IV. IMPROVEMENT PLAN FOR SEWERAGE DEVELOPMENT

4.1 Current Conditions and Review of Existing Plans

(1) Current Sanitation Situation

Wastewater is the eventual product of water consumption. In the Study Area, the projected water demand in 2020 is 197,381 m^3/day. Almost the entire amount would become wastewater and, without any preventive measures, this will cause severe surface and groundwater pollution leading to deteriorating public health condition.

At present, there is no proper sewerage system in Haiphong. Most of the households in the urban area have septic tanks, though septic tank maintenance is inappropriate and inadequate. These septic tanks only receive black water while all gray water is discharged either into surface drains or to the ambient environment. Some households in urban areas and most households in semi-urban areas have a bucket latrine, which is un hygienic. The rest use some sort of pit latrines.

The urban areas are serviced by a combined sewer network. This collects overflows from septic tanks, all gray water and also storm water. These combined sewers then discharge into surface water bodies causing severe surface water pollution. The worst surface water pollution exists in the 3 urban districts. The biological oxygen demand (BOD) is high in all lakes and channels, sometimes as high as 150 mg/l, several times higher than the VN standard of 25 mg/l. High ammonia values are present in the lakes and most probably caused by organic pollution from sewage. The concentrations of nutrients are in the order of 50 mg/l for total nitrogen and 5 mg/l for total phosphorous.

At present, about 2,500 bucket latrines are in use in urban areas and URENCO is responsible for collecting the nightsoil from these bucket latrines. However, present collection covers only around 1,600 bucket latrines. The present practice for nightsoil collection is not hygienic at all. The URENCO staff collect nightsoil manually and deliver it to farmers of sub-urban areas.

Septic tanks are widely used in Haiphong. Usually most of them have sewer connection. It is estimated that there are around 50,000 septic tanks in the urban area. Most of these lack proper maintenance and periodic septage removal. At the moment, SADCO's desludging program is demand based. SADCO provides tank-emptying service only when called out by householders, often after problems arise with blockages in the foul drainage system. Due to this situation, treatment

efficiency septic tanks is generally low, which leads to the surface water quality degradation.

The main problems with sewage management are as follows:

- Since the combined sewage is directly discharged into surface water bodies, lakes and channels are extremely polluted
- Septic tanks are used, but the degree of treatment is not effective due to inadequate management. Wastewater from septic tanks is then discharged directly to lakes and channels without adequate treatment

(2) Review of Existing Plans

The "Haiphong Sewerage and Drainage Master Plan" provides comprehensive development plans for the sewerage systems in the Study Area. However, there is no implementation scheduled in the near future.

There are two externally supported projects going on funded by World Bank and FINNIDA. The proposed World Bank Sanitation Project consists of the following measures for sewerage improvements:

- Constriction of interceptor sewers for 2 lakes
- Construction of septage treatment facilities at Trang Cat Landfill
- Procurement of sewer cleaning and septage collection vehicles
- Revolving fund for households to purchase and install septic tanks

The proposed FINNIDA project consists of the following measures for sewerage improvement:

- Pilot scale wastewater collection and treatment system

4.2 Planning Framework for Sewerage Improvement

(1) Planning Objectives

Planning objectives for sewage management are as follows:

- To provide sewerage in areas with high population densities
- To reduce wastewater discharges to surface water bodies
- To provide a solution that is sustainable and compatible with local standards and practices

This will lead to:

- Healthy living environment
- Favorable urban development

(2) Planning Strategy

A number of criteria are considered in determining the appropriate level of sewage disposal system for a given area. Among those, population density is the key parameter. The following population density-based selection criterion is adopted to select appropriate sewage disposal system in the Study Area.

Population density	Range	Target
High	more than 40 person/ha	Sewer System
Medium	25-39 person/ha	Septic Tank Based Simplified Sewerage System
	11-24 person/ha	Septic Tank
Low	less than 10 person/ha	Improved Latrine (Twin Pit Latrine, VIP Latrine, Compost Latrine etc.)

Based on the population density and future development plan, the appropriate target sewerage systems in 2020 are selected as follows.

Area	2020
Urban area	Central Sewerage System
Kien An Dist.	Central and Simplified Sewerage System, and Septic Tank
Do Son Town	Simplified Sewerage System and Septic Tank
Quan Toan	Septic Tank
Minh Duc	Septic TAnk
Dinh Vu	Industrial Zone Authority will be responsible
New Development Area	Septic TAnk

(3) Phased Implementation

The following schedule is adopted to allow phased implementation of sewerage development:

- Year 2010: Short term
- Year 2020: Long term

(4) Target Areas

The target area is divided into three classes based on present and future development potential. Because of the strategic importance, a different level of study is done as shown below.

Class A area	Three Urban Districts and surroundings	Detailed master plan
Class B area	Kien An, Do Son and Quan Toan	Master plan
Class C area	Minh Duc, Dinh Vu and NDA	Outline master plan

4.3 Preliminary Design and Cost Estimate for the Optimum Measures for Class A Area

(1) Formulation of Alternatives and Selection of the Optimum Alternative

Based on drainage zoning, the total planning area is sub-divided into the following areas:

- Old City Center (OCC): Combined sewerage pipes and septic tanks exist
- Central area: Combined sewerage pipes and septic tanks exist
- New Urban Area (NUA): No sewerage pipes exist, septic tanks exist but coverage is low

The sewerage improvement plan in this Study considers four alternatives. These are based on:

- population density, ambient water quality and development trend of sub-areas within the target area
- target sewerage system
- relevance with other sanitation improvement
- consideration and compatibility with other committed plans

Four alternatives for sewerage improvements have been proposed as shown below.

Alternatives for Sewerage Improvement Plan

	Target Area	**Target System**	**Phase**
Alternative S1	Central Area New Urban Area Old City Center	Combined Combined No action	Phase I Phase II ------
Alternative S2	Central Area New Urban Area Old City Center	Simplified Separate Simplified	Phase I Phase II Phase II
Alternative S3	Central Area New Urban Area Old City Center	Combined Separate Combined	Phase I Phase II Phase II
Alternative S4	Central Area New Urban Area Old City Center,	Separate Separate Separate	Phase I Phase II Phase II

Assessment of the sewerage improvement plan alternatives are based on:

- Investment cost
- Inclusion/exclusion of the Old City Center
- Selection of the most appropriate target system for each sub-area
- Appropriate phasing of the implementation of sewerage improvement for each sub-area

Simplified system is not recommended, as it is not a proven technology in the Asian region. Though OCC has a high population density and economic

importance, it is recommended to develop the sewerage in OCC in Phase II, since it will be costly and time consuming to implement in that area and the impact on the Cam river is negligible. NUA is also recommend for Phase II development as it is still a developing area and the situation is not that urgent.

Sewerage Option S3 is selected as the optimum measure for Class A area. The basis for this selection includes the following:

- Both investment cost and investment cost per beneficiary are the second lowest
- OCC is included, however, sewerage improvement may be delayed for this area
- Time requirement for Central Area and OCC is satisfactory
- For NUA, a higher improvement effect can be assured. Time requirement is also satisfactory

(2) Preliminary Design and Cost Estimates for the Selected Alternatives

Due to topographic, operational, and cost consideration, two treatment plants, namely, west and east are proposed. Sewage generation is estimated based on water supply. The following factors are used in the sewage generation estimation:

- Design water consumption in 2020 is 130 lpcd
- Service ratio: 50 % in the beginning leading to 100 % in 2010
- Industrial wastewater is 80 % of water consumption
- Groundwater infiltration ratio is 10 %

The total sewage generation in 2020 is estimated at 87,485 m^3/day. Out of this the west treatment plant catchment would generate 71,773 m^3/day. The Phase I sewage generation in 2010 is estimated to be 35,325 m^3/day. It is considered that the peak flow is 1.5 times the Average Dry Weather Flow (ADWF, flow when there is no rainfall) for a separate system and 3 times for a combined system.

The planned wastewater quality for 2020 is determined as follows:

- Domestic wastewater:50 g/c/d of BOD
- Commercial wastewater: 350 mg/l of BOD
- Industrial wastewater:400 mg/l of BOD

Treated wastewater quality is decided as 50 mg/l of BOD in conformity to the effluent standards in Vietnam.

Based on the design principle adopted, required sewerage facilities are estimated as shown below:

- Wastewater treatment plants 2
- Main pumping stations 6

- Sub pumping stations 28
- Conveyance sewers 55 km
- Sewer pipes 391 km

There are two proposed treatment plants, namely, west and east treatment plants. For the east treatment plant, stabilization pond is most recommended because land is likely to be available for this relatively small-scale treatment plant. For the west WWTP, there are five options. These are:

- Wastewater Stabilization Pond (WSP)
- Modified Wastewater Stabilization Pond (MWSP)
- Aerated Lagoon (AL)
- Oxidation Ditch (OD)
- Conventional Activated Sludge Process (CAS)

These methods are compared from the following points of view to select the most suitable process:

- Flexibility to shock/over load
- Workability with the operation and maintenance (O&M)
- Required costs of construction and O & M
- Required sludge disposal and volume of excess sludge
- Required land acquisition

Detailed calculation shows that CAS is the most expensive and requires the least land whilst MWSP is the cheapest but has the second highest land requirement. However, effluent BOD concentration is around 100 mg/l from MWSP, which cannot satisfy VN standard of 50 mg/l. The cost and land requirement for AL is moderate. As a result, AL is proposed for the west treatment plant.

The treatment processes as adopted are aerated lagoon for the west plant and stabilization pond for the east plant. Based on the proposed facilities and unit costs, total cost is estimated at US$152 million as direct construction cost. Phase I total cost is US$50 million. The total compensation is US$3.2 million, out of which the Phase I requirement is US$2.2 million.

4.4 Preliminary Design and Cost Estimate for the Optimum Measures for Class B Area

(1) Kien An

It is proposed that out of nine phoungs of Kien An, only one should be served by septic tanks. Three phoungs will have a simplified sewer system and the

remaining five phoungs will be served by a centralized sewer system. As the existing sewer lines are limited, a separate sewer system is proposed in the centralized sewer area.

	Service area	Service population	Sewerage generation
Central Sewerage	1,362 ha	72,213 persons	7,955 m^3/day
Simplified Sewerage	947 ha	28,026 persons	4,425 m^3/day

Based on the design principle adopted, the required sewerage facilities are estimated as shown below:

- Wastewater treatment plants 1
- Simplified treatment plants 3
- Main pumping stations 2
- Sub pumping stations 13
- Conveyance sewers 4 km
- Sewer pipes 160 km

For the Central WWTP, stabilization pond is selected and for the simplified WWTP, Anaerobic Aerobic Bio-filter is proposed. Based on the proposed facilities and unit costs, the total cost is estimated at US$34 million as direct cost. Phase I cost is US$15 million. The total compensation is US$0.8 million, out of which the Phase I requirement is US$0.6 million.

(2) Do Son

It is proposed that out of the five phoungs, three phoungs should be served with a simplified sewer system and the other two phoungs with sanitary latrines by 2020. The estimated service population and service area in 2020 are 23,298 persons and 1,949 ha, respectively. The total sewage generation in 2020 is 2,973 m^3/day.

Based on the design principle adopted, the required sewerage facilities are estimated as shown below:

- Simplified treatment plants 2
- Sub pumping stations 11
- Sewer pipes 49 km
- For the simplified WWTP, Anaerobic Aerobic Bio-filter is proposed. Based on the proposed facilities and unit costs, the total cost is estimated at US$7.3 million as direct cost. The total compensation is US$ 0.1 million

4.5 Phased Development and Cost Schedule

Within the Study Area, sewerage projects are proposed for Class A area, Kien An and Do Son. All projects are divided into two phases. Phase I has a target year of 2010 while the target year of Phase II is 2020. For the areas where no sewerage system is proposed, septic tank and sanitary latrines are recommended. For the new septic tank system development, US$50/person is considered as investment cost. The total investment costs for various areas are:

- Class A area US$160 million
- Kien An US$35 million
- Do Son US$8 million

The total cost for sewerage development for the entire Study Area is US$211 million. The total cost including operation and maintenance is US$224 million.

Construction of the sewerage project is expected to start from 2004. The land acquisition would also start from 2004. Detailed design and pre-construction activities should start from mid-2003 in order to facilitate smooth implementation of the Project.

4.6 Nightsoil Collection and Disposal

The following facility measures are proposed for the improvement of nightsoil collection and disposal:

- Early and confident conversion procedure: Conversion will be carried out by using a revolving fund. In case the revolving fund program fails, suitable subsidies should be considered
- Safe collection practice: Until all bucket latrines are eliminated, a safe and complete collection and disposal system is indispensable. Instead of using hand, small suction pumps can be utilized to transfer the excreta into the trucks

The total cost is estimated at US$1 million.

4.7 Septic Tank Sludge Collection and Disposal

The following facility measures are proposed for the improvement of septage collection and disposal:

- Base line data preparation: In order to carry out the task of septage management, a detailed study of septic tank related issues will be undertaken soon for 21 phoungs. It is recommended to conduct a similar survey for the other phoungs in the Class A area

- Improvement of existing septic tanks: The most important task in the improvement of existing septic tanks is to provide each septic tank with an access hole with sealed cover
- Septage collection: In addition to conventional vacuum tankers, specialized equipment is also required
- Desludging interval: A GIS based computer database is proposed to monitor desludging interval for all septic tanks
- Treatment and disposal of Septage: The proposed co-disposal with solid waste option can handle about 21,000 m^3/year of septage. If there is a greater service area or higher septage generation value, the design would need to be changed
- Septic Tank Monitoring Unit: A monitoring unit within SADCO is proposed to oversee the issues related to septic tanks

The total cost is estimated as US$14 million.

4.8 Strengthening of the Management and Manpower Training for Sewerage/ Septage/Nightsoil and Drainage System

For strengthening of the institutional framework for urban sewerage and drainage, the following measures are proposed:

- TUPWS and then SADCO will have to be assigned with 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
- New units should be created within SADCO, namely, septage management, wastewater treatment plants, pumping stations, and drainage protection
- Strengthen the capacity of the project management unit (PMU) to ensure that it can effectively implement the capital investment projects
- Increase the technical competence of operations and maintenance staff by developing and delivering required training courses
- Recommended incremental staff of SADCO for sewerage improvement is 96, out of which the Phase I requirement is 51
- Recommended incremental staff of SADCO for drainage improvement is 45, out of which the Phase I requirement is 18

For the human resources development, the following measures are proposed:

- Specific courses to be developed and delivered for technical and managerial staffs
- Visit should be arranged to similar project sites
- A program of technical assistance to be provided to support the priority projects

V. WATER QUALITY IMPROVEMENT PLAN FOR LAKES AND CHANNELS

5.1 Problems Associated with Water Quality Conservation

5.1.1 Present Environmental Condition

(1) Water Quality of Lakes and Channels

Most lakes and channels 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 exceed 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) and channels (e.g., An Kim Hai Channel) 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 quality of lakes and channels 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) Management Issues

The organization responsible for the management of a given lake or channel is determined by the primary function of the lake or channel. However, because most channels and lakes in Haiphong area have multiple-functionality, as summarized below, the responsibilities are overlapping, and often not clear.

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

5.1.2 Expected Degradation of Water Quality

In order to estimate the expected degradation of water quality in the future, the pollution loads (BOD, SS, T-N and T-P) to the major lakes and channels in the urban area of Haiphong (Le Chan and Ngo Quyen Districts) were estimated. The pollution loads to these water bodies in 2020 would be 110 – 250 % of the present level (1999). The rates of increase vary from sub-basin to sub-basin. Large

increase in the pollution load is expected 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.

5.2 Planning Framework for Water Quality Improvement for Lakes and Channels

(1) Water Quality Target

Vietnam has the surface water quality standard, TCVN5942-1995[5]. Hence, the ultimate target is "the attainment of water quality standard by 2020".

(2) Principles

This Chapter mainly focuses on the improvement of environmental and recreational conditions, which include water quality, sediment quality, odor, amenity, and aesthetic aspects.

The proposed measures are designed to supplement the proposed sewerage plans to further improve water quality of heavily polluted lakes and channels. Water quality of major rivers in Haiphong, e.g., Cam River and Lach Tray River, is still relatively good, and these rivers have sufficient dilution capacities. Therefore, specific measures to improve water quality of major rivers beyond the proposed sewerage plans were not considered here.

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

5.3 Selection of the Optimum Measures

(1) General Strategies

Considering the complexity of water pollution problems in Haiphong, combinations of the following strategies were adopted in order to improve the water quality of lakes and channels.

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

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) Existing Plans to Improve Water Quality of Lakes and Channels

The existing plans to improve water quality of lakes and channels are summarized in Table below. These plans were included in the Sanitation Master Plan as "given condition".

Existing Plans to Improve Water Quality of Lakes and Channels

Project Name	Components	Implementing Agency	Cost US$ million
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

5.4 Preliminary Design and Cost Estimation for the Optimum Measures

(1) Construction of Interceptor Sewers around Lakes

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

The estimated sewer length for each lake is given in the Table below. The interceptor sewers shall be connected to the proposed sewer lines. As described in the sewerage section, CSO control facilities should be constructed in order to control storm water. Regular maintenance/clean-up of the sewer lines will be carried out.

Preliminary Cost Estimates for Construction of Interceptor Sewers

Component	Lake	Length (km)	Est. Cost (US$ million)
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 in 2020			0.002

*: to be implemented as a part of 1B Project
**: to be implemented by Park Company
Source: Soil and Water, 1998

(2) Lake Rehabilitation Projects

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 easiness of handling/transporting excavated sediment, dry excavation in dry season is desirable. The dredged sediment shall be disposed of at the designated site in environmentally-sound manner. Trang Cat Landfill is available for the dredged material for 1B Project. Once rehabilitated, the project requires regular maintenance of the service roads and control of illegal encroachment.

Preliminary Cost Estimates for Lake Rehabilitation Projects

Component	Lake	Area (ha)	Est. Cost (USD million)
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
	Total	33.0	1.258
O&M in 2020			0.004

*: to be implemented by SADCo as a part of 1B Project
**: to be implemented by Park Company
Source: Soil and Water, 1998

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

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

5.5 Phased Development and Disbursement Schedule

The proposed projects will be implemented during 2001-2004 as the components of 1B Project by SADCO and An Bien Lake Improvement Plan by Park Service.

5.6 Strengthening of the Management and Manpower Training

5.6.1 Improvement the Management and Operation and Maintenance

(1) Regulation of Land, Water, and Ecological Resource use in Haiphong's Lakes, Rivers, and Channels

As there are no specific regulations for environmental protection of lakes, rivers, and streams. Haiphong People's Committee (HPPC) should prepare a decision on the control of all activities using or affecting Hai Phong'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 ecosystem functions
- the 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 to responsible agencies including TUWPS, SADCO, Park Service and DARD

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

Flood control and irrigation are important functions of lakes and channels in Haiphong. It is recommend 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

5.6.2 Manpower Training

In general there are two areas that need strengthening: 1) environmental monitoring; and 2) ecological management of water bodies. One of the responsible agencies that needs capacity building and training is the Haiphong

DOSTE, the other is SADCO. The following components are considered important:

- Upgrading the capacity for environmental monitoring
- Source sampling and water quality analysis by the SADCO Drainage Protection Unit
- O&M for Operation of the Drainage System for Water Quality Management

VI. IMPROVEMENT PLAN FOR SOLID WASTE MANAGEMENT

6.1 Current Conditions and Review of the Existing Plan

6.1.1 Institutional, Legal and Financial Aspect

(1) Institutional Aspect

HPPC has the following three companies that provide solid waste management services:

- Urban Environmental Company (URENCO) that provides service for the central three urban districts, i.e. Hong Bang, Le Chan, and Ngo Quyen
- Kien An Urban Works Company
- Do Son Public Works Company

Administratively, these three companies are under Transport and Urban Public Works Department (TUPWS) that is the principal agency responsible for solid waste administration. Urban Planning Institute (UPI) is responsible for selection of landfill sites. DOSTE is responsible for the hazardous waste control and giving technical advices on landfill. Department of Health is responsible for guiding hospitals concerning hospital waste management. Total number of employees of the 3 companies involved in solid waste management activities is about 1,300.

(2) Legal Aspect

HPPC drafted "Waste Management Regulation by Haiphong City" in 2000. This is the first municipal regulation on solid waste management in Haiphong. However, the Regulation does not clearly define the responsibility of generators of some types of solid waste including industrial waste.

HPPC's enforcement of the regulation is very weak.

(3) Financial Aspect

In 2000, the total cost of solid waste management of the three companies is estimated to be VND17,530 million (US$1.3 million), of which 77 % is the recurring expenditure, and the remaining 23 % is estimated depreciation of the investment costs including landfill construction and vehicle purchase costs. The unit cost spent for management of one (1) ton solid waste is estimated to be VND102 thousands (US$7.3/ton). Ratio of cost recovery through the fee collection is about 21 %.

6.1.2 Waste Collection and Transport

(1) Quantity and Quality of Waste

The three companies collected a total of 471 ton/day on average in 2000, which corresponds to 75 % of the estimated waste generation quantity of the service areas of the three companies. Bulk density of Haiphong waste is 0.45. Dominant components of the waste is kitchen waste and ash of briquette (charcoal) used for cooking.

(2) Collection System

The dominant waste collection system applied in Haiphong comprises of three activities, i.e., 1) the primary collection of waste from generation sources with handcarts, 2) waste transfer from handcarts to waste collection trucks and 3) transport of waste by vehicles to landfill site. This system is very labor-intensive system and common in Vietnam and many other developing countries.

This process of waste transfer is inefficient and unsanitary, and causes adverse impacts on the health, environment and traffic.

Equipment: The three companies have approximately 40 vehicles for waste collection, 5 vehicles for night soil collection, and 4 vehicles for water sprinkling for streets. Most of them are old. Average use period seems to be 10 years.

6.1.3 Waste Disposal

(1) Disposal Method

Haiphong City applies landfill as waste disposal method.

(2) Landfill

As of the beginning of 2001, HPPC has two landfill sites, one at Trang Cat Commune, which receives solid waste collected from the 4 urban districts of Haiphong, and the other in Do Son that receives solid waste collected from Do Son Town.

The existing Trang Landfill Site is about 10 km from URENCO office, has an area of 5 ha. The site is operated by URENCO. The site is going to be full in mid 2001. HPPC is going to construct the Phase 2 Landfill Site (11 ha) adjacent to the Phase 1 site using own fund. The existing site has a leachate collection system and treatment pond. However, the treatment pond is not effective. According to the design, the site has a clay liner of 25 cm thickness. URENCO applies cover soil a

few times a year. The current waste deposit height has reached 14 m. There is a danger that waste deposit can collapse any time. In 2000, amount of incoming waste was 427 ton/day on average. The site receives all kinds of solid waste collected by URENCO and Kien An Urban Works Company. Received waste includes industrial and hospital waste.

Do Son Landfill Site has an area of 1 ha. The site is going to be full at the end of 2002. The next landfill site will be constructed adjacent to the existing one. The site is equipped with leachate collection pipes, storage pond and sedimentation pond. The site was also equipped with gas collection pipes, but they have been removed recently. Current height of waste deposit is about 10 m. There is no heavy equipment used on site. Cover soil has not been applied. The site receives all waste collected by Do Son Public Works Company. Daily average incoming waste is 44 ton/day.

6.1.4 Hospital Waste Management

(1) Quantity of Hospital Waste

It is estimated that about 5 ton/day of hospital waste is generated in the Study Area (4 urban districts and Do Son Town), of which approximately 1 ton/day is medical waste that needs special attention.

(2) Current Situation

In Haiphong, there are 264 medical establishments under Haiphong Department of Health, comprising 9 hospitals, 13 medical centers, 26 diagnostic rooms and 216 medical stations. In addition, there are three more hospitals controlled by other agencies.

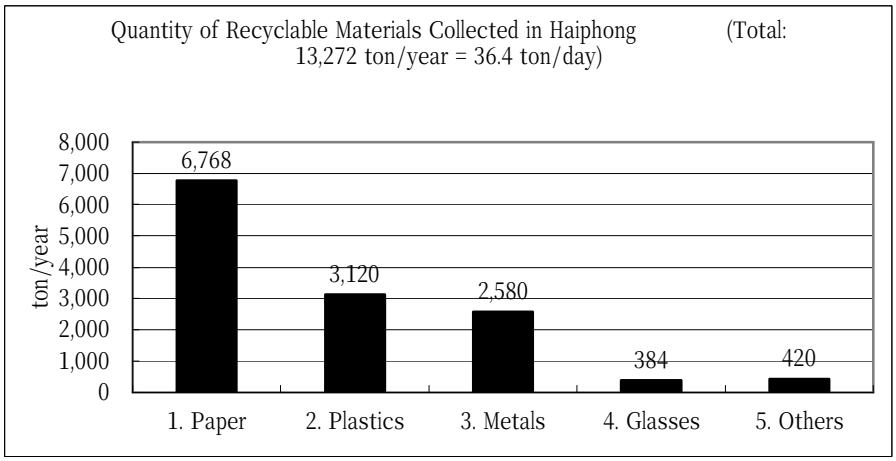
In Haiphong, there is no independent system for management of medical waste. It is collected, and disposed of at landfill site, together with domestic waste. The lack of such independent management system poses risks that people may be infected through the contacts with medical waste.

6.1.5 Recycling

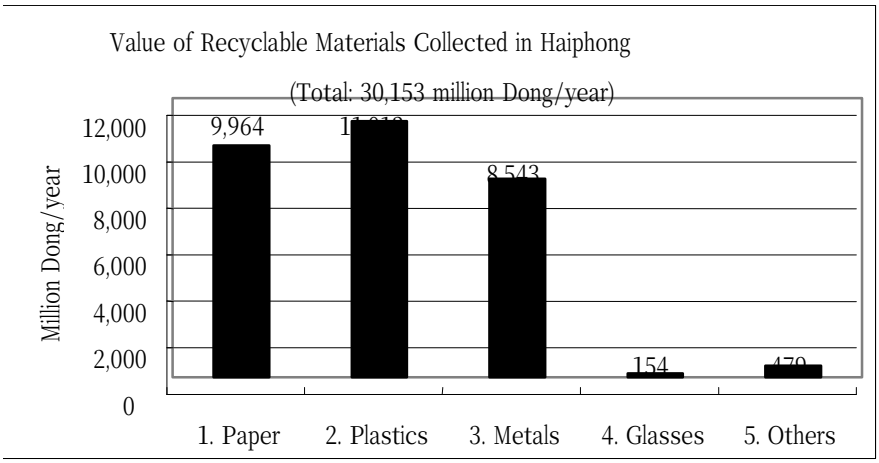
Based on the Recycling Market Survey conducted by the JICA Study Team in October and November 2000 in Haiphong, recycling situation in Haiphong can be described as follows.

