Q3-12 Do you have any problems with your container for waste collection?

	Residential Area	Commercial Area
Yes	37 %	38 %
No	63 %	62 %

If yes, please answer to the question No.3-13.

Q3-13 What is the problem(s) of your container(s)?

	Residential Area	Commercial Area
Too old and dilapidated	17 %	29 %
Inconvenient location	14 %	21 %
Insufficient capacity	37 %	21 %
Insanitary condition	21 %	21 %
Others	7 %	8 %
I don't know.	4 %	0 %

If you answer 3.dust chute to the question No.3-5, please answer to the question No.3-14 and No.3-15.

Q3-14 Are you able to co-operate in carrying your waste to communal containers fixed in your areas without using a dust chute, if you are requested so.

	Residential Area
Yes	40 %
No	50 %
I don't know.	10 %

Q3-15 If "No", what are the reasons?

	Residential Area
Present system is better.	44 %
We have nobody who will carry the waste to communal containers.	0 %
Communal containers are far.	38 %
Communal containers are not hygienic.	13 %
Others	6 %

Q3-16 How are your bulky wastes disposed? (such as large condemned furniture or electric appliances)

	Residential Area	Commercial Area
Collected by the SANITECH	13 %	7 %
Sold and/or collected by special collector	8 %	0 %
Carry to landfill site by ourselves	19 %	14 %
Sold to Junkyard	3 %	4 %
Others	27 %	43 %
I don't know.	30 %	32 %

Within the replies of "Others", most interviewees replied "to discharge bulky waste by containers."

IV Questions on Services of Waste Collection in Your Area

Q4-1 Is there a collection service in your area?

	Residential Area			Commercial Area
	Apartment	Detached	Total	
Yes	76 %	63 %	87 %	100 %
No	23 %	37 %	12 %	0 %
I don't know.	1 %	0 %	1 %	0 %

23 % of residents answered "no collection service", however, it is not possible. This is considered to be due to the lack of consciousness.

If "Yes", please answer the followings; (No.4-2 - No.4-9), otherwise go to V.

Q4-2 Who collects your wastes?

	Residential Area	Commercial Area
SANITECH	72 %	84 %
Private contractor sub-contracted by SANITECH	14 %	3 %
Private contractor other than the above	12 %	0 %
Others	2 %	13 %

Q4-3 Are you satisfied with the collection service?

	Residential Area		Commercial Area
	Private company	Total	
Yes	90 %	63 %	52 %
No	10 %	34 %	45 %
I don't know.	0 %	3 %	3 %

Q4-4 If "No", what are the reasons? (Multiple answers)

	Residential Area	Commercial Area
Frequency of collection service is low.	56 %	23 %
Collection time is irregular.	74 %	92 %
Collection time is very early or late.	8 %	0 %
Behaviour of workers are bad.	0 %	0 %
Collection work is crude.	4 %	31 %
Collection fee is expensive.	5 %	8 %
Collection fee system is not fair.	0 %	8 %
Others	5 %	0 %

Q4-5 Do you know how the waste discharged from your house is collected?

	Residential Area	Commercial Area
Yes	89 %	97 %
No	11 %	3 %

Q4-6 If "Yes", how is the waste collected?

	Residential Area	Commercial Area
Door to door collection system by collection worker.	7 %	14 %
Residents, themselves carry waste to a communal container.	89 %	83 %
Collection from dust chute in the building.	2 %	0 %
Others	2 %	3 %
I don't know.	0 %	0 %

Q4-7 How often is your waste collected?

	Residential Area	Commercial Area
Once 3 days	18 %	47 %
Once 3 - 7 days	32 %	10 %
Once 8 - 14 days	20 %	0 %
Once 15 - 20 days	2 %	0 %
Once 21 - 30 days	5 %	0 %
Others	4 %	20 %
I don't know.	19 %	23 %

Within the replies of "Others", the most interviewees replied to have more frequent waste collection services.

Q4-8 Is collection service done at fixed time in the day?

	Residential Area	Commercial Area
Yes	39 %	37 %
No	32 %	37 %
I don't know.	29 %	26 %

Q4-9 If "Yes", what time is your waste normally collected?

	Residential Area	Commercial Area
6:00 - 8:59	32 %	33 %
9:00 - 11:59	23 %	13 %
12:00 - 14:59	0 %	0 %
15:00 - 17:59	0 %	4 %
Others	6 %	0 %
I don't know.	39 %	50 %

V Questions on Resource Recovery and Recycling

Q5-1 If the municipality introduces a separate waste collection system to utilize waste(i.e. for instance you are requested to segregate your wastes into i. food waste, ii. incombustible waste and iii. other wastes), would you cooperate with the system?

	Residential Area	Commercial Area
Yes	93 %	93 %
No	7 %	7 %

Q5-2 If "No", what are the reasons?

	Overall
It requires several containers or plastic bags.	23 %
It requires certain effort.	0 %
It requires several public containers.	8 %
It is inconvenient.	61 %
It may increase collection cost.	8 %
Others	0 %

Q5-3 Do you think resource recovery from wastes and recycling are necessary?

	Residential Area	Commercial Area
Yes	99 %	100 %
No	1 %	0 %

Q5-4 What kinds of resource recovery from wastes and recycling do you know? (Reply as many as you know)

	Overall
Recycling of reusable materials such as papers, bottles, etc.	87 %
Composting (Fertilizer from wastes)	19 %
Heat recovery by incineration	30 %
Others	0 %

Q5-5 Do you have someone who comes around to collect or buy your reusable or recyclable materials?

	Residential Area	Commercial Area
Yes	4 %	7 %
No	93 %	90 %
I don't know.	3 %	3 %

If "Yes", please answer the followings; (No.5-6 - No.5-7)
Otherwise go to No.5-8.

Q5-6 If "Yes", how often does the collector come around your area?

	Residential Area
Once a week	2 answers
Once a month	2 answers
Once every two month	0 answer
Once a half year	0 answer
Once a year	1 answer
I don't know.	4 answers

Q5-7 What kinds of transportation does the collector use to haul them?

	Overall
Walk	2
Bicycle	1
Pick-up Truck	0
Small Lorry	1
Handcart	1
Others	2
I don't know.	2

Q5-8 Instead of selling recyclable materials to the collector, do you sell the recyclable materials to the shops?

	Overall
Yes	52 %
No	48 %

Q5-9 If the resident association of cooperative in your area were to raise some funds (in order to engage beneficial activities for residents), through sale of reusable of recyclable materials, would you be able to contribute or participate?

	Overall
Yes	87 %
No	6 %
I don't know.	7 %

Q5-10 Do you feed food wastes to your animals?

	Overall
Yes	23 %
No	77 %

VI Collection Fee and Financial Matters

Q6-1 Do you know which authority is responsible for Municipal Solid Waste Management?

	Residential Area
Provincial government	3 %
Municipality	29 %
Yourself	0 %
Municipal company (public) for example SANITECH	38 %
Private company	2 %
Others	1 %
I don't know.	27 %

Q6-2 The present Municipal Solid Waste Management is being carried out by the SANITECH, municipality and private companies. Do you think the present MSWM is appropriate?

	Overall
Yes	42 %
No	58 %

Q6-3 If "No", what organization should take responsibility on MSWM?

	Residential Area	Commercial Area
Municipality	28 %	8 %
Provincial government	0 %	4 %
SANITECH	22 %	45 %
Private company	43 %	35 %
Others	7 %	8 %

Q6-4 How much do you pay for the collection service per a month?
The answers to this question are varied and any trend could not be found.

Q6-5 What do you think about collection fee?

	Residential Area	Commercial Area
Expensive	11 %	4 %
Little bit expensive	7 %	4 %
Little bit cheap	7 %	17 %
Collection fee system is not fair.	3 %	0 %
I don't know.	72 %	75 %

Q6-6 Do you pay the collection fee directly to the collection company or through your cooperative?

	Residential Area	Commercial Area
Directly (by yourself)	25 %	33 %
Through the Cooperative	73 %	47 %
I don't know.	2 %	20 %

Q6-7 Who and how is the fee collected?

	Residential Area	Commercial Area
Through bank account	24 %	50 %
With the other payment to the Cooperative	71 %	50 %
Cashier of enterprises	3 %	0 %
Others	3 %	0 %

Q6-8 The present waste management cost is not sufficient for maintaining the beautiful scenery of the City and its environment. Who do you think should bear the extra cost?

	Residential Area	Commercial Area
Central government	4 %	3 %
Provincial government	5 %	7 %
Municipality	48 %	47 %
Citizens by means of collection fee increase	13 %	13 %
Others	8 %	3 %
I don't know.	22 %	27 %

Within the replies of "Others", more than half interviewees replied for "Board of District "

VII Public Cooperation

Q7-1 Have you ever had any guidance of methods of proper discharge?

	Residential Area	Commercial Area
Yes	6 %	17 %
No	94 %	83 %

Q7-2 Do you think "Clean Day" should be organized?

	Residential Area	Commercial Area
Yes	68 %	63 %
No	19 %	27 %
I don't know.	13 %	10 %

Q7-3 Does anyone in your family clean the road shoulder or adjacent public area in front of your house except for as the guardian?

	Residential Area	Commercial Area
Yes, everyday	12 %	50 %
Yes, sometimes	34 %	27 %
No	54 %	23 %

Q7-4 Do you think public cooperation is necessary in order to maintain the beautiful city and its environment?

	Residential Area	Commercial Area
Yes	91 %	100 %
No	5 %	0 %
I don't know	4 %	0 %

Q7-5 If "Yes", can you cooperate with maintaining the beautiful city and its environment?

	Residential Area	Commercial Area
Yes	90 %	97 %
No	10 %	3 %

Q7-6 Do you think public education for maintaining the beautiful city and its environment is necessary?

	Residential Area	Commercial Area
Yes	95 %	100 %
No	2 %	0 %
I don't know	3 %	0 %

Q7-7 If "Yes", who should take such action?

	Residential Area	Commercial Area
Central government	5 %	7 %
Provincial government	8 %	11 %
Municipality	66 %	54 %
School	15 %	21 %
Family member	5 %	0 %
Church	3 %	7 %
Others	0 %	0 %
I don't know.	0 %	0 %

C.5 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 zl 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).

ANNEX D

INVESTIGATION OF PRESENT AND CANDIDATE DISPOSAL SITE

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APPENDIX D INVESTIGATION OF PRESENT AND CANDIDATE DISPOSAL SITES

D.1 Proposed 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

The land use agreement with Suchy Las for existing Suchy Las disposal site is valid only until the end of 1993. According to the Municipality, the possibility of extension of land use permission is very thin, because Suchy Las is located outside of the Poznan City. The Municipality does not have any measures to persuade the citizens except financial offers, because the citizen of Suchy Las do not have any obligation to receive waste from Poznan. In addition, the citizens in Suchy Las are not cooperative to Poznan. Consequently, the Municipality has given up to get the construction permission of Suchy Las disposal site after 1993

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.

