

MUNICIPALITY OF POZNAN
MINISTRY OF PHYSICAL PLANNING AND CONSTRUCTION
THE REPUBLIC OF POLAND

**THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY
FINAL REPORT
VOLUME II : MAIN REPORT**

MAY 1993

**KOKUSAI KOGYO Co.Ltd.,
PACIFIC CONSULTANTS INTERNATIONAL**

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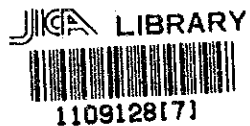
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JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

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In this report, project cost is estimated at January 1993 price and at an exchange rate of 1 US\$ = ¥ 125 = 15,700 Zl.

PREFACE

In response to a request from the Government of the Republic of Poland, the Government of Japan decided to conduct a master plan and feasibility study on the Solid Waste Management for Poznan City and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Poland a study team headed by Mr. Shinya Kawada, Kokusai Kogyo Co., Ltd. and composed of members from Kokusai Kogyo Co., Ltd. and Pacific Consultants International, four times between April 1992 and March 1993.

The team held discussion with the officials concerned of the Government of Poland, 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 Poland for their close cooperation extended to the team.

May 1993



Kensuke Yanagiya

President

Japan International Cooperation
Agency

May 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 Solid Waste Management for Poznan City in the Republic of Poland. This study contains the master plan until 2010 and the feasibility study on the first priority projects.

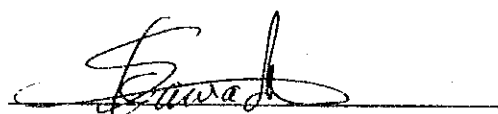
The master plan proposes the construction of an incineration plant, 8 public recycling centres and a sanitary landfill, and the feasibility study was conducted for the first priority projects which consist of the incineration plant (phase 1), 8 public recycling centres and the sanitary landfill (1st section).

Throughout the study, we have taken into full consideration the present situation in Poznan, and have concluded that the proposed first priority projects are feasible. We recommended to the Municipality of Poznan 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, and the Ministry of Welfare. We also wish to express our deep gratitude to the Ministry of Physical Planning and Construction, the Municipality of Poznan, the Municipality of Lublin, and the Embassy of Japan in the Republic of Poland.

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

Respectfully,



Shinya KAWADA

Team Leader

The Study of the Solid Waste
Management of Poznan City

**THE STUDY
ON
THE SOLID WASTE MANAGEMENT
FOR
POZNAN CITY**

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VOLUME I : EXECUTIVE SUMMARY

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- C. Public Opinion Survey
- D. Investigation of Present and Candidate Disposal Sites
- E. Other Field Surveys
- F. Present Municipal Solid Waste Management
- G. Evaluation of Present MSWM
- H. Examination of Technical System Alternative Plan
- I. The Master Plan
- J. Feasibility Study of the First Priority Project
- K. General Recommendation for the Improvement of ISWM

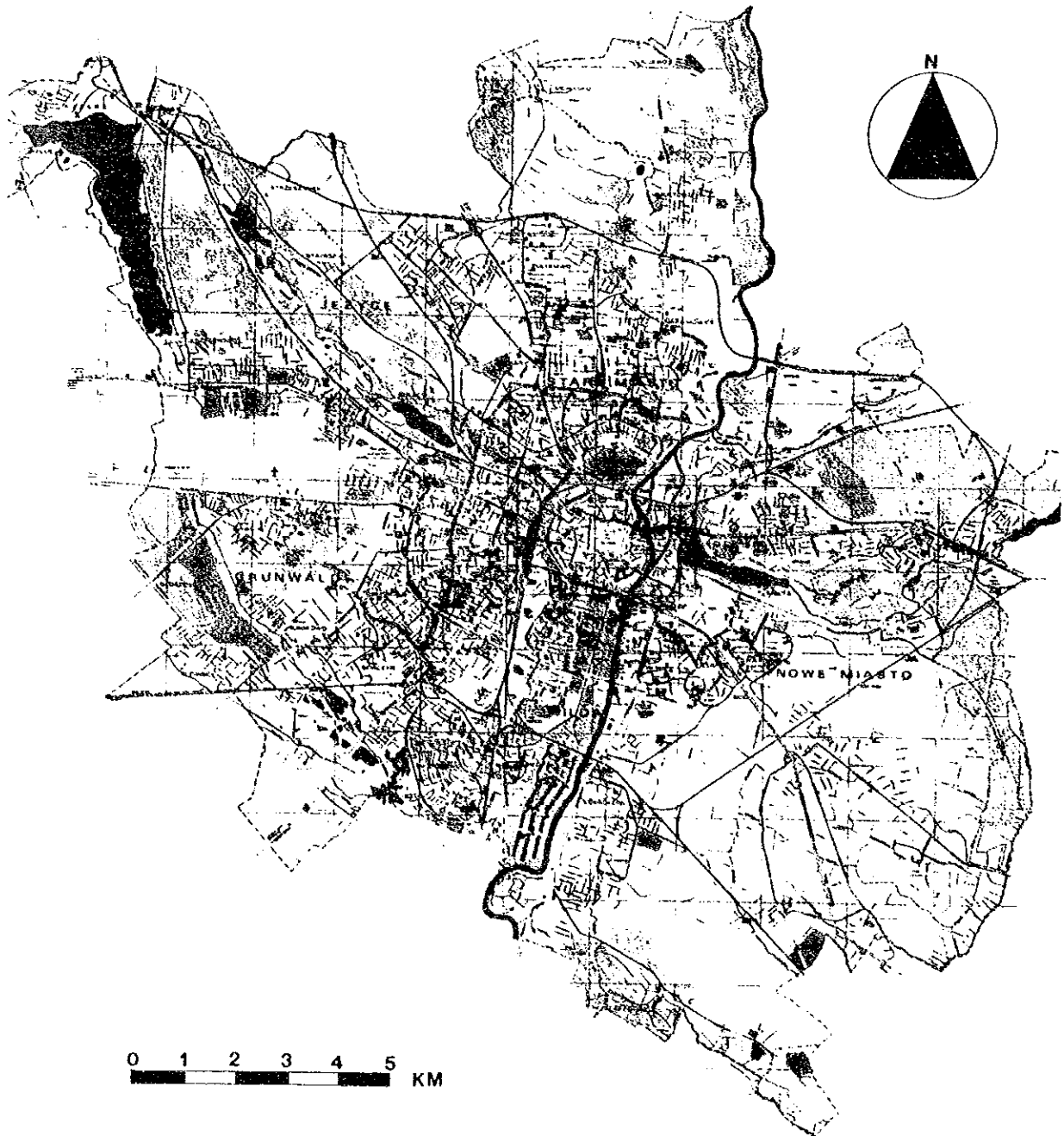
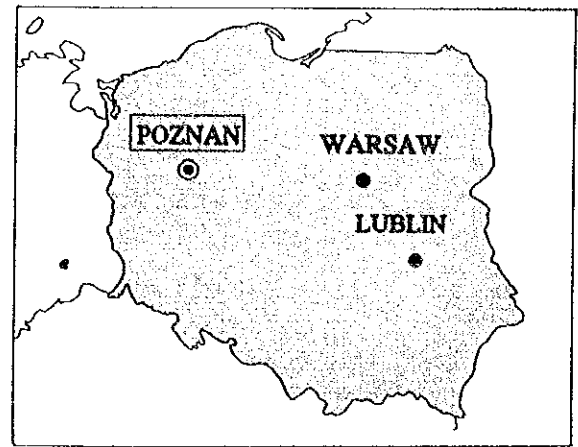
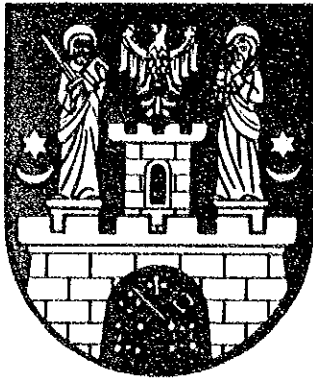
VOLUME IV : DATA BOOK

MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN (English Version)

MANUAL FOR FORMULATION AND IMPLEMENTATION OF MSWM MASTER PLAN (Polish Version)

CASE STUDY OF MSWM MASTER PLAN MANUAL FOR LUBLIN

This is MAIN REPORT.



LOCATION MAP

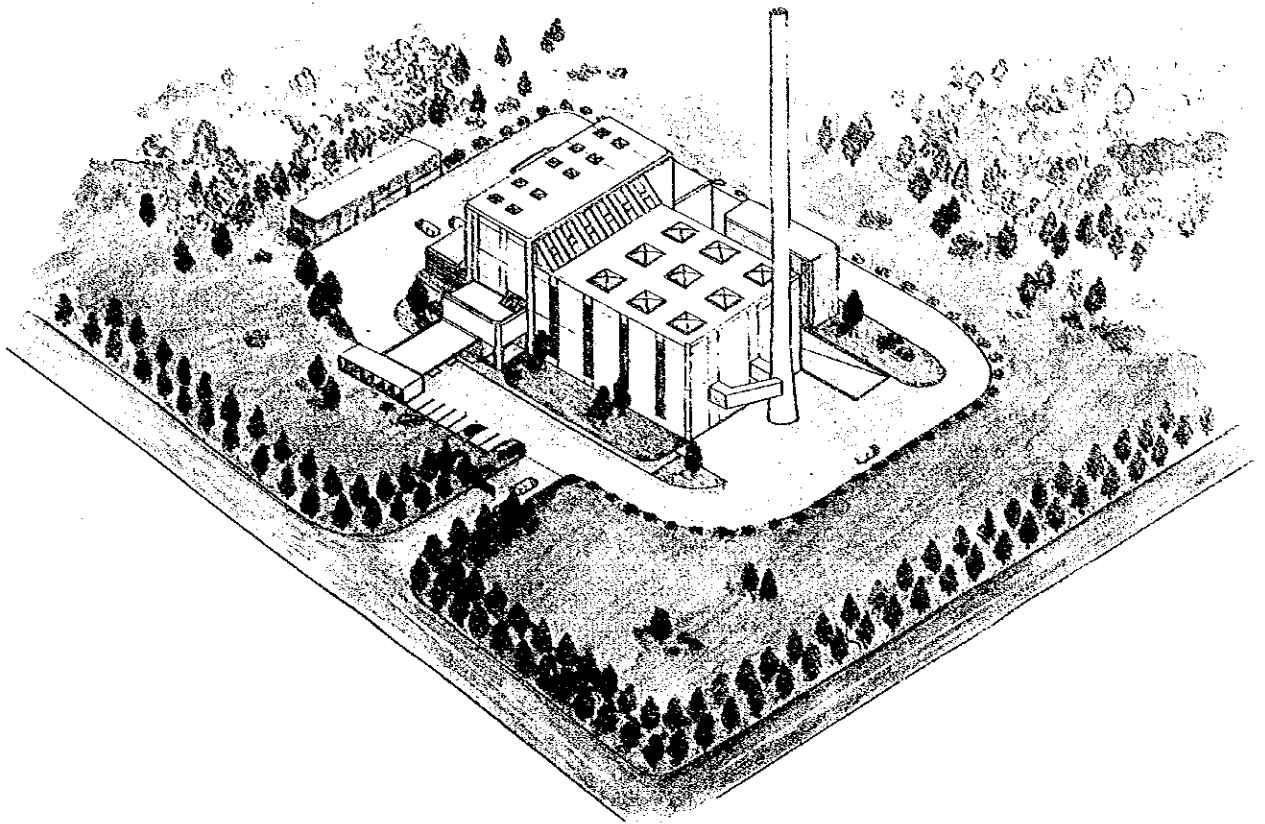


Plate 1 Image of Incineration Plant

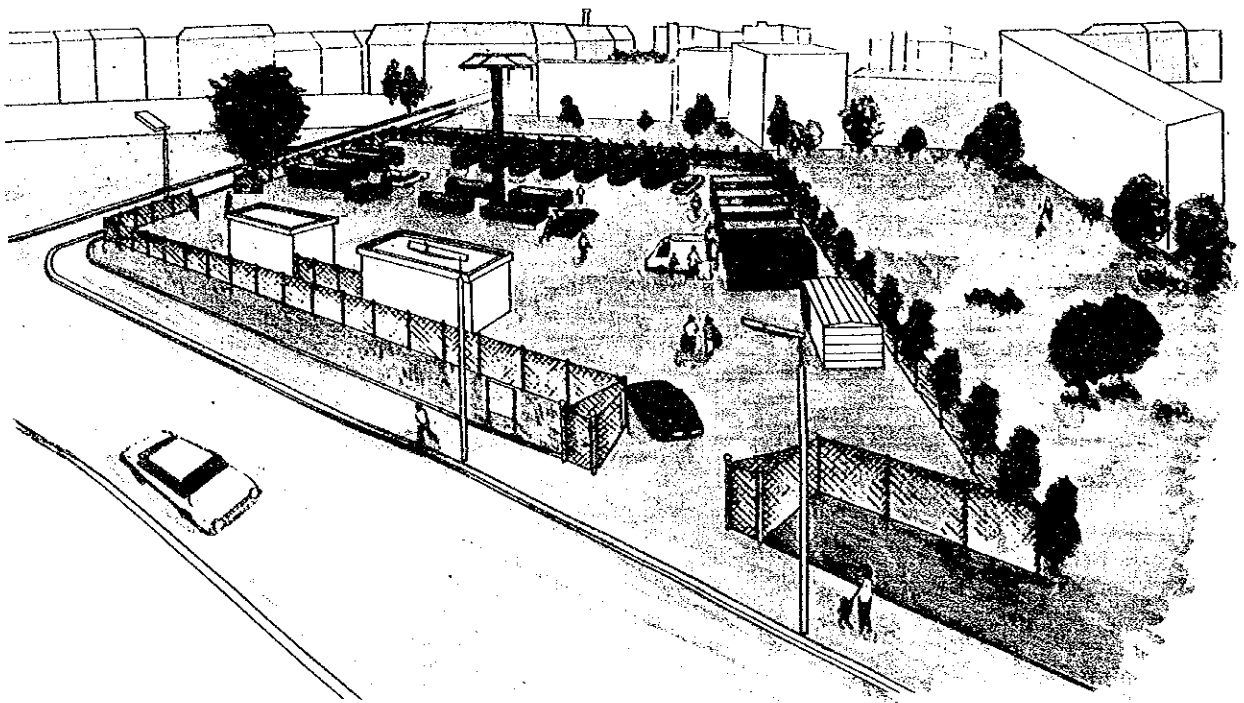
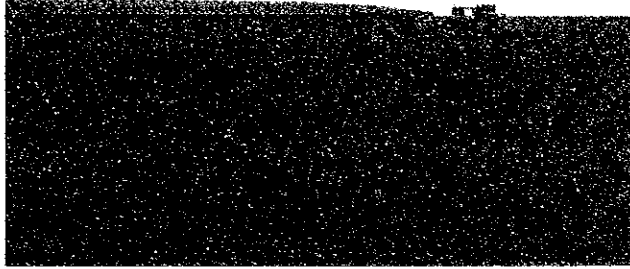
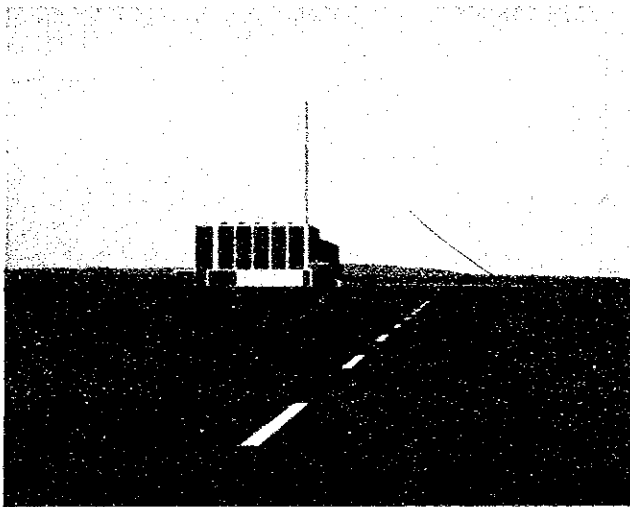