It is estimated that total amount of recycling materials collected and traded in Haiphong is 36.4 ton/day or 13,272 ton/year on average. The value of the materials paid by the end user is estimated to be VND30,152 million or US$2.1 million per year. Major types of recycling materials are as follows:

- Paper
- Plastics
- Metals
- Glasses
- Food and others (shoes waste, duck feather)



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



6.2 Basic Strategy for the Overall Solid Waste Management

Main points are summarized as follows:

- Legal improvement in the municipal solid waste regulation for clearer definition of responsibility of generators of the following types of waste. i.e. industrial waste, infectious waste, demolition waste, soil waste and dredging

waste. Generators of these types of waste should be responsible for management of waste they generate

- Strengthening of the enforcement the regulation concerning solid waste to reduce illegal dumping
- Increases in cost recovery through increases in fees collection revenue. Both reduction in numbers of non-payers and increases in the fee rates are needed

Targets are proposed 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

- Strengthening of URENCO as a Service Provider – More independence from HPPC in terms of fiancé and administration. URENCO should have a responsibility for investment decision
- Promotion of 1) privatization in the form of "contracting out", 2) socialization, and 3) competition
- Improvement of efficiency and sanitary conditions of Haiphong by applying new systems as proposed in the Sanitation Master Plan
- Introduction of the sanitary landfill, which is considered the most economical and appropriate method of disposal for Haiphong
- Creation of an independent system for management of hospital waste
- To keep the current system and conditions that are favorable for reuse and recycling. Separation as sources is far more superior to recovery of useful materials from waste in terms of efficiency and quality of recovered materials

6.3 Waste Quantity, Quality and Target Collection Service

6.3.1 Current Waste Quantity

Based on the surveys conducted by the Study, it is estimated that waste quantity generated in the 4 urban districts and Do Son Town is 630 ton/day in 2000, while the collection amount is 471 ton/day, 75 % of the generation amount.

6.3.2 Current Waste Quality

Average bulk density of Haiphong waste is estimated to be 0.45. Kitchen waste and residue of briquette (charcoal) used for cooking are the two major components

of Haiphong waste. Based on the current and previous studies, it is estimated that kitchen waste (garbage) shares at least 40 % on wet base. Plastic and paper waste share 6.1 % and 3.5 % respectively. As result of the 3 elements analysis, content of each element is estimated as follows: water content 40 %, ash content 30 %, and combustible content 30 %.

6.3.3 Future Waste Generation and Target Collection Service

Future waste generation is estimated considering the population projection and economic growth forecast.

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

Year	URENCO		Kien An		Do Son		Haiphong Total	
	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 %	471	75 %
2005	597	85 %	89	85 %	75	81 %	761	85 %
2010	839	95 %	132	95 %	115	91 %	1,086	95 %
2020	1,082	95 %	183	95 %	176	95 %	1,441	95 %

Waste collection targets are set in terms of ratios of waste collection amounts to generation amounts. The most important target is that 100 % of non-agricultural households in the Study Area will receive household waste collection service in future. This target is equivalent to 95 % in terms of ratio of waste collection amount to generation amount. 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.

6.4 Municipal Waste Management Plan

6.4.1 Scope of the Municipal Waste Management Plan

The scope of the current study covers all relevant aspects related to solid waste management, i.e.:

- Technical and operational aspects
- Legal aspect
- Institutional aspect
- Financial aspect

The scope of the study covers all types of waste collected by Haiphong City, i.e.:

- Household waste
- Commercial and office waste

- Street waste
- Demolition waste
- Hospital waste
- Industrial waste

Concerning industrial waste, the scope of the study is limited to institutional aspects and preparation of an inventory of hazardous waste. Plans for industrial waste management facilities are not included in the scope.

6.4.2 Plan for Waste Collection and Transport

(1) Improvement Needs

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

- Efficiency
- Minimization of adverse impacts of waste collection activities on the heath, environment and traffic

(2) Proposed System

In principle a change from the arrest "Open system" to a "Closed System" is necessary for the waste collection and transport system. Based on this principle, the following is proposed:

- Mechanization of waste loading into vehicles from handcarts or bins
- Gradual shift from the existing double handling system (handcart collection and manual transfer of waste into vehicle) to the direct collection system (single handling system)

For mechanization, it is necessary to use compactor vehicles equipped with a mechanical lifting device.

For introduction of the direct collection system, it is necessary to use both bins and compactors equipped with mechanical lifter.

(3) Advantages of the Proposed System

The major advantages of the proposed single handling system are:

- Economical
- Clean, sanitary and healthy (fewer impacts of collection activities on the environment and health)
- Less impact on the traffic

- Convenient to generators

The proposed system is economical. Under the single handling system, the unit cost needed for collection and transport of one (1) ton of waste will be reduced to approximately 70 % of that needed for the existing double handling system. The difference in the unit cost will increase as the salary of workers increase. When the salary is doubled, the unit cost of the proposed single handling system will be about 50 % of the existing double handling system.

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

A key element for successful implementation of the proposed single handling 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. A vehicle will arrive at bins for empting them. It is necessary to implement this system as a pilot project before application on full scale. The following types of places are suitable for the pilot project:

- Market
- Enterprise
- Apartment building

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 government and the citizens will learn and become accustomed to the new system.

(5) Equipment Procurement Plan

Major types of equipment to be procured for waste collection and transport are compactors for waste collection, bins (660 liter and 240 liter) for waste storage, and workshop equipment for maintenance.

6.4.3 Plan for Waste Disposal

(1) Disposal Method

The JICA Study Team recommends that Haiphong City should apply sanitary landfill as the major method of non-hazardous solid waste disposal because it is considered to be the most economical among disposal options that are environmentally acceptable. Incineration technology is too costly. Composting is not feasible considering the inadequate demand for compost and the low quality of

Haiphong waste that contains much residue of charcoal briquette used for cooking. Open dumping, though cheap, is not acceptable from an environmental viewpoint.

(2) Landfill Plan for the Central Three Urban Districts

1) Location

Trang Cat Site. Note: The site, with total area of 60 ha, has already been approved by the Prime Minister in 1997.

2) Phased Development Plan

The following phased development is planned:

- Phase 1 (5 ha): beginning of 1998 – 2001
- Phase 2 (11 ha): 2001 – end of 2004
- Phase 3 (33 ha): beginning of 2005 – end of 2014
- Phase 4 (20 ha at least, outside the site of 60 ha): beginning of 2015 –

The land use plan of Trang Cat Site is shown in Fig. 4.4.1. It is recommended that HPPC will acquire the Phase 4 land with an area of at least 20 ha in a place adjacent to the Phase 3 site (south of Phase 3).

3) Phase 3 Landfill Site Plan

The JICA Study Team has carried out a feasibility study for the 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 and leachate treatment sludge.

(3) Landfill Plan for Kien An Urban District

At present, Kien An District has been using Trang Cat Phase 1 landfill site. It is planned that Kien An District will use Trang Cat Phase 2 Landfill Site until the end of 2004.

Kien An District should construct a new landfill site that can receive waste from the beginning of 2005. UPI has identified a landfill site at the foot of Mount Man Bong, Xuan Son village in Truong Son Commune, An Lao District. Estimated waste amount from Kien An District is 826,000 ton during 16 years from 2005 till 2020.

According to UPI, it is planned that the site will be used jointly by both Kien An Urban District and An Lao Sub Urban Districts. The site is about 7 km from the Kien An center, and 2 km from the An Lao center.

The proposed plan for Truong Son Landfill Site is as follows:

- Area: 10 ha (a part of the site has to be used as leachate treatment ponds.)
- Height: 9 meter with 3 layers of dykes, each being 3 m high
- Waste receiving capacity: approximately 300,000 ton of waste
- Operation Period: 7 years

UPI also identified another landfill site at a place inside the dyke system of Van Uc River, 1 km to the east of Khue ferry, Chien Thang commune, An Hai District. This location is about 9 km from Kien An Center. The site is rice field at present, and would not be difficult for HPPC to acquire. UPI selected this site for two sub urban districts, i.e. Tien Lang and Vinh Bao. However, the JICA Study Team considers that this site is not suitable for these two sub urban districts as waste has to be transported across the Van Uc River where there is no bridge.

The JICA Study Team recommends that this site should be used as the landfill site for Kien An after the above Truong Son Landfill Site is full.

(4) Landfill Plan for Do Son

The existing landfill site located in Do Son Town will be full by the end of 2002. It is planned that Do Son Town will develop a new landfill site adjacent to the existing site. It is estimated that the cumulative waste collection amount will be about 804,000 ton during 2003 - 2020. A site of approximately 11 ha will be needed to dispose of the said amount of waste.

The height of the dyke of the existing landfill needs to be heightened to protect the site from flood.

6.5 Hospital Waste Management Plan

6.5.1 Scope of the Hospital Waste Management Plan

Among the 25 hospitals and medical centers in Haiphong, 9 hospitals and 9 medical centers are subject to this plan which are located in 4 urban districts and Do Son Town. See the table below.

Number of Health-care Facilities in Haiphong in 1998

	Total No. in Haiphong		Those subject to the Plan	
Type of Facilities	Facilities	Beds	Facilities	Beds
Hospital (under the DoH)	9	2,250	6	2,250
Medical Center	13	1,255	9	290
Other Hospitals	3	225	3	225
Total	25	3,730	18	2,765

Source; Department of Health

6.5.2 In-hospital Management Plan

It is necessary and efficient to separate hazardous medical waste from non-hazardous hospital waste at the generation source. Doctors, nurses and health-care workers put the medical waste into special carton boxes or plastic bags of yellow color with a biohazard marks. The boxes and bags should never be opened again and they are incinerated.

The boxes and plastic bags containing the medical waste are transported to and stored in a specialized storeroom with a lock which should be designed to keep out rodents and insects

6.5.3 Collection, Treatment and Disposal Plan

(1) Collection

URENCO collects the medical waste from the hospitals and medical centers subject to the Plan by using two vehicles used exclusively for the collection.

(2) Treatment

The collected medical waste is incinerated by an incinerator with a capacity of 1.5 ton/day. A dual chamber type of incinerator with after burner for complete combustion of gaseous matters generated from the waste is recommended to prevent dioxin generation. The emission gas quality should comply with the Vietnamese Standards CVN 5939-1995 and 5940-1995 concerning conventional air pollutants.

(3) Disposal

Hospital waste incineration residue will be disposed of at a hospital waste incineration residue landfill site to be constructed within Trang Cat Phase 3 Landfill Site.

6.6 Industrial Waste Management Plan

6.6.1 Quantity of Industrial Waste in Haiphong City

It is estimated that the industrial waste quantity generated in Haiphong is 121 ton per day, of which 70 ton/day (58 %) is the 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.

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

	Industrial Waste				Industrial Materials Recycled (5)	Total (Waste + Recyclable Materials) (6) = (4 +5)
	Landfill (1)	Incinerated (2)	Dispo-sed by Factory Itself (3)	Total = (4) = (1+2+ 3)		
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

6.6.2 Hazardous Industrial Waste

(1) Factories that Generate Hazardous Industrial Waste

As result of the hazardous industrial survey, it has been found that there are 17 factories in Haiphong that generate hazardous industrial waste that are so determined based on the Vietnamese Regulation 155/1999. List and details of the 17 factories are shown in Table 6.6.1.

(2) Quantity and Types 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, of which, 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.

(3) Close Attention on Factories Generating Non-Recycled Hazardous Industrial Waste

It is considered that hazardous industrial waste that is recycled does not pose environmental problems. There are 8 factories in Haiphong that generate non-recycled hazardous waste (0.99 ton/day) as can be seen in Table 6.5.1. These factories need to be monitored closely.

(4) Industrial Waste Considered as Hazardous by DOSTE

Reviewing the result of the Hazardous Industrial Waste Survey conducted by the Study, Haiphong DOSTE has considered that some types of 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.

6.6.3 Legal and Institutional Recommendations

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

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.

(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 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 the 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 the financial assistance is.

(3) Industrial Waste Management at Industrial Parks

It is recommended that HPPC should make it obligatory for organizers of industrial parks to make a plan and arrange solid waste management within the industrial parks.

6.7 Strengthening of Management and Manpower for Overall Solid Waste Management

6.7.1 Summary of Institutional and Managerial Recommendations

The institutional and managerial recommendations shown in the main report are summarize as follows:

- Legal improvement for clearer definition of responsibility of generators of the following types of waste: industrial waste, infectious waste, demolition waste, soil waste and dredging waste
- Strengthening of the enforcement the regulation concerning solid waste to reduce illegal dumping
- Increases of cost recovery (fee revenue) through 1) periodical revisions of fee rates, 2) changes in fee collection method, 3) accurate measurement of commercial/industrial waste volume by using waste bins
- Privatization and socialization with competition

- Strengthening of business planning capacity of solid waste management companies through enhancing 1) investment planning, 2) accounting system, 2) management information system

6.7.2 Arrangements Necessary for Implementation of the Priority Project

HPPC needs to make the following arrangements:

- Creation/strengthening of Project Management Unit to arrange and manage the Priority Project
- Acquisition of land for Trang Cat Phase 3 Landfill Site
- To set up a new company for Trang Cat Site Management and Operation including both solid waste landfill and septage treatment (Recommended option)
- Creation of hospital waste management unit within URENCO
- Training of engineers and technicians responsible for landfill operation; in particular training concerning waste filling method, soil cover arrangement, leachate treatment. For this purpose, it is advisable that HPPC would invite a foreign engineer for 6 – 12 months

6.8 Phased Development and Estimated Cost for Overall Solid Waste Management

6.8.1 Development Schedule

Facilities and equipment provided through the planned Priority Project has a about 10 year service life. Considering this, the overall schedule of major investment for purchase and replacement for next 20 years may be proposed as follows.

Schedule for Investment Preparation and Operation of New Facilities and Equipment

	Investment Preparation	Operation
2001		
2002	Funding arrangement	
2003	Engineering, land acquisition	
2004	Construction & Procurement	
2005	Construction	
2006		
2007		
2008		
2009		
2010		
2011		
2012	Funding arrangement	
2013	Engineering, land acquisition	
2014	Construction & Procurement	
2015		
2016		
2017		
2018		
2019		
2020		

6.8.2 Estimated Costs

It is estimated that the total solid waste management cost required for 20 years during 2001 – 2020 is about US$117 million including both investments and recurring costs of the 3 solid waste management companies. Of the US$117 million, the total investment is 45 %, the remaining 55 % is recurring costs.

Of the US$117 million, cost requirements of each company are as follows: about 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)
. Waste collection & Transport	15,977	2,645	2,602	21,225
. 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: The above costs include costs of administration (3% of the sum of A1, A2 & A3), engineering cost, and physical contingency (10% of the sum of the investment costs including the administration costs).

Table 6.6.1 List of Haiphong Factories Generating Hazardous Industrial Waste

No.	Original No.	Name of Enterprise	Major Products	Generation of Hazardous Industrial Waste (ton/year)		
				Non-Recycled (1)	Recycled (2)	Total (1+2) (3)
1	1	Enamel-ware Factory	Aluminum Ironware Enamel Goods	4	2.5	6.5
2	5	Organic Fertilize Manu-factory	High quality Fertilize		1	1
3	6	Rubber & Plastic Company	Rubber belt, industrial rubber, washer, soap boxes	0.8		0.8
4	7	Haiphong Toaxe Factory	Railroad car & Spare Parts	100	60	160
5	9	Dinh Vang Footwear Lt. Company	High quality Footwear	21		21
6	12	Pressure Equip. Const. Material Company	Pressure equipment & construction materials, Cement Fibro sheet		200	200
7	13	Haiphong Paint Company	Paint for train, Ship; Industry & Civil	51	6.24	57.24
8	14	Daso Chemical Substance stock Lt. Company	Liquid Soap, Detergent, Washing Liquid		9	9
9	16	Hang Kenh Footwear Company	Sport Footwear for export	132		132
10	17	Le Lai I Footwear Company	Sport Footwear for export		38	38
11	18	Chau Giang Lt. Company	Sport Footwear for export	36		36
12	19	Vinh Phat Limited Company	Sport Footwear for export	18		18
13	20	Haiphong Scale Factory	Scales		0.3	0.3
14	24	Sanmigel Glasses Stock Co.	Glasses, Containers		43.4	43.4
15	25	Hoa Mai Mechanical Lt. Co.	Trucks, trailers		2	2
16	26	HP Electric Isolated & Installed Co.	Rubber, Gloves, Boots		3	3
17	28	Tia Sang Battery Co.	Batteries		50	50
	TOTAL (ton/year)			362.80	415.44	778.24
	TOTAL (ton/day)			0.99	1.14	2.13
	Percentage (%)			47%	53%	100%

VII. INSTITUTIONAL MEASURES FOR COORDINATED SANITATION IMPROVEMENT AND ENVIRONMENTAL MANAGEMENT

7.1 Evaluation of Current Institutional and Organizational System

(1) Overall Structure

The Haiphong People's Committee (HPPC) is lead by a chairman and three vice chairmen responsible for general sector, economic sector and education and cultural sector. There are eight key departments that are responsible for sanitation improvement in Haiphong.

(2) Transport and Urban Public Works Service (TUPWS)

The Transport and Urban Public Works Service (TUPWS) is the key agency responsible for the regulation of water supply, sewerage, drainage, and solid waste management services in Haiphong through five companies. These are:

- Sewerage and Drainage Company (SADCO)
- Urban Environment Company (URENCO)
- Water Supply Company (WSCO)
- Do Son Public Works Company (DS PWC)
- Kien An Urban Works Company (KA PWC)

TUPWS, on behalf of the HPPC, retains administrative control of the companies through:

- Review approval of annual plans and budgets
- Authority (through the HPPC) for setting appropriate price for services
- Approval of personnel recruitment and salaries
- Approval of procurement of major capital items

(3) Evaluation of Current Situation

Improvements are needed in the existing legal and regulatory environment such as:

- Specific regulations to guide the implementation of the projects
- Clear policies with respect to socialization and privatization
- Clear policy with respect to finance including tariff and cost recovery
- Specific regulations for environmental protection and management
- More well organized planning with stronger expertise in the field of sanitation improvement

7.2 Legal and Policy Measures

Two new draft regulations have been prepared and are being considered by the HPPC:

- Regulation on Management, Utilization, and Usage or the Urban Sewerage and Drainage System in Haiphong City
- Waste Management Regulation for Haiphong City

These regulations would upgrade the existing regulatory framework, and it is recommended that these be promulgated at the earliest opportunity.

However, there still remains much to be done to further strengthen the legal and policy framework in order to improve the sanitation and environmental conditions of the city and bring the recommended Sanitation Master Plan into reality which include the followings.

(1) Water Supply Sector

- Increased cost recovery to 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) Sewerage and Drainage Sector

- Increased cost recovery
- Continued help to seek official development assistance for capital improvements and human resource development
- Development of private sector for collection and transport of seepage
- Freedom for organizations to recruit better qualified personnel

(3) Solid Waste Management Sector

- Increased cost recovery
- Price deregulation for industrial and hospital waste management services
- Development of private sector companies
- Continued help to seek official development assistance for capital improvements and human resource development
- Freedom for organizations to recruit better qualified personnel

7.3 Organizational Measures for Policy Making and Planning Organizations

(1) Implementation of JICA Sanitation Master Plan

For the effective implementation of the Sanitation Master Plan (SMP) which aims at the improvement of the sanitation conditions of the Haiphong city, a coordination council should newly be formed to:

- Work with HPPC for approval procedure
- Coordinate the implementation of projects and activities of the SMP
- Ensure that the SMP's priority projects and activities are included in socio-economic development plans
- Ensure that the locations of the facilities required for priority projects included in spatial plans for Haiphong

The new Council will monitor and evaluate the results of member departments and public service delivery and do coordination activities.

Another alternative is to have a Technical Working Group under the existing Urban Management Coordination Council for the integrated strategic planning, multi-sector investment programs, public sector investment programs, and inter-departmental action plans in the field of sanitation improvement.

Trang Cat area with the land area of about 60 ha, land acquisition of which has already been approved by the Prime Minister and the existing landfill site for solid waste is one of the focal point of future sanitation improvement. Various activities are expected and both URENCO and SADCO will have operations there. One option to foster the coordination and create efficiency is the creation of a new company to be called the Trang Cat Site Management Company (TCSMC), 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. The other option is to set up a coordination committee which should include the following organizations:

- TUPWS
- URENCO, SADCO
- DOSTE
- District People’s Committee and a Commune representative

(2) Socio-Economic Strategy and Planning

DPI is responsible for the development of the socioeconomic plans. Two technical assistance activities are recommended for DPI to integrate sanitation improvement and environmental protection issues:

- Technical assistance in sanitation and environmental aspects of socioeconomic development planning in Haiphong
- Technical assistance to introduce methods and approaches to economic evaluation of sanitation and environmental improvement projects

(3) Spatial Planning

The spatial planning capability of the UPI needs to be upgraded through provision of trained staff and modern computer-based spatial planning systems. Two technical assistance activities are recommended for UPI:

- Technology transfer on the methodology of sanitation and environmental master planning
- Technical assistance in developing the next amendment of Haiphong Master Plan to 2020

(4) Sanitary and Environmental Protection

The Department of Science Technology and Environment (DOSTE) needs increased capacity to conduct environmental monitoring, particularly water quality monitoring in both fresh and salt water. It is proposed to make specific funding commitments to:

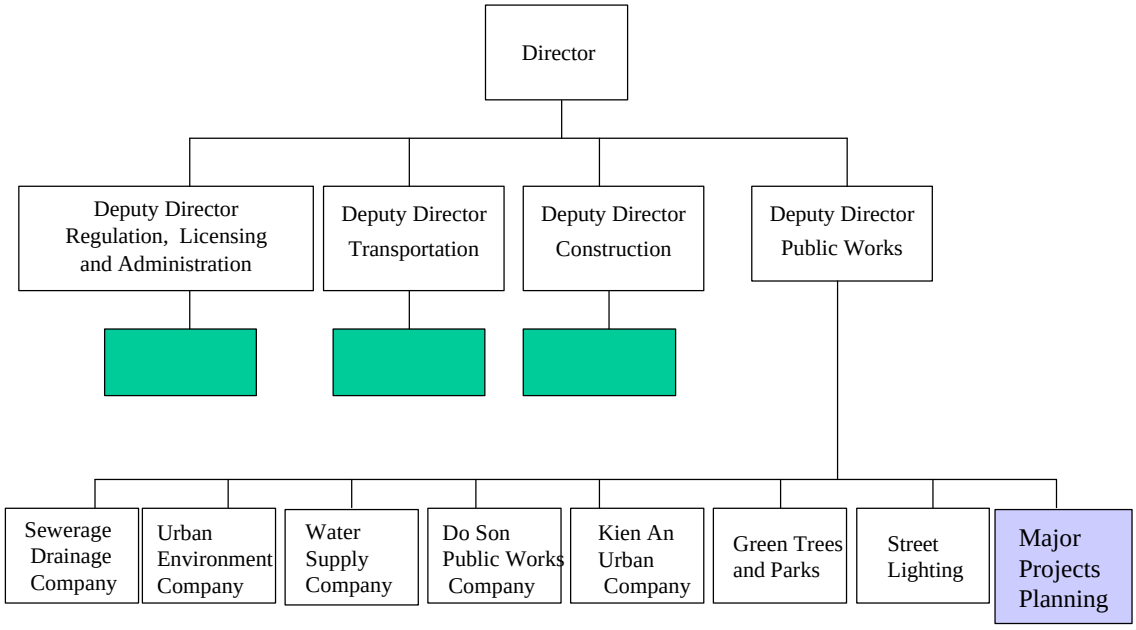
- Enable DOSTE with SADCO to conduct monitoring of the water quality of lakes and channels
- Enable DOSTE with SADCO to conduct source sampling of potential major pollution discharge to the sewerage and drainage system
- Enable DOSTE with URENCO and SADCO to fulfill their environmental responsibilities with respect to the Trang Cat Site

(5) Reinforcement of TUPWS

It proposed that TUPWS be re-organized to formally create a Division of Public Works in charge of water supply, drainage, sewerage, and/or solid waste management under the responsibility of a new Deputy Director. In addition to the companies that are primarily responsible for public works, this division will have a unit of Major Projects Planning, which should assume the following tasks:

- Preparing master plans and schemes for the rehabilitation, upgrading, and repair of construction works for water supply, sewerage and drainage and solid waste management
- Establishing and supervising project management units (PMUs) for implementation of major infrastructure projects

The recommended new organization of TUPWS is given below.



The operating companies instead 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.

7.4 Economic and Financial Measures

7.4.1 Allocation of Finance for Environmental Projects

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.

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, in that resources are allocated more efficiently, and environmental objectives achieved more cheaply, than under physical rationing.

7.4.2 Environmental Service Providers

(1) Solid Waste Management

Main points are summarized as follows:

- HPPC/URECNO should increase cost recovery ratio. With increases in the cost recovery ratio, URENCO will have a grater financial autonomy and stability
- Considering the responsibility of industrial enterprises as waste generators, fees for industrial waste collection and disposal should be set on the full cost recovery basis
- Consideration should be given to the introduction of deposit-refund systems for products such as containers, batteries, crates and car hulks, which can be reused, recycled or which should be returned for destruction
- In order to strengthen financial management capacity of URENCO and other service providers, it is necessary to improve such aspects as accounting system and information management system

(2) Water Supply and Sewerage

- Good progress has been made in Haiphong recently in the water supply sector. 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 and treatment

7.4.3 Tariff Policy

(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

It would 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 the tariff so that by the year 2010, 100 % of O and 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 and 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

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 and 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 20 % 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 and M costs would require only 0.63 percent of disposable incomes in the year 2010.

VIII. INITIAL ENVIRONMENTAL EXAMINATION OF THE PROJECTS RECOMMENDED IN THE SANITATION MASTER PLAN

8.1 Examination Principles

8.1.1 Objective

Initial Environmental Examination (IEE) was carried out to evaluate the social and environmental impacts of the proposed Sanitation Master Plan.

8.1.2 Environmental Laws, Standards and Regulations

(1) Vietnamese Laws and Regulations

The Law on Environmental Protection (December 27, 1993) and Decree No. 175/CP (1994) provide the basic framework for the environmental protection and management in Vietnam. The Law mandates the Central Government's overall responsibility for environmental protection. EIA procedures are described in detail in Decree No. 175/CP (1994) and Circular No. 490/TT-BKNHCMT (1998). Land acquisition and compensation procedures are described in Decree 22/ND-CP (1988).

(2) Vietnamese Environmental Standards

A series of environmental standards have been published in 1995. Among the important environmental standards particularly relevant to the proposed Sanitation Master Plan include: TCVN 5942-1995 (Surface Water Quality Standard), TCVN 5944-1995 (Groundwater Quality Standard), TCVN 5945-1995 (Industrial Waste Water Discharge Standard), TCVN 5937-1995 (Ambient Air Quality Standard), TCVN 5938-1995 (Maximum Allowable Concentrations of Hazardous Substances in Ambient Air), TCVN 5949-1995 (Noise in Public and Residential Areas).

(3) International Environmental Guidelines

In addition to the Vietnamese laws and regulations, a number of international guidelines were followed in the preparation of IEE. They include Environmental Consideration Guideline for Development Studies (1994), OECF Environmental Guidelines (1995), Guide to Preparing an Environmental Impact Assessment (1996) and JBIC Environmental Guidelines for ODA Loans (1999).

8.2 Initial Environmental Examination

The proposed Sanitation Master Plan will contribute to significant improvement of living condition in Haiphong. The social and environmental impacts of the proposed Sanitation Master Plan were evaluated separately for i) water supply component, ii) drainage component, iii) sewerage component and iv) solid waste management component. They were summarized in Tables 8.2.1. The environmental improvement effects of the Sanitation Master Plan are described in Chapter 10.

