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No. 42

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

BUDAPEST CAPITAL CITY GOVERNMENT

THE REPUBLIC OF HUNGARY

THE STUDY

ON

THE MUNICIPAL SOLID WASTE MANAGEMENT

IN

BUDAPEST

FINAL REPORT

EXECUTIVE SUMMARY

SEPTEMBER 1993

ENVIRONMENTAL TECHNOLOGIC CONSULTANT CO., LTD.
(ETC)

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In this report, project cost is estimated at March 1993 price and at an exchange rate of 1US$=84Ft=¥120.

PREFACE

In response to a request from the Government of the Republic of Hungary, the Government of Japan decided to conduct a master plan and feasibility study on the Municipal Solid Waste Management in Budapest and entrusted the study to the Japan International Cooperation Agency (JICA).

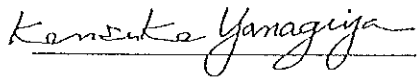
JICA sent to Hungary a study team headed by Mr.Katsuhiro Kawamura, Environmental Technologic Consultant Co., Ltd, four times between April 1992 and July 1993.

The team held discussions with the officials concerned of the Government of Hungary, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Hungary for their close cooperation extended to the team.

September 1993



Kensuke Yanagiya
President
Japan International Cooperation Agency

September 1993

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Yanagiya,

Letter of Transmittal

We are pleased to submit to you the study report on the Municipal Solid Waste Management in Budapest in the Republic of Hungary. This study contains the master plan until 2005 and the feasibility study on the first priority project.

The master plan proposes the construction of the transfer station, operation of the existing incineration plant, construction of the new incineration plant, operation of final disposal sites and purchasing of collection vehicles, and the feasibility study was conducted for the first priority project which consists of the construction of the new incineration plant.

Throughout the study, we have taken into full consideration the present situation in Budapest, and have concluded that the proposed first priority project is feasible. We recommended to the Municipality of Budapest Capital City that the first priority project should be implemented provided economic and financial status would exceed the assumption made in this study.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Ministry of Health and Welfare and Members of the Advisory Committee. We also wish to express our deep gratitude to the Ministry for Environment and Regional Policy, the Municipality of Budapest Capital City, and the Embassy of Japan in the Republic of Hungary.

At last, we hope that this report will be effectively used for the implementation of the project.

Respectfully,

川村勝弘

Katsuhiro Kawamura
Team Leader
The Study on the Municipal Solid Waste Management in Budapest
in the Republic of Hungary

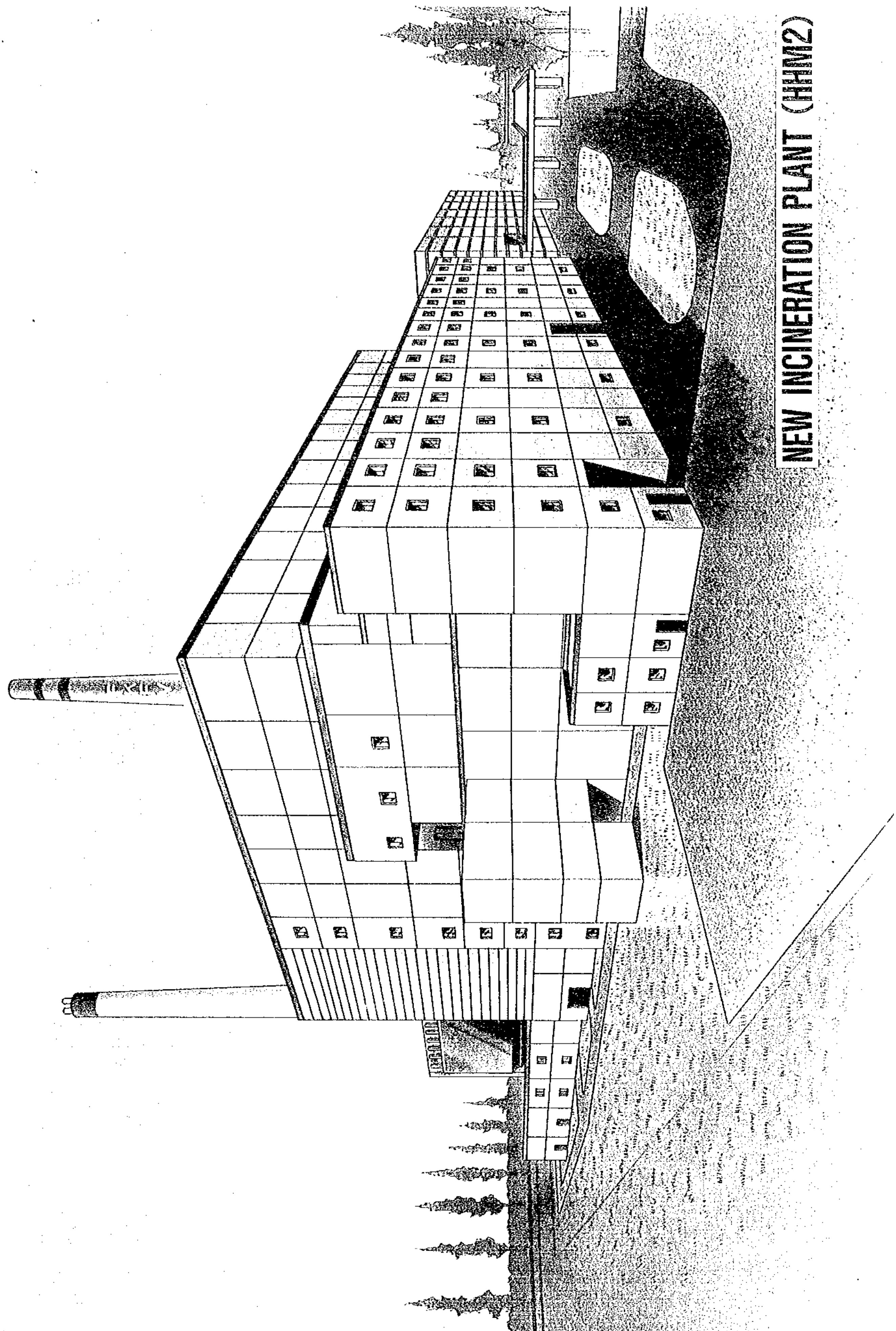


Plate 1 : Image of New Incineration Plant (HHM2)

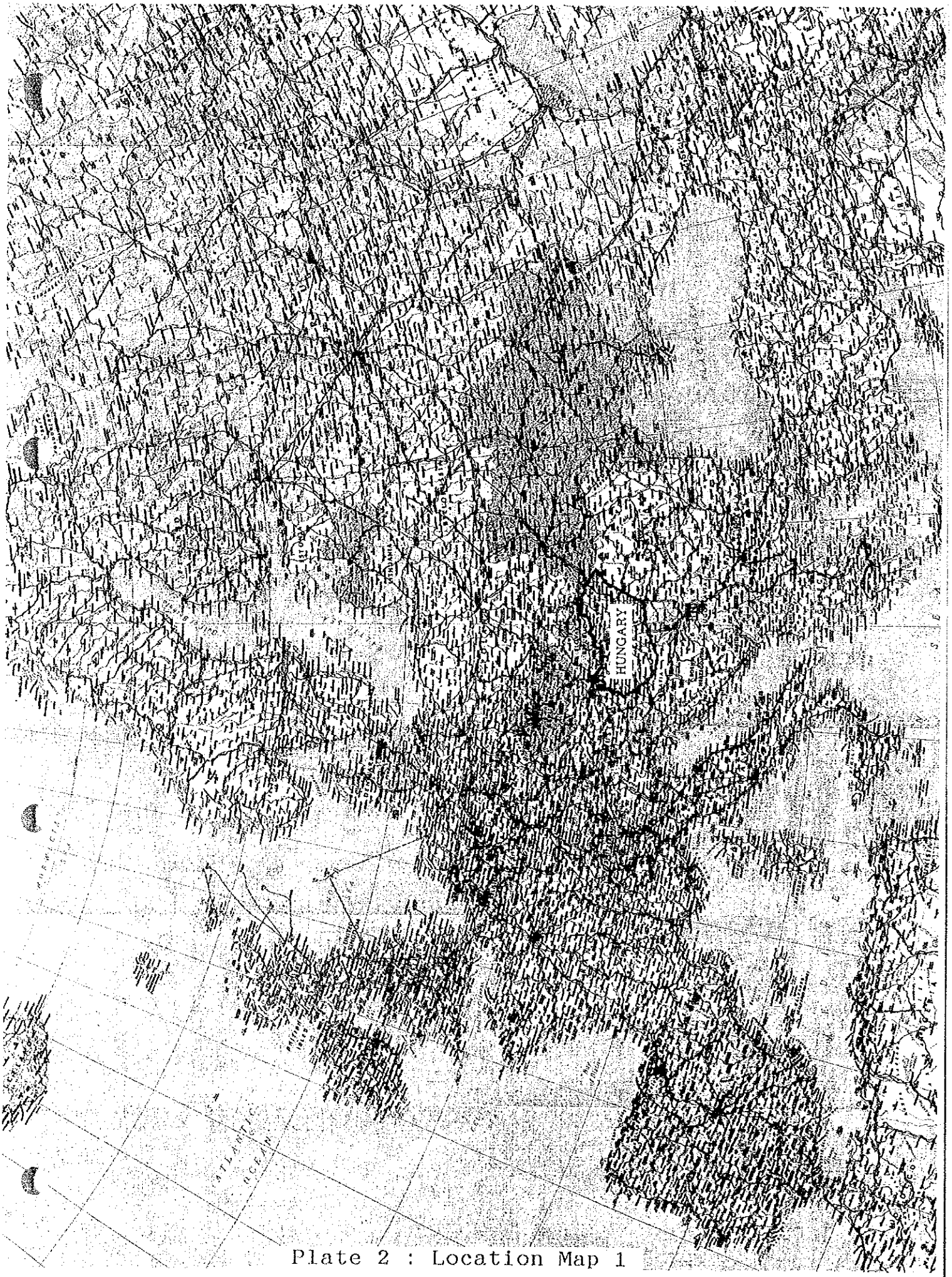


Plate 2 : Location Map 1

THE REPUBLIC OF HUNGARY

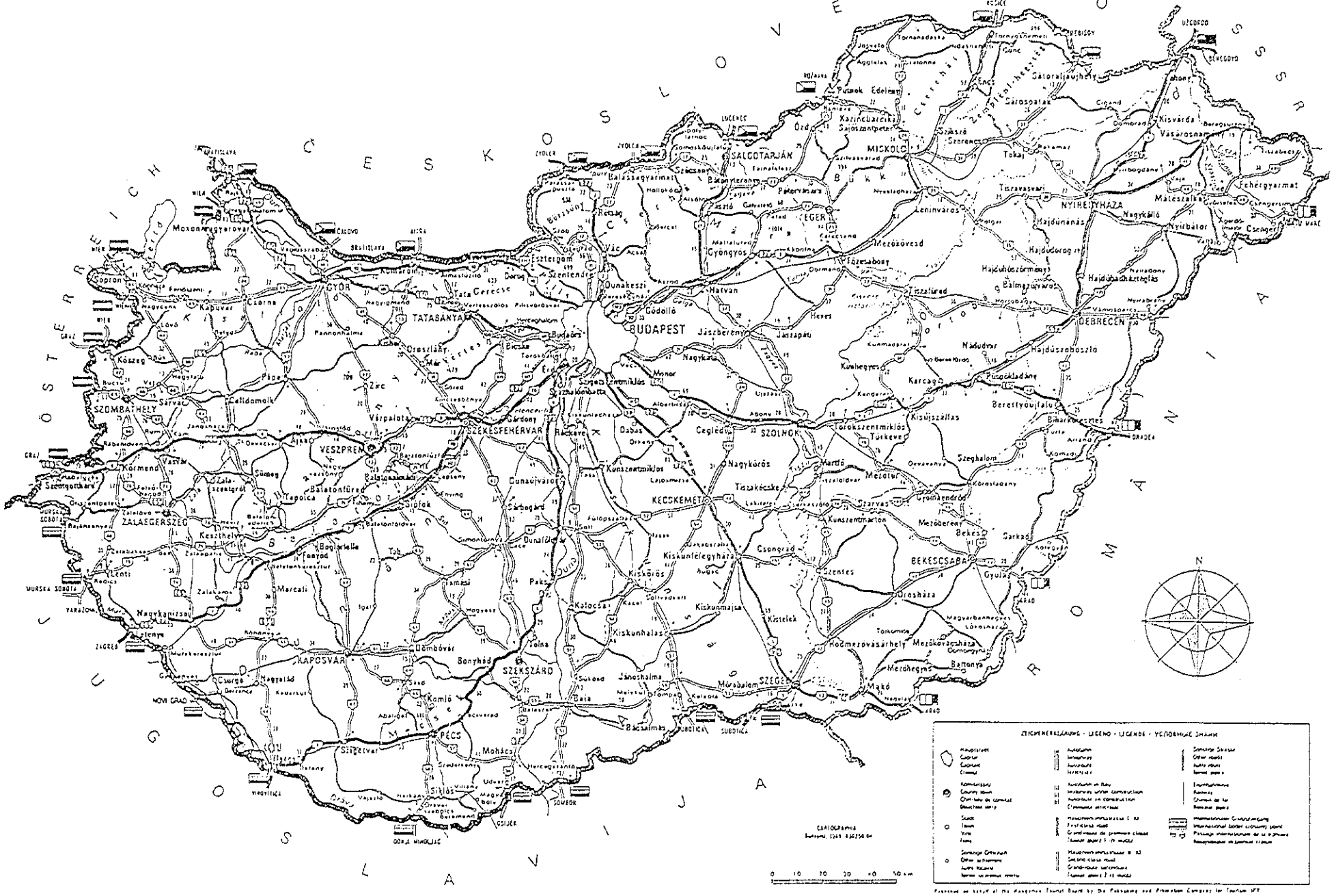


Plate 3 : Location Map 2

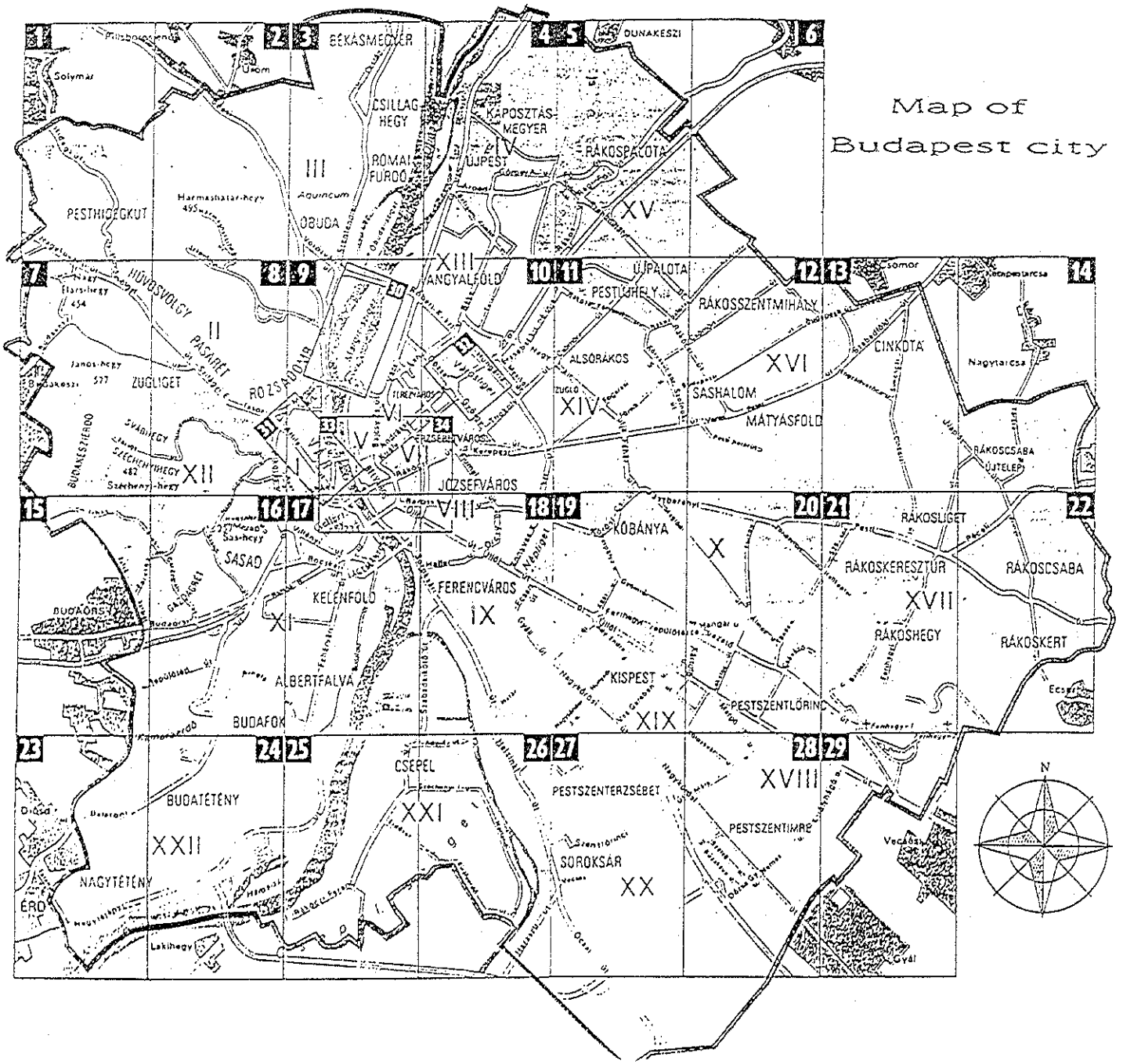


Plate 4 : Map of Budapest City

The Study on the Municipal Solid Waste Management in Budapest in the Republic of Hungary