Plate 2 Image of Public Recycling Centre

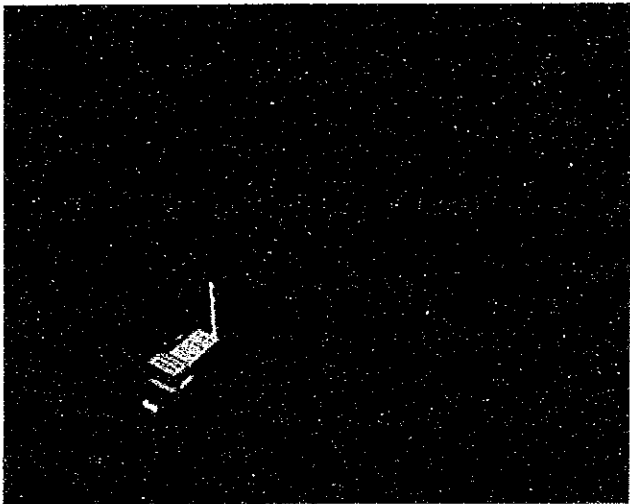
from South

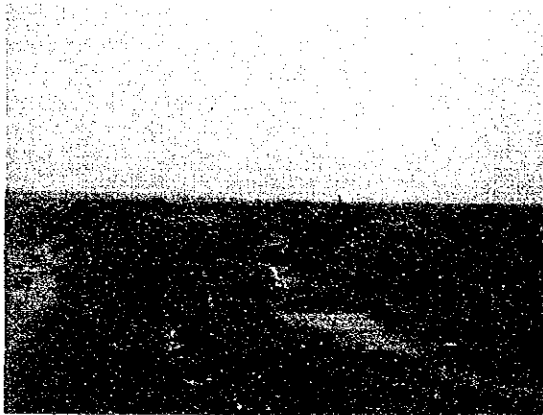


from East



Bird's Eye View
(from Northern East)

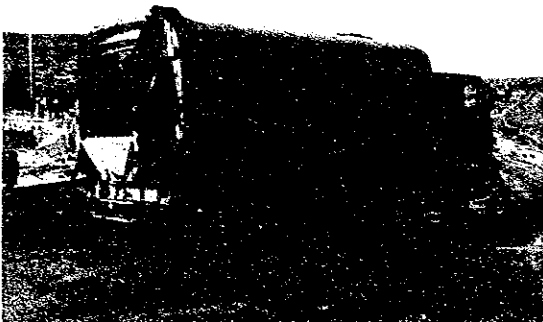




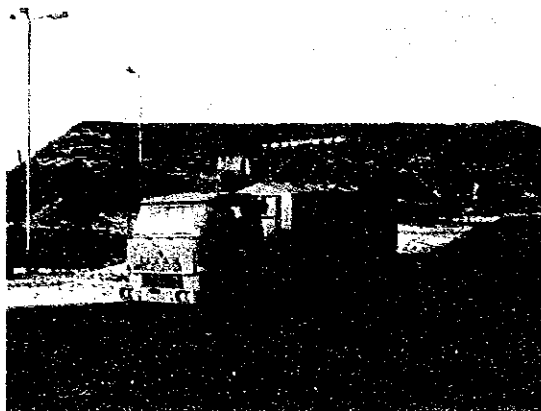
Existing landfill at Suchy Las



Control House and Truck Scale at Suchy Las



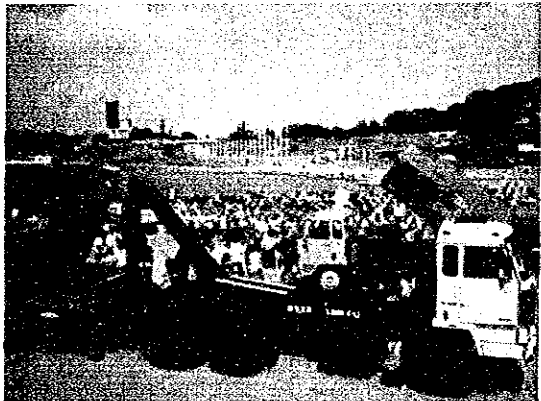
Compaction Truck



Hoist Truck



One of Illegal Dumping Sites



Promotion Event of Public Cooperation
(Malta Ecological Marathon)

THE STUDY ON THE SOLID WASTE MANAGEMENT FOR POZNAN CITY

PREFACE

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ABBREVIATIONS

ORGANIZATIONS

DIA	Department for Investment Affairs, Poznan Municipality
DCRA	Department for Communal and Residential Affairs, Poznan Municipality
EBRD	European Bank for Reconstruction and Development
EC	European Communities
JICA	Japan International Cooperation Agency
LPEC	Lublin Heat Energy Company
MOPPC	Ministry of Physical Planning and Construction
MPO	Municipal Cleansing Company
PEC	Heat Supply Company
SANEPID	Sanitary Epidemiological Institute
SANITECH	Sanitary Technology Company

REPORT and STUDY

ASG	Apparent Specific Gravity
CV	Calorific Value
DF/R	Draft Final Report
F/R	Final Report
IC/R	Inception Report
ISW	Industrial Solid Waste
ISWM	Industrial Solid Waste Management
IT/R	Interim Report
LCV	Lower Calorific Value
M/M	Minutes of Meeting
MSWM	Municipal Solid Waste Management
O & M	Operation and Maintenance
PR/R	Progress Report
S/W	Scope of Work
SWM	Solid Waste Management
WACS	Waste Amount and Composition Survey
EC PHARE Report	Municipal Waste-Strategy for Waste Management and Applicable Methods for Collection and Treatment in 1992

SOCIO-ECONOMY

EIRR	Economic Internal Rate of Return
FIRR	Financial Rate of Return
GDP	Gross Domestic Product

GNP	Gross National Product
GRDP	Gross Regional Domestic Product
USD	U.S. dollar
zl	Zlotych
p.a.	per annually
mill.	million
bill.	billion

UNIT

mm	millimetre
cm	centimetre
m	meter
km	kilometre
m ²	square meter
km ²	square kilometre
ha	hectare
m ³	cubic meter
mg	milligram
lit.	litre
kg	kilogram
ton	ton
sec.	second
min.	minutes
hr	hour
d	day
%	percent
no.	number
nos.	numbers
kw	kilowatt
kj	kilojoule
kcal	kilocalorie

PART I

INTRODUCTION

CHAPTER 1

INTRODUCTION

CHAPTER 1 INTRODUCTION

This chapter describes the outline of the Study, i.e. background, objective, policy, key assumptions, work process and organization of the study. The readers may understand the general feature of the study by the chapter.

1.1 Background

The Republic of Poland has devoted itself to transforming its economy and social-political systems into a democratic free market economy since 1989.

During the socialist government period, environmental protection measures were not fully taken because the government gave priority to industrialization and productivity. After democratization was implemented, environmental pollution problems in Poland were brought up and environmental improvement became a priority.

The improvement of municipal SWM (Solid Waste Management), an item which is directly related to the environment and welfare of the local people, can be and should be carried out under the local governments. The role of the Central Government in this case is to assist the local governments in their efforts concerning MSWM improvement.

The Government of Poland, therefore, has been planning a study project to formulate an MSWM master plan for the City of Poznan as a model for other major cities.

In Poznan City, the MSWM system has not been sufficiently established and many problems such as mix waste collection, unsanitary waste disposal and illegal dumping can be observed. It is, therefore, essential to establish a comprehensive MSWM plan immediately to cope with the expected increase in the demand for MSWM services, both in quantity and quality.

In response to the request of the Government of Poland, the Government of Japan decided to conduct a study on the SWM of Poznan City in accordance with the relevant laws and regulations in force in Japan. Accordingly, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, undertook the Study in close cooperation with the concerned authorities of the

Government of Poland. Kokusai Kogyo Co. Ltd., and Pacific Consultants International were the consultants selected by JICA to carry out the Study.

1.2 Scope of the Study

1) Objective of the Study

The objectives of the Study are:

- to formulate a master plan for the improvement of the Municipal Solid Waste Management of Poznan City in the target year 2010;
- to make recommendations on the future Industrial Solid Waste Management strategies of Poznan City;
- to conduct a feasibility study on the priority project to be identified in the said master plan;
- to prepare a manual for the formulation and implementation of the MSWM master plan; and
- to carry out a case study in Lublin in order to i. check the applicability of the draft manual to other Polish cities, ii. make necessary modifications on it, and iii. to prepare recommendations for the improvement in the City of Lublin including a concept of her municipal SWM master plan.

2) Study Area

The study area was the whole area within the boundaries of Poznan City. The future landfill site and its environs, however, were included in the study area even if they are located outside Poznan City.

3) Study Waste

The wastes studied were household wastes, market wastes, commercial wastes, road sweeping wastes and institutional wastes. Medical wastes, however, were excluded. As for industrial solid waste, a quick diagnosis was carried out based on existing information and data, resulting in the proposal of general recommendations for the improvement of industrial solid waste management in Poznan City.

1.3 Policy of the Study

1) Utilization of Local Consultants

The eminent characteristics of an MSWM study are;

- a. The study has to be carried out during the time when the existing MSWM system is operating.
- b. The essence of MSWM is the prompt removal and appropriate processing/disposal of generated waste. An appropriate MSWM system cannot be established without the mutual cooperation of the public and the administration. In this context, a proper understanding of the social and cultural background of the study area is essential in the preparation of an MSWM plan.
- c. The MSWM is directly related to daily life of the people. The proposed plan would not be sufficient and workable only with the careful consideration of the intention of the administrators and officers concerned in MSWM. It should also take the opinion of the citizens into consideration.
- d. In order to formulate a workable and appropriate MSWM master plan, it is indispensable to understand the resident's way of thinking in the area, customs and their daily activities in addition to the present MSWM technical and institutional system, and the natural and socio-economic conditions of the Study area.

In addition to the above-mentioned aspects, due to the rapid change in the socio-economic, as well as the political situation in Poland, it was very important to identify the present status of the institutional system on MSWM and to make an appropriate institutional development plan. This task, however, was not easy for foreign professionals without the appropriate support of the Polish professionals. Therefore, a team of Polish consultants was utilized to successfully conduct the Study within a limited period and to make a master plan compatible with local conditions.

2) Joint Study

With the above-mentioned reasons, the Study Team proposed the joint implementation of the Study and asked the cooperation and active participation of the Polish side, specially regarding the following works:

- public opinion survey;
- survey on private contractor of waste collection work;
- study on waste amount and composition;
- compost market survey;
- survey on scavengers;
- survey on recycling system and market for reusable materials;
- construction of a truck scale foundation at the present Suchy Las disposal site;
- organization and institution planning;
- financial planning; and
- prompt decision making regarding the selection of the sites for primary facilities and other important matters which require the decision of the Polish side.

3) Environmental Standard

For sanitary and environmental protection, the EC standards as well as the Polish Standards were taken into account in the Study in the light of the Polish intention to be a member of the EC. Environmental evaluation of the first priority project for the Feasibility Study was carried out taking into account the existing EC (European Communities) environmental legislations and/or guidelines. The following aspects were evaluated by the Study Team:

- air pollution (including odour problems);
- surface and/or ground water pollution; and
- noise to be caused by the priority project.

4) Model Project

In Poland, there are several cities with more than a half million population urgently requiring the improvement of Municipal Solid Waste Management. As such, the Government of Poland hoped to use Poznan City as a model for such cities. Therefore, as a result of the Study, a manual on the formulation and implementa-

tion of the municipal solid waste management master plans was prepared taking into account the local conditions which differed from city to city.

In addition, a two-day seminar, which was participated by agencies related with the implementation of the municipal solid waste management master plan for Poznan City as well as the representatives of other cities, was organized in Poznan during the submission of the Draft Final Report. This was to promote the master plan and encourage the formulation and implementation of similar master plans in other cities.