Table 8.2.1 Environmental Check List

Category	Check Items	Major	Problems	Possible Action and Counter Measures	Remarks
Water Supply					
Pollution	1. Disposal of sludge from water treatment plants 2. Water pollution and soil contamination 3. Noise and vibration	Small Small Small	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	Small Small	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	None Not Clear Small	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	None			Water quality at the intake has to be regularly monitored.
Drainage					
Pollution	1. Disposal of dredged sediment 2. Effect on aquatic organisms, fisheries, and other water utilization systems 3. Water pollution and soil contamination 4. Noise and vibration	Major Small Major Small	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.
Natural Environment	1. Effect of construction and operation of the facilities on the ecology 2. Effect on landscape	Small Small	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.
Human Environment	1. Effect of the construction and operation of the facilities on the historical and cultural heritage 2. Accidental flooding 3. Resettlement	None Small Major	Several hundreds of 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.
Others	1. Environmental monitoring	None		During the construction, water quality	Environmental

				and quality of dredged sediment have to be closely monitored.	monitoring has to be done before, during and after construction.
Sewerage					
Pollution	1. Air pollution generated by the operation of facilities 2. Effect on aquatic organisms, fisheries, and other water utilization systems 3. Water pollution and soil contamination 4. Noise and vibration	Major Small Major Small	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.
Natural Environment	1. Effect of construction and operation of the facilities on the ecology 2. Effect on landscape	Small Small	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.
Human Environment	1. Effect of the construction and operation of the facilities on the historical and cultural heritage 2. Effect on existing infrastructure 3. Resettlement	None Small Small	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.
Others	1. Effect on the environment during the construction period 2. Environmental monitoring	Small None	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.
Lake and Channel Improvement					
Pollution	1. Offensive odor and dust problems 2. Water pollution 3. Noise and vibration 4. Disposal of dredged sediment	Small Major Small Major	Temporary degradation of water quality during dredging is anticipated. The dredged sediment must be properly disposed	Instructions of correct work methods will be given in Contract Document Proper disposal of sediment at Trang Cat Landfill site.	SADCo already acquired a section of Trang Cat Landifll site.
Natural Environment	1. Effect on construction and operation of the facilities on the ecology 2. Effect on landscape	Small Small	Important and accessible urban ecosystem may be lost.	Environmentally-friendly design and construction.	
Human Environment	1. Effect on the construction and operation of the facilities on the historical and cultural heritage 2. Effect on existing infrastructure 3. Relocation	None None Small	Limited land acquisition and resettlement of affected people are anticipated.	Development of land acquisition and resettlement plan	

Others	1. Environmental monitoring	None	.	During the construction, water quality and quality of dredged sediment have to be closely monitored.	
Solid Waste Management					
Pollution	1. Air pollution generated by the operation of facilities 2. Effect on aquatic organisms, fisheries, and other water utilization systems 3. Water pollution and soil contamination 4. Noise and vibration	Major Small Small Small	Increases in waste collection amount would lead to increases in trips by waste collection vehicles. However, the planned changes in the system of waste loading into vehicles would substantially reduces impacts on traffic flow. Offensive odor from landfill and incinerator need to be controlled. Proper disposal management is needed to control rats and vermin. 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	
Natural Environment	1. Effect on construction and operation of the facilities on the ecology 2. Effect on landscape	Small Small	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.
Human Environment	1. Effect of the construction and operation of the facilities on the historical and cultural heritage 2. Effect on existing infrastructure 3. Relocation 4. Effect on health and sanitation conditions for workers and neighbouring people	None Small Small Large (Positive)			There is no need for resettlement. Positive impact on living conditions and health situation in the collection area.
Others	1. Effect on the environment during the construction period 2. Environmental monitoring	Small	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.

IX. REQUIREMENT AND AFFORDABILITY OF THE IMPLEMENTATION OF THE SANITATION MASTER PLAN

9.1 Implementation Schedule of the Sanitation Master Plan

The Sanitation Master Plan will be implemented starting from the year 2001 toward the target year of 2020 for the sanitation improvement of the city including water supply, drainage, sewerage, lakes and solid waste management.

Implementation of these projects of urgent needs will be started in 2004 to be completed by 2010 or earlier.

9.2 Financial Requirement

Financial requirement for the implementation and O&M of the Sanitation Master Plan for the whole period until 2020 will be US$656.4 million for capital cost and US$49.4 million for recurring cost for O&M. In total, US$705.8 million would be required for the implementation of the recommended projects and measures for the SMP projects during 20 years from 2001 through 2020. Financial requirement by sector by period is summarized below.

Cost Estimate for Sanitation Master Plan

Unit : US$1000

	Period		
	2001~2010	2011~2020	Total
Water Supply			
- Capital	46,493	16,162	62,655
- Recurrent	912	2,185	3,097
- Sub-total	47,405	18,347	65,752
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
Includes engineering service, administrative cost and physical contingency

9.3 Affordability of Implementation

(1) Indices for Affordability

Affordability of the proposed program for the Sanitation Master Plan 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.

- Total HPPC expenditures

This provides an indication of the fiscal feasibility of the proposed programs for Haiphong City government.

(2) Evaluation of the Affordability

The capital costs of the Sanitation Master Plan proposed by the Study Team are amortized assuming 5 % annual interest rate with 25-year repayment condition. The annual cost which is the sum of the amortized cost and recurrent cost, will constantly increase up to the target year of 2020. It will reach US$29.4 million in the year 2010 in 2000 constant prices and US$64.2 million in 2020. The adopted affordability indices are calculated as summarized below.

Total Sanitation Master Plan Costs in Relation to Key Indicators

Year	Cost as % of GRP in Study Area a	Cost as % of HPPC Exp. c1	Cost as % of HPPC Exp. c2	Cost as % of Disp. Inc. Study Area d
2010	3.1	23.0	16.9	6.1
2020	4.1	30.8	24.0	8.2

Economic growth rates are as assumed for the macro-frame of the Study which is also applied to the increase of HPPC expenditure in the future. Disposable income is assumed at 50 % of the GRP.

As seen in the table, proportion of the cost in Study Area GRP remains reasonable percentage. In terms of disposable income, however, the proportion will be doubled which indicates relatively heavier burden on the residents. Column c1 figures which do not take into account the water tariff revenue of HPPC, are rather high, indicating significant financial burden on HPPC. If considered, the proportion will be much reduced as shown in column c2.

These analyses depend on the actual economic growth to be realized as well as the possible change of distribution ratio from GRP to disposable income and change in cost recovery of public services. However, general conclusion from the

aggregate analysis is that the cost of the Sanitation Master Plan appears to be affordable for the Study Area in terms of capacity of the community to pay, as long as the economic growth rates are in general as predicted.

X. IMPROVEMENT OF THE SANITATION CONDITIONS ACHIEVED 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 Sanitation Master Plan is to provide more people with access to safe and reliable public water supply system. The achievement of this purpose 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 satisfied in some area	satisfied

The proposed Sanitation 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 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 through out 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 Protection from Flooding

The methodology for assessing the flood after implementation of the Drainage Improvement Plan is based on the following:

- Use of existing flood data from previous studies and projects
- Computer simulation of flooding for the present conditions of An Kim Hai Channel using the developed computer model

Based on the analyses and assessments, the 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	
	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

N.B. Phase I project signifies the JICA Drainage Priority Project which covers the central area as target project area and a part of New Urban Area as supplementary beneficiary area. World Bank project covers Old City Center, Central Area and New Urban Area.

As shown in the above table, 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 Phase II projects.

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 cover area of the sewerage improvement measures for Class A area is 5,240 ha with around 575,000 beneficiary. The areas with existing combined sewer system will continue to use the existing systems while separate sewer system is proposed for the new urban areas. 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.

For Kien An, 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 remaining 1 ward will be covered by septic tank based system. The cover area of the sewerage improvement measures for Kien An area is 2,670 ha with around 106,000 beneficiaries in 2020.

For Do Son, 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 remaining 2 wards will be covered by septic tank based system The cover area of the sewerage improvement measures for Do Son area is 3,950 ha with around 42,000 beneficiaries in 2020.

10.3.2 Access to Nightsoil and Septic Tank Sludge Collection

Nightsoil collection and disposal is an interim measure and it is proposed to eliminate all bucket latrines as early as possible. The Study recommends extending the nightsoil coverage to all existing latrines.

Septic tank is also an interim measure in the Class A area. Since the benefits of the sewerage system can be obtained once the treatment plant starts operation, proper septic tank management is proposed until that period. The Study recommends a collection system which covers 100 % of the septic tanks until sewerage system is completed. To ensure such target, proposals include procurement of new vehicles under newly proposed septic tank monitoring unit. The Study also recommends for a separate sludge treatment plant. This will ensure sanitary disposal of septic tank sludge.

10.4 Improvement of Solid Waste Management

"Situation without the implementation of the Sanitation Master Plan" is defined as situation where the solid waste management system capacity will remain unchanged over long period.

10.4.1 Improvement in Service Level and Sanitary Conditions

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 Sanitation 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.

10.4.2 Minimization of the Secondary Pollution Caused by Waste Management Activities

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 the health and environment:

- The proposed collection system will keep the city clean, and also minimize the adverse impacts of waste collection activities on the 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

10.5 Improvement of Water Quality

(1) Pollution Loads to Lakes and Channels

The proposed Sanitation Maser Plan, especially sewerage component, will substantially reduce the pollution loads to lakes (e.g., Sen, Tien Nga, An Bien, others) and channels (NE, SW and An Kim Hai) in the urban area. The estimated reductions of pollution loads in 2020 are roughly 90 % of the "Without the Sanitation Master Plan" case for BOD, T-N and T-P, and 80 % of the "Without the Sanitation Master Plan" case for SS.

(2) Pollution Loads to Major Rivers and Bay

If the proposed Sanitation Master Plan were not implemented, the anticipated levels of pollution loads to major rivers (Cam, Lach Tray, Da Do, Bach Dang) and bay (Bac Bo Bay) in 2020 would be nearly doubled from the present levels. If the Master Plan were implemented, the BOD and SS loads in 2020 would be reduced to nearly 90 to 140 % of the present levels. However, the reduction of nutrients (N and P) will be limited.

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 %)

XI. SELECTION OF THE PRIORITY PROJECTS

11.1 Selection Criteria

The criteria used to select the priority projects comprised the following 2 basic considerations:

- The project should be essential for solving the currently prevailing problem and should be implemented in the short-term
- There has been no detailed study nor F/S for the project and therefore a F/S needed to be carried out in this JICA Study (the Study)

Specifically, the second consideration comprises the following. 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 number of affected people is 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 complementary to each other.

(4) Economic Viability

- Current and expected damage is large and serious. The number of affected people or beneficiaries is large
- Project should be cost-effective relative to other alternatives

(5) Financial Affordability

The financial requirements of the investment costs and operation and maintenance (O&M) costs 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, reliable and already been applied elsewhere in the world, preferably in developing countries in

Southeast Asia. The risk of failure of the project should be low in terms of construction and O&M.

(7) Environmental Acceptability

The adverse impacts that will be 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 Feasibility Study in this JICA Study.

11.2 Selection of the Priority Projects

Three priority projects which meet the selection criteria, have been selected, one each in the drainage, sewerage and solid waste management sectors. Among these, the priority project selected in the solid waste management sector comprises 3 sub-components, i.e., Waste Collection and Transport, Sanitary Landfill and Medical Waste Incineration. To meet the urgent needs, construction and procurement for all 3 priority projects are recommended to be started in the year 2004.

PART 3 FEASIBILITY STUDIES FOR THE PRIORITY PROJECTS

I. OUTLINE OF THE PRIORITY PROJECTS

1.1 Selected Priority Projects

From the Sanitation Master Plan, three priority projects are selected to be implemented by 2010. These are:

- Drainage Priority Project
- Sewerage Priority Project
- Solid Waste Management Priority Project

The solid waste management priority project consists of three components, namely:

- Waste collection and transport
- Trang Cat Phase 3 landfill
- Hospital waste management

A brief outline is given in the following and the details are given in subsequent sections.

1.1.1 Drainage Priority Project

There are three separate drainage catchments in the priority project area, namely, Southwest, Northeast, and An Kim Hai. The drainage priority project recommends integrating these three to increase the overall drainage performance. To augment the storage capacity, it is recommended to rehabilitate the An Kim Hai Channel and construct the new Phoung Luu Regulating Lake.

The salient features of the drainage priority project is given below:

- Location — Central area of Class A area
- Area — 1103 ha
- Population — 240,000 (in 2010)
- Rehabilitation — An Kim Hai Channel, 10 km
- Maintenance road along channel — Both sides of An Kim Hai, 5 m wide
- Demolition of tidal gate — One at Cam River
- Construction of tidal gate — Two, at Cam River and Lac Tray River
- Discharge gate — One at Du Hang
- Phoung Luu site development — 28 ha
- Phoung Luu Lake construction — 24 ha
- Maintenance road along lake — 12 m wide
- Connecting channel — 500 m, 15 m wide
- Road from Road No. 5 to lake site — 400m, 12 m wide
- Box culvert — 450m, $3 \times (3 \times 2)$ m

- Total Capital Cost US$49.1 million
- Implementation Period 2004 to 2009

1.1.2 Sewerage Priority Project

The sewerage priority project will use all existing combined sewer pipes. The plan recommends intercepting combined sewer flow before it enters surface water bodies and separating wastewater from rainwater by combined sewer overflow (CSO). Separated wastewater would then be collected by sewer pipes and transported to a central treatment plant. Raw sewage would be treated by aerated lagoon process satisfying Vietnamese standard. Rainwater separated by CSOs is allowed to bypass into surface water body.

The salient features of the sewerage priority project are given below:

- Location Central area of Class A area
- Area 1103 ha
- Population 240,000 (in 2010)
- Collection System Combined Sewer System
- Estimated Sewage 36,000 m^3/day (in 2010)
- Combined Sewer Overflow 61
- Sewer pipeline 20 km
- Manhole 190
- Pumping Station At An Da (30 m^3/min)
- Treatment Plant Near Vinh Niem Tidal Gate
- Treatment process Aerated lagoon
- Treatment capacity 36,000 m^3/day
- Total Capital Cost US$65.5 million
- Implementation Period 2004 to 2010

1.1.3 Solid Waste Management Priority Project

The solid waste management priority project is comprised of 3 components, i.e. 1) waste collection and transport, 2) sanitary landfill, 3) hospital waste management system, each of which is an integral part of the solid waste management system. Salient features of each component are given below.

A. Waste Collection and Transport System

- Location: 4 urban districts and their neighboring areas to be urbanized, as well as Do Son Town
- Beneficiary: 608,000 (in 2005)
- Operators 3 waste management companies, i.e. URENCO, Kien An Urban Works Company, and Do Son Public Works Company

• Collection System	The Priority Project plans to shift from the existing handcart collection system to a direct collection system with mechanical waste loading into vehicles using bins is planned.
• Waste Collection Capacity	761 ton/day on average (in 2005)
• Equipment to be Procured	• Waste collection vehicles (43 units)
•	• Bins and handcarts (1,234 units)
•	• Workshop equipment (3 sets)
• Total Capital Cost	US$4.6 million
• Procurement Year	2004
• Useful period of equipment	10 years from 2005 to 2014

B. Trang Cat Phase 3 Landfill Site

• Location	Part of Trang Cat Site (60 ha in total) in Trang Cat Commune
• Area	32.7 ha
• Beneficiaries	528,000 (in 2005)
• Disposal System	Sanitary Landfill
• Total Waste Receiving Capacity	2.6 million ton
• Types of waste to be received	• Solid waste excluding industrial waste
	• Incineration residue of medical waste and leachate treatment sludge
• Main Facilities	• Dyke (waste retaining structure)
•	• Leachate collection & treatment system
•	• Artificial liner
•	• Gas ventilation system
•	• On-site road
•	• Heavy equipment
•	• Cover soil
•	Total Capital CostUS$10.6 million
• Construction Period	2 years from 2004 to 2005
• Operation Period	10 years from 2005 - 2014

C. Hospital Waste Management System

? System Components	• In-hospital storage room for infectious waste
	• Waste collection vehicles (1.5 ton/unit × 2 units)
	• Incineration (1 unit)
	• Landfill for incineration residue (included in Trang Cat Site Plan)

• Direct Beneficiaries	18 health care organizations (9 hospitals and 9 medical centers, located in the 4 urban districts and Do Son Town, as well as people who may directly contact infectious waste.)
• Indirect Beneficiaries	Whole population of the 4 urban districts including neighboring areas and Do Son Town (704,000 in 2005)
• Outline of Incinerator	
• Location	A place in the existing Trang Cat Phase 1 Landfill Site, in Trang Cat Commune
• Area required	200 m^2
• Capacity	1.5 ton/day (8 hours operation per day)
• System	Incinerator with 2 combustion chambers: one for solid waste, the other for gases.
• Dioxin emission	0.5 ng-TEQ/Nm^3 (10 % of the Japanese standard (5 ng-TEQ/Nm^3) for small sized incinerators)
• Other gas emissions	Comply with the Vietnamese standard
• Service life	8 years
• Total Capital Cost	US$0.5 million
• Construction/Procurement Year	2004
• Operation Period	8 years from 2005 – 2012

Total Capital Cost for Solid Waste Management Priority Project: US$15.8 million

1.2 Implementation Schedule and Financial Requirement for the Priority Projects

1.2.1 Implementation Schedule of the Priority Projects

Implementation of these projects of urgent needs will be started in 2004 to be completed by 2010 at the latest, depending on the priority project. The details are shown in Fig. 1.2.1 through 1.2.4.

1.2.2 Financial Requirement of Priority Projects

The financial requirements for the implementation and O&M of the priority projects will be US$130.3 million for capital cost and US$2.74 million in 2010 for recurring cost for O&M. Of the total capital cost, about 57 % will be in foreign currency and 43 % is in local currency. Financial requirement by sector by period is summarized below.

Cost Estimate for Priority Projects

Unit: US$ Million

Cost Item	Drainage	Sewerage	Solid Waste Management			Total
			Collection Vehicle	Landfill Phase 3	Medical waste	
Capital	49.1	65.5	4.6	10.6	0.5	130.3
Recurring (in 2010)	0.02	0.43	1.74	0.5	0.05	2.74

The details are shown in Tables 1.2.1 through Table 1.2.4.

1.3 Methodology for Priority Project Evaluation

The priority projects selected for evaluation met the following three basic conditions:

- The project had to be essential to solve a currently prevailing problem and needed to be implemented in the short-term
- The priority project had to be in compliance with the long-term Sanitation Master Plan recommended in this JICA Study
- There had been no detailed study nor F/S for the project requiring a F/S to be carried out as post of this JICA Study (the Study)

Project evaluation was carried out for the selected priority projects to check their viability and feasibility for implementation.

Firstly, the viability of the priority projects was examined in terms of meeting the primary objectives and contributing to the economic development of the Study Area and Haiphong city. Namely:

- Objective Achievement (Satisfaction of the sanitation/environment objectives)
- Economic Viability

Secondly, implementabililty and affordability, as well as social and environmental acceptability, were checked. Namely:

- Financial Affordability
- Technical Feasibility
- Environmental Acceptability
- Organizational Capability

All the selected priority projects were found to be viable and feasible for implementation if all remedial measures are taken for minimizing adverse impacts and organizational strengthening and manpower training are carried out as recommended in the Study.

Table 1.2.1 Disbursement Schedule of Overall Project Cost of the Priority Projects

US $ 1.00 = VND 14,072 , Unit: 1,000US$

Item No.	Description	Total (US$)			2003		2004		2005		2006		2007		2008		2009		2010	
		F.C	L.C	Total	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
I	**Main Component**																			
1	Construction and Procurement Cost																			
	(1) Drainage Priority Project	11,449.5	13,458.5	24,908.1	0.0	0.0	1,040.9	1,223.5	2,045.1	2,208.2	2,220.2	2,532.3	2,393.5	2,852.3	2,469.6	3,029.3	1,280.3	1,612.9		
	(2) Sewerage Priority Project	35,026.4	15,327.3	50,355.1	0.0	0.0	3,184.2	1,393.4	7,849.8	3,141.5	7,849.8	3,141.5	5,964.9	2,586.0	4,079.4	2,030.2	4,079.4	2,030.2	2,018.9	1,004.5
	(3) Solid Waste Management Priority Project	8,956.8	3,386.0	12,342.8			7,307.3	1,736.5	1,649.5	1,649.5										
	Subtotal	55,432.7	32,171.8	87,606.0	0.0	0.0	11,532.4	4,353.4	11,544.4	6,999.2	10,070.0	5,673.8	8,358.4	5,438.3	6,549.0	5,059.5	5,359.7	3,643.1	2,018.9	1,004.5
2	Land Acquisition and House Compensation																			
		0.0	3,700.0	3,700.0		1,850.0		1,850.0												
		0.0	2,165.0	2,165.0	0.0	1,082.5	0.0	1,082.5												
		0.0	602.0	602.0	0.0	602.0														
	Subtotal	0.0	6,467.0	6,467.0	0.0	3,534.5	0.0	2,932.5												
3	Engineering Service Cost																			
		1,145.0	1,715.9	2,860.8	163.7	245.4	163.7	245.4	163.7	245.4	163.7	245.4	163.7	245.4	163.7	245.4	162.6	243.7		
		3,502.6	1,749.2	5,252.0	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7
	Engineering	629.7	338.6	968.3	429.8	208.7	200.0	129.9	0.0	0.0										
	Subtotal	5,277.3	3,803.7	9,081.1	1,031.3	672.8	801.5	594.0	601.5	464.1	601.5	464.1	601.5	464.1	601.5	464.1	600.4	462.4	437.8	218.7
4	Administration																			
		0.0	944.1	944.1		67.8		135.7		139.9		154.8		169.6		177.2		99.0		
		0.0	1,733.1	1,733.1		52.2		189.5		349.4		349.4		276.2		203.0		203.0		110.4
	Administration	0.0	417.4	417.4	0.0	37.2	0.0	281.2	0.0	99.0										
	Subtotal	0.0	3,094.6	3,094.6	0.0	157.2	0.0	606.4	0.0	588.3	0.0	504.2	0.0	445.8	0.0	380.2	0.0	302.0	0.0	110.4
5	Physical Contingency																			
		1,259.4	1,981.8	3,241.3	16.4	216.3	120.5	345.5	220.9	259.3	238.4	293.2	255.7	326.7	263.3	345.2	144.3	195.6		
		3,852.9	2,097.5	5,950.5	43.8	135.3	362.2	288.4	828.8	371.0	828.8	371.0	640.3	308.1	451.7	245.2	451.7	245.2	245.7	133.4
		958.7	474.4	1,433.1	43.0	84.8	750.7	214.8	165.0	174.8	0.0	0.0								
	Subtotal	6,071.0	4,553.7	10,624.9	103.2	436.4	1,233.4	848.7	1,214.7	805.1	1,067.2	664.2	896.0	634.8	715.0	590.4	596.0	440.8	245.7	133.4
	Total without Price Contingency	66,781.0	50,090.8	116,873.6	1,134.4	4,800.9	13,567.3	9,335.0	13,360.6	8,856.7	11,738.7	7,306.3	9,855.9	6,983.0	7,865.5	6,494.2	6,556.1	4,848.3	2,702.4	1,467.0
6	Price Escalation																			
		1,929.1	2,768.6	4,697.7	11.0	145.6	109.2	313.2	252.9	296.9	330.8	407.0	418.2	534.4	497.2	651.8	309.6	419.7		
		5,918.3	3,106.4	9,024.7	29.5	91.1	328.4	261.5	948.8	424.7	1,150.1	514.8	1,047.2	503.9	853.0	463.0	969.4	526.2	591.8	321.2
		898.5	452.0	1,350.5	28.9	57.1	680.7	194.7	188.8	200.2	0.0	0.0								
	Subtotal	8,745.9	6,327.0	15,072.9	69.4	293.8	1,118.3	769.4	1,390.5	921.8	1,480.9	921.8	1,465.4	1,038.3	1,350.2	1,114.8	1,279.0	945.9	591.8	321.2
	Total of I ＊	75,526.9	56,417.8	131,946.5	1,203.9	5,094.7	14,685.6	10,104.4	14,751.1	9,778.5	13,219.6	8,228.1	11,321.3	8,021.3	9,215.7	7,609.0	7,835.1	5,794.2	3,294.2	1,788.2
II	**Supplementary Component of Drainage PP**																			
	1.0 Preparatory Works	610.8	367.2	978.1			610.8	367.2												
	Subtotal	610.8	367.2	978.1			610.8	367.2												
	1.1 Supplementary Component, New Sewers																			
	1) Main sewers	1,050.0	1,050.0	2,100.0					233.1	233.1	233.1	233.1	233.1	233.1	233.1	233.1	117.6	117.6		
	2) Branch sewers	1,225.0	1,225.0	2,450.0					272.0	272.0	272.0	272.0	272.0	272.0	272.0	272.0	137.2	137.2		
	Subtotal	2,275.0	2,275.0	4,550.0					505.1	505.1	505.1	505.1	505.1	505.1	505.1	505.1	254.8	254.8		
	1.2 Supplementary Component, An Kim Hai Channel Bridge																			
	1) Bridge, W 7.0 m x L 12.0 m	162.8	180.9	343.7					36.1	40.2	36.1	40.2	36.1	40.2	36.1	40.2	18.2	20.3		
	2) Bridge, W 7.0 m x L 15.0 m	610.5	678.5	1,289.0					135.5	150.6	135.5	150.6	135.5	150.6	135.5	150.6	68.4	76.0		
	3) Bridge, W 7.0 m x L 20.0 m	271.3	301.6	572.9					60.2	66.9	60.2	66.9	60.2	66.9	60.2	66.9	30.4	33.8		
	Subtotal	1,044.6	1,161.0	2,205.6					231.9	257.7	231.9	257.7	231.9	257.7	231.9	257.7	117.0	130.0		
	1.3 Supplementary Component, Road Ancillary Works																			
	1) Lighting	693.6	21.5	715.0											346.8	10.7	346.8	10.7		
	2) Fence	2,095.2	64.8	2,160.0											1,047.6	32.4	1,047.6	32.4		
	3) Planting	0.0	150.0	150.0											0.0	75.0	0.0	75.0		
	Subtotal	2,788.8	236.3	3,025.0					0.0	0.0	0.0	0.0	0.0	0.0	1,394.4	118.1	1,394.4	118.1		
	Total	6,719.2	4,039.5	10,758.6			610.8	367.2	736.9	762.8	736.9	762.8	736.9	762.8	2,131.3	880.9	1,766.2	503.0		
	2. Engineering Service Cost	671.9	403.9	1,075.9	96.1	57.8	96.1	57.8	96.1	57.8	96.1	57.8	96.1	57.8	96.1	57.8	95.4	57.4		
	3. Administration	0.0	355.0	355.0		4.6		34.0		49.6		49.6		49.6		95.0		72.7		
	4. Physical Contingency	739.1	479.8	1,219.0	9.6	6.2	70.7	45.9	83.3	87.0	83.3	87.0	83.3	87.0	222.7	103.4	186.2	63.3		
	Total without Price Contingency	8,130.2	5,278.2	13,408.5	105.7	68.6	777.6	504.9	916.3	957.2	916.3	957.2	916.3	957.2	2,450.1	1,137.1	2,047.8	696.4		
	5. Price Contingency	1,237.9	739.5	1,977.4	6.5	4.2	64.1	41.6	95.4	99.6	115.6	120.8	136.2	142.3	420.6	195.2	399.5	135.8		
	Total of II ＊	9,368.1	6,017.9	15,385.9	112.2	72.8	841.7	546.5	1,011.7	1,056.8	1,031.9	1,077.9	1,052.6	1,099.5	2,870.7	1,332.2	2,447.2	832.1		
	Total without Price Contingency	74,911.2	55,369.0	130,282.1	1,240.1	4,869.5	14,344.9	9,839.9	14,276.9	9,813.9	12,655.0	8,263.5	10,772.2	7,940.2	10,315.6	7,631.3	8,603.9	5,544.7	2,702.4	1,467.0
	Total ＊	84,895.0	62,435.7	147,332.4	1,316.1	5,167.5	15,527.3	10,650.9	15,762.8	10,835.3	14,251.5	9,306.0	12,373.9	9,120.8	12,086.4	8,941.2	10,282.3	6,626.3	3,294.2	1,788.2
	Total Recurring Cost	0.0	14883.0	14883.0	0.0	0.0	0.0	0.0	0.0	2147.0	0.0	2185.0	0.0	2538.0	0.0	2566.0	0.0	2709.0	0.0	2738.0

