70	100	$ 7,000
3. Transportation and Maintenance						
Equipment Operation and Maintenance	100	2	20	40	100	$ 4,000
4. Environment Teams						
Solid Waste Handling	700	35	5	175	100	$ 17,500
Customer Service	100	5	2	10	100	$ 1,000
5. Inspection Team						
New Inspection Procedures	15	2	10	20	100	$ 2,000
6. Landfill Management Team						
O&M of Sanitary Landfill	30	3	20	60	100	$ 6,000
Environmental Protection	5	1	5	5	100	$ 500
7. Sea and River Environment Team						
Customer Service	20	1	5	5	100	$ 500
Special Waste Handling	20	1	10	10	100	$ 1,000
8. Industrial Waste Management Team						
Customer Service	20	2	5	10	100	$ 1,000
Special Waste Handling	20	2	10	20	100	$ 2,000
Hazardous Waste Handling	20	2	10	20	100	$ 2,000
9. Hospital Waste Management Team						
O&M of Medical Waste Incinerator	6	4	10	40	100	$ 4,000
Hospital Waste Collection and Transport	6	1	20	20	100	$ 2,000
Customer Service and Advice	6	1	10	10	100	$ 1,000
10. Project Management Unit						
Project Management Systems	10	1	5	5	100	$ 500
Financial Management	5	2	5	10	100	$ 1,000
Bidding and Contract Management	5	1	10	10	100	$ 1,000
Foreign Language Training	10	1	40	40	100	$ 4,000
TOTAL COSTS TRAINING						$ 101,000

II. Technical Assistance - Priority Projects	Person Months	Cost/ Month	Total Cost
1. Solid Waste Management Advisor	12	25000	$ 300,000
2. Landfill Advisor	6	25000	$ 150,000
3. Hospital Waste Management Advisor	3	25000	$ 75,000
TOTAL COST TECHNICAL ASSISTANCE			$ 525,000

6.7 Solid Waste Management Priority Project

It is advised that as part of realization of the master plan, HPPC should implement some actions in the form of a priority project outlined below

(1) Project Components

The proposed Priority Project comprises the following components:

Components of the Priority Project in the Field of Solid Waste Management

Project Components	Main Facilities to be Constructed and Equipment to be Procured
1. Improvement of waste collection and transport system	- Vehicles, bins and handcarts - Workshop equipment
2. Trang Cat Phase 3 Landfill	- Trang Cat Phase 3 Landfill Site
3. Improvement of hospital waste management	- Hospital waste incinerator - Waste collection vehicle - Storage rooms in hospitals

(2) Schedule

It is planned that all facilities and equipment provided under the priority project would start operation in the beginning of 2005. In order to achieve this, the following schedule is proposed:

- 2003: Engineering service
- 2004 - 2005: Procurement and construction

Note: All procurement and construction will be completed in 2004 except for some part of Trang Cat Phase 3 Landfill Site.

- 2005: Operation will start in the beginning of 2005

(3) Source of Fund

HPPC should obtain an ODA fund (soft loan) to cover major part of investment costs. The remaining portion and all recurring costs should be borne by HPPC or the three municipal companies that provide solid waste management services.

The feasibility study of the priority project is shown in Volume 2 of the main report.

6.8 Cost Estimation

6.8.1 Cost Structure and Components

Solid waste management costs during 2001 – 2020 have been estimated for each of the three companies, i.e.:

- URENCO
- Kien An Urban Works Company
- Do Son Public Works Company

Major cost components are:

- Cost of waste collection and transport
- Cost of waste landfill
- Cost of hospital waste management including storage, collection, and incineration

Each cost component has the following cost items:

- Investments
    - Land acquisition cost
    - Procurement of equipment
    - Construction cost
    - Engineering service cost (5 % of Item b and 10 % of Item c in principle)
    - Administration (3 % of sum of a, b, c, and d)
    - Physical Contingency (10 % of the sum of all the above cost items)
- Operation

6.8.2 Estimated Costs

It is estimated that the total solid waste management cost for 20 years during 2001 –2020 is about US$117 million including both investments and recurring costs of the 3 solid waste management companies. The total cost comprises of US$52 million investment, and US$65 million recurring costs.

Costs to be borne by each company are as follows: approximately US$90 million for URENCO, US$ 14 million for Kien An Company, and US$13 million for Do Son. See the table below.

Estimated Solid Waste Management Costs of Haiphong during 2001 – 2020

Unit: 1,000 in US$2000 Price

	URENCO (a)	Kien An Company (b)	Do Son Company (c)	Total (a + b + c) = (d)
A1. Waste collection & Transport	15,977	2,645	2,602	21,225
A2. Landfill	18,435	2,858	3,016	24,308
A3. Hospital waste management	926	0	0	926
A4. Cost of administration & physical contingency	4,700	731	747	7,104
A5. Total investment (A1+A2+A3+A4)	40,038	6,234	6,365	52,637
B. Total recurring cost	50,124	7,399	7,127	64,650
C. Total cost (A+B)	90,162	13,633	13,492	117,287

Note: It is assumed that the cost of administration is 3 % of the sum of A1, A2 & A3. The physical contingency is assumed to be 10 % of the sum of the investment costs including the administration costs.

Cost details by company are shown in Tables 6.8.1, 6.8.2 and 6.8.3. Aggregate costs are shown in Tables 6.8.4. Tables 6.3.5 – 6.3.8 show base cost data corresponding to Tables 6.8.1 – 6.8.4.

Table 6.1.1 URENCO's Expected Fee Revenue and Actual Revenue

A. Household Waste					
Types	Number of Beneficiaries (persons)	Fee Rate (Dong/person /year)	Expected Revenue if Fully Collected (Dong/year)	Actual Revenue (Dong per year)	Ratio
	b	c	d = b*c	e	f = e/d
1. People in the Inner City (1000 Dong/month)	180,245	12,000	2,162,940,000		
2. People in the Outskirts (500 Dong/month)	150,456	6,000	902,736,000		
3. Total (1+2)	330,701		3,065,676,000	1,860,844,000	61%
4. Traiding households	5,292	180,000	952,560,000	138,412,000	15%
5. Grand total (3+4)			4,018,236,000	1,999,256,000	50%
B. Business Waste					
	Actual Generation (m3/year)	Fee Rate (Dong/m3)	Fee to be paid based on Actual Generation	Actual Revenue	
	b	c	d = b*c	e	
1. Production (Industrial) Waste	35,496	50,000	1,774,812,500	967,159,338	54%
2. Business (non-industrial) waste	64,788	40,000	2,591,500,000	400,000,000	15%
3. Hospital waste	2,920	40,000	116,800,000	10,558,162	9%
4. Demolition waste	1,825	15,000	27,375,000	0	0%
			4,366,312,500	1,377,717,500	32%
Grand Total (A+B)			8,384,548,500	3,376,973,500	40%

Note:

1. Population in the area of 1000Dong/month (227322 shown in Table 6.1.2) x Service coverage (90%) = 204
   204,589 - (4.6 person/shop x 5,292 shops) = 180,245
2. Population in the area of 500Dong/month (188,070) shown in Table 6.1.2) x Service coverage (80%) = 15(
3. Produciton waste volume: 38.9 ton/day x 365 days/year ÷ 0.4ton/m3 = 64,788 m3/year
4. Business waste volume: 71 ton/day x 365 days/year ÷ 0.4ton/m3 = 34,788 m3/year
5. Hospital waste volume: 3.2 ton/day x 365 days/year ÷ 0.4ton/m3 = 2,920 m3/year
6. Demolition waste volume: 7 ton/day x 365 days/year ÷ 1.4ton/m3 = 1,825m3/year

Table 6.1.2 Number of Fee Payers and Estimated Fee Revenue of URENCO

Unit: Dong

	Fee Rate (Dong/ month)	Fee Rate (Dong/ month)	Registered Population	Revenue from 1000 Dong Payers' Total (Dong/year)	Revenue from 500Dong Payers' Total (Dong/year)	Total
	a	b	c	d = a*c *12months	e = b*c *12months	f = d+ e
1. Hong Bang Dist.						
Quan Toan Ward		500	8,035	0	48,210,000	
Hung Vuong Ward		500	8,732	0	52,392,000	
So Dau Ward		500	10,684	0	64,104,000	
Thuong Ly Ward		500	17,423	0	104,538,000	
Trai Chuoi Ward		500	9,953	0	59,718,000	
Ha Ly Ward	1,000		12,935	155,220,000	0	
Minh Khai Ward	1,000		6,107	73,284,000	0	
Quang Trung Ward	1,000		6,887	82,644,000	0	
Hoang Van Thu Ward	1,000		5,055	60,660,000	0	
Phan Boi Chau Ward	1,000		7,521	90,252,000	0	
Pham Hong Thai Ward	1,000		4,233	50,796,000	0	
Sub-Total			**97,565**	**512,856,000**	**328,962,000**	**841,818,000**
2. Ngo Quyen Dist.						
May To Ward	1,000		13,280	159,360,000	0	
May Chai Ward		500	16,072	0	96,432,000	
Van My Ward		500	15,514	0	93,084,000	
Lac Vien Ward	1,000		12,402	148,824,000	0	
Cau Tre Ward	1,000		15,857	190,284,000	0	
Luong Khanh Thien Ward	1,000		8,600	103,200,000	0	
Gia Vien Ward	1,000		11,072	132,864,000	0	
Cau Dat Ward	1,000		8,366	100,392,000	0	
Le Loi Ward	1,000		8,951	107,412,000	0	
Lach Tray Ward	1,000		10,113	121,356,000	0	
Dang Giang Ward		500	13,142	0	78,852,000	
Dong Khe Ward		500	10,521	0	63,126,000	
Dong Quoc Binh Ward	1,000		8,862	106,344,000	0	
Cat Bi Ward		500	18,871	0	113,226,000	
Sub-Total	**97,503**	**74,120**	**171,623**	**1,170,036,000**	**444,720,000**	**1,614,756,000**
				0	0	
3. Le ChanDist.						
Cat Dai Ward	1,000		9,998	119,976,000	0	
An Bien Ward	1,000		7,889	94,668,000	0	
Me Linh Ward	1,000		5,609	67,308,000	0	
Lam Son Ward		500	12,214	0	73,284,000	
An Duong Ward	1,000		9,925	119,100,000	0	
Tran Nguyen Han Ward	1,000		11,890	142,680,000	0	
Ho Nam Ward	1,000		15,205	182,460,000	0	
Ward Trai Cau	1,000		10,972	131,664,000	0	
Du Hang Ward		500	11,883	0	71,298,000	
Hang Kenh Ward	1,000		15,593	187,116,000	0	
Dong Hai Ward		500	12,549	0	75,294,000	
Niem Nghia Ward		500	22,477	0	134,862,000	
Sub-Total	**87,081**	**59,123**	**146,204**	**1,044,972,000**	**354,738,000**	**1,399,710,000**
Grand Total of the 3 Districts	**227,322**	**188,070**	**415,392**	**2,727,864,000**	**1,128,420,000**	**3,856,284,000**

Table 6.1.3 Population to be Served with Household Waste Collection Service

Unit: Persons

	Whole Population					Non-Agriculture Population					Target Service Ratio to Non-Agriculture Population					Population to be Served				
	URENCO	Kien An Company	Do Son Company	Others	Total	URENCO	Kien An Company	Do Son Company	Others		URENCO	Kien An	Do Son	Others	Average	URENCO	Kien An Company	Do Son Company	Others	
	a	b	c	d	e = a+b+c+d	f	g	h	i	j = f+g+h+i	k	l	m	n		p	q	r	s	t = p+q+r+s
2000	419,813	74,600	44,101	1,158,964	1,697,478	412,228	54,620	15,627	212,045	694,520	87%	85%	37%	0%	59%	356,824	46,427	5,735	0	408,987
2001	424,233	76,199	45,363	1,171,696	1,717,491	417,148	57,148	17,595	218,266	710,157	88%	86%	42%	0%	60%	367,090	49,147	7,390	0	423,628
2002	428,654	77,798	46,624	1,184,428	1,737,504	422,069	59,676	19,563	224,486	725,794	89%	87%	47%	5%	62%	375,641	51,918	9,195	11,224	447,978
2003	473,897	79,396	47,885	1,156,338	1,757,516	465,012	62,204	21,531	224,140	772,886	90%	88%	52%	10%	66%	418,510	54,739	11,196	22,414	506,860
2004	480,047	80,995	49,147	1,167,340	1,777,529	471,962	64,732	23,499	230,082	790,274	91%	89%	57%	15%	68%	429,485	57,611	13,394	34,512	535,003
2005	571,394	82,594	50,408	1,093,146	1,797,542	555,589	67,053	25,361	222,014	870,017	95%	95%	65%	25%	76%	527,810	63,701	16,484	55,504	663,498
2006	581,115	84,162	51,638	1,102,984	1,819,898	566,360	69,343	27,191	228,352	891,246	96%	96%	70%	30%	78%	543,705	66,570	19,033	68,506	697,814
2007	590,836	85,729	52,867	1,112,822	1,842,254	577,159	71,634	29,021	234,690	912,503	97%	97%	75%	35%	80%	559,844	69,485	21,765	82,142	733,236
2008	600,556	87,297	54,097	1,122,660	1,864,610	587,939	73,924	30,851	241,028	933,742	98%	98%	80%	40%	82%	576,180	72,445	24,680	96,411	769,717
2009	610,277	88,864	55,326	1,132,498	1,886,966	598,724	76,214	32,680	247,367	954,985	99%	99%	85%	45%	85%	592,737	75,452	27,778	111,315	807,282
2010	619,998	90,432	56,556	1,142,336	1,909,322	609,509	78,343	34,428	253,468	975,748	100%	100%	90%	50%	87%	609,509	78,343	30,985	126,734	845,571
2011	629,425	91,999	57,786	1,151,377	1,930,587	620,000	80,473	36,176	260,075	996,724	100%	100%	95%	55%	88%	620,000	80,473	34,367	143,041	877,881
2012	638,853	93,567	59,015	1,160,418	1,951,853	630,491	82,603	37,923	266,683	1,017,700	100%	100%	100%	60%	90%	630,491	82,603	37,923	160,010	911,027
2013	648,280	95,134	60,245	1,169,459	1,973,118	640,783	84,732	39,671	273,290	1,038,476	100%	100%	100%	65%	91%	640,783	84,732	39,671	177,639	942,825
2014	657,708	96,702	61,475	1,178,499	1,994,384	650,659	86,862	41,419	279,897	1,058,837	100%	100%	100%	70%	92%	650,659	86,862	41,419	195,928	974,868
2015	667,135	98,269	62,705	1,187,540	2,015,649	660,251	88,867	43,102	286,321	1,078,540	100%	100%	100%	75%	93%	660,251	88,867	43,102	214,741	1,006,960
2016	676,753	99,837	63,935	1,196,133	2,036,658	670,032	90,871	44,786	295,506	1,101,196	100%	100%	100%	80%	95%	670,032	90,871	44,786	236,404	1,042,094
2017	686,370	101,404	65,165	1,204,727	2,057,666	679,814	92,876	46,470	304,691	1,123,851	100%	100%	100%	85%	96%	679,814	92,876	46,470	258,987	1,078,147
2018	695,988	102,972	66,396	1,213,320	2,078,675	689,596	94,881	48,154	313,875	1,146,506	100%	100%	100%	90%	97%	689,596	94,881	48,154	282,488	1,115,118
2019	705,605	104,539	67,626	1,221,913	2,099,684	699,377	96,886	49,838	323,060	1,169,161	100%	100%	100%	95%	99%	699,377	96,886	49,838	306,907	1,153,008
2020	715,223	106,107	68,856	1,230,506	2,120,692	709,159	98,793	51,472	332,102	1,191,526	100%	100%	100%	100%	100%	709,159	98,793	51,472	332,102	1,191,526

Note:
1. Waste collection target ratios are set in terms of ratios of service population to non-agriculture population.
2. Details of population in each area are shown in Tables 6.1.4 - 6.1.7.

Table 6.1.4 Projected Population in Service Area of URENCO

Unit: Person

	Hong Bang	Le Chan	Ngo Quen	Additional Area 1	Additional Area 2	Additional Area 3	Total	Agriculture Population	Non-Agriculture Pop.
	a	b	c	d	e	f	g = a+b+c+d+e+f	h	i = g-h
1999	97,565	146,204	171,623				415,392	8,085	407,307
2000	99,123	147,672	173,018				419,813	7,585	412,228
2001	100,680	149,140	174,414				424,233	7,085	417,148
2002	102,238	150,607	175,809				428,654	6,585	422,069
2003	103,795	152,075	177,204		40,822		473,897	8,885	465,012
2004	105,353	153,543	178,600		42,552		480,047	8,085	471,962
2005	106,910	155,011	179,995	24,856	44,282	60,340	571,394	15,805	555,589
2006	108,506	156,638	181,633	25,609	46,231	62,498	581,115	14,755	566,360
2007	110,102	158,264	183,271	26,362	48,181	64,655	590,836	13,677	577,159
2008	111,698	159,891	184,909	27,115	50,130	66,813	600,556	12,617	587,939
2009	113,294	161,518	186,547	27,868	52,080	68,971	610,277	11,553	598,724
2010	114,889	163,145	188,185	28,621	54,029	71,128	619,998	10,489	609,509
2011	116,485	164,772	189,823	29,306	55,863	73,176	629,425	9,425	620,000
2012	118,081	166,398	191,461	29,991	57,697	75,224	638,853	8,361	630,491
2013	119,677	168,025	193,099	30,676	59,532	77,272	648,280	7,497	640,783
2014	121,273	169,652	194,737	31,360	61,366	79,319	657,708	7,048	650,659
2015	122,869	171,279	196,375	32,045	63,200	81,367	667,135	6,884	660,251
2016	124,465	172,906	198,013	32,728	65,028	83,614	676,753	6,720	670,032
2017	126,061	174,532	199,651	33,410	66,855	85,861	686,370	6,556	679,814
2018	127,657	176,159	201,289	34,092	68,683	88,107	695,988	6,392	689,596
2019	129,252	177,786	202,927	34,775	70,511	90,354	705,605	6,228	699,377
2020	130,848	179,413	204,565	35,457	72,339	92,601	715,223	6,064	709,159

Assumptions on Areas to be Included in Urban District as follows:

1. Area 1 that is located in the south of Hong Bang District will be included in Hong Bang District in 2005.
2. Area 2 that is located in the sourth of Le Chan District will be included in Le Chan District in 2003.
3. Area 3 that is located in the east of Ngo Quyen District will become a new Urban District in 2005.

Table 6.1.5 Projected Population in Kien An Company Are

Unit: Persons

	Urban	Agriculture Population	Non-Agriculture Pop.
	a	b	c = a - b
2000	74,600	19,980	54,620
2001	76,199	19,051	57,148
2002	77,798	18,122	59,676
2003	79,396	17,193	62,204
2004	80,995	16,264	64,732
2005	82,594	15,541	67,053
2006	84,162	14,818	69,343
2007	85,729	14,096	71,634
2008	87,297	13,373	73,924
2009	88,864	12,650	76,214
2010	90,432	12,088	78,343
2011	91,999	11,526	80,473
2012	93,567	10,964	82,603
2013	95,134	10,402	84,732
2014	96,702	9,840	86,862
2015	98,269	9,403	88,867
2016	99,837	8,965	90,871
2017	101,404	8,528	92,876
2018	102,972	8,091	94,881
2019	104,539	7,654	96,886
2020	106,107	7,314	98,793

Table 6.1.6 Projected Population in Do Son Company Area

Unit: Persons

	Do Son Town					R14			Total		
	Urban	Rural	Total	e Populatio n	Non-Agricultur e Pop.	Populatio n on Route 14	e Populatio n	Non-Agricultur e Pop.	e Populatio n	Non-Agricultur e Pop.	Total
	a	b	c=a+b	d	e= c - d	f	g	h= f - g	i = d+g	j =e+h	k = c+f
2000	22,680	8,315	30,995	18,202	12,793	13,106	10,272	2,834	28,474	15,627	44,101
2001	22,979	8,452	31,431	17,973	13,457	13,932	9,794	4,138	27,767	17,595	45,363
2002	23,278	8,588	31,866	17,744	14,121	14,758	9,316	5,442	27,061	19,563	46,624
2003	23,577	8,724	32,301	17,516	14,785	15,584	8,839	6,746	26,354	21,531	47,885
2004	23,876	8,861	32,736	17,287	15,450	16,410	8,361	8,049	25,648	23,499	49,147
2005	24,175	8,997	33,172	17,058	16,114	17,237	7,990	9,247	25,047	25,361	50,408
2006	24,445	9,160	33,605	16,829	16,776	18,032	7,618	10,414	24,447	27,191	51,638
2007	24,715	9,324	34,039	16,600	17,439	18,828	7,247	11,582	23,847	29,021	52,867
2008	24,985	9,488	34,473	16,371	18,102	19,624	6,875	12,749	23,246	30,851	54,097
2009	25,255	9,651	34,906	16,142	18,764	20,420	6,503	13,916	22,646	32,680	55,326
2010	25,525	9,815	35,340	15,913	19,427	21,216	6,215	15,001	22,128	34,428	56,556
2011	25,795	9,978	35,774	15,684	20,089	22,012	5,926	16,086	21,610	36,176	57,786
2012	26,065	10,142	36,207	15,456	20,752	22,808	5,637	17,171	21,092	37,923	59,015
2013	26,336	10,306	36,641	15,227	21,414	23,604	5,348	18,257	20,574	39,671	60,245
2014	26,606	10,469	37,075	14,998	22,077	24,400	5,059	19,342	20,056	41,419	61,475
2015	26,876	10,633	37,509	14,769	22,740	25,197	4,834	20,363	19,603	43,102	62,705
2016	27,146	10,796	37,942	14,540	23,402	25,993	4,609	21,384	19,149	44,786	63,935
2017	27,416	10,960	38,376	14,311	24,065	26,790	4,384	22,405	18,695	46,470	65,165
2018	27,686	11,123	38,810	14,082	24,727	27,586	4,160	23,426	18,242	48,154	66,396
2019	27,956	11,287	39,243	13,853	25,390	28,382	3,935	24,448	17,788	49,838	67,626
2020	28,226	11,451	39,677	13,624	26,053	29,179	3,760	25,419	17,384	51,472	68,856

Table 6.1.7 Projected Population in Other Areas of Haiphong City

Unit: Person

	Urban	Agriculture Population	Non-Agriculture Pop.	Rural	Agricultur e Population	Non-Agriculture Pop.	Total	Agriculture Population	Non-Agriculture Pop.
	a			b			c=a+b		
2000	65,603	29,448	36,155	1,093,361	917471	175,890	1,158,964	946,919	212,045
2001	68,943	28,078	40,865	1,102,753	925352	177,401	1,171,696	953,430	218,266
2002	72,284	26,709	45,575	1,112,145	933233	178,912	1,184,428	959,942	224,486
2003	75,624	25,340	50,284	1,080,714	906859	173,855	1,156,338	932,199	224,140
2004	78,964	23,970	54,994	1,088,376	913288	175,088	1,167,340	937,259	230,082
2005	82,304	22,905	59,399	1,010,842	848227	162,615	1,093,146	871,132	222,014
2006	86,702	21,840	64,862	1,016,282	852792	163,490	1,102,984	874,632	228,352
2007	91,100	20,775	70,325	1,021,722	857357	164,365	1,112,822	878,132	234,690
2008	95,498	19,710	75,788	1,027,162	861922	165,240	1,122,660	881,632	241,028
2009	99,896	18,645	81,251	1,032,603	866487	166,116	1,132,498	885,132	247,367
2010	104,294	17,816	86,477	1,038,043	871052	166,991	1,142,336	888,868	253,468
2011	109,447	16,988	92,459	1,041,930	874314	167,616	1,151,377	891,302	260,075
2012	114,601	16,159	98,441	1,045,817	877576	168,241	1,160,418	893,735	266,683
2013	119,754	15,331	104,423	1,049,704	880838	168,867	1,169,459	896,169	273,290
2014	124,908	14,503	110,405	1,053,592	884100	169,492	1,178,499	898,602	279,897
2015	130,061	13,858	116,203	1,057,479	887361	170,117	1,187,540	901,219	286,321
2016	138,592	13,214	125,378	1,057,542	887414	170,128	1,196,133	900,628	295,506
2017	147,122	12,569	134,553	1,057,605	887467	170,138	1,204,727	900,036	304,691
2018	155,653	11,925	143,728	1,057,667	887520	170,148	1,213,320	899,444	313,875
2019	164,183	11,280	152,902	1,057,730	887572	170,158	1,221,913	898,853	323,060
2020	172,713	10,779	161,934	1,057,793	887625	170,168	1,230,506	898,404	332,102

Table 6.2.1 Estimated Waste Collection and Generation in 2000 (ton/day)

	COLLECTION					GENERATION					COLLECTION RATIO				
	3 Urban Districts	Kien An	Do Son	Others	Total	3 Urban Districts	Kien An	Do Son	Others	Total	3 Urban Districts	Kien An	Do Son	Others	Total
	a	b	c	d	e	f	g	h	i	j					
1. Household	186.4	30.8	1.2	0.0	218.4	219.3	36.3	9.0	231.8	496.3	85%	85%	13%	0%	44%
2. Business waste	85.7	13.0	36.1	0.0	134.8	95.2	14.4	40.1	50.4	200.1	90%	90%	90%	0%	67%
3. Street wasate	45.3	7.5	5.4	0.0	58.2	53.3	8.8	10.9	29.1	102.1	85%	85%	50%	0%	57%
4. Industrial waste	38.9	6.4	0.0	0.0	45.3	43.2	7.1	0.1	25.0	75.4	90%	90%	0%	0%	60%
5. Hospital waste	3.2	1.7	0.1	0.0	5.0	3.2	1.7	0.1	6.6	11.6	100%	100%	100%	0%	43%
6. Demolition waste	7.0	1.2	1.2	0.0	9.3	70.0	11.6	5.8	4.5	91.9	10%	10%	20%	0%	10%
7. Total	366.5	60.6	44.0	0.0	471.1	484.2	79.9	66.0	347.2	977.4	76%	76%	67%	0%	48%

Population in 2000	419,813	74,600	30,995	1,158,964	1,684,372	419,813	74,600	30,995	1,158,964	1,684,372
Unit Rate (kg/capita/day)	0.873	0.812	1.420	0.000	0.280	1.153	1.071	2.129	0.300	0.580

Table 6.2.2 Solid Waste Generation and Target Waste Collection in Haiphong City

	3 Urban Districts			Kien An			Do Son			Others				Haiphong Total		
Year	Genera-tion (ton/day)	Collection Rate	Collection (ton/day)	Genera-tion (ton/day)	Collection Rate	Collection (ton/day)	Genera-tion (ton/day)	Collection Rate	Collection (ton/day)	Genera-tion (ton/day)	Genera-tion in Non-Agriculture	Collection Rate	Collection (ton/day)	Genera-tion (ton/day)	Collection Rate	Collection (ton/day)
a	b	c	d = bxc	b	c	d = bxc	b	c	d = bxc	b	c	d	e = cxd	b	c	d = bxc
2000	484	76%	367	80	76%	61	66	67%	44	347	226	0%	0	856	55%	471
2001	495	77%	381	84	77%	65	75	73%	55	359	235	0%	0	890	56%	501
2002	507	78%	395	89	78%	69	80	75%	60	370	244	5%	12	919	58%	536
2003	565	79%	446	93	79%	74	84	77%	64	370	247	10%	25	988	62%	609
2004	579	80%	464	98	80%	78	88	79%	70	382	256	15%	38	1,021	64%	650
2005	702	85%	597	104	85%	89	93	81%	75	374	254	20%	51	1,153	70%	812
2006	734	90%	660	110	90%	99	99	83%	82	392	268	25%	67	1,211	75%	909
2007	769	92%	707	117	92%	108	105	85%	89	411	283	30%	85	1,274	78%	989
2008	806	93%	749	124	93%	115	112	87%	97	431	299	35%	105	1,341	80%	1,067
2009	844	94%	793	131	94%	123	119	89%	106	452	316	40%	126	1,410	81%	1,149
2010	883	95%	839	139	95%	132	127	91%	115	474	333	45%	150	1,481	83%	1,236
2011	907	95%	862	144	95%	137	133	93%	124	487	345	50%	173	1,529	85%	1,295
2012	932	95%	885	149	95%	142	138	95%	132	502	357	55%	197	1,576	86%	1,355
2013	956	95%	908	154	95%	147	144	95%	137	516	370	60%	222	1,624	87%	1,414
2014	981	95%	932	160	95%	152	149	95%	142	531	383	65%	249	1,672	88%	1,474
2015	1,005	95%	955	165	95%	157	155	95%	147	545	395	70%	277	1,720	89%	1,535
2016	1,031	95%	979	170	95%	162	161	95%	153	564	412	75%	309	1,774	90%	1,603
2017	1,057	95%	1,004	176	95%	167	167	95%	158	583	430	80%	344	1,830	91%	1,674
2018	1,084	95%	1,030	181	95%	172	173	95%	164	602	448	85%	381	1,886	93%	1,747
2019	1,111	95%	1,056	187	95%	178	179	95%	170	622	466	90%	419	1,943	94%	1,823
2020	1,139	95%	1,082	193	95%	183	185	95%	176	642	484	95%	460	2,001	95%	1,901

Table 6.2.3 Solid Waste Generation and Target Waste Collection in the 3 Urban Districts

Area: Hong Bang, Le Chan, and Ngo Quyen and
3 Areas in An Hai Rural District that would become Urban District.
Unit: ton/day

Year	Generation (ton/day)	Collection Rate	Collection (ton/day)	Annul Collection (ton/year)	Cumulative Disposal Quantity at Phase 3 Trang Cat at Year End (ton)
a	b	c	d = bxc	e = dx365 or 366/year	f
2000	484	76%	367	133,773	0
2001	495	77%	381	139,227	0
2002	507	78%	395	144,263	0
2003	565	79%	446	162,831	0
2004	579	80%	464	169,644	0
2005	702	85%	597	217,870	217,870
2006	734	90%	660	241,061	458,931
2007	769	92%	707	258,224	717,156
2008	806	93%	749	274,185	991,341
2009	844	94%	793	289,418	1,280,759
2010	883	95%	839	306,203	1,586,962
2011	907	95%	862	314,546	1,901,508
2012	932	95%	885	323,912	2,225,421
2013	956	95%	908	331,555	2,556,976
2014	981	95%	932	340,030	2,897,006
2015	1,005	95%	955	348,507	3,245,513
2016	1,031	95%	979	358,465	3,603,978
2017	1,057	95%	1,004	366,617	3,970,596
2018	1,084	95%	1,030	375,905	4,346,500
2019	1,111	95%	1,056	385,350	4,731,850
2020	1,139	95%	1,082	396,039	5,127,889

Assumptions on Areas to be Included in Urban District as follows:

1. Area 1 that is located in the south of Hong Bang District will be included in Hong Bang District in 2005.
2. Area 2 that is located in the sourth of Le Chan District will be included in Le Chan District in 2003.
3. Area 3 that is located in the east of Ngo Quyen District will become a new Urban District in 2005.

Table 6.2.4 Solid Waste Generation and Target Waste Collection in Kien An Urban District

Unit: ton/day

Year	Generation (ton/day)	Collection Rate	Collection (ton/day)	Annul Collection (ton/year)	Cumulative Disposal Quantity at Phase 3 Trang Cat at Year End (ton)
a	b	c	d = bxc	e = dx365 or 366/year	f
2000	80	76%	61	22,180	0
2001	84	77%	65	23,690	0
2002	89	78%	69	25,272	25,272
2003	93	79%	74	26,912	52,184
2004	98	80%	78	28,690	80,874
2005	104	85%	89	32,326	113,201
2006	110	90%	99	36,237	149,437
2007	117	92%	108	39,300	188,737
2008	124	93%	115	42,224	230,961
2009	131	94%	123	45,073	276,035
2010	139	95%	132	48,113	324,148
2011	144	95%	137	49,870	374,018
2012	149	95%	142	51,800	425,818
2013	154	95%	147	53,476	479,294
2014	160	95%	152	55,327	534,621
2015	165	95%	157	57,136	591,757
2016	170	95%	162	59,181	650,938
2017	176	95%	167	60,938	711,876
2018	181	95%	172	62,891	774,767
2019	187	95%	178	64,878	839,645
2020	193	95%	183	67,025	906,670

Table 6.2.5 Solid Waste Generation and Target Waste Collection in Do Son Town and Area along Route 14

Area: Do Son Town & Areas along Route 14 in Kien Thuy Rural District

Unit: ton/day

Year	Generation (ton/day)	Collection Rate	Collection (ton/day)	Annul Collection (ton/year)	Cumulative Disposal Quantity at Phase 3 Trang Cat at Year End (ton)
a	b	c	d = bxc	e = dx365 or 366/year	f
2000	66	67%	44	16,104	0
2001	75	73%	55	20,111	0
2002	80	75%	60	21,781	0
2003	84	77%	64	23,534	23,534
2004	88	79%	70	25,443	48,976
2005	93	81%	75	27,467	76,443
2006	99	83%	82	29,909	106,352
2007	105	85%	89	32,613	138,965
2008	112	87%	97	35,658	174,623
2009	119	89%	106	38,713	213,336
2010	127	91%	115	42,039	255,375
2011	133	93%	124	45,172	300,547
2012	138	95%	132	48,131	348,678
2013	144	95%	137	49,894	398,573
2014	149	95%	142	51,827	450,400
2015	155	95%	147	53,762	504,162
2016	161	95%	153	55,912	560,074
2017	167	95%	158	57,798	617,872
2018	173	95%	164	59,879	677,751
2019	179	95%	170	62,004	739,755
2020	185	95%	176	64,319	804,074

Table 6.2.6 Solid Waste Generation and Target Waste Collection in Other Places in Haiphong City

Unit: ton/day

Year	Generation (ton/day)	Generation in Non-Agriculture Area	Collection Rate	Collection (ton/day)	Annul Collection (ton/year)	Cumulative Disposal Quantity at Phase 3 Trang Cat at Year End (ton)
a	b	c	d	e = cxd	f = ex365 or 366/year	g
2000	347	226	0%	0	0	0
2001	359	235	0%	0	0	0
2002	370	244	5%	12	4,459	4,459
2003	370	247	10%	25	9,004	13,463
2004	382	256	15%	38	14,056	27,520
2005	374	254	20%	51	18,546	46,066
2006	392	268	25%	67	24,450	70,516
2007	411	283	30%	85	31,015	101,531
2008	431	299	35%	105	38,328	139,859
2009	452	316	40%	126	46,114	185,973
2010	474	333	45%	150	54,676	240,649
2011	487	345	50%	173	62,964	303,613
2012	502	357	55%	197	71,736	375,349
2013	516	370	60%	222	81,005	456,354
2014	531	383	65%	249	90,784	547,139
2015	545	395	70%	277	101,020	648,159
2016	564	412	75%	309	113,227	761,386
2017	583	430	80%	344	125,535	886,921
2018	602	448	85%	381	138,889	1,025,810
2019	622	466	90%	419	153,002	1,178,812
2020	642	484	95%	460	168,280	1,347,092

Table 6.3.1 Inventory of Vehicles Used by URENCO

1. Trucks for Waste Transport

No.	Registration No.	Brand	Type of truck	Made in	Date of Use	Initial State of Quality	Current Quality
1	16K-0430	IFA	Dump-truck	1987	Apr. 1989	80%	65%
2	16K-3710	IFA	Dump-truck	1987	Apr. 1989	80%	50%
3	16K-0434	IFA	Dump-truck	1983	Dec. 1985	100%	50%
4	16K-0433	IFA	Dump-truck	1983	Dec. 1985	100%	55%
5	16K-1562	IFA	Dump-truck	1984	Apr. 1986	100%	55%
6	16K-2371	IFA	Dump-truck	1983	Dec. 1985	100%	55%
7	16K-3512	IFA	Dump-truck	1982	Apr. 1989	70%	50%
8	16K-4171	IFA	Dump-truck	1982	May-86	70%	50%
9	16K-315	IFA	Dump-truck	1988	6 Dec. 91	70%	55%
10	16K-6041	IFA	Dump-truck	1994	Jan. 1998	80%	60%
11	16K-6050	IFA	Dump-truck	1994	Jan. 1998	80%	60%
12	16K-6051	IFA	Dump-truck	1994	Jan. 1998	80%	60%
13	16K-6050	IFA	Dump-truck	1995	Mar. 1998	80%	60%
14	16K-6051	IFA	Dump-truck	1995	Mar. 1998	80%	60%
15	16K-6153	IFA	Dump-truck	1995	Mar. 1998	80%	60%
	IFA Average			**1988.4**		**83%**	**56%**
16	16K-1149	Toyota	Compactor	1983	Jun. 1996	80%	40%
17	16K-1400	Toyota	Compactor	1983	Jun. 1993	80%	40%
18	16K-1721	Toyota	Compactor	1983	Jun. 1993	80%	40%
19	16K-3200	Toyota	Compactor	1998	Oct. 1994	80%	50%
20	16K-0613	Toyota	Compactor	1998	Oct. 1994	80%	50%
21	16K-3198	Toyota	Compactor	1998	Oct. 1994	80%	55%
22	16K-3127	Nissan	Compactor	1998	Oct. 1994	80%	55%
23	16K-1283	Nissan	Compactor	1998	Nov. 1994	80%	50%
24	16K-1720	Puso	Compactor	1998	Nov. 1994	80%	60%
25	16K-0644	HINO	Compactor	1998	Nov. 1994	80%	45%
26	16K-6793	Kia	Compactor	1982	Oct. 1998	60%	60%
27	16K-3849	Volvo	Compactor	1989	Nov. 1995	80%	55%
28	16K-3864	Volvo	Compactor	1989	Nov. 1995	80%	55%
29	Unknown	Unknown	Fore & Aft Tipper	Unknown	Unknown	80%	50%
	Compactor	**Average**		**1991.9**		**79%**	**50%**
30	16K-7195	HINO	Container	1998	Jul. 1999	100%	85%
31	16K-7196	HINO	Container	1998	Jul. 1999	100%	85%
32	16K-7340	HINO	Swinging	1998	Feb. 2000	100%	90%
	3 Hino	**Average**		**1998**		**100%**	**87%**
	Grand	**Average**		**1990.8**		**83%**	**57%**

2. Trucks for Water Sprinkling

No.	Registration No.	Brand	Type of truck	Made in	Date of Use	Initial State of Quality	Current Quality
1	16K-1146	Zin 130	Road watering	1987	Nov. 1989	100%	60%
2	16K-1130	Zin 130	Road watering	1987	Nov. 1989	100%	60%
3	16K-1153	Zin 130	Road watering	1987	Nov. 1989	100%	55%
4	16K-5371	Zin 130	Road watering	1978	Jan. 1980	100%	60%
	Average			**1984.75**		**100%**	**59%**

3. Trucks for Night-soil Transport

No.	Registration No.	Brand	Type of truck	Made in	Date of Use	Initial State of Quality	Current Quality
1	16K-2187	Zay 53	Tank-truck	1982	Jul. 1986	80%	50%
2	16K-1959	Zay 53	Tank-truck	1984	Oct. 1987	80%	45%
3	16K-0795	Zay 53	Tank-truck	1984	Oct. 1987	80%	40%
4	16K-1875	Zin 130	Tank-truck	1982	May-86	100%	50%
5	16K-2703	Zin 130	Tank-truck	1981	Dec. 1984	100%	40%
	Average			**1982.6**		**88%**	**45%**

Table 6.3.2 URENCO's Estimated Asset Value and Annual Depreciation

Unit costs are estimated in US dollar at 2000 price

		Used Equipment		New Equipment					
		Unit Cost	Quantity	Unit Cost	Quantity	Value	Use Period	Annual Depreciation Cost	**Annual Depreciation by Category**
		a	b	c	d	e = a*b + c*d	f	g = e/f	h
A	**Solid Waste Collection & Transport (1-15) sub total**								**81,444**
1	IFA trucks	10,000	15	0	0	150,000	10	15,000	
2	Compactor (7 ton, 16m3) (Volvo)	30,000	0	71,000	1	80,000	10	8,000	
3	Compactor (3.5 ton, 8m3) (Japanese)	15,000	1	35,000	0	15,000	10	1,500	
4	Compactor (3.5 ton, 8m3) (Korean)	12,000	1	30,000	0	12,000	10	1,200	
5	Compactor (2.7 ton, 6 m3) (Japanese)	14,000	1	32,000	0	14,000	10	1,400	
6	Compactor (2.7 ton, 6m3) (Korean)	11,000	1	25,000	0	11,000	10	1,100	
7	Compactor (2 ton, 4m3)	12,000	8	30,000	0	96,000	10	9,600	
8	Fore and Aft Tipper (3 ton, 6m3)	30,000	1	42,000	0	30,000	10	3,000	
9	Hooklift (Hino) (12m3)	-	0	52,000	2	104,000	10	10,400	
10	Swinger (Hino)	-		52,000	1	52,000	10	5,200	
11	Container (12m3) (given by FINNIDA)	-	0	1,800	12	21,600	10	2,160	
12	Container (12m3) (made by URENCO)	-	0	1,285	12	15,420	5	3,084	
13	Handcarts (0.4m3)	-	0	66	400	26,400	5	5,280	
14	Handcarts (0.7m3)	-	0	140	10	1,400	5	280	
15	Handcarts (0.4 m3, from Hanoi)	-	0	120	10	1,200	5	240	
16	Garages, Workshop and office	-	0	350,000	1	350,000	25	14,000	
B	**Night soil/Septage collection & transport (16-18) sub total**								**6,500**
16	Night soil (Zin130, Russia)	-	0	14,000	2	28,000	10	2,800	
18	Night soil (GAT53, Russia)	-	0	12,000	2	24,000	10	2,400	
19	Septage collection truck	13,000	1	-	0	13,000	10	1,300	
C	**Street Watering (19 & 20) (sub total)**								**9,700**
20	Watering Truck (Zin130, Russia)	-	0	18,000	4	72,000	10	7,200	
21	Pumping facilities for Street Watering	-	0	25,000	1	25,000	10	2,500	
D	**Landfill (21-23) Sub total**								**147,505**
22	Bulldozers (Russia)	-	0	18,000	2	36,000	10	3,600	
23	Trang Cat Landfill Site Phase 1	-	0	492,000	1	492,000	3.5	140,571	
24	Road to Trang Cat Site	-	0	100,000	1	100,000	30	3,333	
E 25	**Administration (Headoffice)**	-	0	350,000	1	350,000	30	11,667	**11,667**
	Grand Total				463	2,120,020	279	256,815	**256,815**

Table 6.3.3 Comparison of Waste Collection/Transport Systems

(Case 1: Current level of salary)

		Dominant System	FINNIDA System	Proposed Future System
	Unit	collection & Manual reloading into truck	Primary collection + 12 m3 container + Hooklift truck	Direct collection with bins but without Primary collection
A. ASSUMPTIONS		a	b	c
1. Waste Amount to be Collected	ton/day	300	300	300
2. Amount of waste to be collected				
a. Amount collected by Handcart of existing type	ton/worker/day	0.7	0.7	0.0
b. Amount collected by Truck	ton/trip	3.5	5.4	3.5
c. Number of trip by truck	trip/truck/day	3.5	7.0	3.5
d. Amount collected by Truck (b x c)	ton/day	12.3	37.8	12.3
3. Usful period				
a. Handcart of existing type	year	1.0		
b. Truck	year	10.0	10.0	10.0
c. Container	year		5.0	2.0
4. Unit Price				
a. Direct salary of driver ($/month)	$/month	40	40	40
b. Direct salary for others ($/month)	$/month	35	35	35
c. Handcart of existing type ($/unit)	$/unit	66	0	0
d. Truck ($/unit)	$/unit	35,000	52,000	42,000
e. Container ($/unit)	$/unit	0	1,500	150
f. Fuel ($/liter)	$/liter	0.26	0.26	0.26
5. Other Assumptions				
a. Number of handcart per worker per		1	1	1
a. Number of drivers per truck (driver/truck)		1	1	1
b. Number of assistannts per truck (worker/truck)		1	1	2
c. Spare truck (%)		15%	15%	15%
d. Running distance for collection (km)		0	0	10
e. Distance from last collection point to transfer station (km)		14	14	14
f. Fuel milage (km/liter)		5	5	5
B. RESULTS				
B1. Number of workers needed				
a. Number of drivers (persons)	person	28	9	28
b. Number of loaders (persons)	person	125	9	56
c. Number of collection workers	person	429	429	0
c. Total (a + b)	person	582	447	84
B2. Number of equipment needed				
a. Handcart of existing type	unit	429	375	0
b. Truck (incl. Spare:15%)	unit	28	9	28
c. Containers	unit	0	56	1,010
B3. Annual cost				
a. Direct salary of driver & others ($/month)	$/year	246,018	188,214	37,176
b. Handcart (depreciation)	$/year	28,286	28,286	0
c. Truck (depreciation)	$/year	98,571	47,460	118,286
d. Container (depreciation)	$/year	0	16,667	75,758
e. Fuel	$/year	13,015	4,218	17,663
f. Annual maintenance cost (4.5% of equipment purchase)	$/year	45,630	25,107	60,047
g. Spare labors and euipment (25% of the above total)	$/year	107,880	77,488	77,232
h. General administration, etc. (35% of the above total)	$/year	188,790	135,604	135,156
i. Sub-total of Investment cost (b+c+d)	$/year	126,857	92,413	194,043
j. Sub-total of Other costs (a+e+f+g+h)	$/year	601,333	430,631	327,274
k. Total (i+j))	$/year	**728,191**	**523,044**	**521,317**
B4. Unit cost per ton ($/ton)	$/ton	**6.65**	**4.78**	**4.76**
B5. Cost Index		**100.0**	**71.8**	**71.6**

Table 6.3.4 Comparison of Waste Collection/Transport Systems

(Case 2: Salary level is doubled)

		Dominant System	FINNIDA System	Proposed Future System
	Unit	collection & Manual reloading into truck	Primary collection + 12 m3 container + Hooklift truck	Direct collection with bins but without Primary collection
A. ASSUMPTIONS		a	b	c
1. Waste Amount to be Collected	ton/day	300	300	300
2. Amount of waste to be collected				
a. Amount collected by Handcart of existing type	ton/worker/day	0.7	0.7	0.0
b. Amount collected by Truck	ton/trip	3.5	5.4	3.5
c. Number of trip by truck	trip/truck/day	3.5	7.0	3.5
d. Amount collected by Truck (b x c)	ton/day	12.3	37.8	12.3
3. Usful period				
a. Handcart of existing type	year	1.0		
b. Truck	year	10.0	10.0	10.0
c. Container	year		5.0	2.0
4. Unit Price				
a. Direct salary of driver ($/month)	$/month	80	80	80
b. Direct salary for others ($/month)	$/month	70	70	70
c. Handcart of existing type ($/unit)	$/unit	66	0	0
d. Truck ($/unit)	$/unit	35,000	52,000	42,000
e. Container ($/unit)	$/unit	0	1,500	150
f. Fuel ($/liter)	$/liter	0.26	0.26	0.26
5. Other Assumptions				
a. Number of handcart per worker per		1	1	1
a. Number of drivers per truck (driver/truck)		1	1	1
b. Number of assistannts per truck (worker/truck)		1	1	2
c. Spare truck (%)		15%	15%	15%
d. Running distance for collection (km)		0	0	10
e. Distance from last collection point to transfer station (km)		14	14	14
f. Fuel milage (km/liter)		5	5	5
B. RESULTS				
B1. Number of workers needed				
a. Number of drivers (persons)	person	28	9	28
b. Number of loaders (persons)	person	125	9	56
c. Number of collection workers	person	429	429	0
c. Total (a + b)	person	582	447	84
B2. Number of equipment needed				
a. Handcart of existing type	unit	429	375	0
b. Truck (incl. Spare:15%)	unit	28	9	28
c. Containers	unit	0	56	1,010
B3. Annual cost				
a. Direct salary of driver & others ($/month)	$/year	492,037	376,429	74,351
b. Handcart (depreciation)	$/year	28,286	28,286	0
c. Truck (depreciation)	$/year	98,571	47,460	118,286
d. Container (depreciation)	$/year	0	16,667	75,758
e. Fuel	$/year	13,015	4,218	17,663
f. Annual maintenance cost (4.5% of equipment purchase)	$/year	45,630	25,107	60,047
g. Spare labors and euipment (25% of the above total)	$/year	169,385	124,542	86,526
h. General administration, etc. (35% of the above total)	$/year	296,423	217,948	151,421
i. Sub-total of Investment cost (b+c+d)	$/year	126,857	92,413	194,043
j. Sub-total of Other costs (a+e+f+g+h)	$/year	1,016,489	748,243	390,007
k. Total (i+j))	$/year	**1,143,347**	**840,655**	**584,051**
B4. Unit cost per ton ($/ton)	$/ton	**10.44**	**7.68**	**5.33**
B5. Cost Index		**100.0**	**73.5**	**51.1**

Table 6.3.5 URENCO's Estimated Annual Costs for Waste Collection and Transport

Unit: US Dollar at 2000 Price

	COSTS ($/Year)									Unit Operation Cost			Equipment Unit Cost & Quantity			
	Operation (Recurrent) Cost				Investment (Equipment)				Total Cost	$/ton			Average Unit Cost of Equipment ($/unit)		Purchase Unit (Units)	
Year	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Total Operation Cost	Waste Transport Vehicles	Waste Bins & handcarts	Workshop Equipment	Total Investment	Operation Cost + Equipment Cost	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Waste Transport Vehicle	Waste Bins & Handcarts	Waste Transport Vehicle	Waste Bins & Handcarts
a	b = k*v	c = l*w	d = m*x	e = b+c+d	f = n*p	g	h	i = f+g+h	j = e + i	k	l	m	n	o = g/q	p	q
2000	172,951	644,639	0	817,589	0	6,700	0	6,700	824,289	10.46	5.49	2.99	30,000	67	0	100
2001	186,730	695,999	0	882,729	80,000	34,356	0	114,356	997,085	10.88	5.71	3.11	40,000	106	2	324
2002	195,735	710,570	23,313	929,619	270,000	50,195	0	320,195	1,249,814	11.31	5.94	3.23	45,000	141	6	355
2003	229,848	784,142	54,752	1,068,742	180,000	71,890	0	251,890	1,320,632	11.77	6.18	3.36	45,000	153	4	469
2004	248,689	794,035	88,860	1,131,584	2,424,200	161,744	300,000	2,885,944	4,017,527	12.24	6.42	3.50	78,200	169	31	959
2005	305,041	785,959	277,443	1,368,443	346,500	170,692	0	517,192	1,885,635	12.73	6.68	3.64	49,500	161	7	1,063
2006	350,721	819,984	364,559	1,535,263	445,500	202,235	0	647,735	2,182,998	13.24	6.95	3.78	49,500	158	9	1,279
2007	390,724	820,296	456,909	1,667,929	346,500	208,472	0	554,972	2,222,901	13.76	7.22	3.93	49,500	151	7	1,385
2008	430,493	801,085	559,349	1,790,926	198,000	242,543	0	440,543	2,231,469	14.32	7.51	4.09	49,500	149	4	1,631
2009	474,013	768,984	677,485	1,920,483	198,000	247,520	75,000	520,520	2,441,003	14.89	7.81	4.26	49,500	140	4	1,768
2010	474,155	746,589	813,225	2,033,969	198,000	276,053	0	474,053	2,508,022	15.48	8.13	4.43	49,500	143	4	1,931
2011	506,639	664,782	941,351	2,112,771	396,000	299,320	0	695,320	2,808,091	16.10	8.45	4.60	49,500	140	8	2,138
2012	540,963	567,856	1,082,444	2,191,264	297,000	320,151	0	617,151	2,808,415	16.75	8.79	4.79	49,500	142	6	2,258
2013	577,223	454,439	1,237,498	2,269,161	1,633,500	355,740	0	1,989,240	4,258,401	17.42	9.14	4.98	49,500	140	33	2,541
2014	616,179	323,406	1,409,083	2,348,669	445,500	336,758	75,000	857,258	3,205,927	18.11	9.51	5.18	49,500	142	9	2,376
2015	590,977	379,107	1,501,611	2,471,695	544,500	373,047	0	917,547	3,389,242	18.84	9.89	5.38	49,500	140	11	2,664
2016	630,062	404,179	1,600,922	2,635,163	495,000	354,765	0	849,765	3,484,928	19.59	10.28	5.60	49,500	142	10	2,504
2017	671,997	431,080	1,707,476	2,810,553	297,000	391,923	0	688,923	3,499,476	20.38	10.69	5.82	49,500	140	6	2,798
2018	716,976	459,934	1,821,761	2,998,670	297,000	373,472	0	670,472	3,669,142	21.19	11.12	6.06	49,500	142	6	2,637
2019	764,477	490,405	1,942,457	3,197,339	346,500	411,137	75,000	832,637	4,029,976	22.04	11.57	6.30	49,500	140	7	2,934
2020	724,117	570,086	2,069,894	3,364,097	594,000	393,157	0	987,157	4,351,254	22.92	12.03	6.55	49,500	142	12	2,776
Total 2001-2020	9,625,760	12,472,918	18,630,391	40,729,068	10,032,700	5,275,169	525,000	15,832,869	56,561,938	Total quantity during 2001 - 2020					186	36,790
Average unit cost per ton during 2001 - 2020 ($/ton)				**7.09**				**2.76**	**9.85**							