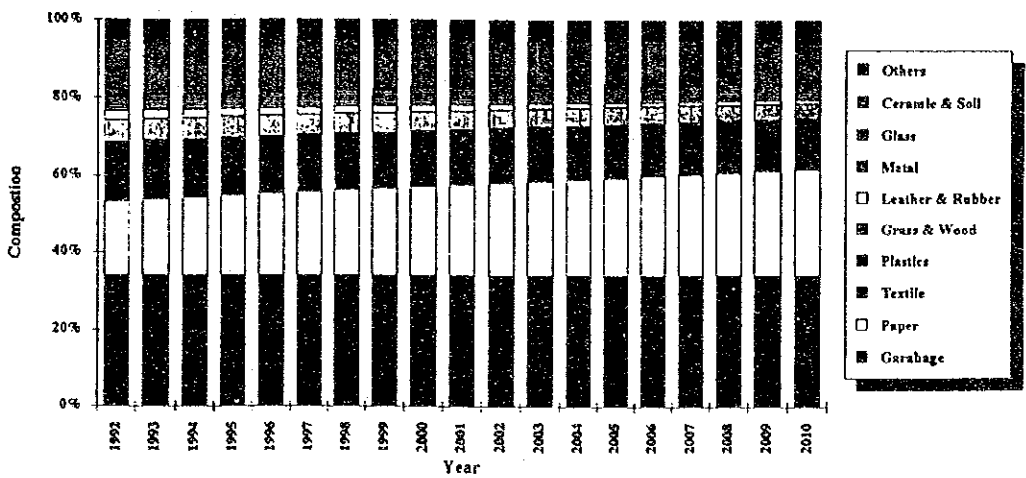
1.4 Key Assumptions

Key assumptions used in this study area are as follows:

1) Socio-economic Conditions

Items	Unit	Descriptions
1. Population		
- Projected Population	persons	1992 2000 2010 590,100 604,000 620,000
- Annual Growth Rate	%	0.275%/year
2. Economy		
- GDP	bill.USD	73.7 in 2000 132.0 in 2010
- Annual Increase Rate of GDP in Real Term	%	1993 - 1994 0% 1995 - 2000 3% 2001 - 2010 6%
- Future Budget Scale of the Poznan Municipality	bill.Zl	The budget in 1992 will increase in accordance with GDP increase rate in real term. 1,062 in 2000 1,902 in 2010
- Income Level of the Citizens	Zl/month	The income will increase according to the GDP increase rate in real term/population growth rate. 4,335,000 in 2000 7,556,000 in 2010
- Currency Exchange Rate		1 USD = 15,700 Zloty = 125 Yen
- Inflation Rate	%	70% in 1991 40 - 45% in 1992 0% from 1993 to 2010 for the economic and financial analysis of the Study

2) Waste Amount and Composition

Items	Unit	Descriptions		
1. Waste Amount				
1-1 Waste Discharge Ratio		1992	2001	2010
- MSW	g/person/day	769(166)	683(151)	867(196)
- MSW excluding Road Sweeping and Bulky Wastes with Ashes	(1,000 ton/year)	735(158)	644(142)	819(185)
- MSW excluding Road Sweeping and Bulky Wastes without Ashes		561(121)	644(142)	819(185)
1-2 Collection Ratio of Household Waste	%	90	100	100
1-3 Annual Increase Rate of Waste Discharge		1992 - 2000	2001 - 2010	
- MSW with Ash	%	- 1.81	2.70	
- MSW without Ash	%	1.40	2.70	
Note: Ash discharge from households will be ended by 2001.				
2. Waste Composition				
2-1 Forecast for Waste Composition				
				
2-2 Lower Calorific Value		1992	2001	2010
- MSW for Incineration (MSW excluding Road Sweeping and Bulky Wastes with Ashes)	kcal/kg	1,437	1,865	1,924
- MSW without Ashes for Incineration	kcal/kg	1,805	1,865	1,924
- Separately Collected MSW for Incineration	kcal/kg	2,199	2,270	2,338
- Sewage Sludge and Separately Collected MSW for Incineration	kcal/kg	1,956	2,020	2,083

3) Life Span of Equipment and Facilities

	Life Span (years)	Salvage value (%)
Container	5	0
Truck and Heavy Equipment	7	10
Machinery	15	0
Building and Civil Works	30	0

Note: The life span of other facilities for the disposal site depends on the period of its operation.

4) Executing Bodies for Technical Systems of MSWM

Technical System	Executing Bodies
1. Collection - MSW except Road Sweeping and Bulky Wastes - Road Sweeping Wastes - Bulky Waste	Department for Municipal Solid Waste Management Provincial Road Authority in the City Department for Municipal Solid Waste Management Department for Municipal Solid Waste Management
2. Recycling Centres	Department for Municipal Solid Waste Management
3. Incineration Plants	Poznan Waste Treatment and Disposal Company
4. Sanitary Landfill	Poznan Waste Treatment and Disposal Company

5) Loan Conditions

	Repayment Schedule and Interest Rate in Real Term
- Long Term Loans	Repayment over 10 years with a 3 years grace period, 7.5% (12.5%)
- Short Term Loans	Repayment in the Following Years, 13.5% (18.5%)

1.5 Work Processes of the Study

The study commenced in April of 1992 based on the Scope of Work (Appendix 1) signed between the Polish Government and JICA in November of 1991, and will end in June of 1993.

The study consisted of the following two phases:

Phase 1: Formulation of a Master Plan

Phase 2: Feasibility Study on the First Priority Project

The work processes of the Study are described below.

1) Phase 1: Formulation of a Master Plan (April – October, 1992)

(1) 1st Study Work in Poland (April – July, 1992)

- a. Submission and discussion of the Inception Report
- b. Data collection and analysis
- c. Survey on present situation of MSWM
- d. Installation of a truck scale
- e. Survey of Suchy Las landfill site
- f. Investigation of new landfill sites and extension of Suchy Las site
- g. Public opinion survey concerning MSWM
- h. Waste amount and composition survey (summer)
- i. Study on the present industrial SWM
- j. Environmental survey, Phase 1
- k. Analysis of present MSWM and identification of issues
- l. Estimation of future waste amount and composition
- m. Data collection and investigation for master plan manual
- n. Submission and discussion of the Progress Report (1)

(2) 1st Study Work in Japan (August – October, 1992)

- a. Compilation of survey data
- b. Determination of planning framework
- c. Establishment of goals and target of the master plan
- d. Planning of Optimum MSWM System
 - collection and haulage plan
 - processing and disposal plan

- site plan
 - primary facility plan
 - project cost estimation
 - institutional development and financial plan
 - operation and maintenance plan
 - comprehensive evaluation
 - implementation plan
- c. Preliminary selection of the first priority project
 - f. General recommendation for the improvement of ISWM
 - g. Compilation of the draft manual for formulation and implementation of master plan
 - h. Preparation of the Interim Report

(3) 2nd Study Work in Poland (October, 1992)

- a. Submission and discussion of the Interim Report
- b. Selection of the first priority project

2) Phase 2: Feasibility Study of the First Priority Project (November 1992 – June 1993)

(1) 3rd Study Work in Poland (November 1992 – January 1993)

- a. Supplementary data collection
- b. Waste amount and composition survey (winter)
- c. Survey of Franowo – Michalowo landfill site
- d. Environmental survey, Phase 2
- e. Confirmation of planning criteria and pre-conditions
- f. Case study of master plan manual in Lublin
- g. Preparation of a seminar
- h. Submission and discussion of the Progress Report (2)

(2) 2nd Study Work in Japan (January – March, 1993)

- a. Compilation of survey data
- b. Data analysis
- c. Planning of optimum MSWM System
- d. Preliminary design of primary facilities
- e. Material and equipment plan
- f. Construction schedule

- g. Operation and maintenance plan
- h. Project cost estimation
- i. Organizational, institutional and financial development plan
- j. Project evaluation
- k. Implementation plan
- l. Preparation of the Draft Final Report

(3) 4th Study Work in Poland (March, 1993)

- a. Submission and discussion of the Draft Final Report
- b. Execution of an MSWM seminar

(4) 3rd Study Work in Japan (April – June, 1993)

- a. Compilation of the Final Report
- b. Compilation of the Master Plan Manual
- c. Compilation of the Report for Lublin
- d. Submission of the Final Report

1.6 Study Organization

The study organization and list of members are attached as Appendix 2. The study was supervised by the Steering Committee of the Polish side and the Advisory Committee of the Japanese side.

CHAPTER 2

PROFILE OF THE STUDY AREA

CHAPTER 2 PROFILE OF THE STUDY AREA

This chapter describes the present background conditions, such as natural conditions, urban structure, social conditions, population and economic conditions, related to the Study.

2.1 Natural Conditions

2.1.1 Location and Area

The Republic of Poland is located north of Central Europe, and is situated between 49° and 55° latitude and between 14° and 24° longitude. Poland is mainly a lowland country with an average altitude of 174 m above sea level and has an area of 325,500sq.km.

According to the census conducted in 1988, the population of Poland was about 38 million. 23.4 million people (61.6% of the population) live in towns and cities. The largest cities (more than 500 thousand inhabitants) are Warsaw, Poznan, Lodz, Wroclaw and Cracow.

The longest Polish rivers are Vistula (1,047 km), Oder (a total length of 854 km but only 742 km is within Polish territory), Warta (808 km) and Bug (a total length of 772 km, but only 587 km is within Polish territory).

Poznan city is located in central-western Poland. The topography of the city is generally flat and its altitude is between 54 m and 154 m above sea level.

The Warta river runs through the centre of the city. Road and railway transportation routes going to the east and west link the city to Warsaw and Berlin (distance between Poznan and Warsaw is 306 km, Poznan-Berlin-332 km). Poznan has its own air and river ports, too.

Poznan is the fifth largest city in Poland. At the end of 1991, Poznan, with an area of 261 sq. km, was inhabited by 590,100 people, which is 2.6% of the urban population of Poland.

Poznan can be called a "green city" because more than 20% of its area is occupied with forests and parks.

2.1.2 Climate

Poland lies in a temperate climatic zone. Its climate borders between marine (due to the effect of the Atlantic) and continental and is characterized by largely varying weather conditions.

Table 2.1.2-1 shows the temperatures and rainfall in Poznan city during the last decade.

Temperature in Poznan city also vary according to its location. The lowest temperature, dropping to nearly -30°C , was recorded in 1987, and the highest temperature exceeded 35°C in 1983 and in 1988.

Annual rainfall in Poznan city ranges from 275 mm to 635 mm and the average annual rainfall during the last decade is around 480 mm. Although it is very cold in winter, there is very little snowfall.

Table 2.1.2-1 The annual temperature and rainfall

Year	Temperature (unit: $^{\circ}\text{C}$)			Annual rainfall (unit: mm)
	Average	Highest	lowest	
1980	7.0	29.6	-17.5	538
1981	8.2	30.6	-17.8	632
1982	8.9	32.0	-20.1	275
1983	9.4	35.7	-14.5	356
1984	8.1	34.0	-11.0	402
1985	7.2	31.4	-24.6	498
1986	7.8	32.6	-22.5	508
1987	7.0	30.2	-28.5	613
1988	8.9	35.7	-10.2	635
1989	9.7	34.9	-13.5	335
1990	9.5	34.3	-9.3	524
1991	8.3	-	-	419

(Source: Statistical Year Book of Poland, 1991, Data of Statistical Division in Poznan city)

2.2 Urban Structure

2.2.1 Administration

Poland had been under a socialist regime since the 2nd World War until 1989 when the country embraced a democratic government. Now, it is presently undergoing a thorough transition with emphasis on democracy, privatization, free market economy, and decentralization of authority. In other words, a complete transformation of the former planned economy and centralized administration.

Since 1989, the Polish Government has done remarkable efforts to reconstruct and modernize the political and administrative systems. A transition as extensive as the Polish, however, will take several or more years as it will primarily involve the formulation of necessary legislation and administration, and secondly, the changing of ways of thinking and behaviour.

1) Organization

Poland is divided into 49 provinces or voivodeships (3 cities, Warsaw, Cracow and Lodz, with provincial status are included) and more than 2,100 municipalities consisting of Urzad Miejski's (bigger municipalities in towns and cities) and Gmina's (small municipalities in rural areas).

2) Political System

As a democratic country, the Polish political system is governed by a President and a two-chamber National Assembly. The Senate is the upper chamber with 100 senators and the "Sejm" is the lower chamber with 460 deputies. The President, Senators and deputies are elected by public voting, and the Government headed by the Prime Minister is the executive organ of the State accounting to the "Sejm".

Two senators represent one Province (Voivodeship), except for Warsaw and Katowice which each have three senators. The Senate does not legislate laws, but has the power to vote or propose changes to bills drafted by the "Sejm". However, the Sejm may overrule a vote from the Senate with a two-third's majority. At a local level the municipalities are headed by publicly elected Councils.

The provincial level does not have a directly elected body. However, a Provincial or Voivodeship Assembly composed of delegates from municipalities is designated advisory and monitoring roles.

3) Administration

Administrative governments are organized at national, provincial and local levels.

The national Government is headed by the Prime Minister and has 16 ministries.

The Provincial Governments (Voivodeships) are executing bodies from the central government. The Provincial Governments headed by the "Voivode", have the right to suspend decisions taken by the municipalities.

The local governments (here referred to as municipalities) are headed by a mayor called "Vojt" in small municipalities ("Gmina"), "Burmistrz" in medium-sized municipalities (towns) and "Prezydent" in major cities (like Poznan).

The Local Government Law passed in 1990 defines the municipal council as the only directly elected unit of local government and designates more power than before. The municipal councils are free to decide on all matters affecting their locality as long as it is within the law. The council's executive body is the Board comprising the Mayor, his deputy and a maximum of 5 other members elected by the Council.

The Local Government Law allows municipalities, on a voluntary basis, to join associations in order to perform certain functions jointly.

4) Poznan Municipality

Poznan Municipality consists of 5 districts. The City Council with 65 seats represents the whole municipality and the 5 districts have administrative and executing roles in some of the municipal activities.

The City Council is the legislative body of Poznan Municipality, and from it twelve commissions are appointed, eg. the Ecological Commission and the Areal Management Commission, to take charge of various aspects.

The executive body, the Board, comprises of the Mayor, three Vice-Mayors and two Board Members. All are elected by the Council, but are not necessarily elected members of the Council.

In February 1992, the new organization structure of Poznan Municipality was proposed. It includes the determination of tasks and responsibilities related to each ad-

ministrative body. According to the municipality the proposed organization will be implemented and the proposal is subject to the following presentation.