Note: All the amounts are shown in 2000 constant price except for those marked with "＊"

Table 1.2.2 Disbursement Schedule of Project Cost for Drainage Priority Project

US $ 1.00 = VND 14,072 , Unit: 1,000US$

Item No.	Description	Total (US$)			2003		2004		2005		2006		2007		2008		2009		2010	
		F.C	L.C	Total	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
1	**Main Component**																			
	1.0 Preparatory Works	1,040.9	1,223.5	2,264.4			1,040.9	1,223.5												
	Subtotal	1,040.9	1,223.5	2,264.4			1,040.9	1,223.5												
	1.1 An Kim Hai Channel																			
	1) Excavation of channel	1,891.5	852.4	2,743.8					419.9	189.2	419.9	189.2	419.9	189.2	419.9	189.2	211.8	95.5		
	2) Revetment works	1,679.2	4,782.9	6,462.1					372.8	1,061.8	372.8	1,061.8	372.8	1,061.8	372.8	1,061.8	188.1	535.7		
	3) Maintenance road	281.9	747.5	1,029.4					62.6	166.0	62.6	166.0	62.6	166.0	62.6	166.0	31.6	83.7		
	4) Construction of tidal gate, Lach Tray river	599.7	201.0	800.7					400.0	134.1	199.7	66.9								
	5) Construction of tidal gate, Cam river	599.7	201.0	800.7							199.7	66.9	400.0	134.1						
	6) Construction of discharge gate to Du Hang lake	599.7	201.0	800.7											400.0	134.1	199.7	66.9		
	7) Demolishing existing outlet gate	0.9	1.1	2.0							0.9	1.1								
	Subtotal	5,652.5	6,987.0	12,639.5					1,255.3	1,551.1	1,255.6	1,552.0	1,255.3	1,551.1	1,255.3	1,551.1	631.2	781.8		
	1.2 Phuong Luu Regulating Lake																			
	1) Excavation of Phuong Luu Regula. Lake	2,998.6	1,396.6	4,395.2					665.7	310.1	665.7	310.1	665.7	310.1	665.7	310.1	335.8	156.4		
	2) Revetment works	192.5	867.1	1,059.6					42.7	192.5	42.7	192.5	42.7	192.5	42.7	192.5	21.6	97.1		
	3) Road works and bridge	136.0	313.5	449.5											68.0	156.7	68.0	156.7		
	4) Excavation of connection channel	46.9	21.8	68.7					31.3	14.5	15.6	7.3								
	5) Revetment works, connection channel	75.2	210.0	285.2					50.1	140.1	25.0	69.9								
	6) Maintenance road	16.3	40.7	57.0											8.2	20.3	8.2	20.3		
	7) Box culvert, 3 x (3.0 m x 2.0 m)	1,290.7	2,398.3	3,689.0							215.5	400.5	429.8	798.6	429.8	798.6	215.5	400.5		
	Subtotal	4,756.1	5,248.0	10,004.2					789.8	657.2	964.6	980.3	1,138.2	1,301.2	1,214.4	1,478.3	649.1	831.1		
	Total	11,449.5	13,458.5	24,908.1	0.0	0.0	1,040.9	1,223.5	2,045.1	2,208.2	2,220.2	2,532.3	2,393.5	2,852.3	2,469.6	3,029.3	1,280.3	1,612.9		
	2. Land Acquisition and House Compensation	0.0	3,700.0	3,700.0		1,850.0		1,850.0												
	3. Engineering Service Cost	1,145.0	1,715.9	2,860.8	163.7	245.4	163.7	245.4	163.7	245.4	163.7	245.4	163.7	245.4	163.7	245.4	162.6	243.7		
	4. Administration	0.0	944.1	944.1		67.8		135.7		139.9		154.8		169.6		177.2		99.0		
	5. Physical Contingency	1,259.4	1,981.8	3,241.3	16.4	216.3	120.5	345.5	220.9	259.3	238.4	293.2	255.7	326.7	263.3	345.2	144.3	195.6		
	Total without Price Contingency	13,853.9	21,800.3	35,654.2	180.1	2,379.5	1,325.1	3,800.0	2,429.7	2,852.8	2,622.3	3,225.7	2,812.9	3,594.0	2,896.7	3,797.1	1,587.2	2,151.1		
	6. Price Contingency	1,929.1	2,768.6	4,697.7	11.0	145.6	109.2	313.2	252.9	296.9	330.8	407.0	418.2	534.4	497.2	651.8	309.6	419.7		
	Total of 1 ＊	15,783.0	24,569.0	40,352.0	191.1	2,525.1	1,434.3	4,113.3	2,682.6	3,149.8	2,953.1	3,632.7	3,231.2	4,128.4	3,394.0	4,448.9	1,896.8	2,570.8		
2	**Supplementary Component**																			
	1.0 Preparatory Works	610.8	367.2	978.1			610.8	367.2												
	Subtotal	610.8	367.2	978.1			610.8	367.2												
	1.1 Supplementary Component, New Sewers																			
	1) Main sewers	1,050.0	1,050.0	2,100.0					233.1	233.1	233.1	233.1	233.1	233.1	233.1	233.1	117.6	117.6		
	2) Branch sewers	1,225.0	1,225.0	2,450.0					272.0	272.0	272.0	272.0	272.0	272.0	272.0	272.0	137.2	137.2		
	Subtotal	2,275.0	2,275.0	4,550.0					505.1	505.1	505.1	505.1	505.1	505.1	505.1	505.1	254.8	254.8		
	1.2 Supplementary Component, An Kim Hai Channel Bridge																			
	1) Bridge, W 7.0 m x L 12.0 m	162.8	180.9	343.7					36.1	40.2	36.1	40.2	36.1	40.2	36.1	40.2	18.2	20.3		
	2) Bridge, W 7.0 m x L 15.0 m	610.5	678.5	1,289.0					135.5	150.6	135.5	150.6	135.5	150.6	135.5	150.6	68.4	76.0		
	3) Bridge, W 7.0 m x L 20.0 m	271.3	301.6	572.9					60.2	66.9	60.2	66.9	60.2	66.9	60.2	66.9	30.4	33.8		
	Subtotal	1,044.6	1,161.0	2,205.6					231.9	257.7	231.9	257.7	231.9	257.7	231.9	257.7	117.0	130.0		
	1.3 Supplementary Component, Road Ancillary Works																			
	1) Lighting	693.6	21.5	715.0											346.8	10.7	346.8	10.7		
	2) Fence	2,095.2	64.8	2,160.0											1,047.6	32.4	1,047.6	32.4		
	3) Plantimg	0.0	150.0	150.0											0.0	75.0	0.0	75.0		
	Subtotal	2,788.8	236.3	3,025.0					0.0	0.0	0.0	0.0	0.0	0.0	1,394.4	118.1	1,394.4	118.1		
	Total	6,719.2	4,039.5	10,758.6			610.8	367.2	736.9	762.8	736.9	762.8	736.9	762.8	2,131.3	880.9	1,766.2	503.0		
	2. Engineering Service Cost	671.9	403.9	1,075.9	96.1	57.8	96.1	57.8	96.1	57.8	96.1	57.8	96.1	57.8	96.1	57.8	95.4	57.4		
	3. Administration	0.0	355.0	355.0		4.6		34.0		49.6		49.6		49.6		95.0		72.7		
	4. Physical Contingency	739.1	479.8	1,219.0	9.6	6.2	70.7	45.9	83.3	87.0	83.3	87.0	83.3	87.0	222.7	103.4	186.2	63.3		
	Total without Price Contingency	8,130.2	5,278.3	13,408.5	105.7	68.6	777.6	504.8	916.3	957.2	916.3	957.2	916.3	957.2	2,450.1	1,137.0	2,047.7	696.3		
	5. Price Contingency	1,237.9	739.5	1,977.4	6.5	4.2	64.1	41.6	95.4	99.6	115.6	120.8	136.2	142.3	420.6	195.2	399.5	135.8		
	Total of 2 ＊	9,368.1	6,017.9	15,385.9	112.2	72.8	841.7	546.5	1,011.7	1,056.8	1,031.9	1,077.9	1,052.6	1,099.5	2,870.7	1,332.2	2,447.2	832.1		
	Total without Price Contingency	21,984.1	27,078.6	49,062.7	285.8	2,448.1	2,102.7	4,304.9	3,346.0	3,810.0	3,538.6	4,182.9	3,729.3	4,551.2	5,346.9	4,934.2	3,634.9	2,847.4		
	Total ＊	25,151.1	30,586.8	55,737.9	303.3	2,597.9	2,276.0	4,659.7	3,694.3	4,206.6	3,985.1	4,710.6	4,283.7	5,227.9	6,264.7	5,781.2	4,344.0	3,402.9		
	Recurring Cost		75.0	75.0				0.0		0.0		0.0		16.0		18.0		20.0		21.0

Note: All the amounts are shown in 2000 constant price except for those marked with "＊"

Table 1.2.3 Disbursement Schedule of Project Cost for Sewerage Priority Project

US $ 1.00 = VND 14,072 , Unit: 1,000US$

Item	Description	Total (US$)			2003		2004		2005		2006		2007		2008		2009		2010	
No.		F.C	L.C	Total	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
1	Construction and Procurement Cost																			
	1.0 Preparatory Works	3,184.2	1,393.4	4,577.7			3,184.2	1,393.4												
	1.1 Trunk Sewer, Open Excavation	3,101.0	3,689.1	6,791.3					564.4	671.4	564.4	671.4	564.4	671.4	564.4	671.4	564.4	671.4	279.1	332.0
	1.2 Trunk Sewer, Pipe Jacking	13,312.1	4,263.1	17,575.2					2,422.8	775.9	2,422.8	775.9	2,422.8	775.9	2,422.8	775.9	2,422.8	775.9	1,198.1	383.7
	1.3 Combined Sewer Overflow Control	1,966.9	298.7	2,265.5					358.0	54.4	358.0	54.4	358.0	54.4	358.0	54.4	358.0	54.4	177.0	26.9
	1.4 Manhole	175.3	178.9	354.3					31.9	32.6	31.9	32.6	31.9	32.6	31.9	32.6	31.9	32.6	15.8	16.1
	1.5 Manhole type pump	358.1	60.5	418.6					65.2	11.0	65.2	11.0	65.2	11.0	65.2	11.0	65.2	11.0	32.2	5.4
	1.6 An Da Relay Pumping Station	691.5	234.5	925.9									115.5	39.2	230.3	78.1	230.3	78.1	115.5	39.2
	1.7 West Wastewater Treatment Plant	10,001.5	2,973.4	12,974.9					4,000.6	1,189.3	4,000.6	1,189.3	2,000.3	594.7						
	1.8 Supplementary Works	2,235.8	2,235.8	4,471.6					406.9	406.9	406.9	406.9	406.9	406.9	406.9	406.9	406.9	406.9	201.2	201.2
	Subtotal	35,026.4	15,327.3	50,355.1	0.0	0.0	3,184.2	1,393.4	7,849.8	3,141.5	7,849.8	3,141.5	5,964.9	2,586.0	4,079.4	2,030.2	4,079.4	2,030.2	2,018.9	1,004.5
2	Land Acquisition and Compensation	0.0	2,165.0	2,165.0	0.0	1,082.5	0.0	1,082.5												
3	Engineering Service Cost	3,502.6	1,749.2	5,252.0	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7	437.8	218.7
4	Administration	0.0	1,733.1	1,733.1		52.2		189.5		349.4		349.4		276.2		203.0		203.0		110.4
5	Physical Contingency	3,852.9	2,097.5	5,950.4	43.8	135.3	362.2	288.4	828.8	371.0	828.8	371.0	640.3	308.1	451.7	245.2	451.7	245.2	245.7	133.4
	Total without Price Contingency	42,382.0	23,072.1	65,455.6	481.6	1,488.7	3,984.3	3,172.4	9,116.4	4,080.5	9,116.4	4,080.5	7,043.0	3,388.9	4,969.0	2,697.1	4,969.0	2,697.1	2,702.4	1,466.9
6	Price Contingency	5,918.3	3,106.4	9,024.7	29.5	91.1	328.4	261.5	948.8	424.7	1,150.1	514.8	1,047.2	503.9	853.0	463.0	969.4	526.2	591.8	321.2
	Total ＊	48,300.2	26,178.6	74,478.8	511.1	1,579.8	4,312.7	3,434.0	10,065.2	4,505.2	10,266.5	4,595.4	8,090.2	3,892.8	5,821.9	3,160.0	5,938.4	3,223.2	3,294.2	1,788.2
	Recurring Cost		1,470.0	1,470.0										309.0		309.0		426.0		426.0

Note: All the amounts are shown in 2000 constant price except for those marked with "＊"

Table 1.2.4 Disbursement Schedule of Project Cost for Solid Waste Management Priority Project

US $ 1.00 = VND 14,072 , Unit: 1,000US$

Item No.	Description	Total (US$)			2003		2004		2005		2006		2007		2008		2009		2010	
		F.C	L.C	Total	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C	F.C	L.C
1	**Waste collection and transport system**																			
	(1) Procurement of collection vehicles, bins, handcarts and work shop equipment	3,907.0	0.0	3,907.0			3,907.0	0.0												
	Subtotal	3,907.0	0.0	3,907.0			3,907.0	0.0												
	(2) Land Acquisition and Compensation	0.0	0.0	0.0	0.0	0.0														
	(3) Engineering Service Cost	195.4	0.0	195.4	195.4	0.0	0.0	0.0												
	(4) Administration	0.0	123.1	123.1		5.9		117.2		0.0										
	(5) Physical Contingency	410.2	12.3	422.5	19.5	0.6	390.7	11.7	0.0	0.0										
	Total without Price Contingency	4,512.6	135.4	4,648.0	214.9	6.4	4,297.7	128.9	0.0	0.0										
	(6) Price Contingency	367.4	11.0	378.4	13.2	0.4	354.3	10.6	0.0	0.0										
	Total *	4,880.0	146.4	5,026.4	228.0	6.8	4,652.0	139.6	0.0	0.0										
	Recurring cost	0.0	10,464.0	10,464.0		0.0		0.0		1,744.0		1,744.0		1,744.0		1,744.0		1,744.0		1,744.0
2	**Trang Cat new landfill site**																			
	(1) Civil works of Trang Cat new landfill site	3,299.0	3,299.0	6,598.0			1,649.5	1,649.5	1,649.5	1,649.5										
	(2) Procurement of heavy equipment	1,411.8	0.0	1,411.8			1,411.8	0.0												
	Subtotal	4,710.8	3,299.0	8,009.8			3,061.3	1,649.5	1,649.5	1,649.5										
	(3) Land Acquisition and Compensation	0.0	602.0	602.0	0.0	602.0														
	(4) Engineering Service Cost	400.5	329.9	730.4	200.5	200.0	200.0	129.9	0.0	0.0										
	(5) Administration	0.0	280.3	280.3		30.1		151.2		99.0										
	(6) Physical Contingency	511.1	451.1	962.2	20.1	83.2	326.1	193.1	165.0	174.8										
	Total without Price Contingency	5,622.4	4,962.3	10,584.7	220.6	915.3	3,587.4	2,123.7	1,814.5	1,923.3										
	(7) Price Contingency	498.1	431.3	929.3	13.5	56.0	295.7	175.1	188.8	200.2										
	Total *	6,120.5	5,393.5	11,514.0	234.0	971.3	3,883.1	2,298.7	2,003.3	2,123.5										
	Recurring cost	0.0	2,592.0	2,592.0		0.0		0.0		356.0		394.0		422.0		448.0		472.0		500.0
3	**Hospital waste treatment**																			
	(1) Procurement of incineration plant	263.0	0.0	263.0			263.0	0.0												
	(2) Site preparation and building	0.0	87.0	87.0			0.0	87.0												
	(3) Procurement of medical waste collection vehicles	76.0	0.0	76.0			76.0	0.0												
	Subtotal	339.00	87.00	426.00			339.00	87.00												
	(4) Land Acquisition and Compensation	0	0	0	0	0														
	(5) Engineering Service Cost	33.9	8.7	42.6	33.9	8.7	0.0	0.0												
	(6) Administration	0.0	14.1	14.1		1.3		12.8												
	(7) Physical Contingency	37.3	11.0	48.3	3.4	1.0	33.9	10.0												
	Total without Price Contingency	410.2	120.7	530.9	37.3	11.0	372.9	109.8												
	(8) Price Contingency	33.0	9.7	42.7	2.3	0.7	30.7	9.0												
	Total *	443.2	130.5	573.7	39.6	11.6	403.6	118.8												
	Recurring cost	0.0	282.0	282.0		0.0		0.0		47.0		47.0		47.0		47.0		47.0		47.0
	Total without Price Contingency	10,545.2	5,218.4	15,763.6	472.7	932.7	8,258.0	2,362.4	1,814.5	1,923.3										
	Total *	11,443.7	5,670.4	17,114.1	501.7	989.8	8,938.7	2,557.1	2,003.3	2,123.5										
	Total Recurring Cost	0.0	13,338.0	13,338.0	0.0	0.0	0.0	0.0	0.0	2,147.0		2,185.0		2,213.0		2,239.0		2,263.0		2,291.0

Note: All the amounts are shown in 2000 constant price except for those marked with "*"

Figure 1.2.1 Overall Implementation Schedule for Selected Priority Project

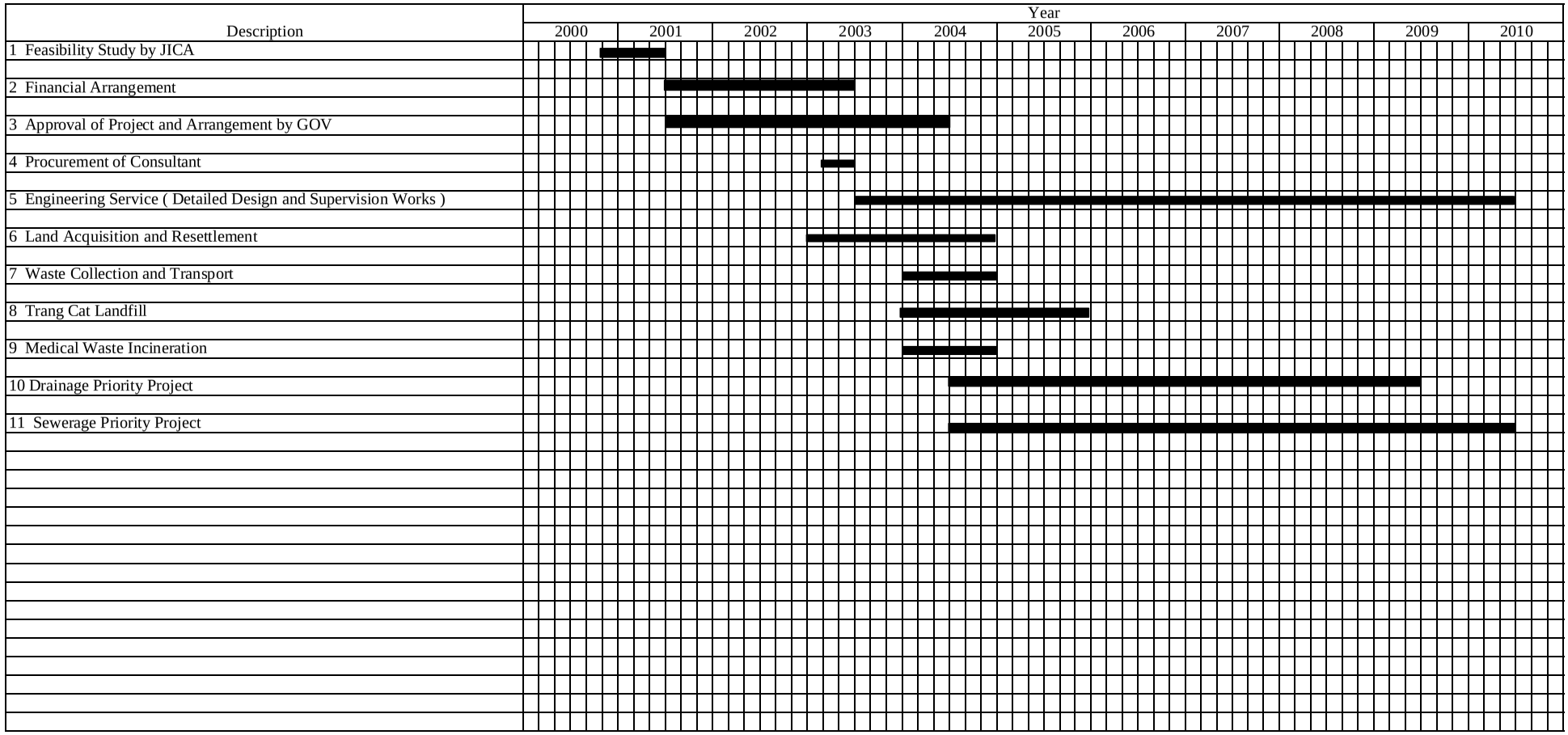


Figure 1.2.2 Implementation Schedule for Drainage Priority Project

Description	Quantity
An Kim Hai Channel and Phuong Luu Regulating Lake	
0 Preparatory Works	L.S
1 An Kim Hai Channel	
1) Excavation of channel	164,500 m3
2) Revetment works	53,200 m3
3) Maintenance road	20,000 m2
4) Construction of tidal gate, Lach Tray river	L.S
5) Construction of tidal gate, Cam river	L.S
6) Construction of discharge gate to Du Hang lake	L.S
7) Demolishing existing outlet gate	L.S
2 Phuong Luu Regulating Lake	
1) Excavation of Phuong Luu Regulating Lake	672,000 m3
2) Revetment works	8,200 m3
3) Road works and bridge	1,400 m2
4) Excavation of connection channel	10,900 m3
5) Revetment works, connection channel	2,660 m3
6) Maintenance road	1,000 m2
7) Box culvert, 3 x (3.0 m x 2.0 m)	450 m
3 Construction of New Sewers	
1) Trunk sewers	3,000 m
2) Lateral sewers	7,000 m
4 Supplementary Component, An Kim Hai Channel Bridge	
1) Bridge, W 7.0 m x L 12.0 m	3 nos
2) Bridge, W 7.0 m x L 15.0 m	9 nos
3) Bridge, W 7.0 m x L 20.0 m	3 nos
5 Road Ancillary Works	
1) Lighting	650nos
2) Fence	24000m
3) Planting	L.S

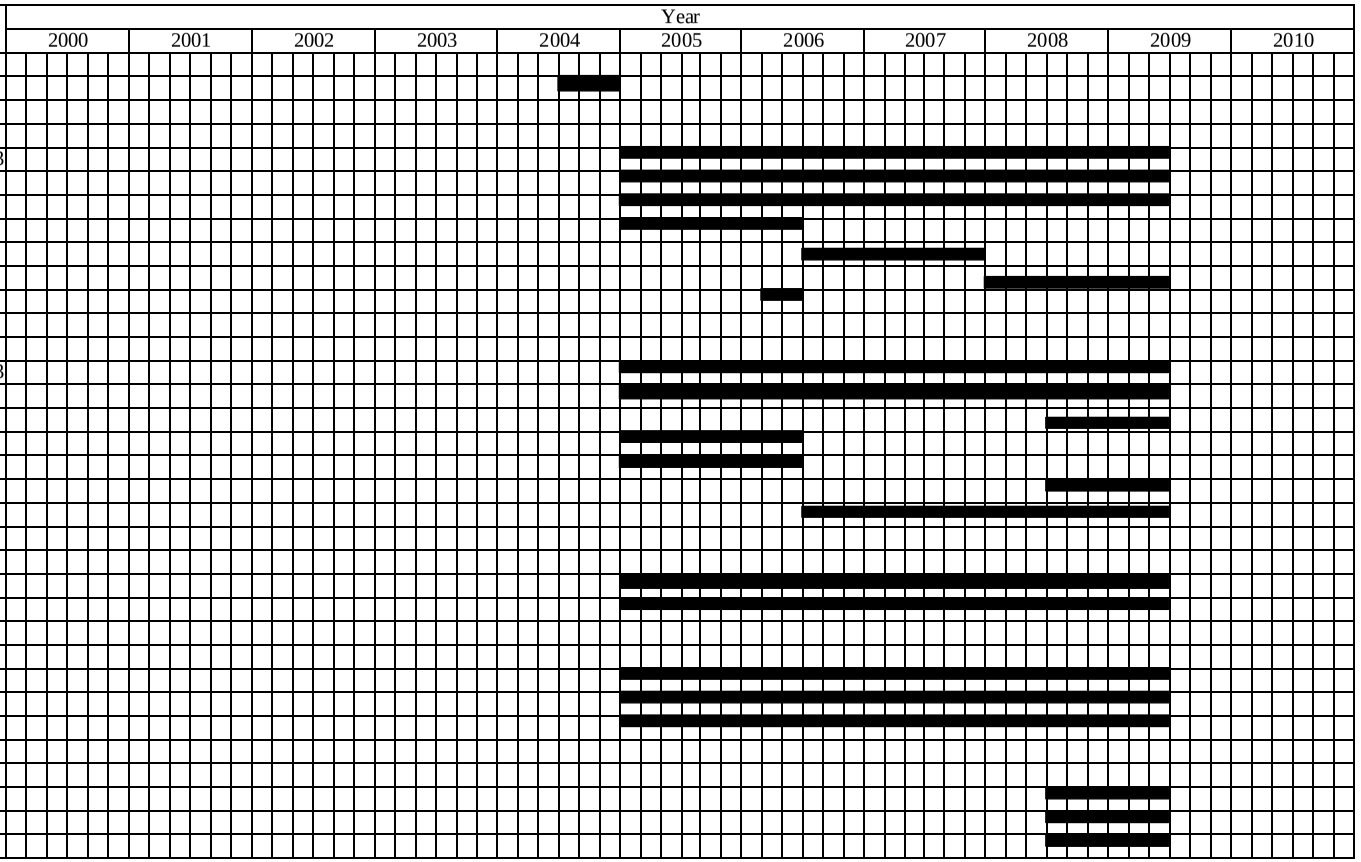


Figure1.2.3 Implementation Schedule for Sewerage Priority Project

Description	Quantity
West Wastewater Treatment Plant, Phase I, Combined Sewer Area	
0 Preparatory Works	L.S
1 Trunk Sewer, Open Excavation, 100-1200 mm dia.	12,260 m
2 Trunk Sewer, Pipe Jacking, 800-1800 mm dia.	7,660 m
3 Combined Sewer Overflow Control Structure	63 nos
4 Manholes	189 nos
5 Manhole Type Pump	
1) Civil Works	5 nos
2) Pumping facilities	5 nos
6 An Da Relay Pumping Station	
6.1 Pumping House Structure	
1) Excavation of common soil	3,110 m3
2) Embankment	5,270 m3
3) Concrete pile	336 m
4) Soil improvement	924 m3
5) Concrete works	447 m3
6.2 Pumping Facilities	
1) Pump, 300 mm dia., 11 m3/min, 18.5 kw	4 sets
2) Electrical equipment	L.S
7 West Wastewater Treatment Plant	
7.1 Pumping House Structure	
1) Excavation of common soil	5,150 m3
2) Backfilling	5,200 m3
3) Concrete pile, 300mmx300mm	540 m
4) Soil improvement	1,520 m3
5) Concrete works	594 m3
7.2 Aerated Lagoon Treatment Process	
1) Excavation of common soil	12,800 m3
2) Soil stabilization	12,800 m3
3) Aerators, 55 kw	32 sets
7.3 Settling Pond	
1) Excavation of common soil	49,000 m3
2) Soil stabilization	8,200 m3
7.4 Chlorination Tank	
1) Excavation of common soil	500 m3
2) Concrete	620 m3
7.5 Stormwater sedimentation pond	
1) Excavation of common soil	4,700 m3
2) Soil stabilization	1,400 m3
7.6 Sludge Drying Bed	
1) Excavation of common soil	1,600 m3
2) Soil stabilization	6,800 m3
3) Concrete	1,530 m3
7.7 Building Works	
1) Operation building	640 m2
2) Other building	430 m2
7.8 Pumping Facilities	
1) Rack rake	4 sets
2) Pump, 400 mm dia., 22.5 m3/min, 55 kw	2 sets
3) Pump, 600 mm dia., 45.1 m3/min, 110 kw	1 set
4) Dredge pump, 1.3 m3/min, 7.5 kw	1 set
5) Electrical equipment	L.S
8.0 Supplementary works	
1) Construction of precast R.C. pipe, 300 mm	10,000 m
2) Construction of precast R.C. pipe, 400 mm	5,000 m
3) Construction of precast R.C. pipe, 500 mm	3,000 m
4) Construction of precast R.C. pipe, 700 mm	2,000 m
5) Manhole	270 nos
6) Manhole type pump	5 nos