Outlines of the Plan (Specifications)

(1) Planning Target Year

- Master Plan (M/P) : 2005
- Feasibility Study (F/S) : 1999

(2) Outlines of the Master Plan (M/P)

1) Generation volume of the Municipal Solid Waste (MSW)

Unit: 1,000 m^3

Year	1990	1991	1992	1993	1994	1995	1996	1997
Generation volume	4,423	4,246	4,323	4,323	4,323	4,409	4,498	4,588

Year	1998	1999	2000	2001	2002	2003	2004	2005
Generation volume	4,679	4,773	4,808	4,966	5,065	5,166	5,270	5,375

2) Lower heating values (H_L) of the MSW

H_L (Max.) = 10,000 KJ/kg
H_L (Med.) = 8,000 KJ/kg
H_L (Min.) = 5,000 KJ/kg

3) Composition of the M/P

The M/P consists of;

- Construction of a transfer station (T/S),
- Operation of the existing incineration plant (HHM1),
- Construction of a new incineration plant (HHM2),

- Operation of final disposal sites, and
- Purchase of collection vehicles.

4) Major specifications of the M/P

i) Transfer station (T/S)

- MSW quantity to be handled	: 770 t/day
- Location	: Akna site (District-X)
- Major facilities	: 2 lines of compactors, hoppers, container moving facility, containers, container trailer trucks, truck scale, civil engineering works and processing building facilities, wastewater treatment system

ii) Existing incineration plant (HHM1)

- Incineration capacity	: 1,200 t/day (24 hour/day operation)
- Number of furnaces	: 300 t/day x 4
- Location	: District-XV

iii) New incineration plant (HHM2)

- Incineration capacity	: 960 t/day (24 hour/day operation)
- Number of furnaces	: 480 t/day x 2
- Location	: District-XV (at the same site with HHM1, required area: approx. 2.2 ha)

iv) Final disposal sites

- Number of the operating final disposal sites : 4 (Akna District-X, Micsurin District-XVII, Peteri major District-XX, Dunakeszi outside Budapest city)
  The total landfill capacity Approx. 3.2 Million m^3 (1992)
- Number of obtaining plan of the new final disposal sites : 1 (Akna, Addition, 1993)
  Landfill capacity 0.7 Million m^3
  1 (Bajna, New, Outside Budapest city, 1994)
  Landfill capacity 9 Million m^3
  1 (Candidate Undecided, 2000)
  Landfill capacity 4.8 Million m^3
  1 (Candidate Undecided, 2003)
  Landfill capacity 2 Million m^3

v) Purchase of collection vehicles

Purchasing Plan for Collection Vehicles

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Truck*1	15	7	4	2	2	2	-	-	-	-	-	-	2
Container Truck*2							2						

Note: *1: For 12 m^3 (min.)
*2: For 24 m^3 (18 ton) container

5) Investment cost for the M/P

Unit: Thousand US$

- Local currency portion	185,776 (63.9%)
- Foreign currency portion	105,067 (36.1%)
Total	290,843 (100%)

Note: Fixed price basis in 1993 including Import Duty and VAT, but excluding Interest During Construction (IDC).

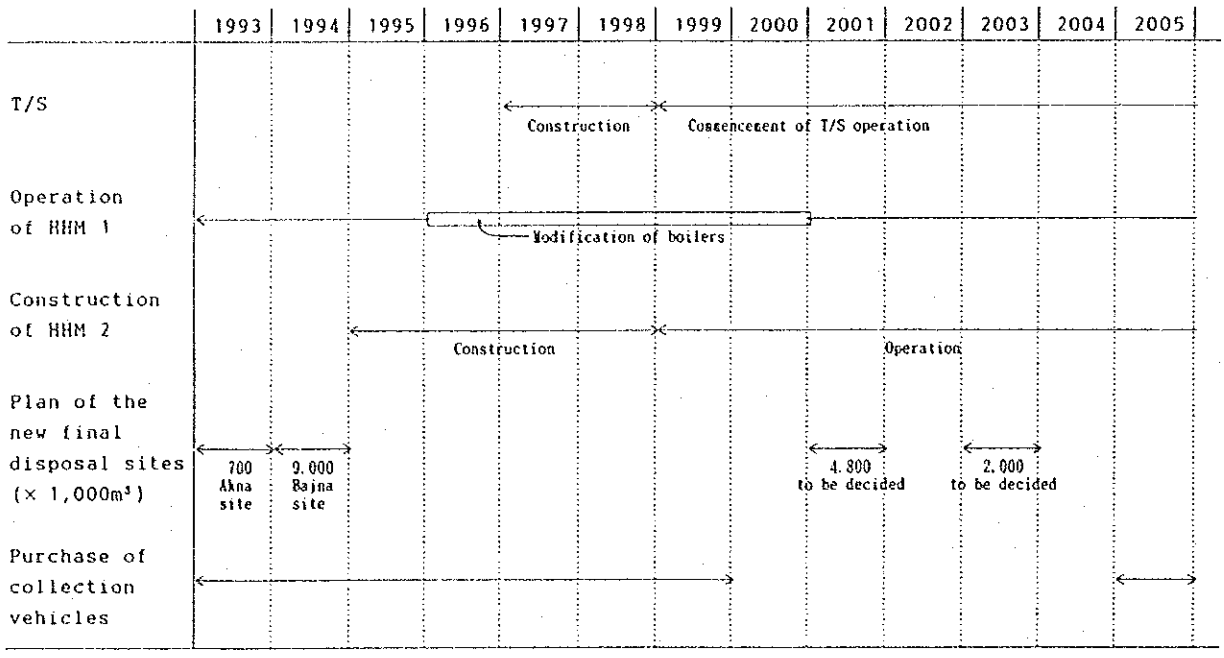
Breakdown: Investment Cost for the M/P (Fixed price basis in 1993)

Unit: Thousand US$

	Local	Foreign	Total
Transfer Station	4,311	-	4,311
Incineration Plant	152,696	105,067	257,763
Final Disposal Sites	24,233	-	24,233
Collection Vehicles	4,536	-	4,536
Investment Cost	185,776	105,067	290,843

Note: The above investment cost includes Import Duty and VAT, but excludes Interest During Construction (IDC).

6) Implementation schedule of the M/P



7) Economic and financial affordability of the M/P

- The present revenue structure can cover the operation/maintenance cost, but cannot cover the investment cost.

- Year-end cash balances for the M/P show deficits for every year. Therefore, the present revenue structure should be improved by applying burden share principles.

8) Environmental affordability of the M/P

- T/S will be constructed at the backfilled land of the existing final disposal site (Akna site).
  T/S will be free from environmental issues since a wastewater treatment will be provided and facilities will be installed within buildings.

- The national emission and immission limit values can be satisfied for HHM1 if a new flue gas treatment system is installed properly. However, this issue is not included in the Scope of Work (S/W) of this Study.

- HHM2 will satisfy the national emission and immission limit values from the initial stage of operation, if necessary countermeasures (semi-dry type flue gas treatment system with bag filter, 80 m stack) defined by the Environmental Evaluation (EE) are applied. However, the night time noise levels at two points on the site boundaries will not satisfy the noise limit value due to the facility location being close to the boundaries. Therefore, mitigation measures applying sound proof construction, sound insulation materials, sound insulating wall, etc. should be examined during the basic and detailed design phase.

- For the new final disposal sites environmental issues such as ground water contamination and odor will be minimized by adoption of a sanitary landfill method.

- Environmental impact of traffic will be minimized in cooperation with the functional effects of T/S.

9) Conclusions

- As the result of system alternative evaluation the M/P consists of (i) operation of HHM1, (ii) construction of HHM2, (iii) operation of the final disposal sites, (iv) construction of T/S and (v) purchase of collection vehicles.

  Taking into account of the economic and social factors for the project as well as political backgrounds in connection with the decision of the Budapest City General Assembly, which agreed with the necessity of HHM2, and the difficulty of securing final disposal sites, the Alternative-2 was selected as the M/P.

- The construction of HHM2 (960 t/day, at the same site with HHM1) was identified as the first priority project for the feasibility study which was selected in the M/P.

10) Recommendations

- It is recommended that the public be informed about the main issues of the present MSW management and the aims of the project for their participation and enlightenment.

- It is recommended to obtain the general consensus of the Budapest citizens (City Council) and the central government to implement the project and finance it.

- It is recommended that a part of the MSW management cost as collection fee shall be borne by the Budapest citizens as the MSW generators, basing upon burden share principles (government, municipality and citizen).

(3) Outlines of the Feasibility Study (F/S)

1) Planning scale of HHM2

- Incineration capacity : 960 t/day (24 hour/day operation)

- Number of furnaces : 480 t/day x 2

- Location : District-XV (at the same site with HHM1, required area approx. 2.2ha)

2) Major facilities of the F/S

- Equipment : MSW receiving and feeding facilities
  Combustion facilities
  Drafting facilities
  Boiler facilities
  Flue gas treatment facilities
  Ash discharging facilities
  Turbine and power generation facilities
  Electric and instrumentation system
  Utility facilities (instrument air unit, emergency diesel generator, etc.)
  Workshop equipment
  Laboratory equipment

- Civil and Building Facilities: Processing building
  MSW receiving/storage building
  Administration building
  Stack (height: 80 m)
  Roads and ramp way

3) Capital requirements for the F/S (HHM2 construction)

Unit: Thousand US$

- Local currency portion	155,375 (57.3%)
- Foreign currency portion	115,718 (42.7%)
Total	271,093 (100%)

Note: Fixed price basis in 1993 including Import Duty and VAT as well as Interest During Construction (IDC).

Financial plan (preconditions for calculation)

. 40% of the capital requirements: by either the Budapest Capital City Government or the central government as a grant.
  The balance (60%) of the capital requirements: by the foreign long term loan (conditions; interest rate: 5%, repayment: 18 years after 7 years grace periods)

. In the case of cash shortage, short term loan should be obtained from local capital market or supplemented by the Budapest Capital City Government.

Breakdown: Estimated Capital Requirements for the "With" Case (Fixed price basis in 1993)

For HHM2 Unit: 1,000 US$

Items	Local	Foreign	Total
A. Land & demolition	357	-	357
B. Civil work	12,023	-	12,023
C. Building construction	22,262	-	22,262
D. External facilities	5,595	-	5,595
E. Equipment & materials			-
- Plant equipment	18,638	62,571	81,209
- Electrical & control equipment	-	22,393	22,393
- Equipment for laboratory & workshop	-	2,345	2,345
F. Ocean freight & insurance	-	4,365	4,365
G. Erection work	10,917	-	10,917
H. Engineering services	833	10,714	11,547
Base Project Cost - 1993	70,625	102,388	173,013
I. Import Duty	13,751	-	13,751
J. Value Added Tax (VAT)	47,987	-	47,987
Erected Plant Cost - 1993	132,363	102,388	234,751
K. Pre-operation expense (incl. Commissioning work)	5,155	-	5,155
L. Interest During Construction (IDC)	-	13,330	13,330
M. Compensation fund for local district	17,857	-	17,857
Estimated Capital Requirement for HHM2 - 1993	155,375	115,718	271,093
For Other Components			
N. Final disposal facilities	24,232	-	24,232
O. New vehicles	4,536	-	4,536
Grand Total	184,143	115,718	299,861

Note: IDC for the compensation fund is excluded from the above IDC amount because the fund will be disbursed at the final year of construction period.

4) Implementation schedule of the F/S

- Commencement of construction : 1995
- Commencement of operation : January, 1999

5) Economic and financial analysis for the F/S (period: 1994 - 2013)

- Financial Internal Rate of Return (FIRR) : -3.81%
- Economic Internal Rate of Return (EIRR) : 0.49%

6) Desirable financial support by the Government

- Government's subsidy or grant for the project

- Tax deduction or exemption on the project (Duty 15%, VAT 25%)

- Use of concessional loans with government's guarantee

7) Financial affordability for the F/S

- The present revenue structure cannot cover the investment cost.

- Burden sharing of the needed investment cost is a key factor for the project implementation.

  It is necessity of burden bearing ability that the capital requirements should be shared by the central government and the municipality according to their abilities, and operation and maintenance fees should be shared by citizens.

- From the view point of burden share principles (government, municipality, citizen), a desirable financial plan for the project is a combination of the following:

  . Total tax exemption by the central government
  . Use of concessional loans and budgeting a repayment in the municipality's budget.
  . New fee collection system from citizens

The model plan based on the above combination is described below.

Financial plan

. Total tax exemption (by the government)
  ..... Duty/VAT exemption
. Repayment of loans (by the municipality)
  ..... 10 million US$/year
. New fee collection (from citizens)
  ..... 118 Ft/month·household (1994-1998)
  ..... 235 Ft/month·household (1999-2013)

In this financial plan, the Financial Internal Rate of Return (FIRR) and the degree of the burden for the government, municipality and citizens are as follows.

Financial internal rate of return (1994 - 2013)

. On the incremental basis
  FIRR: 3.97%
. On the "With" case
  FIRR: 4.54%

Degree of burden (fixed price basis in 1993)

. Government
  Ratio to national Import Duty: 0.014%
  Ratio to national VAT : 0.016%

. Municipality
  Ratio to municipality budget : 1.32%

. Citizen
  Ratio to the average monthly earning (42,100 Ft in 1992) of household in Budapest
  1994 - 1998 : 0.28%
  (118 Ft/Month·household)
  1999 - 2013 : 0.56%
  (235 Ft/Month·household)

  In the view of the collection fees (200 -1,200 Ft/month) collected from citizens in other cities in Hungary, this burden should not be difficulty for the citizens of Budapest.

The project can be considered financially feasible in the event that this model plan is executed.