Table 6.3.6 Kien An Company's Estimated Annual Costs for Waste Collection and Transport

Unit: US Dollar at 2000 Price

	COSTS ($/Year)									Unit Operation Cost			Equipment Unit Cost & Quantity			
	Operation (Recurrent) Cost				Investment (Equipment)				Total Cost	$/ton			Average Unit Cost of Equipment ($/unit)		Purchase Unit (Units)	
Year	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Total Operation Cost	Waste Transport Vehicles	Waste Bins & handcarts	Workshop Equipment	Total Investment	Operation Cost + Equipment Cost	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Waste Transport Vehicle	Waste Bins & Handcarts	Waste Transport Vehicle	Waste Bins & Handcarts
a	b = k*v	c = l*w	d = m*x	e = b+c+d	f = n*p	g	h	i = f+g+h	j = e + i	k	l	m	n	o = g/q	p	q
2000	28,634	107,206	0	135,840	30,000	2,010	0	32,010	167,850	10.46	5.49	2.99	30,000	67	1	30
2001	31,857	118,740	0	150,597	0	6,063	0	6,063	156,660	10.88	5.71	3.11	40,000	106	0	57
2002	34,192	124,125	4,072	162,389	45,000	8,065	0	53,065	215,454	11.31	5.94	3.23	45,000	141	1	57
2003	38,136	130,104	9,084	177,325	45,000	12,701	0	57,701	235,026	11.77	6.18	3.36	45,000	153	1	83
2004	41,806	133,480	14,938	190,223	427,800	23,782	70,000	521,582	711,805	12.24	6.42	3.50	71,300	169	6	141
2005	45,475	117,170	41,361	204,006	0	25,494	0	25,494	229,500	12.73	6.68	3.64	45,000	160	0	159
2006	52,608	122,998	54,684	230,290	45,000	31,010	0	76,010	306,300	13.24	6.95	3.78	45,000	158	1	196
2007	59,686	125,307	69,797	254,790	45,000	31,688	0	76,688	331,478	13.76	7.22	3.93	45,000	150	1	211
2008	66,097	122,997	85,881	274,975	45,000	37,959	0	82,959	357,934	14.32	7.51	4.09	45,000	149	1	255
2009	73,523	119,275	105,083	297,881	45,000	39,340	17,500	101,840	399,721	14.89	7.81	4.26	45,000	140	1	281
2010	74,599	117,461	127,945	320,005	45,000	43,710	0	88,710	408,715	15.48	8.13	4.43	45,000	143	1	306
2011	80,521	105,656	149,611	335,789	45,000	48,440	0	93,440	429,229	16.10	8.45	4.60	45,000	140	1	346
2012	86,799	91,114	173,680	351,593	90,000	50,357	0	140,357	491,950	16.75	8.79	4.79	45,000	141	2	357
2013	93,449	73,571	200,344	367,364	270,000	58,240	0	328,240	695,604	17.42	9.14	4.98	45,000	140	6	416
2014	100,493	52,744	229,808	383,045	45,000	52,336	17,500	114,836	497,881	18.11	9.51	5.18	45,000	140	1	373
2015	97,155	62,324	246,862	406,341	45,000	61,909	0	106,909	513,250	18.84	9.89	5.38	45,000	140	1	442
2016	104,259	66,882	264,913	436,054	45,000	56,005	0	101,005	537,059	19.59	10.28	5.60	45,000	140	1	399
2017	111,776	71,704	284,012	467,492	90,000	65,578	0	155,578	623,070	20.38	10.69	5.82	45,000	140	2	468
2018	119,728	76,804	304,216	500,749	45,000	60,374	0	105,374	606,123	21.19	11.12	6.06	45,000	140	1	430
2019	128,861	82,663	327,422	538,945	90,000	69,247	17,500	176,747	715,692	22.04	11.57	6.30	45,000	140	2	494
2020	122,471	96,419	350,084	568,974	135,000	71,145	0	206,145	775,119	22.92	12.03	6.55	45,000	140	3	507
Total 2001-2020	1,563,491	2,011,537	3,043,796	6,618,825	1,642,800	853,442	122,500	2,618,742	9,237,567	Total quantity during 2001 - 2020					33	5,978
Average unit cost per ton during 2001 - 2020 ($/ton)				7.11				2.81	9.92							

Table 6.3.7 Do Son Company''s Estimated Annual Costs for Waste Collection and Transport

Unit: US Dollar at 2000 Price

	COSTS ($/Year)									Unit Operation Cost			Equipment Unit Cost & Quantity			
	Operation (Recurrent) Cost				Investment (Equipment)				Total Cost	$/ton			Average Unit Cost of Equipment ($/unit)		Purchase Unit (Units)	
Year	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Total Operation Cost	Waste Transport Vehicles	Waste Bins & handcarts	Workshop Equipment	Total Investment	Operation Cost + Equipment Cost	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Waste Transport Vehicle	Waste Bins & Handcarts	Waste Transport Vehicle	Waste Bins & Handcarts
a	b = k*v	c = l*w	d = m*x	e = b+c+d	f = n*p	g	h	i = f+g+h	j = e + i	k	l	m	n	o = g/q	p	q
2000	20,617	77,349	0	97,965	0	1,005	0	1,005	98,970	10.46	5.49	2.99	30,000	67	0	15
2001	26,956	100,472	0	127,428	40,000	5,221	0	45,221	172,649	10.88	5.71	3.11	40,000	107	1	49
2002	29,732	107,935	3,541	141,208	0	7,149	0	7,149	148,357	11.31	5.94	3.23	40,000	140	0	51
2003	32,983	112,523	7,857	153,362	0	11,895	0	11,895	165,257	11.77	6.18	3.36	40,000	153	0	78
2004	37,518	119,790	13,406	170,713	415,200	24,326	60,000	499,526	670,239	12.24	6.42	3.50	69,200	182	6	134
2005	38,322	98,739	34,855	171,915	42,500	20,204	0	62,704	234,619	12.73	6.68	3.64	42,500	174	1	116
2006	43,574	101,877	45,294	190,745	42,500	30,402	0	72,902	263,647	13.24	6.95	3.78	42,500	170	1	179
2007	49,186	103,262	57,517	209,966	42,500	27,611	0	70,111	280,077	13.76	7.22	3.93	42,500	165	1	167
2008	55,751	103,745	72,439	231,936	42,500	38,314	0	80,814	312,750	14.32	7.51	4.09	42,500	161	1	238
2009	63,361	102,790	90,559	256,710	42,500	35,790	15,000	93,290	350,000	14.89	7.81	4.26	42,500	156	1	230
2010	64,991	102,333	111,467	278,792	42,500	47,738	0	90,238	369,030	15.48	8.13	4.43	42,500	156	1	306
2011	72,881	95,630	135,415	303,925	42,500	46,077	0	88,577	392,502	16.10	8.45	4.60	42,500	155	1	297
2012	80,686	84,697	161,449	326,833	42,500	56,461	0	98,961	425,794	16.75	8.79	4.79	42,500	156	1	363
2013	87,092	68,566	186,715	342,373	255,000	55,955	0	310,955	653,328	17.42	9.14	4.98	42,500	155	6	361
2014	93,881	49,274	214,689	357,844	85,000	59,660	15,000	159,660	517,504	18.11	9.51	5.18	42,500	155	2	384
2015	90,967	58,355	231,138	380,460	85,000	60,774	0	145,774	526,234	18.84	9.89	5.38	42,500	155	2	392
2016	98,467	63,166	250,195	411,828	42,500	63,704	0	106,204	518,032	19.59	10.28	5.60	42,500	155	1	410
2017	105,753	67,839	268,706	442,298	85,000	65,593	0	150,593	592,891	20.38	10.69	5.82	42,500	155	2	423
2018	114,159	73,232	290,067	477,458	42,500	68,523	0	111,023	588,481	21.19	11.12	6.06	42,500	155	1	441
2019	123,069	78,948	312,706	514,723	85,000	70,412	15,000	170,412	685,135	22.04	11.57	6.30	42,500	155	2	454
2020	117,786	92,731	336,693	547,210	127,500	73,510	0	201,010	748,220	22.92	12.03	6.55	42,500	155	3	473
Total 2001-2020	1,427,116	1,785,904	2,824,707	6,037,728	1,602,700	869,319	105,000	2,577,019	8,614,746	Total quantity during 2001 - 2020					34	5,546
Average unit cost per ton during 2001 - 2020 ($/ton)				**7.14**				**3.05**	**10.18**							

Table 6.3.8 3 Companies Aggregate Annual Costs for Waste Collection and Transport

Unit: US Dollar at 2000 Price

	COSTS ($/Year)										Unit Operation Cost			Equipment Unit Cost & Quantity			
	Operation (Recurrent) Cost				Investment (Equipment)				Total Cost		$/ton			Average Unit Cost of Equipment ($/unit)		Purchase Unit (Units)	
Year	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Total Operation Cost	Waste Transport Vehicles	Waste Bins & handcarts	Workshop Equipment	Total Investment	Operation Cost + Equipment Cost		Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Waste Transport Vehicle	Waste Bins & Handcarts	Waste Transport Vehicle	Waste Bins & Handcarts
a	b = k*v	c = l*w	d = m*x	e = b+c+d	f = n*p	g	h	i = f+g+h	j = e + i		k	l	m	n	o = g/q	p	q
2000	222,202	829,193	0	1,051,395	30,000	9,715	0	39,715	1,091,110		10.46	5.49	2.99	30,000	67	1	145
2001	245,543	915,211	0	1,160,754	120,000	45,640	0	165,640	1,326,394		10.88	5.71	3.11	40,000	106	3	430
2002	259,659	942,630	30,927	1,233,216	315,000	65,409	0	380,409	1,613,625		11.31	5.94	3.23	45,000	141	7	463
2003	300,967	1,026,769	71,693	1,399,429	225,000	96,486	0	321,486	1,720,915		11.77	6.18	3.36	45,000	153	5	630
2004	328,013	1,047,304	117,203	1,492,520	3,267,200	210,020	430,000	3,907,220	5,399,740		12.24	6.42	3.50	75,981	170	43	1,235
2005	388,838	1,001,868	353,658	1,744,363	389,000	216,230	0	605,230	2,349,593		12.73	6.68	3.64	48,625	162	8	1,337
2006	446,903	1,044,858	464,537	1,956,298	533,000	263,802	0	796,802	2,753,100		13.24	6.95	3.78	48,455	159	11	1,655
2007	499,596	1,048,865	584,223	2,132,684	434,000	267,621	0	701,621	2,834,305		13.76	7.22	3.93	48,222	152	9	1,762
2008	552,341	1,027,827	717,669	2,297,837	285,500	318,961	0	604,461	2,902,298		14.32	7.51	4.09	47,583	150	6	2,125
2009	610,897	991,049	873,128	2,475,074	285,500	322,510	107,500	715,510	3,190,584		14.89	7.81	4.26	47,583	142	6	2,278
2010	613,745	966,384	1,052,637	2,632,765	285,500	367,641	0	653,141	3,285,906		15.48	8.13	4.43	47,583	145	6	2,544
2011	660,041	866,067	1,226,377	2,752,485	483,500	393,697	0	877,197	3,629,682		16.10	8.45	4.60	48,350	142	10	2,780
2012	708,448	743,667	1,417,574	2,869,689	429,500	427,109	0	856,609	3,726,298		16.75	8.79	4.79	47,722	143	9	2,979
2013	757,764	596,576	1,624,557	2,978,898	2,113,500	469,795	0	2,583,295	5,562,193		17.42	9.14	4.98	48,034	142	44	3,317
2014	810,554	425,424	1,853,580	3,089,558	620,500	448,894	107,500	1,176,894	4,266,452		18.11	9.51	5.18	47,731	143	13	3,134
2015	779,099	499,786	1,979,611	3,258,496	674,500	495,590	0	1,170,090	4,428,586		18.84	9.89	5.38	48,179	142	14	3,497
2016	832,789	534,227	2,116,030	3,483,045	582,500	474,614	0	1,057,114	4,540,159		19.59	10.28	5.60	48,542	143	12	3,314
2017	889,526	570,623	2,260,194	3,720,344	472,000	522,954	0	994,954	4,715,298		20.38	10.69	5.82	47,200	142	10	3,688
2018	950,863	609,970	2,416,044	3,976,877	384,500	502,509	0	887,009	4,863,886		21.19	11.12	6.06	48,063	143	8	3,509
2019	1,016,407	652,016	2,582,585	4,251,008	521,500	550,656	107,500	1,179,656	5,430,664		22.04	11.57	6.30	47,409	142	11	3,881
2020	964,374	759,237	2,756,670	4,480,280	856,500	537,952	0	1,394,452	5,874,732		22.92	12.03	6.55	47,583	143	18	3,757
Total 2001-2020	12,616,367	16,270,359	24,498,895	53,385,621	13,278,200	6,998,089	752,500	21,028,789	74,414,410		Total quantity during 2001 - 2020					253	48,315
Average unit cost per ton during 2001 - 2020 ($/ton)				7.10				2.80	9.89								

Table 6.3.9 Base Calculation for Table 6.3.5 (URENCO)

	Waste Collection Quantity (Ton/Day)							Calculation of Number of Units and Costs of Waste Collection Vehicles, Bins and Handcarts Required															
	Total Amount (ton/day)	Ratio to Total Amount			Waste Collection Amount (t/d)			Waste Collection Vehicles (Number of Units)					Bins (Number of units and Costs)					Handcarts (Number of units and Costs)					
Year	URENCO's Waste Collection Amount (ton/day)	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Street Waste (ton/day)	Waste Collected by Existing System with Primary Collection (ton/day)	Waste Collected by Single Handling System (ton/day)	Vehicles required	Number of existing vehicles to be discarded	Remai-ning	Number of new vehicles to be discarded	New Purchase	Number of Bins Needed	Number of Bins to be discarded	Number of new Purchase	Average Unit Cost ($/unit)	Purchase Cost of Bins ($)	Number of handcarts Needed	Number of handcarts to be discarded	Number of new Purchase	Unit Cost ($/unit)	Purchase Cost of Handcarts ($)	Bins & Handcarts (Costs) ($)
a	b	c	d	e	f = b*c	g = b*d	h = b*e	i	j	k = i-j	l	m	n	o	p	q	r= p*q	s	t	y	v	w = u*v	x = r + w
2000	367	12%	88%	0%	45	322	0	32	0	32	0	0	0	0	0	169	0	574	0	100	67	6,700	6,700
2001	381	12%	88%	0%	47	334	0	33	1	31	0	2	0	0	124	169	20,956	596	0	200	67	13,400	34,356
2002	395	12%	83%	5%	47	328	20	34	1	30	0	6	124	0	155	169	26,195	587	0	200	120	24,000	50,195
2003	446	12%	78%	10%	54	348	45	39	1	29	0	4	279	0	280	169	47,320	628	100	189	130	24,570	71,890
2004	464	12%	73%	15%	56	339	70	42	1	28	0	31	435	124	655	169	110,368	617	200	304	169	51,376	161,744
2005	597	11%	54%	35%	66	322	209	54	19	9	0	7	1,306	155	995	160	159,200	597	200	68	169	11,492	170,692
2006	660	11%	49%	40%	73	323	264	60	1	8	0	9	1,650	280	994	155	154,070	600	189	285	169	48,165	202,235
2007	707	11%	44%	45%	78	311	318	64	5	3	0	7	1,989	655	1,347	150	202,050	581	304	38	169	6,422	208,472
2008	749	11%	39%	50%	82	292	375	68	3	0	0	4	2,341	995	1,379	145	199,955	551	68	252	169	42,588	242,543
2009	793	11%	34%	55%	87	270	436	72	0	0	0	4	2,726	994	1,768	140	247,520	518	285	0	169	0	247,520
2010	839	10%	30%	60%	84	252	503	76	0	0	0	4	3,147	1,347	1,734	140	242,760	480	38	197	169	33,293	276,053
2011	862	10%	25%	65%	86	216	560	78	0	0	2	8	3,502	1,379	2,138	140	299,320	425	252	0	169	0	299,320
2012	885	10%	20%	70%	89	177	620	80	0	0	6	6	3,872	1,768	2,119	140	296,660	369	0	139	169	23,491	320,151
2013	908	10%	15%	75%	91	136	681	82	0	0	4	33	4,257	1,734	2,541	140	355,740	311	197	0	169	0	355,740
2014	932	10%	10%	80%	93	93	746	84	0	0	31	9	4,660	2,138	2,234	140	312,760	252	0	142	169	23,998	336,758
2015	955	9%	11%	80%	86	105	764	86	0	0	7	11	4,775	2,119	2,661	140	372,540	255	139	3	169	507	373,047
2016	979	9%	11%	80%	88	108	783	88	0	0	9	10	4,895	2,541	2,359	140	330,260	258	0	145	169	24,505	354,765
2017	1,004	9%	11%	80%	90	110	803	91	0	0	7	6	5,020	2,234	2,791	140	390,740	261	142	7	169	1,183	391,923
2018	1,030	9%	11%	80%	93	113	824	93	0	0	4	6	5,150	2,661	2,489	140	348,460	265	3	148	169	25,012	373,472
2019	1,056	9%	11%	80%	95	116	845	95	0	0	4	7	5,280	2,359	2,921	140	408,940	268	145	13	169	2,197	411,137
2020	1,082	8%	12%	80%	87	130	866	98	0	0	4	12	5,410	2,791	2,622	140	367,108	274	7	154	169	26,049	393,157
	5,743,419	Cumulative Waste Amount for 2001 - 2020 (ton)			573,673	1,615,474	3,554,272	102	0	0	8	186	5,543	2,489	34,306	Total 2001 -2020	4,892,922	280	148	2,484	169	382,248	5,275,169

Table 6.3.10 Base Calculation for Table 6.3.6 (Kien An Company)

	Waste Collection Quantity (Ton/Day)							Calculation of Number of Units and Costs of Waste Collection Vehicles, Bins and Handcarts Required															
	Total Amount (ton/day)	Ratio to Total Amount			Waste Collection Amount (t/d)			Waste Collection Vehicles (Number of Units)					Bins (Number of units and Costs)					Handcarts (Number of units and Costs)					
Year	URENCO's Waste Collection Amount (ton/day)	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Street Waste (ton/day)	Waste Collected by Existing System with Primary Collection (ton/day)	Waste Collected by Single Handling System (ton/day)	Vehicles required	Number of existing vehicles to be discarded	Remai-ning	Number of new vehicles to be discarded	**New Purchase**	Number of Bins Needed	Number of Bins to be discarded	**Number of new Purchase**	Average Unit Cost ($/unit)	Purchase Cost of Bins ($)	Number of handcarts Needed	Number of handcarts to be discarded	**Number of new Purchase**	Unit Cost ($/unit)	Purchase Cost of Handcarts ($)	Bins & Handcarts (Costs) ($)
a	b	c	d	e	f = b*c	g = b*d	h = b*e	i	j	k = i-j	l	**m**	n	o	**p**	q	r= p*q	s	t	**y**	v	w = u*v	x = r + w
2000	61	12%	88%	0%	8	54	0	5	0	5	0	**1**	0	0	**0**	169	0	96	0	**30**	67	2,010	2,010
2001	65	12%	88%	0%	8	57	0	6	0	5	0	**0**	0	0	**22**	169	3,718	102	0	**35**	67	2,345	6,063
2002	69	12%	83%	5%	8	57	3	6	0	5	0	**1**	22	0	**25**	169	4,225	103	0	**32**	120	3,840	8,065
2003	74	12%	78%	10%	9	58	7	7	0	5	0	**1**	47	0	**49**	169	8,281	105	30	**34**	130	4,420	12,701
2004	78	12%	73%	15%	9	57	12	8	0	5	0	**5**	74	22	**96**	169	16,176	104	35	**46**	169	7,774	23,950
2005	89	11%	54%	35%	10	48	31	8	5	0	0	**1**	195	25	**152**	160	24,320	89	32	**6**	169	1,014	25,334
2006	99	11%	49%	40%	11	49	40	9	0	0	0	**1**	248	49	**152**	155	23,560	90	34	**45**	169	7,605	31,165
2007	108	11%	44%	45%	12	48	49	10	0	0	0	**1**	304	96	**208**	150	31,200	89	46	**2**	169	338	31,538
2008	115	11%	39%	50%	13	45	58	11	0	0	0	**1**	360	152	**215**	145	31,175	85	6	**41**	169	6,929	38,104
2009	123	11%	34%	55%	14	42	68	12	0	0	0	**1**	423	152	**280**	140	39,200	81	45	**0**	169	0	39,200
2010	132	10%	30%	60%	13	40	79	12	0	0	1	**1**	495	208	**277**	140	38,780	76	2	**30**	169	5,070	43,850
2011	137	10%	25%	65%	14	34	89	13	0	0	0	**1**	557	215	**345**	140	48,300	68	41	**0**	169	0	48,300
2012	142	10%	20%	70%	14	28	99	13	0	0	1	**2**	622	280	**345**	140	48,300	60	0	**13**	169	2,197	50,497
2013	147	10%	15%	75%	15	22	110	14	0	0	1	**5**	690	277	**415**	140	58,100	51	30	**0**	169	0	58,100
2014	152	10%	10%	80%	15	15	122	14	0	0	5	**2**	760	345	**370**	140	51,800	42	0	**4**	169	676	52,476
2015	157	9%	11%	80%	14	17	126	15	0	0	1	**1**	785	345	**440**	140	61,600	42	13	**1**	169	169	61,769
2016	162	9%	11%	80%	15	18	130	15	0	0	1	**1**	810	415	**395**	140	55,300	43	0	**5**	169	845	56,145
2017	167	9%	11%	80%	15	18	134	15	0	0	1	**2**	835	370	**465**	140	65,100	44	4	**2**	169	338	65,438
2018	172	9%	11%	80%	15	19	138	16	0	0	1	**1**	860	440	**425**	140	59,500	45	1	**6**	169	1,014	60,514
2019	178	9%	11%	80%	16	20	142	16	0	0	1	**2**	890	395	**490**	140	68,600	46	5	**3**	169	507	69,107
2020	183	8%	12%	80%	15	22	146	17	0	0	1	**3**	915	465	**501**	140	70,098	47	2	**7**	169	1,187	71,285
	931,065	Cumulative Waste Amount for 2001 - 2020 (ton)			92,835	260,447	577,783	19	0	0	1	33	941	425	5,667	Total 2001 -2020	807,333	48	6	**312**	169	46,268	853,601

Table 6.3.11 Base Calculation for Table 6.3.7 (Do Son)

	Waste Collection Quantity (Ton/Day)							Calculation of Number of Units and Costs of Waste Collection Vehicles, Bins and Handcarts Required															
	Total Amount (ton/day)	Ratio to Total Amount			Waste Collection Amount (t/d)			Waste Collection Vehicles (Number of Units)					Bins (Number of units and Costs)					Handcarts (Number of units and Costs)					
Year	URENCO's Waste Collection Amount (ton/day)	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Street Waste (ton/day)	Waste Collected by Existing System with Primary Collection (ton/day)	Waste Collected by Single Handling System (ton/day)	Vehicles required	Number of existing vehicles to be discarded	Remai-ning	Number of new vehicles to be discarded	**New Purchase**	Number of Bins Needed	Number of Bins to be discarded	**Number of new Purchase**	Average Unit Cost ($/unit)	Purchase Cost of Bins ($)	Number of handcarts Needed	Number of handcarts to be discarded	**Number of new Purchase**	Unit Cost ($/unit)	Purchase Cost of Handcarts ($)	Bins & Handcarts (Costs) ($)
a	b	c	d	e	f = b*c	g = b*d	h = b*e	i	j	k = i-j	l	**m**	n	o	**p**	q	r= p*q	s	t	**y**	v	w = u*v	x = r + w
2000	44	12%	88%	0%	5	39	0	4	0	4	0	**0**	0	0	**0**	169	0	69	0	**15**	67	1,005	1,005
2001	55	12%	88%	0%	7	48	0	5	0	4	0	**1**	0	0	**19**	169	3,211	86	0	**30**	67	2,010	5,221
2002	60	12%	83%	5%	7	50	3	6	0	4	0	**0**	19	0	**21**	169	3,549	90	0	**30**	120	3,600	7,149
2003	64	12%	78%	10%	8	50	6	6	0	4	0	**0**	40	0	**45**	169	7,605	90	15	**33**	130	4,290	11,895
2004	70	12%	73%	15%	8	51	11	6	0	4	0	**6**	66	19	**105**	185	19,425	93	30	**29**	169	4,901	24,326
2005	75	11%	54%	35%	8	41	26	8	4	0	0	**1**	165	21	**100**	175	17,500	75	30	**16**	169	2,704	20,204
2006	82	11%	49%	40%	9	40	33	9	0	0	0	**1**	205	45	**151**	170	25,670	75	33	**28**	169	4,732	30,402
2007	89	11%	44%	45%	10	39	40	10	0	0	0	**1**	251	105	**153**	165	25,245	74	29	**14**	169	2,366	27,611
2008	97	11%	39%	50%	11	38	49	11	0	0	0	**1**	304	100	**212**	160	33,920	72	16	**26**	169	4,394	38,314
2009	106	11%	34%	55%	12	36	58	12	0	0	0	**1**	365	151	**220**	155	34,100	70	28	**10**	169	1,690	35,790
2010	115	10%	30%	60%	12	35	69	13	0	0	0	**1**	432	153	**284**	155	44,020	66	14	**22**	169	3,718	47,738
2011	124	10%	25%	65%	12	31	81	13	0	0	1	**1**	504	212	**294**	155	45,570	62	26	**3**	169	507	46,077
2012	132	10%	20%	70%	13	26	92	14	0	0	0	**1**	578	220	**349**	155	54,095	55	10	**14**	169	2,366	56,461
2013	137	10%	15%	75%	14	21	103	15	0	0	0	**6**	643	284	**361**	155	55,955	47	22	**0**	169	0	55,955
2014	142	10%	10%	80%	14	14	114	15	0	0	6	**2**	710	294	**374**	155	57,970	39	3	**10**	169	1,690	59,660
2015	147	9%	11%	80%	13	16	118	16	0	0	1	**2**	735	349	**391**	155	60,605	40	14	**1**	169	169	60,774
2016	153	9%	11%	80%	14	17	122	17	0	0	1	**1**	765	361	**399**	155	61,845	41	0	**11**	169	1,859	63,704
2017	158	9%	11%	80%	14	17	126	17	0	0	1	**2**	790	374	**421**	155	65,255	42	10	**2**	169	338	65,593
2018	164	9%	11%	80%	15	18	131	18	0	0	1	**1**	820	391	**429**	155	66,495	43	1	**12**	169	2,028	68,523
2019	170	9%	11%	80%	15	19	136	18	0	0	1	**2**	850	399	**451**	155	69,905	44	11	**3**	169	507	70,412
2020	176	8%	12%	80%	14	21	141	19	0	0	1	**3**	880	421	**460**	155	71,309	45	2	**13**	169	2,201	73,510
	845,968	Cumulative Waste Amount for 2001 - 2020 (ton)			83,944	229,239	532,785	21	0	0	1	34	911	429	5,239	Total 2001 -2020	823,249	46	12	**307**	169	46,070	869,319

Table 6.3.12 Base Calculation for Table 6.3.8 (3 Companies Aggregate)

	Waste Collection Quantity (Ton/Day)							Calculation of Number of Units and Costs of Waste Collection Vehicles, Bins and Handcarts Required															
	Total Amount (ton/day)	**Ratio to Total Amount**			**Waste Collection Amount (t/d)**			**Waste Collection Vehicles (Number of Units)**					**Bins (Number of units and Costs)**					**Handcarts (Number of units and Costs)**					
Year	URENCO's Waste Collection Amount (ton/day)	Street Waste	Waste Collected by Existing System with Primary Collection	Waste Collected by Single Handling System	Street Waste (ton/day)	Waste Collected by Existing System with Primary Collection (ton/day)	Waste Collected by Single Handling System (ton/day)	Vehicles required	Number of existing vehicles to be discarded	Remai-ning	Number of new vehicles to be discarded	**New Purchase**	Number of Bins Needed	Number of Bins to be discarded	**Number of new Purchase**	Average Unit Cost ($/unit)	Purchase Cost of Bins ($)	Number of handcarts Needed	Number of handcarts to be discarded	**Number of new Purchase**	Unit Cost ($/unit)	Purchase Cost of Handcarts ($)	Bins & Handcarts (Costs) ($)
a	b	c	d	e	f = b*c	g = b*d	h = b*e	i	j	k = i-j	l	**m**	n	o	**p**	q	r= p*q	s	t	**y**	v	w = u*v	x = r + w
2000	472	12%	88%	0%	58	414	0	41	0	41	0	**1**	0	0	**0**	169	0	739	0	**145**	67	9,715	9,715
2001	501	12%	88%	0%	62	439	0	44	1	40	0	**3**	0	0	**165**	169	27,885	784	0	**265**	67	17,755	45,640
2002	524	12%	83%	5%	63	435	26	46	1	39	0	**7**	165	0	**201**	169	33,969	780	0	**262**	120	31,440	65,409
2003	584	12%	78%	10%	70	456	58	52	1	38	0	**5**	366	0	**374**	169	63,206	823	145	**256**	130	33,280	96,486
2004	612	12%	73%	15%	73	447	92	56	1	37	0	**42**	575	165	**856**	171	145,969	814	265	**379**	169	64,051	210,020
2005	761	11%	54%	35%	84	411	266	70	28	9	0	**9**	1,666	201	**1,247**	161	201,020	761	262	**90**	169	15,210	216,230
2006	841	11%	49%	40%	93	412	336	78	1	8	0	**11**	2,103	374	**1,297**	157	203,300	765	256	**358**	169	60,502	263,802
2007	904	11%	44%	45%	99	398	407	84	5	3	0	**9**	2,544	856	**1,708**	151	258,495	744	379	**54**	169	9,126	267,621
2008	961	11%	39%	50%	106	375	481	90	3	0	0	**6**	3,005	1,247	**1,806**	147	265,050	708	90	**319**	169	53,911	318,961
2009	1022	11%	34%	55%	112	347	562	96	0	0	0	**6**	3,514	1,297	**2,268**	141	320,820	669	358	**10**	169	1,690	322,510
2010	1086	10%	30%	60%	109	326	652	101	0	0	1	**6**	4,074	1,708	**2,295**	142	325,560	622	54	**249**	169	42,081	367,641
2011	1123	10%	25%	65%	112	281	730	104	0	0	3	**10**	4,563	1,806	**2,777**	142	393,190	555	319	**3**	169	507	393,697
2012	1159	10%	20%	70%	116	232	811	107	0	0	7	**9**	5,072	2,268	**2,813**	142	399,055	484	10	**166**	169	28,054	427,109
2013	1192	10%	15%	75%	119	179	894	111	0	0	5	**44**	5,590	2,295	**3,317**	142	469,795	409	249	**0**	169	0	469,795
2014	1226	10%	10%	80%	123	123	981	113	0	0	42	**13**	6,130	2,777	**2,978**	142	422,530	333	3	**156**	169	26,364	448,894
2015	1259	9%	11%	80%	113	138	1,007	117	0	0	9	**14**	6,295	2,813	**3,492**	142	494,745	337	166	**5**	169	845	495,590
2016	1294	9%	11%	80%	116	142	1,035	120	0	0	11	**12**	6,470	3,317	**3,153**	142	447,405	342	0	**161**	169	27,209	474,614
2017	1,329	9%	11%	80%	120	146	1,063	123	0	0	9	**10**	6,645	2,978	**3,677**	142	521,095	347	156	**11**	169	1,859	522,954
2018	1,366	9%	11%	80%	123	150	1,093	127	0	0	6	**8**	6,830	3,492	**3,343**	142	474,455	353	5	**166**	169	28,054	502,509
2019	1,404	9%	11%	80%	126	154	1,123	129	0	0	6	**11**	7,020	3,153	**3,862**	142	547,445	358	161	**19**	169	3,211	550,656
2020	1,441	8%	12%	80%	115	173	1,153	134	0	0	6	**18**	7,205	3,677	**3,583**	142	508,516	366	11	**174**	169	29,436	537,952
	7,520,452	Cumulative Waste Amount for 2001 - 2020 (ton)			750,452	2,105,159	4,664,841	140	0	0	10	253	7,395	3,343	45,212	Total 2001 -2020	6,523,504	374	166	**3,103**	169	474,585	6,998,089

Table 6.3.13 Description of Future Landfill Site Locations Identified by UPI and Shown in the Haiphong City Master Plan 2020

District to be Served	Location (village, commune, district)	Distance from Each District Center	Current Land Use	Comments
1. Hong Bang, Le Chan, Ngo Quen	Trang Cat Commune, An Hai District	10 km from HPPC Office	Fish pond	
2. Kien An and An Lao Districts	Foot of Mount Mam Bong, 0.4 km to the north of the Road from kien An Center to An Lao Center Xuan Son, Truong Son Commune, An Lao District	7 km from Kien An District Center, 2 km from An Lao District Center	Death penalty execution site (on the foot of the mountain) and rice field	1) Near to both An Lao center and Kien An center. 2) This is execution place, therefore may need approval from the government. 3) 0.4 km of the final access road needs to be paved.
3. Do Son Town	Do Son (Adjacent to the existing landfill site)	5 km from Do Son Publics Company	Fish pond	1) Suitable.
4. Thuy Nguyen District	Outside the Dyke System, Gia Minh Commune, Thuy Nguyen District (Planned site is 4 ha. 6 benchmarks were placed already.)	12 km from Thuy Nui Doi (Nguyen District Center), and 15 km from Minh Duc	Agriculture field (rice and others) Productivity seems low	1) Three bridges including one floating bridge need to be widened and strengthened. 2) 3 km of road needs to be paved. 3) Too far from the District centers, and too much cost for road & bridge improvement.
5. An Hai District (Northwest of the District: New urban area bordered by the Highway No.5 and Kinh Mon - Cam River)	Inside the Dyke System, 1 km to the northwest of Dyke entrance point, Dong Van Village, Dai ban Commune, An Hai District	15 km from An Duong (An Hai District Center)	Rice field	1) 1 km of the Dyke road needs to be strengthened.

Remark:
According to a local resident living just inside the Van Uc River in Chien Thang commune, 3 years ago there was a flood, and water level outside the dyke (river flow side) reached as high as 40 cm below the top level of the dyke. The agricultural field outside the dyke was all flooded. This indicates that it is not good to construct a landfill site outside the dyke of Van Uc River.

Table 6.5.1 (1/3) Result of 100 Factory Survey (Solid Waste Survey Part Only)

		1		30	31	32	33	38	39
		A1		C1	C1	C1	C1	C4	C5
				House hold	Non-hazardous	Hazardous	Total	Collector	Fee
New No.	Original No.	Name of Factory	Category of activity	Ton/ year	Ton/ year	Ton/ year	Ton/ year		Dong/year
1	1	Song Cam Ship Building Corporation	Building ship	18	blk	blk	18	Urenco & the Factory itself	1,200,000
2	2	Haiphong Glass Company	producing glass products	6	30	25	38.5	Urenco	3,900,000
3	3	Duyen Hai Mechanism Corporation	Manufacturing machine	50	75	blk	125	Urenco & the Factory itself	3,700,000
4	4	Hai Phong Steel Factory	Producing steel	0.3	10	blk	10.3	Urenco	600,000
5	5	Son Huyen Iron Casting Mill	producing cast-iron	1	3	blk	4	The factory itself	
6	6	Hong Duc Packing and Printing Stock Company	Manufacturing packages	blk	45	blk	45	Urenco	6,000,000
7	9	Hai Phong Material producing and Service Company	Processing beer	0.2	20	blk	20.2	Urenco	3,600,000
8	10	Asphalt Concrete Factory	Producing asphalt concrete	3	6	blk	9	Urenco	500,000
9	11	No 42 Freezing works Factory	Processing frozen foods	10	675	blk	685	Urenco & the Factory itself	22,000,000
10	13	Iron Cast Mill	Processing cast-iron	1	16	blk	17	The factory itself	
11	14	Gian-V Join-venture Co. Ltd	manufacturing shoes	26	31	blk	57	Hung thinh Company	50,000,000
12	15	Thang 8 Factory	Producing plastic products	blk	12	blk	12	Urenco	1,200,000
13	16	Thanh Cong Shoes Company	producing shoes	10	120	blk	130	private	9,600,000
14	18	Hai Au Co. Ltd	processing beer	0.5	5	0	5.5	Urenco	12,000,000
15	19	Hai Phong Garment Company	producing garment products	blk	150	blk	150	Urenco & the Factory itself	15,000,000
16	20	Hai Phong Beer Company	processing beer	0.5	115	blk	115.5	Urenco & the Factory itself	12,000,000
17	21	7-5 Garment Company	processing gament	3.5	18	blk	21.5	Urenco	2,340,000
18	22	Xuan Thanh Iron Casting Mill	processsing pig-iron	1.44	3.5	blk	4.94	The factory itself	
19	23	Quang Hung Garment Factory	processing garment	6	30	blk	36	Urenco	600,000
20	24	Phu Vinh Plastic Co.Ltd	processing plastic products	1	0	0	1	Private	0
21	25	Tien Huy Plastic Co. Ltd	processing plastic products	1	3	blk	4	The factory itself	
22	26	Dinh Vang Co.Ltd	manufacturing shoes	50	65	blk	115	The factory itself	27,000,000
23	28	TW3 Pharmaceutical Factory	producing medecine	18	25	blk	43	Urenco	3,000,000
24	29	My Dong Iron Casting Mill	processing household products from cast - iron	1.3	blk	10	11.3	The factory itself	
25	30	Thong Nhat Shoes Factory	producing shoes	2	13	blk	15	Urenco	2,160,000
26	32	Hai Phong Copper-works Company	Producing products from copper	3	80	blk	83	Urenco	450,000
27	33	Hai Phong Cement Corporation	manufacturing cement	300	700	blk	1000	Urenco & the Factory itself	3,600,000
28	34	Ha Long Canned food Stock Company	Processing canned food	5	300	3	308	The Factory itself and others	
29	35	Nam Trieu Cooperative	Processing sea-products	blk	18	blk	18	Urenco	1,600,000
30	36	Seasafico Sea-product Factury	Processing frozen products	blk	30	blk	30	Urenco	3,000,000
31	37	Export Gament Manufaturing Factory	producing gament for export	18	24	blk	42	Urenco	5,500,000
32	38	Hai Phong Printing Factory	Printing	0.5	0.5	blk	1	Urenco	10,000,000
33	40	Ngoc Loan Co. Ltd	processing beer	1	10	blk	11	Urenco	600,000
34	42	Hai Phong No 2 Gament Company	processing gament	1.8	3	blk	4.8	Urenco & the Factory itself	5,400,000
35	43	Tan Long Casting Company	casting	10	240	blk	250	Urenco & the Factory itself	15,000,000
36	44	Vinausteel Company	manufacturing steel	30	3000	blk	3030	the Factory itself	
37	45	Hai Phong Trade Service Manufacture	assembling motorbike	0.5	1	blk	1.5	Urenco & the Factory itself	1,320,000
38	46	Thien Vinh Co. LTD	processing shoes	3	27	blk	30	Hung thinh Company	No pay
39	47	Minh Chau Trade Centre	processing sea-products	6	10	blk	16	Urenco&Private	600,000
40	48	Bach Dang Plastic Corporation	manufacturing plastic products	70	20	blk	90	Urenco&Private	3,600,000
41	49	Haiphong Electric Construction & Installation Company	producing and assembling products for construction and mechanic	1.2	no	no	1.2	Kien An Urban Works	600,000
42	50	Bach Dang Ship Building Company	Building ship	3	6	blk	9	Urenco	110,000,000
43	51	Hoa Phuong Gament Factory	processing garment	5	25	blk	30	Urenco	3,000,000
44	52	Haiphong Mechanism Factory	manufacturing ship, boats...	18	200	0	218	Factory	600,000
45	53	Hop Luc Shoes Company	producing shoes	4	10	blk	14	Urenco	600,000

Table 6.5.1 (2/3) Result of 100 Factory Survey (Solid Waste Survey Part Only)

		1		30	31	32	33	38	39
		A1		C1	C1	C1	C1	C4	C5
				House hold	Non-hazar dous	Hazard ous	Total	Collector	Fee
New No.	Original No.	Name of Factory	Category of activity	Ton/ year	Ton/ year	Ton/ year	Ton/ year		Dong/year
46	54	My Huong Coopera tive	processing paper	3	10	blk	13	Urenco	4,500,000
47	56	An Bien Mechanism Factory	mechanism	1	3.6	blk	4.6	Urenco & factory	1,800,000
48	57	Hai Phong Mechanism manufacturing Factory	manufacturing machine	blk	150	blk	150	Urenco	6,000,000
49	58	Hai phong Salt Company	producing salt	6	blk	blk	6	Urenco	600,000
50	59	Compartment Factory	manufacturing compartment for train	12	240	no	252	Urenco & Hung thinh	12,000,000
51	62	Duc Duong Paper Mill	processing paper	blk	12	blk	12	Urenco	3,600,000
52	63	HAITAICO Join veture Company	processing woods	blk	24	blk	24	Urenco	15,000,000
53	64	Ha Long Import-Export and Service Company	processing sea-products	18	36	blk	54	Urenco	7,020,000
54	65	Hai Phong Tobaco Company	manufacturing cigarettes	90	225	blk	315	Urenco	38,250,000
55	66	Enamel covering Company	processing varnist products]	200	93.6	blk	293.6	Urenco & Factory	12,480,000
56	67	Huu Nghi Freeze Factory	maintaining goods in frozen and proceesing frozen sea-products	6	54	blk	60	Urenco	8,400,000
57	68	Phuong Vien Rubber cooperation Factory	producing rubber products	1	0	0	1	Urenco	600,000
58	69	Iron Casting producing Mill	processing household products from pig-iron	0.9	0.35	blk	1.25	Local organization (Thuy Nguyen)	600,000
59	70	Chau Giang Co. Ltd	producing sport shoes	10	288	blk	298	privatecollector MsOanh	20,000,000
60	71	Son Huyen Casting Mill	casting from pig-iron	1	3	blk	4	Factory	
61	74	No 114 Lach Tray Sandal Mill	producing sandal	0.1	3.6	blk	3.7	Urenco & Others	1,000,000
62	76	Printing and packing Stock Company	producing paper-box	blk	35	blk	35	Urenco	10,200,000
63	77	Minh Thanh Export Gament Co. Ltd	processing cotton-toys	6	90	blk	96	Urenco & Factory	6,240,000
64	78	Hong Thai Plastic Factory	manufacturing palastic instrument	1	2	blk	3	The factory itself	
65	79	Hai Phong Wool Factory	producing wool clothes	24	100	blk	124	Urenco	2,400,000
66	82	Jurong - Song Da Construction Copany	processing steel	1.5	5	0	6.5	The factory itself	
67	87	Hai Phong Imp-Export Manufacturing and Trading Company	pocessing garment	0.2	0.8	blk	1	The factory itself	
68	88	Concrete and Construction Factory	producing concrete	1	2	blk	3	Urenco	300,000
69	89	1-5 Mechanism Factory	producing mechanic products	6	4	blk	10	Urenco	4,800,000
70	90	Hai Dang Pig-iron casting Factory	casting products from pig-iron	1095	0.1	blk	1095	Others	
71	92	Soft Chemical Company	producing chemical	12	blk	blk	12	Urenco	1,200,000
72	93	Sanmiguel Yamaha Glass Co.Ltd	processing glass pakages	5	265	blk	270	Urenco	35,100,000
73	94	Thanh Hung Co. Ltd	processign shoes	1.2	6	no	7.2	Hung thinh Company	
74	95	Thieu nien Tien phong Plastic Company	manufacturing plastic products	300	60	blk	360	Urenco & the factory itself	97,000,000
75	96	Daso Co. Ltd	producing detergent	2	3	blk	5	Urenco	1,440,000
76	98	Vinapac Pakage joinventure Company	producing pakages in all kinds	4.4	5.6	blk	10	Urenco & the factory itself	2,400,000
77	99	Toan Thang Mechanism Cooperative	processing household products from aluminium	5	10	blk	15	Urenco	1,200,000
78	100	Xuan Truong pig-iron Casting Mill	processing household products from pig-iron	1.5	350	blk	351.5	Factory	
79	102	Tia Sang Battery Company	Manufacturing battery	6	30	4	40	URENCO	8,000,000
80	103	Hai Phong weaving Company	weaving	6	13	0	19	URENCO	7,000,000
81	104	Hai Phong LG Factory	producing electric cable	2	6	0	8	URENCO	8,000,000
82	105	July 20th Machanism Factory	Manufacturing mechanis products	4	3	0	7	The factory itself	
83	106	Dong Duong Wood Factory	wood products	2	30	0	32	URENCO	1,500,000
84	107	Hai Phong PP Package Company	Producing PP Plastic Package	1.2	4	0	5.2	URENCO	3,900,000

Table 6.5.1 (3/3) Result of 100 Factory Survey (Solid Waste Survey Part Only)

		1		30	31	32	33	38	39
		A1		C1	C1	C1	C1	C4	C5
				House hold	Non-hazar dous	Hazard ous	Total	Collector	Fee
New No.	Original No.	Name of Factory	Category of activity	Ton/ year	Ton/ year	Ton/ year	Ton/ year		Dong/year
85	108	Export Garment Manufacturing Company	Manufacturing garment for export	3	6	0	9	URENCO	4,500,000
86	109	Toan Dat Package Company	Producing Pakages	3	6	0	9	URENCO	1,500,000
87	110	Hai Phong Pharmaceutical Company	Processing medicine	6	17	0	23	URENCO	3,000,000
88	111	Lan Huong Beer Company	processing beer	1	20	0	21	URENCO	6,000,000
89	112	Insulated Material Factory	Producing insulated products	4.5	24	0.5	29	URENCO	8,500,000
90	113	Hai Phong Paint Company	Processing paint	5	20	2	27	URENCO	25,000,000
91	114	Ha Long Sea Product Corp.	Processing Canned Foods and Frozen Foods	4	20	0	24	URENCO	12,000,000
92	115	Hoa Mai Mechanism Company	Building automobile	2	17	1	20	Kien An municipal Company	1,500,000
93	116	Package Factory	processing pakages	3	10	blk	13	the factory itself	
94	117	Phu Cuong Cooperative	Manufacturing Household plastic Products	3	6	blk	9	the factory itself	
95	118	Steel Factory	Processing steel	1	57	13	71	the factory itself	
96	119	Scale Manufacturing Factory	manufacturing scale	6	14	2	22	the factory itself	
97	120	HAPACO Paper Factory	Processing Paper	2	10	3	15	Urenco	3,500,000
98	121	Nam Hoa Co., Ltd	manufacturing sport shoes	4	10	0	14	Urenco	3,000,000
99	122	Kien An Garment Factory	manufacturing clothes	4	6	blk	10	Kien An municipal Company	300,000
100		Han Viet Instruction & heavy industry Co.,	manufacturing industry products	150	300	0	450	the factory itself	
		Total	**(ton/year)**	**2728.24**	**8885.65**	**63.5**	**11654.79**	Possible Collection: 1,294,976,667	**639,300,000**
		Total	**(ton/day)**	**7.475**	**24.344**	**0.174**	**31.931**	**Possible Collection:**	**1,294,976,667**
								Fee Collection Rate	**49%**

Table 6.5.2 List of 28 Factories Surveyed Concerning Hazardous Industrial Waste in November 2000

Factory No.	Name of Enterprise	Address		Phone for contact	Major Products
		District	Complete Address		
a	b	c	d	e	f
1	Enamel-ware Factory	Ngo Quyen	1 Ngo Quyen St.	826139	Aluminium Ironware Enamel Goods
2	Trang Kenh Calcium Carbide Factory	Thuy Nguyen	Minh Duc Town , Thuy Nguyen	875146	Calcium Carbide, Plastic seeds
3	Haiphong Chinfon Cement Plant	Thuy Nguyen	Minh Duc Town , Thuy Nguyen	875480	Cement, clinker
4	Bronze Casting Enterprise	Le Chan	25 Lam Son St.	858611	Bronze producing
5	Organic Fertilize Manu-factory	Hong Bang	152 Thuong Ly Train Station	824513	High quality Fertilize
6	Rubber & Plastic Company	An Hai	An Dong Commune	835389	Rubber belt, industrial rubber, washer, soap boxes
7	Haiphong Toaxe Factory	Ngo Quyen	39 Luong Khanh Thien St.	859646	Railroad car & Spare Parts
8	Thanh Son Iron Casting Enterprise	Thuy Nguyen	My Dong Commune	874562-874057	Dowel door, Fan cover, manhole cover, others
9	Dinh Vang Footwear Lt. Company	Kien Thuy	Hai Thanh Commune	860091	High quality Footwear
10	Workshop No.2 /Duyen Hai Mechanical Factory	Hong Bang	6 Tran Quang Khai St.	837390	Metal forging,refining products, sticks steel, flattening steel
11	Haiphong Paper's Company	Le Chan	441 A Ton Duc Thang St.	835369	Sanitary tissue, Votive paper for export
12	Pressure Equip. Const. Material Company	Hong Bang	Km No.5, Road No. 5	850153	Pressure equipment & construction materials, Cement Fibro sheet
13	Haiphong Paint Company	Ngo Quyen	12 Lach Tray St.	847003; 835710	Paint for train, Ship; Industry & Civil
14	Daso Chemical Substance stock Lt. Company	Ngo Quyen	110 Ngo Quyen St.	837453; 765190	Liquid Soap, Detergent, Washing Liquid
15	Hai Long Limited Company	Kien An	Alley 109, Truong Chinh St.	876449	Agar; Draught beer
16	Hang Kenh Footwear Company	Le Chan	276 Hang Kenh St.	847914; 846681	Sport Footwear for export
17	Le Lai I Footwear Company	Ngo Quyen	Alley 226 Le Lai St.	836107	Sport Footwear for export
18	Chau Giang Lt. Company	Ngo Quyen	Alley 226 Le Lai St.	551605; 826014	Sport Footwear for export
19	Vinh Phat Limited Company	An Hai	Vinh Niem Commune	780078	Sport Footwear for export
20	Haiphong Scale Factory	An Hai	Nam Son Commune	850039	Scales
21	Bach Dang Plastic Co.	Ngo Quyen	9 Hoang Dieu St.	823337	PVC pipe, Plastic sheet
22	HP Beer Company	Ngo Quyen	16 Lach Tray St.	640028	Beer Production
23	Ha Long canned food Stock Co.	Ngo Quyen	43 Le Lai	836480	Canning Product, Agar,Fish liver oil
24	Sanmigel Glasses Stock Co.	Ngo Quyen	17A Ngo Quyen St.	837213	Glasses, Containers
25	Hoa Mai MechanicalLt. Co.	Kien An	Trang Minh Commune	876217	Trucks,trailers
26	HP Electric Isolated & Installed Co.	Hong Bang	991A Ton Duc Thang St.	857285	Rubber, Gloves, Boots
27	Vinausteel Joint. Co.	Hong Bang	Vat cach, Quan Toan	749389	Twisted Steel
28	Tia Sang Battery Co.	An Hai	An Dong Commune	857080	Batteries

Table 6.5.3 List of Factories in Haiphong Generating Hazardous Industrial Waste Based on Survey Conducted by the JICA Study Team in November 2000

No.	Ori-gin-al No.	Name of Enterprise	Address		Phone for contact	Major Products	Generation of Hazardous Industrial Waste (ton/year)		
			District	Complete Address			Non Recy-cled	Recy-cled	Total (1+2)
		a	b	c	d	e	1	2	3
1	1	Enamel-ware Factory	Ngo Quyen	1 Ngo Quyen St.	826139	Aluminium Ironware Enamel Goods	4	2.5	6.5
2	5	Organic Fertilize Manu-factory	Hong Bang	152 Thuong Ly Train Station	824513	High quality Fertilize		1	1
3	6	Rubber & Plastic Company	An Hai	An Dong Commune	835389	Rubber belt, industrial rubber, washer, soap boxes	0.8		0.8
4	7	Haiphong Toaxe Factory	Ngo Quyen	39 Luong Khanh Thien St.	859646	Railroad car & Spare Parts	100	60	160
5	9	Dinh Vang Footwear Lt. Company	Kien Thuy	Hai Thanh Commune	860091	High quality Footwear	21		21
6	12	Pressure Equip. Const. Material Company	Hong Bang	Km No.5, Road No. 5	850153	Pressure equipment & construction materials, Cement Fibro sheet		200	200
7	13	Haiphong Paint Company	Ngo Quyen	12 Lach Tray St.	847003; 835710	Paint for train, Ship; Industry & Civil	51	6.24	57.24
8	14	Daso Chemical Substance stock Lt. Company	Ngo Quyen	110 Ngo Quyen St.	837453; 765190	Liquid Soap, Detergent, Washing Liquid		9	9
9	16	Hang Kenh Footwear Company	Le Chan	276 Hang Kenh St.	847914; 846681	Sport Footwear for export	132		132
10	17	Le Lai I Footwear Company	Ngo Quyen	Alley 226 Le Lai St.	836107	Sport Footwear for export		38	38
11	18	Chau Giang Lt. Company	Ngo Quyen	Alley 226 Le Lai St.	551605; 826014	Sport Footwear for export	36		36
12	19	Vinh Phat Limited Company	An Hai	Road, Vinh Niem Commune	780078	Sport Footwear for export	18		18
13	20	Haiphong Scale Factory	An Hai	Nam Son Commune	850039	Scales		0.3	0.3
14	24	Sanmigel Glasses Stock Co.	Ngo Quyen	17A Ngo Quyen St.	837213	Glasses, Containers		43.4	43.4
15	25	Hoa Mai MechanicalLt. Co.	Kien An	Trang Minh Commune	876217	Trucks,trailers		2	2
16	26	HP Electric Isolated & Installed Co.	Hong Bang	991A Ton Duc Thang St.	857285	Rubber, Gloves, Boots		3	3
17	28	Tia Sang Battery Co.	An Hai	An Dong Commune	857080	Batteries		50	50
	TOTAL						362.8	415.44	778.24
	TOTAL						0.99	1.14	2.13
	Perecentage (%)						47%	53%	100%

Table 6.5.4 Inventory of Hazardous Industrial Waste Generated in Haiphong Based on Survey Conducted by the JICA Study Team in November 2000

Unit: Ton/year

No.	Original Factory No.	Description of Waste Generated in Haiphong	Code & Types of Hazardous Waste based on Regulation 155/1999										Disposal Method				
		Code by Regulation 155/1999	A3050	A3020	A2050	A1020	A3080	A4070	A3130	A3050	A1120						
			Foot-wear waste (Leather, rubber, sponge), etc.	Waste oil or or oil contain-ing cloth	Asbesto contain-ing Cement fibro board	Coal cinder contain-ing PbO/PbO2	Steam solvent (evapo-rate)	Bad paint, liquid color powder & chemical contaiminated container	Phos-phate salt contami-nated-contai-ner or material	Plastic	Pond sludge	Total	Sold/ Reused	Incine-rated	Landfill by URE-NCO	Others	Total (a+b+c+d)
		Factory Name	1	2	3	4	5	6	7	8	9	10	a	b	c	d	e
1	1	Enamel-ware Factory		6.5								6.5	2.5		4		6.5
2	5	Organic Fertilizer Manu-factory									1	1	1				1
3	6	Rubber & Plastic Company	0.8									0.8		0.8			0.8
4	7	Haiphong Toaxe Factory		160								160	60	100			160
5	9	Company	21									21		21			21
6	12	Pressure Equip. Const. Material Company			200							200	200				200
7	13	Haiphong Paint Company					40	17.24				57.24	6.24	1		50	57.24
8	14	Daso Chemical Substance Stock Lt. Company							9			9	9				9
9	16	Hang Kenh Footwear Company	132									132		132		0	132
10	17	Le Lai Footwear Company	38									38	38				38
11	18	Chau Giang Lt. Company	36									36			36		36
12	19	Vinh Phat Lt. Company	18									18			18		18
13	20	Haiphong Scale Factory						0.3				0.3	0.3				0.3
14	24	Sanmigel Glasses Stock Co.		41						2.4		43.4	43.4				43.4
15	25	Hoa Mai Mechanical Co.						2				2	2				2
16	26	HP Electric Isolated & Installed Co.						3				3	3				3
17	28	Tia Sang Battery Co.				50						50	50				50
		TOTAL (ton/year)	245.8	207.5	200	50	40	22.54	9	2.4	1	778.24	415.44	254.8	58	50	778.24
		Total (ton/day)	0.673	0.568	0.548	0.137	0.110	0.062	0.025	0.007	0.003	2.132	1.138	0.698	0.159	0.137	2.132
			31.6%	26.7%	25.7%	6.4%	5.1%	2.9%	1.2%	0.3%	0.1%	100.0%	53%	33%	7%	6%	100%

Notes on "Other Disposal"

1. Of the "Others" of 50 ton/years, 40 t/y (steam solven) evaporates into air, and the remaining 10 t/y (bad paint) s stored in the factory.
2. Of the A3050 (245.8 ton/year), 245 ton/year is waste generated from sportshoes companies.