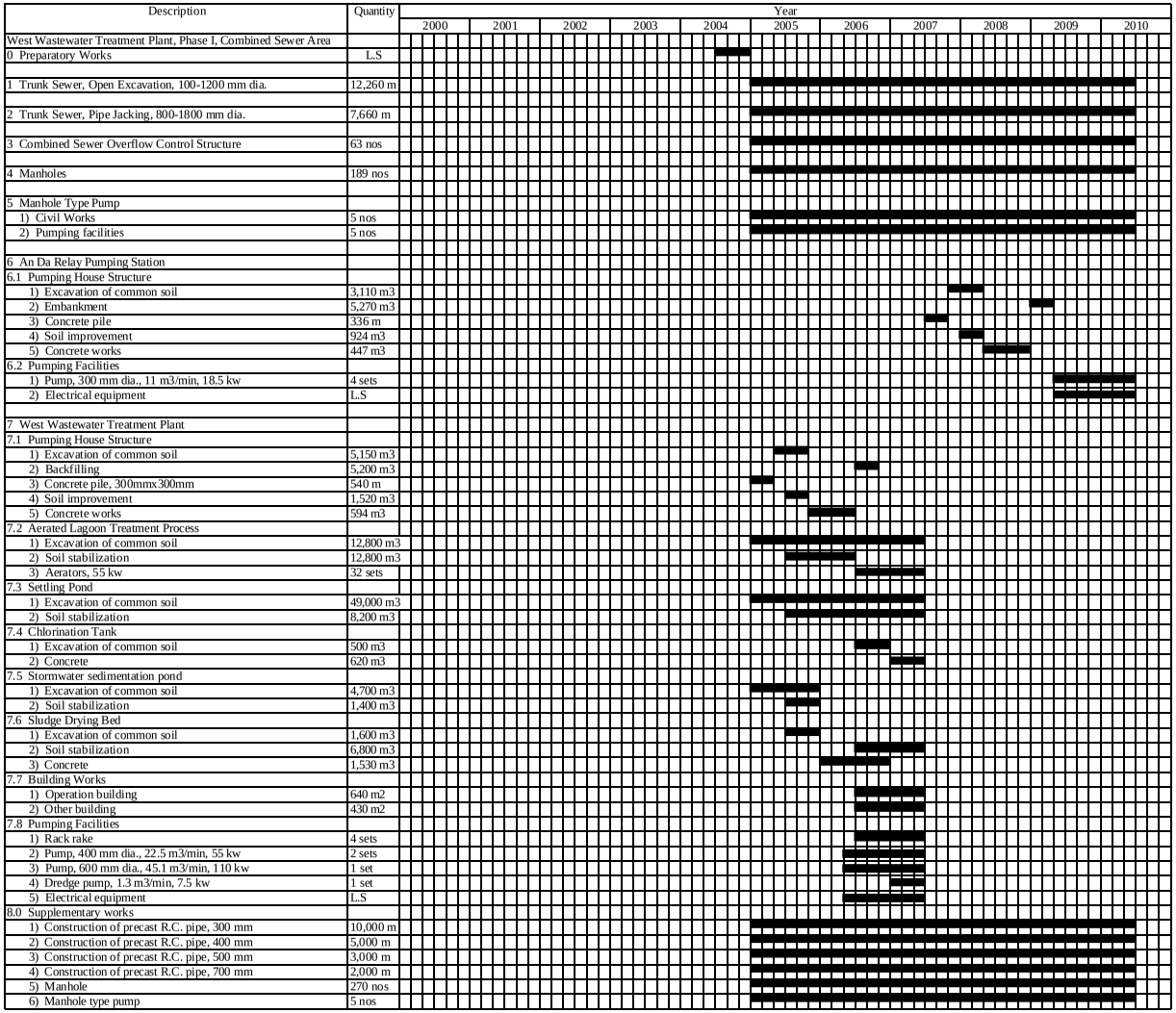
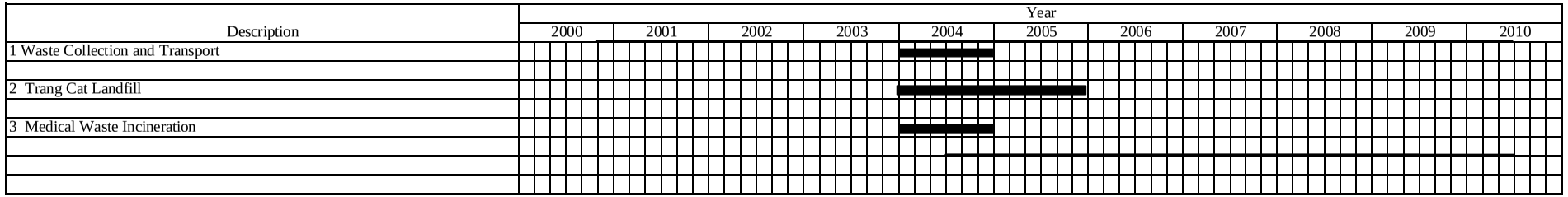


Figure 1.2.4 Implementation Schedule for Solid Waste Management Priority Project



II. FEASIBILITY STUDY ON THE DRAINAGE PRIORITY PROJECT

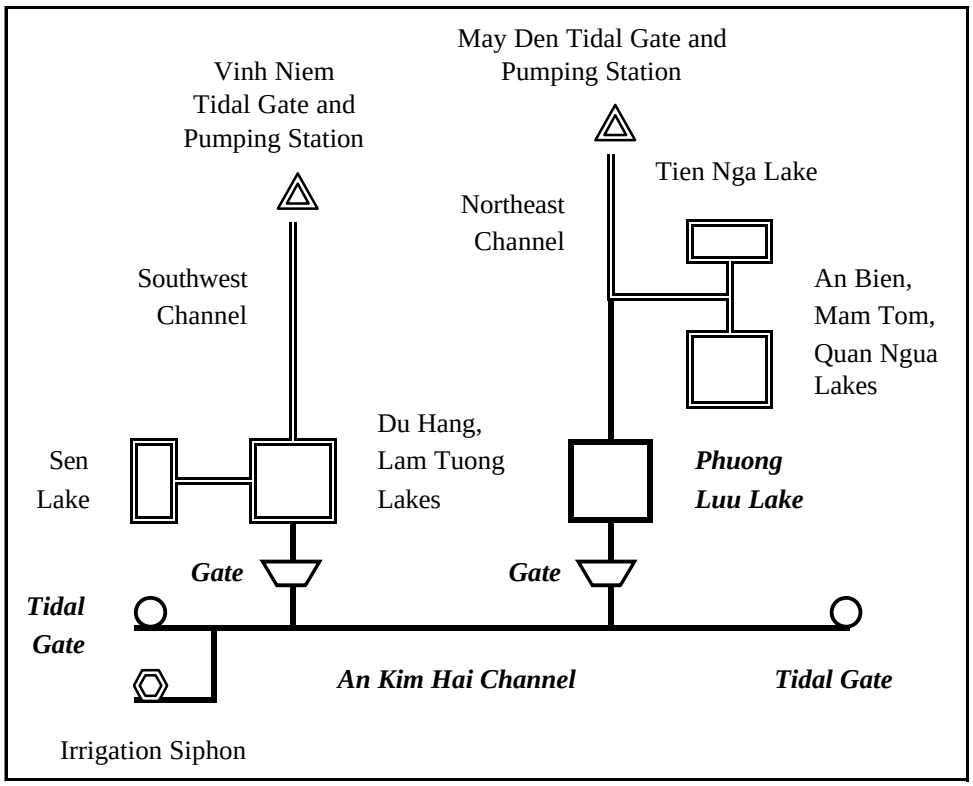
2.1 Recommended Drainage Priority Project

2.1.1 Main Project Components and Given Conditions

The Drainage Priority Project consists of rehabilitating an existing channel and construction of a new lake. The area of the Drainage Priority Project consists of three separate drainage zones as shown in Figure 2.1.1 and as follows:

- Northeast Drainage Zone
- Southwest Drainage Zone
- An Kim Hai Channel Drainage Zone

The development approach is to integrate the three drainage zones by rehabilitating An Kim Hai Channel and constructing Phuong Luu Lake to connect the three drainage zones. The new Phuong Luu Lake will also provide additional storage capacity for the integrated drainage zones. The following figure presents a schematic diagram of the development approach.



Development Approach of Drainage Priority Project

Given conditions are adopted for development of the Drainage Priority Project. These given conditions consist of the existing drainage system in the Project area and implementation of the World Bank Sanitation Project and FINNIDA Storm Water Pumping Stations Project.

Rehabilitation of An Kim Hai Channel consists of the following:

- Excavation and embankment works of existing channel
- Construction of maintenance roads along both sides of the channel
- Demolition of one existing tidal gate at river outlet
- Construction of two tidal gates at river outlets
- Construction of discharge gate at lake outlet

Construction of Phuong Luu Lake consists of the following:

- Excavation and embankment works of new lake
- Construction of roads and margins along the sides of the lakes
- Construction of connecting channel to Northeast Channel
- Construction of road connecting the lake site area to Highway No. 5
- Construction of closed conduit to An Kim Hai Channel and discharge gates

2.1.2 Design Methodology

(1) Hydrological Design Conditions

Design storm hyetographs are developed using rainfall data for storms with 5 year ARI and 10 year ARI and a total rainfall duration of 12 hours. The rainfall data is obtained from the Phu Lien Meteorological Station near Haiphong.

(2) Hydrographic Design Conditions

Design tide levels are developed using data for tide levels with a 10 year ARI for the Cam River. Based on this data, the maximum water level is +4.1 m and the minimum water level is +1.0 m. The complete tide cycle is 24 hours. The duration of water levels above +2.5 m is approximately 12 hours.

(3) System Performance Analysis

The computer software MOUSE 2000 developed by the Danish Hydraulic Institute is used for analyzing the system performance. Computer simulations of the drainage system are done to check the following design conditions:

- 5 year ARI storm during 10 year ARI high tide conditions

In addition, computer simulations of the drainage system are done to assess the following conditions to ensure compatibility with the World Bank Project:

- 10 year ARI storm during 10 year ARI rising tide conditions
- 10 year ARI storm during 10 year ARI falling tide conditions

2.2 Rehabilitation of An Kim Hai Channel

2.2.1 Major Construction Works

Rehabilitation of An Kim Hai Channel consists of the following works:

- Dredging and excavation of the channel of total length of about 10 km

- Construction of embankment works of rubble masonry revetment for the channel with side slopes of 1:1.25
- Construction of maintenance roads and margins along both sides of the channel each with total width of 5 m
- Construction of Lach Tray Tidal Gate at Lach Tray River with three openings of width 3 m and three gates
- Demolition of existing Nam Dong Tidal Gate at Cam River and construction of new tidal gate with three openings of width 3 m and three gates
- Construction of Du Hang Discharge Gate at Du Hang Lake with three openings of width 3 m and three gates

Resettlement of population affected by the Project will be needed for households housing along the channel sides because of the maintenance road construction.

2.2.2 Primary and Secondary Functions of Channel

The channel is needed for drainage in the part of the city in which it is located, where the degree of urbanization is high and will further increase in the near future. The channel can also be used for irrigation in the area, which provides additional benefits without great costs.

The channel is rehabilitated to provide a primary function for drainage and a secondary function for irrigation. The primary function should be for drainage, because the needed hydraulic capacity is greater for drainage than for irrigation.

2.2.3 Layout Design of Channel

(1) Discharge Locations of Channel

A channel layout is adopted which is based on discharge at multiple outlets to the nearest rivers and storage lakes. The selected alternative allows the channel to be used for drainage during both high tide and low tide conditions.

Four discharge locations of the channel were selected as follows:

- Discharge to Lach Tray River
- Discharge to Du Hang Lake
- Discharge to Phuong Luu Lake
- Discharge to Cam River

Tidal gate structures are constructed at Lach Tray and Cam Rivers to allow operation during high and low tide conditions. Discharge gate structures are constructed at Du Hang and Phuong Luu Lakes to allow the channel to be used for irrigation when these gates would be closed.

(2) Hydraulic Layout of Channel

The hydraulic layout of the channel is based on the use of channel cross-sections with side-slopes 1:1.25 and varying top widths as follows:

Locations and Lengths of Channel Design Sections

Location	Length	Top Width
From Lach Tray Tidal Gate to Du Hang Lake Gate	1,900 m	12 m
From Du Hang Discharge Gate to Ha Doan Road	6,550 m	15 m
From Ha Doan Road to Cam River Tidal Gate	1,700 m	20 m

2.2.4 Maintenance Roads and Margins

Maintenance roads on both sides of the channel are adopted. Maintenance roads on both sides of the channels is the most effective measure to prevent illegal encroachment on the channel. The total width of the maintenance roads plus margins on each side is selected as 5 m.

2.2.5 Channel Cross-Sections

The channel cross-sections are based on embankment works consisting of rubble masonry revetment. The levels of the channel banks and channel bottom have been selected to remain constant for the entire length of the channel. The following levels have been selected:

- Levels of channel banks on both sides: +3.8 m
- Level of channel bottom: +0.5 m

Channel side-slopes have been selected as 1:1.25. Selection of this value was based on previous studies. During detailed design geotechnical investigations are needed to confirm the geotechnical stability of this channel side-slope.

2.3 Construction of Phuong Luu Lake

2.3.1 Major Construction Works

Construction of Phuong Luu Lake consists of the following construction works:

- Excavation of the lake with surface area of 24 ha and bottom level +0.0 m
- Construction of embankment works of rubble masonry revetment along the lake edges with side-slopes of 1:1.5
- Construction of roads and margins along the sides of the lakes with total length of 2.2 km, total width of 12 m, and road level of +3.8 m
- Construction of recreational areas at locations along the lake with a total site area of 28 ha for the lake, roads and recreational areas
- Construction of connecting channel to Northeast Channel with length of 500 m, top width of 15 m, rubble masonry revetment with side-slopes 1:1.25, and maintenance roads and margins on both sides each with total width of 7 m

- Construction of road and margins with total width of 12 m and of length 400 m connecting the lake site area to Highway No. 5
- Construction of concrete box culvert of 3 × (3.0 m × 2.0 m) dimensions of length of 450 m located under road connecting site area to Highway No. 5 and discharging to An Kim Hai Channel (Note: 50 m of the box culvert is to be located under Highway No. 5)
- Construction of three flow gates at the discharge location of the box culvert to An Kim Hai Channel each with width of 3 m

The lake site area is also located to allow urban development to occur at the edges of the lake site area. This approach also allows the possibility of locating resettlement areas in this area for the population affected by the Project.

2.3.2 Site Layout of Lake

The location of the new lake is based on the Haiphong Sewerage and Drainage Master Plan. Land is available at the proposed location and consists mostly of land used for agriculture.

The primary function of Phuong Luu Lake is for drainage. However, the lake will also have a secondary function for recreation. The site layout will include margins along the lake which will provide a recreational environment.

2.3.3 Design Storage Capacity of Lake

The most important planning issue for construction of Phuong Luu Lake is the surface area of the lake which defines the storage capacity of the lake. A minimum volume of water with a depth of 1.5 m will be allowed in the lake to obtain the benefits from the secondary function for recreation. Based on the given conditions, the lake can be developed using a total site area of 28 ha and a lake surface area of 24 ha without restrictions from existing housing in the area.

Phuong Luu Lake is to be connected to the Northeast, Southwest and An Kim Hai Channel Drainage Basins. Design criteria is based on maximum water levels in the lakes in the three drainage basins as follows:

- Phuong Luu Lake: +2.7 m
- An Bien, Mam Tom, Quan Ngua and Tien Nga Lakes: +2.9 m
- Du Hang and Lam Tuong Lakes: +2.9 m
- Sen Lake: +3.2 m

The maximum water level for Phuong Luu Lake is based on the Haiphong Sewerage and Drainage Master Plan prepared by HPPC.

The maximum water level for the existing lakes (An Bien, Mam Tom, Quan Ngua, Du Hang, Lam Tuong and Sen Lakes) are based on the rehabilitation design criteria from the World Bank Sanitation Project for these lakes.

The minimum water levels in the lakes are +1.5 m. This design criteria is based on the Haiphong Sewerage and Drainage Master Plan prepared by HPPC.

2.3.4 Lake Road and Embankment Works

Preliminary design of the lake road and embankment works is based on a bottom level of +0.0 m for the lake. This criteria allows a minimum of 1.5 m depth of water when the water in the lake is regulated at the design minimum water level of +1.5 m. The level of the road is selected as +3.8 m which is the same as the levels of the channel banks for rehabilitating An Kim Hai Channel.

The embankment works consist of rubble masonry revetment. The total width of the maintenance roads plus margins on each side is selected as 12 m. The road will consist of two lanes, each with width of 3.5 m. Sidewalk margins of width 2.5 m will be located on both sides of the road.

2.3.5 Channel Connection to Northeast Channel

The lake is connected to the Northeast Channel by a connecting channel of 500 m length. The connecting channel will have side-slopes of 1:1.25, embankment works consisting of rubble masonry revetment, and maintenance roads on both sides. The total width of the maintenance road margin is 7 m.

A bridge is constructed over the channel where it connects to the lake. The length of the bridge is 15 m with a width of 12 m.

2.3.6 Closed Conduit Connection to An Kim Hai Channel

The lake is connected to An Kim Hai Channel by using a box culvert of 450 m length consisting of three conduits each with width of 3 m and height 2 m. Gate structures are to be located at the connection to An Kim Hai Channel.

2.4 Supplementary Components

2.4.1 New Combined Sewers

Cnstruction of new combined sewers are included as a supplementary component in the Priority Project for the following situations:

- Replacement of existing sewers in areas not covered by the rehabilitation works of the World Bank Project
- Construction of new sewers in areas not covered by the World Bank Project, but needed after construction of new roads in the Central Area

Construction of 3 km of new main sewers for sewer replacement and 7 km of new branch sewers to connect to the main sewers of the new roads are provided as supplementary components.

2.4.2 Channel Road Bridges

At present there are 10 road bridges and 21 small wooden and bamboo bridges which cross over An Kim Hai Channel. The small foot bridges will need to be removed. However, the main road bridges do not need to be removed.

Consequently, the Drainage Priority Project includes the construction of new bridges crossing over An Kim Hai Channel as a supplementary component. An amount of 15 bridges is included, with 3 bridges with a length of 12 m, 9 bridges with a length of 15 m, and 3 bridges with a length of 20 m. The widths of the new bridges are 7 m.

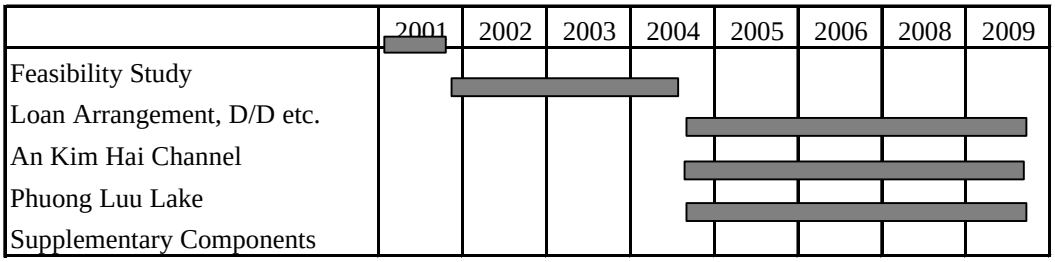
2.4.3 Ancillary Works

Ancillary works are also included in the Priority Project as a supplementary component. The ancillary works consist of lighting of the roads and margin areas by light poles and lamps, metal fences along the edges of the channel and lake roads, and trees and other plantings in the margin areas of the channels and lake.

2.5 Implementation Schedule and Cost Estimates

2.5.1 Implementation Schedule

The implementation of the Drainage Priority Project is proposed to start from mid 2004 and to be completed by mid 2009. The proposed schedule is given below.



2.5.2 Investment Costs and O&M Costs

Investment cost includes direct construction cost and compensation cost. The direct construction cost is US$35.7 million while the land acquisition and compensation cost is US$3.7 million.

O&M costs consist of staff, vehicles, equipment, office, and communications costs, and maintenance and repair materials. It is estimated that the O&M costs is US$21.3 thousand in the Year 2010 and will increase to US$33.2 thousand by the Year 2015 and US$58.7 thousand by the Year 2020.

2.6 Operational and Organization Plan

2.6.1 Operational Plan

The Priority Project includes operation of two new tidal gates, two new discharge gates, and one existing siphon gate.

The two new tidal gates are used for drainage and operated for high and low tide conditions. The tidal gates are closed when the channel is used for irrigation. The existing siphon gate is opened when the channel is used for irrigation, and closed when the channel is used for drainage. The two new discharge gates are closed when the channel is used for irrigation. When the channel is used for drainage, then the two gates are opened.

The new staff comprises 4 operators and 2 indirect staff. This O&M organization structure then allows the possibility that the two tidal gates, two discharge gates, and one siphon gate can be operated for drainage by 1 operator coordinating the activities of 3 operators and 2 indirect staff.

2.6.2 Organization Plan

Key points of the organization plan is summarized below:

- The PMU unit will require further technical assistance to facilitate their participation in the implementation of the Priority Project
- International advisors will need to participate directly in the bidding, procurement and construction supervision
- To strengthen the capacity to ensure that the project can effectively implemented, specific courses on project management and technical operation must be developed and delivered

2.7 Project Evaluation

2.7.1 Achievement of Objectives

Public health improvement is the key indicator to show the beneficial impact of the Project. The central part of the city which is most densely populated and flooding or inundation has been occurring most frequently, will be protected from flooding up to the storm water recurrence period of 5 years. Degree of flooding will be lessened under stronger storms. Duration and degree of unsanitary condition will be shortened and thereby water-borne diseases including the infectious ones will be reduced. Reduction of the infectious diseases will give beneficial impact for the whole city with the population which will be 1,909 thousand in the year 2010 and 2,121 thousand in the year 2020.

Thanks to the rehabilitation including dredging and widening of the channel, storage capacity of the An Kim Hai channel will be much enlarged from 192,000

m3 to 375,000 m3 . Namely, the total storage capacity will be about 95 % greater than that before rehabilitation.

Hydraulic conveyance capacity of the An Kim Hai channel will also be enhanced because of the enlargement of the flow area in the channel and reduction of the roughness of the channel side slope. Namely, after rehabilitation composite (overall) hydraulic conveyance capacity will be 2013 compared with 641 before rehabilitation, i.e., 215 % greater.

Construction of the Phuong Luu new lake will increase the total effective storage capacity of the lakes in the priority project area from the current 500,000 m3 to 790,000 m3, i.e., 58 % increase. In consequence, Drainage Priority Project will directly protect the central city area with about 11km^2 where 240 thousand residents will be living in the year 2010 and 286 thousand in the year 2020. The estimated incremental reduction area attributable to the Project is 46 ha in the case of 5 year ARI storm water. For the same storm, 161 ha in total will be freed from inundation due to the 3 drainage projects including the Project as shown below and Figure 2.7.1

Incremental Flood Reductions in Central Area After Project Implementation

Frequency	World Bank Project	FINNIDA Project	Drainage Priority Project
0.25 year ARI	46 ha	3 ha	4 ha
0.5 year ARI	58 ha	8 ha	11 ha
1 year ARI	76 ha	13 ha	19ha
2 year ARI	88 ha	18 ha	31 ha
5 year ARI	92 ha	23 ha	46 ha

It is noted that flood reduction of 12 ha is also realized in the New Urban Area due to the An Kim Hai channel rehabilitation, though it is outside of the target area.

Living environment will be upgraded in this directly affected area. Economic potential of this area will also be enlarged.

2.7.2 Economic Evaluation

The economic valuation has been carried out in terms of 1) least-cost solution, and 2) cost benefits analysis. It was shown that the planned project satisfies the criterion of the least-cost solution.

In the cost benefit analysis, it was assumed that the project benefits are expressed in terms of increases in value of property (land + buildings), and increases in the productivity (GRP). Then, switching values were calculated, i.e. percentage increases in the property value or the GRP, which will equate the benefit to the cost. All the benefits and costs were calculated on the present value base using a 10 % discount rate.

Under base case where Haiphong GRP will grow on the medium growth scenario that is as assumed as micro-frame for this Sanitation Master Plan shown in

Section 1.2, percentage increases required to economically justify the project is 1.8 % in terms of the property value, and 1.1 % in terms of GRP of the project area. It is judged that it is very probable that both the property value and GRP would increase by these percentages as result of the project, and therefore, the project is economically feasible.

2.7.3 Financial Evaluation

Financial evaluation has been carried out in terms of financial affordability. For this purpose, the whole drainage master plan program costs were used instead of the priority project cost, considering that:

- Currently, 1B drainage improvement projects are under implementation and some projects are expected to be implemented in short-terms, besides the drainage priority project proposed in the Study. These projects are included in SMP
- Under the situation, it would be more realistic to add the costs of these projects to the priority project cost in order to analyze the financial burden and affordability

Costs of the project were calculated on amortized base (amortized cost + recurring cost) using a loan condition (25 years repayment period, 5 % interest rate). Calculated costs were then compared to key indicators including the Study Area GRP, Haiphong GRP, HPPC expenditure, and the Study Area disposal income. In 2010, the project cost corresponds to 0.75 % of the Study Area GRP, and 5.6 % of the HPPC expenditure. Based on this result, the project seems to be affordable for the beneficiaries and HPPC. The results are sensitive to the assumptions on economic growth. Continual monitoring of key economic indicators is required to assess affordability as the program is developed.

In order to check whether or not the proposed Drainage Priority Project is affordable for HPPC for financing, reference was made to the drainage project that is under construction in the Hanoi city. Comparison between the 2 cases (Hanoi and Haiphong) was made from the viewpoints as shown in the table below:

- Ratio of the total project investment cost to the annual city expenditure
- Ratio of the counterpart fund out of the total investment cost to the annual city expenditure
- Ratio of the annual counterpart fund out of the total investment cost to the annual city expenditure

It is noted that majority (about 85 %) of the fund requirement for the Hanoi project has been financed by external ODA loan of concessionary conditions, and for Haiphong project similar loan was assumed to be extended. As shown in Item g in the table, financial burden on HPPC to meet the investment cost that is not covered by the loan, is less than half of the Hanoi case in terms of the whole

requirement (see Item g below) and about half in terms of annual requirement (see Item h below).