8) Environmental affordability for the F/S

- The result of the Environmental Evaluation (EE) showed that HHM2 will satisfy the national emission and immission limit values except for night time noise levels at two points on the site boundaries.

  Necessary mitigation measures applying sound proof construction, sound insulation materials, sound insulating wall, etc. should be examined during the basic and detailed design phase.

9) Conclusion

On an incremental (the incremental which is differential the capital requirements between the "With" case and the case of the existing MSW management system) basis, FIRR and EIRR are -3.81% and 0.49% respectively for the project.
In the HHM2 construction project, the investment cost is high relative to the revenue structure, in spite of the revenue-operation cost ratio being in balance. Therefore, the implementation of the Financial Plan of Section 7) shall be practiced to ensure that the project can be considered financially feasible.

10) Recommendation

It is recommended that the financial plan as specified in Section 7) hereinbefore is established, basing upon share burden principles.

In this model case, FIRR on the incremental basis is 3.97%, while FIRR for the "With" case alone is 4.54%. Therefore, the financial feasibility of the project can be justified.

CONTENTS

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

Presently in Hungary, along with the reformation of the political structure, a large socioeconomic transformation is being promoted. Although relatively systematic Municipal Solid Waste (MSW) management has been carried out until now by the Budapest Capital City Government, the city presently faces the need to accommodate increasing volumes and changes in the quality of the MSW due to changes in the lifestyle.

The volume of the MSW generated in Budapest in 1980 was 4,330,000 m^3, it is anticipated to reach about 5,375,000 m^3 in 2005. On the other hand, the capacities of the existing final disposal sites are anticipated to be filled in 1994. However, the new final disposal sites are hard to obtain due to increasing public awareness about environmental protection. In this respect, environmental assessment and related public relations shall be strongly taken into account.

Accordingly, a comprehensive study of the MSW management system in Budapest city is very important and urgent.

In response to the request of the Government of the Republic of Hungary to the Government of Japan for cooperation in the study of this matter, the Government of Japan decided to conduct the Study of the MSW Management in Budapest in the Republic of Hungary.

Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, undertook the Study in close cooperation with the concerned authorities of the Government of the Republic of Hungary.

Environmental Technologic Consultant Co., Ltd. was the consultant selected by JICA to carry out the Study.

1.2 Objectives of the Study

The objectives of the Study are:

(1) To formulate a Master Plan (M/P) for the improvement of the MSW management in Budapest, and

(2) To conduct the Feasibility Study (F/S) on the first priority project to be identified in the said M/P.

1.3 Scope of the Study

(1) Basic Study

1) Data collection, review of previous studies
2) Field surveys

(2) Analysis of existing conditions and identification of issues

(3) Formulation of the M/P (the target year 2005)

(4) The F/S on the first priority project (the target year 1999)

1) Confirmation of the planning framework
2) Supplementary study
3) Preliminary design of operational systems and main facilities
4) Planning of major equipment
5) Institutional planning
6) Preliminary cost estimation
7) Project evaluation
8) Planning of the project implementation

1.4 Subject of the Study

The subject of the Study was the MSW, which included household waste, market waste, commercial waste and street sweeping waste. Hospital waste and industrial waste were not included. However, a short diagnostic study of the industrial waste such as tires, oils and solvents that get mixed into the MSW was carried out in order to prepare general recommendations for collection and treatment.

1.5 Organization of Executing Bodies

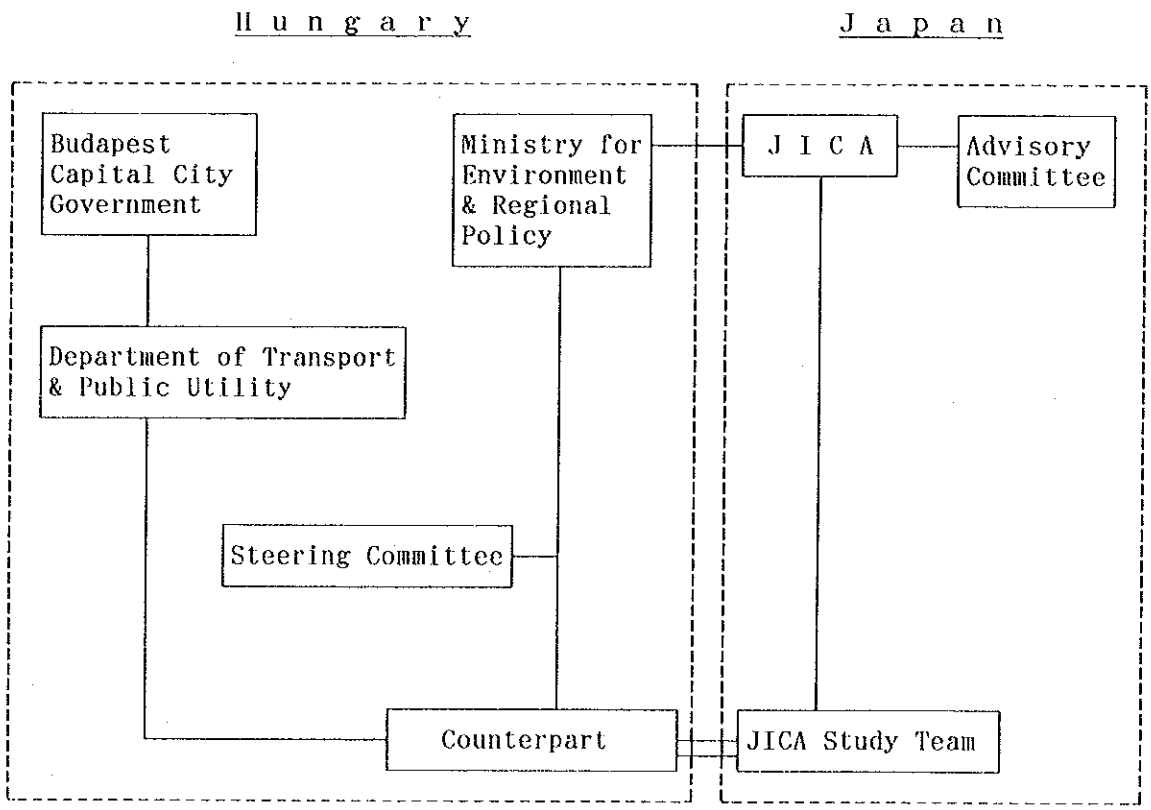


Figure 1-1 Project Organization

CHAPTER 2 PRESENT STATUS OF THE MUNICIPAL SOLID WASTE MANAGEMENT

2.1 Municipal Solid Waste Collection Areas and the Frequency of Collection in Budapest

The collection and transportation of the MSW are basically performed through Monday to Friday with the exception of holidays.

The frequency of collection is set according to the amount of the MSW generated in each district. As shown in the Figure 2-1 the MSW are collected either every day, three times a week, twice a week or once a week depending on the district.

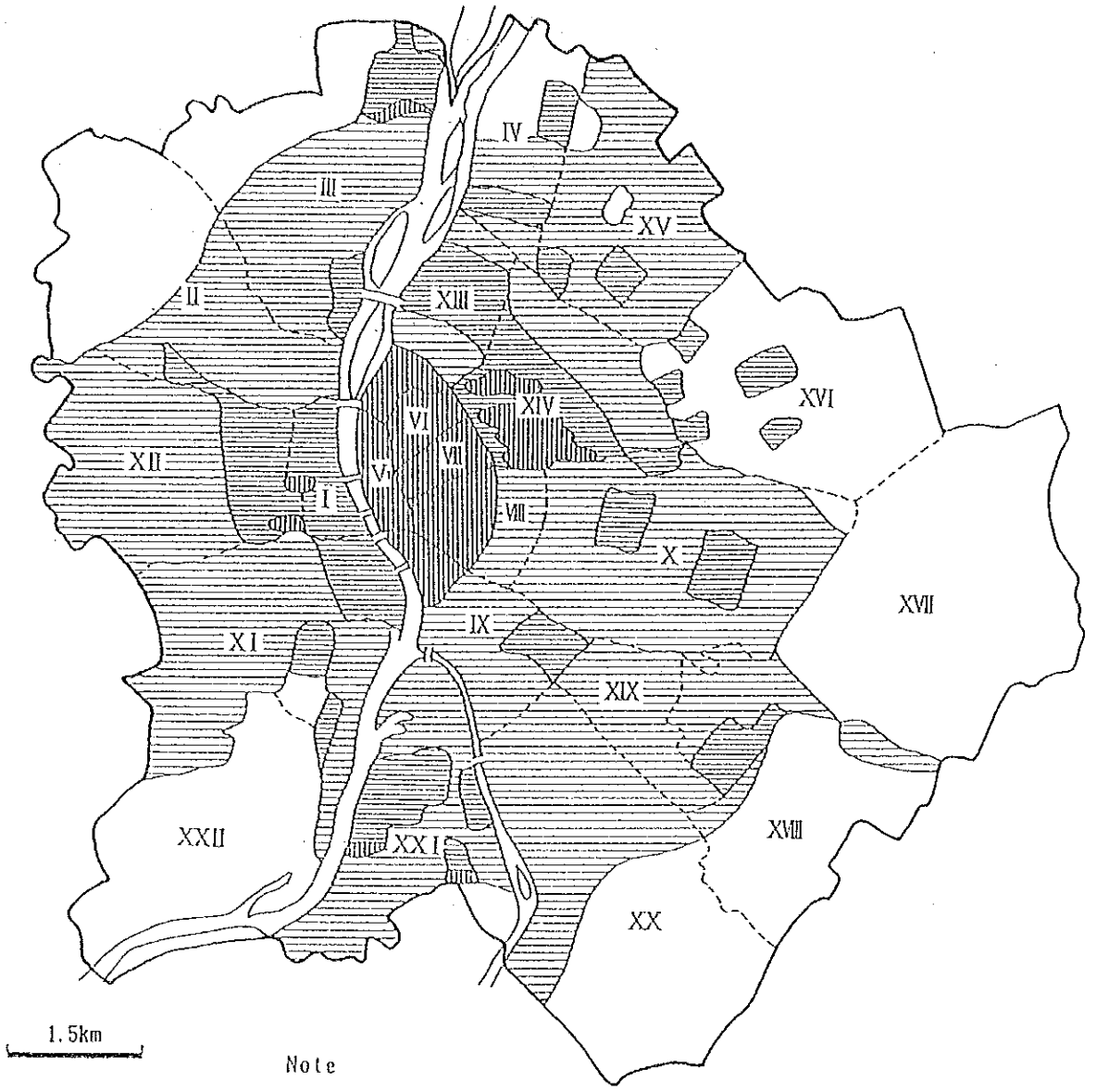


Figure 2-1 Municipal Solid Waste Collection Areas and the Frequency of Collection in Budapest

2.2 Location of the Final Disposal Sites

Presently the MSW and incineration residues generated in Budapest are disposed of at the four final disposal sites shown in the Figure 2-2.

Akna site	District X
Micsurin site	District XVII
Peteri major site	District XX
Dunakeszi site	Outside Budapest city

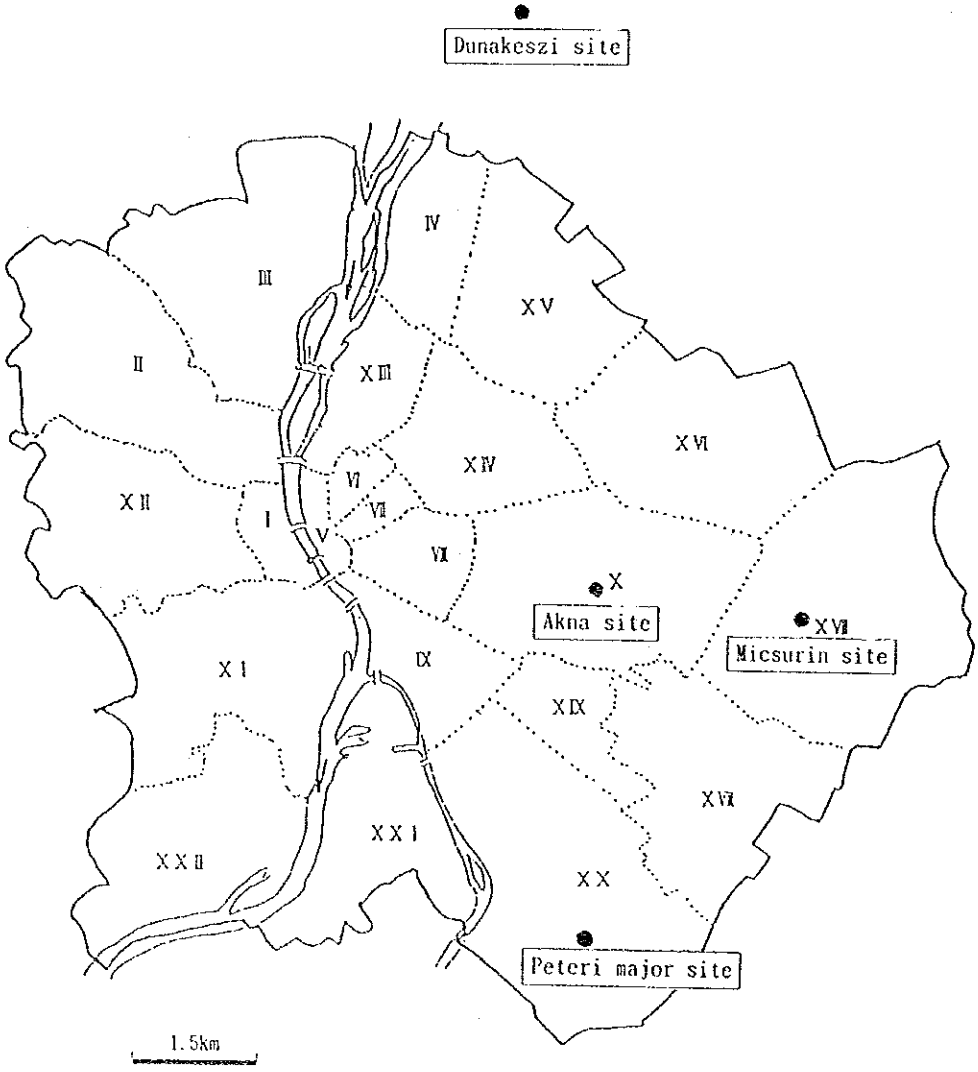


Figure 2-2 Location of the Final Disposal Sites

2.3 Flow of the Municipal Solid Waste in Budapest

Presently, the MSW generated in Budapest is collected, transported and disposed of by the Public Service Enterprise (FKFV) and other small-scale companies. In 1992, FKFV handled approximately 92% of the total MSW generated in Budapest. Flow of the MSW management and disposal volume of the MSW in Budapest is shown in the Figure 2-3.