Table 6.5.5 Inventory of Non-Recycled Hazardous Industrial Waste Generated in Haiphong Based on Survey Conducted by the JICA Study Team in November 2000

Unit: Ton/year

No.	Original Factory No.	Description of Waste Generated in Haiphong	Code & Type of Hazardous Waste					Disposal Method			
		Code by Regulation 155/1999	A3050	A3020	A3080	A4070					
			Foot-wear (Leather, rubber, sponge), etc.	Waste oil or or oil contai-ning cloth	Steam solvent (evapo-rate)	Bad paint, liquid color powder	Total	Incine-rated	Landfill by URE-NCO	Others	Total (a+b+c)
		Factory Name	1	2	3	4	5	a	b	c	d
1	1	Enamel-ware Factory		4			4		4		4
2	6	Rubber & Plastic Company	0.8				0.8	0.8			0.8
3	7	Haiphong Toaxe Factory		100			100	100			100
4	9	Dinh Vang Footwear Lt. Company	21				21	21			21
5	13	Haiphong Paint Company			40	11	51	1		50	51
6	16	Hang Kenh Footwear Company	132				132	132		0	132
7	18	Chau Giang Lt. Company	36				36		36		36
8	19	Vinh Phat Lt. Company	18				18		18		18
		TOTAL (ton/year)	207.8	104	40	11	362.8	254.8	58	50	362.8
		TOTAL (ton/day)	0.569	0.285	0.110	0.030	0.994	0.698	0.159	0.137	0.994
			57.3%	28.7%	11.0%	3.0%	100.0%	70%	16%	14%	100%

Note:

In Haiphong Paint Company, 40 ton/year of steam solvent evaporates into air, 10 ton/year of bad paint and liquid color powder is stored inside the factory.

Table 6.5.6 Projection of Industrial Waste Generation and Disposal Quantity by Disposal Method (Excluding Those Recycled)

Unit: ton/day

Year	Generation			Disposal Amount by Disposal Methods									
				Hazardous Waste (1)			Non Hazardous Waste (2)			Total (3) = (1)+(2)			
a	Hazardous Waste	Non Hazardous Waste	Total	Disposal by Landfill	Incine-ration	Self Disposal	Disposal by Landfill	Incine-ration	Self Disposal	Disposal by Landfill	Incine-ration	Self Disposal	GRP Growth Rate
a	b	c	c = a+b	d	e	f	g	h	i	j = d+g	k = e+h	l = f+ i	i
2000	0.99	69.36	70.35	0.16	0.70	0.13	45.14	8.71	15.51	45.30	9.41	15.64	4.20%
2001	1.03	71.86	72.89	0.17	0.73	0.14	47.04	9.08	15.75	47.20	9.81	15.88	3.60%
2002	1.07	74.44	75.51	0.17	0.76	0.14	48.73	9.40	16.31	48.90	10.16	16.45	3.60%
2003	1.11	77.12	78.23	0.18	0.78	0.15	50.48	9.74	16.90	50.66	10.52	17.04	3.60%
2004	1.15	79.90	81.05	0.19	0.81	0.15	52.30	10.09	17.51	52.49	10.90	17.66	3.60%
2005	1.19	85.09	86.28	0.19	0.84	0.16	54.18	10.46	20.46	54.38	11.30	20.61	6.50%
2006	1.27	92.28	93.55	0.20	0.89	0.17	57.71	11.13	23.44	57.91	12.03	23.61	8.45%
2007	1.37	100.68	102.05	0.22	0.97	0.18	62.58	12.08	26.02	62.80	13.05	26.21	9.10%
2008	1.50	109.84	111.34	0.24	1.06	0.20	68.28	13.17	28.39	68.52	14.23	28.59	9.10%
2009	1.63	119.84	121.47	0.26	1.16	0.21	74.49	14.37	30.98	74.75	15.53	31.19	9.10%
2010	1.78	130.75	132.53	0.29	1.26	0.23	81.27	15.68	33.80	81.56	16.94	34.03	9.10%
2011	1.94	137.28	139.23	0.31	1.37	0.26	88.66	17.11	31.51	88.98	18.48	31.77	5.00%
2012	2.04	144.15	146.19	0.33	1.44	0.27	93.10	17.96	33.09	93.43	19.41	33.35	5.00%
2013	2.14	151.35	153.50	0.35	1.52	0.28	97.75	18.86	34.74	98.10	20.38	35.02	5.00%
2014	2.25	158.92	161.17	0.36	1.59	0.30	102.64	19.80	36.48	103.00	21.40	36.77	5.00%
2015	2.36	166.87	169.23	0.38	1.67	0.31	107.77	20.80	38.30	108.15	22.47	38.61	5.00%
2016	2.48	175.21	177.69	0.40	1.75	0.33	113.16	21.83	40.22	113.56	23.59	40.54	5.00%
2017	2.61	183.97	186.58	0.42	1.84	0.34	118.82	22.93	42.23	119.24	24.77	42.57	5.00%
2018	2.74	193.17	195.91	0.44	1.93	0.36	124.76	24.07	44.34	125.20	26.01	44.70	5.00%
2019	2.87	202.83	205.70	0.46	2.03	0.38	131.00	25.28	46.56	131.46	27.31	46.93	5.00%
2020	3.02	212.97	215.99	0.49	2.13	0.40	137.55	26.54	48.88	138.03	28.67	49.28	5.00%

Note: It is assumed that the industrial waste generation growth rates are same as GRP growth rates.

Table 6.8.1 Annual Investment and Operation Costs for Solid Waste Management (1) URENCO

Unit: $1,000

Cost Items	2000	2001	2002	2003	2004	2005	Sub-total 2001-2005	2006	2007	2008	2009	2010	Sub-total 2006-2010	Sub-total 2001 - 2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Sub-total 2011-2020	Total 2001-2020
A. INVESTMENT																										
1. Waste collection & transport																										
1.1 Equipment (Vehicle, Container, Workshop equipment)	0	114	320	252	2,886	517	4,089	648	555	441	521	474	2,639	6,728	695	617	1,989	857	918	850	689	670	833	987	9,105	15,833
1.2 Engineering service (5% of Item 1.1)	0	0	0	144	0	0	144	0	0	0	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	144
1.3 Total (1.1+1.2)	0	114	320	396	2,886	517	4,233	648	555	441	521	474	2,639	6,872	695	617	1,989	857	918	850	689	670	833	987	9,105	15,977
2. Landfill							0																			
2.1 Site construction (mainly civil works	0	0	0	0	3,299	3,299	6,598	0	280	0	250	0	530	7,128	230	0	220	5,500	0	0	300	0	260	0	6,510	13,638
2.2 Heavy equipment	0	0	0	0	1,412	0	1,412	0	0	0	0	0	0	1,412	0	0	0	350	0	0	0	0	0	0	350	1,762
2.3 Land acquisition	0	0	0	602	0	0	602	0	0	0	0	0	0	602	0	0	486	0	0	0	0	0	0	0	486	1,088
2.4 Total (2.1+2. + 2.3)	0	0	0	602	4,711	3,299	8,612	0	280	0	250	0	530	9,142	230	0	706	5,850	0	0	300	0	260	0	7,346	16,488
2.5 Closure of the former and existing sites	0	0	170	80	0	120	370	80	0	0	0	0	80	450	0	0	0	0	0	0	0	0	0	0	0	450
2.6 Engineering service (10% of 2.1 & 2.5 plus 5% of 2.2)	0	17	8	401	342	8	775	28	0	25	0	23	76	851	0	22	568	0	0	30	0	26	0	0	646	1,497
2.7 Total (2.4+2.5 + 2.6)	0	17	178	1,083	5,053	3,427	9,758	108	280	25	250	23	686	10,444	230	22	1,274	5,850	0	30	300	26	260	0	7,992	18,435
3. Hospital waste treatment							0																			
3.1 Incineration plant (equipment & facility)	0	0	0	0	263	0	263	0	0	0	0	0	0	263	0	0	263	0	0	0	0	0	0	0	263	526
3.2 Incineration plant (site preparation & building)	0	0	0	0	87	0	87	0	0	0	0	0	0	87	0	0	0	0	0	0	0	0	0	0	0	87
3.3 Collection vehicle &	0	0	0	0	76	0	76	0	0	0	76	0	76	152	0	0	76	0	0	0	0	0	0	0	76	228
3.4 Storage rooms in each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5 Engineering Service (10% of the above)	0	0	0	43	0	0	43	0	0	8	0	0	8	50	0	34	0	0	0	0	0	0	0	0	34	84
3.6 Pilot project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.7 Total (3.1+3.2+3.3 + 3.4+3.5+3.6)	0	0	0	43	426	0	469	0	0	8	76	0	84	553	0	34	339	0	0	0	0	0	0	0	373	926
4 Total							0																			
4.1 Sub total of Construction (2.1+2.5+3.2+3.4)	0	0	170	80	3,386	3,419	7,055	80	280	0	250	0	610	7,665	230	0	220	5,500	0	0	300	0	260	0	6,510	14,175
4.2 Sub total of equipment (1.1+2.2+3.1+3.3)	0	114	320	252	4,637	517	5,840	648	555	441	597	474	2,715	8,555	695	617	2,328	1,207	918	850	689	670	833	987	9,794	18,349
4.3 Sub total of land acquisition	0	0	0	602	0	0	602	0	0	0	0	0	0	602	0	0	486	0	0	0	0	0	0	0	486	1,088
4.4 Sub total of Engineering Services (1.2+2.6+3.5+3.6)	0	17	8	587	342	8	962	28	0	33	0	23	84	1,046	0	56	568	0	0	30	0	26	0	0	679	1,725
4.5 Sub total (4.1+4.2+4.3+4.4)	0	131	498	1,521	8,365	3,944	14,460	756	835	474	847	497	3,409	17,869	925	673	3,602	6,707	918	880	989	696	1,093	987	17,469	35,338
4.6 Administration Cost (3% of 4.5)	0	4	15	46	251	118	434	23	25	14	25	15	102	536	28	20	108	201	28	26	30	21	33	30	524	1,060
4.7 Sub total including administration cost (4.5+4.6)	0	135	513	1,567	8,616	4,063	14,893	779	860	488	873	512	3,511	18,405	953	693	3,710	6,908	946	906	1,019	717	1,126	1,017	17,993	36,398
4.8 Contingency (10% of Item	0	13	51	157	862	406	1,489	78	86	49	87	51	351	1,840	95	69	371	691	95	91	102	72	113	102	1,799	3,640
4.9 Total (4.7+4.8)	**0**	**148**	**564**	**1,724**	**9,477**	**4,469**	**16,383**	**857**	**946**	**537**	**960**	**563**	**3,862**	**20,245**	**1,048**	**762**	**4,080**	**7,599**	**1,040**	**997**	**1,121**	**789**	**1,238**	**1,118**	**19,793**	**40,038**
B. OPERATION	0						0																			
1. Collection & transport	0	883	930	1,069	1,132	1,368	5,381	1,535	1,668	1,791	1,920	2,034	8,949	14,330	2,113	2,191	2,269	2,349	2,472	2,635	2,811	2,999	3,197	3,364	26,399	40,729
2. Landfill	0	40	60	80	100	356	636	394	422	448	472	500	2,236	2,872	513	528	541	554	568	584	597	613	628	645	5,772	8,644
3. Hospital waste treatment	**0**	0	0	0	0	47	47	47	47	47	47	47	235	282	47	47	47	47	47	47	47	47	47	47	470	752
4. Total (1+2+3)	**0**	**923**	**990**	**1,149**	**1,232**	**1,771**	**6,064**	**1,976**	**2,137**	**2,286**	**2,439**	**2,581**	**11,420**	**17,484**	**2,673**	**2,766**	**2,857**	**2,950**	**3,087**	**3,266**	**3,455**	**3,659**	**3,872**	**4,056**	**32,640**	**50,124**
C. Grand Total (A + B)	0	**1,071**	**1,554**	**2,873**	**10,709**	**6,240**	**22,447**	**2,833**	**3,083**	**2,823**	**3,400**	**3,144**	**15,282**	37,729	**3,721**	**3,529**	**6,938**	**10,549**	**4,127**	**4,263**	**4,575**	**4,447**	**5,111**	**5,174**	**52,433**	**90,162**

Table 6.8.2 Annual Investment and Operation Costs for Solid Waste Management (2) Kien An Company

Unit: $1,000

Cost Items	2000	2001	2002	2003	2004	2005	Sub-total 2001-2005	2006	2007	2008	2009	2010	Sub-total 2006-2010	Sub-total 2001 - 2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Sub-total 2011-2020	Total 2001-2020
A. INVESTMENT																										
1. Waste collection & transport																										
1.1 Equipment (Vehicle, Container, Workshop equipment)	0	6	53	58	522	25	664	76	77	83	102	89	427	1,091	93	140	328	115	107	101	156	105	177	206	1,528	2,619
1.2 Engineering service (5% of Item 1.1)	0	0	0	26	0	0	26	0	0	0	0	0	0	26	0	0	0	0	0	0	0	0	0	0	0	26
1.3 Total (1.1+1.2)	0	6	53	84	522	25	690	76	77	83	102	89	427	1,117	93	140	328	115	107	101	156	105	177	206	1,528	2,645
2. Landfill							0																			
2.1 Site construction (mainly civil works	0	0	0	0	600	0	600	0	0	0	200	0	200	800	0	0	0	0	0	1,000	0	0	0	0	1,000	1,800
2.2 Heavy equipment	0	0	0	0	150	0	150	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	200	0	200	350
2.3 Land acquisition	0	0	0	200	0	0	200	0	0	0	0	0	0	200	0	0	0	0	200	0	0	0	0	0	200	400
2.4 Total (2.1+2. + 2.3)	0	0	0	200	750	0	950	0	0	0	200	0	200	1,150	0	0	0	0	200	1,000	0	0	200	0	1,400	2,550
2.5 Closure of the former and existing sites	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	100	100
2.6 Engineering service (10% of 2.1 & 2.5 plus 5% of 2.2)	0	0	0	68	0	0	68	0	0	20	0	0	20	88	10	0	0	0	100	0	0	10	0	0	120	208
2.7 Total (2.4+2.5 + 2.6)	0	0	0	268	750	0	1,018	0	0	20	200	0	220	1,238	10	100	0	0	300	1,000	0	10	200	0	1,620	2,858
3. Hospital waste treatment							0																			
3.1 Incineration plant (equipment & facility)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.2 Incineration plant (site preparation & building)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.3 Collection vehicle &	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.4 Storage rooms in each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5 Engineering Service (10% of the above)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.6 Pilot project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.7 Total (3.1+3.2+3.3 + 3.4+3.5+3.6)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Total							0																			
4.1 Sub total of Construction (2.1+2.5+3.2+3.4)	0	0	0	0	600	0	600	0	0	0	200	0	200	800	0	100	0	0	0	1,000	0	0	0	0	1,100	1,900
4.2 Sub total of equipment (1.1+2.2+3.1+3.3)	0	6	53	58	672	25	814	76	77	83	102	89	427	1,241	93	140	328	115	107	101	156	105	377	206	1,728	2,969
4.3 Sub total of land acquisition	0	0	0	200	0	0	200	0	0	0	0	0	0	200	0	0	0	0	200	0	0	0	0	0	200	400
4.4 Sub total of Engineering Services (1.2+2.6+3.5+3.6)	0	0	0	94	0	0	94	0	0	20	0	0	20	114	10	0	0	0	100	0	0	10	0	0	120	234
4.5 Sub total (4.1+4.2+4.3+4.4)	0	6	53	352	1,272	25	1,708	76	77	103	302	89	647	2,355	103	240	328	115	407	1,101	156	115	377	206	3,148	5,503
4.6 Administration Cost (3% of 4.5)	0	0	2	11	38	1	51	2	2	3	9	3	19	71	3	7	10	3	12	33	5	3	11	6	94	165
4.7 Sub total including administration cost (4.5+4.6)	0	6	55	362	1,310	26	1,759	78	79	106	311	92	666	2,425	106	247	338	118	419	1,134	161	118	388	212	3,242	5,668
4.8 Contingency (10% of 4.7)	0	1	5	36	131	3	176	8	8	11	31	9	67	243	11	25	34	12	42	113	16	12	39	21	324	567
4.9 Total (4.7+4.8)	**0**	**7**	**60**	**398**	**1,441**	**28**	**1,935**	**86**	**87**	**117**	**342**	**101**	**733**	**2,668**	**117**	**272**	**372**	**130**	**461**	**1,247**	**177**	**130**	**427**	**233**	**3,567**	**6,234**
B. OPERATION							0																			
1. Collection & transport	0	151	162	177	190	204	885	230	255	275	298	320	1,378	2,262	336	352	367	383	406	436	467	501	539	569	4,356	6,619
2. Landfill	0	0	0	0	0	30	30	30	30	35	35	35	165	195	40	45	45	50	55	60	65	70	75	80	585	780
3. Hospital waste treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Total (1+2+3)	0	151	162	177	190	234	915	260	285	310	333	355	1,543	2,457	376	397	412	433	461	496	532	571	614	649	4,941	7,399
C. Grand Total (A + B)	**0**	**157**	**222**	**576**	**1,631**	**262**	**2,849**	**346**	**372**	**427**	**675**	**456**	**2,276**	5,125	**492**	**669**	**784**	**563**	**922**	**1,743**	**709**	**701**	**1,041**	**882**	**8,508**	**13,633**

Table 6.8.3 Annual Investment and Operation Costs for Solid Waste Management (3) Do Son Company

Unit: $1,000

Cost Items	2000	2001	2002	2003	2004	2005	Sub-total 2001-2005	2006	2007	2008	2009	2010	Sub-total 2006-2010	Sub-total 2001 - 2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Sub-total 2011-2020	Total 2001-2020
A. INVESTMENT																										
1. Waste collection & transport																										
1.1 Equipment (Vehicle, Container, Workshop equipment)	0	45	7	12	499	63	626	73	70	81	93	90	407	1,033	89	99	311	160	146	106	151	111	170	201	1,544	2,577
1.2 Engineering service (5% of Item 1.1)	0	0	0	25	0	0	25	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	25
1.3 Total (1.1+1.2)	0	45	7	37	499	63	651	73	70	81	93	90	407	1,058	89	99	311	160	146	106	151	111	170	201	1,544	2,602
2. Landfill							0																			
2.1 Site construction (mainly civil works	0	0	0	0	700	0	700	0	0	0	0	200	200	900	0	0	0	0	0	0	0	0	700	0	700	1,600
2.2 Heavy equipment	0	0	0	0	150	0	150	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	200	0	200	350
2.3 Land acquisition	0	0	0	400	0	0	400	0	0	0	0	0	0	400	0	0	0	0	0	0	0	400	0	0	400	800
2.4 Total (2.1+2. + 2.3)	0	0	0	400	850	0	1,250	0	0	0	0	200	200	1,450	0	0	0	0	0	0	0	400	900	0	1,300	2,750
2.5 Closure of the former and existing sites	0	0	0	0	80	0	80	0	0	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	80
2.6 Engineering service (10% of 2.1 & 2.5 plus 5% of 2.2)	0	0	0	86	0	0	86	0	0	0	20	0	20	106	0	0	0	0	0	0	0	80	0	0	80	186
2.7 Total (2.4+2.5 + 2.6)	0	0	0	486	930	0	1,416	0	0	0	20	200	220	1,636	0	0	0	0	0	0	0	480	900	0	1,380	3,016
3. Hospital waste treatment							0																			
3.1 Incineration plant (equipment & facility)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.2 Incineration plant (site preparation & building)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.3 Collection vehicle &	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.4 Storage rooms in each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5 Engineering Service (10% of the above)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.6 Pilot project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.7 Total (3.1+3.2+3.3 + 3.4+3.5+3.6)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Total							0																			
4.1 Sub total of Construction (2.1+2.5+3.2+3.4)	0	0	0	0	780	0	780	0	0	0	0	200	200	980	0	0	0	0	0	0	0	0	700	0	700	1,680
4.2 Sub total of equipment (1.1+2.2+3.1+3.3)	0	45	7	12	649	63	776	73	70	81	93	90	407	1,183	89	99	311	160	146	106	151	111	370	201	1,744	2,927
4.3 Sub total of land acquisition	0	0	0	400	0	0	400	0	0	0	0	0	0	400	0	0	0	0	0	0	0	400	0	0	400	800
4.4 Sub total of Engineering Services (1.2+2.6+3.5+3.6)	0	0	0	110	0	0	111	0	0	0	20	0	20	131	0	0	0	0	0	0	0	80	0	0	80	211
4.5 Sub total (4.1+4.2+4.3+4.4)	0	45	7	522	1,429	63	2,067	73	70	81	113	290	627	2,694	89	99	311	160	146	106	151	591	1,070	201	2,924	5,618
4.6 Administration Cost (3% of 4.5)	0	1	0	16	43	2	62	2	2	2	3	9	19	81	3	3	9	5	4	3	5	18	32	6	88	169
4.7 Sub total including administration cost (4.5+4.6)	0	46	8	538	1,472	65	2,129	75	72	83	116	299	646	2,775	92	102	320	165	150	109	156	609	1,102	207	3,012	5,786
4.8 Contingency (10% of 4.7)	0	5	1	54	147	6	213	8	7	8	12	30	65	277	9	10	32	16	15	11	16	61	110	21	301	579
4.9 Total (4.7+4.8)	**0**	**51**	**8**	**592**	**1,619**	**71**	**2,342**	**83**	**79**	**92**	**128**	**329**	**710**	**3,052**	**101**	**112**	**352**	**181**	**165**	**120**	**171**	**670**	**1,212**	**228**	**3,313**	**6,365**
B. OPERATION							0																			
1. Collection & transport	0	127	141	153	171	172	765	191	210	232	257	279	1,168	1,933	304	327	342	358	380	412	442	477	515	547	4,105	6,038
2. Landfill	0	5	10	45	45	50	155	50	50	55	55	55	265	420	60	60	60	65	65	60	72	72	75	80	669	1,089
3. Hospital waste treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4. Total (1+2+3)	**0**	**132**	**151**	**198**	**216**	**222**	**920**	**241**	**260**	**287**	**312**	**334**	**1,433**	**2,353**	**364**	**387**	**402**	**423**	**445**	**472**	**514**	**549**	**590**	**627**	**4,774**	**7,127**
C. Grand Total (A + B)	**0**	**183**	**160**	**790**	**1,835**	**293**	**3,261**	**323**	**339**	**379**	**440**	**662**	**2,144**	**5,405**	**465**	**499**	**755**	**604**	**611**	**592**	**685**	**1,219**	**1,802**	**855**	**8,087**	**13,492**

Table 6.8.4 Annual Investment and Operation Costs for Solid Waste Management (4) Total of the 3 Companies

Unit: $1,000

Cost Items	2000	2001	2002	2003	2004	2005	Sub-total 2001-2005	2006	2007	2008	2009	2010	Sub-total 2006-2010	Sub-total 2001 - 2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Sub-total 2011-2020	Total 2001-2020
A. INVESTMENT																										
1. Waste collection & transport																										
1.1 Equipment (Vehicle, Container, Workshop equipment)	0	165	380	322	3,907	605	5,379	797	702	605	716	653	3,473	8,852	877	856	2,628	1,132	1,171	1,057	996	886	1,180	1,394	12,177	21,029
1.2 Engineering service (5% of Item 1.1)	0	0	0	195	0	0	196	0	0	0	0	0	0	196	0	0	0	0	0	0	0	0	0	0	0	196
1.3 Total (1.1+1.2)	0	165	380	517	3,907	605	5,575	797	702	605	716	653	3,473	9,048	877	856	2,628	1,132	1,171	1,057	996	886	1,180	1,394	12,177	21,225
2. Landfill																										
2.1 Site construction (mainly civil works	0	0	0	0	4,599	3,299	7,898	0	280	0	450	200	930	8,828	230	0	220	5,500	0	1,000	300	0	960	0	8,210	17,038
2.2 Heavy equipment	0	0	0	0	1,712	0	1,712	0	0	0	0	0	0	1,712	0	0	0	350	0	0	0	0	400	0	750	2,462
2.3 Land acquisition	0	0	0	1,202	0	0	1,202	0	0	0	0	0	0	1,202	0	0	486	0	200	0	0	400	0	0	1,086	2,288
2.4 Total (2.1+2. + 2.3)	0	0	0	1,202	6,311	3,299	10,812	0	280	0	450	200	930	11,742	230	0	706	5,850	200	1,000	300	400	1,360	0	10,046	21,788
2.5 Closure of the former and existing sites	0	0	170	80	80	120	450	80	0	0	0	0	80	530	0	100	0	0	0	0	0	0	0	0	100	630
2.6 Engineering service (10% of 2.1 & 2.5 plus 5% of 2.2)	0	17	8	554	342	8	928	28	0	45	20	23	116	1,044	10	22	568	0	100	30	0	116	0	0	846	1,890
2.7 Total (2.4+2.5 + 2.6)	0	17	178	1,836	6,733	3,427	12,191	108	280	45	470	223	1,126	13,317	240	122	1,274	5,850	300	1,030	300	516	1,360	0	10,992	24,308
3. Hospital waste treatment																										
3.1 Incineration plant (equipment & facility)	0	0	0	0	263	0	263	0	0	0	0	0	0	263	0	0	263	0	0	0	0	0	0	0	263	526
3.2 Incineration plant (site preparation & building)	0	0	0	0	87	0	87	0	0	0	0	0	0	87	0	0	0	0	0	0	0	0	0	0	0	87
3.3 Collection vehicle &	0	0	0	0	76	0	76	0	0	0	76	0	76	152	0	0	76	0	0	0	0	0	0	0	76	228
3.4 Storage rooms in each	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.5 Engineering Service (10% of the above)	0	0	0	43	0	0	43	0	0	8	0	0	8	50	0	34	0	0	0	0	0	0	0	0	34	84
3.6 Pilot project	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.7 Total (3.1+3.2+3.3 + 3.4+3.5+3.6)	0	0	0	43	426	0	469	0	0	8	76	0	84	553	0	34	339	0	0	0	0	0	0	0	373	926
4 Total																										
4.1 Sub total of Construction (2.1+2.5+3.2+3.4)	0	0	170	80	4,766	3,419	8,435	80	280	0	450	200	1,010	9,445	230	100	220	5,500	0	1,000	300	0	960	0	8,310	17,755
4.2 Sub total of equipment (1.1+2.2+3.1+3.3)	0	165	380	322	5,958	605	7,430	797	702	605	792	653	3,549	10,979	877	856	2,967	1,482	1,171	1,057	996	886	1,580	1,394	13,266	24,245
4.3 Sub total of land acquisition	0	0	0	1,202	0	0	1,202	0	0	0	0	0	0	1,202	0	0	486	0	200	0	0	400	0	0	1,086	2,288
4.4 Sub total of Engineering Services (1.2+2.6+3.5+3.6)	0	17	8	791	342	8	1,167	28	0	53	20	23	124	1,290	10	56	568	0	100	30	0	116	0	0	879	2,170
4.5 Sub total (4.1+4.2+4.3+4.4)	0	182	558	2,395	11,066	4,032	18,234	905	982	658	1,262	876	4,683	22,917	1,117	1,012	4,241	6,982	1,471	2,087	1,296	1,402	2,540	1,394	23,541	46,458
4.6 Administration Cost (3% of 4.5)	0	5	17	72	332	121	547	27	29	20	38	26	140	688	34	30	127	209	44	63	39	42	76	42	706	1,394
4.7 Sub total including administration cost (4.5+4.6)	0	187	575	2,467	11,398	4,153	18,781	932	1,011	677	1,300	902	4,823	23,605	1,151	1,042	4,368	7,191	1,515	2,150	1,335	1,444	2,616	1,436	24,248	47,852
4.8 Contingency (10% of Item	0	19	58	247	1,140	415	1,878	93	101	68	130	90	482	2,360	115	104	437	719	152	215	133	144	262	144	2,425	4,785
4.9 Total (4.7+4.8)	**0**	**206**	**633**	**2,714**	**12,538**	**4,569**	**20,659**	**1,025**	**1,113**	**745**	**1,430**	**993**	**5,306**	**25,965**	**1,266**	**1,146**	**4,804**	**7,911**	**1,667**	**2,365**	**1,468**	**1,588**	**2,878**	**1,579**	**26,672**	**52,637**
B. OPERATION																										
1. Collection & transport	0	1,161	1,233	1,399	1,493	1,744	7,030	1,956	2,133	2,298	2,475	2,633	11,495	18,525	2,752	2,870	2,979	3,090	3,258	3,483	3,720	3,977	4,251	4,480	34,861	53,386
2. Landfill	0	45	70	125	145	436	821	474	502	538	562	590	2,666	3,487	613	633	646	669	688	704	734	755	778	805	7,026	10,513
3. Hospital waste treatment	0	0	0	0	0	47	47	47	47	47	47	47	235	282	47	47	47	47	47	47	47	47	47	47	470	752
4. Total (1+2+3)	**0**	**1,206**	**1,303**	**1,524**	**1,638**	**2,227**	**7,898**	**2,477**	**2,682**	**2,883**	**3,084**	**3,270**	**14,396**	**22,294**	**3,412**	**3,550**	**3,672**	**3,806**	**3,993**	**4,234**	**4,501**	**4,779**	**5,076**	**5,332**	**42,356**	**64,650**
C. Grand Total (A + B)	**0**	**1,412**	**1,936**	**4,238**	**14,175**	**6,796**	**28,557**	**3,503**	**3,794**	**3,628**	**4,514**	**4,262**	**19,701**	48,259	**4,678**	**4,696**	**8,476**	**11,716**	**5,660**	**6,599**	**5,970**	**6,367**	**7,954**	**6,912**	**69,028**	**117,287**

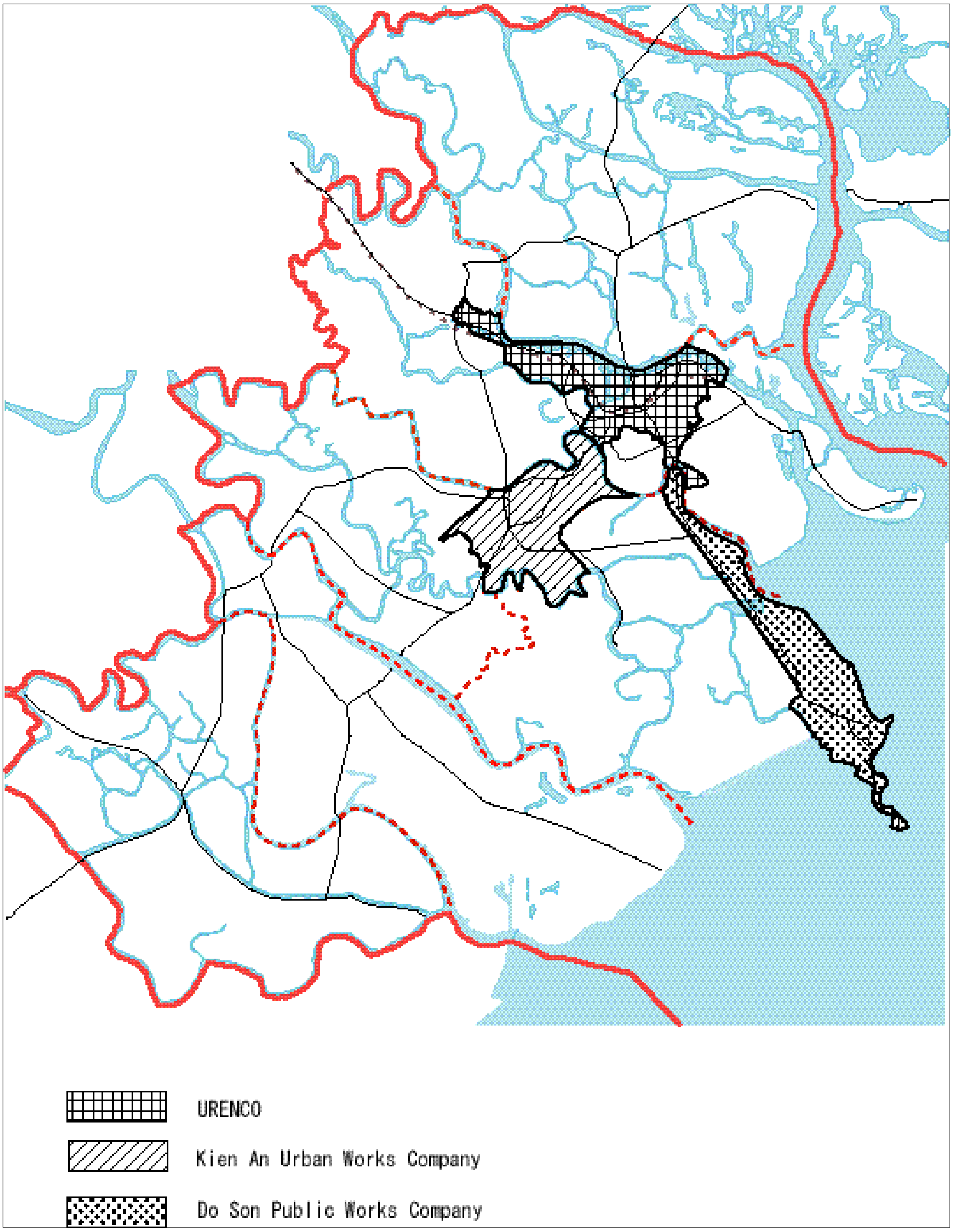


Figure 6.1.1 Solid Waste Collection Responsibility Areas in Haiphong in 2000

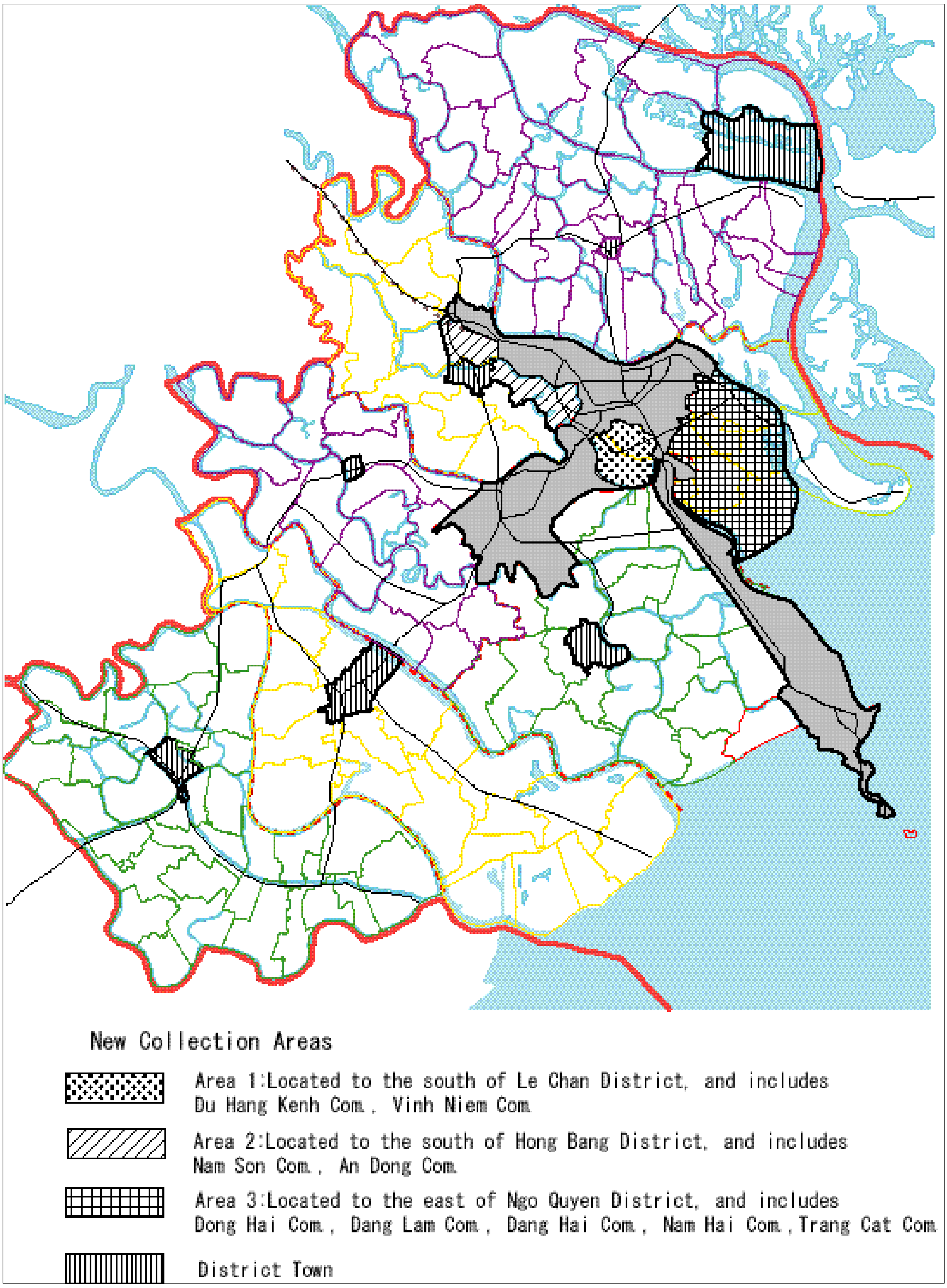


Figure 6.1.2 Solid Waste Collection Responsibility Areas in Haiphong in 2005

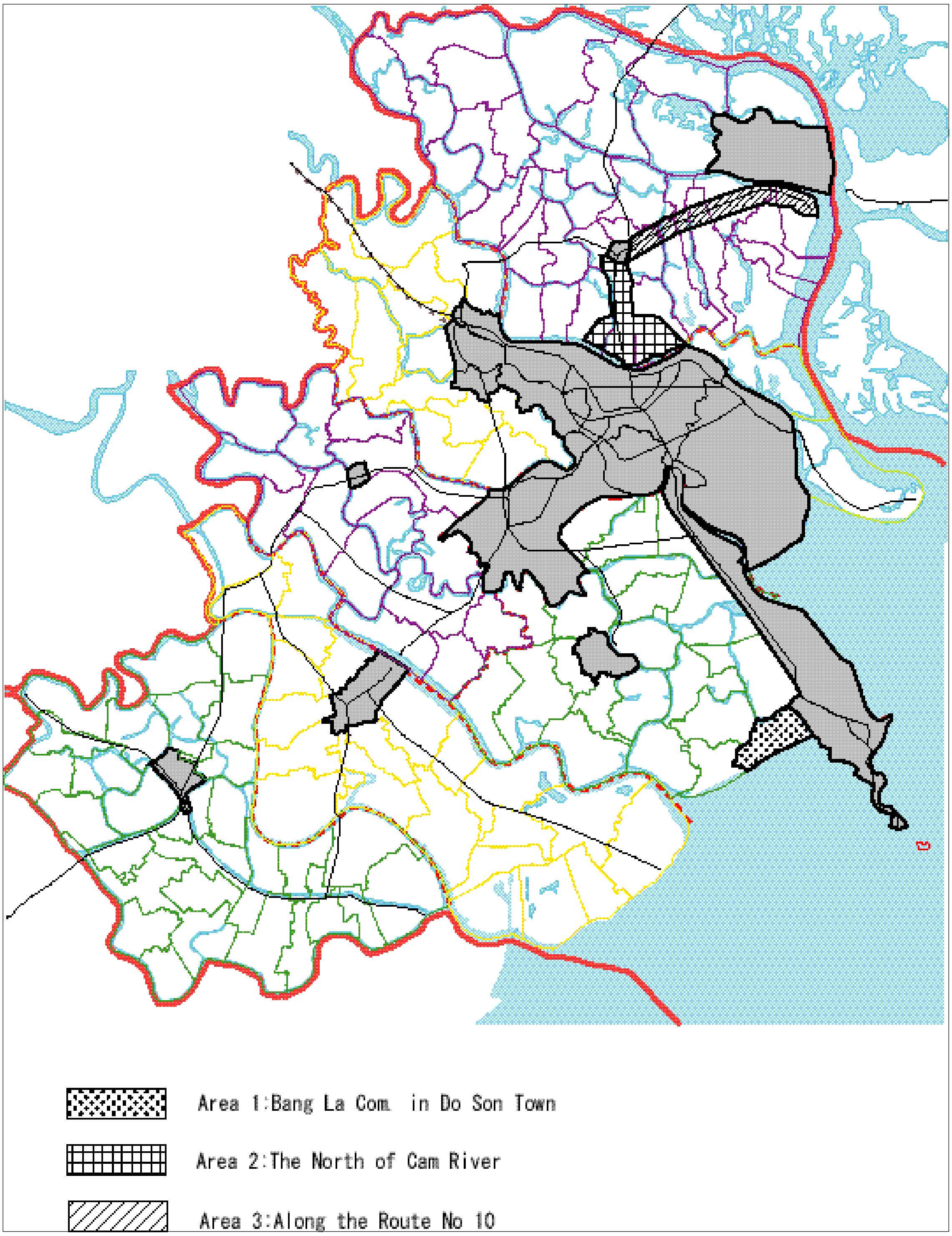
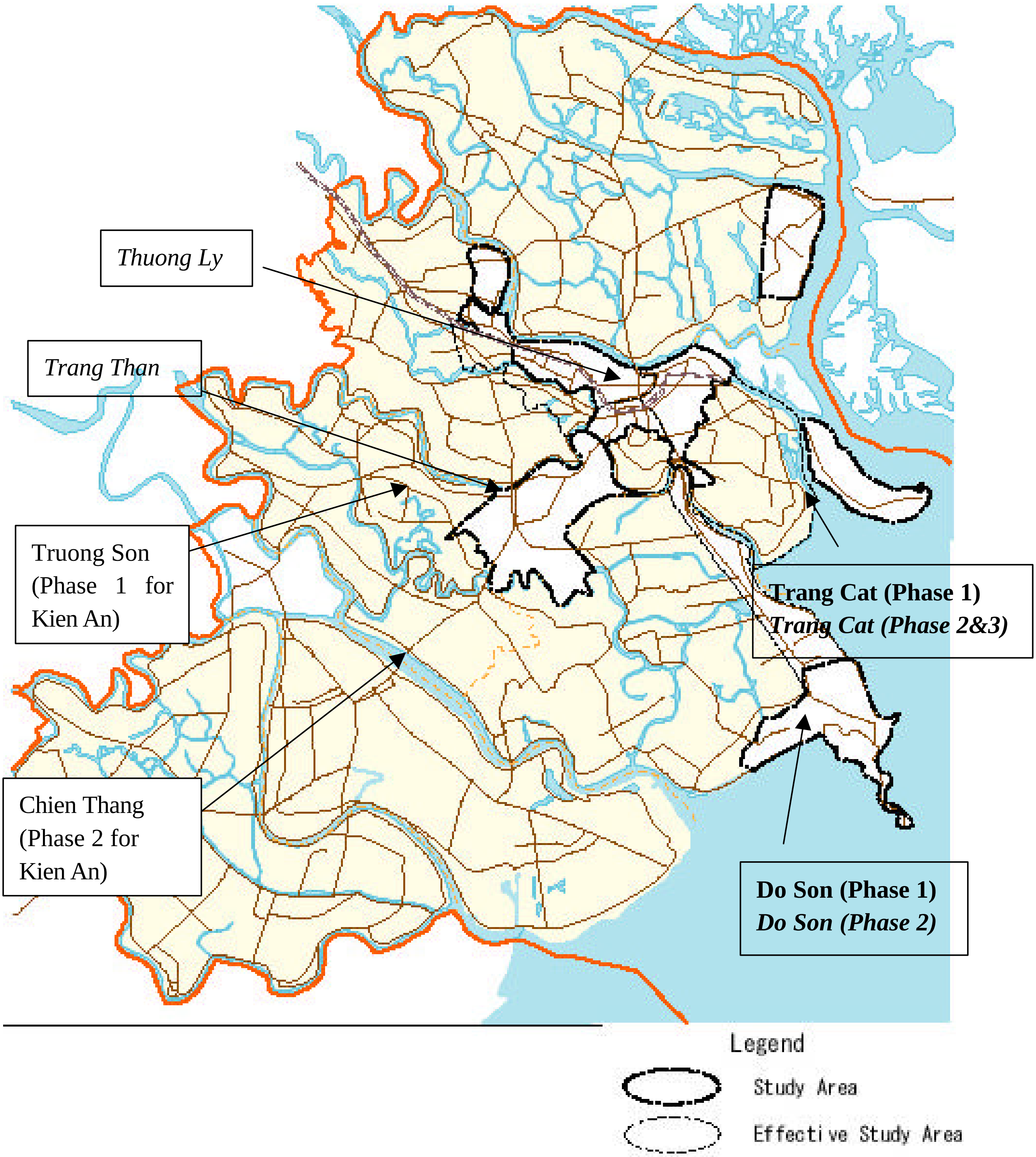