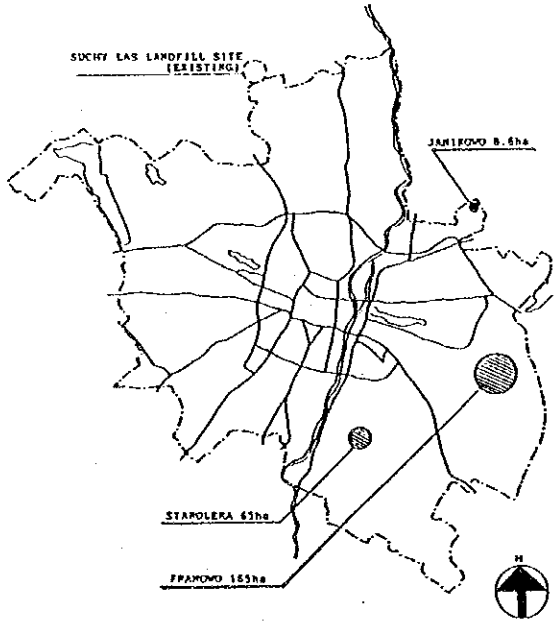

Fig.D.1-1 Location of Candidate Sites

D.2 Contents of the Investigation

The investigation of the candidate sites consists of the following surveys;

- Field reconnaissance
- Study on collected data

The following data were collected.

1) Janikowo
   a. Topographical map
   b. Geological data

2) Starolenka
   a. Topographical map

3) Franowo-Michalowo
   a. Topographical map
   b. Geological data

D.3 Results of the Investigation

1) Janikowo

a. Conditions of the site

- The area of the site is 8.6 ha.
- 3 ha of it is a private land.
- The site lies on the boarder of the Poznan and parts of the site belong to the 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 a 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.

b. 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

a. 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.

b. Geological characteristics of the upper layer

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

3) Franowo-Michalowo

a. 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.

b. 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.

The survey results are summarised in Table D.3-1.

Table D.3-1 Comparison of SWM Candidate Sites

	Item	Jankowo	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**	Necessary	Necessary	Necessary
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 Nil	Urbanization in Promotion area Nil	Nil
3d	Other considerations			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--GL-1.5m	Land use--Industrial area surface soil--Clay, Sand Ground water level--?	Land use--Field Surface soil--Clay, Sand Ground water level--GL-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 deasely 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

D.4 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

ANNEX E

OTHER FIELD SURVEYS

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APPENDIX E OTHER FIELD SURVEYS

This section describes the results of the various miscellaneous field surveys conducted in this Study.

E.1 Investigation of Suchy Las 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.

E.1.1 Topographical 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.

The Suchy Las disposal site is situated near the northern border of Poznan and its present area is approximately 12.94 ha.

The ground surface level ranges from 100 to 115 m above sea level though to 105 to 90 m above sea level going from the southern to the north-eastward area. The average slope of the ground level ranges from 2 to 3 %.

E.1.2 Geological Survey

1) Boring Work

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

2) Sampling

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.

3) Laboratory Test

The following tests were conducted on the three samples;

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

Bulk density and natural moisture values were also taken. The vales for bulk density and natural moisture were taken together with a triaxial shear test for the sample of peat layer.

4) Laboratory Testing Methods

Permeability tests were carried out using the ITB–ZW apparatus. Unconfined compression tests results were determined for cubed samples with the dimensions of 5 x 5 x 5 cm. Based on the triaxial shear test the angle of friction and cohesion values were calculated. Consolidation test values of primary and secondary modules of compressibility have been calculated for load ranges from 0.025–0.2 MPa and the values of secondary modules of compressibility for load ranges from 0.2–0.4 MPa (samples from the depths 6.0 and 12.0 m) and 0.2–0.5 MPa (sample from the depth 17.5 m).

5) Test Result

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. The values of additionally determined parameters are as follows;

Table E.1.2–1 Characteristics of Soil

Depth of sampling (m)	Bulk density (T/m^3)	Natural moisture (%)
6.0	2.19	11.6
12.0	2.23	10.5
17.5	2.10	13.4
18.5	1.06	130.0

1. Location : BIEDRUSKO (64 meters from landfill and 15 meters from road)
2. Elevation: of borehole ground surface: 96,90 meters above sea level
3. Final depth : 20,0 meters below ground surface 4. Date of drilling: 11th June 1992
5. Drilling rig : H3-05H; mechanical-rotary and percussion method

Geological and ground water profile						Laboratory tests results						
Age of format.	Depth of layer (m b.g.s) from	to	Thickness of layer m	GEOLOGICAL DESCRIPTION	Ground water (m b.g.s)	Depth of sampling	Permeability	Unconfined compression test	Triaxial shear test: Angle of friction	Triaxial shear test: Cohesion	Modulus of compressibility: Primary	Modulus of compressibility: Secondary
							m/24 hours	kPa	°	kPa	MPa	
QUATERNARY	0,0	0,2	0,2	loamy top soil, dark grey	slightly outflow from 2,6 (94,3) mas.l to 6,5 (91,4) mas.l	6,0	$8,6 \cdot 10^{-4}$	33,5	14,5	35,3	14,4	36,5
	0,2	0,6	0,4	silty loam, some cobbles, dark grey								
	0,6	1,5	0,9	silty loam, yellow								
	1,5	2,5	1,0	sandy loam with admixture of gravel, greyish yellow								
	2,5	16,9	14,4	sandy loam, dark grey		12,0	$12,0 \cdot 10^{-5}$	34,8	15,5	37,3	13,5	31,0
TERTIARY	16,9	18,0	1,1	silty loam, greyish blue	13,25 (83 65) ground water: stabilized	17,5	$7,0 \cdot 10^{-3}$	36,4	9,5	42,2	10,6	24,5
	18,0	18,8	0,8	peat, thin strata of silt, grey		18,5			5,5	7,8		
	18,8	20,0	1,2	fine sand, grey	18,8 (78 10) drilled							

Fig.E.1.2-2 Result of Geological Survey

E.1.3 Environmental Survey

1) Objective of the 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.

Also, when the environmental evaluation on the first priority project for Feasibility Study is conducted, the results of the survey will be useful information as the environmental basic data.

Furthermore, at the time of the planning of new disposal site, it should be carried out taking into account the results as to the mitigation measures against environmental problems caused by waste.

2) Method of the environmental survey

Preparatory work

First of all, in order to identify the significant environmental impacts caused by the operation of the municipal waste disposal facility, the initial environmental matrix was prepared taking into consideration the existing E C (European Communities) environmental guidelines.

After that, the environmental factors, which may have significant impact on environment and need the detailed survey, were screened with the current available information.(refer to Table E.1.3-1)

Field survey

The methods of the field survey are divided into two manners. Concerning the environmental factors with possible measurable impact at the operation phase which were identified in the preparatory work, the survey was carried out by the collection and compilation of the existing data.

Table E.1.3-1 Environmental impacting actions and environmental factors for disposal site

Environmental impacting actions \ Environmental factors		Living environment							Natural environment			Socio-economic environment		
		Air pollution	Offensive odor	Water pollution: Surface water	Water pollution: Ground water	Soil pollution	Noise nuisance	Vibration	Climatic factors	Fauna	Flora	Population	Landscape	Material assets
Construction phase	Preparation of the ground													
	Transportation of construction vehicles													
	Operation of the construction materials													
Operational phase	Occupancy of the space													○
	Transportation of haulage vehicles	○					●							
	Operation of the landfill materials						○							
	Operation of the leachate disposal facility		○	○			○							
	Existence of the waste	○	●	●	●	○							○	

Legend

● : Significant impact on environment, detailed environmental survey needed

○ : Measurable impact on environment, general environmental information needed

Blank : Insignificant impact on environment, environmental survey not needed

definition

Environmental impacting action :
A project action which impacts on the environmental status adjacent to the project site

Environmental factor :
A factor of phenomena which reflects the effects of human activities

As for the factors with possible significant impact items, the survey was implemented by taking each sample in the surroundings of the existing disposal site and analyzing the data obtained.

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 ;

- 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 with the current available information.

- Soil pollution
- Landscape

Field Survey by taking samples and analyzing the data

The Inspectorate of Environmental Protection in Poznan Provincial Government (voivodeship), 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 Odor)
- Water quality (including the grand water)

- Noise nuisance
- Traffic volume
- Land use

The site for field survey is shown on the Fig. E.1.3-1.

3) Polish Environmental Standards

The Ministry of Environmental Protection, Natural Resources and Forestry has some environmental standards.

In co-operation with the Inspectorate of Environmental Protection in Poznan Provincial Government, the following standards could be obtained concerning the air quality, water quality and Noise level. These standards are shown in Table E.1.3-2, Table E.1.3-3, Table E.1.3-4.

Table E.1.3-2 Air Quality Standard in Poland

(Allowable concentration of substances in Atmospheric air)

(unit: mg/m^3)

Name of Substance	30 min. (D30)	Daily average (D24)	Yearly Average (Da)	Toxic danger coefficient (Ka)
Sulphur dioxide (SO_2)	0.44	0.150	0.032	-
SO_2 (after 1999)	0.40	0.150	0.032	-
Nitrogen dioxide (NO_2)	0.50	0.150	0.050	-
Carbon oxides (CO)	5	1	0.12	0.5
dust	-	0.120	0.050	-
Suspended dust-total (SPM)	0.5	0.15	0.022	2.9
Ozone	0.1	0.03	-	-
Chlorine	0.1	0.03	0.0043	14.9
Fluorine (F)	0.03	0.01	0.0016	40
Ammonia (NH_3)	0.4	0.2	0.051	1.3
Methane (CH_4)	-	-	-	-
Hydrogen sulfide(H_2S)	0.03	0.004	0.0010	-

note:) Concerning the CH_4, not define at present.