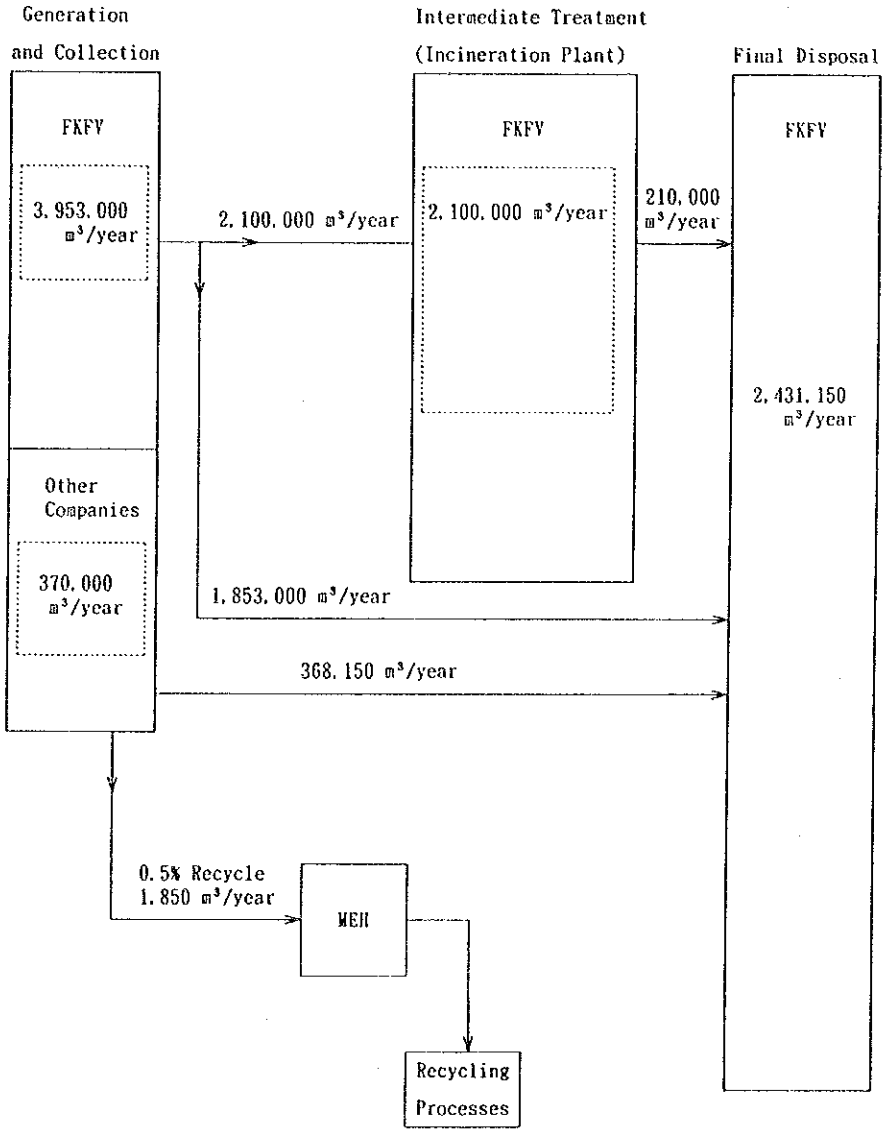


Figure 2-3 Flow of the Municipal Solid Waste

2.4 Municipal Solid Waste Generation Volume

The annual MSW volume handled by FKFV and other small scale companies is shown along with the population of Budapest for each year in the Table 2-1.

Table 2-1 MSW Volume handled by FKFV and Other Companies along with Population

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
MSW Volume (㎥)	4,332,916	4,378,693	4,782,850	4,518,059	4,487,014	4,503,110	4,635,433	4,649,623	4,597,247	4,592,788	4,422,951
Population (person)	2,059,347	2,060,644	2,063,745	2,064,307	2,064,374	2,071,484	2,075,990	2,093,487	2,104,700	—	2,016,300

Sources : FKFV, Hungarian Statistical Yearbook

2.5 Physical Composition and Characteristics (3 components) of the Municipal Solid Waste

The actual measurements of the three components (moistures, incombustibles, combustibles) and the physical composition of the MSW generated in the summer and in the winter during the years 1986 to 1991 are shown in the Table 2-2.

Table 2-2 Physical Composition and Characteristics (3 Components)

Weight(%) 3 components	1986 Winter	1986 Summer Season	1987 Winter	1987 Summer Season	1988 Winter	1988 Summer Season	1989 Winter	1989 Summer Season	1990 Winter	1990 Summer Season	1991 Winter	1991 Summer Season
Moisture	33.36	35.50	42.20	38.45	37.66	40.19	36.40	35.12	34.74	28.92	41.80	43.40
Incombustibles	35.96	29.19	29.89	25.08	27.87	26.12	30.40	27.80	30.85	27.36	27.20	24.92
Combustibles	30.68	34.53	27.92	36.47	34.37	33.69	33.20	37.08	34.41	43.72	31.00	31.68
Weight(%) Physical composition												
Paper(Cardboad)	19.55	21.51	17.58	17.96	19.31	18.25	18.45	20.65	19.42	19.73	17.86	18.00
Plastic	5.23	5.59	4.93	4.11	4.41	4.29	4.42	4.66	5.11	4.15	4.95	4.17
Textile	5.78	5.38	3.95	4.54	4.83	3.53	2.95	4.10	6.35	7.24	3.10	3.06
Decomposing organic (Kitchen garden)	32.60	37.91	37.27	42.23	37.05	34.09	30.46	33.72	31.06	33.61	38.30	38.46
Glass	5.99	5.91	5.01	4.91	4.73	6.05	4.85	7.23	4.31	6.26	3.40	3.36
Metal	4.52	4.14	5.20	4.18	4.43	5.70	6.62	4.16	6.59	5.29	4.50	4.04
Other												
(Inorganic and 16mm fine fraction)	26.33	19.56	26.04	22.02	26.24	29.26	32.25	25.48	27.16	23.72	28.30	28.50

Source: FKFV

2.6 Chemical Composition and the Heating Values of the Municipal Solid Waste

The actual measurements of the chemical composition and the heating values of the MSW generated in the summer and in the winter during the years 1982 to 1991 are shown in the Table 2-3.

Table 2-3 Chemical Composition and Heating Values

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Percentage of each component										
Weight(%)										
Moisture	39.45	39.95	48.88	46.25	34.73	34.25	38.93	35.76	31.83	42.60
Incombustibles	32.94	32.23	24.25	24.95	31.92	29.70	26.99	29.10	29.10	26.06
Combustibles	27.61	27.82	28.80	28.80	33.35	36.05	34.08	35.10	39.07	31.34
Chemical composition of MSW										
Weight(%)										
Total organic C	17.80	17.74	16.61	17.85	20.66	19.23	21.34	22.61	19.27	17.20
Total N	0.70	0.69	0.69	0.60	1.40	1.24	0.97	1.09	0.76	0.70
Heating value of MSW in Budapest 1982-1991										
(KJ/kg)										
Heating value(high)	7495	7465	6890	7230	8510	7900	7220	8590	8120	7250
Heating value(low)	6197	6105	5010	5660	7170	6890	6230	7560	6810	6150

Source: FKFV

2.7 Intermediate Treatment and the Final Disposal Sites

At present, there is only one incineration plant (HHM1: Hulladek Hasznosito Muvek 1) and one pilot scale composting facility of green waste under experiment for intermediate treatment facilities.

Moreover, a system of resource recovery and recycling of the MSW is also under experiment in Budapest.

- Incineration Plant (HHM1)

. Number of furnaces	4
. Capacity of each furnace	300t/day (24-hour/day operation)
. Operational hours	6,000 hour/year
. Type of combustion	Roller type grate
. Type of boiler	3-pass, natural circulation
. Heating value (Max.)	9,660 KJ/kg
. Steam generation	40t/hour
. Steam parameters	35 bar, 395° C
. Power generation	24 MW
. District heat supply	42 MW

- Separate collection of the MSW
  In 1992, the Budapest Capital City Government performed an experiment with the separate collection of glass, paper, metals and dry batteries in the designated areas. Presently, the experiment is being continued in more confined areas.

- Composting of green waste
  The Public Park and Gardens Maintenance Co. (FOKERT) is performing green waste composting by the windrow method on an experimental level.

- Final disposal sites
  . Number of operating sites 4
  . Total free capacity (in 1992) 3,271,000 m^3
    (The sites are predicted to be completely filled within the year 1994.)

2.8 Organization, Institution and Administration

2.8.1 Budapest Capital City Government

In Budapest, all issues related to the MSW management are under the jurisdiction of the Budapest Capital City Government.

The 22 District Councils of the city are not directly involved in the MSW management.

The Budapest Capital City Government cooperates, however, with the District Councils in research for new sites for the MSW final disposal or incineration plant. During the negotiations concerning the acquisition of new sites the District Council imposes certain conditions for the permit, such as the examples below.

- Detailed plan of land use and its modification
- Project documentation
- Development of environmental monitoring network
- Participation of district representatives in the tender procedure
- Construction and/or repair of roads
- Economic incentives for the district residents (priority in employment)

The administrative organization of the Budapest Capital City Government related to the MSW management is shown in the Figure 2-4.

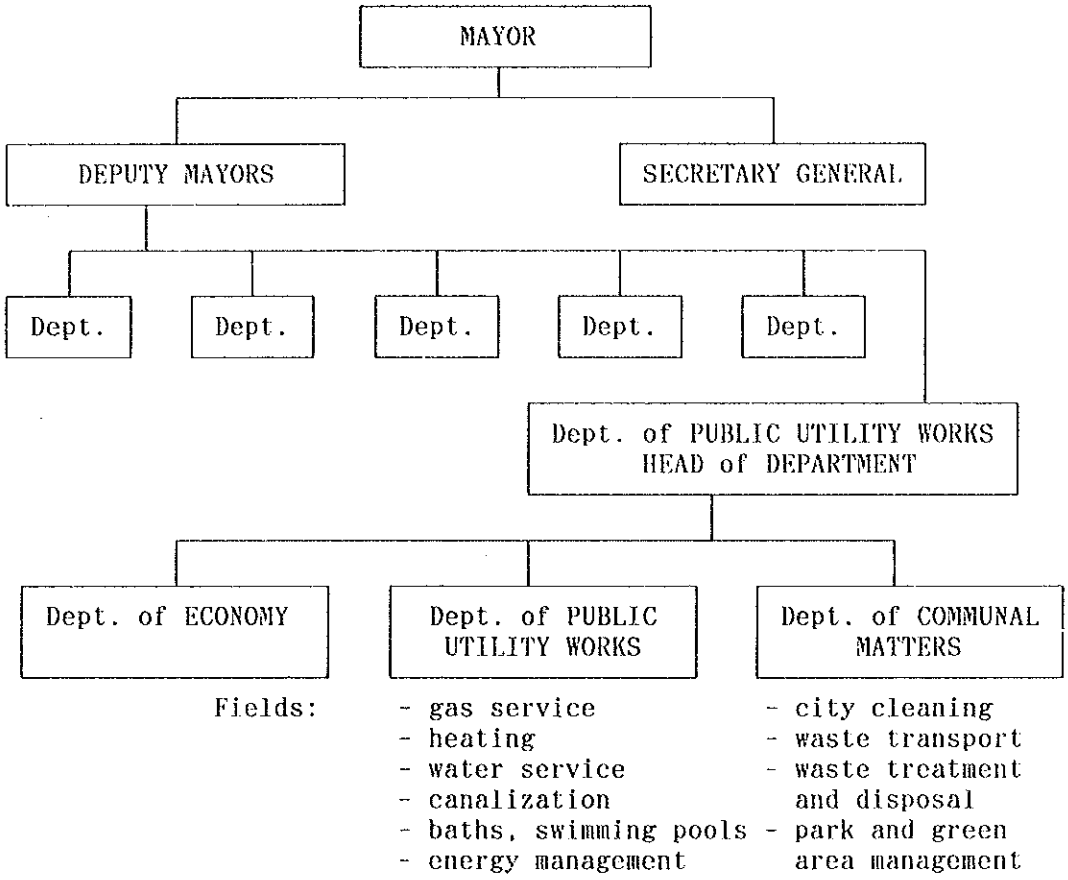


Figure 2-4 Administrative Organization of the Budapest Capital City Government related to the Municipal Solid Waste Management

2.8.2 Public Service Enterprise /FKFV/

The organization responsible for the MSW management in Budapest is FKFV established by the Executive Committee of the Budapest City Council. FKFV collects and transports the MSW, operates and maintains HHM1, operates and manages the final disposal sites, cleans public facilities, etc. under the supervision of the Budapest Capital City Government. The MSW treatment for industries, institutes and public bodies are undertaken by FKFV on the basis of individual

contracts. Approximately 60% of the operation funds for FKFV is covered by income from the FKFV's own collection, transportation, incineration and final disposal activities. The remainder, approximately 40%, is covered by the consignment for the MSW management activities provided by the Budapest Capital City Government.

FKFV employs about 3,500 persons; the full-time staffs in charge of the MSW management are 1,580 persons.

2.8.3 Hungarian Recycling Company/MEH/

MEH is a company dealing with recycling of materials which are reused in the processing industry. The company is under the supervision of the Hungarian Ministry of Industry and Trade. In addition to the raw materials recovered from the MSW, MEH also collects recyclable industrial wastes. The recycling activities concern iron, steel, non-ferrous metals, paper, textiles and plastic.

Until 1991 MEH operated at a profit of about 10 - 15%. During the year 1992, because of reorganization and reconstruction of the Hungarian industry, the cash flow was negative.

According to the management of MEH some new agreements have been signed with foreign companies for processing of recovered materials which will generate some profits in 1993 and succeeding years.

CHAPTER 3 MAJOR ISSUES IN THE PRESENT MUNICIPAL SOLID WASTE MANAGEMENT OF BUDAPEST

(1) Insufficient capacity of the final disposal sites

(2) Insufficient incineration capacity of HHM1 due to technical and superannuated issues

(3) Insufficient measures for the reduction of the generated MSW volume

(4) Difficulty in obtaining the new final disposal sites for the future

(5) Necessity of countermeasures for environmental protection at the final disposal sites and HHM1

1) Ground water contamination likely due to dumping of incineration residue and ash at the final disposal sites
2) Necessity of sufficient quantity of covering soil and compaction effect
3) Necessity of management using truck scale for final disposal operation
4) Installation of new flue gas treatment system satisfying the national emission and immission standards for HHM1

(6) Insufficient number of collection vehicles

(7) Necessity of strengthening management capability of the Budapest Capital City Government for the MSW management

1) Lack of information and data control
2) Necessity of strengthening capability for organizing related companies and organizations and following up new technologies

(8) Weak of financial base

1) Revenue shortage of the municipality due to the decline of subsidy from the central government
2) Inflexibility of municipal finance
3) High inflation rate
4) Lack of funds allotted for investment

CHAPTER 4 THE MASTER PLAN (M/P)

4.1 Goals of the Master Plan

The goal is to ensure a beautiful and clean living environment by overcoming the present issues of the MSW management in Budapest.

The goal of the M/P will be achieved practicing the following matters.

- As a rule, to contain management of all the MSW generated in Budapest within the city

- To establish an adequate MSW management system in consideration of environmental protection

- To reduce the MSW volume before collection (by means of separate collection, etc.)

- To reduce the MSW volume after collection

- To minimize potential environmental impact in the MSW management system

- To strengthen present organization to enable it to set up the most suitable MSW management system to cope with various environmental changes in the future

4.2 Targets of the Master Plan

- To secure and construct the new final disposal sites as follows:
  By 2005, the disposal sites of 16,500 x 10^3 -20,950 x $10^3 m^3$ are to be secured in accordance with a system alternative to be selected

- To introduce a new fee collection system to strengthen the financial capacity for the MSW management activities of the Budapest Capital City Government

- To establish a suitable intermediate treatment system to reduce about 70% of the combustible MSW volume generated in 1999 and 90% in 2005

- To establish a Transfer Station (T/S) by the end of 1998 and secure collection vehicles to cope with the increase of the MSW in the future

- To continue experimentation with separate collection in order to establish a resource recovery and recycling system by the year 2000

- To establish the technical guidelines for the disposal of incineration residue and ash by 1994, and to review the present disposal system based on the guidelines to be established

- To adopt a sanitary landfill method for the new final disposal sites by purchasing bulldozers after 1994

- To set up a specific section, to strengthen the present organization of the Department of Communal Matters, with ten experts to manage the following matters by 1995

  1) Implementation and supervision of the M/P
  2) Control of information and data concerning the MSW management
  3) Research and development of the MSW management system by separate collection, recycling, treatment by composting and a new fee collection system, etc.
  4) Strengthening of cooperative relationships between the residents and the Budapest Capital City Government in the MSW management system
  5) Supervision of FKFV

- To strengthen the present organization of FKFV particularly related to general management for the public relations and the technical department by 1998

4.3 Planning Policy of the Master Plan

In order to formulate the M/P the following concepts will be integrated into the policy.