Figure 6.1.3 Future Waste Collection Responsibility Areas in Haiphong in 2010



Former Landfill Sites: in Italic

Operating Landfill Sites: in Bold

Planned Landfill Sites: in Italic Bold

Fig. 6.3.1 Location of Waste Landfill Sites in Haiphong City

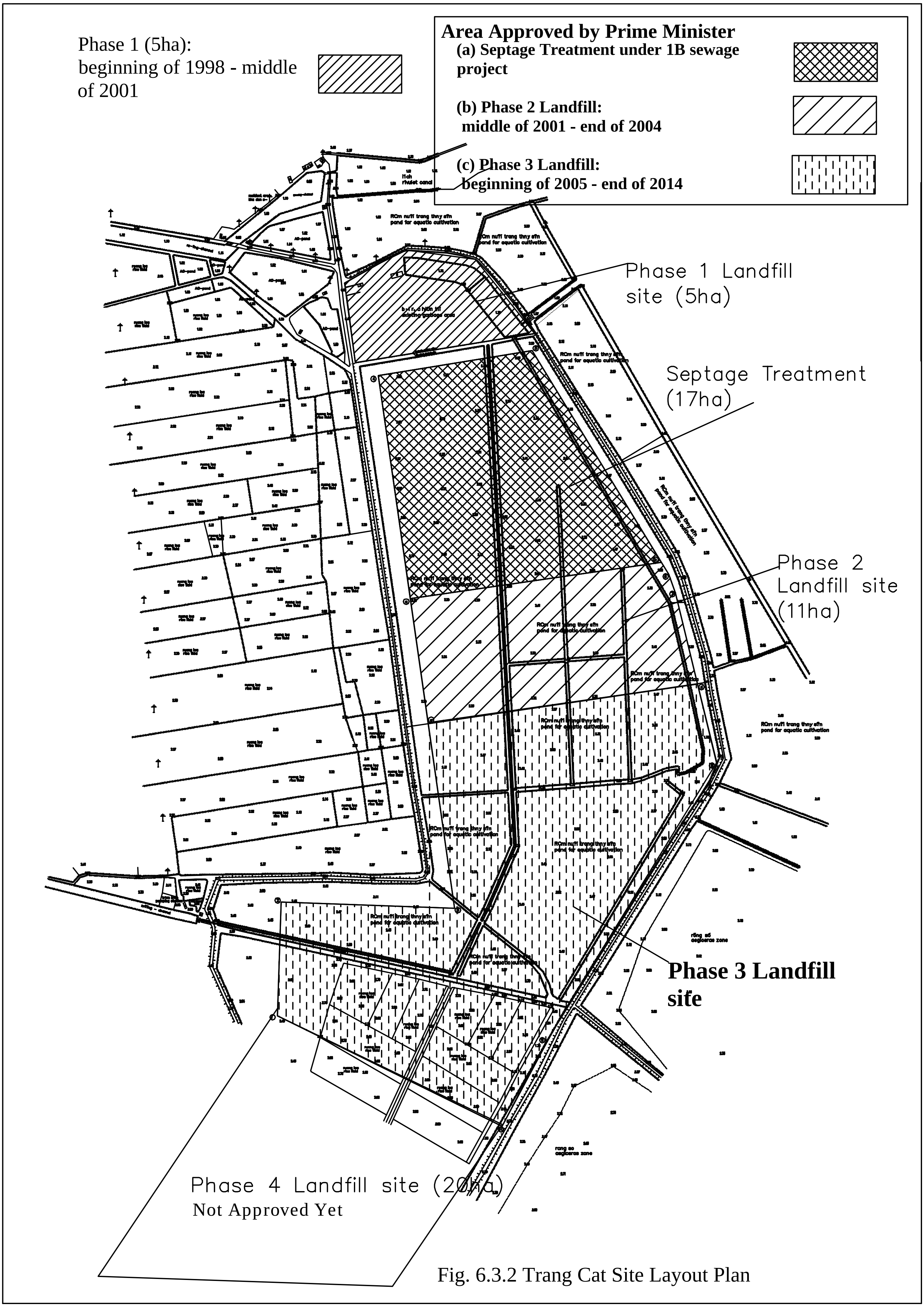


Fig. 6.3.2 Trang Cat Site Layout Plan

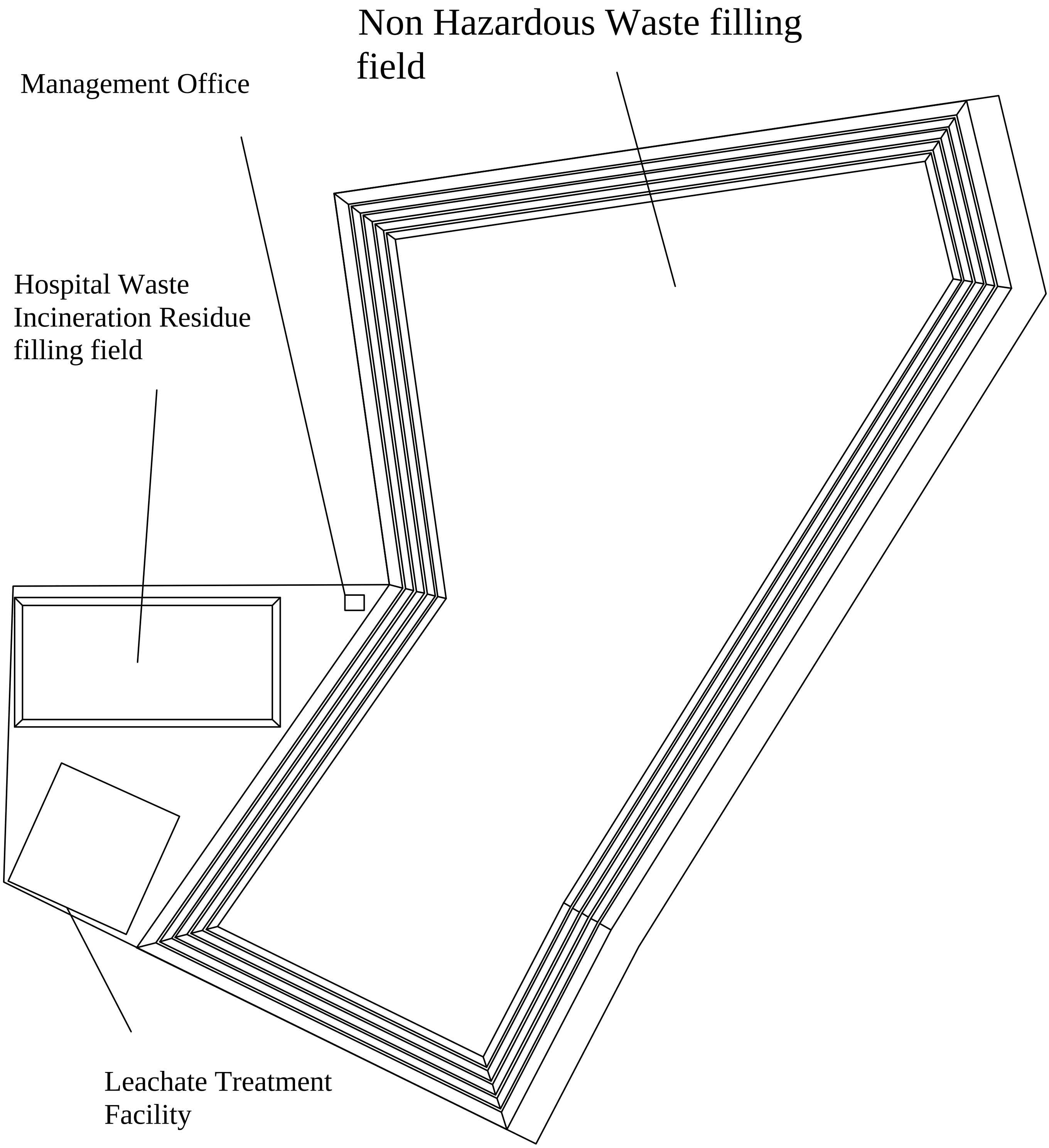


Fig 6.3.3 Layout Plan of Trang Cat Phase 3 Landfill site

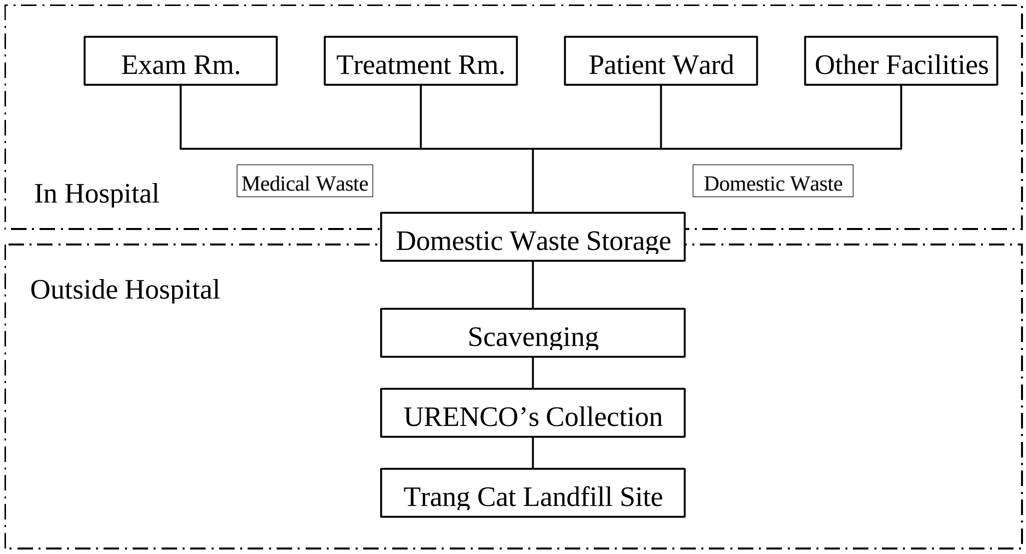


Figure 6.4.1 Current Practice of Hospital Waste Collection

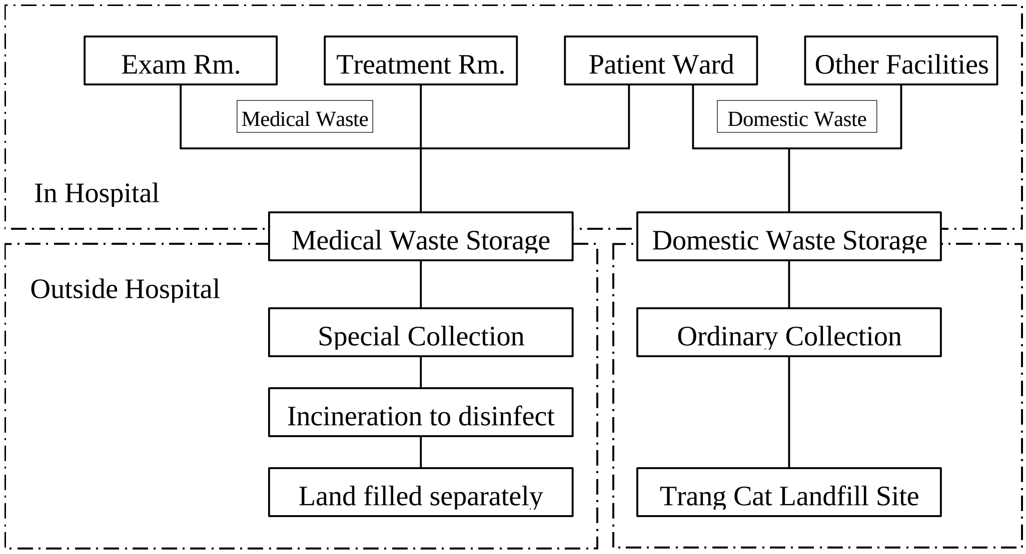


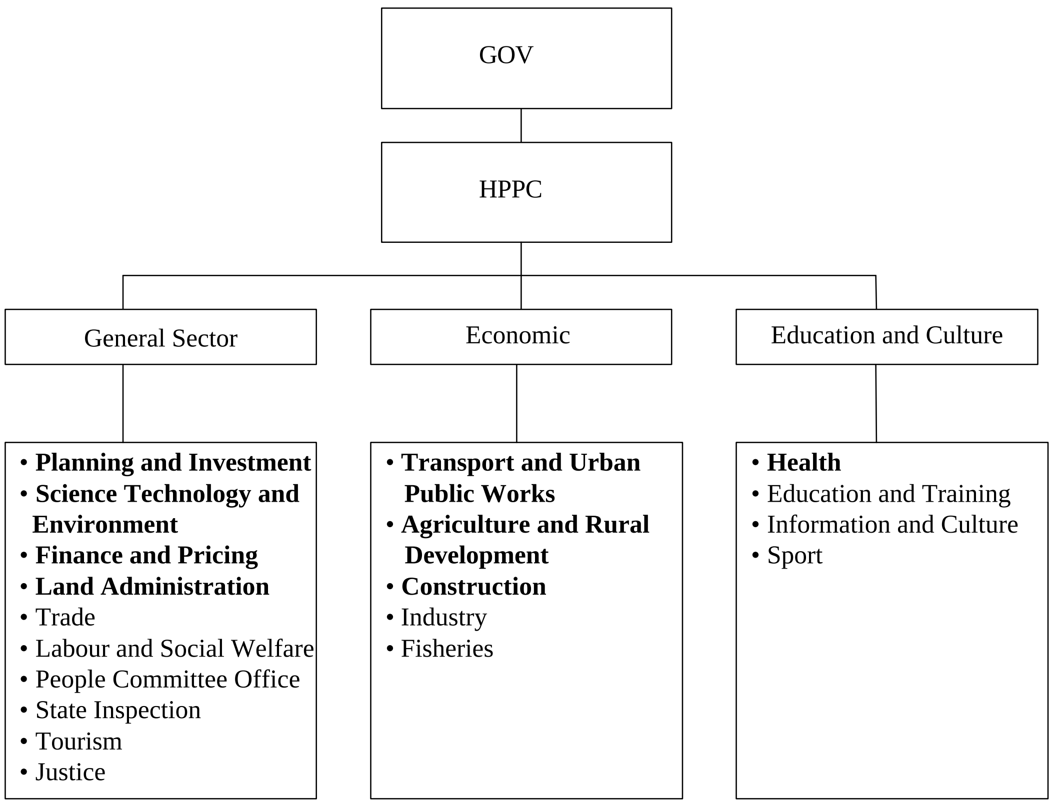
Figure 6.4.2 Proposed Scheme of Hospital Waste Collection

CHAPTER 7 INSTITUTIONAL MEASURES FOR COORDINATED SANITATION IMPROVEMENT AND ENVIRONMENTAL MANAGEMENT

7.1 Evaluation of Current Institutional and Organizational System

7.1.1 Overall Structure of Haiphong City Government

Haiphong City is a centrally administered city under the direct control of the Government of Viet Nam (GOV). The Haiphong People's Committee (HPPC) is lead by a chairman and three vice-chairman. The government departments are grouped in three sectors: 1) general sector, 2) economic sector, and 3) education and cultural sector. There is a vice-chairman responsible for each of these three sectors. The key departments that are responsible for sanitation improvement in Haiphong City are highlighted in **bold** in the figure below.



Overall structure of Haiphong City Government.

7.1 2. Responsibilities of Key Agencies

The major responsibilities of the key agencies for sanitation improvement are provided below.

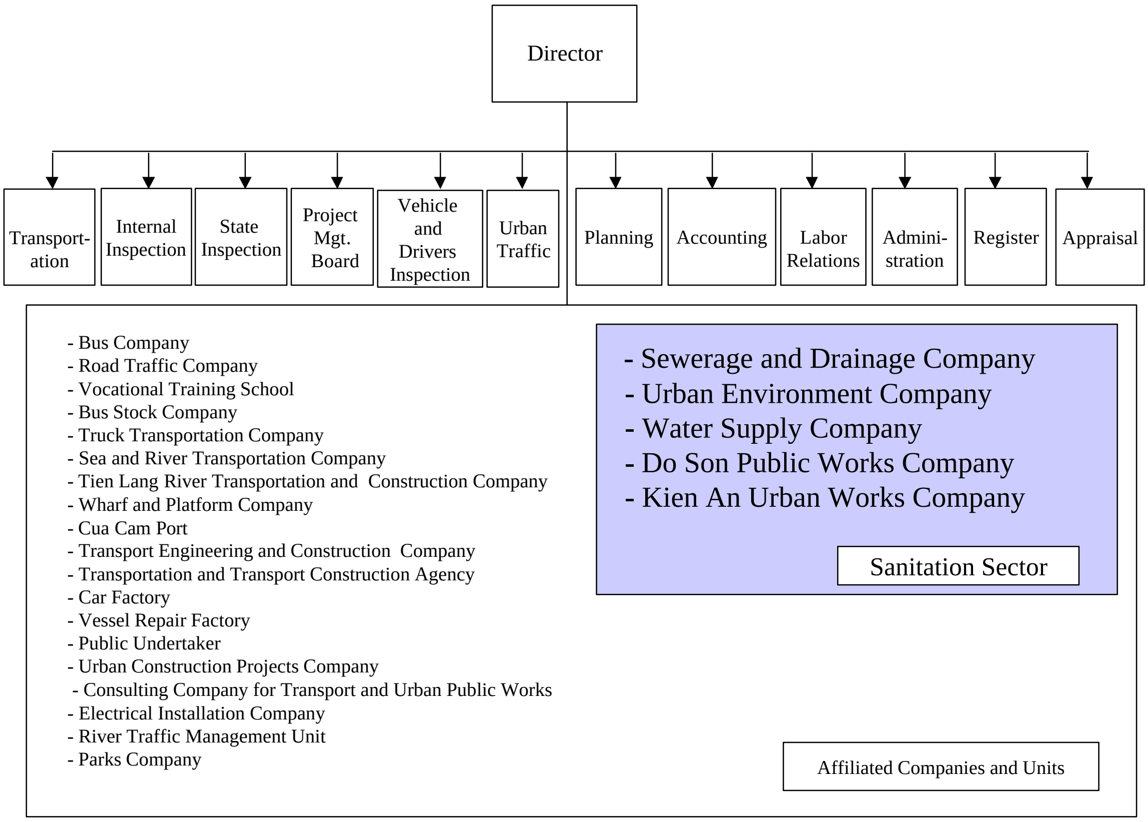
Major sanitation responsibilities of key Haiphong Government Agencies

Department	Responsibility or Authority
Planning and Investment	• Governing financial sources for infrastructure, grant aid, and international joint ventures • Preparing plans for socio-economic development • Review and appraisal of investment projects • Monitoring the implementation of development plans, projects, and programs
Construction Urban Planning Institute	• Urban master planning (spatial or physical planning) • Detailed planning for functioning urban areas, districts, towns and investment zones according to approved master plan. • Reviewing and updating general and detail plans for urban and rural development to be in conformity with socio-economic development plans • To give guidelines to municipal departments and districts in formulating feasibility studies regarding architecture and planning aspects. • Siting of facilities • Approval of designs for construction works • Planning waste transfer stations, landfill sites, and waste treatment facilities
Transportation and Public Works	• Regulation and delivery of water supply, sewerage, drainage, and solid waste management services • State management of the urban sewerage and drainage system • management, maintenance, repair and utilization of the urban sewerage and drainage system (delegated to SADCO) • formulation of plans and proposals for upgrading, rehabilitating, and repairing the sewerage and drainage system • protection of the physical facilities of the urban sewerage and drainage system • Annual planning and budgeting for solid waste collection, transport and treatment • Promotion of sound solid waste management practices
Agricultural and Rural Development	• Water resource management • Dyke management
Finance and Pricing	• Tariff setting
Land Administration	• Land allocation • Planning waste transfer stations, landfill sites, and waste treatment facilities
Science Technology and Environment	• Compliance with environmental protection regulations • Environmental monitoring
Health	• Public health • Inspection of hospitals including solid waste and medical waste management

7.1.3 Transport and Urban Public Works Service

The Transport and Urban Public Works Service (TUPWS) have a dual mandate for 1) transportation, and 2) urban public works. In the transportation sector it is responsible for state management of transportation. It is also responsible for supervision of a large number of companies that are active in the road and marine transportation sector. In the public work sector, TUPWS is the key agency responsible for the regulation of water supply, sewerage, drainage, and solid waste management services in Haiphong. It is also responsible for delivery of these services. The provision of these services is undertaken through five companies:

- Sewerage and Drainage Company
- Urban Environment Company
- Water Supply Company
- Do Son Public Works Company
- Kien An Urban Works Company



Organizational Structure of TUPWS

TUPWS has three deputy directors: one for construction infrastructure, one for transportation and one for public utilities (who is responsible for Green Trees and Parks and Street Lighting).

(1) TUPWS - State Management Responsibilities for Sanitation

1) Urban Sewerage and Drainage

State management over urban sewerage and drainage activities includes:

- Preparing master plans and schemes for the rehabilitation, upgrading, and repair of construction works within the urban sewerage and drainage system for of consideration and approval by HPPC

- Assisting HPPC to issue regulations on management, protection, utilization and usage of the urban sewerage and drainage system
- Organizing and directing the management, protection, utilization, and usage of the urban sewerage and drainage system
- Granting and withdrawing licenses for households to connect to the urban sewerage and drainage system
- Conducting activities for education and propagation of the laws on management, protection, utilization and usage of the urban sewerage and drainage system
- Supervising and checking the compliance to the regulations on management, protection, utilization and usage of the sewerage and drainage system; applying sanctions to violations within their delegated power
- Dealing with conflicts, complaints, and accusations related to the management, protection, utilization and usage of the sewerage and drainage system or requesting authorized agencies to deal them

2) Solid Waste Management

State management responsibilities over waste management include:

- Preparation with Department of Planning and Investment and URENCO of plans for the whole volume of waste to be collected and estimate the total budget for waste management, collection, transport and treatment to be submitted to HPPC for approval at the right time for the annual plan
- Through delegation to URENCO and district administrations the management, collection, transport and treatment waste of the city or districts according to the plans already approved by HPPC. The waste collection process and technology must be approved by the supervising agencies
- The conduct of comprehensive propaganda campaigns on the mass media and in residential quarters in the city about the waste management regulations so that organizations and individuals are aware of and follow them. Such campaigns are to be conducted in coordination with HPPC, and the Departments of Culture and Information, Public Security, Construction, Finance, and other relevant organizations, social organizations and associations
- Planning the implementation guidelines for implementation of waste management regulations and playing the key role, together with district people's committees, in waste management in the city

- Application of fines and other administrative sanctions for violations of waste management regulations in accordance with the existing Decree on Dealing with Administrative Violations. Similarly authority is granted to People's Committees at different levels and public security organizations at urban and rural districts, wards and communes, and towns

(2) Responsibilities of Companies under TUPWS

TUPWS delivers water supply, sewerage, drainage, and solid waste management services through five companies:

- Sewerage and Drainage Company
- Urban Environment Company
- Water Supply Company
- Do Son Public Works Company
- Kien An Urban Works Company

The major responsibilities of these companies are provided in the table below.

(3) Administrative Control of Companies

TUPWS, on behalf of HPPC, retains administrative control of the companies through:

- Review approval of annual plans and budgets
- authority (through HPPC) for setting appropriate price for services
- approval of personnel recruitment and salaries
- approval of procurement of major capital items

Major responsibilities of the Companies under TUPWS

Department	Responsibility or Authority
Urban Environment Company	• organize the separation, collection, and transport of all forms of solid waste (domestic, industrial, hazardous and hospital) • organize treatment and disposal of solid waste (domestic, industrial, hazardous and hospital) • street sweeping and street washing • operation and maintenance of public toilets and other sanitation services • sanitation management of on sea, rivers, and ports including collection and transport of solid waste and liquid waste from ships and boats in the river and sea ports • organize and keep comprehensive records on all components of the solid waste management system • provide household sanitation services such as the bucket latrine management and the implementation of the bucket latrine conversion program • promote public health and sanitation
Sewerage and Drainage Company	• organize access to public sewers • record keeping on sewerage and drainage system • regulation of hydrological performance of sewerage and drainage system • maintenance of sewerage and drainage system • desludging of septic tanks and treatment of septage • promotion of public health and sanitation
Water Supply Company	• water extraction and treatment • operation and maintenance of water treatment plants • distribution of water to consumers • implementation of minor construction works • record keeping on water supply system
Do Son Public Works Company	• Waste collection and treatment including street sweeping • Maintenance of roads • Construction of sea dykes • Development of traffic corridor and signals • To manage and operate rainwater drainage • Public streetlighting • Graveyards and memorial monuments • Maintenance of trees and parks
Kien An Urban Works Company	• Maintenance of roads • Construction of sea dykes • Development of traffic corridor and signals • To manage and operate rainwater drainage • Public Street lighting • Graveyards and memorial monuments • Maintenance of trees and parks

7.1.4 Planning and Approval for Sanitation Improvement Projects

The planning and approval process (see figure below) for implementing sanitation improvement projects has four major steps:

- The socioeconomic development planning at the National Level by the Ministry of Planning and Investment (MPI) or the Department of Planning and Investment (DPI) sets the basic framework by developing investment priorities and approving individual projects (e.g., a new landfill site)
- The master planning or spatial planning as undertaken by the Urban Planning Institute to create a logical spatial arrangement of buildings, infrastructure,

green spaces and lakes, industrial areas, commercial areas, and residential areas. It is also concerned with the location of specific individual projects (approved by MPI or DPI) and setting aside specific areas for specific land uses (e.g., industrial, tourism, commercial)

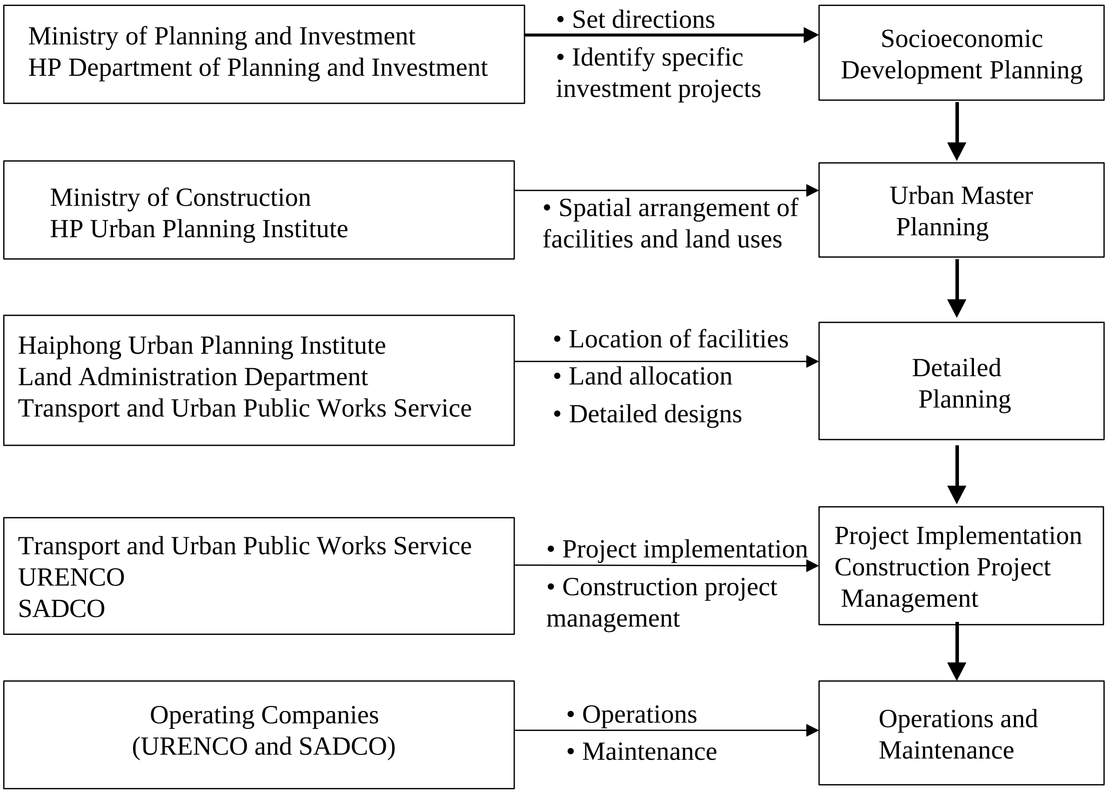
- Each specific project is assigned to an implementation agency (e.g. TUPWS). For many urban environmental projects requiring construction of physical facilities, a project management unit is formed within the implementing agency
- Once the project is completed it would be used as an operating agency (e.g.. URENCO, SADCO, and WSCO) for continued operation and maintenance

(1) Project Planning and Project Management

In practice, TUPWS relies on the individual companies to conduct project planning. For large capital projects, companies will prepare their own proposals. However, TUPWS will review, and provide advice and comments before submitting the proposal to HPPC for approval.

The current organizational structure of TUPWS places the planning responsibility within the individual companies. One result is a relatively weak professional and technical capacity within TUPWS. This means that TUPWS must rely on other agencies for the expertise to plan and evaluate major proposals. This also means that the individual companies must have their own individual expertise or rely on outside agencies to conduct professional and technical aspects of planning.

Each company may be expected to promote its own individual interests. TUPWS's role is to try to balance the interests of the various companies. The allocation of responsibility for management and use of the Trang Cat site provides a good example of current practice and problems. Currently, it appears that TUPWS is facilitating the communication between SADCO and URENCO in determining a practical solution for current use of the site – given the immediate needs of both companies.



Overview of Planning and Approval Process for Sanitation Improvement Projects

(2) Approvals by the Prime Minister

In practice, most approvals and major decisions are taken by the Prime Minister of Viet Nam. This includes approval of major projects and almost all land allocation decisions for facilities. For example, the land allocations at the Trang Cat site are approved by the Prime Minister. Approval processes need to be streamlined with greater delegation of decision-making authority to HPPC. HPPC may also choose to delegate routine decisions for land allocation (e.g. siting of pumping stations, sewer lines, wastewater treatments, and solid waste transfer stations) to the appropriate departments (e.g. Land Administration, Construction, and TUPWS).

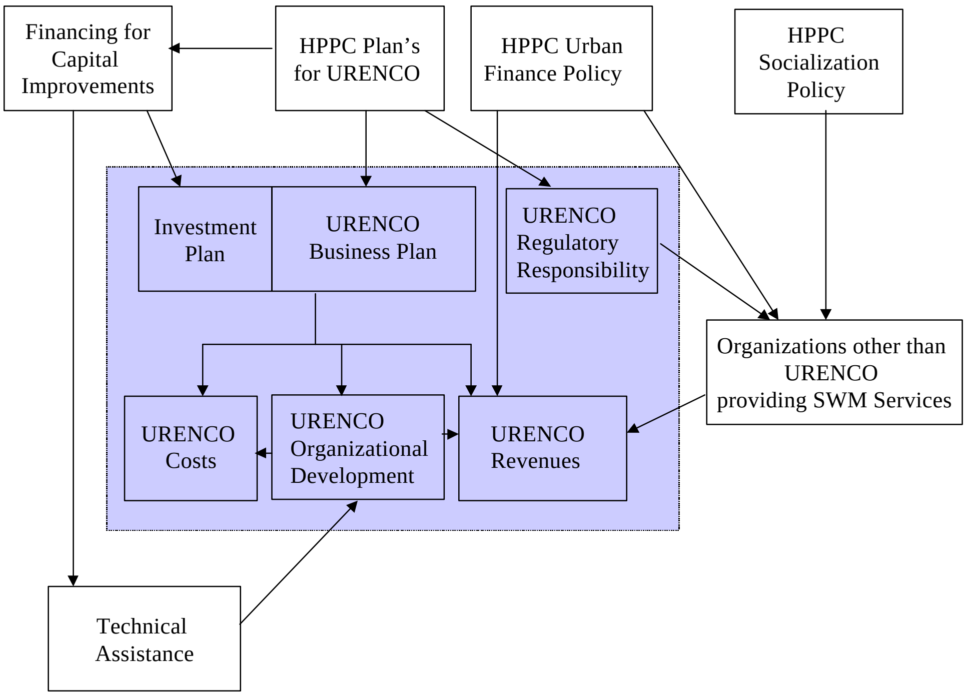
7.1.5 Current Policy Framework for Public Utilities

(1) Public Utility Enterprises

WSCO, URENCO, and SADCO are public utility enterprises. A public utility enterprise (PUE) is a relatively new legal model (mandated in Government Decree 56–CP on Public Service Enterprises) that combines state management responsibilities with business operations. The designation as a PUE gives the utility the opportunity to pursue private business activities. A separate set of records must be kept for business activities. Resources designated for state management purposes may not be used to support private business activities.

(2) Policies Affecting Development of Public Utility Enterprises

The figure below shows the business and political environment for URENCO. The shaded presents the internal institutional framework. While the figure uses URENCO as an example, the situation is similar for SADCO and WSCO.



External factors influencing URENCO development.

The key external factors that will influence URENCO's development can be summarized as follows:

- HPPC Socialization and Privatization Policy
- HPPC Urban Finance Policy
- HPPC Plan for URENCO
- Access to Financing for Capital Improvements
- Access to ODA for Technical Assistance
- Other Solid Waste Management Service Providers

7.1.6 Assessment of the Current Situation

HPPC and the leaders of the relevant government departments (DPI, UPI, TUPWS) and the operating companies (WSCO, URENCO, and SADCO) have expressed strong support for sanitation improvement in Haiphong. However, the current institutional and organizational framework is a significant barrier in making improvements in sanitation and environmental conditions.

There are four central questions that must be addressed:

- Does the existing legal and regulatory environment support the implementation of the Sanitation Improvement Plan?
- Is the Haiphong City Government capable of planning, financing, and implementing the Sanitation Improvement Plan?
- What type of leadership and technical capability is required to successfully implement the Sanitation Improvement Plan?
- How can the existing institutional system be modified to increase the effectiveness and efficiency of the implementation of the Sanitation Master Plan?

(1) Improvements Needed in the Existing Legal and Regulatory Environment

Improvements are needed in the existing legal and regulatory environment. There is a need for new initiatives to develop:

- Specific policies and regulations to guide the implementation of the projects to be implemented under the sanitation improvement plan
- Clear policies with respect to socialization and privatization including guidelines on participation of the private sector in the provision of public sanitation services
- Clear policy with respect urban environmental finance including policies on price deregulation, cost recovery, and financing (funding) for capital improvements
- Specific regulations for environmental protection and environmental management of key natural resources (e.g. lakes, parks, ecological areas, sensitive coastal areas)
- A positive institutional environment to allow for the growth and development of WSCO, SADCO and URENCO

(2) Haiphong City Government's Capability to Plan, Finance and Implement Sanitation Improvements

Planning is not well organized and does not meet the needs for the sanitation improvement for Haiphong City. The technical capability of the planning professionals is limited or constrained by political decisions taken during the past development of plans. Existing urban master plans appear to conflict with the necessary improvements in basic infrastructure.

The necessary infrastructure projects can not be financed without ODA and help from the Central Government.

The current approach to implementation relies on effective operation of the Haiphong approach to the project management units (PMUs). However, the project management units in SADCO and URENCO may not be capable of managing the implementation of the new infrastructure projects. It is certain that they can not cope without technical assistance to build capacity in the various companies and agencies that must participate in the implementation of the projects. The next phase of the Finnida program, the Water Supply, Drainage, Sewerage and Sanitation Management Program in Haiphong (WSDSSMP), will need to direct significant financial and human resources to capacity building and institutional development of SADCO to support the implementation of the World Bank1B loan.

(3) Leadership and Technical Capability Required to Successfully Implement Sanitation Improvements

The Haiphong government does not have the capacity to manage major infrastructure projects. Concerns and problems seem to exist at all levels. Capable experienced leaders are few, and the functioning of the day to day activities is still constrained by the hierarchical decision-making structures that create stumbling blocks to the effective exchange of information.

Senior leaders in the Haiphong City Government need to delegate more responsibility to the technical staff in the PMU's and streamline the internal decision making procedures. Senior leaders need to put in place, support, and fund programs to develop the staff in the PMUs. Such programs will be able access the considerable ODA funding that is available for such capacity building.

(4) Changes to Existing Institutional System to Increase the Effectiveness and Efficiency of the Implementation of the Sanitation Improvements

The first step is to develop a positive program of legal and regulatory reform to allow for orderly development of sanitation planning, project implementation, and development of the organizations responsible for sanitation.

The second step is the formulation of a sanitation master plan to be adopted by HPPC. The current situation is that HPPC through DPI is still reacting to or selecting from a menu of investment projects. There are no stated priorities to guide the selection and orderly development of the individual projects.

The third step is to develop organizational capacity and technical competence in planning and execution of major infrastructure projects.

The fourth step is to create more favorable policies for development of public utilities. Basic business and public administration training is needed. New leaders and managers with the skills to run the new businesses need to be recruited.

7.2 Legal and Institutional Measures

7.2.1 Reinforcement of Haiphong City Regulations on Sewerage, Drainage, and Waste Management

Two new draft regulations have been prepared and are being considered by HPPC:

- Regulation on Management, Utilization, and Usage or the Urban Sewerage and Drainage System in Haiphong City
- Waste Management Regulation for Haiphong City

In general, the regulations assign to TUPWS, two sets of responsibilities: 1) regulatory; and 2) provision of specific public services. These regulations also mandate the planning responsibilities of other key agencies (i.e. DPI and UPI) and provide details on fines and other administrative penalties.

These regulations are a positive step forward and it is recommended that they be promulgated as soon as practically possible.

7.2.2 Reinforcement of the Regulation of Land, Water, and Ecological Resource Use in Haiphong's Lakes, Rivers, and Channels

The proposed new regulation on "The Management, Utilization, and Usage of theUrban Sewerage and Drainage System in Haiphong City" provides general provisions and assigns the overall responsibility to TUPWS. The proposed regulations set out to two sets of responsibilities and authorities: 1) the provision of sewerage and drainage services including the management, maintenance, repair, and utilization of the sewerage and drainage system; and 2) regulatory responsibilities including protection of drainage system and the environment.

However, the proposed regulations do little to clarify the responsibilities for other uses of drainage channels and the environmental protection of lakes, rivers, and channels. SADCO has responsibility to manage, maintain, protect and develop the drainage system including rivers, lakes, and channels. This responsibility is focussed on maintaining the hydrologic function of the drainage system. The responsibility for pollution control and management and environmental monitoring is clearly within the mandate of DOSTE. However, other departments within the Haiphong government and industrial enterprises also have responsibilities. DOSTE is responsible for the environment in general including the water in the lakes and channels. But actual operational responsibility for most of the lakes and channels belongs to SADCO. And the channels have more than one function (e.g. irrigation and drainage). The Department of Agriculture and Rural Development (DARD) has the responsibility for irrigation. Management and protection of the drainage system requires cooperation and coordination amongst agencies.

There are no specific regulations for environmental protection of lakes, rivers, and streams. Haiphong People's Committee (HPC) should prepare a regulation on the control of all activities using or affecting Haiphong's lakes, rivers, and streams. This decision should include provisions for:

- a survey and evaluation of lakes, rivers, and streams should be undertaken to determine the value of different ecosystems
- HPPC to provide initial guidance on the implementation of GOV law and policy with Haiphong's lakes, rivers, and streams
- planning to be undertaken to make the best use of each lakes or river
- allocation of proper authority for regulation of use of waterbodies to responsible agencies

(1) Temporary Regulation on Use of An Kim Hai Channel

An Kim Hai Channel is an irrigation channel and is currently under the control of the Department of Agriculture and Rural Development. The proposed priority project for drainage improvement includes the Rehabilitation of An Kim Hai Channel. TUPWS and then SADCO will have to be assigned sufficient responsibility and authority for An Kim Hai channel to allow for the project to be implemented and the drainage system to be efficiently operated. It is recommended that HPPC pass a temporary regulation or decision to formally assign the necessary responsibilities and authorities to TUPWS and SADCO.

Specific authorities should include:

- Authority to regulate of hydrological performance of sewerage and drainage system
- Authority to prohibit on constructing within specified buffer zones around all sewerage and drainage facilities
- Authority to restrict discharges of sewage, dumping of solid waste, or industrial effluent to the sewerage and drainage system

7.2.3 Clear Policy on Urban Sanitation Management

(1) Create More Favorable Policies for the Development of Sanitation Sector Organizations

The future development of the existing public utilities is constrained by external factors and by controls placed on them by the GOV (see section 1.4) including:

- HPPC Socialization and Privatization Policy
- HPPC Urban Finance Policy
- HPPC Plan for Public Utilities
- Access to Financing for Capital Improvements
- Access to ODA for Technical Assistance
- Other Public Service Providers

New policies that are favorable to the development of each of the sectors are needed.

1) Water Supply Sector

The following will be favorable to development of the water supply sector:

- Increased cost recovery by setting of appropriate prices for water that will allow water supply companies cover both operating and maintenance and capital costs
- Freedom for organizations to recruit better qualified management and staff including setting of salaries
- Allowing more control over procurement decisions
- Encouraging alternate mechanisms for financing capital improvements

2) Solid Waste Management Sector

The policies will be favorable to the solid waste management sector:

- Increased cost recovery for domestic solid waste management through increased tariffs for domestic solid waste management services
- Price deregulation for industrial and hospital waste management services
- Development of private sector companies to service commercial and industrial enterprises
- Continued help to seek official development assistance for capital improvements and human resource development
- Establishment of and enforcement of regulations for all providers of solid waste management services
- Freedom for organizations to recruit better qualified personnel

3) Sewerage and Drainage Sector

The following will be favorable to the sewerage and drainage sector:

- Increased cost recovery for sewerage O&M through increased wastewater charge levied along with water bill
- Continued help to seek official development assistance for capital improvements and human resource development
- Development of private sector for collection and transport of septage
- Freedom for organizations to recruit better qualified personnel

4) Fostering the Growth of For-Profit Businesses under the Public Utility Enterprise Mandate.

URENCO, WSCO, and SADCO have been designated as Public Utility Enterprises. This allows them to develop separate for-profit business enterprises to deliver public services. Any new businesses should meet the criteria for socialization, that is:

- Improvement in the quality of service
- The user pays directly for the service
- The provider collects the fees and pays for labor, other operating and maintenance costs, and capital costs
- The State does not have provide financial assistance
- The State provides guidance and retains the regulatory responsibility and authority

As long as these criteria can be met, URENCO, WSCO, and SADCO should be encouraged to provide services through the PUE mandate. HPPC should allow the utilities to form new business units and should provide financial support (i.e. loans) to these business units during the start-up phase.

(2) Development of Policy on Socialization and Privatization of Public Services

TUPWS wishes to improve the quality of public service delivery and reduce the State budget share of the costs through socialization. Although socialization of some services has already taken place, TUPWS has no experience in formulation of more general program for socialization.

A policy on socialization and privatization of public services must be developed.

This policy should identify which services are candidates for socialization and which forms of socialization are appropriate for each type of public utility services. HPPC should promote models of socialization for:

- Community based or “people founded” waste collection forces for collection of domestic waste at the phuong level
- Private sector competition for the collection of industrial waste
- Private sector for collection of waste from ships and port facilities
- Private sector competition for collection and transport of septage

7.3 Organizational Measures for Policy Making and Planning Organizations

7.3.1 Implementation of JICA Sanitation Master Plan

The JICA Study has expended considerable effort to develop the Sanitation Master Plan (SMP). HPPC must use the opportunity of this JICA study to further develop and adopt a SMP. The implementation arrangements for the SMP have three main considerations: 1) what formal status will the SMP have? 2) how will the priority projects of the SMP be included into socio-economic development plans?, and 3) which agency or body will have responsibility for implementation of the SMP.

(1) Coordination Council for Sanitation Improvement

It is recommended that a Coordination Council for Sanitation Improvement be created to:

- coordinate for sanitation improvement for all aid projects
- coordinate and accelerate implementation of JICA SMP

The responsibilities of the Coordination Council will be to:

- formally submit the SMP to HPPC for approval
- co-ordinate the implementation of projects and activities of the SMP
- to ensure the SMP's priority projects and activities are included in socio-economic development plans
- to ensure that the location of facilities and land allocations for facilities for the priority projects are included in spatial plans for Haiphong

The members of the Coordination Council will include:

Title	Role
Vice Chairman of Haiphong People’s Committee	Chairman
Director of Department of Planning and Investment	Vice Chairman
Director of Transport and Urban Public Works Service	Vice Chairman
Director of Department of Finance and Pricing	Member
Director of Department of Science Technology and Environment	Member
Director of Urban Planning Institute	Member
Director of Water Supply Company	Member
Director of Department of Health	Member
Director of Urban Environment Company	Member
Director of Sewerage and Drainage Company	Member

(2) Urban Management Co-ordination Council

Another alternative is to have the newly created Urban Management Co-ordination Council receive the SMP and promote its implementation.

An Urban Management Co-ordination Council has been set up, with assistance from the pilot Public Administration Reform Project in Haiphong by UNDP, to function as an interdepartmental coordination body to create Integrated Strategic Planning, Multi-Sector Investment Programs, Public Sector Investment Programs (including prioritization lists), and Inter-departmental Action Plans. The Council will have the role of monitoring and evaluatiing operating results of member departments and public service delivery.

Members of the Council include: Vice chairman of HPPC (chairman of Council), leaders of functioning departments: Haiphong People's Committee Office, Department of Planning and Investment, Urban Planning Institute, Department of Finance and Pricing, Department of Science Technology and Environment, Transport and Urban Public Works Service, Department of Organization and Personnel, Department of Construction, and the Department of Industry.

The Urban Management Co-ordination Council operates through a number of sector working groups.

It is recommended that a new sector working group called the Technical Working Group on Sanitation Improvement (TWGSI) be created. This new working group will be given responsibility for the Sanitation Master Plan and its future implementation.

The membership of TWGSI the will be the same as that for the Coordination Council for Sanitation Improvement.

(3) Creation of Trang Cat Site Management Company

Both URENCO and SADCO will have operations at the Trang Cat Site. One option that will foster coordination and create efficiency is the creation of a new company to be called the Trang Cat Site Management Company (TCSMC). The TCSMC will be responsible for all operations (e.g. solid waste, septage, hospital waste) at the Trang Cat Site. In the beginning, the company will be established under TUPWS, but will be a candidate for privatization in the long term. HPPC's major role will be to set up and enforce the standard with respect to environmental protection and sanitation at the Site.

1) Users of the Site

Any organizations or individual will be allowed to bring waste to the site as long as the waste is of acceptable types. Users including URENCO and SADCO will pay disposal fees to TCSMC.

2) Financing

It is proposed that HPPC provide all necessary funds for the establishing the TCSMC and construction of the facilities at the Trang Cat site. The TSCMC will be responsible for the operation and maintenance costs of the Site.

HPPC will not provide a subsidy. To generate revenue, the TCSMC will collect fees from all users. In the beginning, the fee level will be set high enough to recover all salary and other operation and maintenance costs. The objective is to gradually increase fees over a period of ten years until the full cost is recovered. Initially, low fee rates are recommended to provide an inducement to waste generators to bring their waste to the Site.

As the fee rates increase, fee revenue will exceed the operation and maintenance cost. Excess revenue can be returned to HPPC to compensate HPPC for its contribution to the land and capital costs of the Site. However, a portion of the excess revenue should be reserved for a future capital investment fund.

HPPC will retain the authority to control the disposition of the capital investment fund. HPPC will also retain authority to set the tariffs for use of the Site. It is recommended that rates be set at fair market levels. Setting artificially low rates would constrain the financial viability of the TCSMC.

3) Advantages

The management of the Trang Cat Site by one company has certain advantages including:

- Better coordination between septage management and solid waste landfill in terms of site allocation and use, as well as production of compost manufactured from both dried septage and some solid waste
- Greater accountability in the event of environmental pollution problems and complaints by local residents. It will be clear who has responsibility for the pollution, and for taking necessary measures. If two organizations (URENCO and SADCO) manage the Site, it may not be clear as to which organization is responsible for the pollution
- Administrative efficiency – a reduction in total site management cost can be expected by avoiding duplication of costs such as salaries for managers engineers, technicians, and guards
- Increased site use – by encouraging a large number of waste generators to use the Site. At present URENCO is the only company who use the Site

7.3.2 Socio-Economic Strategy and Planning

(1) Haiphong Department and Investment (DPI)

DPI is responsible for the development of the master socioeconomic plans, medium term and annual socioeconomic development plan, and development investment orientations of the sectors. Both sanitation improvement and environmental protection is one of the important issues that must be taken into consideration in the development process. DPI seems to be struggling with both.

1) Technical Assistance in Sanitation and Environmental Aspects of Socioeconomic Development Planning in Haiphong

The technical assistance will involve:

- an in depth institutional analysis of current approaches to socioeconomic development planning including an assessment of current capacity of staff to deal with sanitation improvement and environmental considerations
- introduction of new approaches to planning to integrate sanitation and environmental considerations
- seminar and training course on new approaches
- case studies to test the effectiveness of new approaches
- development of guidance manuals

2) Technical Assistance to Introduce new Methods and Approaches to Economic Evaluation of Aanitation and Environmental Improvement Projects

The technical assistance will involve:

- review of evaluation procedures in developed and ASEAN countries
- development of methodology appropriate to the needs of DPI
- case studies to test the new methods and approaches in practice
- development of guidance manuals
- training courses

7.3.3 Spatial Planning

(1) Urban Planning Institute

The spatial planning capability of the UPI needs to be upgrades through provision of trained staff and modern computer based spatial planning systems.

1) Increased Sanitation and Environmental and Spatial Planning Capacity of UPI.

There are three key potential areas of institutional strengthening:

- the addition of environmental specialists to the staff to participate in master planning activities
- development of the spatial planning capacity through introduction of geographic information systems

- Technology transfer on the methodology of sanitation and environmental master planning

2) Technical Assistance in Developing the Next Amendment of Haiphong Master Plan to 2020.

The technical assistance will include:

- seminar or training courses in methodologies and approaches to sanitation and environmental master planning
- case studies application - amendment of the Haiphong Master Plan to 2020 to test the methods and approaches in practice
- development of guidance manuals

3) Training and Personnel Development

Priority training needs include: 1) learning English; 2) computer application (e.g. GIS); and 3) architectural planning.

7.3.4 Environmental Protection

(1) Department of Science Technology and Environment (DOSTE)

One objective of DOSTE is to improve the overall quality of urban areas through 1) better monitoring and control of pollution; 2) application of new technology for waste treatment; 3) and rezoning industries to Industrial Parks. DOSTE wishes to introduce early prevention of pollution by 1) strengthened EIA licensing; 2) strengthened approval process for new projects; and 3) increased public awareness.

1) Increased Capacity for Water Quality Monitoring

In support of these activities, DOSTE need to increases its capacity to conduct environmental monitoring, particularly water quality monitoring in both fresh and salt water. DOSTE has asked the Viet Nam Canada Environment Project – Phase II to strengthening environmental capabilities through staff training, provision of scientific equipment, and a demonstration project on water quality of the Cam River.

This will provide DOSTE with improved ability to plan for water resource use and pollution control. It will be more able to respond to complaints concerning conflicting water uses. In the future, DOSTE will be able to classify areas for water use. This will improve its capability to manage potential resource use conflict (e.g. tourism and industrial development). This will have a long-term impact, in that DOSTE will be better able to influence policy and planning.

2) Funding for Specific Monitoring Programs

Funding commitments should be made by HPPC to:

- enable DOSTE with SADCO to conduct monitoring of the lakes and channels of the combined sewerage and drainage system to provide routine reports on water quality
- enable DOSTE with SADCO to conduct source sampling of potential major pollution discharges to the sewerage and drainage system
- enable DOSTE with URENCO and SADCO (in the future) to fulfill their environmental protection responsibilities with respect to the Trang Cat Landfill

Without the necessary monitoring programs, it will not be possible to assess the improvements to water quality that are expected to result from the World Bank 1B project and the proposed priority projects.

7.3.5 Strengthening Institutional Arrangements for Project Management Units for Sanitation Investment Projects

(1) Capacity Building for staff in the Project Management Units (PMUs)

The PMU that has been established in SADCO for the World Bank 1B project is currently being strengthened through technical assistance. While progress is slow, the staff in the PMU are gaining valuable experience. After project completion SADCO may have the capacity to manage the future sewerage and drainage investments.

Staff in the new PMU in URENCO are young and relatively inexperienced. This PMU will need considerable organizational strengthening before it will have the capacity to manage a major solid waste management project.

It is recommended that an extensive and intensive program of technical assistance be included with any new ODA loan projects that are to be managed by these PMUs

(2) Alternate Institutional Arrangements for PMUs

1) Current Situation

Currently the PMUs are established within the individuals companies for major projects. Normally the director of the company becomes the director of the PMU. Multi-agency Project Steering Committees are established to supervise the PMUs. A vice-chairman of HPPC chairs these Project Steering Committees. However, there are usually two deputy chairmen: one from TUPWS and one from DPI. This structure allows HPPC to exercise oversight authority over the PMUs.

The advantage of this structure is that it builds the capacity for project management within the individual companies. However, there are problems with this structure:

- it places the PMU at company level – meaning that it will have limited authority given the structure of the Haiphong City Government – however it will have complete responsibility for project implementation
- it requires strong project management capacity in each of the individual companies . This capacity is currently lacking
- As the Director of the Company usually assumes the directorship of the PMU, the workload of the Director is doubled
- major projects are rare and after project completion, the PMU will have no role in the company

2) Project Management Units within TUPWS

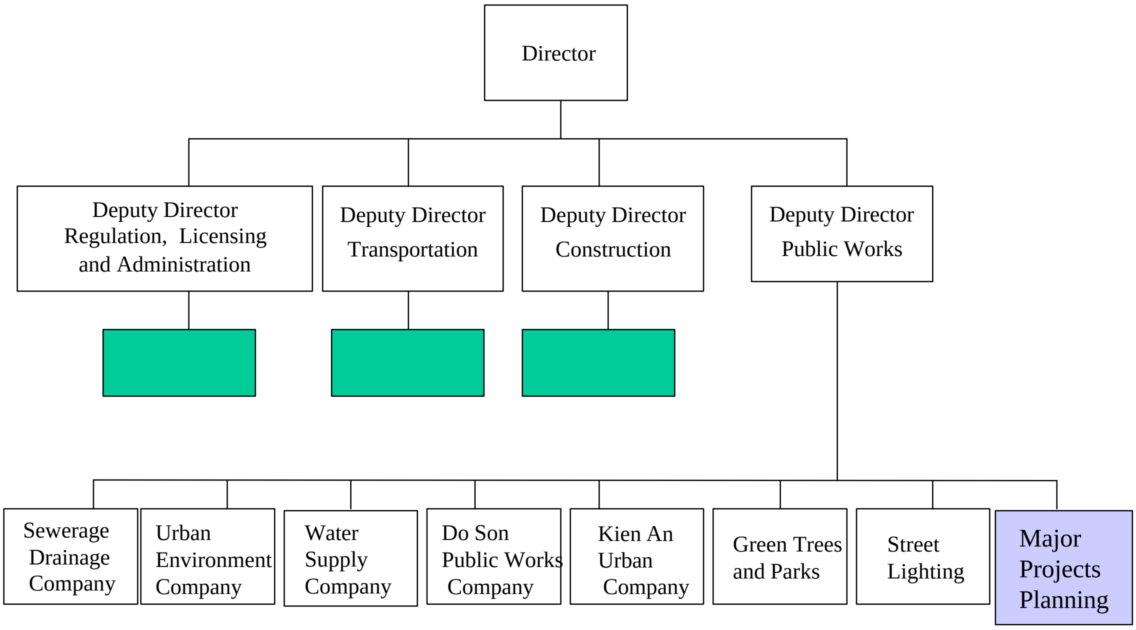
Given these problems and the relatively weak capacity of the existing PMUs in SADCO and URENCO, consideration should be given to formation of PMUs within TUPWS or directly under HPPC. One option is to have the vice-director of TUPWS become the Director of the PMUs that are created for water supply and sanitation projects.