The Drainage Priority project cost is therefore considered affordable to HPPC

Comparison of Hanoi Drainage Project and Haiphong Drainage Project

	Hanoi	**Haiphong**
a. Implementation Period	9 years (1995 – 2003)	7 years (2003 – 2009)
b. Total Project Investment	US$200.0 million	US$55.7 million
c. Counterpart fund financed by the City	US$31.2 million	US$8.4 million
d. Annual average counterpart fund (c/a)	US$3.5 million	US$1.2 million
e. City's Total Expenditure in the mid year of construction period	US$164.5 million in 2000	US$102.4 million in 2006
f. Ratio of Item b to Item e	**121 %**	**54 %**
g. Ratio of Item c to Item e	**19.0 %**	**8.2 %**
h. Ratio of Item d to Item e	**2.1 %**	**1.2 %**

Notes:

1. Hanoi city's total expenditure in 2000 was estimated assuming an exponential expenditure growth between two years of which data were available to the JICA Study Team (US$156.7 million in 1999, and 172.1 million in 2001) Original amount was indicated in Japanese yen. Yen amounts were converted into US dollar using an exchange rate of US$110 yen which seems to be average and dominant rate considering that the rates have ranged from US$100 yen to US$120 yen since 1995 up to present.
2. All other data were obtained by the JICA Study Team

2.7.4 Technical Evaluation

Construction of the Drainage Priority Project will be by means of the traditional method and require no peculiar and advance technology. O&M of the project facility themselves will not accompany any advanced skills.

Appropriate operations manual is essential for the operation of the new tidal and discharge gates together with other related facilities, including the drainage pumping stations, one at the Cam River and the other at Lach Tray River. The established operation rules should duly be observed.

Together with these efforts, the Drainage Priority Project is considered to be technically feasible.

2.7.5 Environmental Impact Assessment

The proposed drainage project is expected to bring overall improvement of drainage and environmental condition in urban Haiphong (approx. 11 km^2). Furthermore, the project will directly improve the environmental condition along An Kim Hai Channel, where the existing environmental condition is the worst in Haiphong due to sever water pollution, illegal dumping of solid waste and encroachment.

The following adverse environmental impacts were identified as relatively important issues. They have to be followed up in the subsequent phase of the project.

(1) Land Acquisition and Resettlement

Three cross-section design options with different service road margins (7 m / 5 m, 5 m / 5 m, 5 m / 2 m) and options of box culvert versus open channel were explored in order to minimize resettlement in densely populated area while satisfying the project objectives. The resulting design (5 m / 5 m option) still requires resettlement of about 1,300 households living along An Kim Hai Channel. No resettlement from the proposed Phuong Luu Lake area is needed as the area is not inhabited.

Land acquisition and resettlement for the proposed project will be implemented in accordance with Decree No.22/1998/ND-CP and other relevant regulations. A Resettlement Action Plan will be developed during the Detailed Design Phase. The land acquisition and compensation activities will be coordinated by a Resettlement Committee to be organized in HPPC, which will be represented by relevant government organizations as well as local People's Committees and representatives from affected residents. Judging from the experiences of HPPC, which include resettlement for Highway 5 and on-going World Bank 1B Project (rehabilitation of NE and SW channels), HPPC is believed to have enough capability to carry out the required land acquisition and resettlement. Three potential resettlement areas were proposed along Highway No. 5 and near Phuong Luu Lake.

(2) Transport and Disposal of Dredged Sediment

According to the results of the sludge analysis, concentrations of heavy metals and other toxic substances in the sludge are low. Therefore, sludge disposal can be done in temporary disposal sites located on wasteland or agricultural land downstream of An Kim Hai Channel in section 5.

(3) Nuisance during Construction

During the construction phase, temporal nuisance, such as offensive odor, noise, dust, and local traffic disruption will occur. Other potential problem is pollution of surface water downstream of the construction site. These problems will be minimized through good operation management and supervision

2.7.6 Organizational Capability of the Implementing and Managing Bodies

Organizational Capability of the Implementing and Managing Bodies

One Project Management Unit (PMU) should be set up which will be responsible for the 2 priority projects of Sewerage Priority Project and Drainage Priority Project considering their inter-relationship, similar implementation timing and the same responsible organizations.

The PMU will assume the prime responsibility of the project implementation while TUPWS will be responsible for giving necessary instruction to PMU for smooth implementation when deemed necessary. SADCO will extend assistance for daily works of PMU when deemed necessary.

A Resettlement Committee with all the concerned organizations as members, will be established in Haiphong PC with the chairmanship of a Vice Chairman of the Haiphong PC. In order to ensure smooth land acquisition/resettlement, detailed Resettlement Action Plan (RAP) should be developed in the early stage of the Detailed Design.

Haiphong PC will have experience in the implementation of large scale drainage project through the execution of World Bank 1B project. Haiphong PC has already experience of land acquisition/resettlement through HWY 5 Project implementation and is about to undertake the land acquisition/resettlement for Rehabilitation of NE and SW Channel.

With the recommended setup together with the experience to be accumulated, it is expected that the Drainage Priority Project will be implemented successfully.

After entering the O&M stage, SADCO will manage the project including all the O&M works. In order to manage the more comprehensive system of the Drainage Priority Project, it is recommended that new sections should be created within SADCO together with the increase of staffs accompanied with the provision of adequate manpower training.

If all the recommended organizational reinforcement and manpower training as well as other efforts to strengthen their capability should be realized, SADCO is considered to be capable of managing the Drainage Priority Project.

2.7.7 Overall Project Evaluation

The Drainage Priority Project will meet the primary objective of the sanitation and environment improvement for the project area as well as for the city by reducing the flood incidence in the central part of the city. Public health will be enhanced through the reduction of the water-borne diseases. Pollution load inflow into the water bodies will be decreased, resulting in the water quality improvement of the ambient waters.

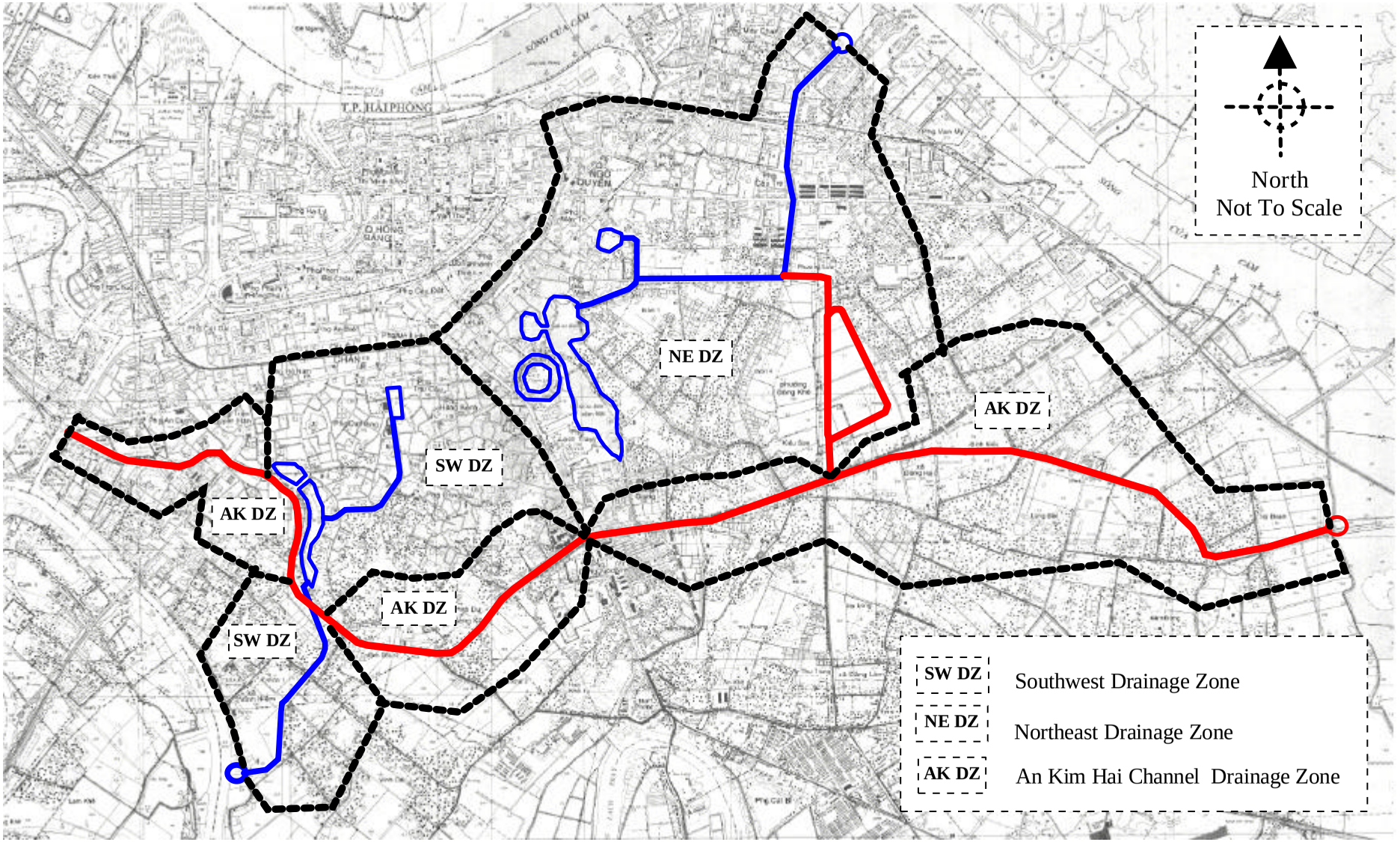
From economic point of view, switching values indicate that the contribution of Drainage Priority Project to the economic growth in the future in terms of GRP growth and property value increase, can justify the required project cost. The

project cost is considered within the affordable range of the HPPC, assuming the sinking fund of 5 % annual interest rate and 25 years repayment period. The project cost is also considered within the affordable range of the Study Area population in terms of the disposable income. From financial viewpoint, the assumed concessionary loan repayment added by the HPPC's own fund requirement is considered within the affordable range of HPPC.

From technical feasibility viewpoint, no difficulty is expected for construction and manufacturing of the project facility. Assuming the recommended organizational strengthening including the setting up of new sections for drainage control as well as adequate training of the staff, operation and maintenance can effectively be carried out by SADCO.

Vigorous efforts of HPPC will be required to implement the resettlement project needed for the An Kim Hai rehabilitation project. Resettlement Action Program should be formulated to alleviate the negative social impact and secure the cooperation of the project affected people. Dredged sludge should be disposed of in environmentally sound manner. Assuming these efforts, Drainage Priority Project is considered as socially acceptable.

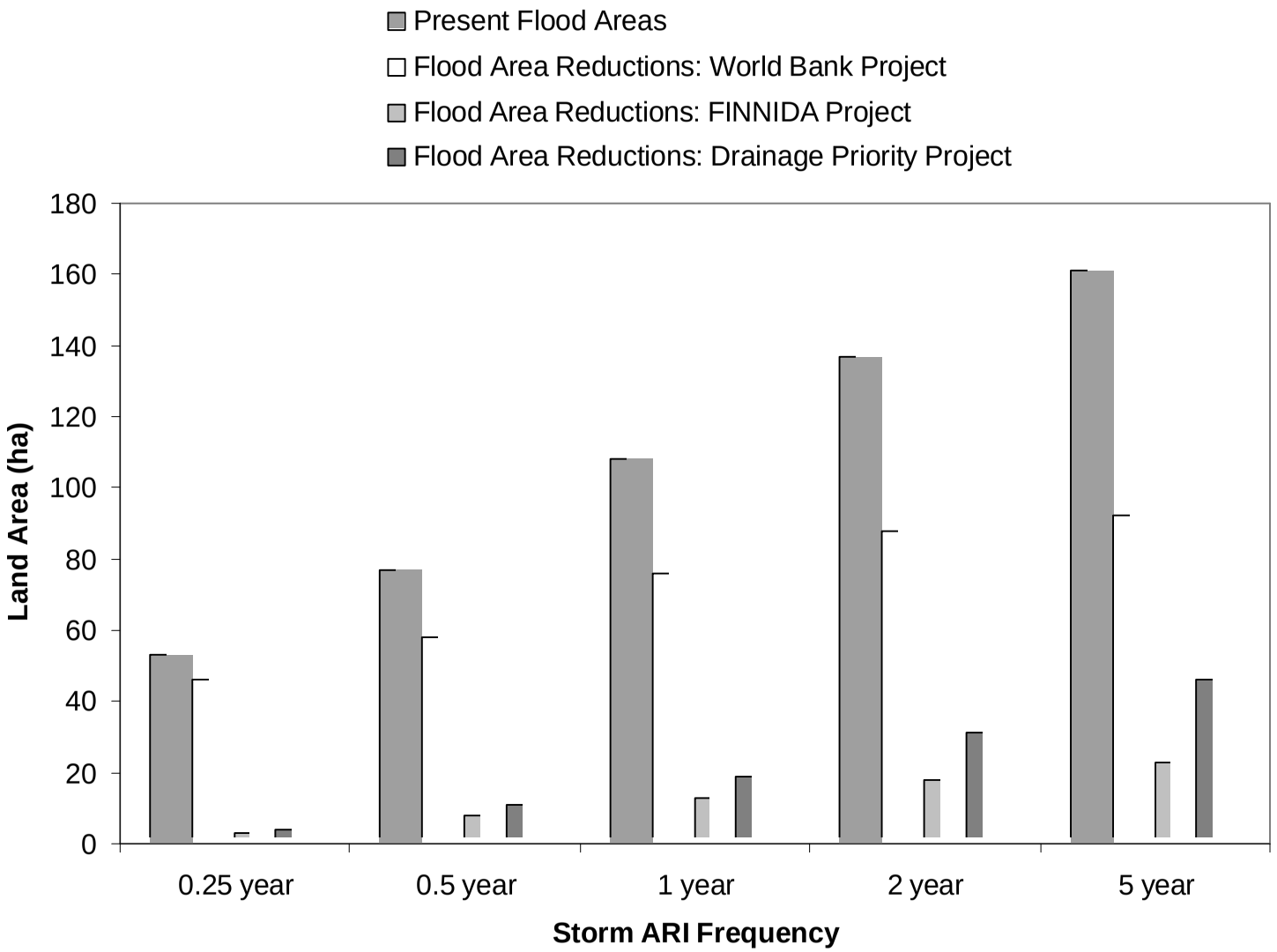
In conclusion, Drainage Priority Project is evaluated to be feasible for implementation.



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

Japan International Cooperation Agency

Figure 2.1.1 Drainage Zones in Drainage Priority Project Area



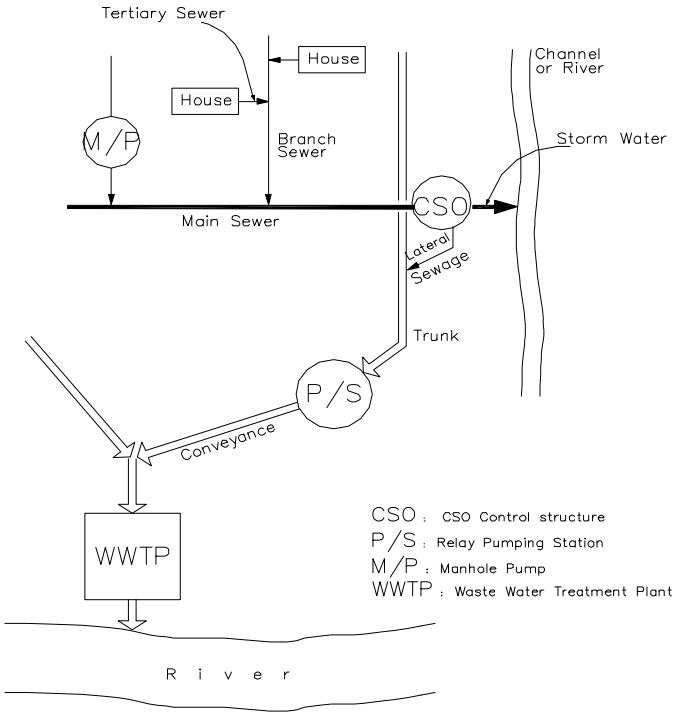
The Study on Sanitation Improvement Plan for Haiphong City in The Socialist Republic of Vietnam	Figure 2.7.1 Incremental Flood Reductions in Central Area After Implementation of Phase I Projects
Japan International Cooperation Agency	

III. SEWERAGE PRIORITY PROJECT

3.1 Recommended Sewerage Priority Project

In the project area at present, most of the households have septic tanks that receive only black water. The effluent of the septic tanks enters into the existing combined sewers where it gets mixed with gray water and, during rain, with storm water. Main sewers collect combined flow from branch and tertiary sewers and discharge into lake, channel and rivers.

The sewerage priority project proposes to use all existing combined sewer pipelines to reduce the investment cost and implementation time. The idea is to intercept the combined flow before it enters into the surface water bodies and separate the sewage from storm water by means of Combined Sewer Overflows (CSO). Separated sewage is collected by sewer pipelines to the wastewater treatment plant (WWTP). The main collector pipe, called a conveyance, will collect wastewater from sewer pipes and direct it to the WWTP near the Vinh Niem Tidal Gate. Sewage lift pump is placed when gravity flow becomes difficult. Sewage is to be treated in WWTP to satisfy VN standards before being discharged into the river. Storm water separated in CSOs is allowed to bypass directly into surface water bodies. The project concept is shown in the following figure.



The existing combined sewer pipes collect most of the sewage at present and directly discharge their wastewater into the water bodies. Based on the relative elevation of the land and sewer pipes, the catchment of the each outlet was identified. At the outlet, CSOs are placed to intercept and separate the sewage.

Considering the cost involved and degree of expected pollution, no treatment is proposed for the bypass water from CSOs.

In the Study, three types of sewage pipelines are proposed, namely, conveyance, trunk and lateral. Wastewater is to be collected from lateral to trunk and from trunk to conveyance. From the topographic, hydraulic and location considerations, it is proposed to locate one major conveyance pipe along Road no. 5.

The capacity of the sewer pipelines are to be designed to collect 3 times the predicted Average Dry Weather Flow (ADWF, flow when there is no rain) in the year 2020. Also, sewage collection for the Phase II area was considered during the pipe dimensioning. The conveyance pipe will deliver the sewage to the WWTP, where the ADWF will be treated before being discharged into the river. Only preliminary treatment is proposed to be carried out for the remaining 2 ADWF flow which would occur only during rainfall.

Sewage generation is estimated to reach 36,000 m^3/day in 2010. At the entrance of the WWTP, a lift pumping station is required with a capacity of 3 ADWF. After that, a preliminary treatment facility will be placed for the 2 ADWF flow. Preliminary treatment facilities will consist of a settling pond of 3 hour retention time and a chlorination tank for disinfection. This will be used in wet weather to provide certain treatment. The settling pond will store water for the first 3 hours of rainfall and the stored water will be returned to the secondary treatment line after the rain stops. This will ensure proper treatment for the first flush 3-hour period. Any flow occurring after the first 3 hours will pass through the chlorination tank for disinfection before bypassing into the river. The secondary treatment will consist of a series of aerated lagoons with a capacity of 1 ADWF. Settling tanks will be placed after that to separate sludge. Before discharging, the flow will pass through a chlorination tank for disinfection. Sludge will be treated in a sludge drying bed. Water from the bed will be re-circulated for treatment. Dried sludge will be disposed of at a landfill site or reused or treated at proposed septage treatment facility.

For areas where combined sewer pipes do not exist, new combined sewer pipes are proposed under the 'Drainage Priority Project'. For areas where existing combined sewer pipes are not functioning properly and will not be rehabilitated under any on-going and planned project, rehabilitation measures are also proposed under 'Drainage Priority Project'.

For houses that now directly discharge sewage into surface water bodies due to lack of nearby sewer pipes, interceptor pipes are proposed under 'Sewerage Priority Project' as a supplementary component.

Figure 3.1.1 in the following page shows the total sewerage priority project.

3.2 Sewer Pipelines, Combined Sewer Overflows and Pumping Stations

(1) Combined Sewer Overflows (CSO)

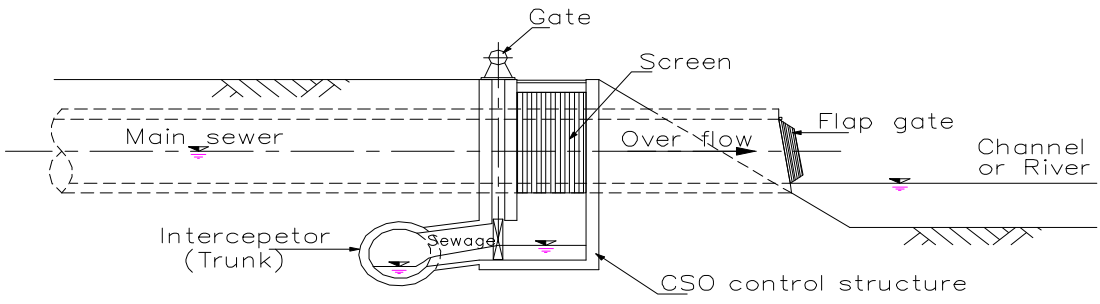
The command areas of sewage collected into each outlet were identified based on ground elevation, flow direction inside the sewer and other related information. There are 65 such CSO command areas. CSOs can either be placed at each existing outlet or can be placed after combining a number of outlets. This Study proposes that a CSO control structure is to be placed at each existing outlet considering cheap installation cost and simple maintenance.

Considering construction cost, size, ease of construction, required maintenance, design simplicity, and tidal influence, two types of CSO control structures are considered as suitable for Haiphong.

Type	Command Area	Merits and demerits
Gate	More than 10ha	The volume of intercepted wastewater is controlled by the gate. It requires manual control.
Orifice	Less than 10ha	In case of small area, orifice type can be adopted to reduce maintenance. However, a functional decline due to a blockage is expected.

Sewage generation for each CSO command area is calculated based on water consumption. A 10 % groundwater infiltration flow is added to the combined domestic, institutional, commercial and industrial sewage generation. A peak factor of 3 is used to accommodate the rainwater as 2 times ADWF.

Although there are 65 CSO command areas the total number of CSO structures proposed is 61, out of which 41 are gate type and 20 are orifice type. There are 4 command areas where it is not possible to provide a CSO easily. As a result, manhole pumps (small capacity sewage lift pumps placed inside of a manhole) would be provided at each location to transfer the sewage to the adjoining command area. A schematic figure of a CSO is given below.



(2) Sewer Pipelines

The length, flow, slope, velocity and diameter were calculated for each segment of pipe lines. From the calculation of longitudinal profile, a sewage lift pumping station would be required in the eastern part. The Governing invert elevation for conveyance found by iterative calculation suggests that the lift head for the pumping station, should be around 3.5 m. All proposed pipes are reinforced concrete except some pressure pipe, which are made of steel. The manhole interval is proposed to vary with pipe diameter.

The proposed facilities include:

- Pipe line 19.92 km, (11.77 km is open cut, 7.66 is jacking and 0.49 km is pressure)
- Manhole 190

(3) Pumping Stations

There are two types of pumps proposed in the Study, namely manhole pumps and sewage lift pumps.

Small pumps called manhole pumps are required where flow is difficult to ensure. In total five manhole pumps are considered in this Study.

From the calculation of trunk layout, there is a requirement for a sewage lift pumping station in the eastern side. This has been Designed so as to minimize investment and operation and maintenance (O&M) costs.

Three alternative locations were identified for the pumping station site. Detailed investigation of these sites, including topographic survey, geo-technical investigation and environmental impact assessment, was carried out.

Finally An Da site was selected from the consideration that:

- No resettlement is required
- Cost-effective from technical aspect
- Far from National Road no. 5 thereby eliminating interference with traffic
- Ease of construction as it is located by the side of a planned road
- Less earth filling compared to the other two sites
- Low expected social and environmental impacts

The facilities include:

- Number of pumps 3 regular and one standby
- Required capacity 0.535 m^3/sec
- Required capacity of each pump 0.178 m^3/sec
- Diameter of the suction pipe 300 mm
- Actual head 3.5 m
- Required head 5.5 m
- Motor rating 18.5 kW

3.3 Wastewater Treatment Plant

(1) Location and Treatment Process

In the draft Sanitation Master Plan, MSP and AL were proposed. Although MSP is a less expensive method, it requires more land and its effluent quality can not satisfy VN standard. After detailed discussion with PMU, TUPWS, SADCO and UPI, it was decided to adopt AL as the treatment process. This will require a minimum land of around 27 ha total in Phase I and Phase II without required buffer zone. Including the buffer zone (which is a requirement of Vietnamese Regulation) and operational buildings, the land requirement is 38 ha.

Because of the land availability, the Study proposed to shift the location of the WWTP proposed in the draft Sanitation Master Plan to further south near the Lac Tray River. The present land use is principally agricultural in nature. In the vicinity of the proposed WWTP, there is an existing dike. A number of roads are planned to be constructed in that area. In this location, the area available is around 31 ha. Thus, available land even in this newly proposed area is not enough to accommodate the WWTP.

After considering all alternatives, the Study proposes to relocate the dike and re-align one road slightly. The dike would need to be between 50 and 100 m. It is proposed to shift the north-south oriented road about 60 m towards the east. The area available after relocating the dike and road is around 38 ha, which is sufficient to construct the treatment plant. These proposed relocations would cause little adverse impact. Shifting of dike will not cause any performance decrease in flood control. The road re-alignment would also not have any negative impact on transportation or urban planning.

(2) Technical Design

Inlet Pump: In the pumping station, a combination of smaller capacity and bigger capacity pumps will be used to save energy cost.

The facilities include:

- Number of pumps — 3 bigger and 2 smaller capacity
- Required capacity — 2.253 m^3/sec
- Required capacity of each pump — 0.751 m^3/sec and 0.376 m^3/sec
- Diameter of the suction pipe — 600 mm and 400 mm
- Actual head — 7.3 m
- Required head — 9.3 m
- Motor rating — 110 kW and 55 kW

Storm Water Settling Ponds: Two ponds have been adopted for storm water preliminary treatment. One pond will be constructed in each phase.

Aerated Lagoon: The flow will be distributed to a number of lagoons by splitter chamber. Since the process is semi-natural, efficiency depends on the ambient temperature. The effluent from the lagoon will comply with the VN standards, which is 50 mg/l of BOD for discharging into a Class B river like Lac Tray.

The facilities include:

- Number of lagoons — 4 for Phase I
- BOD reduction — 85 % minimum
- SS reduction — 80 % minimum
- Design air temperature — 14C in winter and 28C in summer
- Retention time — 3 days in winter and 1.9 days in summer
- Oxygen supply — fixed type surface aerator
- Aerator — eight aerators in each lagoon, total 64
- Aerator power — 55 kW

Settling Ponds: Settling ponds for treated wastewater will be designed for 1 ADWF. There will be 8 ponds corresponding to aerated lagoons. One day retention is sufficient for acceptable settlement.

Chlorination Tank: There will be two types of chlorination tank, one for the flow coming from the secondary treatment train with 1 ADWF capacity and another for the by pass water coming from the storm water settling pond with 2 ADWF capacity. Two tanks are proposed for each type, one each for each Phase. Chlorination will be carried out by liquid chlorine to reduce the risk. A contact time of 15 min is selected.

Sludge Treatment: Sludge treatment is proposed to be through a sludge drying bed. There will be 8 series of beds, each series corresponding to a lagoon. In each series, there will be 16 beds Drying duration is determined from gravity settling, wind, evaporation, temperature, relative humidity and the probability of rainfall during drying. Drying duration is found as 23 days.