(1) To create the cleaner and environmentally better Capital City of Budapest in association with:

- Identification of issues in the present MSW management in Budapest,
- Formulation of alternatives to improve the present situation, and
- Implementation of the selected system alternative (M/P).

(2) To respect the nature and environment of Budapest with the adequate MSW management system technologies, for which the following should be considered

- Environmental evaluation
- Establishment of guidelines and regulations

(3) To consider the positive participation of the public to create their better environment, for which the following should be very essential

- In Budapest, the environment surrounding the MSW disposal management is becoming increasingly difficult. Under such circumstances, it is necessary that the NIMBY (Not In My Backyard) syndrome be eradicated in order to solve the issues for the MSW management. Positive and responsible actions for public education and public relations

by the Budapest Capital City Government, FKFV, etc. are necessary.

- People have to participate in the MSW management. For example, people should be involved in implementation of a system of resource recovery and recycling as well as the separate collection of hazardous wastes in the future.

4.4 Forecast of the Future Municipal Solid Waste Generation Volume and Its Heating Values

4.4.1 Generation Volume

Based on the data of the MSW generation volume from 1980 to 1990 (Section 2.4), the JICA Study Team forecasted the generation volume by adopting the following two methods.

(1) Study on relationship between population in the Budapest city and the MSW generation unit volume per capita

(2) Study on relationship between the MSW generation volume and GDP

The generation volume forecast for the M/P target year of 2005 was 5,280,000 m^3/year according to the method (1) and 5,370,000 m^3/year according to the method (2).

The results of the study corresponded well with the FKFV's forecast for the M/P target year 2005 shown in the Table 4-1.

Table 4-1 Forecast on the Municipal Solid Waste Generation Volume

Unit; 1,000m³

Year	1990	1991	1992	1993	1994	1995	1996	1997
Generation Volume	4,423	4,246	4,323	4,323	4,323	4,409	4,498	4,588

Year	1998	1999	2000	2001	2002	2003	2004	2005
Generation Volume	4,679	4,773	4,808	4,966	5,065	5,166	5,270	5,375

Note: The values in this table were forecasted by FKFV under the assumption that the quantity of the MSW generated will increase at an annual rate of 2% from 1994 in correspondence with the forecasted economic growth of Hungary.

4.4.2 Heating Values

Based on the data investigated by FKFV from 1982 to 1991 (Section 2.6), heating values of the MSW were forecasted according to the following two methods.

- Forecast by an estimation formula taking plastic content into consideration

- Forecast from actual heating value trends of the past ten years

From the results of Study, the heating values for the HHM2 design were decided as follows.

H_L (Max.) = 10,000 KJ/kg
H_L (Med.) = 8,000 KJ/kg
H_L (Min.) = 5,000 KJ/kg

4.5 Selection of the Master Plan

Prior to the selection of a M/P, the alternatives corresponding to each system component constituting a MSW management system, were selected. Then, the alternatives for each system component were carefully evaluated, mainly from technical, economic and environmental view points, to determine the adequate system components for Budapest.

The system components are listed below.

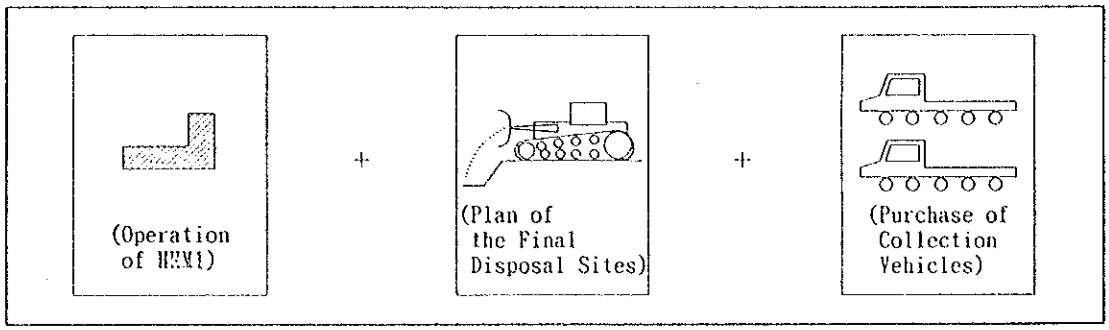
- MSW discharge and storage
- MSW collection and transportation
- MSW intermediate treatment (Matrix-evaluation was performed for: resource recovery and recycling, green waste composting, shredding, mechanical waste compaction, incineration, smelting treatment and RDF (Refuse Derived Fuel))
- MSW final disposal

Based on the evaluation, the conventional system was selected for discharge and storage; a transfer station system was selected for southern districts (9 districts of district number IX - XII and XVII - XXI) of the city with collection vehicles purchased for T/S and transportation; an incineration with a shredding system was selected for intermediate treatment; and a sanitary landfilling method was selected for the final disposal.

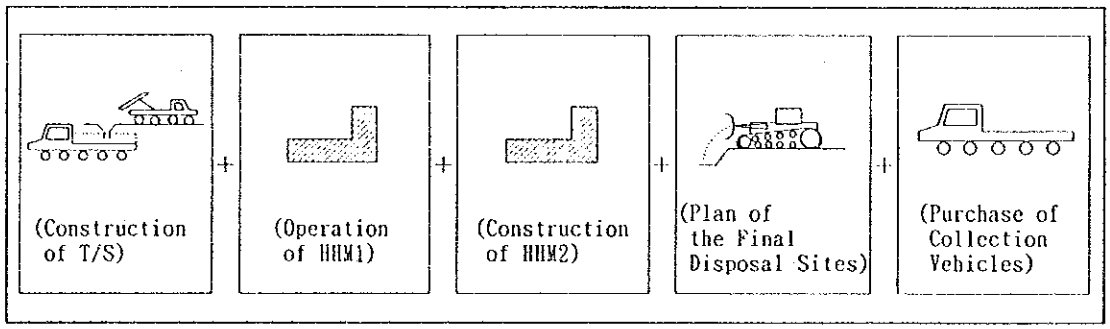
Two system alternatives were formulated based on the combination of the above selected system components and examined by qualitative and economic evaluation using Matrix-evaluation.

Considering the results of the decision of the Budapest City General Assembly, which agreed with the necessity for the HHM2 construction as well, the Alternative-2 was selected as the M/P.

Alternative-1 = Operation of HHM1 + Plan of the final disposal sites + Purchase of collection vehicles (without T/S)



Alternative-2 = Construction of T/S + Operation of HHM1 + Construction of HHM2 + Plan of the final disposal sites + Purchase of collection vehicles (with T/S)



The Evaluation of the Two Alternatives

1. Evaluation Criteria
   - i) Social Requirements
   - ii) Environmental Aspects
   - iii) Economic and Financial Evaluations
   - iv) Technical Evaluations
   - v) Transactional Evaluations

2. Examination and Setting of Priorities for Evaluation Criteria

(1) Necessary Items of Examination

- The items that need to be examined in this Study concern the effective improvement of present and future issues of the MSW management system of Budapest. That is, the top priority is to improve the present MSW management system and establish a system that will meet the requirements of the society in the future.
  Measures that should be given a top priority in this Study are the following.
  * incineration of the combustible MSW
  * final disposal of the MSW at the sanitary final disposal sites
- Environmental protection measures are socially demanded as a measure for prerequisite of each measure.
- Financial burdens are inevitable for the realization of improvements in the MSW management system.
- Since the technology required to solve the issues of the MSW management system is already established, no technological difficulty would be existed.

Taking consideration on the order of importance as stated above, the order of evaluation criteria should be determined.

(2) Prioritization

In view of the above considerations, the order of priority of evaluation criteria was decided as shown below.

1 Social Requirements
2 Environmental Aspects
3 Economic and Financial Evaluations
4 Technical Evaluations
5 Transactional Evaluations

The qualitative evaluations of the Alternatives-1 and Alternative-2 to the evaluation criteria given above were performed as shown in the Table 4-2.
Qualitative evaluations were made for more specific subcriteria of the above each evaluation criteria.

The evaluations were performed by the JICA Study Team with the cooperation of Hungarian side according to the following procedure.

Four evaluation ranks, A, B, C and D were used, with A presented the best, B presented the better, C presented the worse and D presented the worst.

D signifies a critical factor for the implementation of the alternative and when an alternative has an item evaluated as D, the implementation of that alternative is deemed extremely difficult.

(3) Results of Evaluation

14 items in the Alternative-2 were ranked A while seven items were ranked A and one item was ranked D for the Alternative-1.

Taking into account of the decision of the Budapest City General Assembly, which agreed with the necessity of HHM2 in addition to these results, the Alternative-2 was selected as the M/P.

Table 4-2 Evaluation of the Two Alternatives for the MSW Management System

Evaluation Criteria	Evaluation Subcriteria	Alternative 1	Alternative 2	Remarks
Social Requirements	1. Obtaining of the new final disposal sites	D	B	- By the year 2005, the Alternative 1 (Alt-1) will require approximately 4.5 million more m^3 of reclaiming space than the Alternative 2 (Alt-2). - This means that, if the Alt-1 is adopted reclamation sites must be sought outside the Budapest city area and a regional waste disposal system will become necessary by the year 2005. - It is therefore expected that many social, political and technical issues will be encountered for the Alt-1. - Although the Alt-2 provides a larger time margin than the Alt-1, consideration of similar measures will still be necessary. - From the above, the Alt-1 is given D evaluation and the Alt-2 is given B evaluation
	2. Land efficiency in terms of the MSW disposal volume per m^2 of site area to be utilized for the MSW disposing $\frac{\text{MSW disposal volume } (m^3)}{\text{Required area for final disposal and incineration } (m^2)}$	B	A	- The quantity of the MSW treated or disposed (m^3) per site area (m^2) required by the MSW management facility (incineration plant or final reclaiming disposal sites) is: For the Alt-1: $\frac{\text{Final disposal + BY HHM1}}{\frac{40,587,000}{3,218} + \frac{8,033,000}{30,000}} = 815.9\ m^3/m^2$ For the Alt-2: $\frac{\text{Final disposal + By HHM1 + By HHM2}}{\frac{31,057,000}{2,547} + \frac{7,830,000}{30,000} + \frac{5,090,000}{22,000}}$ $= 1,304\ m^3/m^2$
	3. Social acceptance	C	A	- Since there is a possibility that the final disposal sites outside the Budapest city will be required in the future, the execution of wide area cleaning activities is required. - Agreement with neighboring municipalities and residents will be necessary for regional waste disposal activities. Political and administrative difficulties may arise in this case.
	4. Resource Recovery	B	A	- The waste energy recovery for the Alt-2 is bigger than that of the Alt-1.

Evaluation Criteria	Evaluation Subcriteria	Alternative 1	Alternative 2	Remarks
Environmental aspects	1. Quantity of air pollutants and CO_2 in flue gas	A	C	The Alt-1 is superior to the Alt-2, because air pollutants and CO_2 in flue gas will increase with increasing amounts of the combustible MSW incinerated.
	2. Quantity of CH_4 generated from the final disposal sites	C	A	The Alt-2 is superior to the Alt-1, because CH_4 generation is proportional to the amount of the combustible MSW to be disposed at the final disposal site.
	3. Ground water contamination	B	A	Possibility of ground water contamination chiefly depends on the amount of the MSW to be disposed at the final disposal site.
	4. Odor from the final disposal sites	B	A	Possibility of odor generation chiefly depends on the amount of the MSW to be disposed at the final disposal sites.
	5. Pollution due to collection and transportation	B	A	Possibility of pollution due to the collection and transportation vehicles chiefly depends on the number of the vehicles required after construction of the transfer station, therefore the Alt-2 is superior to the Alt-1.
	6. Spreading of environmental impacts	B	A	Spreading of environmental impacts depends on the number of the final disposal sites, therefore, the Alt-2 is superior to the Alt-1.
	7. Residue and fly ash	A	B	Quantities of residue and ash depend on the capacity of an incineration plant, therefore, the Alt-1 is superior to the Alt-2.
Economic and financial evaluation	1. Total investment costs of each alternative	A	C	Necessary expense for the Alt-1 is $40,074 \times 10^3$ US$. Necessary expense for the Alt-2 is $290,843 \times 10^3$ US$.
	2. Total operational costs (1994-2005) of each alternative	A	C	Operational cost for the Alt-1 is $32,410 \times 10^3$ US$. Operational cost for the Alt-2 is $38,536 \times 10^3$ US$.

Evaluation Criteria	Evaluation Subcriteria	Alternative 1	Alternative 2	Remarks
Economic and financial evaluation	3. Effect in creating opportunity of employment and economic effect due to the construction of the facilities.	B	A	The Alt-2 will provide more employment opportunities.
	4. Burden on individuals in preserving good environment	A	B	If, in the future, collection fees are to be collected from the residents in order to secure revenue increases for the municipality, the influence to residents will be greater for the Alt-2 due to the higher investment cost.
	5. Total revenue (1994 - 2005)	B	A	Revenue of the Alt-1 will be 56,631 x 10^3 US$. Revenue of the Alt-2 will be 70,474 x 10^3 US$.
Technical evaluation	1. MSW disposal technology	A	A	Adequate technologies can be used for both alternatives.
	2. Effect for reducing the MSW volume to be hauled to the final disposal sites up to 2005	C	A	The Alt-2 has a better reducing effect.
Transactional evaluation	1. Intricacy of administration and organization required for implementation of Alternative	A	B	This is proportional to the technologies to be applied.
	2. Necessity of EIA Study and its cost	B	A	EIA is required for the construction of each final disposal site and each incineration plant.
	3. Necessity of countermeasures for the public in the vicinity of the facilities	C	A	The Alt-1 is disadvantageous in that a greater number of the final disposal sites will be required.
Results		A = 7 B = 9 C = 4 D = 1	A = 14 B = 4 C = 3 D = 0	

4.6 Composition of the Master Plan

The Table 4-3 presents the composition of the M/P and the Figure 4-1 shows the location of the transfer station with area covered for the MSW collection.