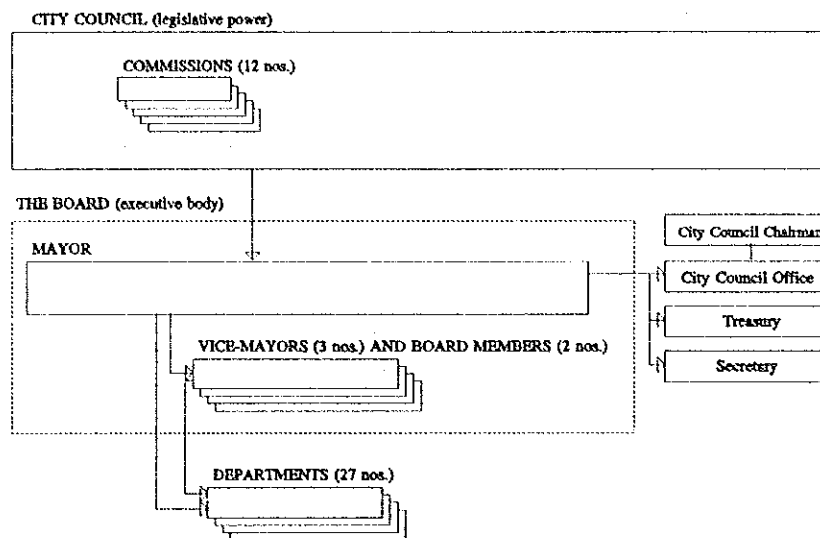


Fig.2.2.1-1 Organization of Poznan Municipality (proposal of February 1992)

The administration includes 27 departments headed by a member of the Board.

At a local level, the City is organized in settlements (Osiedle) represented by a Council of Settlement working on a voluntary basis and is designated no powers and duties. The Council of Settlement acts as advisers to the City administration.

2.2.2 Land Use

Total area of Poznan City is 26,100 ha and its total population was 590,100 at the end of 1991, as shown in Table 2.2.2-1.

Table 2.2.2-1 Land Use Condition of Poznan

Category	Area (ha)	Share (%)
Developed area		
Residential area	5,640	21.6
Commercial area	840	3.2
Industrial area	1,620	6.2
Transportation area	1,150	4.4
Public facilities	70	0.3
Public green area	2,380	9.1
Agricultural Facility Area	520	2.0
Others	380	1.5
Sub-total	12,600	48.3
Non-developed area		
Forest	3,300	12.7
Water area	600	2.3
Meadow	2,100	8.0
Cultivated land	7,500	28.7
Sub-total	13,500	51.7
Total area	26,100	100 %

2.2.3 Infrastructure

1) Transport

The city is located in central-western Poland along the river Warta. Road and rail transportation routes linking Paris and Berlin with Warsaw and Moscow, through the Baltic and Scandinavian countries with the Balkans, are also established here. Poznan has its own air and river ports, too, and tramways and buses in towns are provided for public transportation. Generally, the transportation system has been well developed, but due to modernization, traffic conditions are worsening.

2) Water Supply and Sewage System

The government-owned Water Supply and Sewage Enterprise in Poznan City covers the following towns: Poznan, Lubon, Mosina, Puszczykowo, Swarzedz, Czerwonak, Murowana Goslina.

6 water treatment plans and water supply network with a total length of 1,073 km cover almost all population.

3 sewage treatment plans and network with a total length of 1,169 km cover approximately 80% of the population and all effluent are discharged into the Warta River without biochemical treatment.

3) Heat Supply

2 large and more than 300 district heating supply aim to cover 60% of the population through a heating network with a total length of 296.9 km.

4) Urban Development Master Plan of Poznan City

Although an Urban Development Master Plan has been formulated, it is considered invalid due to the change in government. At present, the formulation of a new Urban Development Master Plan is being carried out by the Poznan Municipality. The phase I study formulating the main scheme of urban development plan, is supposed to be completed at the end of 1992. As for the phase II study, the strategies will be proposed.

According to the Urban Development Master Plan study team, only Franowo-Michalowo area is to be proposed as a solid waste treatment site.

2.3 Social Conditions

2.3.1 Customs and Religion

More than 98% of the Poles are of ethnic origin and the overwhelming majority is Roman Catholic. Religion plays a notable role to all Polish generations. However, the role of religion will not hinder the modernization of the society as in Western-European countries and the United States.

The many years under a socialist system have cultivated in the people dislike in the centralized authority and democracy to them generally means decentralization of authority, establishing minimum central authority as possible.

2.3.2 Public Health

The public health system offers free medical care to the citizens. Financial contributions are conducted on a voluntary basis and is widespread due to lack of financial sources. Private hospitals and clinics are operating and the future development of the private health system will be determined by the financial capability of the citizens and the level of service offered by the public system.

2.3.3 Public Health and Environment

It must be assumed that the years without anti-environmental pollution measures have significantly affected the health situation in Poland.

Poland faces a tremendous environmental challenge requiring considerable technical and financial efforts for the years ahead to protect human health. In addition to gaining control over the continuing pollution of the environment, substantial actions must be taken to clean contaminated sites.

The Ministry of Environmental Protection, Natural Resources and Forestry states that the lack of research on the effects of environmental pollution on human health was viewed by former authorities as convenient in enabling one to believe that environmental health hazards did not exist /NK-1/. The threat was not realized and industrial production was developed without considering the impact on human health and the environment.

Contaminated sites including old dumping sites for municipal and industrial wastes also contribute significantly to poor human health conditions.

The Ministry of Environmental Protection, Natural Resources and Forestry has made a national assessment of measurable and accountable losses caused by environmental pollution. The annual environmental losses suffered by the national economy amount to about 10% of the national income. The distribution of the losses is assessed as:

- Losses due to air pollution : 46 %
- Losses due to surface degradation : 39 %
- Losses due to water pollution : 15 %

Losses involving human health covers 7% of all losses. However, this only applies to monctarial losses arising from increased costs of medical treatment, temporary unfitness for work and resulting production losses /NK1/. The total losses involving human health must be deemed considerably higher, including social and human aspects not assessed.

2.3.4 Living Conditions

The planned economy performed during the socialist period insured uniformed living conditions in Poland.

After 1989, the Government tightened fiscal and monetary policies which should transform the Polish economy into market economy within the shortest time possible. Part of the policies, which was to remove subsidies, affected the living conditions of the Poles as wages could not keep the speed of the inflation. Wage inflation in 1989 caused a significant increase in nominal average earnings. During 1990 and 1991, however, wages decreased by approx. 30% in real terms due to the inflation.

A growth in the national income, which should relieve the consequences of the policy have not yet appeared and thus the incentive for the tight fiscal and monetary policies is missing, leading to a decline in the living conditions and disappointment.

Monthly salaries in public sector added to some 2 million Zl. in November 1991. Social security charges and payroll taxes totalling 65% of the basic salary are additional labour costs for the employer. In December 1991 the minimum wage was a net 900,000 Zl. per month.

2.3.5 Employment

There are 17 million people employed in Poland, 12 million work for the public sector and in the co-operative sector including 4.8 million employed in industry.

Of the 5 million employed in the private sector, 3.7 million are involved in agriculture and the remainder in manufacturing, handicrafts, services and trade.

For many years Poland suffered from a shortage of labour. However, since the collapse of the socialist regime, the unemployment rate has generally been high. In November 1991 it reached the level of 10.8 % with more than 2 million persons unemployed.

There is a public unemployment benefit, but as the employed have difficulties to meet the increasing living costs with the minimal salaries offered, it is significantly worse for the unemployed.

2.4 Population

2.4.1 Present Population

The total population of Poznan City at the end of 1991 was approximately 590,100. This figure includes both registered and unregistered inhabitants such as squatters in workers' gardens, university students, military trainees, and clergies. The average population density is 22.5 persons per hectare and the population density map is presented in Fig.2.4.1-1.

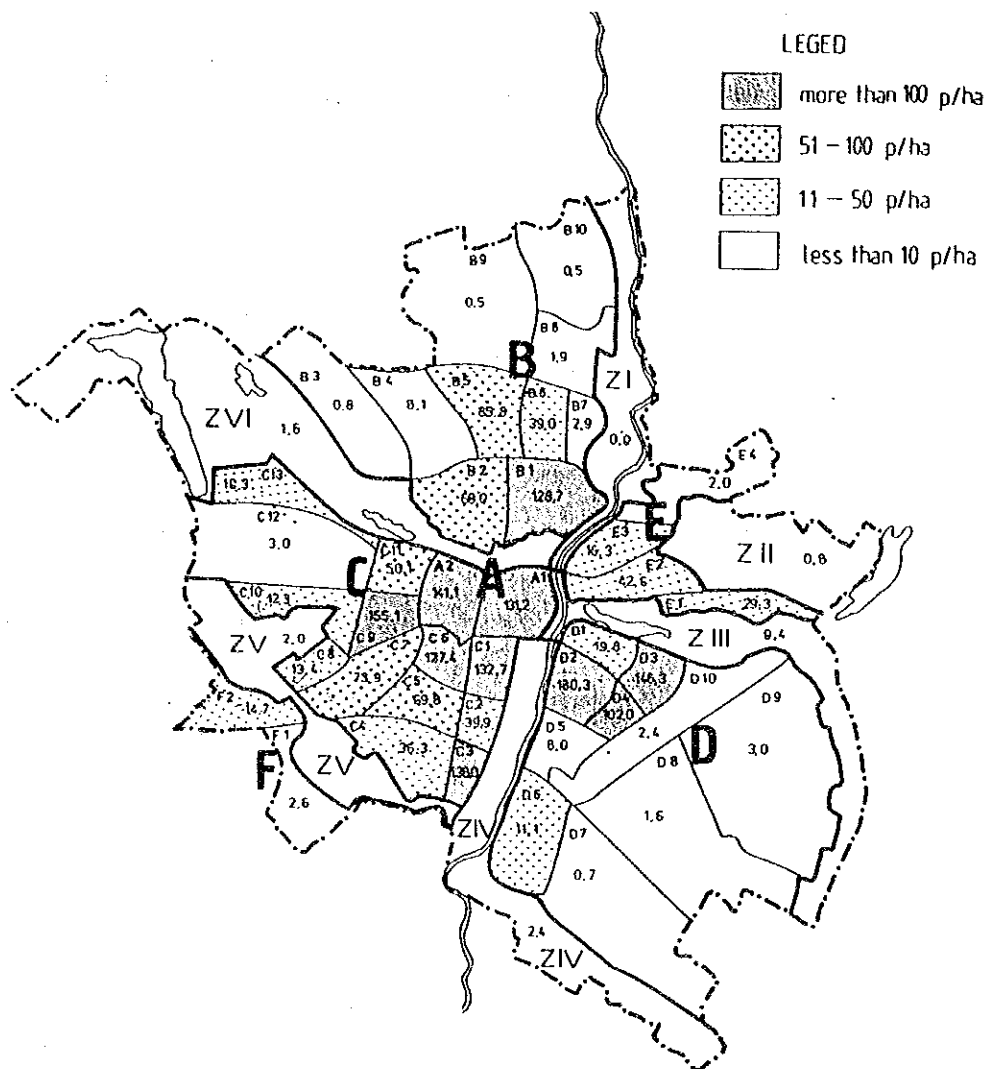


Fig.2.4.1-1 Population Density Map

2.4.2 Population Forecast

The Poznan City Master Plan assumed the range of the population forecast to be 610,000 to 620,000 in 2010 for unforeseen changes. Therefore the population forecast of 620,000 in 2010 is adopted for the SWM master plan.

The annual growth rate of population is, therefore, assumed to be 2.66 %.

The population forecast and the population forecast by age are shown in Table 2.4.2-1 and -2.

Table 2.4.2-1 Population Forecast

Year	1992	1995	2000	2005	2010
Population	590,100	595,083	603,388	611,693	620,000

2.5 Economic Conditions

2.5.1 National Economy

The restructuring of the Polish economy is presently in full swing. Therefore, it is difficult to predict the figures for the near future. Although the hyper-inflation seems to be under control, the rate of inflation is still high. The annual inflation rate for 1991 was 70.3%, which exceeded the forecasted rate of 36%. The major reason is that the imports from republics of the former USSR began to be denominated in hard currency. The inflation rate for 1992 is estimated at a range of 40% to 45%, excluding unforeseen changes.

2.5.2 Regional Economy

Poznan province, which comprises an area of 38,200 sq km, is an industrial/agricultural region with a well-developed network of transportation services. There are no data on GDRP(gross regional domestic product) in Poland, therefore, the industrial characteristics are pointed out by the figures of investment and production of major industries.

4% of the economic growth of the country is attributed to Poznan province although it holds only 3.5% of the country's population and 2.6% of the country's area.

2.5.3 Income Level

The changes in income level based on GDP per capita are shown in Table 2.5.3-1.

Table 2.5.3-1 Changes in Income level

	1985	1986	1987	1988	1989	1990
GDP (trillion zł)	8.7	10.7	14.0	25.0	105.0	506.3
Changing rate (Zł/US \$)	147.2	175.2	265.2	430.6	1446	9500
Population (million)	37.3	37.6	37.8	37.9	38.0	38.2
GDP per capita (US \$)	1,577	1,624	1,398	1,531	1,910	1,395
(reference) GNP per capita* (US \$)	6,470		6,883	7,270	4,560	

Sources: Rocznik Statystyczny 1991

* mark WEIS ARC report(CIA,Economic Statistics 1990)

The standard of living is supposed to be declining due to hyper-inflation. The statistics on income show that the average wage of employees increased 50 times in 5 years, from 1985 to 1990, although the indices of consumer price increased more than 60 times.

Compared to the national level, the income level of Poznan city is much higher. The surveys on Poznan were conducted on employees, retirees and pensioners showed higher income levels than the national survey results.

Table 2.5.3-2 Comparison of Income

1,000 zł/month/person

Household	National			Poznan	
	1985(A)	1990(B)	(B/A)	1990(C)	(C/B)
Employees	11.4 (10.3)	563.0 (488.7)	49.4 (47.4)	632.2 (496.9)	1.12 (1.02)
Employees-farmers	11.4 9.1	596.3 454.6	52.3 50.0		
Farmers	12.0 10.2	577.3 509.3	48.1 49.9		
Retires and pensioners	9.3 (9.8)	493.8 (486.0)	53.1 (49.6)	570.7 (486.0)	1.16 (1.01)

Note: upper figures represent income
lower figures represent expenditure

2.5.4 Industries

1) Manufacturing Industries

The manufacturing industry of Poznan employs 158,600 people, 27% of the province working populace. The remaining 52% are government employees. At present the industry is beset with difficult problems, such as lack of funds for the reconstruction of plants or facilities to introduce modern production methods and standard of efficiency, and absence of effective measures against negative environmental impacts.