Table E.1.3-3 Water Quality Standard in Poland

Index	Unit	Admissible value		
water quality class		I	II	III
BOD	mg/l	4 and lower	8 and lower	12 and lower
COD by dichromate method	mg/l	40 and lower	60 and lower	100 and lower
Clorides (Cl^-)	mg/l	250 and lower	300 and lower	400 and lower
Sulphates (SO_4^{2-})	mg/l	300 and lower	300 and lower	300 and lower
Disolved substances (DO)	mg/l	more than 6	1000 and lower	1000 and lower
Water Temperature	℃	22 and lower	26 and lower	26 and lower
pH	pH	6.5 - 8.0	6.5 - 9.0	6.0 - 9.0
Ammonia nitrogen	mg/l	1.0 and lower	3.0 and lower	6.0 and lower
Cyanides, exl cyanides	mg/l	0.01 and lower	0.02 and lower	0.05 and lower
Phenols	mg/l	0.005 and lower	0.02 and lower	0.05 and lower
Lead	mg/l	0.1 and lower	0.1 and lower	0.1 and lower
Mercury	mg/l	0.001 and lower	0.005 and lower	0.01 and lower
Copper	mg/l	0.01 and lower	0.1 and lower	0.2 and lower
Zinc	mg/l	0.01 and lower	0.1 and lower	0.2 and lower
Cadmium	mg/l	0.005 and lower	0.03 and lower	0.1 and lower
Chromium (Cr^{+6})	mg/l	0.05 and lower	0.1 and lower	0.1 and lower
Nickel	mg/l	1.0 and lower	1.0 and lower	1.0 and lower
Heavy metals-sum	mg/l	1.0 and lower	1.0 and lower	1.0 and lower
Boron	mg/l	1.0 and lower	1.0 and lower	1.0 and lower
Arsenic	mg/l	0.05 and lower	0.05 and lower	0.2 and lower

Table E.1.3-4 Noise Level Standard in Poland

(Allowable noise level in environment)

Type of environment	Noise level dB(A) during hours		Maximum short duration noise level dB(A)
	06.00 - 22.00	22.00- 06.00	
1 a) Suburban residential area	45	35	70
b) Suburban recreation area	–	–	–
2 a) Residential Area with small number of shops, street traffic not exceeding 1000 vehicles per hr. b) social welfare areas c) areas involving permanent or long stay of schoolchildren or babies	50	40	75
3 a) as 2a) but with street traffic not exceeding 2000 veh/hour			
b) urban,parks,garden plots	55	45	80
c) recreation and sports grounds			

4) Results of the Environmental Survey

Living environment

Air pollution

According to the data of the Institute of Environmental Protection, in 1988, the incongruity with the air pollution standards throughout Poland is 14 % for SO_2 and 67 % for NO_X. Moreover, 20 % of the measurement sites have recorded high density values of 5 times over standard.

Poznan City is also suffered from serious air pollution, especially, due to SO_2 and NO_X

The data of the air pollution inside the Pozan City is shown in below ;

- SO_2 0.031 mg/m^3
- NO_X 0.053 mg/m^3
- SPM 0.025 mg/m^3

Offensive Odor

Offensive Odor survey in the surroundings of the existing disposal site was conducted as follows ;

Sampling

Air sampling was carried out at the following points. (refer to Fig.E.1.3-1);

- A1 (at the entrance gate to the landfill)
- A2 (about 50 m from the west part of embankment to windward
- A3 (about 100 m from the north-east part of embankment to leeward
- A4 (about 100 m from the east part of embankment to leeward

Test items

3 items listed below were tested at the laboratory ;

Ammonia (NH_3), Methane (CH_4), Hydrogen sulfide (H_2 S)

Analytical methods

The analyses were made according to "The catalogue of methods for manual measurements of atmosphere pollutions" developed by the Environmental Protection Institute in Warsaw in 1990 and recommended by environmental protection, Natural Resources and Forestry.

The result of the survey

The result of the analysis is tabulated in Table E.1.3-5.

Table E.1.3-5 Result of Offensive Odor survey

Date:
15th June,1992

General Condition	
Weather	Sunny
Temperature	23 ℃
Humidity	51%
Wind direction	west
Wind speed	1.6- 3.3 m/s

Date:
30th June,
1992

General Condition	
Weather	Cloudy
Temperature	31 ℃
Humidity	55%
Wind direction	from east to west
Wind speed	0.7 m/s

Sample point	unit	Result of measurement		
		Ammonia (NH_3)	Methane (CH_4)	Hydrogen sulfides (H_2S)
A1	mg/m^3	0.04221	0.0333	0.00220
A2	mg/m^3	0.15074	_	0.00873
A3	mg/m^3	0.02677	_	0.01906
A4	mg/m^3	0.01915	_	0.01694

note:) NH_3, H_2S were measured in 15th of June
CH_4 was measured in 30th of June
value is each average value from the 2 time measurements

Water Quality

The water quality survey in the surroundings of the existing disposal site was conducted as follows ;

Sampling

Water sampling was carried out at the following points. (refer to Fig.E.1.3-1);

- W1 (at the south-east side of earth embankment surroundings the landfill). Samples could not be taken because the point had been destroyed

- W2 (at the hollow part of the landfill and the most protruding points to the east direction)
  Water-level at 5.68 m below the ground surface
- W3 (at the north side of the hollow part of the landfill)
  Water-level at 4.74 m below the ground surface
- W4 (the most protruding points to the north, about 400 m from the embankment surroundings the landfill)
- W5 (at the north-east side of earth embankment surroundings the landfill)
  Water-level at 5.75 m below the ground surface
- W6 (at the protruding to north, about 450 m from the landfill embankment)
  Water-level at 6.60 m below the ground level
- W7 (placed in the stream flowing into Glinomowieckie lake)
  Samples could not be taken because the stream dried up.
- W8 (Glinomowieckie lake)
  beside the platform in the north-west part of the lake water transparency was also tested in the lake (it was 105 cm).

Test items

13 items listed below were tested at the laboratory ;

pH, COD, BOD, Total nitrogen(T-N), sulphates(SO_4^{-2}),chlorine Ion (Cl^-), lead (Pb), arsenic (As), cadmium (Cd), hexavalent chromium (Cr^{6+}), mercury (Hg), PCB, Colibacillus

Analytical methods

All determinations were made in accordance with standards obligatory in Poland or with methods allowed by the Ministry of Environmental Protection, Nature Resources and Forestry.

The result of the analysis

The result of the analysis is tabulated in Table E.1.3-6, Table E.1.3-7.

Table E.1.3-6 Results of the Water quality survey (1)

Date: 16th June, 1992

General Condition	
Weather	Sunny
Temparature	23.0°C
Water Temperature	12.0°C

Item	unit	Result of each sampling point					
		W2	W3	W4	W5	W6	W8
pH	-	7.3	7.1	7.4	7.3	7.2	8.2
COD(by dichromate method)	mg O_2/l	37.6	19.2	12.2	31.4	34.5	22.7
BOD_5	mg O_2/l	5.4	6.8	1.7	3.4	3.6	4.2
Total Nitrogen(T-N)	mg N/l	1.81	1.17	0.84	1.49	1.69	1.16
SO_4^{2-}	mg SO_4/l	112.0	76.0	61.0	44.0	73.0	64.0
Chloride Ion(Cl)	mg Cl/l	74.0	35.0	25.0	24.0	55.0	26.0
Lead(Pb)	mg Pb/l	0.3167	0.1895	0.1726	0.1825	0.2237	0.1912
Arsenic(As)	mg As/l	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium(Cd)	mg Cd/l	0.0028	0.0030	0.0022	0.0021	0.0019	0.0011
Hexavalent hromium(Cr^{6+})	mg Cr/l	0.0054	0.0410	0.0025	0.0030	0.0020	0.0014
Mercury(Hg)	mg Hg/l	0.0210	0.0192	0.0075	0.0070	0.0050	0.0125
PCB	mg/l	0.0010	0.0005	0.0003	0.0005	0.0005	0.0004
Colibacillus	-						
*coli test faecal type		11	20	20	11	> 50	1
*coli test general		< 0.4	7	20	5	50	0.04

Table E.1.3-7 Results of the Water quality survey (2)

Date: 17th June, 1992

General Condition	
Weather	Sunny
Temparature	21.6℃
Water Temperature	12.5℃

Item	unit	Result of each sampling point					
		W2	W3	W4	W5	W6	W8
pH	–	7.4	7.4	7.4	7.6	7.4	8.2
COD(by dichromate method)	mg O_2/l	18.5	14.0	8.6	27.3	25.4	22.5
BOD_5	mg O_2/l	2.5	3.7	1.7	3.0	3.8	3.8
Total Nitrogen(T-N)	mg N/l	1.37	1.16	0.78	1.61	1.87	1.76
SO_4^{2-}	mg SO_4/l	97.0	87.0	70.0	48.0	93.0	58.0
Chloride Ion(Cl)	mg Cl/l	71.0	35.0	23.0	24.0	52.0	26.0
Lead(Pb)	mg Pb/l	0.1444	0.1320	0.1293	0.0887	0.0322	0.0948
Arsenic(As)	mg As/l	0.0	0.0	0.0	0.0	0.0	0.0
Cadmium(Cd)	mg Cd/l	0.0014	0.0070	0.0007	0.0013	0.0010	0.0006
Hexavalent hromium(Cr^{6+})	mg Cr/l	0.0019	0.0040	0.0019	0.0011	0.0013	0.0004
Mercury(Hg)	mg Hg/l	0.0008	0.0008	0.0129	0.0011	0.0004	0.0021
PCB	mg/l	–	–	–	–	–	–
Colibacillus	–						
*coli test faecal type		50	20	>50	20	20	0.04
*coli test general		0.4	7	>50	20	7	0.04

According to the result, except for the Lead (Pb), it may be concluded that there were no concentrations of the tested pollutants to exceed Polish admissible standards.

Soil Pollution

The soil pollution standard is not established in Poland.

According to our hearing from the relevant authorities, soil pollution problem occurred at the illegal dumping place in recent time.

Noise Nuisance

In order to recognize the situation of the noise nuisance in the surroundings of the Suchy Las disposal site, the noise survey and the traffic volume survey were carried out as follows ;

Survey points

The noise survey and the traffic volume survey were conducted at the same survey points. The survey points are shown in Fig. E.1.3-2.

- NT1 (located at the entrance gate to the disposal site, on the west side of the road)
- NT2 (located at the crossing of Suchy Las road, Morasko road and access road to the disposal site)

Survey items

- Operation noise (Survey point - NT1)
- Transportation noise (Survey point - NT2)
- the number and direction of vehicle categorized as shown below;
  - i) large vehicle
  - ii) small vehicle

Survey time

12 hours from 7:00 to 19:00 on weekday (15th of June, 1992).

Noise level measurement method

Noise level measurement methods is based on the following standards and regulations

- Noise. Measurement methods (PN - 81/N - 01306)
- Sound level meters. General requirements and tests (PN - 79/T - 06460)
- The Cabinet Decree of 30th September, 1980 on environment protection from noise and vibrations.

The results of the noise survey and traffic volume survey

The result of the noise survey is tabulated in Table E.1.3-8.