Table 4-3 Composition of the Master Plan

	Name	Abbreviation	Symbol
Composition of the M/P	Construction of the Transfer Station	T/S	(T/S)
	Operation of the Existing Incineration Plant	HHM1	(HHM1)
	Construction of the New Incineration Plant	HHM2	(HHM2)
	Plan of the Final Disposal Sites		(FDS)
	Purchase of Collection Vehicles		(VEHICLE)

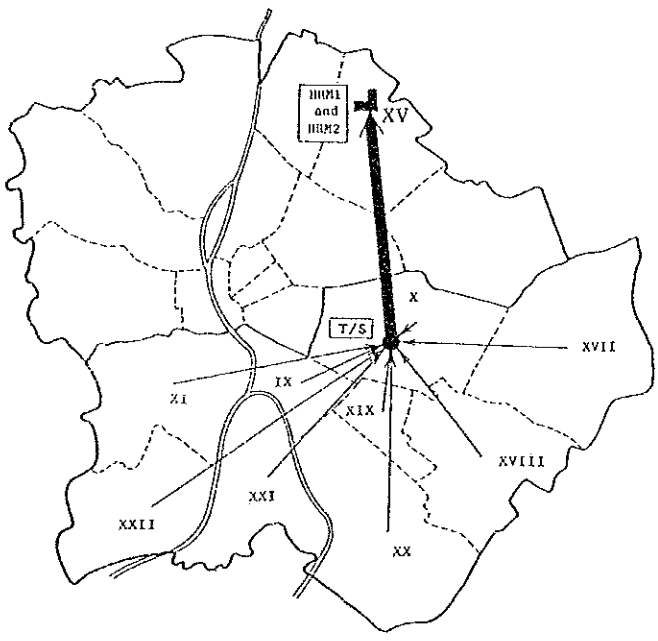


Figure 4-1 Location of the Transfer Station with Collection Areas

4.7 Major Specifications of the Master Plan

(1) Transfer station (T/S)

- MSW quantity to be handled : 770 t/day
- Location : Akna site (District-X)
- Major facilities : 2 lines of compactors
  2 hoppers
  Container moving facility
  15 containers
  7 container trailer trucks
  1 truck scale
  Civil engineering works and processing building facilities
  Wastewater treatment system

(2) Incineration plants

1) HHM1 (existing)
   - Number of furnaces : 300 t/day x 4
   - Incineration capacity of HHM1 : 1,200 t/day (24 hour/day operation)
   - Location : District-XV
   - Boilers : 4
     3-pass, natural circulating type boiler

2) HHM2 (planned)
   - Number of furnaces : 480 t/day x 2
   - Incineration capacity of HHM2 : 960 t/day (24 hour/day operation)
   - Location : District-XV (on the premises of HHM1, required area approx. 2.2 ha)

- Boilers : 2
  Natural circulating type boilers
  Normal press: 32 kg/cm²abs.
  (super heater outlet)
  Normal temp : 385' C (super heater outlet)
  Max. steam generation
  : 124 t/h.2 boilers

- Major facilities
  . Equipment : MSW receiving and feeding facilities
  Combustion facilities
  Drafting facilities
  Boiler facilities
  Flue gas treatment facilities
  Ash discharging facilities
  Turbine and power generation facilities
  Electric and instrumentation system
  Utility facilities (instrument air unit, emergency diesel generator, etc.)
  Workshop equipment
  Laboratory equipment

  . Civil and Building Facilities : Processing building
  MSW receiving/storage building
  Administration building
  Stack (height: 80 m)
  Roads and ramp way

(3) Final disposal sites

In addition to the operating final disposal sites (Total landfill capacity as of 1992: 3.2 Million m³), the following new site securing plan must be used.

- Site securing plan for the new final disposal sites : 1 (Akna, Addition, 1993)
  Landfill capacity
  0.7 Million m^3
  1 (Bajna, New, Outside Budapest city, 1994)
  Landfill capacity
  9 Million m^3
  1 (Candidate Undecided, 2000)
  Landfill capacity
  4.8 Million m^3
  1 (Candidate Undecided, 2003)
  Landfill capacity
  2 Million m^3

(4) Purchase of collection vehicles

The purchasing plan for collection vehicles is intended to cope with the increases in the MSW volume in the future. T/S is taken into account in the MSW transportation system together with the purchasing plan for collection vehicles.

Table 4-4 Purchasing Plan for Collection Vehicles

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Truck *1	15	7	4	2	2	2	-	-	-	-	-	-	2
Container Truck *2							2						

Note: *1 : For 12 m^3 (min.)
*2 : For 24 m^3 (18 ton) container

4.8 Investment Cost for the Master Plan

Table 4-5 Investment Cost for the M/P

Unit: Thousand US$

- Local currency portion	185,776 (63.9%)
- Foreign currency portion	105,067 (36.1%)
Total	290,843 (100%)

Note: Fixed price basis in 1993 including Import Duty and VAT, but excluding Interest During Construction (IDC).

Table 4-6 Breakdown, Investment Cost for the M/P (Fixed price basis in 1993)

Unit: Thousand US $

	Local	Foreign	Total
Transfer Station	4,311	-	4,311
Incineration Plant	152,696	105,067	257,763
Final Disposal Sites	24,233	-	24,233
Collection Vehicles	4,536	-	4,536
Investment Cost	185,776	105,067	290,843

Note: The above investment cost includes Import Duty and VAT, but excludes Interest During Construction (IDC).

Table 4-7 Investment Schedule for the M/P

Unit: 1,000 US$

Items	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Transfer Station	-	-	-	1,724	2,587	-	-	-	-	-	-	-
Incineration Plant (HHM2)	-	24,441	77,774	77,774	77,774	-	-	-	-	-	-	-
Final Disposal Sites	10,714	-	-	-	-	-	9,543	-	-	3,976	-	-
Collection Vehicles	1,695	848	445	445	445	212	-	-	-	-	-	446
Total Investment Cost	12,409	25,289	78,219	79,943	80,806	212	9,543	0	0	3,976	0	446
Financial Burden to Municipality (%)	1.63	3.33	10.31	10.54	10.66	0.02	1.26	0	0	0.52	0	0.06

Note: Financial burden to the municipality bases on the case that the municipality totally finances and manages the master plan project.

4.9 Implementation Schedule of the Master Plan

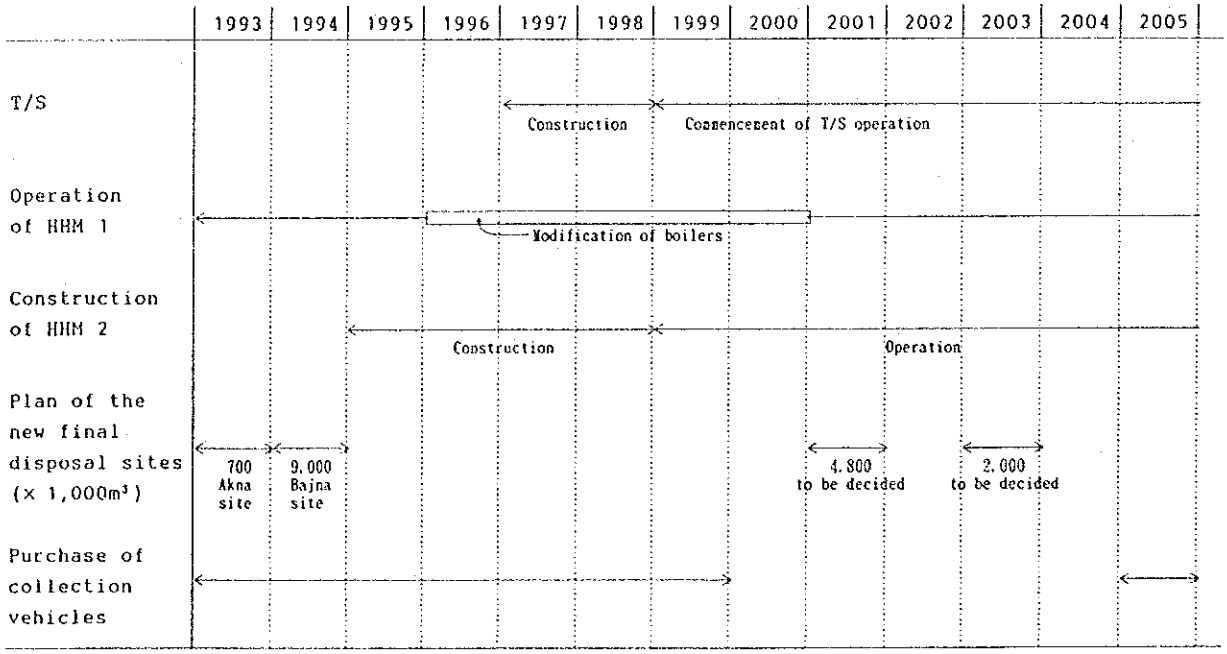


Figure 4-2 Implementation Schedule of the Master Plan

4.10 Conclusion of the Master Plan

The results of examination of technical, institutional, economic and environmental aspects were concluded as follows.

4.10.1 Composition of the Master Plan

The M/P consists of;

- Construction of T/S,
- Operation of HHM1,
- Construction of HHM2,
- Plan of the final disposal sites, and
- Purchase of collection vehicles.

4.10.2 Technical Aspects

- T/S with two compaction lines will be constructed at the district-X Akna site.
- The number of collection vehicles to be purchased can be minimized in cooperation with the functional effects of T/S.
- HHM1 will be continuously operated with the modification of boilers to maintain an incineration capacity of 2,100,000 m^3/year.
- HHM2 will be located in district-XV at the same site with HHM1 and will satisfy the national environmental standards and regulations of the Republic of Hungary.

- For the new final disposal sites, a sanitary landfill method will be adopted.

- Capacities of the new final disposal sites are anticipated to be 16,500,000 m^3. (Refer to the Section 4.7-(3) of p.31)

4.10.3 Organizational and Institutional Aspects

- T/S will be operated by a new organization established in FKFV with seven FKFV employees.

- HHM1 and HHM2 will be managed under a common administrative organization; HHM2 requires fewer employees (89) than HHM1 (182).

- For the new final disposal sites' operation, administrative control of the Budapest Capital City Government will be strengthened to establish a sanitary landfill method.

- The establishment of a special section comprised of ten experts by the year 1995 will be needed to strengthen the present Department of Communal Matters organization, particularly in order to strengthen the following matters of management:

  1) Implementation and supervision of the M/P
  2) Management of information and data concerning the MSW management
  3) Research and development of a MSW management system by separate collection, recycling, treatment by composting and a new fee collection system, etc.
  4) Strengthening of cooperative relationships between the residents and the Budapest Capital City Government in the MSW management system
  5) Supervision of FKFV

- Continuation of experiments on resource recovery and recycling systems and on a compost pilot plant should be carried out by the Budapest Capital City Government.

4.10.4 Financial and Economic Aspects

On the basis of cost and revenue comparison for the both system alternatives, the following advantages and disadvantages are noted.

(1) There is a considerable difference in the investment costs of the two alternatives. In the case of the Alternative-1, only the investment costs for the new final disposal sites and purchase of new vehicles are needed, while in the Alternative-2 the costs of several new items are incurred. Especially, the investment cost for the HHM2 construction makes a big difference between both estimates.

(2) The cost difference between both estimates for operation and maintenance is narrower than the investment cost; however, there is still a 1.2-fold difference. The Alternative-2 costs more than the Alternative-1.

(3) In terms of revenue, however, the Alternative-2 is slightly higher (1.25-fold) than the Alternative-1. The main factor for a small revenue difference is the service fee for final disposal which is higher than the incineration fee under the present service fee system.

(4) Revenues from energy sales contribute a little to the profitability of the project.

(5) In comparison between the operation/maintenance cost and revenue over the projected period, the revenue

exceeds the operation/maintenance cost by a great margin in both cases. This means that the operation/ maintenance cost is covered within the present revenue structure.

(6) The Alternative-2 will have a cash shortage after 1999 (when the operation of HHM2 is started) due to an inbalance between the expenditures (investment cost plus operation cost) and revenues.

In this case, taking into account of the economic, social factors for the project and the following socioeconomic benefits as well as political backgrounds in connection with the decision of the Budapest City General Assembly, which agreed with the necessity of HHM2, and the difficulty of securing the final disposal sites, the Alternative-2 was selected as the M/P.

Socioeconomic benefits

i) Creation of clean environment and contribution to public health
ii) Prolongation of the final disposal sites' lives by reducing the MSW volume generated
iii) Benefit from electric power generation by utilizing the waste energy from the MSW incineration causing fuel import reduction
iv) Contribution to tourism industry

4.10.5 Environmental Aspects

- T/S will be free from environmental problems since noise protection and odor protection as well as a wastewater treatment will be provided.

- The national emission and immission limit values can be satisfied for HHM1 if a new flue gas treatment system is installed properly. However, this issue is not included in the Scope of Work (S/W) of this Study.

- HHM2 will satisfy the national emission and immission limit values from the initial stage of operation, if necessary countermeasures defined by the Environmental Evaluation (EE) are applied. However the night time noise level at two points on the site boundaries will not satisfy the noise limit value due to the facility location being close to the boundaries.

- For the new final disposal sites the environmental problems such as ground water contamination and odor will be minimized by adoption of a sanitary landfill method.

- Environmental impacts of traffic will be minimized in cooperation with the functional effects of T/S.

CHAPTER 5 THE FEASIBILITY STUDY OF THE FIRST PRIORITY PROJECT

In the F/S, the financial, technical and environmental aspects for the first priority project (F/S Project) of the HHM2 construction (as previously shown specifications) were examined.

Furthermore, the first priority project was predicated upon the decision of the Steering Committee of November 12, 1992. The decision of the Steering Committee is based on the decision of the Budapest City General Assembly of October 29, 1992 which underlines the necessity of the construction of HHM2 and the decision to locate it in district-XV at the same site with HHM1.

The installation of a flue gas treatment facility at HHM1 must satisfy the emission and immission values of Hungary as a prerequisite for the conditions for the construction of HHM2.

5.1 Financial Aspects

5.1.1 Financial Analysis

On an incremental basis, the Financial Internal Rate of Return (FIRR; for the period 1994 - 2013) is -3.81% and the Economic Internal Rate of Return (EIRR; for the period 1994 - 2013) is 0.49%.

Although the ratio of revenue to operation/maintenance cost is balanced, investment cost is high relative to the revenue structure. Therefore, total year-end cash balances show deficits for every year.

The execution of the following financial substantiation is therefore necessary.

(1) To minimize the investment cost

- Tax deduction or exemption on the project

(2) To lighten the municipality's financial burden

- Use of government's subsidy or grant for the project
- Use of concessional loans under government's guarantee
- Introduction of a new fee collection system

From the burden share principles (government, municipality, citizen), a desirable financial plan for the project is a combination of the following.

- Total tax exemption by the central government
- Use of foreign concessional loans and budgeting a repayment in the municipality's budget.
- New fee collection system from citizens

The model plan based on this combination is described below (Refer to the Figure 5-1).

It is necessary to exempt all custom duties and VAT on the project and on the other hand to collect the user charges at 118 Ft/month·household for first five years (1994 - 1998) then increase to 235 Ft (1999 - 2013) by FKFV. The municipality as the project owner takes responsibility for loan repayment on the project. It is assumed that the municipality's burden amount will be 840 million Ft (=10 million US$) every year after the commencement of the HHM2 operation.

- Financial plan
  . Tax exemption (by the government)
    .... Duty/VAT exemption
  . Repayment of loans (by the municipality)
    .... 10 Million US$/year
  . New fee collection (from citizens)
    .... 118 Ft/month·household (1994-1998)
    .... 235 Ft/month·household (1999-2013)

In this case the Financial Internal Rate of Return (FIRR) is as follows and the project can be considered financially feasible.