Although the production of private companies was only 7,185 billion (30%) in 1990, privatization was implemented. This new trend has revealed the willingness of many production companies to join or merge with foreign firms.

Sales production in 1990 in Poznan Province was dominated by the food industry, followed by the electrical appliance and machineries manufacturing industry which holds the largest number of employees.

New legal regulations, concerning the investment of foreign capital in Poland combined with the positive attitudes of local authorities towards various forms of cooperation with foreign investors as well as efficient handling of all the necessary formalities, has placed the Poznan Province second in the country with a number of foreign firms with foreign capital. In the network of foreign enterprises, chemical, clothing, food and textile industries predominate. Among joint venture com-

panies, food and crop processing, clothing and building materials industries are numerous. In joint venture companies, German investors have the largest share, that is 54% of the total.

2) Agriculture

The agricultural industry (livestock and crop production) in Poznan Province has a high standard and productivity despite of poor soil quality. This makes the province one of the leading regions in agricultural output.

There area has 544.9 thousand hectares of agricultural land and 44% and 56% are owned by the public and private sector, respectively. 474.3 thousand hectares are cultivated and seeded, and 41% is occupied by the private sector.

3) Tourist

There are 19 hotels with 2,373 rooms and 4,195 beds in Poznan city. The number of overnight stays in 1991 reached 490,100.

The Poznan International Fair affects the economy of the city. Every year, about 20 different international trade events are held and the most famous is the Fair in June which attracted 4,151 exhibitors from 38 countries and over 200,000 tourists in 1991.

2.5.5 Local Finance

From the aims mentioned above, the portion the of municipal has to shoulder is larger than that of the voivodeship.

2.5.6 Tax System and Utilities Charging System

- Corporate Profits Tax
- Sales Tax(Turnover Tax)
- Individual Income Tax

Other taxes are "Withholding Taxes"(20% for dividends and royalties and 30% on interest) and "Inheritance and Gift Taxes"(progressive tax rates ranging from 5% to 40%).

Poland imposes three local taxes:

- Real property tax
- Transport trucks tax
- Dog ownership tax

Certain fees are also levied in addition to local taxes. Administrative fees are charged if a new law is passed by the communal authorities and official actions are not covered by a stamp indicating duty legislation. Vendors must pay a market-place fee. A local fee is also charged on persons staying temporally at spas and similar facilities.

The fee for SWM is collected by "SANITECH", which is one of the municipal enterprises. The fee for waste collection depends on the types of containers and frequencies of collection, although the latter diverts from the contract specifications.

The tipping fee at the disposal site depends on the volume of waste, therefore compression to reduce the volume of waste is becoming a good business in Poznan.

The tariff on electric, thermal power and water supply is also charged by these supply and distribution companies. In Poland, a contract is usually made between the managing authorities of buildings and these companies. The residents make a contract with the authorities for total management fees including solid waste collection fee, for example in proportion to their area or the number of family because there is no way the volume of each consumption can be determined. It is easier to collect the fees for waste collection, but difficult to reduce the volume of solid waste.

CHAPTER 3

FIELD SURVEYS

CHAPTER 3 FIELD SURVEYS

This chapter describes the result of various field surveys executed in this Study. These results are used as the basic data for the formulation of the MSWM Master Plan.

3.1 Waste Amount and Composition Survey

3.1.1 Objectives and Definitions

1) Objective of the Survey

Basic information such as the quantity of solid waste generated in the survey area, the population covered by the collection services, collection area map, etc., is the key for the formulation of a successful and workable solid waste management plan.

A WACS (Waste Amount and Composition Survey) was thereby carried out in order to obtain basic information on waste generation ratio, discharge amount, amount of self-disposal and collection, and finally to clarify the waste stream in the Study area.

The WACS was carried out both in summer (June, 1992) and winter (December, 1992) to get the waste data in these season. The average data was then determined from these data.

2) Definitions of Wastes

In order to make the contents of the WACS and the waste stream clearly understood, the words used in the study are defined as follows:

a. Household waste

Waste generated in or discharged from each household. Those generated through commercial activities are excluded.

b. Commercial waste

Only refers to wastes generated and discharged from shops or any commercial activity. Shops include restaurants, hotels, drug stores, grocery shops, printing shops, private offices, etc..

c. Market waste

Waste generated in or discharged by markets both for wholesale and retailing.

d. Institutional waste

As for institutional waste, government office waste is examined in the Study.

e. Road sweeping waste

Road sweeping waste include all wastes generated by the following cleansing services:

- road sweeping service; and
- public area cleansing service.

f. Bulky waste

Abandoned bulky items (such as furniture and trucks), which are discharged from the above-mentioned categories of sources, is considered as bulky waste in the Study.

g. Other wastes

Other wastes in the Study are wastes disposed of at the present Suchy Las disposal site and are not considered as MSW (item a. to f.).

3.1.2 Method of Waste Amount Survey

1) Method of Survey

Waste amount survey was divided into the following three methods:

- discharge ratio survey at generation sources;

- final disposal amount survey at the present Suchy Las landfill; and
- interview survey for generation sources.

In addition, the results of the POS were referred for the final determination of the amount. The method applied to the WACS is tabulated in Table 3.1.2-1.

Table 3.1.2-1 Method of Waste Amount Survey

Category	Discharge Ratio Survey	Disposal Amount Survey	Interview Survey
MSW (Total)		x	
Household Waste	x		
Market Waste	x		
Commercial	x		
Institutional	x		
Road Sweeping	x		
Bulky Waste		x	
Other Wastes (Total)	x		
PEC Ash			x
Sewage Sludge			x
Others	x		

Note: The item given "x" was surveyed in the Study.

2) Selection of Sampling Point for Discharge Ratio Survey

In order to know the discharge ratio of each waste, the following categories of wastes were sampled at each generation sources. However, bulky and other wastes were only studied regarding their amount by means of observation at the present landfill. The sampling points are presented in Table 3.1.2-2.

Table 3.1.2-2 Sampling Points of Waste Amount and Composition Survey

Category (1)	Category (2)	Category (3)	Nos.
Household Waste	New Apartment	Heat Supply	25
	New Apartment	Non Heat Supply	5
	Old Apartment	Heat Supply	5
	Old Apartment	Non Heat Supply	10
	Detached or Semi-detached House	Heat Supply	5
	Detached or Semi-detached House	Non Heat Supply	10
	Mixed Waste (only in winter)	Heat Supply	1
Commercial Waste	Shops Other than Catering		7
	Catering Shops		3
Market Waste	Wholesale		1
	Retailing		1
Institutional Waste	Municipality Office		1
	Pension Office		1
* Road Sweeping Waste			1

Note: * As for the road sweeping waste, only its amount was surveyed once in summer by Time and Motion Survey.

3) Survey Period of Discharge Ratio Survey

The survey was conducted in summer from 10th to 17th June 1992, and in winter from December 4th till 11th in 1992.

4) Method of the Discharge Ratio Survey

Method of the Survey is tabulated in Table 3.1.2-3. Upon consideration of the daily fluctuation in discharged waste, the survey was conducted continuously for 8 days.

a. Collection of sample

Before the execution of the WACS, a required number of plastic bags were distributed to residences, shops and offices selected as sampling points. Then, the samples collected by the Study Team are classified or distinguished with a sticker.

Samples discharged in markets were collected by the container.

b. Waste amount survey

Amount of waste was measured at each sampling point. Samples taken from plastic bags were measured by spring balance and samples from containers were measured at the truck scale installed by the Study Team.

c. Waste composition survey

i. Method of sampling

The composition of waste was measured in the dry base in summer and in the wet base in winter in accordance with the following categories.

- residential area (PEC)
- residential area (Non PEC)
- commercial
- market
- institutional
- mixed waste from new apartment area (only in winter)

Table 3.1.2-3 Method of Waste Amount and Composition Survey

Discharge source	Collection of Sample	Waste Amount Survey	Waste Composition Survey
Residential Area (PEC)	by plastic bag	by spring balance	Analysis Items - ASG (Apparent Specific Gravity) - Physical composition ... dry base (garbage, paper, textile, plastic, glass, grass and wood, leather and rubber, metal, ceramic and soil, others) - Chemical analysis + Three contents (moisture, combustibles, ash) + Lower calorific value + Ultimate analysis (carbon, hydrogen, nitrogen, sulphur, chlorine, oxygen)
Residential Area (NO PEC)	by plastic bag	by spring balance	
Commercial Area	by plastic bag	by spring balance	
Market	by container	by weighbridge	
Institutional	by plastic bag	by spring balance	
Residential Area (Mixed Waste)	from communal container	nil	

ii. Composition analysis

Physical composition and chemical analysis were conducted on the following items:

- physical composition

The physical composition was measured in dry base in summer and wet base in winter and the samples were divided into the following 10 items:

- moisture content

- chemical analysis

- ash content

Ash content in this Study refers to ash after the combustion of the combustible and non-combustible items, i.e., metal, glass, ceramic and soil, others.

- combustible content

- lower calorific value

- ultimate analysis

Ultimate analysis was done on the carbon, hydrogen, nitrogen, sulphur, chlorine and oxygen contents in wastes.

3.1.3 Findings

1) Waste Amount

a. Discharge ratio

i. Household waste

The waste discharge of households receiving heating supply from the district in winter was almost the same as in summer. On the other hand, the waste discharge of households not receiving any heating from the district in winter is much higher than the data in summer. Ashes resulting from the burning of coals used as heating sources were observed to cause the increase in waste discharge. Table 3.1.3-1 presents the comparison of the waste discharge ratio of the population supplied and not supplied with heating.

Table 3.1.3-1 Discharge Ratio of Household Wastes

unit: g/person/day

Category of population	Population	Summer	Winter	*Weighing Average
With Heating supply	354,060	427.0	499.7	469.4
Without heating supply	236,040	676.4	1,081.6	912.8

Note:

* According to the information from PEC, summer is in May to Sep. (5 months) and winter is in Oct. to Apr. (7 months). The weighing average is deduced based on this period.

Although the population that discharges ash fluctuates by season, about 50% of the population not receiving heat from the district uses coal for heating according to the POS and WACS done by the Study Team. Table 3.1.3-2 shows the comparison of waste discharge ratio of the population using coal for heating and those not using coal among the household not having district heating.

Table 3.1.3-2 Waste Discharge Ratio of Non-heat Supply Population

unit: g/person/day

Category of population	Population	Summer	Winter	Weighing Average
Coal-heating	118,020	903.0	1,663.6	1,346.7
Non-Coal-heat-ing	118,020	449.8	499.6	479.0

Table 3.1.3-3 presents the comparison of the waste discharge ratio of household waste and domestic ash of the population using coal for heating. Domestic ash here means the ash discharged by households using coal-heating.

For better understanding, the component of household waste is illustrated in Fig.3.1.3-1.

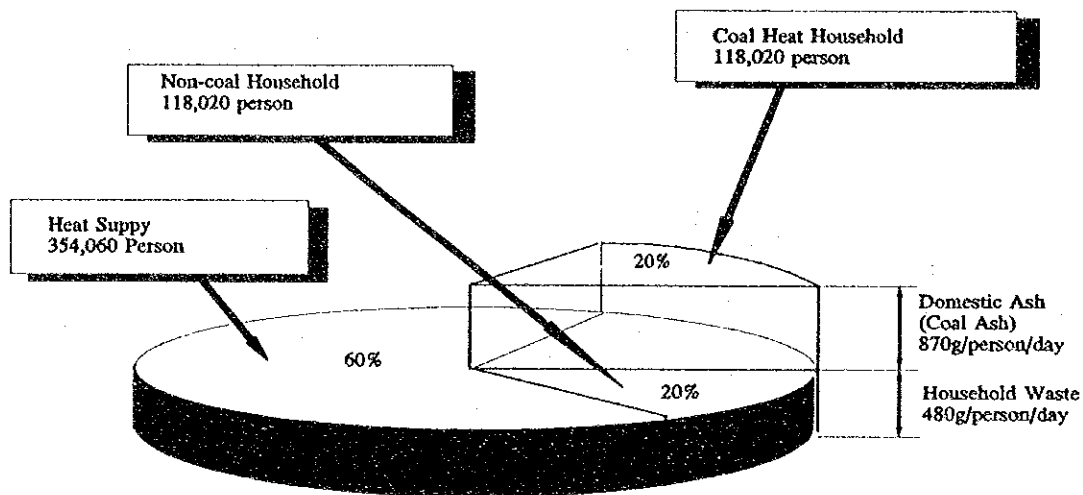


Fig.3.1.3-1 Component of Household Waste

Table 3.1.3-3 Waste Discharge Ratio from Population Using Coal-Heating unit: g/person/day

Category of Waste	Population	Summer	Winter	Weighing Average
Household waste	118,020	449.8	499.6	479.0
Ash from coal	118,020	453.2	1164.0	867.8

As clearly shown in Fig.3.1.3-1, household waste is divided into two categories: household waste and domestic ash. Consequently, the discharge ratios in 1992 are concluded as follows:

household waste : 480 g/person/day for total population

domestic ash : 870 g/person/day for ash discharging population

: 174 g/person/day for total population

Hence, the discharge amount of wastes is:

Household Waste : 283.2 tons/day

Domestic Ash : 102.8 tons/day

Total : 386.0 tons/day

ii. Commercial, market and institutional waste

Based on the average of the data in summer and winter, the unit discharge ratio was determined as shown in Table 3.1.3-4.

Table 3.1.3-4 Waste Discharge Ratio

Waste Category	unit	Summer	Winter	Average	Adopted Figure
Commercial Waste					
Shops	g/m ² /day	24.5	22.9	23.7	24
Catering	g/m ² /day	173.4	143.6	158.5	160
Market Waste	g/shop/day	3,204.7	2,861.2	3,037	3,040
Institutional Waste	g/employee/day	63.2	52.7	58.0	58.0

Accordingly, the discharge amount in 1992 of each category of waste is as follows:

- Commercial waste

The floor areas of each business category are as follows:

Catering shops	: 202,966 m ²
Shops other than catering	: 172,725 m ²

Hence, the amount of wastes discharged were estimated as:

Catering shops	: 27.6 tons/day
Other shops	: 4.9 tons/day

Total	: 32.5 tons/day
-------	-----------------

- Market waste

The number of shops in the markets given were 1,970 shops in 1992.