PMUs created within TUPWS should be able to take a broader role in context of the implementation of the overall Sanitation Master Plan. This may mean that a standing or permanent PMU for implementation of all water supply and sanitation projects will need to be set up. For example in Hanoi, the Department of Organization and Personnel and the Government Committee on Organization and Personnel are currently considering a proposal to create a standing sector Project Management Boards for transport, infrastructure (e.g. drainage), environmental improvement (e.g. solid waste, water), and other sectors. The new sector Boards would be responsible for large projects and new investment projects.

7.3.6 Reform of TUPWS

TUPWS is responsible for oversight management and financial control of a large number of organizations. For our purposes, we are primarily concerned with the role of TUPWS in the sanitation sector with regard to: 1) URENCO, 2) SADCO, 3) WSCO, 4) the Kien An Urban Works Company, and the Do Son Public Works Company.

It is proposed that TUPWS be re-organized to formally create a Division of Public Works under the leadership of a Deputy Director. A deputy director with a strong background in water supply, drainage, sewerage, and/or solid waste management will need to be recruited. In addition to the companies that are primarily responsible for public works, this division will have a unit for Major Projects Planning.



(1) Major Projects Planning Unit

The Major Projects Planning Unit will have responsibility for:

- Preparing master plans and schemes for the rehabilitation, upgrading, and repair of construction works within the water supply sector, urban sewerage and drainage sector and solid waste management sectors
- Establishing and supervising project management units (PMUs) for implementation of major infrastructure projects. PMUs will remain under the direct administrative control of TUPWS. In establishing the PMUs, the major projects planning unit will recruit competent technical experts from the appropriate sectoral companies and agencies and or contract outside experts

(2) Role of the Division of Regulation, Licensing, and Administration

TUPWS will also have a division for regulation, licensing, and administration. In addition to general administration for all of TUPWS, the division will concentrate on TUPWS's regulatory responsibilities in the transport and urban public works sectors. It will not have any responsibility for delivery of public services in either of the urban public works or transport sectors. With respect to the sanitation sector, it will discharge TUPWS's state management responsibilities for:

- Assisting HPPC to issue regulations on management, protection, utilization and usage of the facilities in the water supply sector, urban sewerage and drainage sector and solid waste management sectors

- Organizing and directing the management, protection, utilization, and usage of facilities in the water supply sector, urban sewerage and drainage sector and solid waste management sectors
- Granting and withdrawing licenses for households to connect to the water supply system and urban sewerage and drainage system
- Conducting activities for education and propagation of the laws on management, protection, utilization and usage of facilities in the water supply sector, urban sewerage and drainage sector and solid waste management sectors
- Supervising and checking the compliance to the regulations on management, protection, utilization and usage of facilities in the water supply sector, urban sewerage and drainage sector and solid waste management sectors and applying sanctions to violations within their delegated power
- Dealing with conflicts, complaints, and accusations related to the management, protection, utilization and usage of facilities in the water supply sector, urban sewerage and drainage sector and solid waste management sectors

(3) Operating Companies

The operating companies will concentrate on the delivery of public services.

Their participation in master planning and major project planning will be limited to the provision of short term inputs of technical and engineering expertise and to representing the interests of their respect companies during the planning process.

Their participation in project management units will be limited to providing competent technical staff to the project management unit. Of course, the company's senior management will be members of any multi-sector project steering committees created to coordinate project implementation.

(4) A Separate Department of Water Supply and Sanitation

At present TUPWS has responsibility for both the transport and urban public works sector. In the past the transport sector has been by far the most important focus of TUPWS's activities. With the major investments that will be made in the sector, in the next ten years, water supply and sanitation will become more important. To better plan, coordinate, and manage the companies and the new investments in the water supply and sanitation sector, a separate department of water supply and sanitation should be created.

7.4 Economic and Financial Measures

7.4.1 Allocation of Finance for Environmental Projects

Financing of environmental improvement in Haiphong faces problems common to most cities in developing countries which are in the process of transition to market-based, industrializing and increasingly urban-oriented economies.

In Vietnam, the provision of environmental services, such as water supply/sewerage, and solid waste management, as well as of other services, such as electricity supply, has traditionally been under public management. Soft budget constraints have resulted in inefficient operational and financial management, and operating costs have been correspondingly high. Dependence upon subsidies from general revenues rather than charging beneficiaries the full costs of supply have encouraged wasteful use of the natural and other economic resources involved, the result being an excessive burden on the environment. Dependency upon central revenues also creates uncertainty and is an obstacle to long term planning.

Similar issues apply to the control of industrial pollution. Historically, state-owned industrial operations have also faced soft budget constraints, and have been able to pass costs on to the general budget. This has resulted in wasteful use of energy and other natural resources. Efforts to introduce financial incentives to make more efficient use of resources, including the discharge of waste into the natural environment, will only succeed if industrial operations in general are also responsive to changes in prices and costs.

The failure of the totally free market system to achieve an efficient use of natural resources (due largely to the presence of environmental externalities) means that the evolution of the free market system must be accompanied by effective government intervention. Economic/financial as well as regulatory instruments have an important role to play in addressing environmental issues. Criteria for selection of alternative financial instruments should include their contribution to the achievement of technically efficient; economically efficient; or cost-effective solutions, as well as their fiscal and social consequences and administrative feasibility.

Market based instruments (MBIs), which employ economic incentives, can be contrasted to Command and Control (CAC) methods which provide mandatory regulation of the quantity and quality of environmental damage that may be permitted. A major advantage of MBIs, particularly where the cost of environmental damage is fully reflected in the price or tax a polluter or user of a natural resource has to pay, is that resources are allocated more efficiently, and environmental objectives achieved more cheaply, than under physical rationing.

The above criteria are referred to below with regard to developing a financial strategy for (a) Environmental Service Providers and (b) Industrial Air and Water Pollution.

7.4.2 Environmental Service Providers

(1) Solid Waste Management

1) User Charges

In principle, charges for solid waste collection and disposal in Haiphong, as elsewhere, should be based upon the economic costs of the service provided, and these might include residential fees based on volume or household characteristics. However, in practice there appears to be no real prospect of charging individual householders on the basis of the amount of solid waste they generate. To do so would invite illegal dumping and evasion of payment for services provided. So in practice user charges will have to be on a flat rate per household basis.

Recent accounting improvements which identify revenues for solid waste management obtained from households are important, in part because they create an important public awareness of the problem. However, the continued heavy reliance upon general revenues to subsidize the operations of URENCO and the other solid waste agencies in Haiphong reduces the value of this. For future planning, more accurate costing of the services provided for different beneficiary groups and identification of both the costs and potential revenues from households will be a necessary requirement for possible concessionary arrangements with private sector operators.

A distinction should be made between solid waste collection and disposal on the one hand and street cleaning on the other. While the accounting systems of the various solid waste management agencies should reflect the costs of the different types of service, the former should be allocated directly to actual beneficiaries, while costs of the latter, which is a public good, do not depend upon individual waste generation, should be paid for out of general municipal funds.

There are greater prospects of collecting fees from industrial waste dischargers on the basis of the costs they impose. This will require an assessment of the contribution of various sectors to the total waste load and costs of collection and disposal. The feasibility of introducing charges for each type of user should then be tested. A possible result will be to find that with regard to industrial waste, user charges, whether in the form of tipping fees, based on quality and type of waste, or collection fees based on volume, are administratively feasible, and sufficient to cover the total costs involved. For this to occur, a monitoring and regulatory system adequate to prevent evasion of payment and illegal dumping will have to be developed; in practice the first priority should be given to those industries that produce the largest and most environmentally damaging waste.

2) Deposit-Refund Systems and Product Charges

Consideration should also be given to the introduction of deposit-refund systems for products or substances, which can be reused, recycled or which should be returned for destruction. Traditionally operated in many countries for beverage containers for strictly financial purposes the approach this system is eminently suitable for environmental ones. Deposit-refund systems are appropriate for products such as containers, batteries, crates, and car hulks. Since substantial parts of household waste consists of packaging deposit-refund systems, particularly in parallel with a system of product charges, can considerably reduce waste volumes, and in particular to a reduction in the release of toxic substances into the environment, such as from the disposal of batteries or incineration of plastics. Deposit-refund systems may also be used a part of life-cycle management for certain products that require special handling such as electric appliances. A similar administrative mechanism may be used to introduce “product charges” where taxes are levied on products that will eventually involve environmental costs when ultimately disposed of. These are referred to below under the general heading of Environmental Taxes.

It is important, however, to note that many of these interventions cannot be introduced at the city level, but rather at the national level.

3) Financial Management

URENCO has made considerable progress in improving financial management of environmental services in Haiphong in recent years. Expenditures on environmental services have been separated from those on other municipal activities, and a distinction is made between capital and operating costs. Increasingly information is being generated on the allocation of costs between broad categories of waste dischargers, such as industry and households, and steps are being taken to provide more up to date and adequate indicators of efficiency in cost-output terms. Major requirements now are:

- above all, to give the provider of solid waste services (URENCO) greater financial autonomy and stability, by increasing user charges and reducing its financial dependence upon general revenues
- to accelerate computerization of financial management to provide more rapid and comprehensive indicators of performance
- to plan for possible private sector involvement, by increasingly accurate estimation of the real economic costs of the existing service and proposed

long-term expansion plans (this will permit city managers to be in a strong position to negotiate with potential private suppliers)

(2) Water Supply and Sewerage

Financial, as well as technical and other administrative aspects of sewerage management should be addressed together with water supply. The rate of discharge of sewage is determined primarily by the volume of water consumption, which itself is influenced heavily by pricing policy. Thus water and sewerage pricing and cost recovery policies should be seen as a serious tool for determining the desired rate of water consumption.

Good progress has been made in Haiphong in recent years in the water supply sector, so that user charges now approximate the economic costs of supply. Priority now must be to gradually increase charges further, to reflect the associated costs of wastewater collection, treatment and disposal (i.e. sewerage). With regard to the total costs of SADCO's operation, an important distinction may be made between sewerage and drainage. The costs of the former should in principle be borne directly by water consumers, while the latter, which is a public good, available to the whole population, irrespective of individual consumption patterns, should continue to be paid for out of general municipal funds.

Artificially low water prices encourage wasteful use, and generate inadequate revenues for system operation and expansion. Decline in service quality is accompanied by greater difficulty in raising prices, resulting in a vicious circle of underfunding and shortages. The cost to consumers of a service not being available is often more than the cost of expanding the service, even when costs are rising. Underpricing - or subsidization - of water supply and sanitation is therefore unjustified in economic and financial terms. It also tends to have perverse income distributional consequences, placing a fiscal burden on the government, and, by encouraging wasteful use, it is also a detriment to the environment.

Some additional costs may be incurred in reforming this situation. Thus an effective pricing policy would require expanding the number of consumers whose consumption is subject to volumetric measurement (i.e. the costs and benefits of expanding the metering system should be addressed). Nevertheless, the scope for policy reform with its multiple economic, financial and environmental advantages is therefore considerable, and this should be given extremely high priority in Haiphong.

Detailed study is required, but it is probable that an improved pricing/cost recovery system for sewerage would involve including sewerage and sewage treatment costs in the metered water rate where applicable, or in a flat tax per household or commercial or industrial establishment where metering does not exist. (In fact, for larger water users, water metering should be mandatory).

Investment costs may be recovered by means of connection charges or betterment levies.

The points made earlier with regard to financial management for solid waste apply in a general sense equally to water supply and sewerage. The autonomy derived from greater reliance upon revenues from consumers will be conducive to the efficiency of both short term operations as well as long term sectoral planning, including, if desired, the eventual transfer of operations to a private sector operator.

7.4.3 Industrial Air and Water Pollution

The general principles referred to below apply to industrial operations as well as other sectors, such as transportation. The main financial issue relates to the prospects for using environmental taxation of various forms. Taxation may be used to finance regulatory operations, and, more importantly, to influence the amount and quality of waste discharged to the environment. At present, environmental taxation is virtually non-existent in Vietnam.

Ideally, environmental taxes should be set so that waste discharge would take place up to the point that the additional benefit of waste reduction equals the additional cost of achieving it. In principle, one of the main advantages of environmental taxes is that they provide a continuous incentive effect which stimulates waste generators to seek out the least-cost combination of disposal, recycling and reuse that is available to them. However, the efficiency and environmental effectiveness of such instruments is conditioned by the institutional context in which the instruments are introduced. Most developing countries, including Vietnam, lack an extensive and effective waste and pollution control system and enabling agencies, so administrative feasibility is a major constraint.

Various forms of environmental taxation should be considered, as follows:

(1) Effluent or Emission Charges

These should be based upon quantity and quality of effluents discharged by enterprises. In many ways an ideal form of environmental tax, this application of the "polluter pays principle" has merits on efficiency, equity and fiscal grounds. Ideally, charges would equal the economic costs of damages caused, for example to downstream water consumers or fisheries, or the public health costs of air pollution, or the traffic congestion caused by automobile use. Such charges (e.g. based upon sulfur dioxide emissions or on BOD or COD), which reflect marginal damage costs and are levied upon individual dischargers, have the potential advantage of ensuring that ambient quality standards are achieved at least cost to society as a whole since each discharger is given the opportunity to weigh the costs of damage against. the costs of taking remedial abatement measures. Ideally the charges should reflect regional variations in ambient air or water quality objectives.

An advantage of charges is of course that they raise revenues, which may or may not be used for pollution control purposes by government. Difficulties arise with regard to the measurement of damage costs, and in particular to their impact upon health, and thus in determining the appropriate level of charge, but this problem is not unique to the choice of economic instruments. Another serious problem – which again applies to any type of instrument based on plant-level action – is that of determining the responsibility of individual waste dischargers for damages caused, and practicality and cost of the monitoring and enforcement mechanism required. Emission charge policy is generally developed at the national level, but city mayors can take the initiative in setting local standards, as well as playing a major role in enforcement.

(2) Product Charges

Although there is increasing recognition of the advantages of environmental taxation, the administrative problems associated with emission fees have in practice been a major constraint to their introduction. An alternative approach that is becoming more widespread is to make use of blunter instruments which are based on the presumed environmental damage or disposal costs involved in the use of certain materials in production or consumption.

These instruments are known as product charges (or presumptive charges), in which there is a presumed relationship between the use of a resource and its eventual contribution to pollution. In view of the smaller administrative costs associated with presumptive charges, the use of such instruments has been growing at a faster rate in the industrialized countries than effluent or discharge fees. It is also a characteristic of the blunter instruments that they must normally be implemented at the national, rather than the local level.

Product charges can be applied to products or materials that are used in production or consumption in large quantities and diffuse patterns. Items that have been subject to product charges in OECD countries include those on non-returnable beverage, packaging materials, plastic bags, and batteries. Product charges also include special taxes on leaded gasoline, on pesticides, fertilizers, the sulfur content of coal, or on carbon; a sewerage surcharge based upon the volume of water consumed by households is another example.

Product charges correspond more closely to emission fees the more precise the technical relationship between the input used and the quality of the eventual discharge to the environment. In some cases (e.g. carbon) this relationship is remarkably precise, which makes it a particularly effective tax.

Taxes may be levied on the product, or tax differentiation can be used to discourage the use of products that are highly polluting or difficult to dispose of, and at the same time encourage the use of more environmentally friendly alternatives (where however a product is highly toxic and its use should be completely eliminated or substantially reduced, a partial or total ban will be preferable). Product charges may be used both for incentive purposes or for raising revenues. They may be introduced at various points, such as a surtax on import duties, or a surcharge may be placed on the price of products. In principle, charges should be based upon the total cost (including environmental cost) of disposing of the waste material after the product has been utilized.

While not as efficient as effluent taxes, in that they do not encourage improvement in the quality of discharges, they clearly do have some incentive effects, and are relatively easy to administer. In view of this, their consideration should be given high priority in Vietnam. However, such intervention will primarily have to take place at the national, rather than the city level.

(3) Subsidies

Clearly contrary to the "polluter pays principle", governments frequently find subsidization of industrial expenditures on pollution control a necessary complement to pollution taxes or regulatory instruments. Subsidies take a number of forms, including such things as accelerated depreciation for tax purposes or low interest loans. to encourage industries to co-operate in pollution control efforts.

While inefficiencies in capital markets and considerations of equity may justify such subsidies during the transition period, it would be desirable if this policy were to be phased out over time. Explicit subsidization of pollution control equipment may distort investment decisions, e.g. by favoring end-of-pipe treatment rather than (often cheaper) industrial process changes, and of course they impose a fiscal burden on government. Subsidies from national to provincial or municipal agencies may however be justified, even beyond the transition period, on grounds of equity or where cross-jurisdictional benefits may result from environmental improvements. Moreover, subsidies directed at activities that are inherently environmentally beneficial, such as public transport, may also be justified.

(4) Tradable Permits

A variety of other instruments, which make use of economic incentives, may also be employed. These include tradable permits, in which licenses to pollute are allocated among various enterprises, which can then sell those rights to other enterprises. In principle, this, in common with the emission tax, can also result in the least cost means of achieving ambient targets. Certainty in the attainment of environmental targets is also achieved, and the initial issuance of permits can yield revenues.

(5) Pricing of Public Services

The supply and consumption of certain public services, notably electricity supply, are major causes of environmental degradation. As stated earlier with regard to water supply, efficient use of energy requires that prices reflect true economic and environmental damage costs. Such a policy, of critical importance for urban environmental management, also lies outside the jurisdiction of Haiphong City managers, and must be addressed at the national level.

7.4.4 Financial Strategy

Financial strategy for the urban environment in Haiphong, as in other cities, is important not only with regard to the generation of revenue for environmental services and regulation to be performed, but also as a means of influencing the quantity of waste actually generated. The latter has not only environmental implications, but also affects the costs that environmental service providers and regulators have to incur. Financial policy is thus important for both revenues and costs.

The main thrust of financing strategy for Haiphong can therefore be summarized as follows:

- greater financial and operating autonomy for environmental service providers, based on increased user charges
- acceleration of ongoing financial management and accounting reforms for environmental service providers
- consideration of certain environmental taxes for industrial polluters, with priority for deposit-refund measures and product charges; in general, systematically determining the appropriate combination of market based and regulatory instruments in urban environmental management
- continuing on-going price reform in sectors that are responsible for environmental degradation, such as electricity, water supply and transport

Of the above, the first two items fall within the jurisdiction of the Haiphong City government, with the third being primarily under the control of the national government. Under the fourth item, electricity is primarily a national level responsibility, transport is both national and city level, and water supply primarily under the control of the city.

The ability of Haiphong to effectively manage urban environmental problems is therefore seriously constrained by industrial, energy, and certain environmental policies that lie outside its control. As the third largest city in the country, it can however take a proactive role in making the case for national level policy reforms, such as those relating to environmental taxation and resource pricing policy, which will enable not only Haiphong itself, but also other cities in Vietnam, to be more effective in urban environmental management.

It is recognized that pricing and associated reforms will in practice have to be introduced gradually, but the creation of the institutional capacity for implementing such reforms should begin right away. This involves legislation, training, and introduction of the necessary administrative responsibilities.

7.4.5 Cost Recovery

Specific recommendations regarding cost recovery policy for the sub-sectors in which priority projects have been identified, namely drainage; sewerage: and solid waste, are as follows.

(1) Drainage

As a public good, user charges are not necessary, and this function should continue to be financed out of general revenues.

(2) Sewerage

Operational efficiency of the sewerage program will be improved as SADCO becomes more financially autonomous, which requires increasing reliance upon user charges from direct beneficiaries. Although the existing and immediate program is also essentially a public good, this will become less so in future as more properties are connected individually to the sewerage system and their level of water consumption and wastewater discharge will determine the need for future investments in the system.

It would be therefore be appropriate to begin to establish the principle and concept of user charges for sewerage, and develop the required administrative system now, and gradually increase charges. Where water supply is metered, charges should be based on water consumption, otherwise a flat charge will be required; criteria for such a charge require further study. It is recommended that user charges should be gradually increased, so that by the year 2010, 100 % of O&M costs are recovered in the form of user charges. The eventual target should be full cost recovery, including full amortization of investment costs, by 2020. Attainability of this target will be conditional upon the rate of economic policy reform at the macroeconomic level, both with regard to general affordability as measured by GRP, as well as by the rate at which disposable incomes increase in relation to GRP.

It is considered that these targets are easily affordable. For example, data presented in Chapter 9 of this report indicate that recovery of O&M costs (assuming disposable incomes remain as the same proportion of GRP) would require only 0.12 percent of disposable incomes in 2010.

(3) Solid Waste

Operational efficiency of the solid waste program will be improved as the various solid waste companies become more financially autonomous, which requires increasing reliance upon user charges from direct beneficiaries.

As in the case of sewerage, it is recommended that user charges should be gradually increased, so that by the year 2010, 100 % of O&M costs are recovered in the form of user charges, with full cost recovery, including full amortization of investment costs, by 2020. Achievement of this objective should be even more straightforward than for sewerage, because user charges from households and industry already correspond to approximately 25 % of solid waste O and M costs, or 18 % of total costs. The precise structure of the solid waste tariff structure requires further study, with volume-based charges being used wherever feasible, such as tipping fees for industrial users. For households however a flat charge will be required. Approximately 10 % of the costs relate to street sweeping and other communal activities, the costs of which should continue to be borne by the Haiphong City government.

It is considered that these targets are easily affordable. Recovery of O&M costs would require only 0.63 % of disposable incomes in the year 2010.

CHAPTER 8 INITIAL ENVIRONMENTAL EXAMINATION OF THE PROJECTS RECOMMENDED IN SANITATION MASTER PLAN

8.1 Examination Principles

8.1.1 General

The environmental assessment of the project is carried out in two phases. During the master plan study an Initial Environmental Examination (IEE) was carried out to evaluate the impacts of the proposed Sanitation Master Plan on the social and natural environment of the area, and Terms of Reference for Environmental Impact Assessment (EIA) for the Priority Projects were prepared. EIA including necessary surveys will be carried out during the feasibility study.

8.1.2 Vietnamese Environmental Law, Standards and Regulations

(1) Environmental Management

The Ministry of Science, Technology and Environment (MOSTE) is the top decision-making body with overall responsibility within the environmental sector. MOSTE's main role is to assist the Government in the strategies and policy-planning issues related to science, technology and environment. In addition, there are several other agencies involved in the management and protection of the environment.

Within the Ministry, the National Environmental Agency (NEA) is the environmental arm, whose main task is to act as co-ordinating body for other Ministries with environmental responsibilities. It is also in charge of developing legislation and regulations, programme, control and monitoring systems to enforce the protection of the environment throughout the country.

Depending on the local People's Committee, the local environmental authorities have an important role in environmental management and enforcement of regulations.

The National Program on the Environment and Sustainable Development: Framework of Action was published in 1990 and approved by the chairman of the Council of Ministers in June 1992. The framework has seven action programs:

- Urban development and population control
- Management of watershed forests
- Management of coastal regions and river mouths
- Protection of wetland
- Maintenance of biodiversity
- Creation and maintenance of reserves and national parks for wild animals and plants
- Pollution control and waste treatment

A large number of environmental protection laws and regulations have been passed and promulgated over the past few years. Some of the most important are listed as follows:

Vietnamese Environmental Laws and Regulations

Number and Date of Law	Name of Law
Decree No.22/CP 22.5.1993	Tasks, Power and Organization of MOSTE
27.12.1993	Law on Environmental Protection issued according to the order 29-L/CTN 10.1.1994
Decree 175/CP 18.10.1994	Guidance for implementation of the Law on Environmental Protection
Decree No.42/CP 16.7.1996	Issuing Regulation of Construction and Investment Management
Order No.199/TTg 3.4.1997	Measurements in Solid Waste Management in Town and Industrial Areas
Decision No.2920-QD/MTg 21.12.1996	Application of Vietnam Environmental Standards
Decree No.26/CP 26.4.1996	Regulation on Punishment for Administratively Violating Environmental Protection Legislation
Interministral Circular No 1485/TTLB 28.10.1994	A guidelines on organization, authority and scope of activities of the inspection of environmental protection
Circular No 490/1998/TT-BKNHCNMT 29.4.1998	Guidance on Setting up and Appraising the Environmental Impact Assessment Report for Investments Project

(2) The Law on Environmental Protection

In Vietnam, the basic national environmental policy is based on the Law on Organization of the Government (September 30, 1992), the Law on Environmental Protection (December 27, 1993) and the Decree No. 175/CP (October 18, 1994). The Law on Environmental Protection provides the basic framework for environmental protection and management in Vietnam. This law mandates the Central Government's overall responsibility for environmental protection. In general, the Law on Environmental Protection stipulates:

- That polluting activities are strictly prohibited
- That environmental impact assessment of new projects and existing facilities are required
- That the introduction of new technologies or alien species is controlled
- That the government may demand financial contributions for those causing damage to the environment
- Inspection procedures to ensure compliance with the Law
- Procedures for dealing with environmental accidents

The general provisions of the law are described in Chapter 1, which defines the meaning of the term. Article 2 of the Law defines waste, pollutants and environmental pollution as follows:

"Wastes mean substances discharged from daily life, production processes or other activities. Wastes may be in a solid, gaseous, liquid or other forms. Pollutants mean factors that render the environment noxious. Environmental pollution means alteration in the properties of the environment, violating environmental standards."

(3) Laws and Regulations on Environmental Impact Assessment

Articles 17 and 18 describe the EIA-procedure. According to the Law on Environmental Protection, Article 18:

Organizations, individuals when constructing, renovating production areas, population centers or economic, scientific, technical, health, cultural, social, security and defense facilities, owners of foreign investment or joint venture projects, and owners of other socio-economic development projects, must submit EIA reports to the State Management Agency for environmental protection for appraisal. The result of the appraisal of EIA reports shall constitute one of the bases for competent authorities to approve the projects or authorize their implementation. The Government shall stipulate in detail the formats for the preparation and appraisal of EIA reports and shall issue specific regulations with regard to special security and defense establishments mentioned in Article 17 and in this article. The National Assembly shall consider and make decision on projects with major environmental impacts. A schedule of such types of projects shall be determined by the Standing Committee of the National Assembly.

On October 18, 1994, the Government of Vietnam issued a decree providing Guidance for the Implementation of the Law on Environmental Protection, which includes assessment of environmental impacts. This decree, together with other documents needed for an EIA, was published in 1995 by MOSTE as a separate guideline document.

Guidance for Environmental Impact Assessment for Technical-Economic Projects was proposed by MOSTE in September 1993 (No 1485/Mtg). Considering this statement, and an Instruction No 73/Ttg signed by the Prime Minister on December 27, 1993, Haiphong People's Committee has promulgated Instructions on Environmental Impact Assessment of Technical-Economic Projects No 49 CT/UB.

(4) Approval Procedure of EIA

MOSTE is the authority responsiblefor the approval of EIA. The EIA can, however, be appraised by the local DOSTE and further be delivered to HPPC for approval. The EIA-appraisal Council of DOSTE consists of the Chairman, Vice-Chairman and Secretary (who are the Director, Deputy Director and Director of Environmental Department of DOSTE, respectively) and six experts from different departments, depending on the project.

The EIA of this project will be appraised by the Council as a category: New project, and then submitted to MOSTE for approval. The period of time for appraising an EIA report can not be longer than two months from the date when all related documents are received. If the local DOSTE approves the EIA, there will not be any additional two months approval time for MOSTE. The EIA will be, in general, approved in the next appraisal meeting of the council of MOSTE.

(5) Vietnamese Environmental Standards and Regulations

The Government shall stipulate the nomenclature of environmental standards and delegate the authority at different levels for promulgating and supervising the implementation of such standards.

MOSTE has published 1995 Vietnamese Environmental Standards, and standardization work is in progress. In cases where the applicable Vietnamese standard is inadequate, not regulated or applicable, project agencies must obtain MOSTE's approval for the use of equivalent standards of the countries that have provided the technology and equipment to Vietnam, or apply equivalent standard from a third country. At least the following environmental standards are related to wastewater discharge and use of sludge as fertilizer.

Vietnamese Environmental Standards (MOSTE 1995)

Number of standard	Name of Standard
TCVN 5298 – 1995	Requirements to the use of wastewater and their sludge for watering and fertilizing purpose
TCVN 5524 – 1995	General requirements for protecting surface water against pollution
TCVN 5525 – 1995	General requirements for protection of underground water
TCVN 5942 – 1995	Surface water quality standard
TCVN 5943 – 1995	Coastal water quality standard
TCVN 5944 – 1995	Groundwater quality standard
TCVN 5945 – 1995	Industrial wastewater discharge standards
TCVN 5993 – 1995	Guidance on the preservation and handling of samples (ISO 5667-3:1985)
TCVN 5994 – 1995	Guidance on sampling from natural lakes and man-made lakes (ISO 5667-4:1987)
TCVN 5996 – 1995	Guidance on sampling on rivers and streams (ISO 5667-6:1990)
TCVN 5997 – 1995	Guidance on the sampling of wet deposition (ISO 5667-8:1993)
TCVN 5998 – 1995	Guidance on sampling from marine waters (ISO 5667-9:1992)
TCVN 5999 – 1995	Guidance on sampling of wastewater (ISO 567-10:1992)
TCVN 6000 – 1995	Guidance on sampling of groundwater (ISO 5667-11:1992)

Water Quality Limits according to the Vietnamese Standards (MOSTE 1995)

mg/l	Industrial wastewater Category B TCVN 5945-95	Surface water Other use TCVN 5942-95	Coastal water Aquatic cultivation TCVN 5943-95	Groundwater TCVN 5944-95
BOD	50	<25	<10	-
COD	100	<35	-	-
Ammonia (N)	1	1	0.5	-
Suspended solids	100	80	50	-
Coliform (MPN/100ml)	10,000	10,000	1,000	3
As	0.1	0.1	0.01	0.05
Cd	0.02	0.02	0.005	0.01
Cr^{6+}	0.1	0.05	0.05	0.05
Cr	1	1	0.1	-
Pb	0.5	0.1	0.05	0.05
Hg	0.005	0.002	0.005	0.001
Ni	1	1	-	-
Zn	2	2	0.01	5
Fe	5	2	0.1	1-5
Oil	1	0.3	1	-

Besides water related standards there are several standards concerning air quality, noise and soil quality, such as TCVN 5302-1995,the General Requirements for Soil Reclamation.

According to TCVN 5298-1995, Requirements for use of wastewater and sludge for watering and fertilizing purposes, wastewater and sludge should not contain any harmful and toxic matters and the sludge can only be used for fertilizing purposes after treatment of toxic matters. The wastewater and sludge should be tested before use and under control of an environmental management authority. However, there are no required parameters and no maximum allowable concentrations in the standard.

Vietnamese Air Quality and Noise Standards (MOSTE 1995)

Number of standard	Name of Standard
TCVN 5937 - 1995	Air quality – Ambient air quality standards
TCVN 5938 - 1995	Air quality – Maximum allowable concentrations of hazardous substances in ambient air
TCVN 5939 - 1995	Air quality – Industrial emission standards – Inorganic substances and dusts
TCVN 5940 - 1995	Air quality – Industrial emission standards – Organic substances
TCVN 5970 - 1995	Air quality – Planning of ambient air quality monitoring (ISO/TR 4227:1989)
TCVN 5948 - 1995	Acoustics – Road and vehicle noise – Maximum permitted noise level
TCVN 5949 - 1995	Acoustics – Noise in pubic and residential areas – Maximum permitted noise level
TCVN 5964 - 1995	Description and measurement of environmental noise Part 1: Basic quantities and procedures (ISO 1996/1:1982)
TCVN 5965 – 1995	Description And measurement of environmental noise – Part 3: Application to noise limits (ISO 1996/3:1987)

(6) Vietnamese Hygienic Regulations

The Council of Ministries promulgated the Hygienic Regulations and Administrative Penalty in Health Service in July 1991 (No 23/HDBT). These are based on the Organization Law and People Health Protection Law. The content of the regulations is good, but many of these regulations are not monitored or followed. Chapter IV of these regulations concerns hygienic regulations for industrial and domestic waste including wastewater.

(7) Vietnamese Laws for Land Use and Resettlement

The following laws and decrees are of importance in land use planning, land acquisition, resettlement, and the definition of protection zones around a wastewater treatment plant.

These laws and decrees give a general framework for physical planning and the construction of public infrastructure. They also describe the administrative system controlling the planning of infrastructure development in Vietnam. However, they do not clearly identify standards that could be used as a guideline when planning the areas to be reserved for the protection zones. Decree 22/1998 describes the Vietnamese land acquisition and resettlement procedures. The requirement for public relation program is not clearly defined in the law, although Article 34 of the Decree 22 briefly describes the responsibility of resettlement committee to "distribute the declarations, conduct popularization work, …".

Vietnamese Laws and Standards for Land Use and Resettlement

Number and data of law	Name of law
24L/CTN 14.7.1993	The Law on Land
Decree No. 87/CP 17.8.1994	On the price frame for land categories
Decree 22/1998/ND-CP 24.4.1998	Compensation for damage when the State recovers land for use in purposes of national defense, security, national interest and public interest
Decree No. 91/CP, 17.8.1994	Promulgating regulations on urban planning management
Decree No. 18/CP, 13.2.1995	Detailed regulations on applying decree of rights and obligations, which are transferred land and lent land by the Government
Decision of the Ministry of Construction No. 628/BXD – CSXD, 14.12.1996	Vietnamese Construction Regulation and Standards
20TCN-33-85	Design Standard for Water Supply Networks and Water Supply Projects
Ministry of Construction 1998	Instructions for Preparation and Approval of Town Construction Planning

8.1.3 Japanese Environmental Guidelines

Environmental Consideration Guideline for Development Studies (JICA, 1994), OECF Environmental Guidelines (2nd Version) (OECF, 1995), Guide to Preparing an Environmental Impact Assessment (OECF, 1996) and JBIC Environmental Guidelines for ODA Loans (JBIC, 1999) have been followed in the preparation of Initial Environmental Examination of the project.

The guidelines give guiding principles related to environmental consideration by JICA and JBIC in its appraisal of a project. They also give the environmental matters to be considered and environmental measures to be prepared by the recipient country in the planning and preparation stages of a project.

Basic rules for environmental consideration are as follows: A project is to comply with regulations stipulated in the laws and standards of the recipient country relating to the environment. Monitoring and evaluation of project related environmental issues should be carried out. In the planning and implementation of a project, there is to be adequate consideration for people who will be relocated and resettled involuntarily and/or lose a major source of income because of the project. The cost of mitigation measures to conserve the environment, including social environment, is to be included in the project cost.

8.2 Initial Environmental Examination

8.2.1 Water Supply

(1) Project Description

Table below summarizes the water supply component of the Master Plan. Details are explained in Chapter 2.

Outline of Water Supply Master Plan

Target Area	Project Component
Class A Area (Hong Bang, Le Chan and Ngo Quyen)	Expansion of transmission mains, rehabilitation of distribution network and An Duong WTP (Water Treatment Plant), expansion of reservoir capacity by 40,000 m^3, others
Class B Area (Do Son, Kien An, Quan Toan)	Installation of new house connections and meters, rehabilitation of Cay Nguyet WTP and Vat Cach WTP, construction of Hoa Binh intake/WTP, others
Class C Area (Minh Duc, Dinh Vu, New Development Area	Installation of new house connections and meters, construction of new transmission main/service connections in Song He – Cat Bi area, construction of Minh Duc intake/WTP, water supply service in Dinh Vu, others

The main targets for Class A area are to finalize the on-going rehabilitation of distribution main and to increase house connections to essentially 100 %. The targets for Class B area are to reduce high unaccounted-for-water and to expand the network. The target for Class C area is the development of water supply systems.

(2) Impacts

Because the proposed projects are mainly rehabilitation and limited extension of existing facilities, the environmental impact will be limited. Below are brief descriptions of the initial examination.

1) Pollution

No major pollution problem is anticipated from the operation of the water supply facilities, although the sludge from the WTPs must be properly disposed.

The installation and rehabilitation of house connections have to be carried out efficiently, especially in densely populated area because limited traffic problems, noise, dust and other nuisance are unavoidable. Coordination with related civil works, such as installation of sewer lines, is recommended to minimize overall negative environmental impacts of these related civil works.

2) Natural Environment

The project area is generally urban and agricultural area, and there is no area where strict protection of natural environment is required, such as a national park. The area is located on a large delta of Red River system, and natural/semi-natural water systems are abundant. Hence, environmental impact to natural environment will be limited.

3) Human Environment

Overall, the proposed projects are expected to significantly improve the living condition of the Study Area by increasing the access to safe drinking water.

Although the area is abundant in water, most major rivers are not suitable sources for drinking water because they are saline and the concentration of SS is relatively high. Sustainable use of the existing and proposed water resources (e.g., Hoa Binh intake) is important. Should any dispute over water use arise, Haiphong PC should establish a competent committee to resolve the problem.

At this point, no major land acquisition or resettlement is anticipated (see Chapter 2).

8.2.2 Drainage Master Plan

(1) Project Description

System and facility measures for storm water drainage improvement have been identified. They are based on the phased implementation schedule as follows: short term year 2005; mid term year 2010, and long term year 2020. Planning targets have been identified according to the target areas and target drainage levels. Target drainage levels are based on hydrographic and hydrological planning criteria on three levels.

Four options for storm water drainage for Class A area along with drainage proposals for Kien An were proposed to be implemented in two phases. The selected candidate projects are summarized in the following table:

Outline of the Drainage Master Plan Alternatives

Option and area	Project components
Option D1 Le Chan, Ngo Quyen, New Urban Area	Rehabilitation of An Kim Hai Channel (7 km); box sewer (2 km), rehabilitation and construction of tidal gates, construction of Phuong Luu lake, construction of connecting channel (1 km), construction of new main sewer, rehabilitation and construction of other drainage channel, and construction of pumping stations
Option D2 Hong Bang, Le Chan, Ngo Quyen, New Urban Area	All components of Option D1, 6 tidal gates, 6 pumping stations, new sewer (5 km)
Option D3 Hong Bang, Le Chan, Ngo Quyen, New Urban Area	All components of D2, 2 pumping stations at An Kim Hai Channel; new main sewers (5 km)
Option D4 Hong Bang, Le Chan, Ngo Quyen, New Urban Area	All components of D3 but designed to serve higher target drainage level
Kien An	Rehabilitation of existing sewer (10 km), construction of new sewer (5 km), rehabilitation of tidal gate
Do Son	Only natural drainage is proposed

The main advantage of Options D1 and D2 is that these options represent the least expensive alternative to improve storm water drainage in the target areas to a suitable target drainage level. The recommended option is D2.

Emphasis is given to North-East and South-West Channel systems in Phase I, and Old City Center and New Urban Area in Phase II. The timeframe for Phase I is estimated as 5 years. The total timeframe when including Phase II is 10 years.

In Phase I the objective is to rehabilitate An Kim Hai Channel as a drainage channel which will be then connected to the NE and SW Channel systems. Construction of Phuong Luu lake is also included in the drainage system to increase the total storage capacity of the connected system. Functional tidal gates are needed at both ends of An Kim Hai Channel which discharge to tide influenced rivers.

In Phase II the objective for the Old City Center is to provide tidal gates and pumping stations to pump storm water during storms which occur at the same time as high tide. In the Old City Center, several outlets will be blocked and new main sewers to connect to the pumping stations will be implemented to minimize the number of tidal gates and pumping stations. Drainage system of New Urban Area will be rehabilitated including construction of new main sewers, rehabilitation and construction of drainage channels and tidal gates, and construction of pumping stations.

The total area of Phase I drainage catchments is 1,275 ha and Phase II drainage catchments is 3,965 ha, totaling 5,240 ha.

(2) Impacts

1) Pollution

Air pollution problem associated with the operation of the drainage system would be minor. Odor during the construction must be controlled by selecting proper construction methods.

In general, the proposed drainage projects are expected to improve the water quality in channels and lakes due to the increased capacity and flow, and revetment or other rehabilitation of banks. However, it should be noted that the improvement of drainage system does not decrease pollution load to water bodies.

An Kim Hai Channel is very polluted especially in the west end due to discharge of wastewater from houses, over-hung latrines and solid waste dumping. Rehabilitation of An Kim Hai Channel will improve remarkably the water quality in the channel by increasing the flow and controlling the discharge of wastewater from households to the channel.

During the dredging activities, it is important to prevent deterioration of water quality in the downstream by the proper selection of dredging method. The dredged sludge must be transported and disposed in the proper way in the sludge treatment area, e.g. in Trang Cat. To stop further solid waste dumping to the channel, a solid waste management campaign is also recommended.

Construction of new Phuong Luu Lake will increase the storage capacity and most probably also stabilize the water quality.

2) Natural Environment

Rehabilitation of An Kim Hai Channel will improve the ecological conditions of channel because the existing water quality is so bad that only some most tolerant animals and plants can survive in the upper part of the channel.

Landscape will be improved when dirty and formless upper part of An Kim Hai Channel with hundreds of houses and other structures constructed on the banks and partly over the channels will be relocated.

New Phuong Luu lake is proposed to be constructed on the existing agricultural area, and the new lake will most likely increase the value of future urban landscape.

3) Human Environment

The biggest negative impact for human living environment is the need of resettlement along An Kim Hai Channel, where hundreds of households have to be resettled and compensated. Rough estimation is that about 1,300 houses should be relocated.

Other rehabilitation and construction does not cause significant resettlement needs. Proposed Phuong Luu Lake is located in the agricultural area and there are no houses to be relocated, only compensation for agricultural land and cemeteries is needed. The exact location, size and shape of the proposed lake have to be designed to avoid cemeteries nearby. There are no other historical and cultural heritage areas or buildings in the proposed construction areas.

Positive impact of the drainage project will be improved health situation especially along An Kim Hai Channel.

4) Others

Rehabilitation and construction of drainage facilities will cause negative impacts during construction, but these negative impacts can be minimized with proper design and planning of construction activities. In the selection of the dredging method, attention has to be paid to the water quality and environmental issues to prevent further contamination of the water downstream. Dry method could be used for dredging.

Water quality monitoring of An Kim Hai Channel and Phuong Luu Lake should be a part of the general environmental monitoring including duties of DOSTE.

8.2.3 Sewerage Master Plan

(1) Project Description

System and facility measures for sewerage improvement have been identified and based on phased implementation schedule as follows: short term year 2005; mid term year 2010, and long term year 2020. Planning targets have been identified according to target areas and target drainage levels. The target sewerage levels are based on appropriate public health planning criteria.

Four options for sewerage improvement for Class A area along with proposals for Kien An and Do Son were proposed to be implemented in two phases. The selected candidate projects are summarized in the following table:

Outline of the Sewerage Master Plan Alternatives

Option and area	Project components
Option S1 Le Chan, Ngo Quyen, New Urban Area	Construction of 2 WWTPs (Wastewater Treatment Plants), interceptor trunk sewer, interceptor branch sewer, and wastewater pumping stations
Option S2 Hong Bang, Le Chan, Ngo Quyen, New Urban Area	Construction of 6 small-scale WWTPs, trunk separate sewer, small bore branch sewer, wastewater pumping stations, 2 WWTPs, trunk sewer, branch sewer
Option S3 Hong Bang , Le Chan, Ngo Quyen, New Urban Area	Construction of 2 WWTPs, interceptor trunk sewer, interceptor branch sewer, wastewater pumping stations, trunk separate sewer, branch separate sewer
Option S4 Hong Bang, Le Chan, Ngo Quyen, New Urban Area	Construction of 2 WWTPs, separate sewer trunk, separate branch sewer, wastewater pumping stations
Kien An	Phase I Separate system: WWTP, 2 pumping stations, sewer area 7.84 km^2 Phase II Separate system: Simplified system: 3 wastewater treatment facilities,
Do Son	Phase I Simplified system: treatment facility, pumping stations, Phase II Simplified system: treatment facility, pumping station,

The main advantages of Options S1 and S3 are easier construction and faster construction period and septic tanks can be used, but are not needed.

The recommended option is S3.

Sewerage Option S3 is based on combined sewer network with interception of dry weather sewage flows for Le Chan, Ngo Quyen and Hong Bang districts. New Urban Area is based on complete separate system with no septic tanks. The timeframe for Phase I is estimated as 5 years. The total timeframe when including Phase II is 15 years.

System facility measures for S3 include the following:

Phase I

- WWTP to be located near Vinh Niem tidal gate
- 20 km of trunk sewer pipe
- 20 km of interceptor sewers to collect intercepted wastewater
- 1 main wastewater pumping stations and 10 small pumping stations

Phase II – Old City Center

- Expansion of WWTP at Vinh Niem tidal gate
- Interceptor trunk sewer system
- Interceptor branch sewer system
- Wastewater pumping stations

Phase II – New Urban Area

- Expansion of WWTP at Vinh Niem tidal gate
- WWTP at Cam River near Dinh Vu
- Trunk separate system
- Branch and tertiary separate sewer system
- Wastewater pumping stations

(2) Impacts

1) Pollution

Although the proposed WWTPs sites are located in remote agricultural areas, and the immediate odor problem will be localized around the WWTPs, it is still important to further reduce odor problem by selecting appropriate design of treatment facilities.

In the Phase I, the WWTP is proposed to be built near Vinh Niem tidal gate and treated wastewater will be discharged to Lach Tray river. The dilution capacity of Lach Tray is reasonably high due to large flow and tidal impact (see Section 12.5). During Phase II the second WWTP will be constructed by Dinh Vu. Water quality at discharging points and environmental aspects should be considered during the final selection of the discharging locations as well as the treatment method (e.g., aerated lagoon, oxidation ditch, and activated sludge, see Chapter 4).

Protection zones according to the Vietnamese design regulations have to be included in the wastewater treatment plant design.

Construction of sewers and especially construction of interceptors will improve water quality in channels and lakes, and thus improve living conditions and health situation in the city center.

2) Natural Environment

There are no rare or endangered animals or vegetation in the proposed WWTP sites, which has been used for agricultural and aquaculture area, and the impact to natural environment will be small.

WWTPs are totally new structures in the rural landscape especially in Vinh Niem. There should be a fence around the area and trees may be planted to minimize the negative impacts on the landscape.

3) Human Environment

There are no historical and cultural heritage areas or buildings in the proposed construction areas.

The resettlement due to the proposed sewerage projects will be limited because the large facilities, especially WWTPs, are planned in remote agricultural area. Nevertheless, the potential impacts should be fully considered in the final selection of sites in order to minimize the affected residents, and proper land acquisition and compensation procedures must be followed.

4) Others

Construction of sewers, pumping stations and wastewater treatment plant will cause significant temporary impacts, such as traffic interference, dust, noise and other public nuisance. Such problems must be minimized in the construction plans.

The effluent quality from wastewater treatment plants has to be monitored frequently. Effluent has to satisfy Vietnamese standards.

8.2.4 Septage Management

(1) Project Description

System and facility measures for septage and nightsoil management have been identified. They are based on the phased implementation schedule only for short term year 2005. Planning targets have been identified according to target areas and target drainage levels. The target sewerage levels are based on the appropriate public health planning criteria and presented as follows:

- Level A: Wastewater is collected and treated. Septic tanks are not used
- Level B: Wastewater is collected and treated. Septic tanks are used

Elimination or continuation of septic tanks depends on sewerage system adopted. For separate sewerage system, septic tanks are not required. As simplified sewerage system is septic tank based, absolute management of septic tank is prerequisite. For the combined system, it is better to have septic tanks to reduce the inflow of solids into sewers with low gradient.

The proposed system and facility measures are presented in the following table.

Proposed Septage Management Projects

Option	Project components
Septic tank monitoring unit	A monitoring unit within SADCO is to be implemented to check all new construction, to improve existing ones, and to control septage collection and disposal
Collection vehicles	Additional vacuum trucks with a capacity of 25 m^3/day, hand cart based small scale vacuum pumps and one high pressure vacuum pump with 100 m nozzle
Disposal : Independent treatment system	Septage will be treated in waste stabilization pond system

Base line data preparation, installation of Septic Tank Monitoring Unit, and trucks for septage collection are essential and have to be implemented in Phase 1.

(2) Impacts

1) Pollution

There will be offensive odor in the process of emptying, transporting and treating septage. Discharged effluent from septage treatment must be controlled in order to prevent deterioration of the water quality around the facility.

2) Natural Environment

Selection of the disposal method has to fulfill environment and health demand.

Protection zones around the septage treatment facility has to be included to the design according to the Vietnamese regulations.

3) Human Environment

Construction site of the septage treatment plant has to be selected that does not have any historical or cultural heritage area or buildings and densely populated areas has to be avoided to minimize need of resettlement and nuisance to public.

4) Others

Construction of septage treatment plant will cause temporary impacts, such as disruption of traffic, dust, noise and other public nuisance. The construction plans should be developed in order to minimize such impacts.

The effluent quality from septage treatment plants has to be monitored frequently. Effluent has to satisfy Vietnamese standards.

8.2.5 Water Quality Improvement of Lakes and Channels

(1) Project Description

Three system and facility measures other than sewerage development were suggested in order to improve water quality of lakes and channels. They are summarized in the table below.

Outline of the Projects to Improve Water Quality of Lakes and Channels

Project Name	Target Area	Project Component
Installation of Interceptor Sewers	Le Chan and Ngo Quyen	Installation of interceptor sewers (2.6 km) around lakes
Lake Rehabilitation	Le Chan and Ngo Quyen	Rehabilitation of lakes (including dredging)
Strategic Operation of Drainage Systems	All Drainage System	Strategic operation of tidal gates and pumping stations to facilitate flushing of polluted wastewater out from lakes and channels.

* : construction and O&M costs

(2) Impacts

The environmental impacts of the proposed projects for water quality improvement of lakes and channels have been addressed in the EIA Report of 1B Project (1998).

1) Pollution

Minor offensive odor and dust problems are anticipated during the dredging.

During the dredging, temporary degradation of water quality is anticipated. Also, if external waters from Cam River, Lach Tray River and other water bodies are introduced in order to flush the drainage system, the water quality of incoming water has to be monitored.

2) Natural Environment

The project areas are urban areas, and there is no rare or endangered animals or plant species to be protected. However, the lakes and channels form important urban ecosystem which are readily accessible to the local residents. Hence it is recommended to incorporate as much environmental considerations, such as constructing lake/channel beds with natural materials, and maintaining open water surface, to improve environmental conditions of the area.

3) Human Environment

Limited land acquisition and resettlement of affected people are anticipated, e.g., around Tien Nga Lake. Sufficient consultation and compensation must be provided to the affected people.

4) Others

Although the results of sediment analysis did not indicate pollution by heavy metals and other toxic substances, dredged sediment has to be disposed of in an environmentally-sound manner. The disposal method proposed in 1B project should be followed.

8.2.6 Solid waste management

(1) Proposed Priority Projects

Table below summarizes the proposed priority projects.