Table E.1.3-8 Result of the Noise survey

unit: dB(A)

Survey point	NT1				NT2		
Measurement Hour	L_1	L_{99}	L_{eq}	L_{90}	L_{max}	L_{min}	L_{eq}
7:00 - 8:00	81.8	36.0	69.4	44.5	88.3	30.8	63.7
8:00 - 9:00	83.3	51.3	72.4	56.3	96.1	30.8	67.3
9:00 -10:00	86.3	45.8	73.5	54.8	89.4	33.6	67.7
10:00 -11:00	83.3	38.8	70.7	49.3	88.3	34.5	66.2
11:00 -12:00	86.3	45.5	73.8	52.5	91.5	36.7	68.1
12:00 -13:00	84.3	45.3	71.5	56.5	91.0	35.2	66.2
13:00 -14:00	82.3	45.3	70.1	50.0	89.3	35.3	64.3
14:00 -15:00	83.8	44.0	71.7	54.3	89.8	37.0	65.7
15:00 -16:00	81.3	42.8	68.8	47.5	86.3	29.2	63.3
16:00 -17:00	78.3	36.0	65.3	40.5	92.7	29.4	61.6
17:00 -18:00	76.3	34.3	64.0	40.0	81.7	29.4	60.6
18:00 -19:00	70.3	32.0	59.6	38.0	88.8	28.1	59.8
Average value	81.5	41.4	69.2	48.7	89.4	32.5	64.5
L_{eq} 7:00 - 15:00			71.9				66.4

Interpretation:

L_{max} - maximum momentary sound level at Survey Point

L_{min} - minimum value of recorded sound level corresponding with acoustic background level after elimination of distinguishable sources of noise

L_1 - maximum value of sound level at Survey Point

L_{90} - disposal operation noise level (without the traffic noise)

L_{99} - acoustic background level (after elimination of the traffic noise and operation noise level

L_{eq} - equivalent sound level

The result of the traffic volume survey is tabulated in Table E.1.3-9.

Natural environment

Natural preservation area

In the whole country, the Natural Conservation Act favours establishment of national parks and reserves. The existing 15 national parks occupy 1,257 thousand ha of area (0.4 % of the country).

The eighteen natural preservation areas are located within the Poznan City as shown in Fig. E.1.3-3.

Flora and Fauna

In the whole country, following degradation of woodland, the living conditions for many species of wild plants and animals are getting worse. High endangered is at present about 400 plant species and about 890 animal species.

There are many forest in Pozan City. However, there are not living so many valuable species. Most of plants and animals are common ones.

Nevertheless, the following 3 species are designated to be preserved especially.

- European beaver
- Bats
- Turf spider

Socio-economic environment

Land use in the surroundings of the Suchy Las disposal site

The land use in the surroundings (2000 ha) of the disposal site is shown in Table E.1.3-10.

Table E.1.3-10Land use in the surroundings of the disposal site

Land use	Area (unit: ha)	Percentage
Cultivated area	276.1	13.8%
Forest	659.5	33.0%
Army management	840.7	42.0%
Waste dumps	18.0	0.9%
Garden plots	83.0	4.2%
Residential	11.0	0.6%
Public facility	10.1	0.5%
Others	101.6	5.1%
Total	2000.0	100.0%

Landscape

At present, many illegal waste dumping places can be seen within Poznan City. Especially, on the open space, it constitutes aesthetic problem.

The landscape surroundings of the existing disposal site is unseemly because the surface of the disposal site only covered with soil without green belt.

Location of public facilities

Fig E.1.3-4 shows the spatial distribution of the public facilities (including the facilities of the historical value)

Most of the hospitals and primary schools are located in the center of the city.
So many traditional architectures, not only religious facilities, like churches but also cultural facilities can be seen everywhere within the Poznan City.