Amount of waste discharged : 6 tons/day

- Institutional waste (Office waste)

The total number of institutional employees were estimated at 161,085 persons by the statistic data, hence:

Amount of waste discharged : 9.3 tons/day

iii. Road sweeping waste

Based on the Time & Motion Survey conducted in June 1992, the following discharge ratio was obtained:

Total discharge amount	: 410 kg
Total mileage	: 7.2 km

Hence,

Unit discharge ratio	: 57 kg/km
Average sweeping distance per day per truck	: 20 km/day
Average number of sweepers working per day	: 4 units
Average sweeping length per day	: 80 km/day

Hence,

Amount of waste collected	: 4.6 tons/day
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However, if the number of working days a year is 315, then,

Discharge ratio per day	: 4.0 tons/day
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iv. Bulky waste

The amount of the bulky waste was obtained by the three days observation of incoming trucks in the SLL (Suchy Las Landfill) in May 1992. The amount of the bulky waste is deduced as follows:

- average number of trucks per day	: 13 units
- average weight	: 1.4 tons/day
- disposal amount per day	: 18.2 tons/day

The working days of the SLL a year is 315 days. Hence,

Discharge ratio per day	: 15.7 tons/day
-------------------------	-----------------

v. Other wastes

The Suchy Las landfill received wastes other than MSW mentioned above, and they are categorized as follows:

- PEC ash
- sewage sludge
- others

The total disposal amount of the other wastes was obtained by the record of truck scale installed in June 1992. Considering the working days (315 days) of the SLL and the results of interview survey to the PEC and two sewage plants, daily disposal amount of the other wastes are as follows:

- PEC ash : 14.9 tons/day
- sewage sludge : 40.9 tons/day
- others : 26.6 tons/day

vi. Conclusion

The waste discharge and disposal ratio was concluded as shown in Table 3.1.3-5.

Table 3.1.3-5 Waste Discharge

Category of Waste	Discharge Ratio	Quantity	Waste Amount per Day (tonne/day)
1. MSW			
Household Waste	-	-	386.0
(Household Waste)	(480)	(590,100 persons)	(283.2)
(Domestic Ash)	(870)	(118,020 persons)	(102.8)
Commercial Waste	-	-	32.5
(Shops)	(24)	(202,966 m ²)	(4.9)
(Catering)	(160)	(172,725 m ²)	(27.6)
Market Waste	3,040	1,940 shops	6.0
Institutional Waste	58	161,085 employee	9.3
Road Sweeping Waste	-	-	4.0
Bulky Waste	-	-	*15.7
Sub-total			453.5
2. Other Wastes			
PEC Ash	-	-	14.9
Sewage Sludge	-	-	40.9
Others	-	-	26.6
Sub-total			*82.4
Total			535.9

Note: * Disposal amount.

Accordingly, the following major figures on waste discharge ratio are deduced:

- MSW discharge amount : 453.5 tons/day
- MSW discharge ratio per capita : 769 g/person/day
- Annual MSW discharge : 165,500 tons/year

b. Waste disposal amount at Suchy Las landfill

The waste disposal amount at Suchy Las landfill obtained by the use of the truck scale is as follows:

in summer	: 573.4 tons/day	
in winter	: 600.6 tons/day	
Average	: 589.3 tons/day	(5 months in summer and 7 months in winter)

Assuming that the working days per year for the disposal site is 315 days/year, the total disposed amount per day is **508.6 tons/day**.

According to the observation shown in Table 3.1–8, the disposal amount of wastes other than MSW was 82.4 tons/day. Consequently, the actual disposal amount of MSW is calculated as **426.2 tons/day**. The figure is equivalent to **93.9%** of the estimated discharge amount of MSW.

Considering that the present collection coverage ratio is 90 % and the permissible error of the WACS, these results are observed to be quite reasonable.

2) Waste composition

a. Apparent specific gravity

The result of the Apparent Specific Gravity survey is tabulated in Table 3.1.3–6.

Table 3.1.3–6 Apparent Specific Gravity

Category	Apparent Specific Gravity in Summer	Apparent Specific Gravity in Winter
Household (With Heat Supply)	0.216	0.216
Household (Without Heat supply)	0.206	0.222
Market	0.199	0.248
Commercial (Catering)	0.228	0.170
Institutional	0.074	0.129
Household (from collection truck)	–	0.247

b. Results of the survey

The results of waste composition survey are tabulated in Tables 3.1.3-7 and -8. The following items shall be noted for the use of the results:

i. Domestic ash

- Domestic ash was excluded for physical composition analysis.
- Domestic ash was not observed among the wastes other than household wastes (Non PEC).

ii. Analysis base

- Physical composition analysis in dry and wet bases was done in summer and winter respectively.
- For better comparison, the results of the summer analysis (in dry base) was converted into wet base, using the average water content of each category of waste in winter.

iii. Estimation of the lower caloric value

The lower calorific value (LCV) of waste can also be estimated by the following formula, based on the result of the study in Poznan and data obtained in Japan.

Since the samples are limited (about 1/5000 of the samples for physical composition analysis, i.e. 1 to 2 g), and the quality constantly varies due to the random method used, the LCV measured in one sampling may differ in another. Therefore, by using the LCV measured in laboratory as a reference, the formula below was used to estimate the LCV applied to the design of the incineration plant in this study.

$$\text{LCV} = (\text{RGa}^{\ast 1} \times 1,400 + \text{RPa}^{\ast 2} \times 2,550 + \text{RT}^{\ast 3} \times 2,450 + \text{RPl}^{\ast 4} \times 6,900 + \text{RGr}^{\ast 5} \times 630 + \text{RL}^{\ast 6} \times 3,400) / 100$$

$\text{Rga}^{\ast 1}$;Ratio of the weight of garbage in wet base (%)
$\text{Rpa}^{\ast 2}$;Ratio of the weight of paper in wet base (%)
$\text{RT}^{\ast 3}$;Ratio of the weight of textile in wet base (%)
$\text{RPl}^{\ast 4}$;Ratio of the weight of plastic in wet base (%)
$\text{RGr}^{\ast 5}$;Ratio of the weight of grass and wood in wet base (%)
$\text{RL}^{\ast 6}$;Ratio of the weight of leather and rubber in wet base (%)

Table 3.1.3-7 Summary of Waste Composition Survey in Summer

Classification			Household (PEC)	Household (Non PEC)	Market	Comm ercial	Institu- tional
Physical composi- tion	combust- ibles	garbage (%)	31.36	29.32	32.64	29.99	9.38
		paper (%)	16.94	16.71	22.40	14.64	62.33
		textile (%)	8.66	7.93	7.89	6.63	7.69
		plastic (%)	8.14	7.30	8.51	8.14	5.19
		grass and wood (%)	11.90	12.29	19.47	7.21	3.15
		lather and rubber (%)	2.54	3.64	0.44	0.15	0.00
		Total (%)	79.54	77.19	91.35	66.76	87.74
	non- comb- ustibles	metal (%)	4.00	4.03	2.49	7.19	4.55
		glass (%)	11.02	8.76	2.36	23.10	5.18
		ceramic and soil (%)	1.44	6.32	2.08	1.68	1.17
		other (%)	4.01	3.69	1.71	1.26	1.37
		Total (%)	20.47	22.81	8.64	33.23	12.27
	Total (%)		100.01	99.99	99.99	99.99	100.01
Chemical analysis	Three contents	moisture (%)	42.19	40.34	70.11	40.94	20.50
		combustibles (%)	36.04	35.32	21.59	26.07	63.56
		ash (%)	21.77	24.34	8.30	32.99	15.94
		Total (%)	100	100	100	100	100
	Chemical contents of combu- stible	carbon (%)	18.35	18.92	10.90	13.37	29.08
		hydrogen (%)	3.92	4.05	2.46	2.90	6.68
		nitrogen (%)	0.88	0.80	0.34	0.37	0.32
		sulphur (%)	0.04	0.08	0.04	0.02	0.06
		chlorine (%)	0.31	0.19	0.19	0.14	0.25
		oxygen (%)	12.54	11.28	7.65	9.27	27.16
		Total (%)	36.04	35.32	21.59	26.07	63.56
	Measured LCV (kcal/kg)		1,662	1,490	536	1,126	2,987
	Estimated LCV (kcal/kg)		1,806	1,736	1,946	1,568	2,287

Table 3.1.3-8 Summary of Waste Composition Survey in Winter

Classification			Household (PEC)	Household (Non PEC)	Market	Commercial	Institutional	Truck Sample
Physical composition	combustibles	garbage (%)	43.63	35.28	32.40	29.31	9.01	39.76
		paper (%)	16.31	19.20	21.14	21.54	56.11	18.51
		textile (%)	5.76	9.17	2.03	1.46	2.81	4.16
		plastic (%)	6.90	8.13	7.63	13.64	8.11	6.89
		grass and wood (%)	2.43	1.17	16.39	0.80	0.86	3.33
		leather and rubber (%)	2.06	2.55	0.26	0.00	0.00	1.41
		Total (%)	77.09	75.50	79.85	66.75	76.90	74.06
	non-combustibles	metal (%)	3.37	2.52	2.54	8.27	3.04	4.71
		glass (%)	18.34	17.42	12.73	24.40	18.94	14.74
		ceramic and soil (%)	0.00	0.00	0.60	0.43	0.76	1.34
		other (%)	1.19	4.50	4.31	0.11	0.34	5.10
	Total (%)		22.90	24.43	20.18	33.21	23.08	25.89
	Total (%)		100	100	100	100	100	100
Chemical analysis	Three contents	moisture (%)	33.12	32.34	48.26	29.56	16.46	32.82
		combustibles (%)	39.48	39.61	27.83	35.22	54.91	37.24
		ash (%)	27.40	28.06	23.91	35.21	28.63	29.95
		Total (%)	100	100	100	100	100	100
	Chemical contents of combustible	carbon (%)	19.36	19.72	12.57	16.93	24.51	19.60
		hydrogen (%)	4.28	4.45	3.09	3.87	6.06	3.82
		nitrogen (%)	0.75	0.63	0.60	0.70	0.46	0.76
		sulphur (%)	0.04	0.09	0.01	0.01	0.05	0.03
		chlorine (%)	0.84	0.22	0.53	0.56	0.11	0.33
		oxygen (%)	14.21	14.50	11.03	13.08	23.72	12.71
	Total (%)		39.48	39.61	27.83	35.23	54.91	37.25
	Measured LCV (kcal/kg)		1,993	2,075	1,110	2,004	2,870	1,788
	Measured LCV (kcal/kg)		1,729	1,863	1,681	1,942	2,191	1,675

c. Waste composition

Upon consideration of the ratio of the discharge amount of each category of waste, the composition of MSW except for domestic ash, road sweeping and bulky wastes is estimated and tabulated in Table 3.1.3-9 and 3.1.3-10: i.e. the weighing average waste composition of household waste excluding ash, commercial, market and institutional wastes is calculated.

Table 3.1.3-9 Physical Composition of MSW (Wet Base)

Category	Item	Ratio (%)
Combustible	Garbage	33.95
	Paper	19.33
	Textile	7.27
	Plastics	7.89
	Grass & Wood	5.90
	Leather & Rubber	2.26
	Sub-total	76.60
Noncombustible	Metal	3.76
	Glass	15.16
	Ceramic & Soil	1.53
	Others	2.93
	Sub-total	23.38
	Total	100

Note: MSW here excludes domestic ash and road sweeping and bulky waste.

Table 3.1.3-10 Chemical Composition of MSW

Category	Item	Ratio (%)
Three contents	Moisture	35.74
	Combustible	38.04
	Ash	26.23
Chemical Contents of Combustible Wastes	Carbon	19.03
	Hydrogen	4.21
	Nitrogen	0.71
	Sulphur	0.05
	Chlorine	0.40
	Oxygen	13.63
C/N Ratio		26.8
Lower Calorific Value (All Waste)		1,854 kcal/kg
		7,762 kj/kg
Lower Calorific Value (Combustible Matter)		5,442 kcal/kg
		22,785 kj/kg

Note: 1. MSW here excludes domestic ash and road sweeping and bulky waste.
2. The lower calorific values were measured using a calorimeter.

In order to clearly understand the lower calorific value (all waste) of MSW excluding road sweeping and bulky wastes, the following figures are calculated by the formula described in the previous section b, iii Estimation of the LCV.

Table 3.1.3-11 Lower Calorific Values

Waste Category	Lower Calorific Value (kcal/kg)
MSW ^{*1} without Ash (Measured)	1,854
MSW without Ash (Estimated)	1,805
MSW with Ash (Estimated)	1,437
Household Waste without Ash (Estimated)	1,792
Household Waste with Ash (Estimated)	1,384
Wastes, with ashes, of Households with Coal Based Heating System (Estimated)	806
Household Waste (1984/85 Waste Study) ^{*2}	855

Note: *1 MSW here excludes domestic ash and road sweeping and bulky waste.
 *2 1984/85 Waste Study means "Research on Technological Properties of Poznan Municipal Waste" done by Engineering College of Warsaw.

For the elaboration of Table 3.1.3-11 upon consideration of the 1984/85 Waste Study, the three contents of the coal ash were supposed as follows: i.e., coal ash can still be used as a heating stimulant.

- Moisture : 45 %
- Combustibles : 10 %
- Ash : 45 %

According to Table 3.1.3-11, the estimated LCV of household wastes with ash from houses with a coal based heating system is calculated at 806 Kcal/kg. This is very similar to the figure (855 Kcal/kg) of the 1984/85 Waste Study.

3.2 Public Opinion Survey

3.2.1 Objectives of the Survey

The public opinion survey was carried out to understand the people's view on SWM, which will be taken into account in the formulation of the SWM master plan. The main objectives are summarized below.

- a. To collect basic information concerning SWM.
- b. To understand the present SWM problems.
- c. To understand the present waste discharge, storage and collection systems.
- d. To obtain the ratio of the families discharging ash.
- e. To comprehend the citizen's understanding level of SWM.
- f. To obtain public cooperation in waste segregation at the generation source.
- g. To understand the given waste collection fee for citizens
- h. To understand the present SWM level considered satisfactory by the citizens.