Outline of Candidates/Candidate Components for the Priority Project for Solid Waste Management

Target Area	Project Components
Ngo Quyen, Le Chan and Hong Bang, Kien An Districts, Do Son Town and Trang Cat Commune	Procurement of waste collection vehicles, (compactors with mechanical lifting device), bins, handcarts, and maintenance facilities
Ngo Quyen, Le Chan and Hong Bang Districts, Trang Cat Commune, and possibly Kien An District	Construction of sanitary Trang Cat Phase 3 Landfill with dykes and facilities for leachate collection and treatment and gas control, procurement of heavy equipment, and training
Ngo Quyen, Le Chan, Hong Bang and Kien An Districts, and Do Son Town	Construction of a hospital waste incinerator with facility for control of flue gas including dioxins, procurement of vehicles for collection, training

(2) Project Description of Waste Collection & Transport Component

For improvement of the sanitary aspect of solid waste discharge, collection, transferring and transport, more “closed” system than the current system is proposed. For improvement of efficiency, (1) the loading of waste into compactors will be mechanized with mechanical lifting devices attached to the compactors, and (2) the direct collection system with bins but without handcarts is proposed.

The following equipment and vehicles are proposed:

- Compactor vehicles with mechanical lifting device
- Bins (with capacity of 240 and 660 liter) that are placed on fixed locations, and bin type handcarts (660 liter) that can be mechanically lifted
- Dustbins at public places, e.g. 240 liter bins that can be mechanically lifted
- Workshop equipment used for vehicle maintenance

(3) Impacts

1) Pollution

No major pollution problem is anticipated.

The proposed collection system is expected to improve sanitary condition of the Study Area by reducing the amount of uncollected waste, and by reducing exposure to solid waste.

The introduction of waste collection vehicles with mechanical lifting device will improve sanitary conditions of streets because waste is not spilled onto the streets when loading into vehicles.

In addition, the resulting elimination of manual loading of waste into vehicle will also bring about substantial improvement of working conditions for waste collection workers and their occupational health situation. The proposed system will be good also for people living near waste transfer points.

Improved collection system, especially dustbins next to lakes and channels, will decrease the amount of solid waste thrown to water bodies.

2) Natural Environment

No significant impact on natural environment and ecosystem is anticipated. The proposed system will help reduce habitats of rats and vermin, which feed on uncollected solid waste.

Landscape around solid waste transfer stations will be improved.

3) Traffic Flow

At present, waste loading into a vehicle from handcarts takes about one hour each time. During this loading operation, the vehicle occupy one side of road, and often affect traffic flow. The introduction of vehicles with mechanical lifting device will also reduce loading time, and results in less impact on traffic flow.

(4) Project Description of Trang Cat Landfill Component

Construction of Trang Cat Phase 3 Landfill Site, approximately 33 ha, and procurement of heavy landfill equipment is proposed to be one of the priority projects. Exact location of the future landfill sites has not officially been determined by HPPC, yet.

The design policy is based on the following:

- Satisfy all the laws, regulations, and guidelines set by Vietnamese government and HPPC
- Apply the Best Available Techniques Not Entailing Excessive Cost (BATNEEC)
- Economically affordable for Haiphong citizens and financial affordable for HPPC

The design will include specification for liner system, leachate collection, leachate treatment, gas collection and ventilation, and filling work.

(5) Impacts

1) Pollution

Landfill will have significant impact on air quality, such as offensive odor, dust, landfill gases, and smoke of uncontrolled fires. Proper management of landfill will be essential for environmentally-sound operation of the land fill.

Leachate will be collected and treated. There is no standard for landfill leachate, but standard for industrial wastewater can be used as reference and quality of treated leachate has to fulfill that. If the treatment system is working in the proper way, the negative impacts of the effluent are insignificant. Discharging point has to be selected so that dilution capacity is the best possible and the discharge area is not used for aquaculture.

HPPC has a plan to construct a new lake next to Dinh Vu by constructing a dyke. If HPPC implements such a plan, it needs to be taken into consideration in the selection and design of discharging point, and there should be separate alternative for short-term and long-term discharging options.

2) Natural Environment

Proposed landfill site is at present used as fishponds. After the construction the ecosystem of the area will be changed totally. However, there are no natural rare or endangered animal or plant species in the proposed area.

The proposed landfill area is already now reserved for landfill use and there is the existing Trang Cat Phase 1 Landfill Site and landscape has already changed from agricultural area to landfill area. To improve the area after the landfill use, landscaping has to be included to the operation plan of the landfill.

3) Human Environment

There are no historical and cultural heritage areas or building in the proposed area.

The plan proposes application of daily cover soil, which would contribute to substantial reduction of generation fires, smoke, rodents, fly, which in turn contribute to the improvement in the working conditions for landfill site workers.

Proposed area is very sparsely inhabited and there are no houses in the vicinity of the proposed area so there is no need for resettlement.

4) Others

During the construction time there will be a lot of extra traffic to the construction site causing temporary nuisance.

Monitoring of leachate and landfill gases has to be arranged according to the Vietnamese regulations.

(6) Project Description of Hospital Waste Incinerator Component

The targets are to treat medical waste with complete elimination of the risk of infection by the most suitable method, and to prevent environmental impact on the neighbors of the treatment facility. Considering the infectious nature of the materials, incineration is considered as the most desirable technique to treat and disinfect medical waste in the Study Area.

It is proposed to install an incinerator with a capacity of 1 – 1.5 ton/day exclusively for medical waste treatment. The incinerator should operate in an optimum condition to minimize dioxin generation. Emission gas from the incinerator should be treated completely in order to prevent dioxin problem as well as air pollution such as black smoke or offensive odor.

200 m^2 of land is needed to construct a small building for incinerator. It is proposed to construct the incinerator at the area of existing landfill site near the existing gate.

(7) Impacts

1) Pollution

Dust, gases, e.g. dioxin problems are possible if the incinerator and/or emission treatment unit is not operated in the proper way.

2) Natural Environment

There will be no impact on ecology.

There will be little impact on landscape because the proposed building is small and located inside the existing landfill area.

3) Human Environment

There are no historical and cultural heritage areas or buildings on the proposed area, and there is no need for resettlement.

4) Others

The negative impacts during construction time will be negligible.

Monitoring of emission gas has to be arranged according to the Vietnamese regulations.

Environmental check lists for each field are shown in the Table 8.2.1 - 8.2.5

Table 8.2.1 Environmental Checklist
Water supply

Category	Check Items	Major	Small	None	Not clear	Problems	Possible Actions and Countermeasures	Remarks
Pollution	1. Disposal of sludge from water treatment plants 2. Water pollution and soil contamination 3. Noise and vibration		X X X			Sludge generated in the water treatment process has to be properly disposed. Installation of transmission mains and service pipes could cause temporary noise and dust problems.	Sludge disposal plan has to be developed and followed. Noise barrier and dust cover may be used.	
Natural Environment	1. Effect of construction and operation of the facilities on the ecology 2. Effect on landscape		X X			Withdrawal of large amount of water may affect the ecology around the intake.	see below	The project area is urban-agricultural area.
Human Environment	1. Effect of the construction and operation of the facilities on the historical and cultural heritage 2. Impact on existing water use right 3. Relocation		X (3)	X (1)	X (2)	Dispute over the use of water (e.g., irrigation). Minor land acquisition is needed.	A committee represented by stakeholders should be formed to resolve water right dispute. Proper consultation and compensation has to be provided to affected residents.	No major land acquisition/ resettlement is anticipated.
Others	1. Environmental monitoring			X				Water quality at the intake has to be regularly monitored.

Table 8.2.2 Environmental Checklist
Drainage

Category	Check Items	Major	Small	None	Not clear	Problems	Possible Actions and Countermeasures	Remarks
Pollution	1. Disposal of dredged sediment	X				Treatment of dredged sludge from An Kim Hai Channel has to be arranged in the proper way to minimize impacts on water and environment quality. Water pollution during dredging is a concern.	Instructions of correct work methods will be given in Contract Document.	The existing sediment quality data do not indicate pollution by heavy metals and other toxic substances.
	2. Effect on aquatic organisms, fisheries, and other water utilization systems		X					
	3. Water pollution and soil contamination	X						
	4. Noise and vibration		X					
Natural Environment	1. Effect of construction and operation of the facilities on the ecology		X			Phuong Luu Lake will be new structure on agricultural area.	Cemeteries near proposed Phuong Luu Lake has to be avoided	Rehabilitation of AKH Channel will improve the landscape.
	2. Effect on landscape		X					
Human Environment	1. Effect of the construction and operation of the facilities on the historical and cultural heritage			X		Several hundred houses along An Kim Hai Channel have to be relocated. Accidental flooding due to mismanagement of drainage system.	Resettlement action plan has to be prepared. Operation manual has to be developed.	The proposed project will markedly reduce the flooding problems.
	2. Accidental flooding		X					
	3. Resettlement	X						
Others	1. Environmental monitoring			X			During the construction, water quality and quality of dredged sediment have to be closely monitored.	Environmental monitoring has to be done before, during and after construction.

Table 8.2.3 Environmental Checklist
Sewerage and Septage

Category	Check Items	Major	Small	None	Not clear	Problems	Possible Actions and Countermeasures	Remarks
Pollution	1. Air pollution generated by the operation of facilities	X				Offensive odor from WWTP and during septage collection. Water pollution might increase locally in effluent discharge point if there are problems in O&M of treatment process.	Environmental aspects have to be considered in the final selection of WWTP and discharging point location.	In general, water pollution will decrease from urban center after wastewater collection and treatment.
	2. Effect on aquatic organisms, fisheries, and other water utilization systems		X					
	3. Water pollution and soil contamination	X						
	4. Noise and vibration		X					
Natural Environment	1. Effect of construction and operation of the facilities on the ecology		X			WWTP in Vinh Niem will be totally new structure in agricultural area.	Planting around WWTPs is recommended in order to minimize odor problem and to improve landscape.	The proposed WWTPs sites are in agricultural area.
	2. Effect on landscape		X					
Human Environment	1. Effect of the construction and operation of the facilities on the historical and cultural heritage			X		Limited resettlement is anticipated at the proposed WWTP in Vinh Niem.	Resettlement action plan has to be prepared.	Wastewater treatment will improve living conditions and health situation.
	2. Effect on existing infrastructure		X					
	3. Resettlement		X					
Others	1. Effect on the environment during the construction period		X			The construction of sewer network will cause temporary noise and traffic problems, especially in urbanized area.	Monitoring program has to be included to EIA report. There has to be monitoring of effluent and water quality in discharging point from WWTPs.	Environmental monitoring has to be done before, during and after construction.
	2. Environmental monitoring			X				

Table 8.2.4 Environmental Checklist
Water Quality Improvement Of Lakes And Channels

Category	Check Items	Major	Small	None	Not clear	Problems	Possible Actions and Countermeasures	Remarks
Pollution	1. Offensive odor and dust problems		X			Temporary degradation of water quality during dredging is anticipated.	Instructions of correct work methods will be given in Contract Document	SADCo already acquired a section of Trang Cat Landfill site.
	2. Water pollution	X						
	3. Noise and vibration		X			The dredged sediment must be properly disposed	Proper disposal of sediment at Trang Cat Landfill site.	
	4. Disposal of dredged sediment	X						
Natural Environment	1. Effect on construction and operation of the facilities on the ecology		X			Important and accessible urban ecosystem may be lost.	Environmentally-friendly design and construction.	
	2. Effect on landscape		X					
Human Environment	1. Effect on the construction and operation of the facilities on the historical and cultural heritage			X		Limited land acquisition and resettlement of affected people are anticipated.	Development of land acquisition and resettlement plan	
	2. Effect on existing infrastructure			X				
	3. Relocation		X					
Others	1. Environmental monitoring			X		.	During the construction, water quality and quality of dredged sediment have to be closely monitored.	

Table 8.2.5 Environmental Checklist
Solid Waste Management (1/2)

Category	Check Items	Major	Small	None	Not clear	Problems	Possible Actions and Countermeasures	Remarks
Pollution	1. Air pollution generated by the operation of facilities	X				Increases in waste collection amount would lead to increases in trips by waste collection vehicles that might cause more air pollution. However, the planned changes in the system of waste loading into vehicles would substantially reduce impacts on traffic flow. Offensive odor from landfill and incinerator is obvious. Rats and vermin might be a problem if collection, transportation and disposal is not done in the proper way. Leachate treatment and effluent discharging has to be arranged in the proper way to minimize adverse impacts.	Instructions of correct work methods will be given in Contract Document	
	2. Effect on aquatic organisms, fisheries, and other water utilization systems		X					
	3. Water pollution and soil contamination	X						
	4. Noise and vibration		X					
Natural Environment	1. Effect on construction and operation of the facilities on the ecology		X			At Trang Cat ecosystem will be changed from fish ponds to landfill. Landfill will change the landscape.		In Trang Cat there is already existing landfill.
	2. Effect on landscape		X					
Human Environment	1. Effect of the construction and operation of the facilities on the historical and cultural heritage			X				There is no need for resettlement. Positive impact on living conditions and health situation in the collection area.
	2. Effect on existing infrastructure		X					
	3. Relocation			X				
	4. Effect on health and sanitation conditions for workers and neighbouring people	X (posi-tive)						

Table 8.2.5 Environmental Checklist
Solid Waste Management (2/2)

Category	Check Items	Major	Small	None	Not clear	Problems	Possible Actions and Countermeasures	Remarks
Others	1. Effect on the environment during the construction period 2. Environmental monitoring		X			There will be limited impacts on aquatic and terrestrial environment during the construction.	Monitoring program has to be included to EIA report. There has to be monitoring of leachate from landfill and air emissions from incinerator.	Environmental monitoring has to be done before, during and after construction.

CHAPTER 9 FINANCIAL REQUIREMENT AND AFFORDABILITY OF THE IMPLEMENTATION OF THE SANITATION MASTER PLAN

9.1 Implementation Schedule of Sanitation Master Plan

The sanitation master plan for Haiphong is consisting of 6 sub-sectors, namely, water supply, drainage, sewerage, septage, lake improvement and solid waste management. The study area of the master plan is also divided into a number of areas. Table 9.1.1 gives the overall implementation schedule by areas and by sectors.

9.2 Financial Requirement

The overall financial requirement for the implementation of the Sanitation Master Plan is summarized below. Details of the costs are given in Table 9.2.1 together with the recurrent costs of the existing facilities.

Capital and Recurrent Costs for SMP

Unit : US$1000

	Period		
	2001~2010	2011~2020	Total
1. Water Supply			
- Capital	46,493	16,162	62,655
- Recurrent	912	2,185	3,097
- Sub-total	47,405	18,347	65,752
2. Drainage			
- Capital	96,645	141,948	238,592
- Recurrent	839	3,311	4,150
- Sub-total	97,484	145,259	242,742
3. Sewerage			
- Capital	94,259	185,969	280,227
- Recurrent	1,871	11,055	12,926
- Sub-total	96,130	197,024	293,153
4. Lake Improvement			
- Capital	2,928	0	2,928
- Recurrent	43	60	103
- Sub-total	2,971	60	3,031
5. Septage			
- Capital	19,368	0	19,368
- Recurrent	2,478	4,130	6,608
- sub-total	21,846	4,130	25,976
6. Solid Waste management			
- Capital	25,965	26,672	52,637
- Recurrent	13,340	9,207	22,548
- Sub-total	39,305	35,880	75,185
Total of Capital	285,657	370,751	656,408
Total of Recurrent	19,483	29,948	49,432
Grand Total	305,140	400,699	705,840

Note: Recurrent costs of the exiting facilities are excluded.
Constant price of June, 2000

Costs include engineering services, administrative costs and physical contingency.

As shown above, US$705.8 million would be required in total for the implementation of the recommended projects and measures for the SMP Project during 20 years from 2001 through 2020, which comprises the capital cost of about US$656.4 million and about US$49.4 million for incremental recurrent costs including O&M and personnel costs.

9.3 Affordability of Implementation

This section addresses the affordability of the Sanitation Master Plan proposed by the Study Team. Financial projections are made of a program which consists of (a) the existing water supply and sanitation program, (b) projects for which financing has been secured or is expected from domestic, international, or bilateral sources, and (c) new projects identified by the Study Team.

Key economic indicators and population data relevant for this analysis are contained in Table 9.3.1 attached. Economic indicators correspond to the Average Growth scenario, described earlier.

Affordability of the proposed program is assessed in terms of the relationship between the cost of the program and alternative indicators, namely:

- Per capita GRP in areas benefiting from the program. This provides an indicator of the feasibility of the programs in terms of the overall economic capacity of the concerned community to pay for the services
- Per capita disposable income of direct beneficiaries. This provides an indicator of the financial feasibility of direct beneficiaries to pay, out of their discretionary household incomes, for the services provided. This information is important in a strategic policy sense. Thus, even though costs of water and sanitation services may be low when compared with GRP, this may not be so when household disposable incomes are concerned. The objective of decentralizing operation and management of water and sanitation services requires a financial system based upon recovery of costs from actual recipients of the services. If the proportion of GRP that is received as disposable income is low, this may frustrate the objective of decentralization. The relationship between the costs of the water and sanitation program and disposable incomes thus provides some indication as to how realistic are the prospects for the effective autonomy of the utilities concerned
- Total HPPC expenditures. This provides an indication of the fiscal feasibility of the proposed programs for Haiphong City government. This is particularly important for solid waste and for sewerage and drainage, even though an increasing proportion of costs are to be recovered in the form of user charges or fees. It is much less of an important indicator for water supply, which is rapidly becoming financially independent of HPPC. To the extent that decentralization and financial self-sufficiency of SADCO and URENCO take place, this indicator will become less important in the case of sanitation services as well

9.3.1 Cost of the Sanitation Master Plan for Haiphong

Costs of the master plan proposed by the Study Team are analyzed below in terms of the following components: (a) water supply (b) drainage (c) sewerage (d) lake improvement (e) septage, and (f) solid waste.

In the following table, investment costs are presented in two ways. First, there is the cash cost, representing the cost of physical resources (labor, land, and materials) in the year they are actually employed. These costs therefore show considerable variation from one year to the next.

Secondly, investment costs are amortized, thereby showing how much it will cost, year by year, to repay loans required to finance the program. It is assumed in this report that funds will be borrowed on terms that correspond on average to a 25-year loan at a 5 % interest rate. In practice, of course, the terms may be more or less favorable than this, and feasibility of any particular investment would have to be assessed in light of the actual funding terms that are available.

The 25 year – 5 % assumption is thus used for illustrative purposes, in the absence of any precise information on actual financing or lending terms. Note that even if funds are provided in grant form, or on a more favorable basis than the above, they still may represent opportunities foregone, and will thus typically involve real economic costs to the recipient.

The costs of the Sanitation Master Plan, showing both measures of investment cost, are summarized in the following table. (Details by sector are contained in Table 9.3.2 (A-F), attached.

Sanitation Master Plan Cost Summary

(US$'000, 2000 prices)

Year	Capital Cost (Cash Basis)	Cumulative Amortized Capital Costs	Recurrent Cost	Total Cost (Cash)	Total Cost (Amortized Capital plus Recurrent)
2001	7,274	516	3,694	10,968	4,210
2002	28,080	2,508	4,023	32,103	6,531
2003	30,365	4,663	4,556	34,921	9,219
2004	60,229	8,936	4,977	65,206	13,913
2005	40,519	11,811	6,244	46,763	18,055
2006	39,988	14,648	6,618	46,606	21,266
2007	26,103	16,501	7,534	33,637	24,035
2008	21,738	18,043	8,100	29,838	26,143
2009	19,464	19,424	8,683	28,147	28,107
2010	11,898	20,268	9,144	21,042	29,412
2011	42,755	23,302	9,649	52,404	32,951
2012	52,243	27,008	10,203	62,446	37,211
2013	53,474	30,803	10,933	64,407	41,736
2014	39,590	33,612	11,673	51,263	45,285
2015	32,383	35,909	12,256	44,639	48,165
2016	30,450	38,070	13,358	43,808	51,428
2017	29,554	40,167	14,420	43,974	54,587
2018	29,674	42,272	15,491	45,165	57,763
2019	30,963	44,469	16,582	47,545	61,051
2020	29,665	46,574	17,631	47,296	64,205

All subsequent estimates in this section use amortized values for investment costs, and all costs and values of indicators are presented in constant prices. The following table presents costs of the program in terms of the various sub-programs or sectors, and clearly shows that in terms of total expenditures, water supply and sewerage are of the major importance, followed by solid waste and drainage, with septage, and, particularly lake improvement, being much less significant.

Total Sanitation Master Plan Costs by Sector

(US$'000, 2000 prices)

Year	Water Supply	Drainage	Sewerage	Lake Improve-ment	Septage	Solid Waste	Total
2001	2,747	219	0	24	0	1,220	4,210
2002	3,368	1,271	0	73	458	1,363	6,533
2003	3,726	2,516	140	145	917	1,777	9,221
2004	4,725	4,114	710	212	1,375	2,779	13,915
2005	5,756	4,631	1,977	214	1,788	3,693	18,059
2006	6,705	5,189	3,359	214	1,788	4,016	21,271
2007	7,097	5,786	4,853	214	1,788	4,299	24,037
2008	7,327	6,530	5,734	214	1,788	4,553	26,146
2009	7,572	7,057	6,624	214	1,788	4,856	28,111
2010	7,833	7,207	7,261	214	1,788	5,112	29,415
2011	8,349	8,364	8,895	214	1,788	5,345	32,955
2012	8,935	9,532	11,183	214	1,788	5,563	37,215
2013	9,499	10,551	13,661	214	1,788	6,026	41,739
2014	10,074	11,563	14,928	214	1,788	6,721	45,288
2015	10,581	12,573	15,987	214	1,788	7,027	48,170
2016	11,364	13,583	17,048	214	1,788	7,436	51,433
2017	12,081	14,594	18,108	214	1,788	7,807	54,592
2018	12,798	15,603	19,167	214	1,788	8,197	57,767
2019	13,515	16,613	20,227	214	1,788	8,699	61,056
2020	14,232	17,623	21,286	214	1,788	9,067	64,210

Note:Costs = Investment cost on amortized basis plus recurrent costs.

These comparisons are highlighted in the next table, which presents the foregoing information in percentage terms.

Ratios of the Sanitation Master Plan Cost by Sector

(percentages)

Year	Water Supply	Drainage	Sewerage	Lake Improve-ment	Septage	Solid Waste	Total
2001	65.2 %	5.2 %	0.0 %	0.6 %	0.0 %	29.0 %	100.0 %
2002	51.6 %	19.5 %	0.0 %	1.1 %	7.0 %	20.9 %	100.0 %
2003	40.4 %	27.3 %	1.5 %	1.6 %	9.9 %	19.3 %	100.0 %
2004	34.0 %	29.6 %	5.1 %	1.5 %	9.9 %	20.0 %	100.0 %
2005	31.9 %	25.6 %	10.9 %	1.2 %	9.9 %	20.5 %	100.0 %
2006	31.5 %	24.4 %	15.8 %	1.0 %	8.4 %	18.9 %	100.0 %
2007	29.5 %	24.1 %	20.2 %	0.9 %	7.4 %	17.9 %	100.0 %
2008	28.0 %	25.0 %	21.9 %	0.8 %	6.8 %	17.4 %	100.0 %
2009	26.9 %	25.1 %	23.6 %	0.8 %	6.4 %	17.3 %	100.0 %
2010	26.6 %	24.5 %	24.7 %	0.7 %	6.1 %	17.4 %	100.0 %
2011	25.3 %	25.4 %	27.0 %	0.6 %	5.4 %	16.2 %	100.0 %
2012	24.0 %	25.6 %	30.0 %	0.6 %	4.8 %	14.9 %	100.0 %
2013	22.8 %	25.3 %	32.7 %	0.5 %	4.3 %	14.4 %	100.0 %
2014	22.2 %	25.5 %	33.0 %	0.5 %	3.9 %	14.8 %	100.0 %
2015	22.0 %	26.1 %	33.2 %	0.4 %	3.7 %	14.6 %	100.0 %
2016	22.1 %	26.4 %	33.1 %	0.4 %	3.5 %	14.5 %	100.0 %
2017	22.1 %	26.7 %	33.2 %	0.4 %	3.3 %	14.3 %	100.0 %
2018	22.2 %	27.0 %	33.2 %	0.4 %	3.1 %	14.2 %	100.0 %
2019	22.1 %	27.2 %	33.1 %	0.4 %	2.9 %	14.2 %	100.0 %
2020	22.2 %	27.4 %	33.2 %	0.3 %	2.8 %	14.1 %	100.0 %

Note:Costs = Investment cost on amortized basis plus recurrent costs.

These tables show that a considerable increase in the sanitation program is proposed, with total costs increasing from about US$4 million in 2001 to US$64 million by 2020. The increase in importance of the sewerage sector is substantial: it is estimated by the Study Team to cost a negligible amount in the base year, but would account for 33 % of the program by 2020. Drainage grows from a very low base to a steady proportion of about one quarter of the program throughout the period. Combining sewerage and drainage, there is an increase from 5 % to over 61 % of the program by 2020. There is a corresponding reduction in the relative importance of water supply, which falls from 65 % of the program to 22 %. Solid waste management shows a similar pattern, with a reduction in percentage terms over the period, from about 29 % to 14 %, but as in the case of other major sectors, its costs in absolute terms will continue to increase.

One obvious explanation for the declining relative importance of water supply is that the system is already quite well developed, and incremental requirements are relatively small, particularly when compared to sewerage and drainage, which both start from an extremely low base. The relative decline of solid waste is similarly explained. However, data limitations, particularly toward the end of the period, are another explanation. For example, the water supply program cost estimates are assumed constant for the last five years of the period.

Due to the extreme uncertainties involved in such long-term projections it is proposed that, in terms of the affordability of the program, that years 2005 and 2010 should receive the focus of attention.

The tables show that in year 2005, water supply, drainage and solid waste are the major components (accounting for 32 %, 26 %, and 21 % of total costs respectively). However, by 2010, water supply, drainage, and sewerage will each account for about one quarter of the program, with solid waste accounting for 17 %.

Lake improvement will involve some investment costs in the first few years, with just recurrent costs for the remainder; total costs are very small. Although somewhat more costly than the lake improvement program, the same pattern applies in the case of septage.

The costs of the Sanitation Master Plan may now be compared with certain key indicators to allow judgment to be made about their affordability. This is shown in the following table. Detailed information, showing program costs as a percentage of population and income indicators by sub-sector is shown in Tables 9.3.3 to 9.3.8, attached. The methodology and assumptions used to estimate the values of key indicators such as GRP, disposable income, and HPPC expenditure, have been explained earlier in this report.

Total Sanitation Master Plan Costs in Relation to Key Indicators

(percentages)

Year	Total Cost (US$'000)	Cost as % Of GRP in Study Area a	Cost as % of GRP in Haiphong b	Cost as % of HPPC Exp. c1	Cost as % of HPPC Exp. c2	Cost as % of Disp. Inc. Study Area d	Per Capita Cost in Study Area See note) e	Per Capita Cost in Haiphong (See note) F
2001	4,210	1.0 %	0.6 %	6.6 %	2.3 %	1.9 %	7.4	2.5
2002	6,531	1.4 %	0.9 %	9.6 %	4.6 %	2.8 %	11.4	3.8
2003	9,219	1.8 %	1.1 %	12.7 %	7.6 %	3.7 %	15.9	5.2
2004	13,913	2.6 %	1.6 %	18.0 %	11.9 %	5.2 %	23.7	7.8
2005	18,055	3.1 %	2.0 %	22.1 %	15.0 %	6.3 %	30.5	10.0
2006	21,266	3.3 %	2.1 %	23.4 %	16.0 %	6.5 %	35.5	11.7
2007	24,035	3.3 %	2.2 %	24.0 %	16.9 %	6.6 %	39.7	13.0
2008	26,143	3.2 %	2.2 %	23.9 %	17.2 %	6.5 %	42.7	14.0
2009	28,107	3.2 %	2.1 %	23.7 %	17.3 %	6.3 %	45.4	14.9
2010	29,412	3.1 %	2.1 %	23.0 %	16.9 %	6.1 %	47.0	15.4
2011	32,951	3.2 %	2.2 %	24.3 %	18.1 %	6.4 %	52.1	17.1
2012	37,211	3.4 %	2.3 %	25.9 %	19.7 %	6.9 %	58.2	19.1
2013	41,736	3.6 %	2.5 %	27.5 %	21.2 %	7.3 %	64.6	21.2
2014	45,285	3.8 %	2.5 %	28.3 %	22.0 %	7.5 %	69.4	22.7
2015	48,165	3.8 %	2.6 %	28.7 %	22.4 %	7.6 %	73.1	23.9
2016	51,428	3.9 %	2.6 %	29.2 %	22.8 %	7.8 %	77.3	25.3
2017	54,587	3.9 %	2.7 %	29.6 %	23.1 %	7.9 %	81.2	26.5
2018	57,763	4.0 %	2.7 %	30.1 %	23.4 %	8.0 %	85.1	27.8
2019	61,051	4.1 %	2.7 %	30.5 %	23.7 %	8.1 %	89.1	29.1
2020	64,205	4.1 %	2.8 %	30.8 %	24.0 %	8.2 %	92.8	30.3

Notes
1) Costs = Investment cost on amortized basis plus recurrent costs.
2) Costs in c2 column exclude those of water supply sector.

As the above table shows, per capita costs of the program are expected to increase at a rapid rate, e.g. in the Study Area they will grow from about US$7 in 2001 to US$30 in 2005 and to US$47 in 2010. However, based upon the assumptions made about the predicted growth in incomes in Haiphong, they continue to represent a reasonable proportion of GRP at least throughout the first phase of the program, i.e. up to 2010. Thus in year 2005, total program cost is expected to be 3 % of GRP in the Study Area (i.e. where the primary beneficiaries live), and 2 % for Haiphong City as a whole. These percentages remain about the same in 2010.

However, when seen in relation to disposable incomes, this picture changes significantly. As described earlier in this report, disposable incomes are estimated to be 50 % of GRP. Consequently, program costs as a proportion of disposable incomes in the Study Area will be 6.3 % in 2005, and 6.1 % in 2010.

It will be noted that in the preceding table there are two indicators relating to HPPC expenditures. The first (column c1) uses total Sanitation Master Plan costs; the second (column c2) excludes the costs of water supply, because these costs are now recovered directly from consumers in the form user charges. The table implies that all other costs are borne by HPPC, which is a slight overstatement, since already about 20 % of the costs of solid waste management and a small proportion of sewerage costs are now recovered in the form of user charges, and this is expected to increase still further in the future.

Even subtracting the element of costs covered by user charges, the Master Plan will account for a relatively significant increase in the proportion of total public expenditures that will have to be allocated to the program, i.e. 15 % in 2005 and 17 % in 2010. In practice, this projection will obviously be heavily dependent upon progress made in transferring the financial burden to consumers in the form of user charges.

Improvement in the efficiency of public services in the sanitation field requires financial autonomy (as is being achieved for water supply) and thus increasing reliance upon user charges rather than funding from general public revenues. As noted, in year 2010 the program will cost about 3 % of GRP in the Study Area, which gives grounds for optimism about its affordability for the community as a whole. However, the fact that this corresponds to a fairly large 6 % of disposable income, appears to be a considerable constraint in transferring the burden to actual consumers in the form of user charges. And the very rough data we have about the post-2010 period suggests that this problem will get worse.

In practice the financial viability of the overall program will be almost totally dependent upon the rate of economic growth. Close monitoring of costs and income data will thus be required, and if necessary the program would have to be modified or phased out over a longer time period if the estimated key indicators vary significantly from those currently forecast.

A key issue is therefore the rate of economic policy reform, which will be required if the Average Growth scenario is to be achieved. A particularly important aspect of this concerns the relationship between GRP and disposable incomes. Fiscal decentralization and financial autonomy for sanitation services requires a system of cost recovery from user charges. If affordable for the community as a whole, this requires that a greater share of GRP would have to be distributed to the population for their discretionary expenditure. Thus the rate at which HPPC can effectively devolve responsibility to specialized sanitation agencies, thereby reducing its own financial burden in this area will be more rapid, the quicker the reform in the Vietnamese economy as a whole.

A more precise judgment is made about affordability of individual components of the program, and their sensitivity to assumptions about key indicators and cost estimates in the Feasibility Study (Volume 2 of this report). There estimates are made of the incomes and the number of people directly benefiting from investments in the priority projects, but the general conclusion from the preceding aggregate analysis is that the cost of the Sanitation Master Plan appears to be affordable for Haiphong in general and for the Study Area in particular, in terms of the overall capacity of the community to pay, as long as the economic growth rates are in general as predicted. However, efficiency, and presumably cost-effectiveness of the program, will be enhanced if HPPC's direct financial responsibility for the bulk of these operations is reduced and replaced by a system of user charges.

Table 9. 1. 1 Overall Implementation Schedule by Sector and by Area

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1. Water Supply																					
1) Hong Bang, Le Chan&Ngo Quyen areas																					
2) Quan Toan area																					
3) Kien An area																					
4) Minh Duc area																					
5) Dinh Vu area																					
6) New Development arae																					
7) Do Son area																					
2. Drainage																					
1) Hong Bang, Le Chan&Ngo Quyen areas																					
2) Quan Toan area																					
3) Kien An area																					
4) Minh Duc area																					
5) Dinh Vu area																					
6) New Development arae																					
7) Do Son area																					
3. Sewerage																					
1) Hong Bang, Le Chan&Ngo Quyen areas																					
2) Quan Toan area																					
3) Kien An area																					
4) Minh Duc area																					
5) Dinh Vu area																					
6) New Development arae																					
7) Do Son area																					
4. Lake Improvement																					
1) Hong Bang, Le Chan&Ngo Quyen areas																					
2) Quan Toan area																					
3) Kien An area																					
4) Minh Duc area																					
5) Dinh Vu area																					
6) New Development arae																					
7) Do Son area																					
5. Septage																					
1) Hong Bang, Le Chan&Ngo Quyen areas																					
2) Quan Toan area																					
3) Kien An area																					
4) Minh Duc area																					
5) Dinh Vu area																					
6) New Development arae																					
7) Do Son area																					
6. Solid Waste Management																					
1) Hong Bang, Le Chan&Ngo Quyen areas																					
2) Quan Toan area																					
3) Kien An area																					
4) Minh Duc area																					
5) Dinh Vu area																					
6) New Development area																					
7) Do Son area																					

Table 9.2.1 Sanitation Master Plan Costs and Recurring Costs of Existing Facilities (1/6) (Water Supply)

US $ 1.00 = VND 14,072 , Unit: 1,000US$

		1 st Stage Project										Sub-total	2 nd Stage Project										Sub-total	Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
1. Water Supply																								
1) Hong Bang, Le Chan&Ngo Quyen areas																								
Capital cost		6,582	5,365	490	8,119	8,042	8,410	0	0	0	0	**37,008**	1,817	2,002	1,965	1,817	1,817	0	0	0	0	0	**9,418**	**46,426**
Recurring costs		0	0	65	65	65	65	90	90	90	90	**620**	90	90	90	90	90	135	135	135	135	135	**1,125**	**1,745**
Recurring costs including existing cost		1,470	1,591	1,812	1,956	2,110	2,164	2,393	2,533	2,698	2,859	**21,586**	3,045	3,235	3,425	3,615	3,805	4,272	4,739	5,206	5,673	6,140	**43,155**	**64,741**
2) Quan Toan area																								
Capital cost		0	0	20	0	0	457	0	0	0	0	**477**	610	795	0	0	0	0	0	0	0	0	**1,405**	**1,882**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0		**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
3) Kien An area																								
Capital cost		0	124	79	1,827	1,827	1,831	0	0	0	0	**5,688**	0	271	464	271	0	0	0	0	0	0	**1,006**	**6,694**
Recurring costs		0	0	0	0	0	0	20	20	20	20	**80**	20	20	20	20	20	20	20	20	20	20	**200**	**280**
Recurring costs including existing cost		810	920	1,010	1,080	1,180	1,240	1,350	1,440	1,520	1,620	**12,170**	1,754	1,884	2,014	2,144	2,274	2,524	2,774	3,024	3,274	3,524	**25,190**	**37,360**
4) Minh Duc area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	333	632	613	475	271	0	0	0	0	0	**2,324**	**2,324**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	35	35	35	35	35	**175**	**175**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	35	35	35	35	35	**175**	**175**
5) Dinh Vu area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
6) New Development area																								
Capital cost		0	0	47	634	609	610	0	0	0	0	**1,900**	0	19	136	285	68	0	0	0	0	0	**508**	**2,408**
Recurring costs		0	0	0	0	0	0	20	20	20	20	**80**	20	20	20	20	20	34	34	34	34	34	**270**	**350**
Recurring costs including existing cost		0	0	0	0	0	0	20	20	20	20	**80**	20	20	20	20	20	34	34	34	34	34	**270**	**350**
7) Do Son area																								
Capital cost		0	0	25	480	457	458	0	0	0	0	**1,420**	0	25	255	746	475	0	0	0	0	0	**1,501**	**2,921**
Recurring costs		0	0	0	0	0	0	33	33	33	33	**132**	33	33	33	33	33	50	50	50	50	50	**415**	**547**
Recurring costs including existing cost		0	0	0	0	0	0	33	33	33	33	**132**	33	33	33	33	33	50	50	50	50	50	**415**	**547**
Capital cost	0	6,582	5,489	661	11,060	10,935	11,766	0	0	0	0	**46,493**	2,760	3,744	3,433	3,594	2,631	0	0	0	0	0	**16,162**	**62,655**
Recurring costs	0	0	0	65	65	65	65	163	163	163	163	**912**	163	163	163	163	163	274	274	274	274	274	**2,185**	**3,097**
Total : Capital + Recurring		6,582	5,489	726	11,125	11,000	11,831	163	163	163	163	**47,405**	2,923	3,907	3,596	3,757	2,794	274	274	274	274	274	**18,347**	**65,752**
Recurring costs including existing cost	0	2,280	2,511	2,822	3,036	3,290	3,404	3,796	4,026	4,271	4,532	**33,968**	4,852	5,172	5,492	5,812	6,132	6,915	7,632	8,349	9,066	9,783	**69,205**	**103,173**
Total for SMP: Capital + Recurring +Existing	**0**	**8,862**	**8,000**	**3,483**	**14,096**	**14,225**	**15,170**	**3,796**	**4,026**	**4,271**	**4,532**	**80,461**	**7,612**	**8,916**	**8,925**	**9,406**	**8,763**	**6,915**	**7,632**	**8,349**	**9,066**	**9,783**	**85,367**	**165,828**

Note: Constant Price of June 2000
Includes engineering services, administrative costs and physical contingency

Table 9.2.1 Sanitation Master Plan Costs and Recurring Costs of Existing Facilities (2/6) (Drainage)

US $ 1.00 = VND 14,072 , Unit: 1,000US$

		1 st Stage Project										Sub-total	2 nd Stage Project										Sub-total	Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
2. Drainage																								
1) Hong Bang, Le Chan&Ngo Quyen areas																								
Capital cost		151	14,825	17,559	21,233	7,156	7,722	8,281	10,281	7,322	1,912	**96,441**	14,321	14,321	12,409	12,409	12,409	12,409	12,409	12,409	12,409	12,409	**127,912**	**224,353**
Recurring costs		0	0	0	91	100	110	120	134	142	142	**839**	173	205	237	268	299	330	362	393	424	455	**3,146**	**3,985**
Recurring costs including existing cost		208	208	208	299	308	318	328	342	350	350	**2,919**	381	413	445	476	507	538	570	601	632	663	**5,226**	**8,145**
2) Quan Toan area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
3) Kien An area																								
Capital cost		0	0	0	0	0	0	0	0	0	204	**204**	1,548	1,643	1,439	1,344	1,344	1,344	1,344	1,344	1,344	1,344	**14,036**	**14,240**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	3	8	13	16	19	22	25	28	31	**165**	**165**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	3	8	13	16	19	22	25	28	31	**165**	**165**
4) Minh Duc area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
5) Dinh Vu area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
6) New Development area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
7) Do Son area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Capital cost	0	151	14,825	17,559	21,233	7,156	7,722	8,281	10,281	7,322	2,116	**96,645**	15,869	15,964	13,848	13,753	13,753	13,753	13,753	13,753	13,753	13,753	**141,948**	**238,592**
Recurring costs	0	0	0	0	91	100	110	120	134	142	142	**839**	173	208	245	281	315	349	384	418	452	486	**3,311**	**4,150**
Total : Capital + Recurring		151	14,825	17,559	21,324	7,256	7,832	8,401	10,415	7,464	2,258	**97,484**	16,042	16,172	14,093	14,034	14,068	14,102	14,137	14,171	14,205	14,239	**145,259**	**242,742**
Recurring costs including existing cost	0	208	208	208	299	308	318	328	342	350	350	**2,919**	381	416	453	489	523	557	592	626	660	694	**5,391**	**8,310**
Total for SMP: Capital + Recurring +Existing	**0**	**359**	**15,033**	**17,767**	**21,532**	**7,464**	**8,040**	**8,609**	**10,623**	**7,672**	**2,466**	**99,564**	**16,250**	**16,380**	**14,301**	**14,242**	**14,276**	**14,310**	**14,345**	**14,379**	**14,413**	**14,447**	**147,339**	**246,902**

Note: Constant Price of June 2000
Includes engineering services, administrative costs and physical contingency

Table 9.2.1 Sanitation Master Plan Costs and Recurring Costs of Existing Facilities (3/6) (Sewerage)

US $ 1.00 = VND 14,072 , Unit: 1,000US$

		1 st Stage Project										Sub-total	2 nd Stage Project										Sub-total	Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
3. Sewerage																								
1) Hong Bang, Le Chan&Ngo Quyen areas																								
Capital cost		0	0	1,970	7,157	13,197	13,197	10,432	7,666	7,666	5,453	**66,737**	17,979	24,009	24,009	11,948	11,948	11,948	11,948	11,948	11,948	11,948	**149,632**	**216,369**
Recurring costs		0	0	0	0	0	0	309	309	426	426	**1,470**	426	473	653	834	867	901	935	968	1,002	1,035	**8,094**	**9,564**
Recurring costs including existing cost		0	0	0	0	0	0	309	309	426	426	**1,470**	426	473	653	834	867	901	935	968	1,002	1,035	**8,094**	**9,564**
2) Quan Toan area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	47	47	47	47	47	47	47	47	47	47	**470**	**470**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	1	1	1	1	**5**	**5**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	1	1	1	1	1	**5**	**5**
3) Kien An area																								
Capital cost		0	0	0	792	3,615	4,804	4,804	2,426	2,426	2,653	**21,520**	3,743	5,970	5,970	1,516	1,516	1,516	1,516	1,516	1,516	1,516	**26,295**	**47,815**
Recurring costs		0	0	0	0	0	0	0	95	106	118	**319**	129	141	203	264	271	278	285	292	299	306	**2,468**	**2,787**
Recurring costs including existing cost		0	0	0	0	0	0	0	95	106	118	**319**	129	141	203	264	271	278	285	292	299	306	**2,468**	**2,787**
4) Minh Duc area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	228	228	228	228	228	228	228	228	228	228	**2,280**	**2,280**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	1	1	2	2	3	3	4	4	5	**25**	**25**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	1	1	2	2	3	3	4	4	5	**25**	**25**
5) Dinh Vu area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
6) New Development arae																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	198	198	198	198	198	198	198	198	198	198	**1,980**	**1,980**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	1	1	2	2	3	3	4	4	**20**	**20**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	1	1	2	2	3	3	4	4	**20**	**20**
7) Do Son area																								
Capital cost		0	0	0	83	1,047	1,474	1,474	620	620	683	**6,001**	666	937	937	396	396	396	396	396	396	396	**5,312**	**11,313**
Recurring costs		0	0	0	0	0	0	0	26	27	29	**82**	30	31	39	46	47	48	49	50	51	52	**443**	**525**
Recurring costs including existing cost		0	0	0	0	0	0	0	26	27	29	**82**	30	31	39	46	47	48	49	50	51	52	**443**	**525**
Capital cost	0	0	0	1,970	8,032	17,859	19,475	16,710	10,712	10,712	8,789	**94,259**	22,861	31,389	31,389	14,333	14,333	14,333	14,333	14,333	14,333	14,333	**185,969**	**280,227**
Recurring costs	0	0	0	0	0	0	0	309	430	559	573	**1,871**	585	646	897	1,147	1,189	1,233	1,276	1,318	1,361	1,403	**11,055**	**12,926**
Total : Capital + Recurring		0	0	1,970	8,032	17,859	19,475	17,019	11,142	11,271	9,362	**96,130**	23,446	32,035	32,286	15,480	15,522	15,566	15,609	15,651	15,694	15,736	**197,024**	**293,153**
Recurring costs including existing cost	0	0	0	0	0	0	0	309	430	559	573	**1,871**	585	646	897	1,147	1,189	1,233	1,276	1,318	1,361	1,403	**11,055**	**12,926**
Total for SMP: Capital + Recurring + Existing	**0**	**0**	**0**	**1,970**	**8,032**	**17,859**	**19,475**	**17,019**	**11,142**	**11,271**	**9,362**	**96,130**	**23,446**	**32,035**	**32,286**	**15,480**	**15,522**	**15,566**	**15,609**	**15,651**	**15,694**	**15,736**	**197,024**	**293,153**

Note: Constant Price of June 2000

Includes engineering services, administrative costs and physical contingency

Table 9.2.1 Sanitation Master Plan Costs and Recurring Costs of Existing Facilities (4/6) (Lake Improvement)

US $ 1.00 = VND 14,072 , Unit: 1,000US$

		1 st Stage Project										Sub-total	2 nd Stage Project										Sub-total	Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
4. Lake Improvement																								
1) Hong Bang, Le Chan&Ngo Quyen areas																								
Capital cost		335	677	1,005	911	0	0	0	0	0	0	**2,928**	0	0	0	0	0	0	0	0	0	0	**0**	**2,928**
Recurring costs		0	1	2	4	6	6	6	6	6	6	**43**	6	6	6	6	6	6	6	6	6	6	**60**	**103**
Recurring costs including existing cost		0	1	2	4	6	6	6	6	6	6	**43**	6	6	6	6	6	6	6	6	6	6	**60**	**103**
2) Quan Toan area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
3) Kien An area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
4) Minh Duc area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
5) Dinh Vu area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
6) New Development arae																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
7) Do Son area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Capital cost	0	335	677	1,005	911	0	0	0	0	0	0	**2,928**	0	0	0	0	0	0	0	0	0	0	**0**	**2,928**
Recurring costs	0	0	1	2	4	6	6	6	6	6	6	**43**	6	6	6	6	6	6	6	6	6	6	**60**	**103**
Total : Capital + Recurring		**335**	**678**	**1,007**	**915**	**6**	**6**	**6**	**6**	**6**	**6**	**2,971**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**60**	**3,031**
Recurring costs including existing cost	0	0	1	2	4	6	6	6	6	6	6	**43**	6	6	6	6	6	6	6	6	6	6	**60**	**103**
Total for SMP: Capital + Recurring + Existing	**0**	**335**	**678**	**1,007**	**915**	**6**	**6**	**6**	**6**	**6**	**6**	**2,971**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**60**	**3,031**

Note: Constant Price of June 2000

Includes engineering services, administrative costs and physical contingency

Table 9.2.1 Sanitation Master Plan Costs and Recurring Costs of Existing Facilities (5/6) (Septage)

US $ 1.00 = VND 14,072 , Unit: 1,000US$

		1 st Stage Project										Sub-total	2 nd Stage Project										Sub-total	Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
5. Septage																								
1) Hong Bang, Le Chan&Ngo Quyen areas																								
Capital cost		0	6,456	6,456	6,456	0	0	0	0	0	0	**19,368**	0	0	0	0	0	0	0	0	0	0	**0**	**19,368**
Recurring costs		0	0	0	0	413	413	413	413	413	413	**2,478**	413	413	413	413	413	413	413	413	413	413	**4,130**	**6,608**
Recurring costs including existing cost		0	0	0	0	413	413	413	413	413	413	**2,478**	413	413	413	413	413	413	413	413	413	413	**4,130**	**6,608**
2) Quan Toan area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
3) Kien An area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
4) Minh Duc area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
5) Dinh Vu area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
6) New Development arae																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
7) Do Son area																								
Capital cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Recurring costs including existing cost		0	0	0	0	0	0	0	0	0	0	**0**	0	0	0	0	0	0	0	0	0	0	**0**	**0**
Capital cost	0	0	6,456	6,456	6,456	0	0	0	0	0	0	**19,368**	0	0	0	0	0	0	0	0	0	0	**0**	**19,368**
Recurring costs	0	0	0	0	0	413	413	413	413	413	413	**2,478**	413	413	413	413	413	413	413	413	413	413	**4,130**	**6,608**
Total : Capital + Recurring		0	6,456	6,456	6,456	413	413	413	413	413	413	**21,846**	413	413	413	413	413	413	413	413	413	413	**4,130**	**25,976**
Recurring costs including existing cost	0	0	0	0	0	413	413	413	413	413	413	**2,478**	413	413	413	413	413	413	413	413	413	413	**4,130**	**6,608**
Total for SMP: Capital + Recurring + Existing	**0**	**0**	**6,456**	**6,456**	**6,456**	**413**	**413**	**413**	**413**	**413**	**413**	**21,846**	**413**	**413**	**413**	**413**	**413**	**413**	**413**	**413**	**413**	**413**	**4,130**	**25,976**

Note: Constant Price of June 2000
Includes engineering services, administrative costs and physical contingency

Table 9.2.1 Sanitation Master Plan Costs and Recurring Costs of Existing Facilities (6/6) (solid Waste & Grand Total)

US $ 1.00 = VND 14,072 , Unit: 1,000US$

		1 st Stage Project										Sub-total (01-10)	2 nd Stage Project										Sub-total (11-20)	Total (2001-2020)
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
6. Solid Waste Management																								
6.1 URENCO																								
Capital cost		148	564	1,724	9,477	4,469	857	946	537	960	563	**20,245**	1,048	762	4,080	7,599	1,040	997	1,121	789	1,238	1,118	**19,793**	**40,038**
Recurring costs		0	0	0	0	1,771	1,809	1,837	1,863	1,887	1,915	**11,085**	1,928	1,943	1,909	1,922	0	0	0	0	0	0	**7,704**	**18,788**
Recurring costs including existing cost		923	990	1,149	1,232	1,771	1,976	2,137	2,286	2,439	2,581	**17,484**	2,673	2,766	2,857	2,950	3,087	3,266	3,455	3,659	3,872	4,056	**32,640**	**50,124**
6.2 Kien An Public Works Company																								
Capital cost		7	60	398	1,441	28	86	87	117	342	101	**2,668**	117	272	372	130	461	1,247	177	130	427	233	**3,567**	**6,234**
Recurring costs		0	0	0	0	204	204	204	204	204	204	**1,224**	204	204	204	204	0	0	0	0	0	0	**816**	**2,040**
Recurring costs including existing cost		151	162	177	190	234	260	285	310	333	355	**2,457**	376	397	412	433	461	496	532	571	614	649	**4,941**	**7,399**
6.3 Do Son Public Works Company																								
Capital cost		51	8	592	1,619	71	83	79	92	128	329	**3,052**	101	112	352	181	165	120	171	670	1,212	228	**3,313**	**6,365**
Recurring costs		0	0	0	0	172	172	172	172	172	172	**1,031**	172	172	172	172	0	0	0	0	0	0	**688**	**1,719**
Recurring costs including existing cost		132	151	198	216	222	241	260	287	312	334	**2,353**	364	387	402	423	445	472	514	549	590	627	**4,774**	**7,127**
Capital cost		206	633	2,714	12,538	4,569	1,025	1,113	745	1,430	993	25,965	1,266	1,146	4,804	7,911	1,667	2,365	1,468	1,588	2,878	1,579	**26,672**	**52,637**
Recurring costs		0	0	0	0	2,147	2,185	2,213	2,239	2,263	2,291	13,340	2,304	2,319	2,285	2,298	0	0	0	0	0	0	**9,207**	**22,548**
Total : Capital + Recurring		**206**	**633**	**2,714**	**12,538**	**6,716**	**3,211**	**3,326**	**2,984**	**3,694**	**3,284**	**39,305**	**3,570**	**3,466**	**7,090**	**10,209**	**1,667**	**2,365**	**1,468**	**1,588**	**2,878**	**1,579**	**35,880**	**75,185**
Recurring costs including existing cost		1,206	1,303	1,524	1,638	2,227	2,477	2,682	2,883	3,084	3,270	22,294	3,412	3,550	3,672	3,806	3,993	4,234	4,501	4,779	5,076	5,332	**42,356**	**64,650**
Total for SMP: Capital + Recurring + Existing		**1,412**	**1,936**	**4,238**	**14,175**	**6,796**	**3,503**	**3,794**	**3,628**	**4,514**	**4,262**	**48,259**	**4,678**	**4,696**	**8,476**	**11,716**	**5,660**	**6,599**	**5,970**	**6,367**	**7,954**	**6,912**	**69,028**	**117,287**
TOTAL OF THE 6 SECTORS																								
1. Grand Total Capital Cost		7,274	28,080	30,365	60,229	40,519	39,988	26,103	21,738	19,464	11,898	285,657	42,755	52,243	53,474	39,590	32,383	30,450	29,554	29,674	30,963	29,665	370,751	656,408
2. Grand Total Recurring Cost		0	1	67	160	2,731	2,779	3,224	3,385	3,546	3,588	19,483	3,644	3,755	4,009	4,308	2,086	2,275	2,353	2,429	2,506	2,582	29,948	49,432
3. Grand Total : Capital + Recurring (1+2)		7,274	28,081	30,432	60,389	43,250	42,767	29,327	25,123	23,010	15,486	305,140	46,400	55,999	57,484	43,898	34,469	32,725	31,907	32,103	33,469	32,247	400,699	705,840
4. Grand Total Recurring costs including existing cost		3,694	4,023	4,556	4,977	6,244	6,618	7,534	8,100	8,683	9,144	**63,573**	9,649	10,203	10,933	11,673	12,256	13,358	14,420	15,491	16,582	17,631	**132,197**	**195,770**
5. Grand Total for SMP : Capital + Recurring +Existing (1+4)		**10,968**	**32,103**	**34,922**	**65,206**	**46,763**	**46,606**	**33,636**	**29,838**	**28,147**	**21,041**	**349,230**	**52,405**	**62,446**	**64,407**	**51,262**	**44,639**	**43,808**	**43,974**	**45,165**	**47,545**	**47,296**	**502,948**	**852,178**