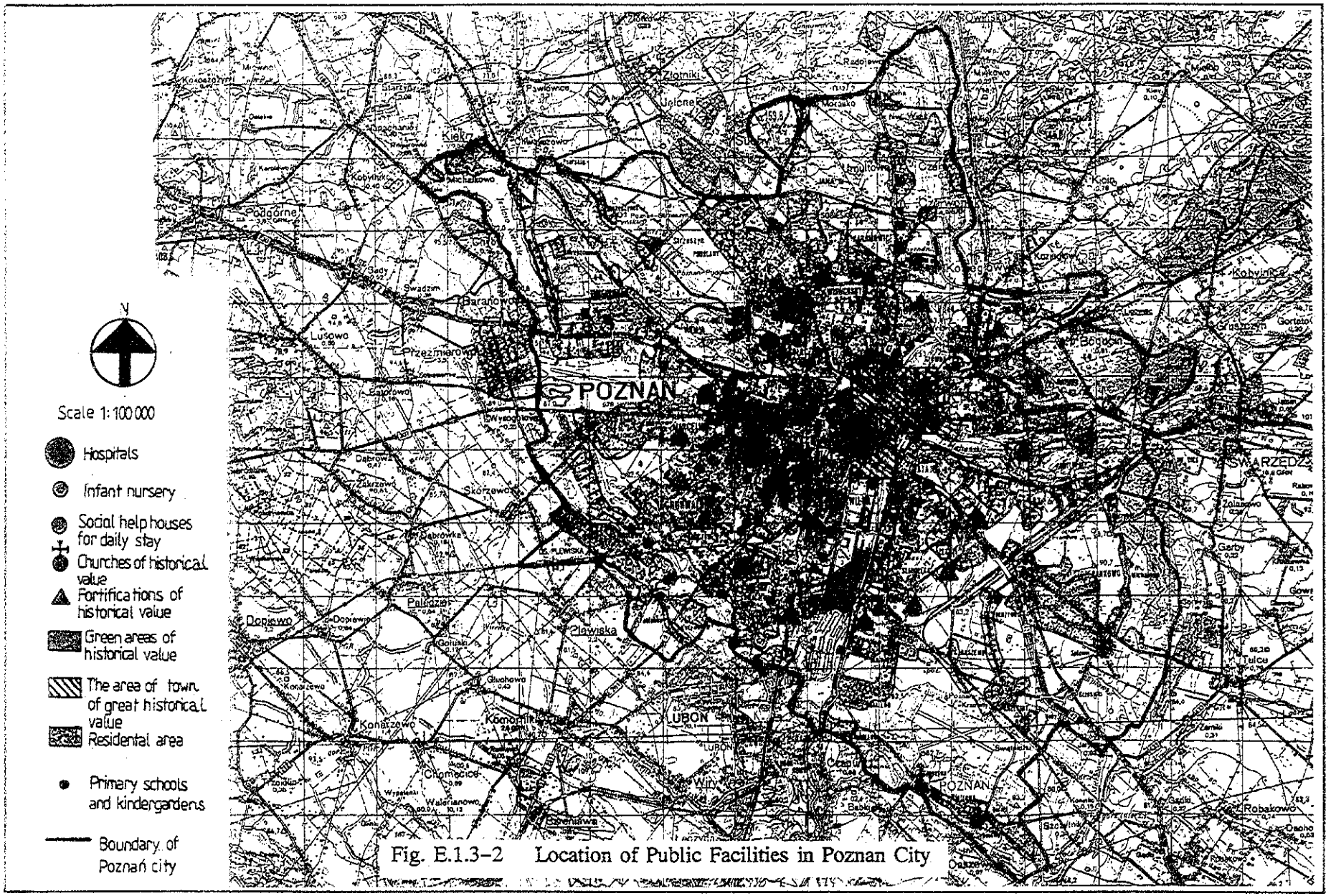


Fig. E.1.3–2 Location of Public Facilities in Poznan City

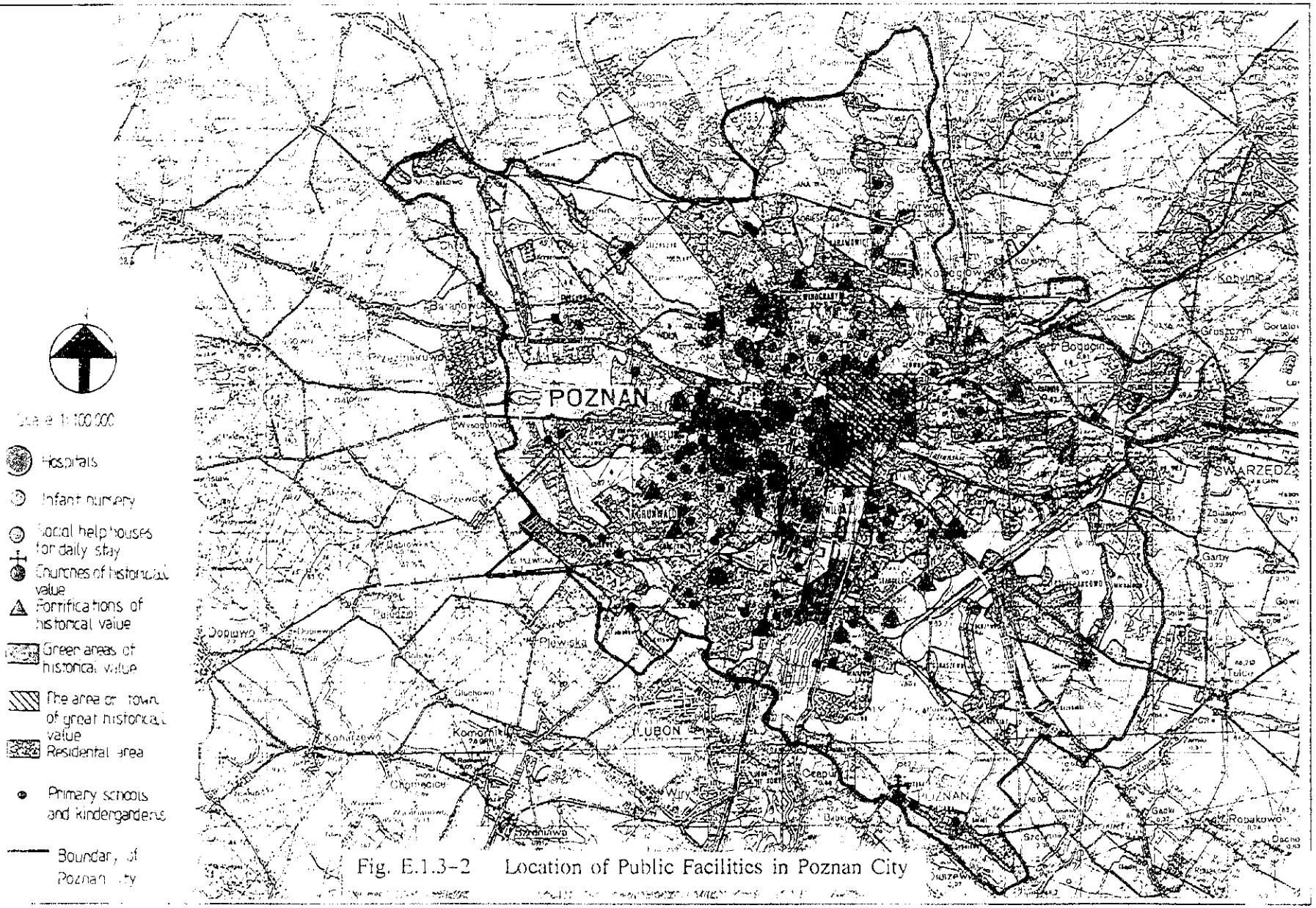


Fig. E.1.3-2 Location of Public Facilities in Poznan City

Fig. E.1.3-3 Natural Preservation Area in Poznan City

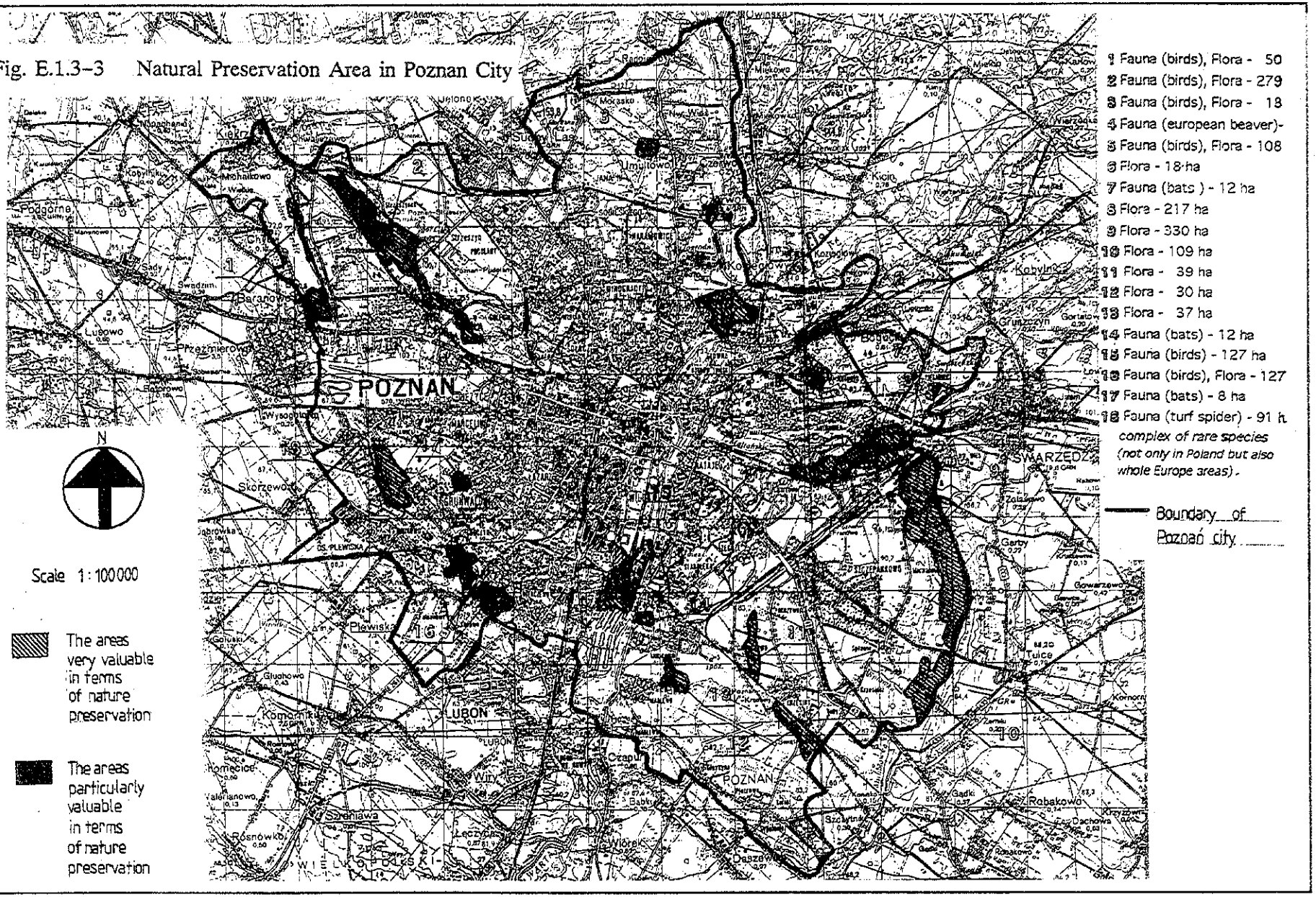
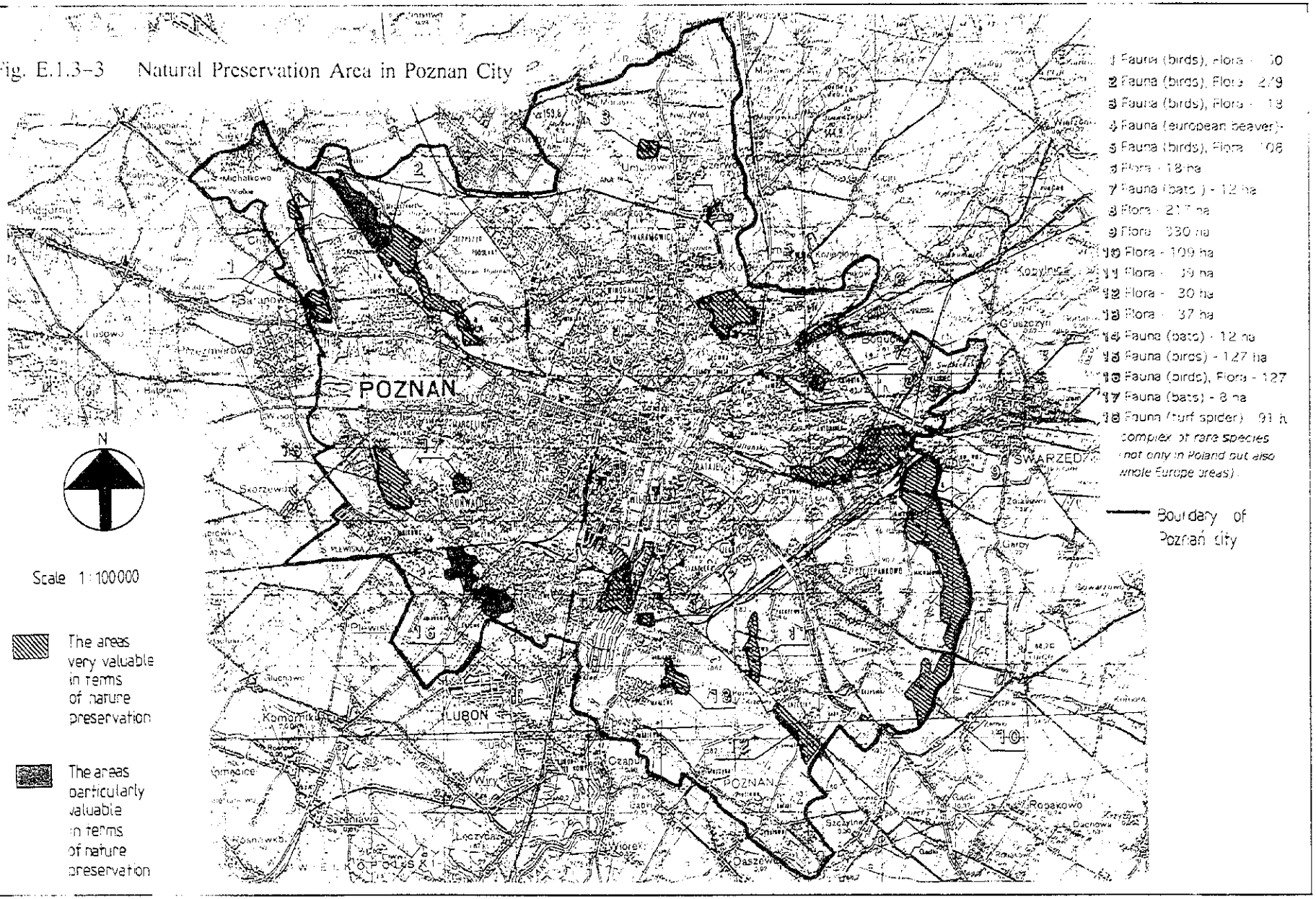


Fig. E.1.3-3 Natural Preservation Area in Poznan City



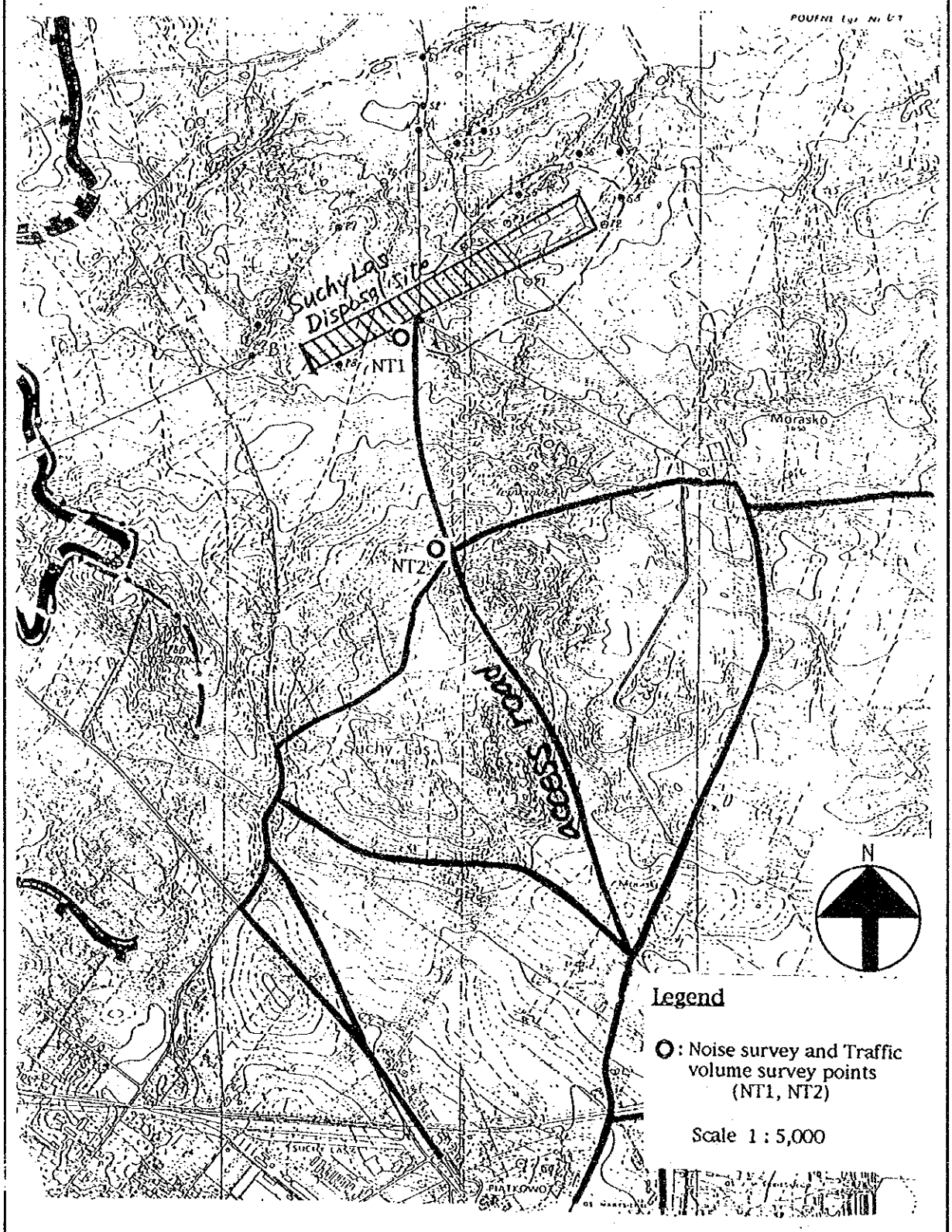


Fig. E.1.3-4 Noise and Traffic Volume Survey

E.2 Survey on Private Contractors

The situation of the private contractor operation had not been understood by the municipality or SANITECH because a license for the waste collection service is not required for private contractors and also most of them were established recently, at the end of 1991. JICA Study Team identified two private contractors which are carrying waste to the Suchy Las disposal site therefore it is understood that other private contractors dealing with municipal waste do not exist.