3.2.2 Selection of the Survey Area

In order to obtain the public opinion of and the basic information concerning the majority of the citizens in Poznan City, the sample residences and shops were selected in the following manners:

- 1) The residential area was classified into the three categories shown below and the interviewees were selected in each categories in proportion to the actual population of these residential areas.
 - New buildings constructed after 1945 : 60 interviewees
 - Old buildings constructed before 1945 : 30 interviewees
 - Detached or semi-detached houses : 30 interviewees
- 2) The disposal of ashes from residential stoves to waste containers is considered to be very important in determining the composition of waste. Forty percent of the interviewees in residential areas were selected from areas not receiving heat supply from the municipal company, PEC. Therefore, the population in Poznan City receiving heat supply from PEC was 60% in 1991.

- 3) For sampling in shops and restaurants, areas with various shops were selected so that the average composition of waste represents will be obtained.

Table 3.2.2-1 Sample Points of Public Opinion Survey

No	Category	Heat	Sample No.	Location
1	New Apartment after 1945	PEC*	10	Piatkowo
2			10	Piatkowo
3			10	Winogrody
4			10	Winogrody
5			10	Rataje Osiedle Orla Bialego 47-71
6		Not PEC	10	Wilda ul. Rolna
7	Old Apartment before 1945	PEC	10	Centrum
8		Not PEC	10	Lazarz Rynek Lazarski
9			10	Wilda ul. Madalinskiego
10	Detached or Semi-detached House	PEC	10	Winogrody, os, Kosmonautow/os, Przyjazni
11		Not PEC	10	Junikowo ul. Braniborska
12			10	Solacz
13	Shop, Restaurant, etc.	-----	15	Sw. Marcin
14		-----	15	Stare Miasto
Total			150	

Note: * Represents area receiving heat from municipal heating company.

3.2.3 Findings

1) General Questions

- 35 % of the interviewees are not supplied with heat by the municipal heating distribution company. 60 to 70 % use stoves which produce ash and the remainder uses gas or electric heating systems. 50 % of the ash is collected separately to be utilized as construction material. The remaining 50 % is collected with the municipal solid waste. Ash is usually discharged at an average of 6.9 months per year (refer Q2-7,-8,-9,3-1).

- The family expenditure of 50% of the population is 2 to 4 million zł per month (refer Q2-11).

2) Questions on Discharging Waste

- 42 % of families state that the garbage is discharged by the master of the house (refer to Q3-4).
- According to this survey, the ratio of residents who are using dust chutes is low at 3 % (refer to Q3-5).
- 71 % of the residents discharge garbage with a bucket (refer to Q3-6).
- A fixed waste discharging time was clearly not observed. However, a slight tendency of discharging waste at the following time was seen (refer to Q3-8,-9).

Residential area	:6:00 – 8:59, 18:00 – 20:59
Commercial area	:15:00 – 20:59

- 40 % of the interviewed population complained about the waste containers and 37% of the people interviewed in residential areas complained about their insufficient capacity (refer to Q3-12 and Q3-13).
- A standard manner of discharge was not observed (refer to Q3-16).

3) Questions on Waste Collection Services

- 37 % of residents in detached houses answered they were not receiving any waste collection service (refer Q4-1).
- 70% to 80% of the collection is conducted by SANITECH (refer Q4-2) but collection in the new apartment building areas is mainly conducted by private collection companies.
- 63 % of the residents are satisfied with the present waste collection services. However, 10 % of the interviewees were dissatisfied with the collection services of private companies, with 56% and 74% expressing complaints on less frequent collection services and irregular collection time, respectively (refer to Q4-3 and Q4-4).

- Only 49 % of the interviewed residents receive waste collection services once or twice a week (refer to Q4-7).

4) Questions on Resource Recovery and Recycling

- Since 93 % of the interviewed people are willing to cooperate with waste segregation at source, the introduction of separate collection is expected to be accepted by the citizens (refer to Q5-1).
- 99 % of the interviewed people admit the importance of recycling waste (refer to Q5-3).
- Only 4 % of the interviewed people receive collection services for recyclable materials (refer to Q5-5). More efficient collection services should be introduced to utilize more reusable wastes.
- More than 50 % of the interviewed people answered "to sell reusable things to the recycle shops" (refer to Q5-8).

5) Question on Fee and Financial Matter

- 58 % of the interviewed people think that the present MSWM done by SANITECH, the Municipality and private companies is not appropriate. (refer to Q6-2).
- More than 70 % of the interviewed people do not know the present waste collection fee. Most people appear not to be interested in waste collection fee. (refer to Q6-5).
- About 48 % of the interviewed people answered that the municipality should provide subsidies to supplement the cost of SWM (refer to Q6-8).

6) Questions on Public Cooperation

- More than 90 % of the interviewed people agreed to cooperate in SWM (refer to Q7-4, 7-5).
- 60 % of the interviewed people answered that the Municipality should campaign for SWM by means of public education (refer to Q7-7).

3.3 Investigation of Present and Candidate Disposal Sites

3.3.1 Candidate Sites

Poznan Municipality requested the Study Team to investigate the following four sites for disposal sites selection.

- Northern area of the existing Suchy Las disposal site
- Janikowo
- Starolenka
- Franowo-Michalowo

However, the northern area of the existing Suchy Las disposal site was excluded from the candidate sites because its use is allowed for only another few years.

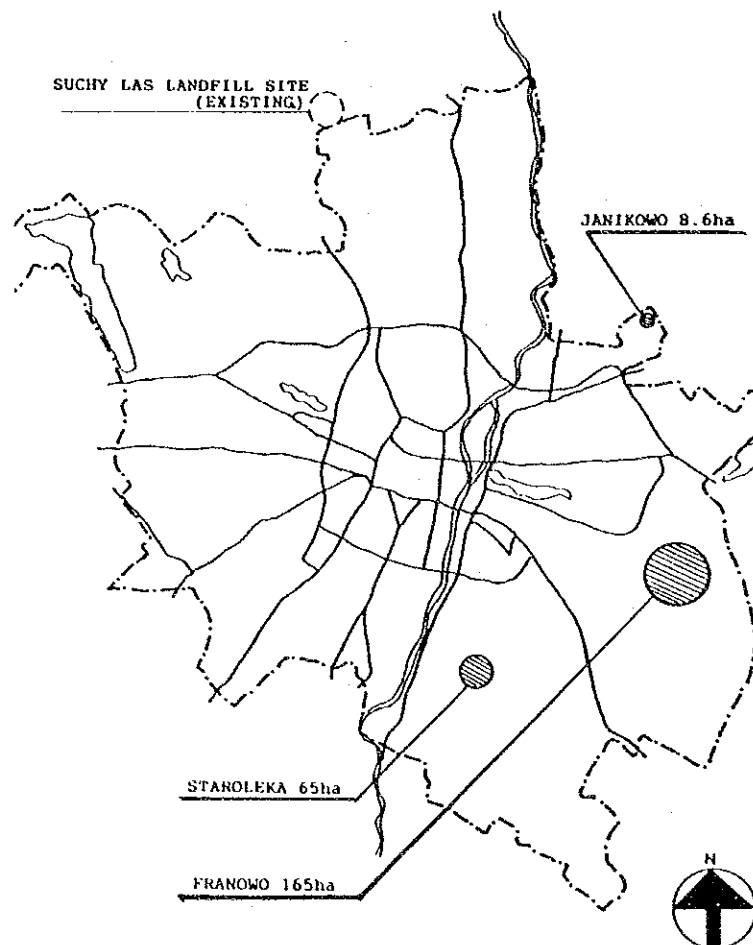


Fig.3.3.1-1 Location of Candidate Sites

3.3.2 Results of the Investigation

1) Janikowo

i. Conditions of the site

- The area of the site is 8.6 ha.
- 3 ha of it is private land.
- The site lies on the boarder of Poznan and parts of the site belong to two towns (gmina).
- The road width in front of the site is 8 m and there is a meat factory within 100 m from the boundary of the site.
- There is an underground gas pipe, 300 mm in diameter, running along the road in front of the site and it is designated as a security zone.
- Some private gardens with a small house are adjacent to the site.
- The topography of the site is irregular, because excavation, filling and dumping waste were done without a plan.
- The surrounding land except the road side is a wheat field.
- The site is overgrown with weeds and pine trees.

ii. Geological characteristics of the upper layer

- Disposed soil and wastes can be found up to 50 cm below ground surface.
- A clay layer followed by a sand layer and another clay layer are formed from 50 cm below the ground.
- The ground water table is 1.5 m below the ground surface.
- Topographically, the area is a watershed.

2) Starolenka

i. Conditions of the site

- The area of the site is 65 ha.
- It is partially occupied by an asphalt plant and a storage yard of coal and a railway siding for coal transportation. The remainder is a wheat field.
- The land is privately owned.

- A historical fortification and the area inhabited with rare bats can be found nearby.
- The site is almost flat.
- Residential areas are located about 500 m southwest of the site boundary.

ii. Geological characteristics of the upper layer

Although data on the geology of the site can not be obtained, the surrounding conditions indicate a geology similar to Janikowo.

3) Franowo-Michalowo

i. Conditions of the Site

- The area of the site is 165 ha.
- All lands are owned by the Municipality.
- The whole site area is cultivable.
- A railway station exists nearby.
- Absence of important monuments or sites of national significance.
- There is a residential area more than 200 m on the south boundary of the site.

ii. Geological characteristics of the upper layer

- The layer of the topsoil is 50 cm thick.
- A clay layer followed by a sandy layer, gravel layer and another clay layer are formed from the upper layer.
- The ground water table is 3.9 to 5.8 m below ground surface.

Table 3.3.2-1 Comparison of SWM Candidate Sites

Item		Janikowo	Starolenka	Franowo
1	Possibility of Land Acquisition			
1a	Land use restriction	Nil	Industrial area	Nil
1b	Land ownership	5.5 ha Private 3.1 ha State	52.0 Private 13.0 State	State
1c	Necessity of compensation	Necessary	Necessary	Necessary
1d	Other considerations	Nil	Nil	Nil
2	Possibility of Getting Neighbourhood Consensus			
2a	Necessity of neighbourhood consensus	Necessary	Necessary	Necessary
2b	Necessity for site to be unseen	Necessary	Necessary	Necessary
2c	Necessity for isolation from noise, dust and odour	Nil	Nil	Nil
2d	Other conditions			
3	Compatibility with Regional Development Plans			
3a	Compatibility with development plans	Nil	Nil	Yes
3b	Conformity with the City Master plan and Land use plan	Nil(park)	Nil	Good
3c	Direction of urbanization towards sites	Urbanization in promotion area	Urbanization in Promotion area	Nil
3d	Other considerations	Nil	Nil	Nil
4	Economic Feasibility			
4a	Location of site (distance from main waste generation area)	7.0 km	5.5 km	7.0 km
4b	Area of site (ha)	8.6 ha	65.0 ha	165.0 ha
4c	Life expectancy (years)	Landfill 2.5 years	Landfill 15 years	More than 30 years (Landfill)
4d	Accessability of public services	Good	Good	Good
4e	Public services available	Electricity, Sewage & water supply	Electricity, Sewage & Water Supply	Electricity
4f	Present conditions of site	Land use--Green area Surface soil--Clay,Sand,Clay Ground water level--G1.-1.5m	Land use--Industrial area surface soil--Clay, Sand Ground water level--?	Land use--Field Surface soil--Clay, Sand Ground water level--G1.-3.9 to -5.8 m
4g	Technical consideration	Construction of seepage control work (landfill)	Construction of seepage control work (Landfill)	Construction of seepage control work (Landfill)
4h	Benefits of site upon completion	Nil	Nil	Nil
5	Environmental Acceptability			
5a	Risk of drinking water pollution	Low	Low	Low
5b	Risk of surface water pollution	Low	Low	Low
5c	Risk of flooding	Nil	Nil	Nil
5d	Risk of ground water pollution	Low	Low	Low
5e	Distance from other public facilities	LIGOWIEC Station 2km	Water intake facility (water supply)	FRANOWO Station (railway)
5f	Distance from densely populated areas	7.0 km	5.5 km	7.0 km
5g	Hazards from dust noises and odour	Low	Low	Low
5h	Land use of adjacent area	Wheat field	Wheat field	Wheat field
5i	Slope stability	Flat	Flat	Flat
5j	Inshore or river fishery	Nil	Nil	Nil
5k	Terrestrial vegetation and wildlife	Nil	Little	Little
5l	Impact on Natural landscape	Measurable	Measurable	Measurable
5m	Historic places or structures	Nil	Yes	Nil
5n	Religious places or structures	Nil	Nil	Nil

3.3.3 Evaluation

The following were concluded according to the survey results:

- The Janikowo site is not suitable for the construction of SWM facilities because of a limited area.
- The use of Starolenka and the Franowo-Michalowo site is possible if the processing plant and the disposal site are constructed together.
- Starolenka site should be preserved because of the presence of a historical monument and endangers species.
- The priority is, therefore, determined as follows,
 - 1 Franowo-Michalowo site
 - 2 Starolenka site
 - 3 Janikowo site

3.4 OTHER FIELD SURVEYS

3.4.1 Investigation of Suchy Disposal Site

In order to obtain the basic data for making a diagnosis on the Suchy Las Disposal Site, the only disposal site operating at Poznan City, topographical, geological and environmental surveys were carried out. The results of each survey are described here in detail.

1) Topographic Survey

A topographical map of the whole area of the existing disposal site in the scale of 1 to 1000, was drawn by the Study team using the survey data.

2) Geological Survey

A borehole was drilled down to the depth of 20 m into the northern side of the existing Such Las disposal site.

Three undisturbed samples for laboratory tests were taken from the borehole at 6.0, 12.0, 17.5 m below ground level. Additionally one sample of peat was taken from 18.5 m below ground level.

The following tests were conducted on the three samples;

- . Permeability test
- . Unconfined compression test
- . Triaxial shear test
- . Consolidation test

According to the result of survey, from the geological investigation carried out to 20 m below ground level sandy loam and silty loam layers were distinguished within the Quaternary Age Formation. For the depths ranging from 16.9 m to 20.0 m the Tertiary Age Formation sediments represented by silty loam, peat (0.8 m thick) and fine sand were investigated. The layers described above form a zone with a good bearing capacity with the exception to the layer of peat.

3) Environmental Survey

The objective of the environmental survey is to know the present environmental status of the area adjacent to the existing disposal site in Suchy Las.