Note: Constant Price of June 2000
Includes engineering services, administrative costs and physical contingency

Table 9.3.1 Key Economic Indicators and Population, Study Area and Haiphong

($'US '000, 2000 prices)

Year	GRP in Study Area	GRP in Haiphong	HPPC Expenditure	Disposable Income in Study Area	Study Area Population	Haiphong Population
2001	432,050	705,042	63,493	216,025	567,387	1,717,491
2002	467,528	755,728	68,057	233,764	573,785	1,737,503
2003	503,007	806,413	72,621	251,503	580,183	1,757,516
2004	538,485	857,099	77,186	269,243	586,581	1,777,529
2005	573,999	907,785	81,750	287,000	592,579	1,797,542
2006	651,992	1,009,928	90,957	325,996	599,245	1,819,898
2007	729,985	1,112,070	100,164	364,992	605,911	1,842,254
2008	807,978	1,214,213	109,371	403,989	612,576	1,864,610
2009	885,971	1,316,356	118,578	442,985	619,242	1,886,966
2010	963,928	1,418,570	127,786	481,964	625,908	1,909,322
2011	1,024,310	1,507,938	135,836	512,155	632,517	1,930,587
2012	1,084,692	1,597,306	143,886	542,346	639,126	1,951,853
2013	1,145,074	1,686,673	151,936	572,537	645,735	1,973,118
2014	1,205,456	1,776,041	159,986	602,728	652,344	1,994,384
2015	1,265,838	1,865,409	168,036	632,919	658,953	2,015,649
2016	1,326,220	1,954,777	176,086	663,110	665,556	2,036,658
2017	1,386,602	2,044,144	184,136	693,301	672,160	2,057,666
2018	1,446,984	2,133,512	192,186	723,492	678,763	2,078,675
2019	1,507,366	2,222,880	200,236	753,683	685,367	2,099,683
2020	1,567,713	2,312,212	208,286	783,856	691,970	2,120,692

Table 9.3.2 Sanitation Master Plan: Program Costs, Water Supply, Drainage, Sewerage, Lake Improvement, Septage, Solid Waste (1/3)

A. Water Supply ($ '000, 2000 prices)

Year	Capital Costs	Amortized Capital Costs (5%/25 yrs)	Cumulative Amortized Capital Costs	Total Recurrent Costs	Total Water Supply Costs
2001	6,582	467	467	2,280	2,747
2002	5,489	389	857	2,511	3,368
2003	661	47	904	2,822	3,726
2004	11,060	785	1,689	3,036	4,725
2005	10,935	776	2,466	3,290	5,756
2006	11,766	835	3,301	3,404	6,705
2007	0	0	3,301	3,796	7,097
2008	0	0	3,301	4,026	7,327
2009	0	0	3,301	4,271	7,572
2010	0	0	3,301	4,532	7,833
2011	2,760	196	3,497	4,852	8,349
2012	3,744	266	3,763	5,172	8,935
2013	3,433	244	4,007	5,492	9,499
2014	3,594	255	4,262	5,812	10,074
2015	2,631	187	4,449	6,132	10,581
2016	0	0	4,449	6,915	11,364
2017	0	0	4,449	7,632	12,081
2018	0	0	4,449	8,349	12,798
2019	0	0	4,449	9,066	13,515
2020	0	0	4,449	9,783	14,232

B. Drainage

Year	Capital Costs	Amortized Capital Costs (5%/25yrs)	Cumulative Amortized Capital Costs	Total Recurrent Costs	Total Drainage Costs
2001	151	11	11	208	219
2002	14,825	1,052	1,063	208	1,271
2003	17,559	1,246	2,308	208	2,516
2004	21,233	1,507	3,815	299	4,114
2005	7,156	508	4,323	308	4,631
2006	7,722	548	4,871	318	5,189
2007	8,281	588	5,458	328	5,786
2008	10,281	729	6,188	342	6,530
2009	7,322	520	6,707	350	7,057
2010	2,116	150	6,857	350	7,207
2011	15,869	1,126	7,983	381	8,364
2012	15,964	1,133	9,116	416	9,532
2013	13,848	983	10,098	453	10,551
2014	13,753	976	11,074	489	11,563
2015	13,753	976	12,050	523	12,573
2016	13,753	976	13,026	557	13,583
2017	13,753	976	14,002	592	14,594
2018	13,753	976	14,977	626	15,603
2019	13,753	976	15,953	660	16,613
2020	13,753	976	16,929	694	17,623

Table 9.3.2 Sanitation Master Plan: Program Costs, Water Supply, Drainage, Sewerage, Lake Improvement, Septage, Solid Waste (2/3)

C. Sewerage

Year	Capital Costs	Amortized Capital Costs (5%/25yrs)	Cumulative Amortized Capital Costs	Total Recurrent Costs	Total Sewerage Costs
2001	0	0	0	0	0
2002	0	0	0	0	0
2003	1,970	140	140	0	140
2004	8,032	570	710	0	710
2005	17,859	1,267	1,977	0	1,977
2006	19,475	1,382	3,359	0	3,359
2007	16,710	1,186	4,544	309	4,853
2008	10,712	760	5,304	430	5,734
2009	10,712	760	6,065	559	6,624
2010	8,789	624	6,688	573	7,261
2011	22,861	1,622	8,310	585	8,895
2012	31,389	2,227	10,537	646	11,183
2013	31,389	2,227	12,764	897	13,661
2014	14,333	1,017	13,781	1,147	14,928
2015	14,333	1,017	14,798	1,189	15,987
2016	14,333	1,017	15,815	1,233	17,048
2017	14,333	1,017	16,832	1,276	18,108
2018	14,333	1,017	17,849	1,318	19,167
2019	14,333	1,017	18,866	1,361	20,227
2020	14,333	1,017	19,883	1,403	21,286

D. Lake Improvement

Year	Capital Costs	Amortized Capital Costs (5%/25yrs)	Cumulative Amortized Capital Costs	Total Recurrent Costs	Total Lake Improvement Costs
2001	335	24	24	0	24
2002	677	48	72	1	73
2003	1,005	71	143	2	145
2004	911	65	208	4	212
2005	0	0	208	6	214
2006	0	0	208	6	214
2007	0	0	208	6	214
2008	0	0	208	6	214
2009	0	0	208	6	214
2010	0	0	208	6	214
2011	0	0	208	6	214
2012	0	0	208	6	214
2013	0	0	208	6	214
2014	0	0	208	6	214
2015	0	0	208	6	214
2016	0	0	208	6	214
2017	0	0	208	6	214
2018	0	0	208	6	214
2019	0	0	208	6	214
2020	0	0	208	6	214

Table 9.3.2 Sanitation Master Plan: Program Costs, Water Supply, Drainage, Sewerage, Lake Improvement, Septage, Solid Waste (3/3)

E. Septage

Year	Capital Costs	Amortized Capital Costs (5%/25yrs)	Cumulative Amortized Capital Costs	Total Recurrent Costs	Total Septage Costs
2001	0	0	0	0	0
2002	6,456	458	458	0	458
2003	6,456	458	917	0	917
2004	6,456	458	1,375	0	1,375
2005	0	0	1,375	413	1,788
2006	0	0	1,375	413	1,788
2007	0	0	1,375	413	1,788
2008	0	0	1,375	413	1,788
2009	0	0	1,375	413	1,788
2010	0	0	1,375	413	1,788
2011	0	0	1,375	413	1,788
2012	0	0	1,375	413	1,788
2013	0	0	1,375	413	1,788
2014	0	0	1,375	413	1,788
2015	0	0	1,375	413	1,788
2016	0	0	1,375	413	1,788
2017	0	0	1,375	413	1,788
2018	0	0	1,375	413	1,788
2019	0	0	1,375	413	1,788
2020	0	0	1,375	413	1,788

F. Solid Waste

Year	Capital Costs	Amortized Capital Costs (5%/25yrs)	Cumulative Amortized Capital Costs	Total Recurrent Costs	Total Solid Waste Costs
2001	206	15	15	1,206	1,220
2002	633	45	60	1,303	1,363
2003	2,714	193	252	1,524	1,777
2004	12,538	890	1,142	1,638	2,779
2005	4,569	324	1,466	2,227	3,693
2006	1,025	73	1,539	2,477	4,016
2007	1,113	79	1,618	2,682	4,299
2008	745	53	1,670	2,883	4,553
2009	1,430	101	1,772	3,084	4,856
2010	993	70	1,842	3,270	5,112
2011	1,266	90	1,932	3,412	5,345
2012	1,146	81	2,013	3,550	5,563
2013	4,804	341	2,354	3,672	6,026
2014	7,911	561	2,916	3,806	6,721
2015	1,667	118	3,034	3,993	7,027
2016	2,365	168	3,202	4,234	7,436
2017	1,468	104	3,306	4,501	7,807
2018	1,588	113	3,419	4,779	8,197
2019	2,878	204	3,623	5,076	8,699
2020	1,579	112	3,735	5,332	9,067

Table 9.3.3 Water Supply Program Costs as Percentage of Key Indicators

values in 2000 prices

Year	Cumulative Amortized Capital Costs ($US'000)	O and M Cost ($US'000)	Total Cost ($US'000)	Total Cost as % of Study Area GRP (%)	Total Cost as % of Haiphong GRP (%)	Total Cost as % of Study Area Disp. Inc. (%)	Annual Per Cap. Cost in Study Area ($)	Annual per Cap. Cost in Haiphong ($)
2001	467	2,280	2,747	0.64	0.39	1.27	4.84	1.60
2002	857	2,511	3,368	0.72	0.45	1.44	5.87	1.94
2003	904	2,822	3,726	0.74	0.46	1.48	6.42	2.12
2004	1,689	3,036	4,725	0.88	0.55	1.75	8.06	2.66
2005	2,466	3,290	5,756	1.00	0.63	2.01	9.71	3.20
2006	3,301	3,404	6,705	1.03	0.66	2.06	11.19	3.68
2007	3,301	3,796	7,097	0.97	0.64	1.94	11.71	3.85
2008	3,301	4,026	7,327	0.91	0.60	1.81	11.96	3.93
2009	3,301	4,271	7,572	0.85	0.58	1.71	12.23	4.01
2010	3,301	4,532	7,833	0.81	0.55	1.63	12.51	4.10
2011	3,497	4,852	8,349	0.82	0.55	1.63	13.20	4.32
2012	3,763	5,172	8,935	0.82	0.56	1.65	13.98	4.58
2013	4,007	5,492	9,499	0.83	0.56	1.66	14.71	4.81
2014	4,262	5,812	10,074	0.84	0.57	1.67	15.44	5.05
2015	4,449	6,132	10,581	0.84	0.57	1.67	16.06	5.25
2016	4,449	6,915	11,364	0.86	0.58	1.71	17.07	5.58
2017	4,449	7,632	12,081	0.87	0.59	1.74	17.97	5.87
2018	4,449	8,349	12,798	0.88	0.60	1.77	18.85	6.16
2019	4,449	9,066	13,515	0.90	0.61	1.79	19.72	6.44
2020	4,449	9,783	14,232	0.91	0.62	1.82	20.57	6.71

Table 9.3.4 Drainage Program Costs as Percentage of Key Indicators

values in 2000 prices

Year	Cumulative Amortized Capital Costs ($US'000)	O and M Cost ($US'000)	Total Cost ($US'000)	Total Cost as % of Study Area GRP (%)	Total Cost as % of Haiphong GRP (%)	Total Cost as % of HPPC Exp. (%)	Total Cost as % of Study Area Disp. Inc. (%)	Annual Per Cap. Cost in Study Area ($)	Annual per Cap. Cost in Haiphong ($)
2001	11	208	219	0.05	0.03	0.34	0.10	0.39	0.13
2002	1,063	208	1,271	0.27	0.17	1.87	0.54	2.21	0.73
2003	2,308	208	2,516	0.50	0.31	3.47	1.00	4.34	1.43
2004	3,815	299	4,114	0.76	0.48	5.33	1.53	7.01	2.31
2005	4,323	308	4,631	0.81	0.51	5.66	1.61	7.81	2.58
2006	4,871	318	5,189	0.80	0.51	5.70	1.59	8.66	2.85
2007	5,458	328	5,786	0.79	0.52	5.78	1.59	9.55	3.14
2008	6,188	342	6,530	0.81	0.54	5.97	1.62	10.66	3.50
2009	6,707	350	7,057	0.80	0.54	5.95	1.59	11.40	3.74
2010	6,857	350	7,207	0.75	0.51	5.64	1.50	11.51	3.77
2011	7,983	381	8,364	0.82	0.55	6.16	1.63	13.22	4.33
2012	9,116	416	9,532	0.88	0.60	6.62	1.76	14.91	4.88
2013	10,098	453	10,551	0.92	0.63	6.94	1.84	16.34	5.35
2014	11,074	489	11,563	0.96	0.65	7.23	1.92	17.73	5.80
2015	12,050	523	12,573	0.99	0.67	7.48	1.99	19.08	6.24
2016	13,026	557	13,583	1.02	0.69	7.71	2.05	20.41	6.67
2017	14,002	592	14,594	1.05	0.71	7.93	2.10	21.71	7.09
2018	14,977	626	15,603	1.08	0.73	8.12	2.16	22.99	7.51
2019	15,953	660	16,613	1.10	0.75	8.30	2.20	24.24	7.91
2020	16,929	694	17,623	1.12	0.76	8.46	2.25	25.47	8.31

Table 9.3.5 Sewerage Program Costs as Percentage of Key Indicators

values in 2000 prices

Year	Cumulative Amortized Capital Costs ($US'000)	O and M Cost ($US'000)	Total Cost ($US'000)	Total Cost as % of Study Area GRP (%)	Total Cost as % of Haiphong GRP (%)	Total Cost as % of HPPC Exp. (%)	Total Cost as % of Study Area Disp. Inc. (%)	Annual Per Cap. Cost in Study Area ($)	Annual per Cap. Cost in Haiphong ($)
2001	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2002	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2003	140	0	140	0.03	0.02	0.19	0.06	0.24	0.08
2004	710	0	710	0.13	0.08	0.92	0.26	1.21	0.40
2005	1,977	0	1,977	0.34	0.22	2.42	0.69	3.34	1.10
2006	3,359	0	3,359	0.52	0.33	3.69	1.03	5.61	1.85
2007	4,544	309	4,853	0.66	0.44	4.85	1.33	8.01	2.63
2008	5,304	430	5,734	0.71	0.47	5.24	1.42	9.36	3.08
2009	6,065	559	6,624	0.75	0.50	5.59	1.50	10.70	3.51
2010	6,688	573	7,261	0.75	0.51	5.68	1.51	11.60	3.80
2011	8,310	585	8,895	0.87	0.59	6.55	1.74	14.06	4.61
2012	10,537	646	11,183	1.03	0.70	7.77	2.06	17.50	5.73
2013	12,764	897	13,661	1.19	0.81	8.99	2.39	21.16	6.92
2014	13,781	1,147	14,928	1.24	0.84	9.33	2.48	22.88	7.49
2015	14,798	1,189	15,987	1.26	0.86	9.51	2.53	24.26	7.93
2016	15,815	1,233	17,048	1.29	0.87	9.68	2.57	25.62	8.37
2017	16,832	1,276	18,108	1.31	0.89	9.83	2.61	26.94	8.80
2018	17,849	1,318	19,167	1.32	0.90	9.97	2.65	28.24	9.22
2019	18,866	1,361	20,227	1.34	0.91	10.10	2.68	29.51	9.63
2020	19,883	1,403	21,286	1.36	0.92	10.22	2.72	30.76	10.04

Table 9.3.6 Lake Improvement Program Costs as Percentage of Key Indicators

values in 2000 prices

Year	Cumulative Amortized Capital Costs ($US'000)	O and M Cost ($US'000)	Total Cost ($US'000)	Total Cost as % of Study Area GRP (%)	Total Cost as % of Haiphong GRP (%)	Total Cost as % of HPPC Exp. (%)	Total Cost as % of Study Area Disp. Inc. (%)	Annual Per Cap. Cost in Study Area ($)	Annual per Cap. Cost in Haiphong ($)
2001	24	0	24	0.01	0.00	0.04	0.01	0.04	0.01
2002	72	1	73	0.02	0.01	0.11	0.03	0.13	0.04
2003	143	2	145	0.03	0.02	0.20	0.06	0.25	0.08
2004	208	4	212	0.04	0.02	0.27	0.08	0.36	0.12
2005	208	6	214	0.04	0.02	0.26	0.07	0.36	0.12
2006	208	6	214	0.03	0.02	0.24	0.07	0.36	0.12
2007	208	6	214	0.03	0.02	0.21	0.06	0.35	0.12
2008	208	6	214	0.03	0.02	0.20	0.05	0.35	0.11
2009	208	6	214	0.02	0.02	0.18	0.05	0.35	0.11
2010	208	6	214	0.02	0.02	0.17	0.04	0.34	0.11
2011	208	6	214	0.02	0.01	0.16	0.04	0.34	0.11
2012	208	6	214	0.02	0.01	0.15	0.04	0.33	0.11
2013	208	6	214	0.02	0.01	0.14	0.04	0.33	0.11
2014	208	6	214	0.02	0.01	0.13	0.04	0.33	0.11
2015	208	6	214	0.02	0.01	0.13	0.03	0.32	0.11
2016	208	6	214	0.02	0.01	0.12	0.03	0.32	0.11
2017	208	6	214	0.02	0.01	0.12	0.03	0.32	0.10
2018	208	6	214	0.01	0.01	0.11	0.03	0.32	0.10
2019	208	6	214	0.01	0.01	0.11	0.03	0.31	0.10
2020	208	6	214	0.01	0.01	0.10	0.03	0.31	0.10

Table 9.3.7 Septage Program Costs as Percentage of Key Indicators

values in 2000 prices

Year	Cumulative Amortized Capital Costs ($US'000)	O and M Cost ($US'000)	Total Cost ($US'000)	Total Cost as % of Study Area GRP (%)	Total Cost as % of Haiphong GRP (%)	Total Cost as % of HPPC Exp. (%)	Total Cost as % of Study Area Disp. Inc. (%)	Annual Per Cap. Cost in Study Area ($)	Annual per Cap. Cost in Haiphong ($)
2001	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
2002	458	0	458	0.10	0.06	0.67	0.20	0.80	0.26
2003	917	0	917	0.18	0.11	1.26	0.36	1.58	0.52
2004	1,375	0	1,375	0.26	0.16	1.78	0.51	2.34	0.77
2005	1,375	413	1,788	0.31	0.20	2.19	0.62	3.02	0.99
2006	1,375	413	1,788	0.27	0.18	1.97	0.55	2.98	0.98
2007	1,375	413	1,788	0.24	0.16	1.79	0.49	2.95	0.97
2008	1,375	413	1,788	0.22	0.15	1.63	0.44	2.92	0.96
2009	1,375	413	1,788	0.20	0.14	1.51	0.40	2.89	0.95
2010	1,375	413	1,788	0.19	0.13	1.40	0.37	2.86	0.94
2011	1,375	413	1,788	0.17	0.12	1.32	0.35	2.83	0.93
2012	1,375	413	1,788	0.16	0.11	1.24	0.33	2.80	0.92
2013	1,375	413	1,788	0.16	0.11	1.18	0.31	2.77	0.91
2014	1,375	413	1,788	0.15	0.10	1.12	0.30	2.74	0.90
2015	1,375	413	1,788	0.14	0.10	1.06	0.28	2.71	0.89
2016	1,375	413	1,788	0.13	0.09	1.02	0.27	2.69	0.88
2017	1,375	413	1,788	0.13	0.09	0.97	0.26	2.66	0.87
2018	1,375	413	1,788	0.12	0.08	0.93	0.25	2.63	0.86
2019	1,375	413	1,788	0.12	0.08	0.89	0.24	2.61	0.85
2020	1,375	413	1,788	0.11	0.08	0.86	0.23	2.58	0.84

Table 9.3.8 Solid Waste Management Program Costs as Percentage of Key Indicators

values in 2000 prices

Year	Cumulative Amortized Capital Costs ($US'000)	O and M Cost ($US'000)	Total Cost ($US'000)	Total Cost as % of Study Area GRP (%)	Total Cost as % of Haiphong GRP (%)	Total Cost as % of HPPC Exp. (%)	Total Cost as % of Study Area Disp. Inc. (%)	Annual Per Cap. Cost in Study Area ($)	Annual per Cap. Cost in Haiphong ($)
2001	15	1,206	1,220	0.28%	0.17%	1.92%	0.56%	2.15	0.71
2002	60	1,303	1,363	0.29%	0.18%	2.00%	0.58%	2.37	0.78
2003	252	1,524	1,777	0.35%	0.22%	2.45%	0.71%	3.06	1.01
2004	1,142	1,638	2,779	0.52%	0.32%	3.60%	1.03%	4.74	1.56
2005	1,466	2,227	3,693	0.64%	0.41%	4.52%	1.29%	6.23	2.05
2006	1,539	2,477	4,016	0.62%	0.40%	4.42%	1.23%	6.70	2.21
2007	1,618	2,682	4,299	0.59%	0.39%	4.29%	1.18%	7.10	2.33
2008	1,670	2,883	4,553	0.56%	0.37%	4.16%	1.13%	7.43	2.44
2009	1,772	3,084	4,856	0.55%	0.37%	4.10%	1.10%	7.84	2.57
2010	1,842	3,270	5,112	0.53%	0.36%	4.00%	1.06%	8.17	2.68
2011	1,932	3,412	5,345	0.52%	0.35%	3.93%	1.04%	8.45	2.77
2012	2,013	3,550	5,563	0.51%	0.35%	3.87%	1.03%	8.70	2.85
2013	2,354	3,672	6,026	0.53%	0.36%	3.97%	1.05%	9.33	3.05
2014	2,916	3,806	6,721	0.56%	0.38%	4.20%	1.12%	10.30	3.37
2015	3,034	3,993	7,027	0.56%	0.38%	4.18%	1.11%	10.66	3.49
2016	3,202	4,234	7,436	0.56%	0.38%	4.22%	1.12%	11.17	3.65
2017	3,306	4,501	7,807	0.56%	0.38%	4.24%	1.13%	11.62	3.79
2018	3,419	4,779	8,197	0.57%	0.38%	4.27%	1.13%	12.08	3.94
2019	3,623	5,076	8,699	0.58%	0.39%	4.34%	1.15%	12.69	4.14
2020	3,735	5,332	9,067	0.58%	0.39%	4.35%	1.16%	13.10	4.28

CHAPTER 10 IMPROVEMENT OF THE SANITATION CONDITIONS ACHIVED BY THE IMPLEMENTATION OF THE SANITATION MASTER PLAN

10.1 Improvement of the Access to Sanitary Water Supply

10.1.1 Overall Achievement

The overall goal of the Sanitation Master Plan is to improve sanitation conditions of Haiphong City. There is no doubt that the proposed Sanitation Master Plan will significantly contribute to this goal by providing safe drinking water to the people in Haiphong. Most notable benefits of the Water Supply component of the Master Plan include provision of safe drinking water, reduction of water-borne diseases, and improvement of hygienic standard.

In addition, the expansion of the service area will provide basic infrastructure necessary for urban development. It will boost the development potential of the service area, and will increase the overall property value of Haiphong.

10.1.2 Achievement of Project Purpose

The main purpose of the Water Supply component of the Master Plan is to provide more people with access to a safe and reliable public water supply system. Achievement of this may be measured in terms of the following indicators associated with water supply system.

Indicators of Project Purpose Achievement

Indicator	Before Project (1999)	After Project (2020)
Service Area	35 km^2	195 km^2
Population Served	336,000 people	794,000 people
Total Water Supplied (Ave.)	111,200 m^3/d	197,400 m^3/d
Unit Consumption (Domestic)	60 – 90 lcpd	130 lcpd
Water Quality Standard	not satisfiedin some area	satisfied

The proposed Master Plan will roughly double the number of people who have access to public water supply system, and it will also allow people to use more water.

Essentially 100 % of the urban population will be connected to the public water supply system in 2020. The connection rate in semi-urban area, such as Kien An, Do Son and the Augmented Area (e.g., south of Hong Bang District) will be 84-95 % in 2020.

The proposed plan also includes basic water supply facilities in rural areas, such as Minh Duc and Quan Toan. However, installation of individual house connections in sparsely inhabited area takes a long time. Consequently, the connection rate in rural area will be much lower than the connection rates in urban and semi-urban areas. Table below shows the estimated connection rate by area.

Estimated Connection Rate by Area

Area	Before Project (1999)	After Project (2020)
Hong Bang	24 %	100 %
Ngo Quyen	77 %	99 %
Le Chan	97 %	100 %
Kien An	35 %	84 %
Do Son	37 %	90 %
Quan Toan	0 %	40 %
Minh Duc	0 %	9 %
NDA	4 %	65 %
Augmented Area	2 %	95 %

10.1.3 Project Output

In order to cover much larger service area, and in order to meet the future demand, water supply network has to be expanded substantially. Major project outputs include expansion of An Duong Water Treatment Plant (to 100,000 m^3/d), construction of new Hoa Binh intake/WTP (10,000 m^3/d), construction of Minh Duc intake/WTP (depends on planned industrial activities), construction of transmission mains (27 km in 1A Project, Kien An transmission mains 12 km, City Center Transmission Mains 12 km, Do Son Road transmission mains 7 km, Vat Cach transmission mains, 5 km), and construction of distribution pipes and house connections throughout the area.

The efficiency of the system will also be improved. Through the reduction of leakage and installation of functioning water meters, the share of Non-Revenue Water (NRW) will be reduced from nearly 50 % (present) to 20 % in 2020. This leads to substantial saving of precious water resources, and improvement of cost recovery.

10.2 Reductions in Flooding

10.2.1 Class A Areas

(1) Present Flood Conditions from Data of World Bank Project

Quantitative data on the present flood conditions was utilized from the World Bank Project. For the interpretation of the data, it is assumed that flood areas are associated with streets, alleys, and open public spaces, since flooding cannot occur where land is occupied by buildings. For the interpretation it is assumed that flooding would occur in 20 % of the total land area.

Based on reported flood locations, the data from the World Bank Project includes flooding in Old City Center, Central Area, and New Urban Area. The total land area of the potential flood areas is estimated as 2,340 ha and the potential flood area is 20 % of this value, or about 470 ha. Based on this approach, the following table assesses the interpreted data from the World Bank Project.

Present Degree of Flooding in Class A Areas

Frequency	Potential Flood Area	Reported Flood Area	% of Potential Area
0.25 years	470 ha	140 ha	29.7 %
0.5 years	470 ha	180 ha	38.3 %
1 year	470 ha	250 ha	53.2 %
2 year	470 ha	280 ha	59.6 %
5 year	470 ha	320 ha	68.1 %

The data for the flood areas in the World Bank Project includes flood areas where the flood magnitudes are 10-30 cm. These magnitudes are less than the flood magnitudes reported by SADCo. However, the interpreted data of the World Bank is considered consistent with the assessments of SADCo, and is used in the flood reductions assessment.

(2) Assessed Flood Reductions from World Bank Project

Quantitative data on the assessed flood reductions was obtained from the World Bank Project after its implementation. The data is interpreted and assessed using the same approach as for the data on the present flooding conditions and presented in the following table

Flooding in Class A Areas After Implementation of World Bank Project

Frequency	Potential Flood Area	Reported Flood Area	% of Potential Area
0.25 years	470 ha	31 ha	6.7 %
0.5 years	470 ha	48 ha	10.2 %
1 year	470 ha	75 ha	16.0 %
2 year	470 ha	98 ha	20.9 %
5 year	470 ha	150 ha	31.9 %

(3) Assessed Flood Reductions from FINNIDA Project

Quantitative flood data for flood reductions from implementation of the FINNIDA Project was utilized from the FINNIDA Project. The data consists of quantitative estimates for the flooding conditions during high tide after implementation of the World Bank Project and the flooding conditions during high tide after implementation of it and the FINNIDA Project.

In the World Bank Project the Northeast and Southwest Channels were designed for a storm with a 10 year ARI (Average Recurrence Interval) during falling tide conditions. Consequently, the degree of flooding in the Central Area is expected to decrease significantly for storms with frequencies of 5 year ARI or less. However, the risk of flooding remains for storms which may occur during high tide conditions.

The FINNIDA Project was developed to construct pumping stations for these two channels in the Central Area. An assessment of flood reductions after project implementation, and including implementation of the World Bank Project, was provided in the project documentation. The approach for the assessment was based on quantitative data, which was verified by results of computer simulations of flooding in the Central Area.

The quantitative data consisted of flood areas during high tide conditions with and without the project for storms of different frequency. The assessed flood areas were then multiplied by a risk factor of 25 % to determine the expected flood areas which would occur for storms of different frequency.

The quantitative data on the assessed flood reductions, based on data from the FINNIDA Project, is presented in the following table.

Flooding in Class A Areas After Implementation of World Bank and FINNIDA Projects

Frequency	Potential Flood Area	Reported Flood Area	% of Potential Area
0.25 years	470 ha	28 ha	6.0 %
0.5 years	470 ha	40 ha	8.5 %
1 year	470 ha	62 ha	13.2 %
2 year	470 ha	80 ha	17.0 %
5 year	470 ha	127 ha	27.0 %

As shown in the table, the actual flood areas are significant, even after project implementation, if a high tide occurred during the duration of the storm. The data is also consistent with the assessments from the World Bank Project.

(4) Assessed Flood Reductions from Drainage Improvement Projects

Assessment of flood reductions from implementation of the Drainage Improvement Projects is based on estimating the present flood areas which can be attributed to the present inadequate hydraulic capacity of An Kim Hai Channel without any connections to existing storage lakes. This flooding would then be reduced after implementation of Phase I of the Drainage Improvement Project for the Central Area.

The assessment of the flood reductions after implementation of Phase I was done in the Feasibility Study of the Drainage Priority Project provided in Volume 2. The quantitative data on the assessed flood reductions is presented in the following table.

Flooding in Class A Areas After Implementation of Phase I Projects

Frequency	Potential Flood Area	Reported Flood Area	% of Potential Area
0.25 years	470 ha	22 ha	4.7 %
0.5 years	470 ha	24 ha	5.1 %
1 year	470 ha	39 ha	8.3 %
2 year	470 ha	43 ha	9.1 %
5 year	470 ha	69 ha	14.7 %

The remaining flood areas are then associated with high tide conditions in the Old City Center and New Urban Area. This flooding would then be reduced during implementation of Phase II of the Drainage Improvement Projects.

Incremental flood reductions which would be achieved after implementation of the Phase I and Phase II projects are presented in the following table.

Incremental Flood Reductions After Implementation of Phase I and Phase II Projects

Storm Frequency	Present Flood Areas	Phase I Projects			Phase II Projects
		World Bank Project	FINNIDA Project	Phase I Project*	
0.25 year ARI	140 ha	109 ha	3 ha	6 ha	22 ha
0.5 year ARI	180 ha	132 ha	8 ha	16 ha	24 ha
1 year ARI	250 ha	175 ha	13 ha	23 ha	39 ha
2 year ARI	280 ha	182 ha	18 ha	37 ha	43 ha
5 year ARI	320 ha	170 ha	23 ha	58 ha	69 ha

*: The estimated flood reduction by Phase I project includes reduction in New Urban Area.

After implementation of the three Phase I projects, the amount of flooding in Class A area is reduced by about 80 %. The remaining flooding is reduced after implementation of the Phase II projects.

10.2.2 Class B Areas

No quantitative data exists on the present flooding conditions in Kien Anh. However, flooding has been reported to occur regularly in the main commercial areas of the district.

Facilities and measures for improvements in storm water drainage are planned to be implemented during Phase II in the period from 2011 to 2020. It is expected that the degree of flooding which would occur in Kien Anh by the Year 2011 would be of comparably relative magnitude as the present degree of flooding in the Class A area, because the degree of land development will be greater.

In the same way, the reductions in flooding after implementation of the facilities and measures selected for Kien Anh is considered to be of comparably relative magnitude as the flooding reductions in Class A area, after implementation of the works planned for Class A area.

Thus, the flood reductions from implementation of the Phase II projects is considered as comprehensive and meaningful.

10.3 Improvement of the Access to Sewerage System

10.3.1 Access to Sewerage System

The Study proposes to construct a central sewerage system in the Class A area. The areas with existing combine sewer system will continue to use the existing systems while a separate sewer system is proposed for the new urban areas. Two treatment plants are also proposed.

At present, in most cases, only black water is entering in the existing septic tanks, whilegray water is discharged in the drainage pipes. As a result, it is not possible for all black and gray water to be collected from the beginning. It is assumed that initially around 80 % of the water consumption can be collected as sewage for domestic, commercial and institutional use. This value will increase gradually and will reach to 100 % by the target year of 2020. Because of various water losses in the industrial processes, it is considered that sewage generation for industrial purpose is 80 % of the water consumption and it is considered as constant. The service ratio is considered as 50 % in the beginning and will reach 100 % of the water supply coverage by the year 2020.

The coverage of the sewerage improvement measures for Class A area is 5,240 ha with around 575,000 beneficiaries.

For Kien An, one central wastewater treatment plant and three simplified sewage treatment plants are proposed. Out of 9 wards, 8 wards will come under sewerage system. Five wards will have 100 % service ratio and 3 wards will have 80 % service ratio. The coverage of the sewerage improvement measures for Kien An area is 2,309 ha with around 100,000 beneficiaries.

For Do Son, three simplified sewage treatment plants are proposed. Out of 5 wards, 3 wards will come under sewerage system. Two wards will have 90 % service ratio and 1 ward will have 80 % service ratio. The coverage of the sewerage improvement measures for Kien An area is 1,949 ha with around 23,000 beneficiaries.

The sewerage improvement proposal made by the Study is a comprehensive and provides total access to the sewerage system.

10.3.2 Access to Nightsoil Collection

Nightsoil collection and disposal is an interim measure and it is proposed to eliminate all bucket latrines as early as possible. At present, there are around 2,500 bucket latrines in the Class A area. Out of this, about 1,600 are served by URENCO. Owners of the remaining latrines dispose the nightsoil by themselves and hand over to farmers. This poses a huge public health risk. The Study proposes to extend the coverage to all existing latrines. This will reduce the risk.

The present collection practice of URENCO is not hygienic. The staffs collect the nightsoil manually. This is an extremely dangerous practice. Protective clothing and small vacuum pumps should be used to collect nightsoil. This will the eliminate risk from the collection system.

At present, the collected nightsoil is collected by the farmers without any control. This also constitutes a major threat to public sanitation. The disposal practice should be regulated to eliminate this public health threat.

However, bucket latrines are one of the most unsanitary practices. The ultimate target is to eliminate all bucket latrines. Until 2000, significant subsidy is provided for up-gradation of bucket latrines. The practice will end by the end of 2020 and a revolving fund is proposed under 1B project to continue the up-gradation. Because of the recent favorable practice, there is a serious concern on the success of the program. A subsidy should be provided to complete the up-gradation. With the conversion of all bucket latrines, this unhygienic practice will come to an end.

10.3.3 Access to Septic Tank Sludge Collection

Septic tank is an interim measure in the class A area. Since the benefits of the sewerage system can be obtained only once the treatment plant starts operation, proper septic tank management is proposed until that period. A collection system should be provided which covers 100 % of the septic tanks. To ensure such target, proposals include procurement of new vehicles including specialized vehicles that can access to narrow alleys, desludging frequency monitoring database, provision of access hole in each septic tanks and septic tank monitoring unit. This will eliminate clogging and overflow of septic tanks.

At present, septic tank sludge is disposed to landfill site without any control. A separate sludge treatment plant should be provided which will ensure sanitary disposal of septic tank sludge.

10.4 Improvement of Solid Waste Management

"Situation without the implementation of the Master Plan" is defined as situation where the solid waste management system capacity will remain unchanged .

10.4.1 Improvement in Service Level

The current average collection ratio is 75 % in terms of collection quantity in the Study Area (4 urban districts and Do Son Town).

Without the implementation of the master plan, the corresponding ratios will drop to 52 % in 2005, and 31 % in the year 2020. In this situation, cleanliness and sanitation conditions of Haiphong City will seriously deteriorate. In addition, it would be difficult for the Haiphong people to continue normal social and economic life.

With the Project, the service population will increase from 409,000 in 2000 to 719,000 in 2010, which is almost 100 % of the non-agricultural population in the Study Area.

With the Project, the waste collection ratio will increase year by year, and reach 95 % in 2010 in the Study Area. 95 % is considered as the maximum ratio possible. With this ratio, the city will be kept clean and sanitary.

Waste Collection Service Level in 2010
With or Without Implementation of the Sanitary Master Plan

	Current Conditions in 2000	Conditions in 2010 Without Implemen-tation of the MP	Conditions in 2010 With Implementation of the Master Plan (MP)
A1. Population served with waste collection & disposal service	409,000 persons (100)		719,000 persons (176)
A2. Average waste collection and disposal amount	471 ton/day (100)		1,086 ton/day (231)
A3. Collection service ratio (population served with collection service/total population)	85 %	53 %	94 % (100 % of non-agricultural population)
A4. Collection ratio (collection amount/generation amount)	75 %	43 %	95 %

Changes in Waste Collection Service Level
With or Without Implementation of the Master Plan

		Without the Project (Waste collection amount will remain at current level)		With the Project	
Year	Generation	Collection (t/d)	Collection ratio	Collection (ton/day)	Collection Ratio
2000	630	471	75 %	471	75 %
2005	899	471	52 %	761	85 %
2010	1,148	471	41 %	1,086	95 %
2020	1,517	471	31 %	1,441	95 %

10.4.2 Improvement in the Sanitary Conditions

Implementation of the Sanitary Master Plan will keep the city clean and sanitary. In addition, the improved waste management system will substantially reduce the environmental impacts of solid waste management activities on public health and the environment:

- The proposed collection system will keep the city clean, and also minimize the adverse impacts of waste collection activities on public health and the environment
- The proposed sanitary landfill system will minimize the secondary pollution that would be caused without the improved system
- The proposed hospital waste management system will substantially eliminate risks of transmission of infectious diseases associated with contact with infectious waste

The following table summarizes the environmental impacts of solid waste management activities with or without the implementation of the sanitary master plan.

Environmental Impact of Solid Waste Management Activities
With or Without the Implementation of the Sanitary Master Plan

	Current Conditions in 2000	Conditions in 2005 Without Implemen-tation of the Master Plan	Conditions in 2005 With Implementation of the Master Plan
A. Waste Collection Activity	Open system		Closed system
A1. Impacts of the waste collection activities on Health and Environment, and Traffic	Much	Very High	Low
B. Landfill	Open dumping		Sanitary landfill
B1. Risk of open water pollution with leachate	Already open water is being polluted.		Very low because of leachate collection/ treatment system
B2. Adverse impacts on workers, local residents, and surrounding environment by waste deposited (Risk of generation of fire, smoke, rodents, dusts and waste scattering)	High		Low because of periodical (weekly) application of cover soil
B3. Risk of explosion and accidental fires with gases	Some		Very low because of gas collection and exhaust system
B4. Risk of collapse of waste layers	High		No Because of dyke and improved filling method
B5. Generation of greenhouse (methane) gas contributing to global warming	Some		Low Can be reduced to about one third.
C. Hospital Waste Management	Non independent system for infectious waste		Independent System for infectious waste
C1. Risk of transmission of infectious disease such as AIDS	High		No

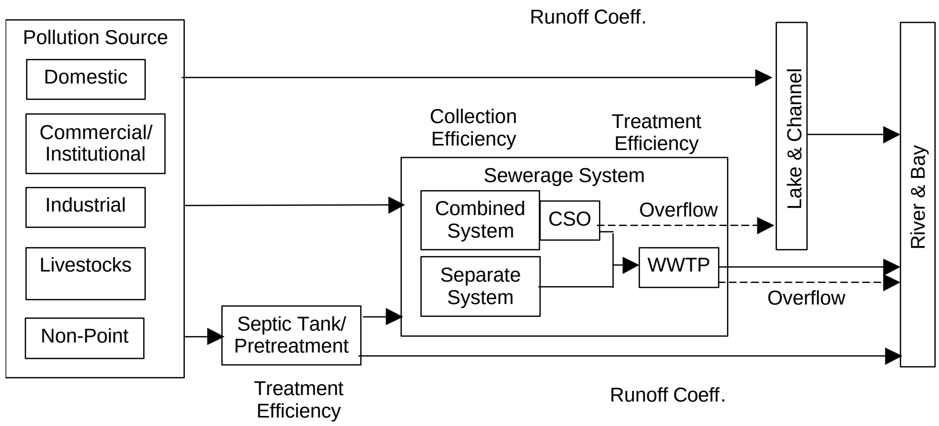
10.5 Improvement of Water Quality

10.5.1 General Methodologies

In this section, the anticipated reduction of pollution loads to water bodies in the Effective Study Area was estimated in three steps:

- estimation of pollution loads generated from domestic, industrial, commercial, institutional, domestic animals and non-point pollution source
- estimation of collection/treatment efficiencies of the proposed sewerage systems, and estimation of pollutant runoff coefficients in each sub-basin
- estimation of pollution loads to major water bodies in the Effective Study Area including lakes, channels, rivers and Bac Bo Bay

The results were analyzed for "With Master Plan" and "Without Master Plan" cases, and the anticipated reduction of pollution loads due to the proposed Master Plan were estimated. The figure below illustrates the general framework of the estimation procedures.



Schematic Diagram of Generation and Transport of Pollutants

10.5.2 Generation of Pollution Loads

(1) Domestic Sources

The pollution loads from domestic sources were estimated from the forecasted population and the estimated per capita unit pollution load generations for domestic source. The per capita unit pollution load generations for wastewater, BOD, SS, T-N, and T-P were estimated based on the following information: results of the source-wise unit pollutant load survey carried out in May 2000, estimated water demand, WHO Rapid Inventory Method (1993), guideline by Japan Sewage Association (1997), and similar studies in Vietnam.

Estimated Unit Pollution Load from Domestic Sources

Parameter	Unit	1999	2005	2010	2015	2020
Wastewater*	l/c/d	91-123	100-120	110-130	120-130	130
BOD	g/c/d	40	43	45	48	50
SS	g/c/d	36	39	41	43	45
T-N	g/c/d	8.0	8.6	9.0	9.5	10.0
T-P	g/c/d	0.80	0.86	0.90	0.95	0.10

* : based on the estimated water demand data

source: WHO (1993), Japan Sewerage Assoc. (1997), modified by the JICA Study Team

Table below summarizes the estimated generation of pollution loads from domestic sources.

Estimated Pollution Load from Domestic Sources

Pollutant	Unit	1999	2005	2010	2015	2020
Wastewater	m^3/day	63,490	85,200	99,520	107,980	116,010
	(%)	(100 %)	(134 %)	(157 %)	(170 %)	(183 %)
BOD	kg/day	26,350	31,070	35,090	40,110	44,620
	(%)	(100 %)	(118 %)	(133 %)	(152 %)	(169 %)
SS	kg/day	23,710	28,180	31,970	35,930	40,160
	(%)	(100 %)	(119 %)	(135 %)	(152 %)	(169 %)
T-N	kg/day	5,270	6,213	7,017	7,938	8,924
	(%)	(100 %)	(118 %)	(133 %)	(151 %)	(169 %)
T-P	kg/day	527	621	702	794	892
	(%)	(100 %)	(118 %)	(133 %)	(151 %)	(169 %)

Pollution loads from domestic sources are expected to increase 70-80 % by 2020 due to increase in population and change in life style.

(2) Industrial, Commercial and Institutional Sources

Local data on pollution loads from industrial sources in Haiphong were scarce, and were insufficient to directly estimate pollution load from industrial sources. Hence, mean effluent concentrations were estimated from the makeup of major industries in Haiphong and typical effluent concentrations from such industries.

Industrial Activities in Hiphong and Typical Concentrations of Pollutants in Industrial Wastewater

Industry	Sales in 1998*	BOD	SS	T-N	T-P
	VND billion	mg/l	mg/l	mg/l	mg/l
Food and Drink	287	500-2,000	200-600	20-100	5-30
Tobacco	271	600	200	-	30
Textiles	124	120	200	2	2
Garments	74	300	70	5	1
Footware	1,351	200-2,000	20-2,000	50	10
Wood Processing	17	100	100	15	10
Paper	110	300	500	10	10
Publication/Printing	7,	200	150	15	2
Chemicals	232	500-2,000	200-400	20-80	2-20
Plastic & Rubber	211	200-1,000	100-500	20-150	3-30
Other Non-metal	1,518	50-500	20-200	20-100	5-20
Metals	1,135	50-100	100-500	10-80	1-20
Metal Products	163	50-300	60-200	50-500	10-50
Electrical	48	100-300	100-300	20-100	5-20
Radio, TV	163	200	80	20	2
Motor Vehicle	9	200	300	30	30
Ship-building	277	200	240	20	3
Furniture	39	120	550	10	2

source: WHO (1993), Japan Sewerage Assoc. (1997)

* : Statistical Abstract of Haiphong City 1995-1998, 1999

The mean effluent concentrations from commercial and institutional sources (public offices, schools etc.) were assumed the same as the average pollutant concentrations of domestic wastewater (Japan Sewerage Assoc., 1997). They were estimated by dividing the per capita unit pollution load generation by per capita water consumption. The estimated mean pollutant concentrations are given in the table below.

Anticipated Mean Effluent Concentrations of Pollutants from Industrial/Commercial/Institutional Sources

Pollutant	Unit	Industrial	Commercial	Institutional
Wastewater	-	based on estimated water consumption		
BOD	mg/l	350	380	380
SS	mg/l	410	350	350
T-N	mg/l	30	80	80
T-P	mg/l	12	8	8

Pollution loads were estimated, then, from these mean pollutant concentrations and the estimated water consumption (see water supply section of the Master Plan). It was assumed that the mean effluent concentrations for these sources stay at the same level in the future.

Table below summarizes the estimated pollution loads from industrial, commercial and institutional sources.

Estimated Pollution Loads from Industrial Sources

Pollutant	Unit	1999	2005	2010	2015	2020
Wastewater	m^3/day	6,780	9,680	19,320	24,540	29,960
	(%)	(100 %)	(143 %)	(285 %)	(362 %)	(442 %)
BOD	kg/day	2,370	3,390	6,760	8,590	10,490
	(%)	(100 %)	(143 %)	(285 %)	(362 %)	(443 %)
SS	kg/day	2,780	3,970	7,920	10,060	12,280
	(%)	(100 %)	(143 %)	(285 %)	(362 %)	(442 %)
T-N	kg/day	203	290	580	736	899
	(%)	(100 %)	(143 %)	(286 %)	(363 %)	(443 %)
T-P	kg/day	81	116	232	294	360
	(%)	(100 %)	(143 %)	(286 %)	(363 %)	(444 %)

Estimated Pollution Load from Commercial Sources

Pollutant	Unit	1999	2005	2010	2015	2020
Wastewater	m^3/day	3,100	4,600	6,100	6,900	8,200
	(%)	(100 %)	(148 %)	(197 %)	(223 %)	(265 %)
BOD	kg/day	1,180	1,760	2,320	2,620	3,120
	(%)	(100 %)	(149 %)	(197 %)	(222 %)	(264 %)
SS	kg/day	1,090	1,620	2,130	2,420	2,870
	(%)	(100 %)	(149 %)	(195 %)	(222 %)	(263 %)
T-N	kg/day	248	370	488	553	656
	(%)	(100 %)	(149 %)	(197 %)	(223 %)	(265 %)
T-P	kg/day	25	37	49	55	66
	(%)	(100 %)	(148 %)	(196 %)	(220 %)	(264 %)

Estimated Pollution Load from Institutional Sources

Pollutant	Unit	1999	2005	2010	2015	2020
Wastewater	m^3/day	6,320	6,850	8,860	9,990	11,300
	(%)	(100 %)	(108 %)	(140 %)	(158 %)	(179 %)
BOD	kg/day	2,400	2,600	3,370	3,790	4,300
	(%)	(100 %)	(108 %)	(140 %)	(158 %)	(179 %)
SS	kg/day	2,210	2,400	3,100	3,490	3,960
	(%)	(100 %)	(109 %)	(140 %)	(158 %)	(179 %)
T-N	kg/day	505	548	709	799	904
	(%)	(100 %)	(109 %)	(140 %)	(158 %)	(179 %)
T-P	kg/day	51	55	71	80	90
	(%)	(100 %)	(108 %)	(139 %)	(157 %)	(176 %)

Several-fold increase in pollution loads from industrial sources is expected due to rapid industrialization of the area. Pollution loads from commercial sources will also increase significantly.

(3) Livestock

Table below summarizes the agricultural areas and numbers of pigs and buffaloes/cows in each district.

Agricultural Area and Number of Livestock in 1998

District	Agri. Area	Pigs		Buffaloes & Cows	
	ha	head	head/ha*	head	head/ha*
Thuy Nguyen	19,700	90,100	4.57	9,897	0.50
An Hai	15,300	60,200	3.93	7,707	0.50
An Lao	12,100	47,600	3.93	6,088	0.50
Kien Thuy	17,400	65,800	3.78	4,742	0.27
Tien Lang	19,400	51,300	2.64	10,031	0.52
Vinh Bao	24,400	65,800	2.70	14,851	0.61
Kien An	1,700	21,000	12.35	747	0.44
Do Son & Others	2,100	28,900	13.76	1,519	0.72
Total	112,100	430,700	3.84	55,582	0.50

* : heads per ha of agricultural area

source: Statistical Abstract of Haiphong City 1995-1998, 1999

The numbers of livestock in the Effective Study Area were estimated based on the estimated agricultural area (see below) and density of animals in agricultural area. The densities of these animals in the sub-urban area are higher than those of the rural areas. As the urbanization progresses, the animal densities are expected to increase. Hence, the densities of animals in 2020 were estimated at 14 head/ha for pig and 0.72 head/ha for buffalo/cow for the Effective Study Area. Other domestic animals for which detailed statistical data were not available, such as chickens, were excluded from separate analysis, and their contributions were assessed as non-point sources. Table below shows the estimated number of animals in the Effective Study Area by river basin.

Estimated Numbers of Livestock

Basin	Unit	1999		2020	
		Pig	Buffalo/Cow	Pig	Buffalo/Cow
Cam	heads	9,200	730	2,000	100
Lach Tray	heads	15,500	730	19,700	1,010
Da Do	heads	12,800	760	6,900	360
An Kim Hai	heads	30	10	0	0
Bac Bo	heads	14,700	960	16,300	840
Bach Dang	heads	5,300	580	14,900	760
Total	heads	57,530	3,770	59,800	3,070

The following unit pollution loads (g/head/day) were used to estimate pollution load associated with livestock.