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 below.

1) LEWAR

LEWAR originated from the construction and repairing department of the cooperative and became independent in November 1991. They are operating waste collection work in the Piatokowo area which consists of new apartments. They are using two hundred and fifty 8 m^3 containers for waste collection services, and all those containers are owned by the cooperative.

LEWAR collects 8 m^3 containers, with 4 armroll trucks assigned to accomplish the task, from the container yards provided in the apartment buildings and transports it to the transfer station, located 2 km away from the centre of Piatokowo district and 8 km away from the Suchy Las disposal site, and unloads the waste there. The waste is loaded and compressed into a 10 m^3 container using a power shovel. The density of waste doubles during this operation. These 10 m^3 containers with the compressed waste are transported to the Suchy Las disposal site with a armroll car. Two armroll cars are assigned for this task. The purpose of this operation are considered to be the following;

- to minimize the damage of the armroll trucks caused by the rough surface of the temporary access road to the Suchy Las disposal site
- to minimize the dumping fee of the Suchy Las disposal site

The basic information on LEWAR is described below;

- Scope of Business
  - . Waste collection and transportation
  - . Rent construction machinery
  - . Repairing of vehicle
  - . Purchasing and selling of slag and ash
- Equipment owned (concerning SWM)
  - . Container 8 m^3 : 120 units (owned by the corporative)
  - . Container 10 m^3 : 3 units
  - . Armroll truck : 6 units
- Number of employees : 28 persons
- Population covered by LEWAR : 44,190 persons
- Number of households covered : 12,395 households
- Price of waste collection : 500,000zl/8m^3 container/trip
- Quantity of waste collected per month : approximately 800 containers/8 m^3 container
- Monthly trip record to Suchy Las disposal site

Table K.2-1 Number of Trips to Suchy Las Disposal Site

Month	Number of Trips (10 m^3 container)
January	252
February	234
March	232
April	303 (Easter)
May	255

2) TECH-KOM

The owner of TECH-KOM came from SANITECH and the company was established in December 1991. TECH-KOM is operating waste collection work in Gmina Suchy Las, Gmina Czerwonak and Osiedle Zwycięstwa areas located in the northern area of Poznan City. Osiedle Zwycięstwa area consists of the new apartment buildings. TECH-KOM is using approximately one hundred 8 m^3 containers and three armroll trucks. All wastes are carried to the Suchy Las disposal site. All of the armroll trucks were purchased from SANITECH. The basic information of TECH-KOM are described below;

- Operating area
  - i. Osiedle Zwycięstwa in Poznan
  - ii. Gmina Suchy Las and Firms
  - iii. Gmina Czerwonak
  - iv. "Poldrob" Poultry processing plant

- Number of Container carried to the Suchy Las disposal site
  approximately 250 containers per month

Table 6.2-2 Service Area of TECH-KOM

Service Area	Container
Osiedle Zwycięstwa in Poznan	150
Gmina Suchy Las and Firms	60
Gmina Czerwonak	30
"Poldrob" Poultry processing plant	16

- Collection Fee : 500,000 zlotych per 8 m^3 container/trip

3) Miscellaneous

Like the contractors stated above, the military and the state casting company of POMET are known to carry waste daily to the Suchy Las disposal site. The military carries approximately 8 ton of household waste daily with an armroll truck. It is understood that POMET carries 70 ton of moulding sand which is discharged from its factory.

E.3 Compost Market Survey

1) Objective of Survey

Compost is one of the most valuable products which can be produced through waste processing. A composting plant is expected to be one of the effective facilities which might be adopted in SWM M/P. Therefore the demand of compost needs to be understood in order to examine the necessity of a plant in terms of financial aspects.

2) Method of Survey

The compost market survey consists of the following three surveys:

- Compost producers' survey in Warsaw and Katowice
- Compost customers' survey of Warsaw and Katowice composting plants
- Potential demand for composting in Poznan Province

i. Compost producers' survey in Warsaw and Katowice

There are two large and modern composting plants operating in Poland. They are located in Warsaw and Katowice and the operational conditions of both plants were surveyed on 21 and 22 May 1992.

ii. Compost customers' survey of Warsaw and Katowice composting plants

Ten customers were interviewed from each composting plant using a questionnaire between 23 June to 27 June in 1992.

iii. Potential demand to composting in Poznan Provincial

The agricultural department of the Poznan Provincial Government provided the information on the present situation in agriculture.

3) Result of Compost Producer Survey

a. General

According to the survey the main objective of compost production in Poland is neutralization of waste rather than producing fertilizers. The compost produced is

being utilized mainly for land reclamation and cultivation of landfills. The quality of compost is poor due to the contamination by many glasses and pieces of plastic, and this is because waste segregation is not being applied at its sources. In addition, it is observed that sufficient attention is not being paid to the quality of compost.

In the workshop held by the study team of "Municipal Waste – Strategy for Waste Management and Applicable Methods for Collection and Treatment", it was concluded that:

The use of compost should be limited to use on gardens (not food), forest, cultivation of low grade soils and as a means of restoring old landfills or despoiled land. Large areas of Poland consist of sandy soils which require humus to maintain their fertility and there appears to be a potential for creating a market. However, careful consideration must be given to the widespread application of compost which could contain environmentally detrimental materials such as heavy metals. It is generally agreed that these potentially harmful materials should be constricted for possible treatment rather than spread widely, making such treatment impossible.

Despite the problems associated with large scale composting, it has been agreed that there are good opportunities for composting at garden or village scale in Poland.

b. 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.

The basic information of the plant is described as follows:

- Expansion Program

	Operation Start
Test Plant	: 1965
Phase I Project	: April, 1992

Phase II Project : December, 1993

- Capacity of Plant (Waste Received)

Project	Main system	Capacity	Total
Test plant	: 50 t/day x 1 bio-stabilizer =	50 t/day	50 t/day
Phase I	: 120 t/day x 2 bio-stabilizer =	240 t/day	290 t/day
Phase II	: 145 t/day x 2 bio-stabilizer =	290 t/day	580 t/day

- Project Cost

The total project cost for Phase I and II is 30 to 35 mill. US$. 150 bill. zl has been invested for Phase I and a part of Phase II so far.

- Productivity

	Compost Production	Production/Waste
Test Plant	: 22.5 ton/day	: 45 %
Phase I	:132 ton/day	: 55 %
Phase II	:145 ton/day	: 50 %

- Operation and Maintenance Cost

This data was not available due to a short operation period.

- Number of Staff

	Total
Test Plant	: 20 persons
Phase I	: 50 persons
Phase II	: 55 persons

- Type of Waste used for Compost

Only municipal waste is utilized for compost processing, however, segregation of waste at sources are not being carried out. Manual segregation of bulky waste from municipal waste is carried out at the plant prior to the fermentation processing.

- Price of Compost:

. 40,000 zl per ton for cultivation
. 60,000 zl per ton for fertilizer

- Production Flow

. Unloading waste into a pit which has 3 days storage capacity.
. Remove bulky waste manually.
. 1st fermentation in Dano drum for 36 hours.

. Remove metal, heavy objects, etc. using several sorting machines.
. 2nd fermentation outdoors for 6 weeks with aeration using an air supply machine.

The production process of compost for cultivation is complete. Other sorting processes are added to produce high grade compost for fertilizer after these processes.

c. 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.

The basic information of the plant is described as follows:

- Capacity of Plant (Waste Received)
  120 t/day x 2 bio-stabilizer = 240 t/day

- Project Cost
  The project cost is 6.7 mill. US$ at the present value.

- Productivity : 50 % of waste

- Operation and maintenance cost : 962 mill. zl per month

- Number of Staff : 23 persons

- Type of Waste used for Compost
  Only municipal waste is utilized for compost processing, and segregation of waste at sources are not carried out. However, an experiment segregating paper, metals, glasses, organic materials and others started this year.

- Price of Compost: 50,000 zl per ton

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
- MPGK Utilization Department - Katowice, Milowicka St. 7.

The survey was carried out between 20th June, 1992 and 3rd July, 1992.

After the interviews with the compost buyers, who purchase goods from the two compost production plants, we concluded that:

a) Nine consumers are enterprises owned by the State Treasury while two others belong to physical bodies. Four of the nine mentioned state enterprises are involved mainly in creating and building green areas. The five remaining repair and build green areas to meet their own demands, eg. the "Warszawa" steel plant and hard coal mine "Wujek". Both private enterprises are linked with building green areas, improving soil quality, planting trees and bushes as well as production of trees, bushes, flowers etc.

b) The percentage of services and production share of the total annual sales differs considerably each year and it has been changing immensely during the last three years. These are some of the trends noticed:

   - decrease in demand for flowers and vegetables grown in greenhouses
   - decrease in demand for cuttings in green areas and for improving soil quality
   - the private companies conducting less planting operations within green and cultivated areas
   - less areas are being cultivated.