Internal Pipelines: Since the outfall river is a tidal river, discharge is not possible during the high tide. All pipelines are designed for 1.5 ADWF and there is a 100 % allowance for small diameter pipes, thus the pipelines can handle the discharge.

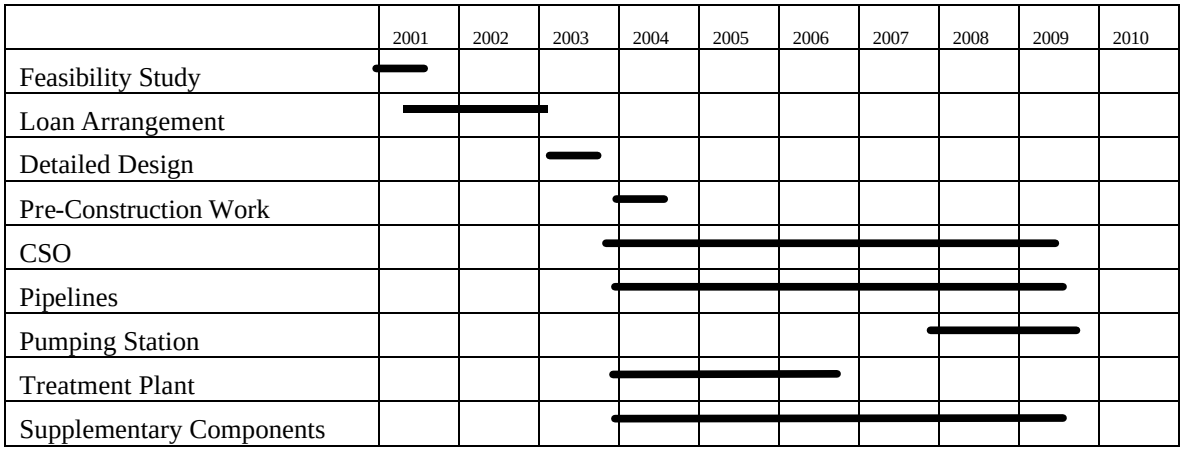
3.4 Supplementary Component

In the Sewerage Priority Project area, not all households are connected with the existing sewer pipes. There are a number of households now discharging their wastewater directly to surface water bodies. To collect such wastewater, new interceptor pipes would be constructed. The cost for a total of 20 km of such pipe is included in the Study. The cost of other miscellaneous components are also included in the Project.

3.5 Implementation Schedule and Cost Estimates

3.5.1 Implementation Schedule

The implementation of the sewerage priority project is proposed to start from mid 2004 and to be completed by mid 2010. The proposed schedule is given below.



3.5.2 Investment Cost and O&M Cost

Investment cost includes direct construction cost and compensation cost. The direct construction cost is US$50.4 million while the land acquisition and compensation cost is US$2.2 million.

To operate the new facilities proposed in the Priority Project, the required operation and maintenance cost consists of staff cost, electric power cost, repair cost, chemical cost, sludge disposal cost and water quality test cost. Total O&M cost is US$0.5 million per year.

3.6 Operation and Maintenance Plan

(1) Operation Plan

The Project includes CSOs, sewer pipes, pumping stations, and wastewater treatment plant. Proper operation of these facilities is important to obtain optimum service from these facilities.

There are two types of CSOs proposed in the Project, namely gate type and orifice type. Both types of CSOs need periodic cleaning. When rainfall intensity and duration are high, gate type CSOs should be closed manually. These gates are simple to operate and SADCO staff could operate them using an operation manual. One persen can operate a number of CSOs.

Sewer pipes and manholes need periodic cleaning. Smaller diameter pipes can be cleaned manually while suction pumps should be used for larger diameter pipes.

Pumping stations need periodic cleaning and also periodic instrument inspection. Repair should be done based on operational manual if required.

Routine water quality testing is important for the smooth operation of a wastewater treatment plant. The plant also needs periodic cleaning. Since discharge is not continuous, regular gate control is required.

(2) Organization Plan

The key organizational plan is summarized below:

- The PMU unit will require further technical assistance to facilitate their participation in the implementation of the priority project
- International advisors will need to participate directly in the bidding, procurement and construction supervision
- New technical units will be created within SADCO, namely, waste treatment plants, pumping stations and septage management
- There will be a requirement for 51 additional staff, out of which 34 will directly involved in O&M of the new facilities and 17 will provide logistic and administrative support
- To strengthen the institutional capacity to ensure that the project can effectively implemented, specific courses on project management and technical operation must be developed and delivered
- During the commissioning phase of the wastewater treatment plant and pumping stations, it will be essential to have technical experts on-hand to ensure that the plants and stations are operating efficiently

3.7 Project Evaluation

3.7.1 Objective Achievement

Public health improvement is the key indicator by which to measure the beneficial impact of the Project. The central part of the city that is most densely populated will be provided with a central sewerage system which will provide hygienic conditions for the residents. Water-borne diseases, including infectious ones, will be reduced. Reduction of infectious diseases will have a beneficial impact on the whole city population which will be 1,909 in the year 2010 and 2,121 in the year 2020.

In terms of the scale of development and size of influence, the Sewerage Priority Project will provide the central sewerage system over about 11 km^2 where 240 thousand residents will be living in the year 2010 and 286 thousand in the year 2020. The living environment will be upgraded in this directly affected area and its economic potential will also be enlarged.

Through the project implementation, BOD load to be discharged into the water bodies will be reduced by 9,673 kg per day in the year 2010. Namely, about 72 %

of the BOD load will be removed, which would be discharged if Sewerage Priority Project is not implemented.

The function and operational scale of the Sewerage Priority Project is sizable. Through the implementation of the Sewerage Priority Project, about 36,000 m^3 of sewage will be treated at the waste water treatment plant.

3.7.2 Economic Evaluation

The economic valuation has been carried out in terms of 1) least-cost solution, and 2) cost-benefit analysis.

It was shown that the planned project satisfies the criterion of the least-cost solution.

The same approach was used for the cost benefit analysis of the sewage project as for the drainage project. Refer to Section 2.7.4 for the approach.

Under base case where Haiphong GRP will grow on the medium growth scenario that is as assumed as micro-frame for this Sanitation Master Plan shown in Section 1.2, the percentage increases required to economically justify the project are 2.7 % in terms of property value, and 1.6 % in terms of GRP of the project area. It is judged that it is very probable that both the property value and GRP would increase by these percentages as a result of the project, and therefore, the project is economically feasible.

3.7.3 Financial Evaluation

Financial evaluation was carried out in terms of financial affordability in the same way as for drainage. For this purpose, the whole sewage master plan program costs were used instead of the priority project cost. The calculated costs were then compared to key indicators including the Study Area GRP, Haiphong GRP, HPPC expenditure, and the Study Area disposal income. In 2010, the project cost corresponds to 0.75 % of the Study Area GRP, and 5.7 % of the HPPC expenditure. Based on this result, the project seems to be affordable for the beneficiaries and HPPC. The results are sensitive to the assumptions on economic growth. Continual monitoring of key economic indicators is required to assess affordability as the program is developed.

3.7.4 Technical Evaluation

Sewerage Priority Project comprises the combined sewers, CSOs (combined sewer overflow), sewers (lateral, trunk and conveyance sewers), pumps and waste water treatment plant. For the selection of the most appropriate system for sewerage development, various alternatives were considered and compared.

For technical feasibility, the alternatives were examined from the preparative whether they are based on proven technology that has been adequately implemented elsewhere in the world,particularly in Asian, countries comparable to Vietnam. The required skill level for the O&M of the sewerage system alternatives was examined in the light of the current level in Vietnam and the expected level after future improvement. In this context, among the conceived alternatives, small-bore with simplified treatment plant alternative was dropped considering that it is not yet a proventechnology for which there are a very limited number of examples all of which are implemented outside of Asia. For waste water treatment plant, an aerated lagoon type was selected for various reasons. One of the major reasons is that the plant can be operated and maintained by SADCO personnel after certain manpower training.

The selected sewerage system is based on the combined sewer system which is a system based on sure and proven technology in operation in many countries throughout Asia. Construction of the system will not require any special and advanced technology. Required facilities and equipment are not peculiar to this priority project and can either be manufactured in Vietnam or can be imported from overseas.

CSO is a rather new facility to be introduced to Vietnam. However, the operation, i.e., gate operation, will be properly done with appropriate instruction based on operation manual. For the orifice type CSO, no manual operation is required, although ordinary maintenance work is needed. The required skill level for the aerated lagoon is medium among the studied options and certainly attainable by Vietnamese engineers and technical staff with some training.

In order to ensure successful operation of the system, it is recommended that external technical assistance for acquiring the operation technology by ODA (Official Development Aid) and guidance by the manufacturers of the facility/equipment at the initial stage of the operation be obtained. Similar projects implemented in other cities in Vietnam prior to this project should be studied and experiences and knowledge should be transferred to the personnel to be engaged in this project.

Assuming that these efforts will be made the Sewerage Priority Project is considered to be technically feasible.

3.7.5 Environmental Impact Assessment

The proposed sewerage project is expected to bring the following positive impacts: i) improvement of sanitation and public health condition, and ii) up to 80 to 100 % reduction of pollution loads to lakes and channels in the project area.

Among the relatively significant adverse impacts include: i) land acquisition and resettlement of about 23 households and relocation of dike, ii) limited pollution of the Lach Tray River, iii) disposal of treatment sludge, and iv) offensive odor from the WWTP.

(1) Land Acquisition and Resettlement

About 23 households living along the dike of Lach Tray River have to be resettled for the construction of Vinh Niem WWTP. In addition, farmers and fishermen using the proposed WWTP site (38 ha) must be compensated for their losses. Overall, the impact is relatively small, for example, compared to the drainage project. Nevertheless, close cooperation among local People's Committees, SADCO, and other relevant organizations is important for the smooth land acquisition and resettlement.

(2) Limited Pollution of Lach Tray River by Effluent from WWTP

Wastewater will be treated to the level permitted by the discharge standard (BOD 50 mg/l), and discharged to Lach Tray River. Due to the large flow, which is nearly 100 times larger than the effluent volume, and due to the strong tidal dispersion, Lach Tray River has sufficient dilution capacity to absorb the pollution loads within the Environmental Standard TCVN 5942-1995.

(3) Disposal of Sludge from WWTP

The proposed project includes sludge drying beds within the WWTP. The dried sludge may be transported to a designated landfill or used as soil conditioner if the heavy metal contents are within acceptable levels. The estimated volume of sludge is approximately 40 m^3/day.

(4) Offensive Odor from WWTP

Although the proposed WWTP area is not densely populated, a minor odor problem will be unavoidable. This problem should be taken into consideration in the detailed facility designs of the WWTP. A buffer zone of green trees will be built around the WWTP to control odor and to improve the landscape.

3.7.6 Organizational Capability of the Implementing and Managing Bodies

The organizational strengthening plan of the Study proposes to create new relevant units within SADCO and incremental staff required for smooth operation of the Project. Also, provision is made for manpower development through training and external technical assistance. This will ensure SADCO is equipped to implement and manage the priority project.

3.7.7 Overall Project Evaluation

The Sewerage Priority Project will meet the primary objectives of sanitation and environmental improvement for the project area as well as for the city by providing a central sewerage system. Public health will be enhanced through the reduction of water-borne diseases. Pollution load inflow into the water bodies will be decreased, resulting in the water quality improvement of the ambient waters.

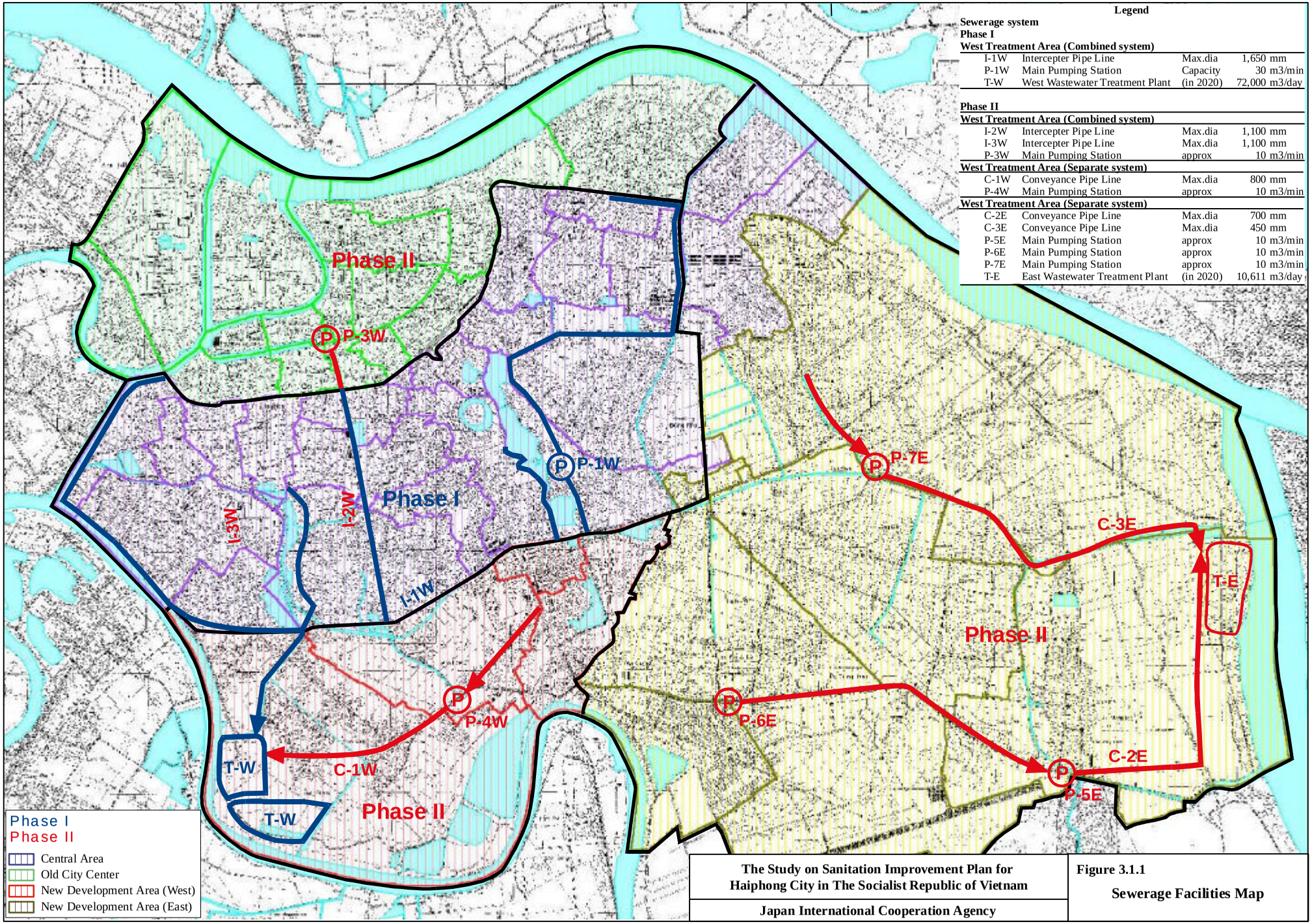
From an economic point of view, the expected contribution of the Sewerage Priority Project to future growth in GRP and property value justifies the investment cost needed to implement the project. The project cost is considered within the affordable range of the HPPC/Government in terms of the annual equivalent cost of the project assuming sinking fund with the condition of 5 % annual interest rate and 25 year repayment period. From a financial viewpoint, the assumed concessionary loan is considered repayable by HPPC/Government.

From a technical feasibility viewpoint, no difficulty is expected for construction and manufacturing of the project facilities. Assuming the recommended organizational strengthening is implemented, including the setting up of new sections for sewerage control and the waste water treatment plant as well as adequate training, operation and maintenance can effectively be carried out by SADCO.

although the expected social impact is not significant, a Resettlement Action Program should be formulated to alleviate the negative impact of resettlement and to secure the cooperation of the project affected people. Alleviation measures also should be taken to minimize the negative environmental impact, including the provision of a buffer zone around the waste water treatment plant site.

with the adoption of these measures, the Sewerage Priority Project is considered to be socially acceptable.

In conclusion, the Sewerage Priority Project is evaluated to be feasible for implementation.



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

Japan International Cooperation Agency

Figure 3.1.1

Sewerage Facilities Map

IV. FEASIBILITY STUDY ON THE SOLID WASTE MANAGEMENT PRIORITY PROJECT

4.1 Assessment of the Current Situation

4.1.1 Current Situation

Haiphong City has the following 3 companies that provide solid waste management services:

- Urban Environmental Company (URENCO) which is responsible for the 3 urban districts, i.e., Hong Bang, Le Chan, and Ngo Quen
- Kien An Urban Works Company
- Do Son Public Works Company

It is estimated that the 3 companies collect 471 tons of solid waste per day on average, i.e. 75 % of the estimated total amount generated. In terms of population, however, these 3 companies provide a waste collection service to about 85 % of the population in their respective areas.

At present, Haiphong City has two official landfill sites: one in Trang Cat commune of An Hai sub urban district, and the other in Do Son Town. The Trang Cat Landfill site receives solid waste collected by URENCO and Kien An Company, while the Do Son Landfill site receives solid waste collected by Do Son Company.

4.1.2 Major Problems

It is generally observed that the Haiphong City is kept clean and sanitary.

In addition to a normal problem of developing countries of inadequate financial resources, there are number of specific problems in Haiphong City with respect to solid waste management. These are as follows:

- Illegal dumping by citizens and weak enforcement by the City administration
- Inefficient waste collection system that adversely affects the health of workers and local residents, the sanitary condition and traffic
- Unsanitary landfill operation causing environmental pollution on surface water, and site workers' health. There is a danger of collapse of the deposited waste
- No independent system for management of hospital waste, which poses risks of infectious diseases

4.2 Waste Quantity and Quality

4.2.1 Current Waste Generation and Collection Quantity

It is estimated that the three companies' average waste collection in the service area totals 471 ton per day, i.e. 75 % of the estimated generation quantity as shown below.

Estimated Solid Waste Collection and Generation in Haiphong in 2000

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	630 ton/day	75 %

4.2.2 Projection of Future Waste Generation and Collection Targets

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

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

Year	URENCO		Kien An		Do Son		Haiphong Total	
	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 %	471	75 %
2005	597	85 %	89	85 %	75	81 %	761	85 %
2010	839	95 %	132	95 %	115	91 %	1,086	95 %
2020	1,082	95 %	183	95 %	176	95 %	1,441	95 %

The most important principle is that 100 % of non-agricultural households in Haiphong City will receive household waste collection service in the 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.

4.2.3 Current Waste Quality

The average bulk density of Haiphong waste is estimated to be 0.45. Kitchen waste and residue of briquette (charcoal) used for cooking are the two major components of Haiphong waste. Based on the current and previous studies, it is estimated that kitchen waste (garbage) shares at least 40 % on a wet basis. Plastic and paper waste share 6.1 % and 3.5 % respectively. The result of the 3 elements analysis, shows the proportions of each major element of the waste stream as follows: water content 40 %, ash content 30 %, and combustible content 30 %.

4.3 Waste Collection and Transport Plan

4.3.1 Recommended Waste Collection System

Two important criteria for improvement of waste collection and transport are:

- Sanitary and hygiene level
- Waste collection efficiency

Based on the above criteria, the following systems are recommended:

- Mechanical Lifting (Use of waste collection vehicle equipped with device that mechanically lifts up handcarts) (See Photo 1)
- Gradual application of "Direct Collection System with Use of Fixed Location Bins" (single handling system) instead of the existing handcart collection system (double handling system)

Benefits that would derive from application of the above systems are as follows:

- Increases in waste collection efficiency
- Minimization of adverse impacts by waste transfer activity on
  - Health of workers
  - Amenity for the local people
  - Environment
  - Traffic

It is estimated that the cost of the proposed direct collection system is about 70 % of that of the double handling system. The cost advantage of the proposed system will be even stronger as salaries of workers increase in future.

It is strongly recommended that URENCO implement a pilot project for the direct collection system at such places as market, large waste generators (enterprises), and apartment buildings.

4.3.2 Equipment Procurement Plan

(1) Target Waste Collection Amount

Target waste quantities to be collected by the three (3) companies in the beginning of 2005 are set as follows:

- URENCO 597 ton/day on average
- Kien An Urban Works Company 89 ton/day on average
- Do Son Public Works Company 75 ton/day on average
- Total of the 3 Companies 761 ton/day on average

Actual waste collection quantity changes every day. Equipment capacity required will be 15 % larger than the above average amounts.

(2) Types of Equipment

The following types of equipment will be procured:

- Waste collection vehicles (compactors, in principle, with capacity of 4 – 16 m^3) equipped with a mechanical lifting device
- Bins to be placed at fixed locations for direct collection (660 and 240 liter)
- Handcarts (a new type with 660 liter bin is recommended.)
- Workshop equipment used for maintenance

(3) Equipment Procured

Quantity of equipment to be procured for the 3 companies in 2004 under the priority project is estimated as follows:

- Waste collection vehicles equipped with mechanical lifter 43
- Bins including those to be used as handcarts 1,010
- Traditional handcarts 224
- Workshop equipment 3 sets

(4) Estimated Procurement Cost

The direct cost of procurement is estimated to be US$3.907 million for the 3 companies.

4.3.3 Operation and Maintenance Plan

(1) Operation Plan

The 3 companies in Haiphong have a good operation system for waste collection and transport. The Priority Project does not require any change in the vehicle operation system.

(2) Maintenance Plan

URENCO has adequate staffing for vehicle maintenance. However, maintenance equipment is not adequate in terms of quantity and quality.

It is proposed that the 3 companies, with new maintenance equipment provided under the Priority Project, will carry out preventive maintenance a on more regular basis than now.

(3) Organization Plan

The implementation of the Priority Project does not require a new organization or additional staff. On the contrary, some waste collection workers and waste loaders will be made redundant as a result of the efficiency increases that would be made possible by introduction of the proposed new waste collection systems, i.e. the direct waste collection system and mechanical loading.

Gradual application of the proposed system is recommended so as not to necessitate dismissal of the existing workers.

4.3.4 Cost Estimation

The cost of procurement is estimated to be approximately US$4.6 million including engineering cost, administration cost and physical contingency for the 3

companies. The total annual recurring cost is estimated to be approximately US$1.7 million in 2005. Useful period of the equipment provided under the Priority Project will be 10 years.

4.4 Trang Cat Phase 3 Landfill Site

4.4.1 Recommended Sanitary Landfill

The JICA Study Team recommends that Haiphong City will construct the Trang Cat Phase 3 landfill site as a priority project.

(1) Planning Policy for Trang Cat Phase 3 landfill site

The concepts of BATNEEC (Best Available Technology Not Entailing Excessive Cost) and step-wise improvement approach are applied for designing the Trang Cat Phase 3 landfill site. The site will be designed and constructed in compliance with Vietnamese laws and regulations.

(2) Location and Area

The site will be located at the southern part of an area approved by the Prime Minister. The area is very flat but not well consolidated. The total area for the Phase 3 landfill site is 32.7ha.

(3) Basic Specification of the Phase 3 site

1) Capacity and Lifetime

The phase 3 site will have two landfill sites, i.e. The major one, and for non hazardous solid waste (NHSW) whilst the other is small, for hospital waste incineration residue (HWIR). The total capacity of the NHSW site is 2.6 million ton for about 10 years from the beginning of 2005. The HWIR site has waste receiving capacity of approximately 36,600 ton, which is large enough to receive hospital waste incineration residue and treatment sludge (total sum is about 5 ton/day) for about 20 years.

2) Basic Structure

- The phase 3 site will consist of two separate landfills, one for NHSW and the other for HWIR
- There are to be five layers in the embankment to a height of 17 m in total to contain the filled wastes in the NHSW site, and one layer embankment with a height of 3 m for HWIR site
- The slope of the outside embankment is to be 1:2, and 1:1.5 for the inside. The stability factor for shape with filled waste of 17 m height will be 1.5 at least

- There exists clay of low permeability with thickness of 5 m or more on the site. This clay can serve as natural clay liner. However, Phase 3 Landfill site will be provided with artificial liner to comply with the new Joint Circular issued on 18 January 2002 concerning landfill site
- The Joint Circular requires that the loading capacity of landfill ground should be 1 km/cm^2 or more. To strengthen the ground as well as to lower the permeability of the soil in Trang Cat Phase 3 site, surcharge method will be applied. The surcharge will be carried out during the site construction. The non-hazardous solid waste site will be divided into 4 segments. After the surcharge operation in one segment is completed, soil used for the surcharge will be removed and carried to the next segment. The soil will finally be used as material for 2nd and 5th embankments
- The proposed leachate treatment facility would apply the precipitation process with lime powders and accept the leachate from both landfill sites through leachate collection pipes and pump pits. Further treatment by aeration and natural removal of nutrients by aqueous plant pond would also applied
- Vertical gas collection pipes will be installed on a 40 m × 40 m grid, at least, and a horizontal collection bed in or a 40 m spacing will also be applied
- Cover will be applied daily for the HWIR site. a step-wise improvement will be applied for cover works at the NHSW site. Soil cover will be applied once every three days for the first period, once every two days for the second period, and daily thereafter

4.4.2 Operation and Maintenance Plan

(1) Operation Plan for Strategic Filling Works

The JICA Study Team recommends that URENCO should periodically make an operation plan for filling work. The plan should describe the following items:

- Weekly filling plan with filling area map
- Plan of installation of gas collection pipes and collection beds
- Plan of construction works for section dikes and cover works
- Monitoring plan for leachate treatment, filled waste, and so on

(2) Records of Amounts of Incoming Wastes

There will be a weighbridge for measuring the weight of collection vehicles. The weight of wastes collected by URENCO should be recorded every day.

(3) Staffing and Training

The JICA Study Team recommends that staff of URENCO should receive appropriate training concerning waste filling and heavy equipment operation. It is preferable that a foreign expert would be invited for 6 – 12 months for this purpose. It is also recommended that URENCO should recruit one chemical plant engineer or a person who has sufficient skills about water treatment plant operation.

(4) Environment Monitoring

The JICA Study Team recommends that URENCO should have staff and equipment to monitor basic parameters of the leachate directly and a budget for analysis of leachate and treated water by an external organization.

4.5 Hospital Waste Management Plan

4.5.1 Proposed System of Hospital Waste Management

Hospital Waste Management is composed of the following four stages:

- In-hospital Management
- Collection and Transport
- Treatment (incineration is strongly recommended as it is effective)
- Final disposal

4.5.2 Facility Specification

Specification of the incinerator is summarized in the table below.

Major Specifications of the Incinerator

Item	Specification	Purpose or Condition
Capacity	1.5 ton/day = 187.5 kg/h	8 hours operation/day
Waste Loading Method	Batch type incinerator	with a recombustion chamber
Structure of chambers	Dual-chamber	Secondary chamber to incinerate gaseous matters to prevent dioxin generation
Secondary Chamber	Recombustion chamber	The temperature should be more than 800 °C during incineration
Supplementary burner	Necessary to heat the recombustion chamber	Fuel can be heavy oil, kerosene or gas
Thermo-sensor	Thermo-sensor in each chamber	To monitor the temperature in each chamber
Blower	Necessary	To control air supply for the recombustion chamber
Dust Collector	Cyclone type or a bag filter	To collect dust from the stack smoke

4.5.3 Operation and Maintenance

The incinerator would operate every day except for breaks for maintenance.

It will be necessary to repair the brick wall on the inside of the incinerator chamber as it wears out. Duration of shut down for maintenance will be less than 3 days a year for the first three years.