- Financial Internal Rate of Return (1994 - 2013)
  . On the incremental basis
    FIRR: 3.97%
  . On the "With" case*)
    FIRR: 4.54%

The degree of the burden for the government, municipality and citizens, in the event that this financial plan is executed, is respectively shown below:

- Degree of burden
  . Government
    Ratio to national import duty : 0.014%
    Ratio to national VAT : 0.016%

  . Municipality
    Ratio of 10 million US$ to municipality budget : 1.32%

. Citizen

Ratio to average monthly earning (42,100 Ft in 1992) of household

1994-1998: 0.28%
(118 Ft/Month·household)

1999-2013: 0.56%
(235 Ft/Month·household)

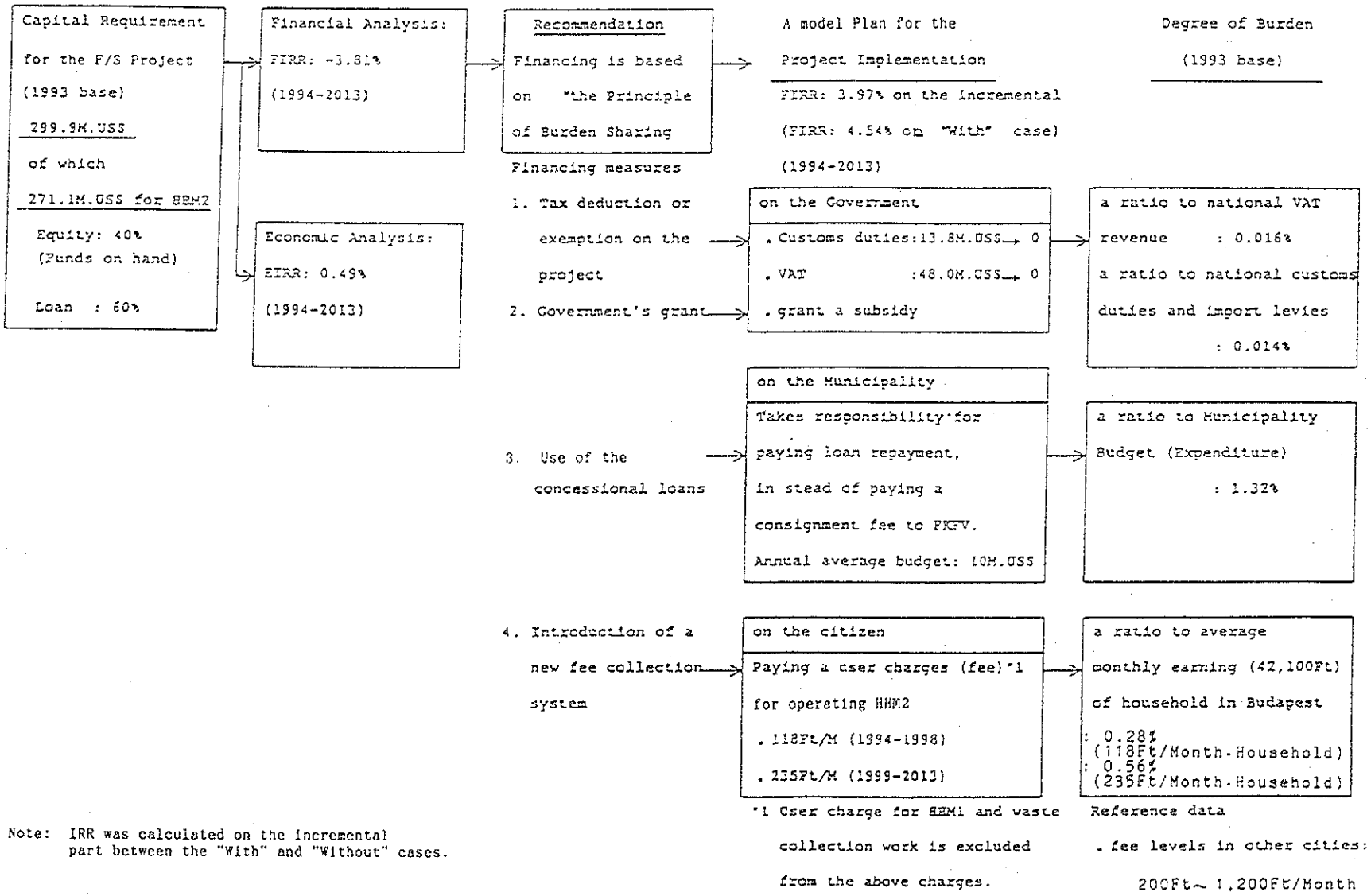
In comparison with the collection fees (200 - 1,200 Ft/month) collected from citizens in other cities in Hungary, this burden should not be difficulty for the citizens of Budapest.

The Figure 5-2, image of cashflow describes the conceptual image of cashflow in this financial plan.

Note*): "With" case

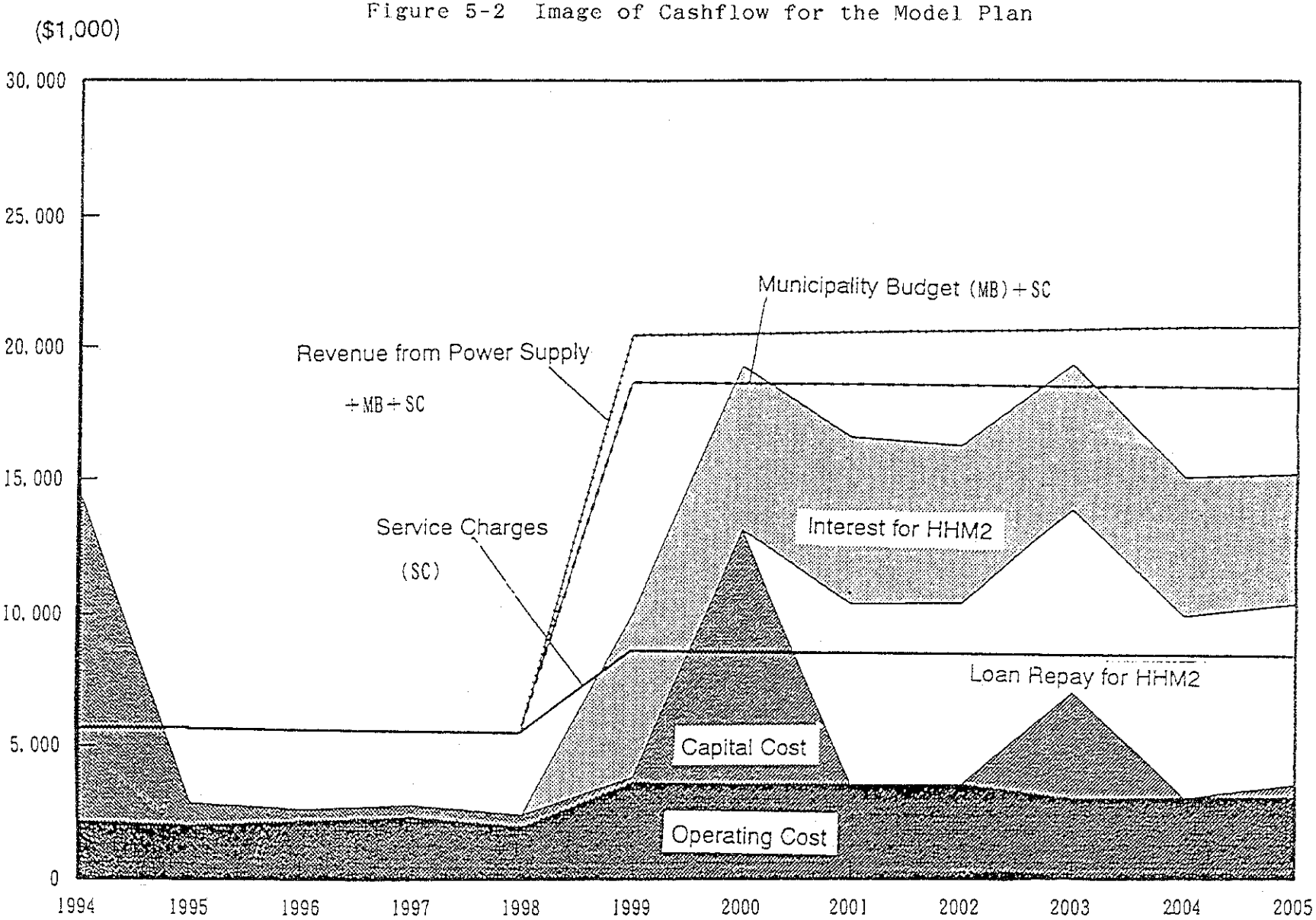
The scope of the Feasibility Study (F/S) is defined as the construction of HHM2. It is, however, a fact that in the future the MSW management system cannot be achieved only by maintaining HHM2. Complementary components such as vehicles to transport the MSW to HHM2 and the final disposal sites for disposing residues from HHM2 are at least needed. The "With" case refers to the project in which such necessary components are included.

Figure 5-1 Recommended Plan for the F/S Project Implementation



Note: IRR was calculated on the incremental part between the "With" and "Without" cases.

Figure 5-2 Image of Cashflow for the Model Plan



Note: Capital cost includes only the cost for the final disposal facilities and purchase of collection vehicles.

5.1.2 Capital Requirements for the Feasibility Study Project

The scope of the Feasibility Study (F/S) is defined as the construction of HHM2. It is, however, a fact that in the future the MSW management system cannot be achieved only by maintaining HHM2. In addition to the capital requirements for HHM2 shown in the Table 5-1, complementary components such as vehicles to transport the MSW to HHM2 and the final disposal sites for disposing residues from HHM2 are at least needed. The capital requirements for the "With" case including the costs for such necessary components are presented in the Table 5-2.

Table 5-1 Estimated Capital Requirements for the F/S Project (HHM2 construction)

Unit: Thousand US$

- Local currency portion	155,375 (57.3%)
- Foreign currency portion	115,718 (42.7%)
Total	271,093 (100%)

Note: Fixed price basis in 1993 including Import Duty and VAT as well as Interest During Construction (IDC)

Financial plan (preconditions for calculation)

. 40% of the capital requirements: by either the Budapest Capital City Government or the central government as a grant.
The remained 60% of the capital requirements: by foreign long term loan (conditions; interest rate: 5%, repayment: 18 years after 7 years grace periods)
. In the case of cash shortage, short term loans should be obtained from local capital market or supplemented by the Budapest Capital City Government.

Estimated capital requirements for the "With" case*) is presented in the following Tables.

Table 5-2 Estimated Capital Requirements for the "With" Case (Fixed price basis in 1993)

For HHM2 Unit: 1,000 US$

Items	Local	Foreign	Total
A. Land & demolition	357	-	357
B. Civil work	12,023	-	12,023
C. Building construction	22,262	-	22,262
D. External facilities	5,595	-	5,595
E. Equipment & materials			-
- Plant equipment	18,638	62,571	81,209
- Electrical & control equipment	-	22,393	22,393
- Equipment for laboratory & workshop	-	2,345	2,345
F. Ocean freight & insurance	-	4,365	4,365
G. Erection work	10,917	-	10,917
H. Engineering services	833	10,714	11,547
Base Project Cost - 1993	70,625	102,388	173,013
I. Import Duty	13,751	-	13,751
J. Value Added Tax (VAT)	47,987	-	47,987
Erected Plant Cost - 1993	132,363	102,388	234,751
K. Pre-operation expense (incl. Commissioning work)	5,155	-	5,155
L. Interest During Construction (IDC)	-	13,330	13,330
M. Compensation fund for local district	17,857	-	17,857
Estimated Capital Requirement for HHM2 - 1993	155,375	115,718	271,093
For Other Components			
N. Final disposal facilities	24,232	-	24,232
O. New vehicles	4,536	-	4,536
Grand Total	184,143	115,718	299,861

Note: IDC for the compensation fund is excluded from the above IDC amount because the fund will be disbursed at the final year of construction period.

): Refer to Note) "With" case in p43.

Table 5-3 Investment Schedule for the "With" Case*)

	Unit:1,000 US$	%
ICR (1994 - 1998)	285,685	95.3%
of which 1994 - 95	(40,366)	(13.4%)
1996	(81,773)	(27.3%)
1997	(81,773)	(27.3%)
1998	(81,773)	(27.3%)
ACR 1 (1999 - 2002)	9,755	3.3%
ACR 2 (2003 - 2005)	4,421	1.4%
	299,861	100.0%

Note: The above investment cost includes the cost of the new final disposal sites, new collection vehicles and Interest During Construction (IDC).

ICR: Initial capital requirement
ACR: Additional capital requirement

): Refer to Note) "With" case in p43.

Table 5-4 Municipality's Financing Burden in the "With" Case*)

Unit: 1,000 US$, %

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
I	Municipality's Total Budget	758,083	758,083	758,083	758,083	758,083	758,083	758,083	758,083	758,083	758,083	758,083	758,083
II	Municipality's MSW management budget (in 1993 basis)	12,229	12,229	12,229	12,229	12,229	12,229	12,229	12,229	12,229	12,229	12,229	12,229
III	Additional MSW management budget (Municipality's covering ratio, 40% of future operating cost)	863	806	306	931	790	1,440	1,425	1,413	1,418	1,202	1,205	1,211
IV	Additional Capital Requirement 1)	12,409	848	445	445	445	9,686	19,017	20,000	19,474	22,923	18,421	18,340
V	Additional Financing Burden (III + IV)	13,272	1,654	751	1,376	1,235	11,126	20,442	21,413	20,892	24,125	19,626	19,551
VI	Additional Financing Burden Ratio (%) (V/I)	1.75	0.22	0.10	0.18	0.16	1.47	2.70	2.82	2.76	3.18	2.59	2.58

Note: 1) The amount excepting equity portion
2) Total budget and the MSW management budget of the municipality were fixed with 1993 basis without escalation and other factors.

: Refer to Note) "With" case in p43.

5.2 Technical Aspects

As a result of technical examination of incineration process components, the first priority project is structured as shown in the Figure 5-3.

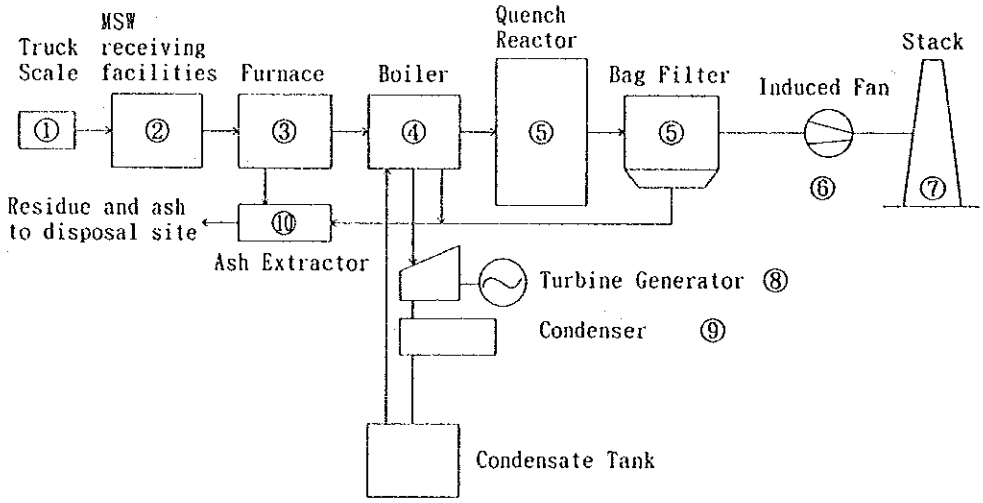


Figure 5-3 Process Flow

Specification :

① Truck scale : Automatic scaling type

② MSW receiving facilities : Pit and overhead crane system

③ Furnace : Stoker type, water-cooled tube wall, Automatically programmed combustion control

④ Boiler : Natural circulation type

⑤ Flue gas treatment system : Semi-dry, bag filter type

⑥ Induced draft fan: Motor driven turbo fan

⑦ Stack : Two steel made inner stacks with 80m height and one concrete made outer stack,

⑧ Turbine generator: Steam turbine - condensing extraction turbine Max. power capacity; Approx. 35,000kW (at 212 ton/hour)

⑨ Condenser : Air-cooled type condenser

⑩ Ash extractor : Semi-wet type extractor

5.3 Environmental Aspects

The EE was quantitatively carried out for air and noise pollutions. Water and odor were also qualitatively evaluated.

(1) Air pollution

The model of ISAQA (Gaussian-plume Individual Source Air Quality Algorithm) was used for a dispersion study.

The conditions for dispersion study and results are shown in the Table 5-5 and Table 5-6.

The emission value from HHM2 satisfies the emission control value of Hungary.