   The interviewees stated that this was caused by recession and having to import flowers and vegetables from the EC countries.

c) The distance from the compost production plant to the place where the compost is used ranges from 1 km to 20 km.

d) Compost produced by the production plants was first used for gardening and improving soil quality. The daily consumption varied considerably; the minimum was 5 t/day and the maximum 40 t/day. At present, the majority of compost is received regularly by the municipal waste dump in Pruszkow near Warsaw, 40 t daily, since the 1st June, 1992.

e) Since not all of the interviewed consumers produced the data on the annual compost purchase we are unable to give the total amount of compost purchased by the 20 companies in this report.

f) The interviewed companies utilize compost in the spring-summer-autumn periods. Only one of them used it during winter for cultivation.

g) The price of purchased compost differed. This year, the Warsaw compost production plant requested for buyers to pay: 40,000 zl for 1 t of poor grade compost and 60,000 for 1 t of fine compost and the Katowice compost production plant received 25,000 zl for 1 t of poor grade compost in 1991 and 50,000 for 1 t in 1992.

h) Compost was used in following ways:
   - low grade soils were covered with compost, then lawns were made on them
   - low grade soils were mixed with compost and lawns were made on fertilized soil
   - pits were filled with compost and trees and bushes planted in the pits
   - occasionally, compost was used in recreation gardens and tree nurseries.

i) Compost was collected by self-discharge trucks with capacity of 10 ton -20 ton.

j) All questioned consumers agreed that the only reason they used compost for was lack of humus, crop soil or peat on site and in its surrounding. Compost from the production plant was the nearest obtainable material.

k) Half of the questioned used additional dressings such as gardening peat, fertilizers, i.e. nitro-chalk, auperphosphate, potassium salt, lime, ammonium saltpetre and multi fertilizers with trace elements. They use no animal dressings. The quantity of fertilizers and gardening peat varied a lot, one of the interviewed used 1,000 t of gardening peat and only 4 t of fertilizers in 1991 while another - 100 t of fertilizers and 1,750 t of compost from the compost

production plant. One used 10 t of fertilizers and 100 t of compost from the compost reduction plant.

l) All of those interviewed agreed that the reasons why they use additional dressings are:
   - low quality of compost
   - high price (compost from a compost production plant costs 50,000 zl/t, while you can buy peat for 25,000 zl/t in Poland)
   - problems with spreading the compost, because it has a tendency of caking
   - compost production plants do not give results of compost content tests listing components including heavy metals
   - compost being contaminated with sharp metal waste (needles, nails) etc.
   - negative physical characteristics, i.e. caking during drought
   - it has muddy consistence after rain which makes even spreading increasingly difficult
   - dying of trees, bushes and grass or sometimes abnormal grass growth
   - unpleasant odour

   These complaints prove that compost quality is very low. All those interviewed stress that they are cautious and often fearful when using compost.

5) Potential Demand to Compost in Poznan Provincial

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.

6) Standard of Compost Quality

The standard was enforced by the Institute of Spatial and Communal Management which was established by the Institute Director on 28 April, 1989 as a standard binding from 1st January, 1990.

General qualitative requirements

Compost should be characterized by the following organoleptic features: colour either black or brown, odour of fresh garden soil, lump structure being loose. Strong putrid or peculiar odours are not acceptable.

Table E.3-1 Specific requirements for Compost

No.	Features	Classes					Survey methods according to:
		I		II		III	
		Type					
		D	G	D	G		
1	Organic substance content, % of dry mass not less than	40		30		20	BN-88/9103-07
2	Organic carbon content, % of dry mass, not less than	18		13		8	1)
3	Organic nitrogen content, % of dry mass, not less than	0.8		0.6		0.3	BN-80/0520-13
4	Phosphor content, % P_2O_5 in dry mass, not less than	0.6		0.4		0.3	BN-88/9103-06
5	Potassium content, % K_2O in dry mass, not less than	0.2		0.1		0.1	BN-88/9103-05
6	Reaction (pH in H_2O)	6.5 : 8.0		6.5 : 8.0		6.0:9.0	BN-72/0520-09
7	Water content, %	25 : 40		25 : 40		50	BN-88/9103-07
8	Size of particles, mm	0:15	15:25	0:15	15:25	0 : 40	BN-72/0520-10
9	Content of glass and ceramics, % not more than	0.5		1.0		2.0	BN-88/9103-08
	Content of heavy metals, mg/kg of dry mass, not more than						
10	Cd	5		15		25	
11	Cr	300		500		800	
12	Cu	300		600		800	PN-81/C-047
13	Ni	100		200		200	
14	Pb	350		500		800	
15	Zinc	1500		2500		2500	

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E.4 Survey on Scavengers

1) The Objective of this Study

This survey was carried out in order to understand the present situation of scavengers who are involved in personal recycling businesses. Understanding the scavenger situation is sometimes quite important in estimating the impact on society by the implementation of a SWM master plan.

2) The Method of the Study

- Ten scavengers were interviewed using questionnaires.
- The number of scavengers working in the Suchy Las disposal site was counted at 11 am daily from 23rd June to 1st July, for 7 days.
- The present status and the trend of scavengers in Poznan was investigated.

3) Result of Scavenger Survey

- The average number of scavengers at the landfill in Suchy Las disposal site is about 20, as shown below;

Table E.4-1 Record of Scavenger Numbers

Date	No. of Scavenger
23rd June, 1992	21
24th June, 1992	19
25th June, 1992	2
26th June, 1992	19
29th June, 1992	19
30th June, 1992	21
1st July, 1992	20
Average	19.86

- Ten scavengers were interviewed, six of the interviewed scavengers work at the Suchy Las disposal site and the other four within the City.

- 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.

- None of them pays for permission to collect wastes.

- Scavengers use their own means of transport such as carriages, bikes and their feet to take the goods and recyclable materials collected in order to sell them to waste purchase stations.

- 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 scavengers earned most from were non-ferrous metals and cardboard.

- The interviewed scavengers have been collecting wastes for an average period of eight years and the average working day is 5.7 hours long.

- The number of scavengers in 1991 as well as the quantity of wastes collected and amount of money paid to scavengers can not be established because purchasing stations carry no separate record for scavengers.

- The scavengers are not organized in a trade union and carry their activity without applying for legislation in the economic activity record.

- They claim that the number of scavengers in the city decreases because the inhabitants sell more and more wastes on their own. The number of scavengers working at the disposal site therefore increases because of shrinking opportunities within the city limits and the worsening social and economic situation caused by unemployment.

- Non-ferrous metals, scraps, waste paper, bottles and rags are collected manually at the disposal site and carried by the scavengers' own transport to the purchasing station at the Suchy Las disposal site.

- The interviewed scavengers claimed that the amount of recovered non-ferrous metals and iron decreased and the quantity of waste paper from package increased.

4) Result of Questionnaire to Scavengers

Q.1 Location

. Suchy Las : 6 persons

. Town : 4 persons

Q.2 Age

24, 61, 32, 55, 34, 65, 65, 63, 72, 60

Average age : 53.2 years old

Q.3 Income per month

total	: 2,153,500 zl
scavenging work	: 14,745,000 zl
pension	: 1,208,000 zl (5 persons)
other work	: nobody

Q.4 Do you pay money for somebody to conduct scavenging work.

no

Q.5 Who do you sell the waste collected to?

Surmet

Q.6 How do you carry it?

Bike

Carriage

Hand, Back

Q.7 Do the selling prices fluctuate greatly?

Yes	: 3
No	: 6
No idea	: 1

Q.8 Which items do you make the most money from?

Non-ferrous metal	: 7
Cardboard	: 7
Bottle	: 1
Paper	: 2
Steel waste	: 2

Q.9 How long have you been doing the waste collection work?

3, 5, 3, 20, 0.2, 6, 35, 8, 5, 2 years

Average years : 8.42 years

Q.10 What are your usual working hours?

7:00 – 14:00 is the most common working hour.

E.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.

1) Equipment provided by JICA

. Indicator/Recorder Model:HM-TCP150	1 set
. Load cell, Model:HP-1015W	2 pcs
. Spacer, Model:HF-1015W	8 pcs
. Ramp plate, Model:HR-1015W	4 pcs
. Rubber mat, Model:HG-1015W	2 pcs
. Cable case, Model:HCW	1 pc
. Engine generator, Model:EX-300	1 set
. Auto-voltage regulator 300W	1 set
. Spare cable for load cell	2 pcs
. Spare cable for indicator – load cell	2 pcs
. Ink ribbon	10 pcs
. Recording paper	100 rolls
. Data sheet 1000 sheet/box	2 box

2) Work Assignment

. Surveying	Poznan Municipality
. Detailed design	JICA Study Team
. Construction & Installation	Poznan Municipality
. Operation	Poznan Municipality (SANITECH)

3) Detailed Design

The detailed design drawings concerning the truck scale are shown in Data Book.

E.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 include;

- relationship between time, distance and weight on 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) The Method of Survey

The activities of six different types of waste collection vehicles and a road sweeper which belong to SANITECH were traced and recorded precisely.

The activities were precisely recorded using a record sheet. All waste collection stations and the route taken by the vehicles were drawn on the map.

The quantity of waste collected by the vehicles were weighed using the truck scale at the Suchy Las disposal site. In order to obtain the precise mass of waste, the vehicles were weighed twice at the entrance to the Suchy Las disposal site; upon entry and when departing.

The amount of waste collected with a road sweeper was weighed using the weigh bridge installed in the premises in Surmet located near SANITECH as the waste is usually deposited within SANITECH's premises.

The Study Team consist of four members including a driver. Duties and responsibilities of each member were assigned in the preparation stage. The following objectives were assigned to each study team member.