Unit Pollution Load for Livestock

Animals	BOD	SS	T-N	T-P
	g/head/day			
Pig	90	200	20	6.3
Buffalo + Cow	630	4,200	220	33

source: WHO (1993), Japan Sewerage Assoc. (1997), modified by the JICA Study Team

Table below shows the estimated pollution loads from livestock. The pollution loads in years other than 1995 and 2010 were estimated by linearly interpolating the pollution load data in 1999 and 2020.

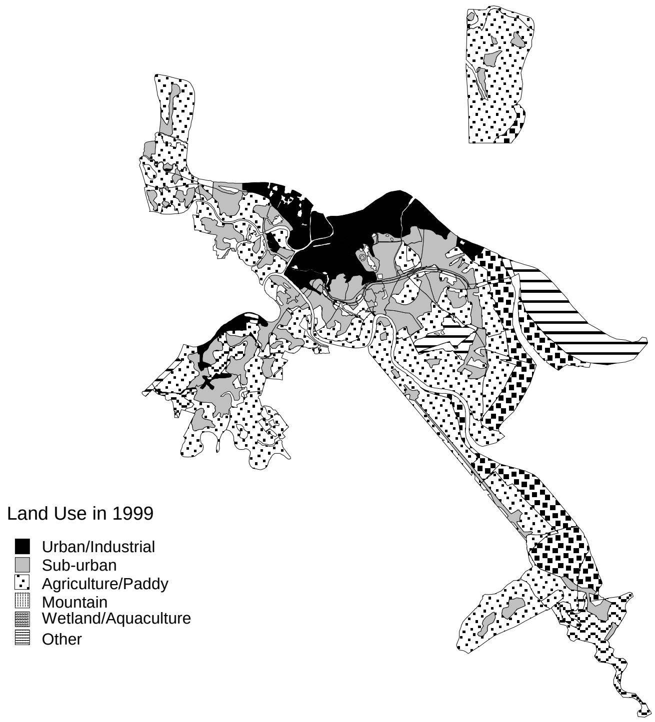
Estimated Pollution Load from Livestock

	Unit	1999	2005	2010	2015	2020
BOD	kg/day	7,590	7,530	7,480	7,410	7,340
	(%)	(100 %)	(99 %)	(99 %)	(98 %)	(97 %)
SS	kg/day	22,790	22,359	22,000	21,585	21,170
	(%)	(100 %)	(98 %)	(97 %)	(95 %)	(93 %)
T-N	kg/day	3,132	3,120	3,110	3,090	3,070
	(%)	(100 %)	(100 %)	(99 %)	(99 %)	(98 %)
T-P	kg/day	480	483	485	488	490
	(%)	(100 %)	(101 %)	(101 %)	(102 %)	(102 %)

While the densities of livestock per unit area will increase in the future, the agricultural area will diminish due to urbanization. Consequently, the pollution loads from livestock will not change significantly.

(4) Non-point Sources

The pollution loads from non-point sources, such as urban surface, agricultural field, etc., were estimated from the estimated land use and unit pollution load from each land use category. Figures below summarize the land uses in 1999 and 2020, which were estimated based on the satellite image data, existing land use data/map, proposed City's Master Plan and other information.



Land Use in 1999

Anticipated Land Use in 2020

The following unit pollution loads were used to estimate pollution loads from each land use categories.

Unit Pollution Loads from Non-point Sources

Land Use	BOD	SS	T-N	T-P
	kg/km^2/day			
Urban	40	400	20	12
Sub-urban	15	500	10	7
Industrial	40	400	20	12
Agriculture	15	500	20	5
Paddy	10	100	2	0.5
Mountain	15	750	10	4
Wetland	0	0	0	0
Aquaculture	20	200	10	4
Other	15	750	10	5

source: WHO (1993), Japan Sewerage Assoc. (1997), modified by the JICA Study Team

Table below summarizes the estimated pollution loads from the non-point sources. The pollution loads were determined for 1999 and 2020 and extrapolated for the years between .

Estimated Pollution Load from Non-point sources

Pollutant	Unit	1999	2005	2010	2015	2020
BOD	kg/day	2,230	2,612	2,930	3,265	3,600
	(%)	(100 %)	(117 %)	(131 %)	(146 %)	(161 %)
SS	kg/day	65,590	70,128	73,910	78,050	82,190
	(%)	(100 %)	(107 %)	(113 %)	(119 %)	(125 %)
T-N	kg/day	2,010	2,146	2,260	2,375	2,490
	(%)	(100 %)	(107 %)	(112 %)	(118 %)	(124 %)
T-P	kg/day	710	857	980	1,095	1,210
	(%)	(100 %)	(121 %)	(138 %)	(154 %)	(170 %)

Overall, the pollution loads from non-point sources are not expected to change drastically.

(5) Overall Pollution Loads

1) Overall Trends

Table below shows the estimated amount of pollutant generated in the area, which is a sum of pollution loads from domestic, industrial, commercial, institutional, livestock and non-point sources. As of 1999, 42,100 kg/day of BOD, 118,200 kg/day of SS, 11,400 kg/day of T-N and 1,870 kg/day of T-P were generated in the Effective Study Area.

Predicted Total Pollution Load Generation in Effective Study Area

Pollutant	Unit	1999	2005	2010	2015	2020
BOD	kg/day	42,100	48,900	57,900	65,800	73,400
	(%)	(100 %)	(116 %)	(138 %)	(156 %)	(174 %)
SS	kg/day	118,200	128,700	141,000	151,500	162,700
	(%)	(100 %)	(109 %)	(119 %)	(128 %)	(138 %)
T-N	kg/day	11,400	12,700	14,200	15,500	16,900
	(%)	(100 %)	(111 %)	(125 %)	(136 %)	(148 %)
T-P	kg/day	1,870	2,170	2,520	2,810	3,110
	(%)	(100 %)	(116 %)	(135 %)	(150 %)	(166 %)

In the future, the total pollution loads in the Effective Study Area will steadily increase although the rate of increase differs from pollutant to pollutant. The rapidest increase is expected for BOD, which mainly comes from domestic sources.

If the analysis is limited to domestic, industrial, commercial and institutional sources, for which the proposed sanitation measures are targeted, the overall pollution loads will be roughly doubled by 2020.

Predicted Pollution Load Generation from Domestic, Industrial, Commercial and Institutional Sources

Pollutant	Unit	1999	2005	2010	2015	2020
Wastewater	m^3/day	79,700	106,400	133,800	149,400	165,500
	(%)	(100 %)	(134 %)	(168 %)	(187 %)	(208 %)
BOD	kg/day	32,300	38,800	47,500	55,100	62,500
	(%)	(100 %)	(120 %)	(147 %)	(171 %)	(193 %)
SS	kg/day	29,800	36,200	45,100	51,900	59,300
	(%)	(100 %)	(121 %)	(151 %)	(174 %)	(199 %)
T-N	kg/day	6,230	7,420	8,790	10,030	11,380
	(%)	(100 %)	(119 %)	(141 %)	(161 %)	(183 %)
T-P	kg/day	684	829	1,053	1,223	1,408
	(%)	(100 %)	(121 %)	(154 %)	(179 %)	(206 %)

2) Pollution Sources

Table below summarizes the generation of pollution loads from domestic, industrial, commercial, institutional, livestock and non-point sources in 2020.

Total Pollution Load Generation by Source in 2020

Pollutant	Unit	Dom.	Indus.	Comm.	Inst.	Livestock	Non-point	Total
BOD	kg/day	44,600	10,500	3,100	4,300	7,300	3,600	73,400
	(%)	(61 %)	(14 %)	(4 %)	(6 %)	(10 %)	(5 %)	(100 %)
SS	kg/day	40,200	12,300	2,900	4,000	21,200	82,200	162,800
	(%)	(25 %)	(8 %)	(2 %)	(2 %)	(13 %)	(50 %)	(100 %)
T-N	kg/day	8,900	900	700	900	3,100	2,500	17,000
	(%)	(52 %)	(5 %)	(4 %)	(5 %)	(18 %)	(15 %)	(100 %)
T-P	kg/day	890	360	70	90	490	1,210	3,110
	(%)	(29 %)	(12 %)	(2 %)	(3 %)	(16 %)	(39 %)	(100 %)

Domestic source is the main contributor of BOD and T-N loads, while a half of SS comes from non-point sources.

10.5.3 Pollution Pathways

(1) Efficiency of Sewerage Systems

1) Collection System

It was assumed that the release of pollution loads from separate and simplified collection systems is negligible, and the collection efficiencies of these systems are essentially 100 %.

The efficiency of combined sewer system to collect pollution load is not 100 % because combined sewer overflow (CSO) contains substantial amount of pollutants. It is difficult to estimate the release of pollutants from CSO because the pollution load in overflow is highly dependent on the frequency and intensity of large storm events, design of CSO control facilities, frequency of sewer line cleanup, and other factors.

According to a study conducted in Tokyo, over 95 % of the generated BOD was collected by a combined system. In another study conducted in Osaka, Japan, as much as 30 % of the BOD load and 50 % of the SS load released from a combined sewer system with secondary treatment (i.e., CSO + treated effluent from treatment plant + storm water release after primary treatment) were attributed to the overflow (Wada, 1990). Based on these data, the following first-cut estimates of collection efficiency were assumed.

Efficiency of Sewage Collection Systems

unit:%

Collection	BOD	SS	T-N	T-P
Separate	100	100	100	100
Simplified	100	100	100	100
Combined	90	80	90	90

2) Treatment System

Table below summarizes the estimated efficiency of treatment systems.

Efficiency of Treatment Systems

unit:%

Treatment	BOD	SS	T-N	T-P
WWTP	80	80	15	15
Septic Tank	25	30	0	0

WWTP: Wastewater Treatment Plant (aerated lagoon or equivalent)

source: WHO (1993), Japan Sewerage Assoc. (1997), Metcalf & Eddy, 1991; modified by the JICA Study Team

The proposed WWTPs were designed to meet the effluent quality of BOD 50 mg/l (see Chapter 4). Assuming the inflow BOD concentration of 350 mg/l, the efficiency of the WWTP to remove BOD would be in the order of 85 %. However, the inflow maybe weaker due to seepage of groundwater into the sewer system. In addition, stormwater collected from combined system will be discharged after primary treatment if its volume were larger than the design capacity. Considering these factors, the BOD removal efficiency of a WWTP was estimated at 80 %. Similar estimates were made for other pollutants on the basis of the typical removal efficiency of similar systems. Septic tank was assumed to receive only black water.

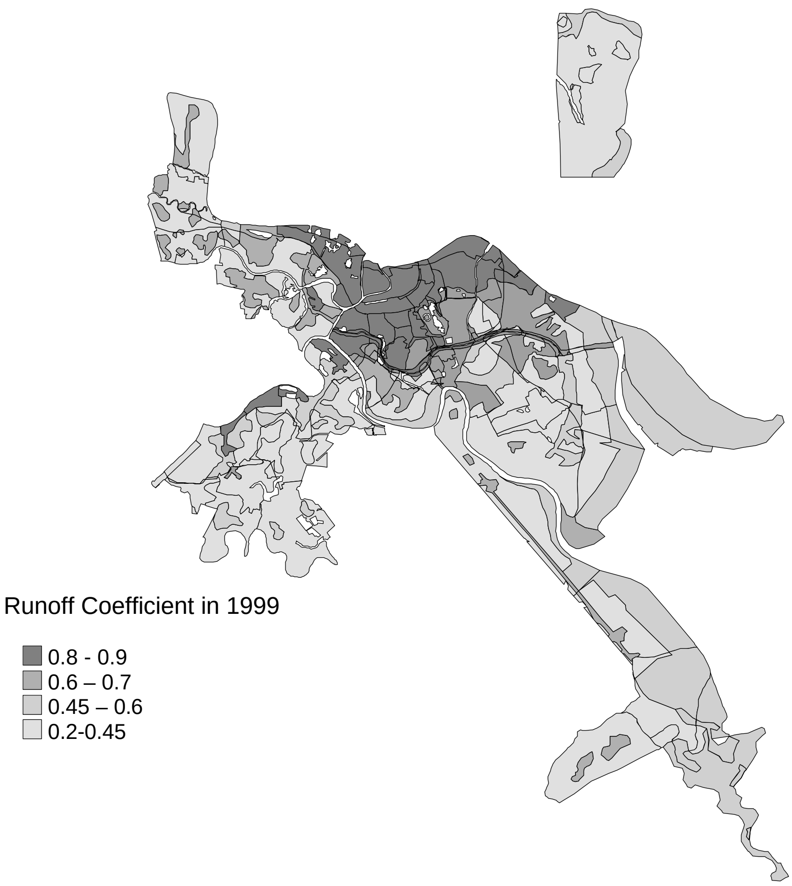
(2) Runoff Coefficient

The pollutant runoff coefficient, which was defined as the ratio of pollutant generated to the pollutant reaching water body, was estimated based on the land use, population density, distance from water body, level of sewerage system, and other factors. Their typical ranges are given below.

Estimated Runoff Coefficient by Land Use

Land Use	Runoff Coefficient
Urban/industrial	0.6-0.95
Residential/sub-urban	0.5-0.8
Agricultural	0.2-0.7

Figure below shows the distribution of estimated runoff coefficients in 1999. Similar estimates were made for 2020.



Runoff Coefficient in 1999

10.5.4 Anticipated Reduction of Pollution Loads to Water Bodies

(1) Pollution Loads to Lakes and Channels

The pollution loads to the following channels and lakes were made:

- NE Channel System (An Bien/Mam Tom Lake, Tien Nga Lake, other)
- SW Channel System (Sen Lake, Du Hang/Lam Tuong Lake, Sen Lake South Area, other)
- An Kim Hai Channel System (direct flow to An Kim Hai Channel, Dong Hai Lake)

These lakes and channels in the city center are the most heavily polluted water bodies in the Effective Study Area, and it was of interest to estimate the reduction of pollution loads by the Master Plan.

Table below summarizes the anticipated increases in pollution loads to these lakes and channels.

Pollution Loads to Channels and Lakes: BOD (kg/day)

Channel	Sub-basin	1999	2010		2020	
		Present	Without MP	With MP	Without MP	With MP
NE Channel	An Bien-Mam Tom Lakes	1,402	1,533	154	1,969	197
		(100 %)	(109 %)	(11 %)	(140 %)	(14 %)
	Tien Nga Lake	459	510	51	516	52
		(100 %)	(111 %)	(11 %)	(113 %)	(11 %)
	Other	3,093	4,091	2,072	5,059	534
		(100 %)	(132 %)	(67 %)	(164 %)	(17 %)
	Total	4,954	6,134	2,277	7,544	782
		(100 %)	(124 %)	(46 %)	(152 %)	(16 %)
SW Channel	Sen Lake	598	675	68	802	80
		(100 %)	(113 %)	(11 %)	(134 %)	(13 %)
	Du Hang-Lam Tuong Lakes	1,071	1,233	123	1,459	146
		(100 %)	(115 %)	(12 %)	(136 %)	(14 %)
	Sen Lake South Basin	572	872	86	1,254	122
		(100 %)	(152 %)	(15 %)	(219 %)	(21 %)
	Other	194	496	176	753	63
		(100 %)	(255 %)	(90 %)	(388 %)	(32 %)
	Total	2,436	3,276	453	4,268	411
		(100 %)	(134 %)	(19 %)	(175 %)	(17 %)
An Kim Hai Channel	An Kim Hai Channel	659	1,094	429	1,394	108
		(100 %)	(166 %)	(65 %)	(211 %)	(16 %)
	Dong Hail Lake	400	645	65	977	98
		(100 %)	(161 %)	(16 %)	(244 %)	(24 %)
	Total	1,059	1,740	494	2,371	206
		(100 %)	(164 %)	(47 %)	(224 %)	(19 %)

Pollution Loads to Channels and Lakes: SS (kg/day)

Channel	Sub-basin	1999	2010		2020	
		Present	Without MP	With MP	Without MP	With MP
NE Channel	An Bien-Mam Tom	1,670	1,795	359	2,173	435
	Lakes	(100 %)	(107 %)	(22 %)	(130 %)	(26 %)
	Tien Nga Lake	558	610	123	611	122
		(100 %)	(109 %)	(22 %)	(110 %)	(22 %)
	Other	5,037	6,100	3,178	7,069	1,977
		(100 %)	(121 %)	(63 %)	(140 %)	(39 %)
	Total	7,265	8,505	3,660	9,854	2,534
		(100 %)	(117 %)	(50 %)	(136 %)	(35 %)
SW Channel	Sen Lake	669	749	151	861	172
		(100 %)	(112 %)	(23 %)	(129 %)	(26 %)
	Du Hang-Lam Tuong	1,195	1,359	273	1,560	312
	Lakes	(100 %)	(114 %)	(23 %)	(131 %)	(26 %)
	Sen Lake South Basin	882	1,295	221	1,770	286
		(100 %)	(147 %)	(25 %)	(201 %)	(32 %)
	Other	676	937	489	1,154	403
		(100 %)	(139 %)	(72 %)	(171 %)	(60 %)
	Total	3,422	4,341	1,134	5,345	1,173
		(100 %)	(127 %)	(33 %)	(156 %)	(34 %)
An Kim Hai	An Kim Hai Channel	1,208	1,626	984	1,901	701
Channel		(100 %)	(135 %)	(81 %)	(157 %)	(58 %)
	Dong Hail Lake	619	841	168	1,133	227
		(100 %)	(136 %)	(27 %)	(183 %)	(37 %)
	Total	1,827	2,468	1,152	3,034	928
		(100 %)	(135 %)	(63 %)	(166 %)	(51 %)

Pollution Loads to Channels and Lakes: T-N (kg/day)

Channel	Sub-basin	1999	2010		2020	
		Present	Without MP	With MP	Without MP	With MP
NE Channel	An Bien-Mam Tom	277	306	31	395	39
	Lakes	(100 %)	(110 %)	(11 %)	(143 %)	(14 %)
	Tien Nga Lake	90	102	10	104	10
		(100 %)	(113 %)	(11 %)	(115 %)	(12 %)
	Other	645	842	418	1,032	123
		(100 %)	(131 %)	(65 %)	(160 %)	(19 %)
	Total	1,012	1,250	459	1,530	173
		(100 %)	(124 %)	(45 %)	(151 %)	(17 %)
SW Channel	Sen Lake	121	137	14	162	16
		(100 %)	(112 %)	(11 %)	(134 %)	(13 %)
	Du Hang-Lam Tuong	218	251	25	295	29
	Lakes	(100 %)	(115 %)	(12 %)	(135 %)	(14 %)
	Sen Lake South Basin	120	186	18	266	25
		(100 %)	(155 %)	(15 %)	(222 %)	(21 %)
	Other	50	109	39	158	17
		(100 %)	(220 %)	(79 %)	(318 %)	(34 %)
	Total	509	682	96	881	87
		(100 %)	(134 %)	(19 %)	(173 %)	(17 %)
An Kim Hai	An Kim Hai Channel	140	226	92	285	29
Channel		(100 %)	(161 %)	(65 %)	(203 %)	(21 %)
	Dong Hail Lake	83	134	14	199	20
		(100 %)	(161 %)	(16 %)	(239 %)	(24 %)
	Total	224	360	105	484	49
		(100 %)	(161 %)	(47 %)	(216 %)	(22 %)

Pollution Loads to Channels and Lakes: T-P (kg/day)

Channel	Sub-basin	1999	2010		2020	
		Present	Without MP	With MP	Without MP	With MP
NE Channel	An Bien-Mam Tom Lakes	38	44	5	53	5
		(100 %)	(115 %)	(12 %)	(137 %)	(14 %)
	Tien Nga Lake	14	15	1	15	2
		(100 %)	(107 %)	(11 %)	(111 %)	(11 %)
	Other	116	140	64	160	30
		(100 %)	(121 %)	(55 %)	(138 %)	(26 %)
	Total	168	199	70	227	37
		(100 %)	(118 %)	(42 %)	(135 %)	(22 %)
SW Channel	Sen Lake	16	17	2	20	2
		(100 %)	(105 %)	(11 %)	(127 %)	(13 %)
	Du Hang-Lam Tuong Lakes	29	34	3	37	4
		(100 %)	(117 %)	(12 %)	(129 %)	(13 %)
	Sen Lake South Basin	18	31	3	45	3
		(100 %)	(168 %)	(15 %)	(248 %)	(19 %)
	Other	11	19	8	26	5
		(100 %)	(176 %)	(72 %)	(234 %)	(50 %)
	Total	74	101	16	129	15
		(100 %)	(136 %)	(21 %)	(173 %)	(20 %)
An Kim Hai Channel	An Kim Hai Channel	24	31	16	40	9
		(100 %)	(130 %)	(67 %)	(169 %)	(40 %)
	Dong Hail Lake	13	19	2	28	3
		(100 %)	(150 %)	(16 %)	(219 %)	(22 %)
	Total	36	50	18	68	12
		(100 %)	(137 %)	(49 %)	(186 %)	(34 %)

The results of the analysis can be summarized as follows:

If the proposed Master Plan were not implemented, the pollution loads to these lakes and channels would increase considerably in the next 20 years, although the rates of increase vary from sub-basin to sub-basin. Pollution loads would increase 100 % or more in the south and east of the existing urban area (e.g., Sen Lake South Basin area, Dong Hai Lake area, west of Ngo Quyen District) where the population is expected to grow rapidly. On the other hand, increase in pollution loads in already developed area, e.g., Sen Lake area and An Bien-Mam Tom Lake area, will be limited.

The proposed Master Plan would reduce the overall pollution loads to the lakes and channels to approximately 10 % of the “Without Master Plan” case for BOD, T-N and T-P, and 20 % of the “Without Master Plan” case for SS. The catchment areas for these channels/lakes will be mainly covered by combined sewers, and the pollution loads to the lakes and channels are due to overflow from the CSO control structures[1]. The levels of pollution loads correspond to roughly 10-30 % of the present level for BOD, T-N and T-P, and 20-50 % of the present level for SS.

1 It was assumed that CSO control structures are developed throughout the area, and overflow will enter the lakes and channels. If the interceptor sewers are built around the lakes and channels and wastewater is diverted from these water bodies, as proposed in WB 1B Project, the pollution loads will be even smaller.

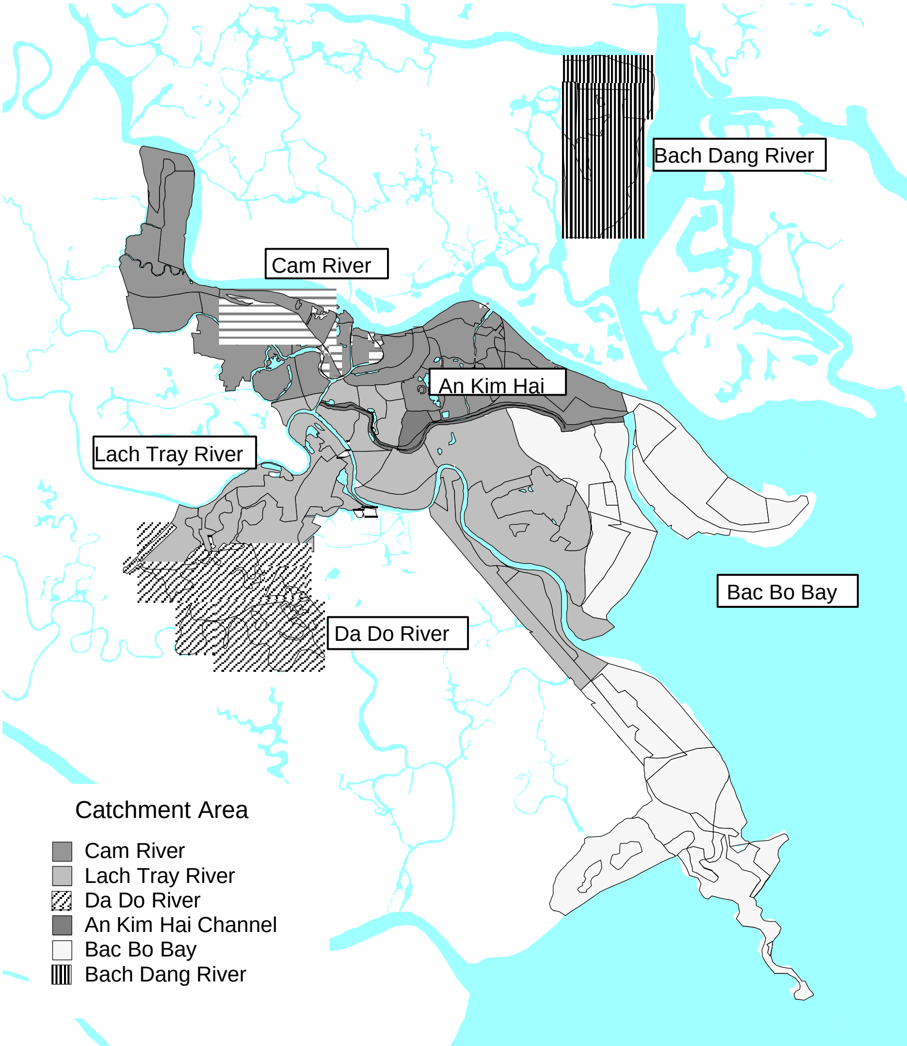
(2) Pollution Loads to Major Rivers

1) Pollution Loads to Rivers

The overall pollution loads to the following water bodies were analyzed: Cam River, Lach Tray River, Da Do River, An Kim Hai Channel, Bac Bo Bay (direct inflow), and Bach Dang River. Catchment areas for these major water bodies in 1999 are estimated in the figure below.

The following factors complicated the basin-wise analysis of pollution load:

- Complex Hydrological Characteristics: Hydrological characteristics in the area is strongly affected by tidal fluctuation
- Alteration of Catchment Area by the proposed Project: Catchment areas will be altered by the proposed drainage and sewerage projects. For example, wastewater from Old City Center is currently discharged to Cam River. However, in the future, the area will be serviced by combined sewer, and wastewater will be discharged to Lach Tray River. Similar trans-basin sewer system is also considered in Kien An area. The proposed drainage project will connect SW Channel System, NW Channel System and An Kim Hai Channel System. Such impacts of the proposed Master Plan were taken into account in analyzing the pollution loads to each water body



Catchment Area Map of Major Rivers

Table below summarizes the estimated pollution loads to major water bodies under five cases; (i) present (1999), (ii) 2010 without Master Plan, (iii) 2010 with Master Plan, (iv) 2020 without Master Plan, and (v) 2020 with Master Plan.

Total Pollution Loads to Major Rivers

Pollutant	Unit	1999	2010		2020	
Case	-	Present	Without MP	With MP	Without MP	With MP
BOD	kg/day	23,300	36,200	26,200	48,300	21,000
	(%)	(100 %)	(155 %)	(112 %)	(207 %)	(90 %)
SS	kg/day	50,900	74,900	64,700	98,000	70,000
	(%)	(100 %)	(147 %)	(127 %)	(193 %)	(138 %)
T-N	kg/day	5,550	8,160	7,820	10,620	11,160
	(%)	(100 %)	(147 %)	(141 %)	(191 %)	(201 %)
T-P	kg/day	890	1,430	1,400	1,940	2,020
	(%)	(100 %)	(161 %)	(157 %)	(218 %)	(230 %)

If the proposed Master Plan were not implemented, the anticipated levels of pollution loads to major rivers in 2020 would be nearly doubled from the present levels: 207 % for BOD, 193 % for SS, 191 % for T-N and 218 % for T-P.

The Master Plan would significantly reduce pollution loads of BOD and SS from the "Without Master Plan Case". If the Master Plan were implemented, the pollution loads in 2020 will be 90 % of the present level for BOD, 138 % of the present level for SS, 201 % of the present level for T-N and 230 % of the present level for T-P.

The proposed Master Plan would not significantly affect the pollution loads of T-N and T-P. In fact, the pollution loads of T-N and T-P may be increased by the Master Plan for the following reasons:

- the sewer network, which will efficiently collect and transport wastewater to WWTP will reduce the chance of wastewater to be treated "naturally" in lakes, channels and soils
- the removal efficiencies of T-N and T-P by the proposed treatment processes will be limited

As was discussed in the sewerage section, the proposed system was designed to collect and treat wastewater in a technically and economically feasible way. Removal of nutrients, such as nitrogen and phosphorous, is very costly, and is not a viable option at the time. However, if the removal of nutrients becomes desirable in the future, more advanced treatment process may be introduced. Furthermore, control of pollution loads from non-point sources and livestock is important as these sources account for over 30 % of the pollution loads.

Tables below compare the pollution loads to each river.

BOD Loads to Major Rivers

unit: kg/day

Basin	1999	2010		2020	
	Present	Without MP	With MP	Without MP	With MP
Cam River	11,600	17,300	13,100	20,600	4,800
	(100 %)	(149 %)	(113 %)	(178 %)	(41 %)
Lach Tray River	7,300	12,000	8,100	15,900	9,200
	(100 %)	(164 %)	(111 %)	(218 %)	(126 %)
Da Do River	700	900	900	1,500	500
	(100 %)	(129 %)	(129 %)	(214 %)	(71 %)
An Kim Hai	1,100	1,700	500	2,400	200
Channel	(100 %)	(155 %)	(45 %)	(218 %)	(18 %)
Bac Bo Bay	2,100	2,800	2,300	5,400	4,200
	(100 %)	(133 %)	(110 %)	(257 %)	(200 %)
Bach Dang River	500	1,500	1,300	2,500	2,100
	(100 %)	(300 %)	(260 %)	(500 %)	(420 %)
Total	23,300	36,200	26,200	48,300	21,000
	(100 %)	(155 %)	(112 %)	(207 %)	(90 %)

SS Loads to Major Rivers

unit: kg/day

Basin	1999	2010		2020	
	Present	Without MP	With MP	Without MP	With MP
Cam River	12,000	23,500	18,400	32,200	15,600
	(100 %)	(196 %)	(153 %)	(268 %)	(130 %)
Lach Tray River	17,300	24,900	21,600	31,800	25,400
	(100 %)	(144 %)	(125 %)	(184 %)	(147 %)
Da Do River	3,900	4,100	4,100	4,700	3,700
	(100 %)	(105 %)	(105 %)	(121 %)	(95 %)
An Kim Hai	1,800	2,500	1,200	3,000	900
Channel	(100 %)	(139 %)	(67 %)	(167 %)	(50 %)
Bac Bo Bay	13,600	15,700	15,300	20,000	18,700
	(100 %)	(115 %)	(113 %)	(147 %)	(138 %)
Bach Dang River	2,200	4,200	4,100	6,300	5,700
	(100 %)	(191 %)	(186 %)	(286 %)	(259 %)
Total	50,800	74,900	64,700	98,000	70,000
	(100 %)	(147 %)	(127 %)	(193 %)	(138 %)

T-N Loads to Major Rivers

unit: kg/day

Basin	1999	2010		2020	
	Present	Without MP	With MP	Without MP	With MP
Cam River	2,310	3,360	2,550	4,100	1,330
	(100 %)	(145 %)	(110 %)	(177 %)	(58 %)
Lach Tray River	1,790	2,810	3,540	3,680	6,530
	(100 %)	(157 %)	(198 %)	(206 %)	(365 %)
Da Do River	290	320	320	410	270
	(100 %)	(110 %)	(110 %)	(141 %)	(93 %)
An Kim Hai	220	360	110	480	50
Channel	(100 %)	(164 %)	(50 %)	(218 %)	(23 %)
Bac Bo Bay	760	930	920	1,340	2,370
	(100 %)	(122 %)	(121 %)	(176 %)	(312 %)
Bach Dang River	180	380	380	610	610
	(100 %)	(211 %)	(211 %)	(339 %)	(339 %)
Total	5,550	8,160	7,820	10,620	11,160
	(100 %)	(147 %)	(141 %)	(191 %)	(201 %)

T-P Loads to Major Rivers

unit: kg/day

Basin	1999	2010		2020	
	Present	Without MP	With MP	Without MP	With MP
Cam River	270	550	420	740	340
	(100 %)	(204 %)	(156 %)	(274 %)	(126 %)
Lach Tray River	310	470	590	610	1,030
	(100 %)	(152 %)	(190 %)	(197 %)	(332 %)
Da Do River	60	60	60	70	60
	(100 %)	(100 %)	(100 %)	(117 %)	(100 %)
An Kim Hai	40	50	20	70	10
Channel	(100 %)	(125 %)	(50 %)	(175 %)	(25 %)
Bac Bo Bay	180	220	220	310	440
	(100 %)	(122 %)	(122 %)	(172 %)	(244 %)
Bach Dang River	30	80	90	140	140
	(100 %)	(267 %)	(300 %)	(467 %)	(467 %)
Total	890	1,430	1,400	1,940	2,020
	(100 %)	(161 %)	(157 %)	(218 %)	(227 %)

Cam River and Lach Tray River, which flow north and south of urbanized area, receive over a half of the pollution loads in the Effective Study Area. Minh Duc area (Bach Dang River basin), where industrialization and urbanization are anticipated, will also experience rapid increase in pollution loads, although the amount of pollution loads will be still limited.

If the proposed Master Plan were implemented, the pollution loads to Cam River will be reduced drastically, in part because the pollution loads from the Old City Center (Hong Bang District) will be transported to Vinh Niem WWTP and discharged to Lach Tray River. On the contrary, Lach Tray River will receive more pollution loads, though the amount of BOD and SS discharged to Lach Tray River will be still smaller than the “Without Master Plan” case.

2) Water Quality

In order to assess the anticipated change in water quality with and without the Master Plan, simple calculations of anticipated water qualities were made by dividing the estimated pollution load by the discharge. Because the analysis of pollution loads indicated that the pollution loads to Cua Cam River and Lach Tray River are considerably larger than to other rivers, these two rivers were selected for further analysis.

The following background conditions, i.e., water quality and discharge condition upstream of the Effective Study Area, were assumed based on the existing discharge and water quality data. Water quality is worse in the dry season, because the dilution capacity is lower under the low discharge condition. In order to assess the water quality in such condition, the background discharge level was set at roughly 25-percentile value of the estimated average seaward flows[2].

Background Conditions

Parameter	Unit	Cua Cam	Lach Tray
Discharge*	10^3 m^3/day	34,000	3,000
BOD	mg/l	5.0	8.0
SS	mg/l	22.0	116.0
T-N	mg/l	0.50	0.650
T-P	mg/l	0.60	0.50

* : equivalent to 50 % of average seaward flow

Table below compares the anticipated concentrations of pollutants.

Anticipated Water Quality of Cua Cam River

Pollutant	Unit	1999	2010		2020		TCVN
		Present	Without MP	With MP	Without MP	With MP	5942-1995
BOD	mg/l	5.3	5.5	5.4	5.6	5.1	25
	(%)	(100 %)	(95 %)	(95 %)	(105 %)	(96 %)	-
SS	mg/l	22.4	22.7	22.5	23.0	22.4	80
	(%)	(100 %)	(102 %)	(101 %)	(103 %)	(100 %)	-
T-N	mg/l	0.57	0.60	0.58	0.62	0.54	15*
	(%)	(100 %)	(105 %)	(101 %)	(109 %)	(95 %)	-
T-P	mg/l	0.61	0.62	0.61	0.62	0.61	-
	(%)	(100 %)	(101 %)	(101 %)	(102 %)	(100 %)	-

* : as nitrate

** : TCVN 5942-1995

[2] Discharges of Cam River and Lach Tray River have not been monitored regularly, and the discharge values adopted here are only rough estimates based on the available data (Hydrometeorological Station, 2000) and the results of hydrological survey conducted in Nov. 2000.

Anticipated Water Quality of Lach Tray River

Pollutant	Unit	1999	2010		2020		TCVN
		Present	Without MP	With MP	Without MP	With MP	5942-1995
BOD	mg/l	10.4	12.0	10.7	13.3	11.1	25
	(%)	(100 %)	(115 %)	(103 %)	(127 %)	(106 %)	-
SS	mg/l	121.8	124.3	123.2	126.6	124.5	80
	(%)	(100 %)	(102 %)	(101 %)	(104 %)	(102 %)	-
T-N	mg/l	1.25	1.59	1.83	1.88	2.83	15*
	(%)	(100 %)	(127 %)	(147 %)	(151 %)	(227 %)	-
T-P	mg/l	0.60	0.66	0.70	0.70	0.84	-
	(%)	(100 %)	(109 %)	(115 %)	(117 %)	(140 %)	-

* : as nitrate

** : TCVN 5942-1995

It is clear that the impacts of the pollution loads from the Effective Study Area to the water qualities of these rivers are not large. In particular, the impact to Cam River is negligible even if the proposed Master Plan were not implemented. This is because Cam River has a sufficiently large discharge compared to the sewage volume. The water quality would easily satisfy the TCVN 5942-1995.

The impact is larger for Lach Tray River, which is roughly 1/10 in discharge, and the treated water from the western WWTP, which covers most of the urban center of Haiphong, will be discharged to it. Nevertheless, the impact is still small, and the TCNV 5942-1995 will be satisfied except for SS, which is high in the background.

It should be mentioned that the analysis in this section was carried out to roughly assess the potential impacts of the proposed Master Plan. Contributions from outside of the Effective Study Area (e.g., north side of Cam River) were neglected, and detailed hydrodynamic and physical/chemical/biological processes, such as dispersion, settling, nutrient cycle, etc., were not taken into account. Although these factors are believed to be secondary, the results should be interpreted accordingly.

References

- Japan Sewerage Association, Guideline for Comprehensive Basin-wise Planning of Sewerage System, pp.253, 1997
- Kunimatsu,T. and Muraoka,K., Modeling Analysis of River Pollution, pp.266, Gihodo, 1990
- Metcalf & Eddy Inc., Wastewater Engineering: Treatment, Disposal, and Reuse, 3rd ed., pp.1334, Irwin/McGraw-Hill, 1991
- National Research Council, Managing Wastewater in Coastal Urban Areas, National Academy Press, Washington DC, 1993
- Thomann,R.V. and Mueller,J.A., Principles of Surface Water Quality Modeling and Control, pp.644, Harper Collins Publ., 1987
- Wada,Y., Modeling Analysis of Non-Point Pollution Sources, pp.214, Gihodo, 1990
- World Health Organization (WHO), Assessment of Air, Water, and Land Pollution: A Guide to Rapid Source Inventory Techniques and Their Use in Formulating Environmental Control Strategies, WHO/PEP/GETNET/93.1A, 1993

CHAPTER 11 SELECTION OF THE PRIORITY PROJECTS

11.1 Selection Criteria

Criteria for the selection of the priority projects comprises the following 2 basic considerations:

- The project should be essential for solving the currently prevailing problem and should be implemented in short-term
- There has been no detailed study nor F/S for the project and therefore F/S should be carried out in this JICA Study (the Study)

Specifically, the second consideration comprises the followings. It should be noted that in the F/S to follow, these issues will be studied in depth.

(1) Necessity and Urgency

Sanitary conditions are in danger at present and urgent actions are needed. Damage, both current or potential, is serious and the size of affected people are large.

(2) Objective Achievement (Satisfaction of the sanitation/environment objectives)

Sanitation improvement of the Haiphong City has 2 principle objectives to be satisfied through the implementation of the projects and measures, i.e., a) improvement of sanitary condition of citizens, b) improvement of ambient environment including surface water quality, cleanliness of the city, etc.

(3) Compliance with the Sanitation Master Plan

The priority project should be in compliance with the long-term sanitation master plan recommended in the JICA sanitation master plan.

The contents and time schedule of the priority projects should be well coordinated with other plans/projects.

It is desirous that selected priority projects be complimentary to each other.

(4) Economic Viability

- Current and expected damage is large and serious. Size of affected people or number of the beneficiaries is large
- Project should be cost-effective relative to other alternatives

(5) Financial Affordability

Financial requirement of the investment cost and operation and maintenance (O&M) cost should be within the affordable range of the Government and people.

(6) Technical Feasibility

The technology to be used in the priority project should be proven and sure one which has already been applied elsewhere in the world or preferably in developing countries in the Southeast Asia. Risk of failure of the project should be low for construction and O&M.

(7) Environmental Acceptability

The adverse impacts which will be generated associated with the project implementation should be in the range acceptable to the affected citizens.

(8) Organizational Capability

The projects should be implementable by the responsible organizations after required organizational reinforcement.

The priority projects selected through the above criteria are worth carrying out the F/S in the JICA Study.

11.2 Selection of the Priority Projects

Three priority projects have been selected, one each in drainage, sewerage and solid waste management sectors. Among these, the priority project selected in the solid waste management sector comprises 3 sub-components.

11.2.1 Priority Project for Drainage Improvement

Phase 1 of the D2 alternative (see Figure 3.5.2 of page 3-71) selected for the drainage master plan, should be the priority project for drainage improvement for Haiphong City as explained below.

(1) Need for New Detailed Study

Though some plans/projects have been worked out for limited part of the city center, they are limited in space and the target level of the drainage improvement is considered inadequate. Therefore, F/S should be carried out in this JICA Study.

(2) Necessity and Urgency

The Central Area lying in the Le Chan and Ngo Quyen districts with about 11 km^2 which is to be covered by the Ph.1 of D2 option, is affected by frequent flooding seriously almost every year. The selected Drainage Priority Project can be completed within 5 to 6 years and can meet the urgent need.

(3) Objective Achievement

Sanitation condition will be improved by avoiding the frequent flooding. Water quality degradation due to the inflow of the flood water into the channels, lakes and rivers, will also be avoided.

(4) Compliance with the Sanitation Master Plan and Coordination with Other Plans

The priority project forms an integral part of D2 (see Figure 4.3.3 of page 4-141) which is recommended for the long-term sanitation master plan to be implemented in the first phase.

World Bank and FINNIDA project covers the 2 basins of the North-east and South-west channels out of the 3, while the priority project covers the remaining basin of the An Kim Hai channel. Together the projects will much improve the drainage condition of the Central Area.

Implementation of the priority project is also very much desirous for the implementation of the recommended sewerage priority project, i.e., Phase 1 of S3 because it adopts the combined sewer system.

The selected Drainage Priority Project is, thus, in good coordination and complimentary with other plans.

(5) Economic Viability

The Central Area is the most densely populated area in the city with the expected population density of 224 persons per ha in the year 2020. Number of the beneficiaries will total 259 thousand in 2020 and 240 thousand in 2010. Drainage condition will be improved for about 11 km^2. Investment cost per beneficiary is the smallest among all the drainage alternatives worked out in the JICA Study.

(6) Financial Affordability

Investment cost is the second lowest next to D1 which does not cover the Old City Center.

(7) Technical Feasibility

Proposed plan will mainly consist of the ordinary civil works and no special technology will be applied both for construction and O&M.

(8) Environmental Acceptability

Since it will include the rehabilitation of the An Kim Hai channel for about 10 km, resettlement of about 1,300 households along the channel will be unavoidable mainly for constructing maintenance road. Considering the past and recent experience of resettlement in Vietnam as well as good regulatory frame for the implementation of resettlement already established in Vietnam, the required resettlement is implementable. Before the implementation, however, detailed study such as Resettlement Action Plan should be worked out to minimize the scale of resettlement and its impact.

(9) Organizational Capability

SADCO is responsible for the operation and maintenance of the existing drainage facility though it is with limited scale. To manage the 1B project facility, which is under construction to be completed in 2005, reinforcement of the organization and staffing of SADCO is scheduled. Assuming further strengthening of SADCO, SADCO is considered as capable of operating and managing the Drainage Priority Project.

11.2.2 Priority Project for Sewerage Improvement

Phase 1 of the S3 alternative selected for the sewerage master plan, should be the priority project for sewerage improvement for Haiphong City as explained below.

(1) Need for New Detailed Study

To date, no sewerage project has been planned except a small-scale pilot project (World Bank Sanitation Project and FINNIDA Projects)

Therefore, F/S for sewerage development should be carried out in this JICA Study.

(2) Necessity and Urgency

At present, BOD, COD and coliform values exceed the Vietnamese standard in all the lakes in the Central Area to be covered by the priority project. Also eutrophication is in progress in the An Kim Hai channel and Tien Nga lake with Nitrogen value of more than 50 mg/l. There is an urgent need to solve these problems to implement a full-scale sewerage project.

Already the area is equipped with the combined sewers. Time required for the construction of the project will be much shorter than the other alternatives, in particular the new construction of a separate sewer system.

(3) Objective Achievement

Sanitation condition of the inhabitants within the Central Area will significantly be improved. Surface water quality degradation will be much alleviated by collecting and treating the sewage and thus reducing the pollutant inflow into channels, lakes and rivers.

(4) Compliance with the Sanitation Master Plan and Coordination with Other Plans

The priority project is the first phase development of S3, which is recommended for SMP and an integral part of SMP.

For the Central Area, Drainage Priority Project is selected in the Study based on the combined sewer network. World Bank and FINNIDA propose sanitation improvement plans also based on the combined sewer development.

(5) Economic Viability

The Central Area is the most densely populated area in the city with the expected population density of 224 persons per ha in the year 2020. Number of the beneficiaries will total 259 thousand in 2020 and 240 thousand in 2010. Sewerage system will be provided for about 11 km^2.

Investment cost per beneficiary is the third lowest among the sewerage alternatives worked out in the JICA Study. However, the other two alternatives with the lower cost have fundamental defects of either not covering the Old City Center or adopting not-proven technology.

(6) Financial Affordability

Investment cost is the third lowest among the 4 alternatives.

(7) Technical Feasibility

The combined sewer technology has been applied in many countries in the world and in Asia and considered to be proven and sure technology. Certain skill and knowledge will be required for the operation of the separation facility for sewage and rain water in the combined sewers and some manpower training will be needed.

(8) Environmental Acceptability

Though sizable area will be required for the sewage treatment station, appropriate land can be found to the south-west of the service area where only small number of the residents are currently living, necessitating limited scale resettlement.

Environmental impacts can be alleviated within permissible range by ordinary counter-measures.

(9) Organizational Capability

To date, SADCO's responsibility is mainly for drainage and it is very limited for sewerage. To manage the full-scale sewerage system, re-organization and recruiting and training of SADCO, which can meet the new requirement, will be essential. If these requirements are met, SADCO is considered as capable for managing the Sewerage Priority Project.

11.2.3 Priority Project for Solid Waste Management (Collection System)

Priority Project in the field of the solid waste management, should comprises 3 sub-projects or components, i.e., I) Procurement of waste collection vehicles and waste bins for improving the collection system in the 4 urban districts and Do Son area, ii) Sanitary landfill for the 3 central urban districts of Le Chan, Ngo Quyen and Hong Bang and iii) Hospital waste incineration for the major 18 hospitals and health centers in the 4 urban districts and Do Son area. Reasons and justification for selecting the waste collection component of the solid waste management priority project are given below.

(1) Need for New Detailed Study

To date, no detailed study nor F/S has been carried out for the improvement of the waste collection system for the Haiphong City and therefore a F/S is needed to be carried out in this JICA Study.

(2) Necessity and Urgency

The waste collection service only cover three fourths of the waste in terms of waste amount. Total waste volume to be generated is on increasing trend and collection capacity is needed to be reinforced. The current collection vehicle fleet includes sizable number of old ones which need to be replaced. The current double collection system should in principle be replaced by single collection system. The procurement of collection vehicles and waste bins are specially needed for the 4 urban districts and Do Son tourism area.

Once budget is secured, procurement can be made quickly.

(3) Objective Achievement

Sanitation condition of the inhabitants will significantly be improved by higher ratio of waste collection as well as avoiding waste dumping practice by installing waste bins. City will be cleaner with less scattered waste on the streets and channels.

(4) Compliance with the Sanitation Master Plan and Coordination with Other Plans

There exists no waste collection plans covering long time period. The priority project forms an integral part of SMP for solid waste management.

(5) Economic Viability

The proposed areas are either the most urbanized areas or tourism area with biggest number of visitors.

Cost per beneficiary including the investment and recurring costs is small with less than US$10 per beneficiary per year.

(6) Financial Affordability

Size of the investment cost is small with about US$20 million.

(7) Technical feasibility

No special technology will newly be required.

(8) Environmental Acceptability

With newer collection vehicle fleet, air pollution impact may be positive in net and no significant negative impacts are expected.

(9) Organizational Capability

Currently URENCO is collecting the solid waste effectively. If proper attention is paid for the single collection system operation, URENCO is considered as capable for managing the system.

11.2.4 Priority Project for Solid Waste Management (Trang Cat Landfill Ph.3)

Trang Cat landfill Ph.3 should be one component of the priority project for solid waste management for Haiphong City together with the other two components of waste collection system and hospital waste incineration as explained below.

(1) Need for New Detailed Study

To date, no detailed study nor F/S has been carried out for the disposal of the solid waste to be generated in the 3 central urban districts after the planned Phase 2 landfill is filled up. Therefore, a F/S is needed to be carried out in this JICA Study.

(2) Necessity and Urgency

The existing landfill at Trang Cat is expected to be filled up within this year, 2000. Though phase 2 project is envisaged in Trang Cat, capacity is not large and will be filled up within a few years. Trang Cat Ph.3 project to be designed as sanitary landfill should be implemented within short-term to receive the waste from the urban districts of Hong Bang, Le Chan and Ngo Quyen.

This priority project has been worked out in due consideration with the relevant solid waste management plans and projects including the planned Trang Cat Landfill Phase 2 which is to be implemented preceding this priority project.

The selected land for Trang Cat Ph.3 lies within the area whose land acquisition has already been approved by the Prime Minister. Construction work requires only 2 years.

(3) Objective Achievement

Sanitary condition of the residents in the 3 central urban districts will be secured. Waste will be disposed of in sanitary manner, giving environmental impacts below permitted level. City will be cleaner with less scattered waste on the streets and channels.

(4) Compliance with the Sanitation Master Plan and Coordination with Other Plans

This priority project component is worked out in due consideration of the Trang Cat Ph.2 project for which a F/S has already been completed.

This priority project component forms an integral part of SMP for solid waste management.

(5) Economic Viability

The above 3 urban districts are the most densely populated area with the expected population of 446 thousand in 2010.

Cost per beneficiary including the investment and recurring costs is small with a little bit bigger than US$1 per beneficiary per year.

(6) Financial Affordability

Size of the investment cost is not big with about US$13.6 million.

(7) Technical Feasibility

O&M of the sanitary landfill may require certain level of technology and require certain manpower training. If adequate training is carried out, URENCO is considered as capable of managing the sanitary landfill system of Trang Cat Ph.3.

(8) Environmental Acceptability

By designing proper sanitary landfill, environmental impact can be minimized both in terms of water and air environment. No resettlement will be required.

(9) Organizational Capability

New technology and expertise will be required for sanitary landfill operation including leachate treatment. If proper reinforcement is made for the organization and staffing of the existing landfill section, URENCO is considered as capable of managing the sanitary landfill system.

11.2.5 Priority Project for Solid Waste Management (Hospital Waste Incineration)

Installation of a incinerator for the hospital waste (infectious waste) should be one component of the priority project for solid waste management for Haiphong City together with the other two components of waste collection and transport project and Trang Cat sanitary landfill as explained below.

(1) Need for New Detailed Study

To date, no detailed study nor F/S has been carried out for the collection and disposal infectious and dangerous waste generated in the hospitals and F/S is needed to be carried out in this JICA Study.

(2) Necessity and Urgency

Currently, infectious waste and domestic waste generated in the hospitals are not separately collected and disposed of together with other ordinary domestic waste. Separated collection and special treatment of infectious waste is urgent to secure the public health of the Haiphong citizens as well as tourists.

Once specification is prepared, procurement can be made within a year.

(3) Objective Achievement

Sanitary and health condition of the workers and consequently citizens will be improved through this project.

(4) Compliance with the Sanitation Master Plan and Coordination with Other Plans

This priority project component forms an integral part of SMP for solid waste management.

(5) Economic Viability

Reduction of infectious diseases can be expected, which will bring about the economic benefit of reducing medical expenses and avoiding the decrease of working days of the citizens.

Cost per beneficiary who live in the served areas including the investment and recurring costs is small with US$0.9 per year.

(6) Financial Affordability

Size of the investment cost is small with about US$1 million.

(7) Technical Feasibility

Waste incinerator is not in operation in Haiphong at present. Peculiar technology will be required for O&M of the incinerator. Operators need to be trained.

(8) Environmental Acceptability

An incinerator which prevents hazardous gas emission will be selected. It should be located in the Trang Cat landfill area where currently solid waste is disposed of by after its closure to minimize the social and environmental impacts.

(9) Organizational Capability

At present, URENCO has no section for hospital waste incineration. New technology and expertise will be required for O&M of the incinerator. New section for this purpose should be set up within URENCO and staff should be trained.