Table 5-5 Conditions for Dispersion Study

Case	Plant	Stack height m	Flue gas flow Nm^3/h	Temperature °C	Speed m/s
A	HHM1+FGTS	120	240,000	140	10,5
B	HHM2	80	114,300	145	29
C	HHM2	100	114,300	145	29

Note: FGTS = Flue gas treatment system

Table 5-6 Results of Dispersion Study

Case	Pollutants $\mu g/m^3$								Distance from the stack Km
	SO_2	NO_x	HCl	HF	Hg	Cd, Tl	Σ_1	Σ_2	
A	23	31	6	0.2	0.012	0.012	0.005	0.12	1.5
B	18	24	4	0.2	0.009	0.009	0.09	0.09	0.5
C	12	16	3	0.1	0.006	0.006	0.06	0.06	1 and 3

Note: Σ_1 = Σ(As, Se, Ni, Co, Tc) Σ_2 = Σ(Pb, Cr, V, Sn, Mn, Sb)

The result of the EE shows that the immission limits were satisfied.
(Refer to the Table 5-7 of immission limit values)

An analysis of these results gives the following information.

- The impact + background concentration in connection with HHM2 are below the immission limit values for every case.
- The necessary stack height for HHM2 is 80 m (case B in the Table 5-5 was used.)

Table 5-7 Immission Limit Values

(Unit: mg/m³)

Air pollutant (mg/m³)	specially protected area	protected area I	protected area II
SO_2			
- annual average	0.03	0.07	0.15
- 24 hours average	0.10	0.15	0.50
- 30 minutes value	0.15	0.50	1.00
NO_2			
- annual average	0.03	0.07	0.12
- 24 hours average	0.07	0.085	0.15
- 30 minutes value	0.085	0.10	0.20
CO			
- annual average	1.0	2.0	5.0
- 24 hours average	2.0	5.0	10.0
- 30 minutes value	5.0	10.0	20.0
suspended particles			
- annual average	0.03	0.05	0.10
- 24 hours average	0.06	0.10	0.20
- 30 minutes value	0.10	0.20	0.30
lead			
- 24 hours average	0.0003	0.0003	0.001
- 30 minutes value	0.0003	0.0003	0.002
ozone			
- 24 hours average	0.10	0.10	0.10
- 30 minutes value	0.20	0.20	0.20

Source: Standard MSZ-21854-1990

Note : Protected area I is subjected to this project.

(2) Noise pollution

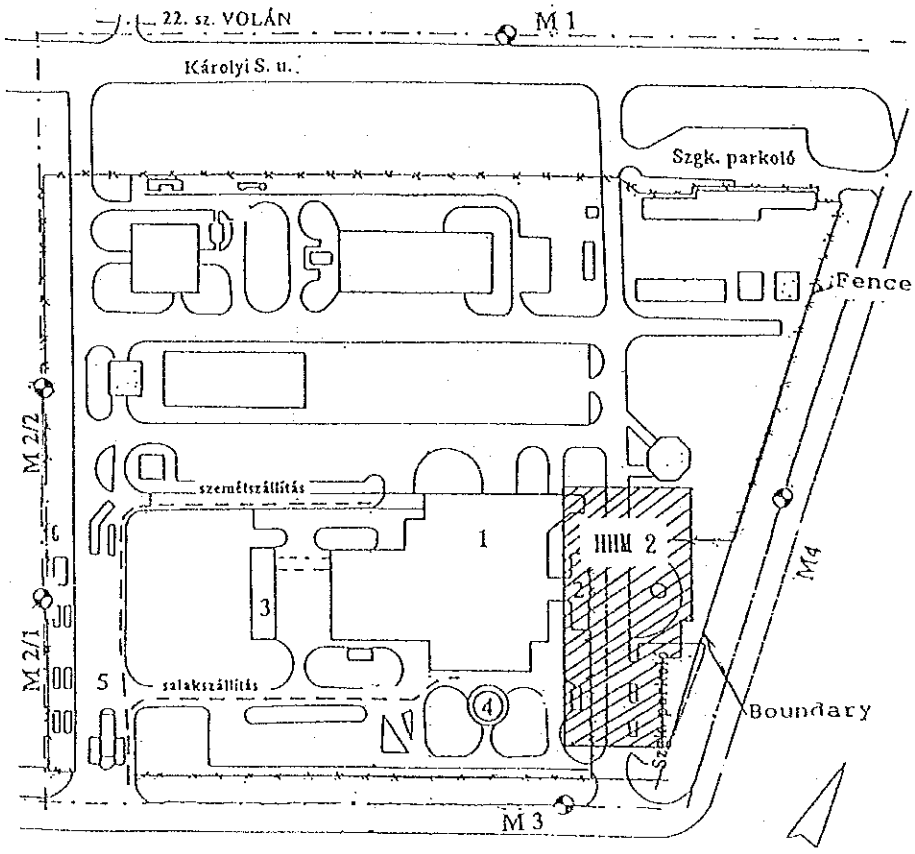
Total noise levels from the incineration plants were calculated by means of simulation, and results show that the noise levels at the designated points on the site borderlines were below the Hungarian standards. However, two points at M3 and M4 were slightly over the standards (50 dB(A)) during the night time.

Necessary mitigation measures applying sound proof construction, sound insulation materials, sound insulating wall, etc. should be examined for the points at M3 and M4 which will exceed the night limit values during the basic and detailed design phase.

Table 5-8 Noise Levels

Points	HHM1		HHM2		Traffic	Total noise levels	
	Day	Night	Day	Night	Day	Day	Night
M1	52	46	15	15	+0.7	<53	<46
M2/1	48	<41	25	25	+0.7	<49	<41
M2/2	48	41	23	23	+0.7	<49	<41
M3	52	53	32	32	+0.7	<53	<53
M4	58	58	33	33	+0.7	<59	<53

Note: All values given in dB(A)



:Location of Forecasting Points S : 1/2850

Note: 1:HHM1, 2:OFFICE, 3:STEAM CONDENSER,
4:STACK,5:TRUCK SCALE

Figure 5-4 Location of Measuring Points

5.4 Implementation Schedule of the First Priority Project

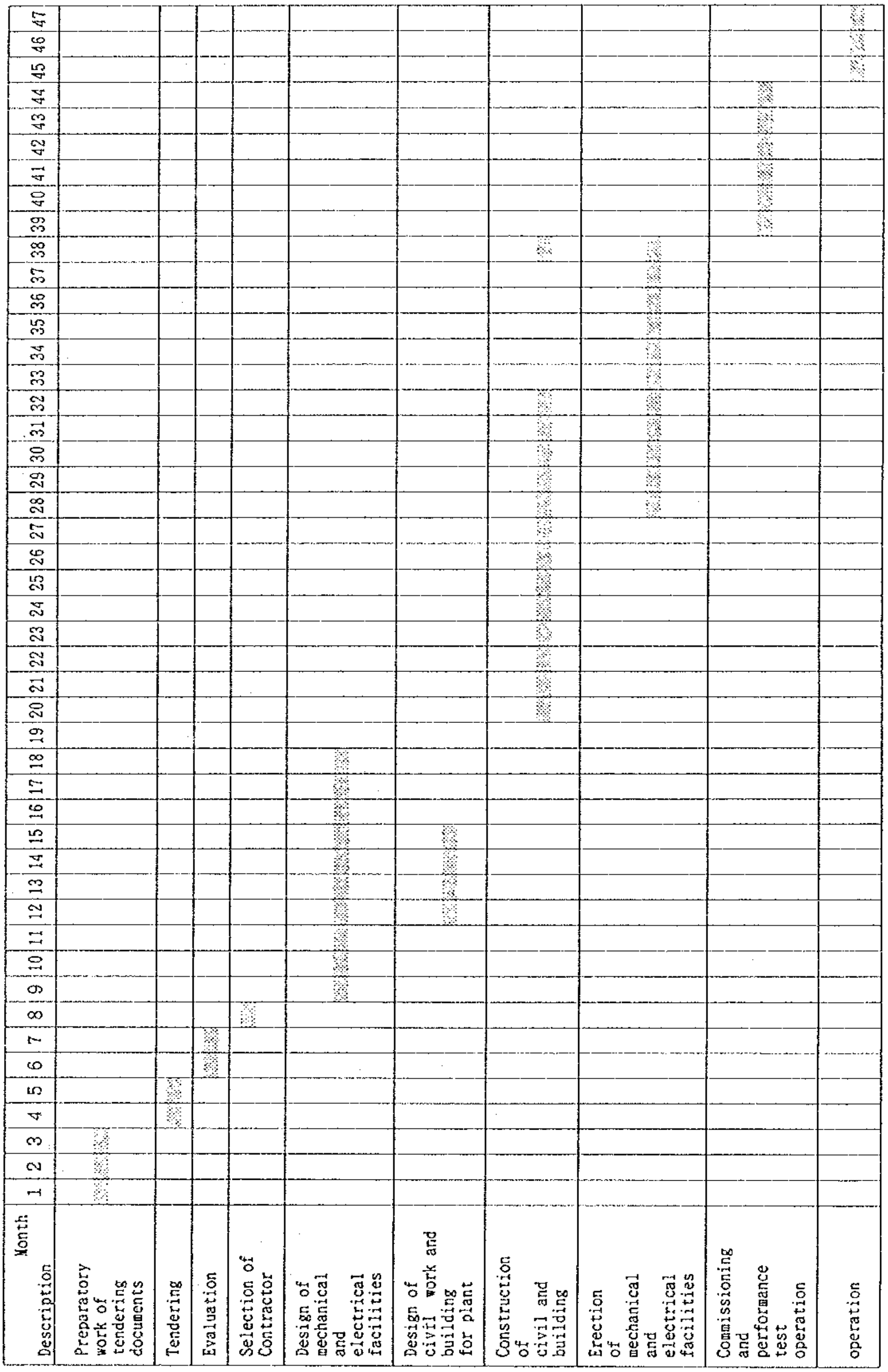


Figure 5-5 Implementation Schedule of the First Priority Project

5.5 Conclusions of the Feasibility Study

Given the prerequisite that financial substantiation will be provided the following conclusions can be derived from the F/S on the first priority project defined as the construction of HHM2.

5.5.1 Financial and Economic Aspects

- On an incremental basis, FIRR and EIRR are -3.81% and 0.49% respectively for the project.

  In the HHM2 construction project, the investment cost is high relative to the revenue structure, in spite of the revenue-operation cost ratio being in balance. Namely, the HHM2 construction requires the provision of financial substantiation by changing the revenue structure to cover the investment plus interest cost or by financing the investment cost by subsidies (or grants) from the government.

  Therefore, from the financial point of view, in order to implement the project the terms and conditions of financing capital must be softened. For instance, FIRR indicates 4.54% in case of tax exemptions and an increase in revenues which mean the incineration and the final disposal fees in this case, of up to 200% in the "With" case*).

  ): Refer to Note) "With" case in p43.

5.5.2 Technical and Operational Aspects

- The capacity of HHM2 is 960 t/day (6,000 hour/year operation).
  By adopting adequate equipment and systems, HHM2 can operate for a long period of over 6,000 hours in a year.

- The results of the geological investigation at the HHM2 construction site will present technical information and data for civil engineering and building design.

5.5.3 Organizational and Institutional Aspects

- Taking advantage of the fact that HHM2 will be constructed at the same site with HHM1, HHM2 can be operated with a minimum number of employees. Under a plant superintendent with 19 managing staff members, both plants can be effectively managed.

5.5.4 Environmental Aspects

- The Environmental Evaluation (EE) carried out by the JICA Study Team showed that HHM2 will satisfy the national emission and immission limit values except for night time noise levels at two points which exceed slightly noise limit level on the site boundaries. With necessary mitigation measures applying sound proof construction, sound insulation materials, sound insulating wall, etc., these exceeding noise levels will be reduced below the limit level.

CHAPTER 6 RECOMMENDATIONS

6.1 Introduction

The aim of the proposed recommendations is to formulate the conditions necessary for the implementation of the first priority project and to assure smooth implementation of the main components of the M/P.

6.2 Recommendations on the Master Plan

6.2.1 Administrative and Organizational Aspects

- Economic incentives for resource recovery and recycling and legal or taxation measures should be established to reduce the MSW volume generated.

- It is recommended that the public be informed about the main issues of the present MSW management and the aims of the M/P for their participation and enlightenment.

- A specific section with ten experts for strengthening present organization of the Department of Communal Matters should be set up to manage the following.

  1) Implementation and supervision of the M/P
  2) Management of information and data concerning the MSW management
  3) Research and development of the MSW management system by separate collection, recycling, treatment by composting and a new fee collection system, etc.
  4) Strengthening of cooperative relationships between the residents and the Budapest Capital City Government in the MSW management system
  5) Supervision of FKFV

6.2.2 Technical Aspects

- Although the final disposal site of Bajna is located outside the Budapest city, the Budapest Capital City Government must provide all necessary technical measures and technical support (management and control of the sanitary final disposal site).

6.2.3 Financial Aspects

The economic and social factors for the project should be considered in comparison of the two alternatives. For instance, the cost of waste treatment by individual households for the Alternative-1 will be higher than the projected investment cost for the Alternative-2 (M/P).

The general consensus of the Budapest citizens (City Council) and the central government is first needed to implement the project and finance it. Furthermore, the municipality should adopt a management plan from the view point of the Polluter Pays or Burden Share Principles among three parties (government, municipality and citizen).

6.2.4 Environmental Aspects

- The Environmental Impact Assessment (EIA) should be performed in accordance with the Hungarian EIA guidelines for the new final disposal site in Bajna as well as for other future disposal sites.

- From the view point of pollution prevention, the separate collection of wastes such as batteries, dry cells, oil, solvents, and tires that get mixed into the MSW should be studied.

6.3 Recommendations on the Feasibility Study

6.3.1 Administrative and Organizational Aspects

- The establishment of an administrative and organizational scheme for the common management of HHM1 and HHM2 is recommended.

6.3.2 Technical Aspects

- In order to absorb monthly and daily fluctuations of the MSW generation, it is recommended that HHM2 should be designed with the conditions of (i) sufficient capacity with 15% in excess of the rated capacity, (ii) four days storage capacity of the MSW and (iii) increasing operation hour capability up to 7,000.

- It is recommended to establish the necessary disposal conditions for disposal of incineration residues (residue, ash) from HHM2 and to start tests on treatment of these residues in order to transform them into harmless material used for construction.

6.3.3 Financial Aspects

Raising of the needed capital is a key subject for project implementation. The following measures are therefore recommended.

(1) Minimize the investment cost

- Tax deduction or exemption on the project

(2) Lighten the municipality's financial burden

- Use of government's subsidy or grant for the project

- Use of concessional loans under government's guarantee
- Introduction of a new fee collection system
- Raising of own revenue sources (request for increasing of tax distribution by the central government)

From the view point of burden share principles, a desirable financial plan for the project is a combination of the following.

- Total tax exemption by the central government
- Use of foreign concessional loans and incorporation of a repayment plan in the municipality's budget
- New fee collection system from citizens

The model plan in the Section 5.1.1 of p40 shows an example of a desirable financial plan for the project. Exemption of all custom duties and VAT on the project and collection of user charges, 118 Ft/month per household for the first five years (1994 - 1998); raised to 235 Ft/month thereafter (1999 - 2013) by FKFV should be implemented. As the project owner, the municipality is responsible for loan repayment on the project. It is assumed that the municipality's burden will be 840 million Ft per year after the commencement of the HHM2 operation.

In this case, FIRR on the incremental basis is 3.97%, while FIRR for the "With" case*) alone is 4.54%. Therefore, the financial feasibility of the project can be justified.

): Refer to Note) "With" case in p43.

6.3.4 Environmental Aspects

- The results of the Environmental Impact Assessment (EIA) for HHM2 should be analyzed by the Budapest Capital City Government, and approved by the City Council.

- The necessary mitigation measures for noise pollution, etc. should be examined during the basic and detailed design phase.

- With regards to equipment performance which may cause some impact on the environment, necessary tests and inspections should be carried out to confirm that specifications are met during the commissioning of the plant.