4.5.4 Procurement Schedule and Cost Estimation

the total investment cost is estimated to be US$427 thousand including that of the incinerator, US$263 thousand. Average operation/maintenance cost is estimated to be US$45,860 per year. Unit cost of the medical waste treatment will be US$242.5 including that of collection, incineration and disposal. Incinerators with housing and collection vehicles should be procured in 2004. The service life of the incinerator is assumed to be 8 years.

4.6 Cost Estimation

4.6.1 Construction and Procurement

(1) Summary

The total investment cost of the priority project for the solid waste management sector is estimated to be approximately US$15.8 million approximately, and comprises the following items.

Investment Cost of Solid Waste Management Priority Project

Cost Items	Amount (US$1,000)
a. Construction and procurement	12,343
b. Engineering service	968
c. Land acquisition	602
d. Administrative cost (3 % of a, b & c)	417
e. Contingency (10 % of sum of a, b, c & d)	1,434
f. Total (a + b + c + d)	15,764

(2) Investment Cost by Project Components

The estimated investment costs by components are shown below.

Investment Cost of Solid Waste Management Priority Project by Components

Cost Items	Amount (US$1,000)
a. Waste collection and transport equipment	4,648
b. Trang Cast Phase 3 Landfill Site	10,585
c. Hospital waste incinerator and hospital waste collection vehicles	531
e. Total (a + b + c)	15,764

(3) Costs by Type, Components, and Company

Investment costs by items and by project components are shown below

Solid Waste Management Priority Project Investment Cost (Unit: US$1,000)

	Construction & Procurement				Engineer-ing Cost	Land Acquisi-tion Cost	Total E+f+g	Administ-ration Cost	Total including Admi. Cost	Contin-gency j*10%	Grand Total including Contin-gency
	URENCO	Kien An Company	Do Son Company	Total							
a	b	d	d	e = b+c+d	f	g	h	i = h* 3%	j = h+i	k=	l = j+k
1. Waste Collection and Transport Equipment	2,886	522	499	3,907	195	0	4,102	123	4,225	423	4,648
2. Trang Cat Phase 3 Landfill	8,010	0	0	8,010	730	602	9,342	280	9,622	963	10,585
3. Hospital Waste Management Facilities	426	0	0	426	43	0	469	14	483	48	531
4. Total (1+2+3)	11,322	522	499	12,343	968	602	13,913	417	14,330	1,434	15,764

4.6.2 Operation and Maintenance Costs

It is planned that the operation of all the facilities and equipment provided under the priority project will start in the beginning of 2005. It is estimated that the total operation and maintenance cost in 2005 will be US$2.1 million.

Estimated Operation and Maintenance Costs of the Priority Project (2005)

	1,000 US$
a. Waste collection and transport including administrative employees	1,744
b. Trang Cat Phase 3 Landfill Site	356
c. Hospital waste management (collection and incineration)	47
d. Total	2,147

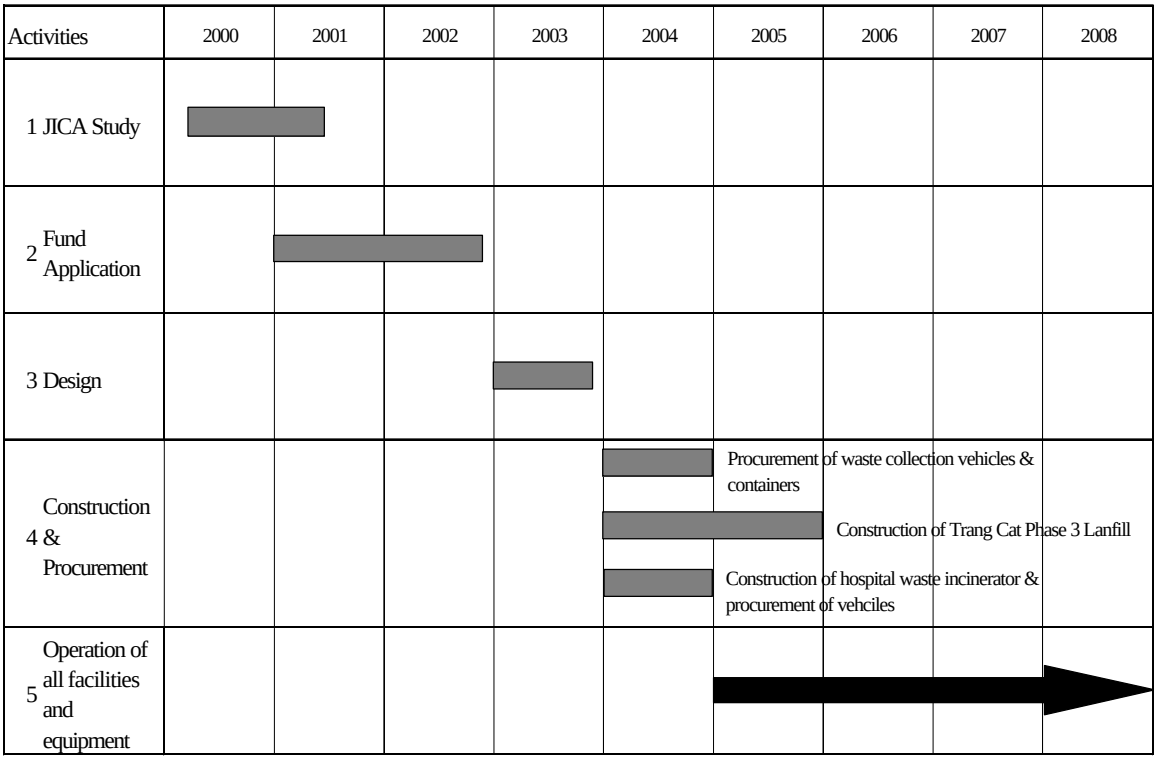
The detailed operation and maintenance costs, as well as the detailed investment costs by year and by companies, are shown in Tables 4.6.1- 4.6.4.

4.7 Implementation Schedule

4.7.1 Implementation Schedule

The implementation schedule of the priority project for solid waste management is proposed as follows:

Proposed Schedule for Implementation of the Priority Project for Improvement of Solid Waste Management



4.7.2 Financing Plan

The following funding plan is proposed. The amounts below include price contingency:

- 85 % (approximately US$14.6 million) of the total project investment cost (US$17.1 million) would be financed by either multilateral or bilateral ODA (loan) of which the major conditions would be as follows:
  - Repayment period is 30 years including 10 years grace period
  - Interest rate is 1.3 %/year for construction and procurement, and 0.75 % for the engineering service
  - Loan agreement will be made in 2002
- The remaining 15 % (approximately US$2.5 million) of the total project cost would be financed by HPPC's own fund
- All the recurring costs will be paid by the 3 solid waste management companies (A quarter of which is currently covered by fee revenue.)

4.7.3 Project Implementation Organization Plan

Key organizations and major tasks for each stage are as follows:

Key Organizations and Major Tasks for the Project Implementation

Stages	Key Organizations	Major Task
1st Stage from now till acquisition of ODA fund	Department of Planning and Investment DPI), TUPWS and other relevant departments of HPPC	1. To obtain the prime minister's approval for the feasibility study, and 2. Acquisition of an ODA fund (loan)
2nd Stage during the construction and procurement including tendering	Project Management Unit (PMU) to be formulated under the leadership of TUPWS PMU members will include representatives from relevant departments and the URENCO	1. Detailed project preparation, 2. Tendering and selection of consultants and contractors, 3. Land acquisition, and 4. Administration and supervision of the whole process.
3rd Stage for operation	URENCO, Kien An Company and Do Son Company	Operation of the proposed waste management system using the facilities and equipment provided through the project

4.8 Project Evaluation

We have evaluated the Priority Project for Improvement of Solid Waste Management in terms of the following aspects:

- Objective achievement
- Economic evaluation
- Financial evaluation
- Technical evaluation
- Environmental Impact Assessment
- Organizational capability of the implementing and managing bodies

4.8.1 Objective Achievement

The objective of the solid waste management priority project is the improvement of urban sanitation and public health of Haiphong city.

Achievement of the above objective will be very much facilitated by implementation of the Priority Project which will establish the following systems:

- Sanitary and cost effective waste collection and transport system
- Sanitary and cost effective waste disposal system at Trang Cat Phase 3 Landfill Site
- Sanitary and cost effective hospital waste management system

Sanitary Indicator and Situation Before and After the Priority Project

Indicators/Aspects	Before the Project (2000)	After the Project (2005)
1.1Population served with waste collection service	409,000 persons (100 %)	608,000 persons (149 %)
2.Average waste collection amount	471 ton/day (100 %)	761 ton/day (162 %)
3. Collection service ratio in terms of population	85 %	94 %
4. Collection ratio (collection amount/generation amount)	75 %	85 %
5. Landfill system	Open dumping	Sanitary landfill with cover soil and leachate treatment
6. Environmental impact by landfill	Surface water is polluted Danger of fires and health hazard at the landfill site	Leachate treatment will prevent water pollution Cover soil will eliminate fires, dusts, and breeding of rodents
7. Hospital waste management	No separation in hospitals, No treatment, risk of spreading infections disease	Will be separated at hospitals Infectious waste will be completely disinfected by incineration

4.8.2 Economic Evaluation

There are no approaches for quantification of the benefits to be brought about by improvement of solid waste management, which are generally accepted and used. So we apply the least cost solution for economic evaluation.

(1) Waste Collection and Transport System

The proposed single handling system is more efficient and economical than the existing double handling system with handcarts. Unit cost will be reduced to roughly 70 % by changing the existing system with the proposed new system.

(2) Treatment and Disposal System

The proposed sanitary landfill has the least cost among options that are environmentally sound. Unit cost of the proposed landfill is about US$2/ton. Incineration option is at least US$58/ton. Composting is not feasible due to insufficient demand.

(3) Hospital Waste Management System

The proposed incineration system has the least cost. Autoclave is another option but is much more costly than the incineration. Chemical treatmentmay be cheaper than incineration. However, it has the serious disadvantage that disinfection cannot be guaranteed after treatment.

4.8.3 Financial Evaluation

We have examined the financial affordability of the project for the beneficiaries. Instead of using the cost of the Priority Project, we have used the whole master plan program cost that includes the Priority Project cost. We have compared the program cost to key indicators including the disposal income and GRP of the beneficiary area. In 2010, for example, the program cost corresponds to 0.46 % of the GRP and 0.92 % of disposal income. From these percentages, we judge that the whole master plan program that includes the Priority Project is affordable for the beneficiaries. In 2010, the program cost is 4.0 % of the projected HPPC's total expenditure, which is also affordable for HPPC.

4.8.4 Technical Evaluation

In the system planning and selection of equipment, the following technical and other aspects were considered:

- Whether or not the system would be locally manageable and operational
- Whether or not spare parts and materials, including cover soil, are or can be locally available
- Whether or not the proposed system has been implemented and proven to be successful by some other cities in Vietnam and Asian countries
- Whether or not the proposed systems satisfy the relevant Vietnamese laws and regulations with respect to environmental pollution control
- Whether or not the proposed facilities can be constructed with local technology

The proposed systems are judged to be technically feasible provided that URENCO will arrange the necessary training and hire new staff as recommended by the Study Team.

4.8.5 Environmental Impact Assessment

The proposed project is expected to bring large overall positive environmental impacts, which include: i) reduction of uncollected solid waste in the city, ii) improvement of health condition, iii) environmentally-sound disposal of collected waste, and iv) safe management and disposal of medical waste.

The adverse environmental impacts of Trang Cat Landfill Phase 3 will be reasonably small and localized as explained below.

(1) Landscape Change

The project site is already degraded as it has been already used as a waste dumping site. In future upon closure of the site, the site will be properly covered and rehabilitated by tree.

(2) Noise and Other Nuisance along the Access Road

The proposed collection system will minimize these nuisances with efficient and sanitary system.

(3) Odor and Air Pollution from Landfill

Odor, fires, smoke, dusts, and rodents will be prevented by weekly application of cover soil.

(4) Pollution of Cam River

This pollution will be minimized by the leachate collection and treatment system.

(5) Pollution of Groundwater

The confined upper aquifer under the proposed Trang Cat Landfill Phase 3 site is hydro-geologically isolated from the landfill by a thick (30-50 m) clay strata.

4.8.6 Organizational Capability of the Project Implementation and Administration Bodies

Considering the fact that HPPC, URENCO and the other two service providing companies have many years of experience in the improvement of solid waste management, we conclude that HPPC and the existing 3 companies of solid waste management have certain level of organizational and managerial capacity.

In order to prepare, implement and manage the Project, HPPC needs to make the following arrangements:

- Creation/strengthening of a Project Management Unit to arrange and manage the Priority Project
- Creation of hospital waste management unit within URENCO
- Training of engineers and technicians responsible for landfill operation; in particular training concerning waste filling method and soil cover arrangement. For this purpose, it is advisable that HPPC would invite a foreign engineer for 6 – 12 months. It is advisable that URENCO will recruit one engineer of water treatment

The Priority Project is considered to be feasible with respect to the organizational and managerial capacity of HPPC and the 3 solid waste management companies, provided that they make the necessary organizational arrangements shown above.

4.8.7 Conclusion

Based on the evaluation of the Priority Project from various aspects as shown above, we judge that the Priority Project is feasible if implemented and operated in the manners planned and recommended.

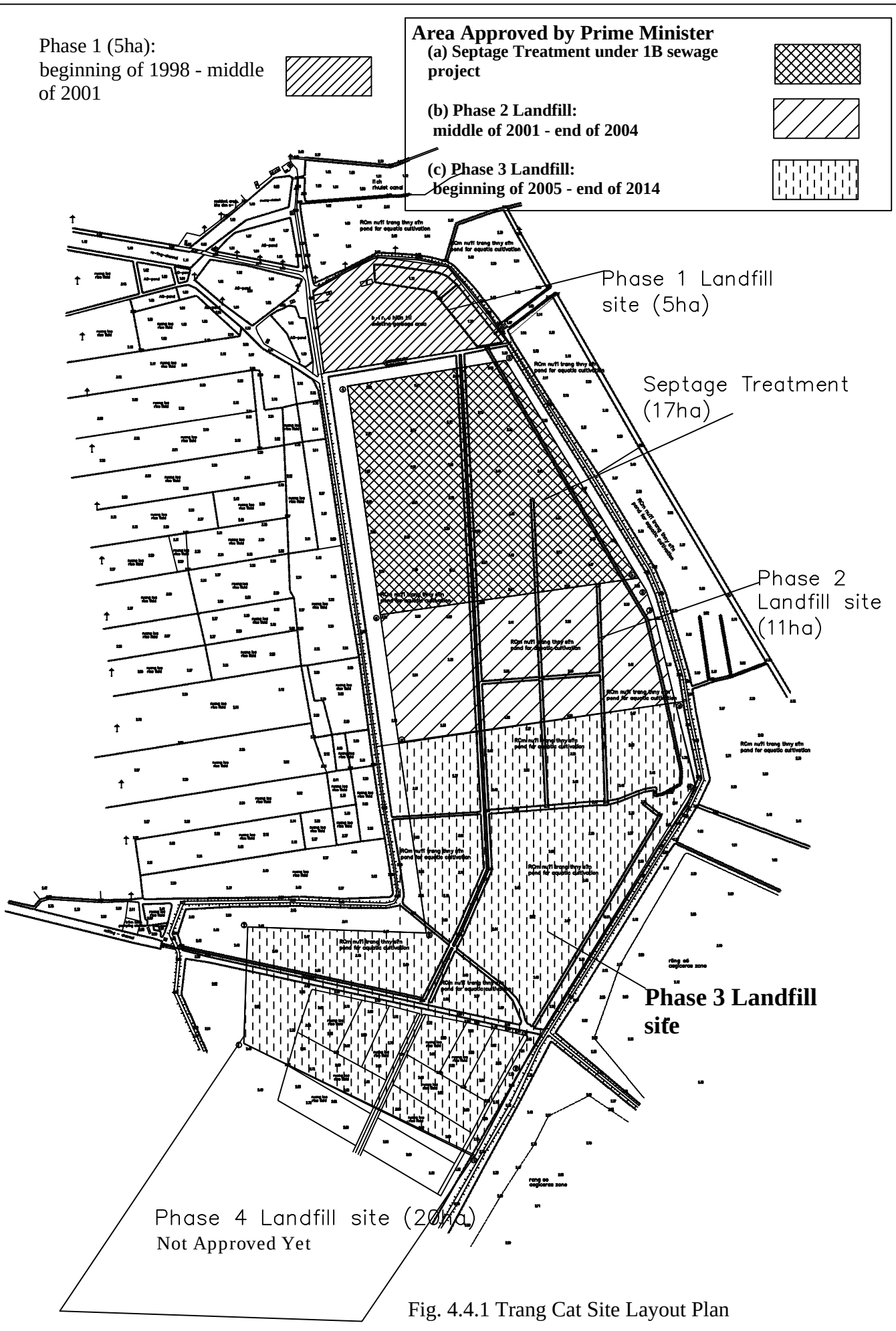


Fig. 4.4.1 Trang Cat Site Layout Plan

V. OVERALL FEASIBILITY OF THE PRIORITY PROJECTS

5.1 Economic Feasibility

This chapter evaluates the drainage and sewage projects taken together by assessing the switching values obtained by aggregating those of the drainage project and sewerage project.

Costs of Drainage and Sewage Projects as Percentage of Property Values and Productivity in the Project Area, and Sensitivity to Cost Estimates

Unit: Percentage

	Base Case	Costs + 10 %	Costs + 20 %
Project Cost Ratio to Property value – under No Growth case	9.4	10.3	11.3
Project Cost Ratio to Property value - under Average Growth case	4.5	4.9	5.4
Project Cost Ratio to Project Area GRP value – under No Growth case	6.3	6.9	7.6
Project Cost Ratio to Project Area GRP value – under Average Growth case	2.7	3.0	3.2

The above table indicates that the property values, on base case, would have to increase by 4.5 % to economically justify the project, i.e. to realize the situation where the project benefit exceeds the project cost. The table also shows that the Project Area GRP would have to increase by 2.7 % to demonstrate economic justification. In terms of these percentage increases required, the two Priority Projects taken together seem to be economically feasible.

The corresponding percentages get higher under the no growth case with 10 % or 20% project cost increases. However, considering that 1) no growth scenario is unlikely to happen, and 2) the estimated Priority Project costs already include 10 % physical contingency, the scenario of no growth with 20 % cost increase is unlikely.

5.2 Financial Evaluation and Affordability

Similar to the other priority projects and package, program cost for the two sectors are used for affordability analysis.

In terms of their GRP and disposal income in the Study Area as well as HPPC's expenditure, the following table suggests that the combined program of drainage and sewage is likely to be affordable for Haiphong City residents, direct beneficiaries and HPPC under the base case scenario.

In 2010, ratios of the combined project cost (amortized investment cost + operation/maintenance cost) are 1.5 % of the Study Area GRP, 3 % of the Study Area disposal income, 11.3 % of HPPC expenditure. The corresponding percentages in 2020 are 2.5 %, 5 % and 18.7 % respectively.

Table: Affordability of the Drainage and Sewerage Program 2001-20
Costs as Percentage of Key Indicators (Value in 2000 Price)

Year	Cumula-tive Amortized Capital costs	Operation and Mainte-nance cost	Total Cost	Total cost as % of Study Area GRP	Total Cost as % of Haiphong	Total cost as % of HPPC	Total cost as % of Study Area Disposal Income	Annual per Capita cost in Haiphong
	($US'000)	($US'000)	($US'000)	(%)	(%)	(%)	(%)	($)
2001	11	208	219	0.05	0.03	0.34	0.10	0.13
2002	1,063	208	1,271	0.27	0.17	1.87	0.54	0.73
2003	2,448	208	2,656	0.53	0.33	3.66	1.06	1.51
2004	4,525	299	4,824	0.90	0.56	6.25	1.79	2.71
2005	6,300	308	6,608	1.15	0.73	8.08	2.30	3.68
2006	8,229	318	8,547	1.31	0.85	9.40	2.62	4.70
2007	10,003	637	10,640	1.46	0.96	10.62	2.92	5.78
2008	11,492	772	12,264	1.52	1.01	11.21	3.04	6.58
2009	12,772	909	13,681	1.54	1.04	11.54	3.09	7.25
2010	**13,545**	**923**	**14,468**	**1.50**	**1.02**	**11.32**	**3.00**	**7.58**
2011	16,293	966	17,259	1.68	1.14	12.71	3.37	8.94
2012	19,653	1,062	20,715	1.91	1.30	14.40	3.82	10.61
2013	22,863	1,350	24,213	2.11	1.44	15.94	4.23	12.27
2014	24,856	1,636	26,492	2.20	1.49	16.56	4.40	13.28
2015	26,848	1,712	28,560	2.26	1.53	17.00	4.51	14.17
2016	28,841	1,790	30,631	2.31	1.57	17.40	4.62	15.04
2017	30,834	1,868	32,702	2.36	1.60	17.76	4.72	15.89
2018	32,827	1,944	34,771	2.40	1.63	18.09	4.81	16.73
2019	34,820	2,021	36,841	2.44	1.66	18.40	4.89	17.55
2020	36,812	2,097	38,909	2.48	1.68	18.68	4.96	18.35

5.3 Aggregate Project Cost

Cost of the individual priority projects and aggregate cost of the three projects combined together are shown in the table below. Total cost of the three priority projects is estimated to be US$160.5 million in 2000 price.

Drainage, Sewerage and Solid Waste Project Costs 2003-2023

(Cash Costs) in 2000 prices

Year	Drainage (US$'000)	Sewerage (US$'000)	Solid Waste (US$'000)	Total (US$'000)
2003	2,734	1,970	1,405	6,109
2004	6,408	7,157	10,621	24,185
2005	7,156	13,197	5,885	26,238
2006	7,722	13,197	2,185	23,104
2007	8,296	10,741	2,213	21,251
2008	10,299	7,975	2,239	20,513
2009	6,502	8,092	2,263	16,857
2010	21	4,595	2,291	6,908
2011	23	426	2,304	2,753
2012	25	426	2,319	2,770
2013	26	426	2,285	2,738
2014	30	426	2,298	2,754
2015	33	426	0	459
2016	38	426	0	464
2017	43	426	0	469
2018	49	426	0	475
2019	54	426	0	480
2020	59	426	0	485
2021	64	426	0	490
2022	69	426	0	495
2023	74	426	0	500

5.4 Financial Affordability

Financial affordability of the package of the three Priority Projects is evaluated using the 3 sectors program costs that include the priority projects costs. The affordability is assessed in terms of ratio of the project costs to key indicators including the Study Area GRP, Haiphong GRP, HPPC expenditures, and Study Area disposal income. Similar to the other priority projects and package, program cost for the three sectors are used for affordability analysis.

The table below suggests that the program consisting of the three sub-sectors, drainage, sewerage and solid waste, is likely to be affordable for Haiphong City residents and direct beneficiaries in terms of their GRP under the base case scenario.

Affordability of the Drainage, Sewage and Solid Waste Program 2010 – 2020 Costs as Percentage of Key Indicators (Value in 2000 Price)

Year	Cumulative Amortized Capital Cost (US'000)	O and M Cost ($US'000)	Total Cost (US 1,000)	Total Cost as % of Study Area GRP (%)	Total Cost as % of Haiphong GRP (%)	Total Cost as % of HPPC Exp. (%)	Total Cost as % of Study Area Disposal Income (%)	Annual per Capita Cost in Haiphong (US$)
2001	25	1,414	1,439	0.33%	0.20%	2.27%	0.67%	0.84
2002	1,122	1,511	2,633	0.56%	0.35%	3.87%	1.13%	1.52
2003	2,700	1,732	4,432	0.88%	0.55%	6.10%	1.76%	2.52
2004	5,666	1,937	7,603	1.41%	0.89%	9.85%	2.82%	4.28
2005	7,765	2,535	10,300	1.79%	1.13%	12.60%	3.59%	5.73
2006	9,768	2,795	12,563	1.93%	1.24%	13.81%	3.85%	6.90
2007	11,620	3,319	14,939	2.05%	1.34%	14.91%	4.09%	8.11
2008	13,162	3,655	16,817	2.08%	1.39%	15.38%	4.16%	9.02
2009	14,543	3,993	18,536	2.09%	1.41%	15.63%	4.18%	9.82
2010	**15,387**	**4,193**	**19,580**	**2.03%**	**1.38%**	**15.32%**	**4.06%**	**10.26**
2011	18,225	4,378	22,603	2.21%	1.50%	16.64%	4.41%	11.71
2012	21,666	4,612	26,278	2.42%	1.65%	18.26%	4.85%	13.46
2013	25,217	5,022	30,239	2.64%	1.79%	19.90%	5.28%	15.33
2014	27,771	5,442	33,213	2.76%	1.87%	20.76%	5.51%	16.65
2015	29,882	5,705	35,587	2.81%	1.91%	21.18%	5.62%	17.66
2016	32,042	6,024	38,066	2.87%	1.95%	21.62%	5.74%	18.69
2017	34,139	6,369	40,508	2.92%	1.98%	22.00%	5.84%	19.69
2018	36,245	6,723	42,968	2.97%	2.01%	22.36%	5.94%	20.67
2019	38,441	7,097	45,538	3.02%	2.05%	22.74%	6.04%	21.69
2020	40,546	7,429	47,975	3.06%	2.07%	23.03%	6.12%	22.62

However, affordability will be greatly dependent upon the rate of economic growth. While in 2010 the program appears to be affordable in terms of GRP, it will increasingly put pressure upon the HPPC budget, accounting for about 15 % of HPPC expenditures by 2010. and 23 % by 2020.

Also, prospects for full cost recovery from direct beneficiaries through user charges will also be hampered unless general economic reforms, including increasing the proportion of disposable incomes to GRP, are carried out.

Under the most conservative assumptions (economic growth rate being halved, and 20 % cost increase), in 2010 the costs of the total program would be about 7.2 % of disposable incomes.

Thus while individual sub-sector programs (drainage, sewerage, and solid waste) all appear to meet affordability criteria in isolation, they may not do so under an undesirable situation (lower economic growth and rising of the project cost) if they are combined together.

The financial viability of the package depends heavily upon economic growth; if it does materialize as predicted, the package is viable, but if it does not, the project would have to be modified or phased over a longer period.

It is therefore imperative to continue to monitor macroeconomic parameters closely and to adjust the sanitation program accordingly if required.

5.5 Funding Requirements and Financing Plan

A funding plan was prepared assuming the following conditions:

- 85 % of the total project investment cost will be financed by a soft ODA loan
- HPPC will be the borrower
- The remaining 15 % and all recurring costs will be borne by HPPC
- Conditions of the loans are as follows
    - For the engineering services, a very soft loan with a 0.75 % interest with loan repayment period of 40 years, of which the first 10 years is a grace period during which only interest will be paid
    - For the procurement and construction, a soft loan with a 1.3 % interest with loan repayment period of 30 years, of which the first 10 years is a grace period during which only interest will be paid

Main Report Volume 2 Table 5.2.3 shows an annual cash requirement based on the above conditions. The table shows that during 2003 – 2007, required annual cash amounts correspond 5 – 7 % of annual HPPC's expenditures with the peak being 7.2 % in 2004. the percentages drop to 2.7 % - 4.7 % during 2008 – 2012. In 2013, the year when the repayment of loan starts, the corresponding percentage will be 5.7 %. Thereafter, the percentages will decrease. The table indicates that securing of the local fund (15% of the project investment cost) is a crucial to materialize the financial plan shown in the table. If HPPC secure this fund, the implementation of the Priority Project will be financially feasible.