The field survey includes the following items:

- Field survey by the compilation of the existing data

The counterparts of the JICA Study Team, the Town Planning Office of Poznan Municipality, Inspectorate of Environmental Protection for Poznan Province, and Institute of Meteorological and Water Management Branch in Poznan have collected the following data and information on:

- . Air Pollution
- . Location of public facilities (including material assets)
- . Distribution of the natural preservation area
- . Flora and Fauna

The above information was compiled by the Study Team.

Also, the following items were compiled by the Study Team using currently available information.

- . Soil pollution
- . Landscape

- Field Survey by taking samples and data analysis

The Inspectorate of Environmental Protection in Poznan Provincial Government (viovodeship), Adam Mickiewicz University in Poznan city and the National Institute of Hygiene in Warsaw took each sample and analyzed the data relating to the following environmental factors under the supervision of the Study Team:

- . Air quality (Offensive Odour)
- . Water quality (including ground water)
- . Noise (as a nuisance)
- . Traffic volume
- . Land use

All survey's results are included in ANNEX E.

3.4.2 Survey on Private Contractors

There are two private contractors dealing with municipal solid waste collection in Poznan City and both of these companies, which were established in 1991, provide services to high rise apartment buildings located in the northern area of Poznan City by using hoist trucks and large communal containers.

The similarities between the two companies are:

- Their clients are only cooperatives.
- They conduct services in the northern area of Poznan City.
- The waste collection and transportation method is by hoist trucks with containers.

These are due to the following reasons:

- It is easy to collect waste collection fees from the cooperatives for a large amount of waste produced rather than from detached house owners through the direct fee collection system.
- Transportation cost is less than in other areas as they are working near the existing landfill sites.
- The initial investment for the equipment for this collection system is minimal.
- The system using hoist trucks with large communal containers is considered to be the most efficient waste collection system in Poland, at present.

The two private contractors, LEWAR and TECH-KOM, are described in ANNEX E in detail.

3.4.3 Compost Market Survey

1) Warsaw Composting Plant

MZO, the Warsaw municipal enterprise for cleaning services operates two composting plants, one since 1965 (a capacity of 240 tons/day) and another since April 1992.

The latter is a full-scale plant, very modern and large, with 2 DANO drums and produces approximately 130 and 10 tons of low and high grade composts a day respectively. However, there are not that many customers buying compost and as a consequence, the municipality assigned private consulting companies to do market research. At the moment the biggest customer is MZO itself and it plans

to use 20,000 tons of compost for the reconstruction of old landfills in 1992. Most of the compost is transported to the former landfill site 20 km away from the composting plant by trucks.

2) Katowice Composting Plant

MPO, the Katowice municipal enterprise for communal cleansing services has been operating a composting plant, with a capacity of 240 tons/day since June 1989. This plant is very modern and large with two DANO drums, and produces approximately 120 tons of low grade compost. The population of Katowice is approximately 300,000 and this composting plant accommodates half of the waste generated in Katowice.

All the compost produced is being utilized as top soil for cultivation. There is a demand for compost as the quality of soil in this region is not very fertile. The main customers are the provincial and municipal governments and its enterprises and compost is utilized for land reclamation and repairing of old mines.

MPO, however, points out a problem, that is the rapid wearing out of the inside liner of the drum due to non-segregation of waste.

4) Result of Compost Customer Survey

Twenty of the customers purchasing compost from the two plants were interviewed:

- E-13 Compost Production Plant - Warsaw, Kampinoska St. 1
- MP GK Utilization Department - Katowice, Milowicka St. 7.

The following are concluded based on the interview results:

- The distance from the compost production plant to the place where the compost is used is from 1 km to 20 km.
- Compost produced by the production plants was first used for gardening and improving soil quality. The daily consumption varied considerably; the minimum was 5 tons/day and the maximum 40 tons/day. At present, 40 tons of compost are daily supplied to the disposal site in Pruszkow near Warsaw since June 1st, 1992.

- The interviewed companies utilize compost in spring, summer, and autumn. Only one of them uses it during winter for cultivation.
- All interviewed consumers agreed that compost is only used due to the lack of humus, crop soil or peat at the site and its surrounding. Compost from the production plant was the nearest obtainable material.
- Half of those interviewed used additional dressings such as gardening peat, fertilizers, i.e. nitro-chalk, superphosphate, potassium salt, lime, ammonium saltpetre and multi fertilizers with trace elements. They use no animal dressings. The quantity of fertilizer and gardening peat varied a lot; one of the interviewee used 1,000 t of gardening peat and only 4 t of fertilizer in 1991, while another – 100 t of fertilizer and 1,750 t of compost from the compost production plant. One used 10 t of fertilizer and 100 t of compost from the compost reduction plant.

4) Potential Demand for Compost in Poznan Province

With soil that is fertile and suitable for agricultural production, the province of Poznan produces a lot of agricultural produce. A variety of vegetables and fruits are mainly planted on fertile soil, while only potatoes, carrots and onions are planted on infertile soil. Cow manure is used as fertilizer and is applied once every year on the former and once every four years on the latter. Chemical fertilizers are only used as supplements or substitute for shortage of manure.

The exportation of vegetables and fruits to Holland started recently as a result of the rise in the value of crops produced through organic farming in Western Europe. The production of flowers, however, has decreased since 1989 due to economic recession.

High grade composts are strongly in demand for crop production.

3.4.4 Survey on Scavengers

This survey was carried out to understand the present situation of scavengers personally involved in the recycling business. The understanding of the situation is sometimes quite important in estimating the impacts of the implementation of an SWM master plan on society.

- . The average number of scavengers at the landfill in Suchy Las disposal site is about 20.
- . The age largely varied from 24 to 72 years old, with the mean at 53 years old.
- . Average income per month is 2,153,500 zl, where approximately 1,474,500 zl comes from scavenging and the rest from welfare.
- . Most scavengers answered that the selling price of recyclable materials do not alter. However, three scavengers pointed out that the prices of cardboard and bottles fluctuated. The items which are usually profitable to scavengers are non-ferrous metals and cardboard.
- . As more and more residents sell their wastes independently, the number of scavengers in the city decreases. Scavengers tend to flock at the disposal site as opportunities in the city dwindle down due to worsening social and economic conditions caused by unemployment.

3.4.5 Construction of an Inspection Building and Installation of a Truck Scale

An inspection building was constructed and a portable truck scale was installed at the entrance of the Suchy Las disposal site.

Construction work was carried out from early May until early June in 1992 and the truck scale was used from 9th June. Since then all trucks entering the disposal site between 7 am. and 4 pm. are weighed.

3.4.6 Time and Motion Study

1) The Objective of this Study

Solid waste collection involves intensive work. The cost for collection work is the largest share in the total solid waste management cost. It is, therefore, necessary to meet the following requirements to improve collection efficiency:

- . Maximum use of truck capacity
- . Maximum use of legal working hours

Accordingly, this survey was carried out to comply with the need to understand the present condition precisely and determine the problems in order to prepare the improvement plan.

2) Contents of the Survey

The contents are:

- . relationship between time, distance and weight in terms of collection and haulage
- . type of dustbin and container
- . working efficiency of collection workers
- . collection route
- . level of customers' cooperation for waste collection work
- . service level
- . maintenance and condition of equipment

3) Result of Survey

a. Type of dustbin and container

i. New Apartment Areas

8 – 10 m³ communal containers are widely used, however, 1.1 m³ communal containers and dustbins are used in some apartments using dust chutes. Waste collection is less efficient in this system.

ii. Old Apartment Areas

1.1 m³ communal containers and dustbins are generally used. Most of the lids and some of the wheels of 1.1 m³ containers are damaged making collection more difficult to the workers. Most dustbins appeared to have been damaged by the loading machine of the compactor truck creating additional work such as cleaning the container yard.

iii. Detached and Semi-detached Houses

Only dustbins are used in this area. The residents place everything in the dustbins, including grass and soil. The container comprising soil, etc., exceeds 100 kg, that even a hydraulic jack was not able to lift it.

b. Working efficiency of collection workers

The productivity of the trucks obtained by the survey is shown in the table below.

Table 3.4.6-1 Productivity of the Collection Trucks

Date in 1992	Type of Truck	Status	Productivity ton/man/hour	Category of Col- lection Area
23 June	Compactor truck	Direct	0.253	Downtown area
24 June	Compactor truck	Direct	0.430	New apartment area
25 June	Compactor truck	Direct	0.230	Detached and semi-detached housing area
25 June	Hoist truck	Sub-con	0.807	New apartment area
29 June	Compactor truck	Sub-con	0.321	Downtown area
30 June	Hoist truck	Sub-con	1.143	New apartment area
29 June	Road sweeper	Direct	-----	Provincial Road

CHAPTER 4

PRESENT MUNICIPAL SOLID WASTE MANAGEMENT

THE UNIVERSITY OF CHICAGO
LIBRARY
100 EAST 57TH STREET
CHICAGO, ILL. 60637

CHAPTER 4 PRESENT MUNICIPAL SOLID WASTE MANAGEMENT

This chapter describes the present situation of municipal solid waste management in Poznan City. It is understood that the management of municipal waste is currently an issue rather than a problem.

4.1 Overview of MSWM Situation in Poznan

4.1.1 Sanitary Condition

Poznan is generally a very beautiful and clean city, a fact that may be attributed to the efforts made by the Municipality on sanitation. However, an increasing number of insanitary places can still be found within the residential area.

1) Public Space

The public spaces are kept clean and hygienic. A sufficient number of trash boxes are provided in public areas and waste collection is conducted frequently. Trash boxes overflowing with waste and litters can be hardly observed.

2) Residential Area

a. New Apartment Building Area

This area is kept clean and hygienic. Large containers are provided and a hoist truck collection system, which is considered to be working very well, is employed widely in this area.

b. Old Apartment Building Area

Containers overflowing with garbage can be seen in many places. Containers are mostly found at the backyard of these buildings. The reason behind the inadequate implementation of storage and discharge are as follows:

- The majority of the residents do not care about the sanitation of the area, and all responsibilities are left to the guardians. The sanitary condition of the area is, therefore, highly dependent on the guardians.

- The residents and also SANITECH are not particularly interested in these areas as the waste storage area can not be seen from outside.
- Offices are closely situated together in apartment buildings and employees are not very particular with proper waste disposal measures.

c. Detached and Semi-detached Housing Area

Waste collection, which is conducted once a week or every other week, is less frequent in these areas compared to the others, and, therefore, gives way to the breeding of maggots and flies in many of the containers. Although many of the residents put soil in the dust bins to prevent the breeding of these insects, the quantity placed only adds up to the weight of the dust bins, thus making collection less efficient.

3) Suchy Las Disposal Site

All sorts of waste, including hazardous ones, are disposed of at the Suchy Las Disposal Site. Although soil covering is implemented, the operation is not conducted appropriately to keep the site clean.

4.1.2 SWM Situation

SWM is the responsibility of the Municipality, and two departments are designated for it, namely the Investment Department and the Communal and Residential Affairs Department. The present SWM situation of Poznan City is shown in Table 4.1.2-1.

The implementation of SWM is left to the municipal enterprise, SANITECH, and the municipality is not directly involved with the management. Further, the Municipality is considered to have little influence on the SWM, since all subsidies to SANITECH have been terminated.

Table 4.1.2-1 Present Solid Waste Management Situation

Description		Responsible Administration Body	Executing Agencies	
			Governmental Enterprise	Private Enterprise
Disposal Site	Planning	Investment Dept. Municipality	-----	-----
	Construction		City Development Authority Sub-con (SANITECH)	
	Operation	Communal & Residential Affairs Dept. Municipality	SANITECH	-----
Municipal Waste Collection			SANITECH	LEWAR, TECH-KOM
Road Sweeping	State Road	Provincial Government	Provincial Authority for Roads in the City Sub-con (SANITECH)	Sub-con (Lekan) (HUBERTUS) (DROMO) (SRCE)
	Provincial Road			
	Municipal Road	Communal & Residential Affairs Dept. Municipality	SANITECH	
Public Area Cleansing	Green Area		Green Area Authority	
	Trash Boxes along Street		-----	HUBERTUS

4.1.3 Final Disposal

1) General Characteristics

Except for the old incinerators installed in hospitals, the city of Poznan has no waste processing facilities. The Suchy Las Disposal Site located outside of the city to the north of Poznan, is the only disposal site used by the city and virtually all kinds of wastes, i.e, municipal, industrial, construction, hospital, are disposed of.

The operation of the site started in 1984. The methods employed are considered not adequately hygienic and waste volume is not precisely monitored by weight.

2) Present Problems

The most serious problem concerning the construction of a disposal site is the difficulty in obtaining permits for land use.

During the regime of the Socialist Government, land use permits were easily granted by the absolute authority. After the democratization of the country in 1989, however, any proposal made by the Government or Municipality were opposed or questioned by the people.

A democratic manner has not been adopted yet as to the establishment of an agreement between the Government and the residents concerning the granting of permit for the construction of a disposal site. In addition, there are no intermediary agencies that may conduct such negotiations for the Municipality or the Government.

Almost all administrative organizations and institutions are reluctant to issue permits because they fear criticism from the people. This negative behaviour delays necessary countermeasures and widens the gap between the facts and requirements specified by the legislation. The majority of the supervising agencies seem to have given up supervising the implementation due to these too big gaps.

Those residing near the Suchy Las disposal site are not whatsoever obliged to cooperate with the waste disposal measures of the City, because they are not residents of the city. To persuade these residents, the Municipality agreed to give financial support. Compensation started in 1989 and the total cost for 3 years, from 1989 to 1991, amounted to approximately 6 million US\$. The enormity of the cost seems to weigh down the finances of the municipality, making the further use of Suchy Las as a disposal site or the use of a disposal site outside of the city very difficult.

3) Background of SWM Facility Site

There are 25 previous and existing registered disposal sites operated after 1945 as shown in Fig.4.1.3-1. Before the operation of the Suchy Las disposal site, cavities or holes were used for garbage disposal. These former disposal sites are now utilized as parks, public ground and green areas.

Since all of the cavities in the cities have been filled up with wastes, there are no suitable sites left for disposal. The final disposal site has to bank waste on flat land. However, waste embankment restricts future land use measures, leaving waste to consume the entire space. The acquisition of permits for the use of such land in Poznan is very difficult as the citizens are strongly opposed to its recommended use.