Group leader	Dustbin and container studies (size, condition, number), road condition, crew behaviour, collection vehicle (condition, loading capacity, covering area)
Member A	Mapping of the route and set out points for dustbins and containers set out points
Member B	Acquiring time, distance and weight measurements
Driver	Tracing the solid waste collection vehicle

a. Time Recording

The following time were recorded in the field with a watch.

i. departure time from vehicle depot
ii. arrival and departure times from each point on the collection route
iii. arrival and departure times from disposal site
iv. arrival time at vehicle depot

The time consumed in each cycle was calculated later in the office.

b. Distance

The following distances in kilometres were recorded in the field using the odometer of a car.

i. distance in kilometres at the time of departure from the vehicle depot
ii. distance in kilometres at the time of arrival at each station
iii. distance in kilometres at the time of arrival at the disposal site
iv. distance in kilometres at the time of arrival at the vehicle depot

c. Dustbin and Container

Dustbins and containers were counted and classified according to their size and types.

d. Mapping

The following information were marked on the map.

i. collection route
ii. collection points
iii. direction of vehicle depot
iv. direction of disposal site
v. serial number of the collection points

4) Survey Schedule

The survey schedule is as follows;

Table E.6-1 Schedule of Time and Motion Survey

Date in 1992	Type of Vehicle	Status	Category of Collection Area
23 June	Compaction truck	Direct	Downtown
24 June	Compaction truck	Direct	New apartment area
25 June	Compaction truck	Direct	Detached and semi-detached housing area
25 June	Armroll truck	Sub-con	New apartment area
29 June	Compaction truck	Sub-con	Downtown area
30 June	Armroll truck	Sub-con	New apartment area
29 June	Road sweeper	Direct	Provincial Road

5) Result of Survey

a. Relationship between time, distance and weight on collection and haulage

The results relative to the matters said above are summarized in Table E.6-2.

b. Type of dustbin and container

i. New Apartment Areas

8 - 10 m^3 communal containers are widely used, however, 1.1 m^3 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 m^3 communal containers and dustbins are generally used. Most of the lids and some of the wheels of 1.1 m^3 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.

c. Working efficiency of collection workers

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

Table E.6-3 Productivity of the Collection Vehicles

Date in 1992	Type of Vehicle	Status	Productivity ton/man/hour	Category of Collection Area
23 June	Compaction truck	Direct	0.253	Downtown
24 June	Compaction truck	Direct	0.430	New apartment area
25 June	Compaction truck	Direct	0.230	Detached and semi-detached house area
25 June	Armroll truck	Sub-con	0.807	New apartment area
29 June	Compaction truck	Sub-con	0.321	Downtown area
30 June	Armroll truck	Sub-con	1.143	New apartment area
29 June	Road sweeper	Direct	-------	Provincial Road

The detailed data of each survey are presented in Table E.6.6-4 to -10.

d. Collection route

Collection routes traced are shown in Data Book.

e. Level of customers' cooperation for waste collection work

The residents' cooperation towards waste collection was unsatisfactory. In the downtown area, especially where the container yard was provided in the inside yard, it was observed that the manner in which waste was discharged of was intolerable in several cases. There was a large overflow of waste from the container. In this case, the waste collection workers swept and collected it. This awful discharge manner was found to be one of the causes for low work efficiency.

In the detached and semi-detached housing areas, it was found that people discharging anything into the dustbins was a considerable problem. Soil, home carpentry waste, home factory waste , etc. disturbed the waste collection work.

f. Service level

The waste collection service reached a satisfactory level if the frequency of waste collection was not considered.

g. Maintenance and condition of equipment

The armroll truck and the road sweeper broke down during the survey. The standard of maintenance work can not be determined from the few facts available. However it can be said that most of the machineries are too old to be maintained in good conditions.

Table E.6.6-4 Data of Time and Motion Survey No.1

Date : 23 June 1992
Weather : Sunny
Collection area : Centrum, Stare Miasto
Crew : Driver-1, Worker-3
Type of vehicle : Compaction Car, Liaz Universal, Loading capacity 14 m³, 6 ton
Diesel consumption : 70.1 km / 135 l = 0.52 km/l
Working hour : 5:50 to 14:00 = 8 h 10 m
Number of trip : 2 trips
Waste amount collected: 1st - 3.92 ton
2nd - 4.35 ton
Total - 8.27 ton
Productivity : 8.27 ton / 4 m / 8 h 10 m = 0.253 ton/man/hour

Time from- to	Duration min.	Meter km	One trip km	Activity	St No	Container collected			Av. Haulage		Waste Q'ty ton
						110 l	1.1 m³	Others	bri.	ret.	
5:50- 6:05	15	0.5		Inspection, Preparation					m	m	
1st trip 6:05- 6:19	14	5.3	4.8	Garage to Collection area							
6:19- 8:10	111	7.5	2.2	Waste collection work	23	33	35	3 pl.	5	31.5	3.92
8:10- 8:35	25	21.8	14.3	Collection area to Suchy Las							
8:35- 9:00	25	22.3	0.5	Unloading waste							
2nd trip 9:00- 9:20	20	37.3	15.0	Suchy Las to collection area							
9:20-11:16	116	39.1	1.8	Waste collection work	18	35	29	3 pl.	4.2	34.7	4.35
11:16-12:05	49	55.0	15.9	Collection area to Suchy Las							
12:05-12:27	22	55.6	0.6	Unloading waste							
12:27-13:07	40	70.1	14.1	Suchy Las to Garage							
13:07-14:00	53	70.1	0	Filling up, Washing, etc.							

Table E.6.6-5 Data of Time and Motion Survey No.2

Date : 24 June 1992
Weather : Rainy
Collection area : Osiedle, Kopernika, Grunward
Crew : Driver-1, Worker-2
Type of vehicle : Compaction car, Liaz RTIC, Loading capacity 14 m³, 7 ton
Diesel consumption : 73.6 km / 120 l = 0.61 km/l
Working hour : 5:50 to 14:00 = 8 h 10 m
Mumber of trip : 2 trips
Waste amount collected: 1st - 3.78 ton
2nd - 6.76 ton
Total - 10.54 ton
Productivity : 10.54 ton / 3 m / 8 h 10 m = 0.430 ton/man/hour

Time from- to	Duration min.	Meter km	One trip km	Activity	St No	Container collected			Av. Haulage		Waste Q'ty ton
						110 l	1.1 m³	Others	bri.	ret.	
5:50- 6:10	20	0.2		Inspection, Fuel, Preparation					m	m	
1st trip 6:10- 6:30	20	4.5	4.3	Garage to Collection area							
6:30- 8:06	96	7.3	2.8	Waste collection work	7		29	1 pl.	16.6	23.6	3.78
8:06- 8:51	45	23.6	16.3	Collection area to Suchy Las							
8:51- 9:06	15	24.2	0.6	Unloading waste							
2nd trip 9:06- 9:40	34	37.8	13.6	Suchy Las to collection area							
9:40-11:35	115	39.3	1.5	Waste collection work	7		48	1 pl.	10.1	10.1	6.76
11:35-12:30	55	58.4	19.1	Collection area to Suchy Las							
12:30-12:40	10	59.0	0.6	Unloading waste							
12:40-13:35	55	73.1	14.1	Suchy Las to Garage							
13:35-14:00	25	73.6	0.5	Filling up, Washing							

Table E.6.6-6 Data of Time and Motion Survey No.3

Date : 25 June 1992
Weather : Sunny
Collection area : Osiedle, Swierczewo
Crew : Driver-1, Worker-2
Type of vehicle : Compaction car, Liaz RTK, Loading capacity 14 m^3, 7 ton
Diesel consumption : 77.2 km / 120 l = 0.64 km/l
Working hour : 5:50 to 14:00 = 8 h 10 m
Number of trip : 2 trips
Waste amount collected: 1st - 2.58 ton
2nd - 3.05 ton
Total - 5.65 ton
Productivity : 5.65 ton / 3 m / 8 h 10 m = 0.230 ton/man/hour

Time from- to	Duration min.	Meter km	One trip km	Activity	St No	Container collected			Av. Haulage		Waste Q'ty ton
						110 l	1.1 m^3	Others	bri.	ret.	
5:50- 6:03	13	0.1		Inspection, Preparation					m	m	
1st trip 6:03- 6:14	11	2.4	2.3	Garage to Collection area							
6:14- 7:55	101	3.5	1.1	Waste collection work	44	141		14 pl.	10	10	2.58
7:55- 8:32	37	20.3	16.8	Collection area to Suchy Las							
8:32- 8:50	18	20.9	0.6	Unloading waste							
2nd trip 8:50- 9:45 (9:15- 9:30)	55 (15)	37.2	16.3	Suchy Las to collection area							
9:45-11:36	111	38.1	0.9	Waste collection work	45	139		19 pl.	10	10	3.05
11:36-12:10	34	56.4	18.3	Collection area to Suchy Las							
12:10-12:25	15	57.0	0.6	Unloading waste							
12:25-13:35	70	77.2	20.2	Suchy Las to Garage							
13:35-14:00	25	77.2	0	Filling up, Washing							

Table E.6.6-7 Data of Time and Motion Survey No.4

Date : 25 June 1992
Weather : Sunny
Collection area : Osiedle Rusa, Piastowski
Status : Sub-contractor of Sanitech
Crew : Driver-1
Type of vehicle : Armroll type, STAR
Diesel consumption : 117 km / 30.5 l = 3.84 km/l
Working hour : 16:55 to 22:00 = 5 h 05 m
Number of trip : 3 trips
Waste amount collected: 1.39 ton/trip x 3 trips = 4.17 ton
Productivity : 4.17 / 1 man / 5 h 05 m = 0.807 ton/man/hour

Trip No.	Time from - to	Duration min.	Meter km	One trip km	Activity	St No-	Waste Quuantity ton
	16:55-17:00	5	531		Inspection, Preparation		
1	17:00-17:15	15	535.0	4.0	Garage to collection point		
	17:15-17:25	10	535.0	0	Loading container	1	1.39
	17:25-18:15	50	554.4	19.4	Travel to Suchy Las		
	18:15-18:25	10	555.0	0.6	Disposal waste		
2	18:25-19:00	35	571.2	16.2	Suchy Las to collection point		
	19:00-19:15	15	571.2	0	Loading container	2	1.39
	19:15-19:40	25	588.1	16.9	Travel to Suchy Las		
	19:40-19:50	10	588.7	0.6	Disposal waste		
3	19:50-20:30	40	608.2	19.5	Suchy Las to collection point		
	20:30-20:40	10	608.2	0	Loading container	3	1.39
	20:40-21:10	30	628.3	20.1	Travel to Suchy Las		
	21:10-21:20	10	628.9	0.6	Disposal waste		
	21:20-21:55	35	648.0	19.1	Return to garage		
	21:55-22:00	5	648.0	0	Stop work due to wheel damage		

Table E.6.6-8 Data of Time and Motion Survey No.5

Date : 29 June 1992
Weather : Sunny
Collection area : Osiedle Chwaliszewo, Srodka, Zawady
Enterprise : Sub-contractor of Sanitech
Crew : Driver-1, Worker-2
Type of vehicle : Compaction type, loading capacity 16 m³
Diesel consumption : 105.6 km / 160 l = 0.66 km/l
Working hour : 01:55 to 12:45 = 10 h 50 m
Number of trip : 3 trips
Waste amount collected: 1st - 3.58 ton
2nd - 3.29 ton
3rd - 3.58
Total - 10.45 ton
Productivity : 10.45 ton / 3 man / 10 h 50 m = 0.321 ton/man/hour

Time from- to	Duration min.	Meter km	One trip km	Activity	St No	Container collected			Av. Haulage		Waste Q'ty ton
						110 l	1.1 m³	Others	bri.	ret.	
1:55- 2:00	5	0		Inspection, Preparation					m	m	
1st trip 2:00- 2:15	15	2.1	2.1	Gorecka Garage to service ar							
2:15- 4:15	120	5.1	3.0	Waste collection work	13	32	25	2 pl.	21	21	3.58
4:15- 4:45	30	19.4	14.3	Collection area to Suchy Las							
4:45- 5:00	15	20.4	1.0	Unloading waste							
2nd trip 5:00- 5:20	20	31.2	10.8	Suchy Las to collection area							
5:20- 7:35	135	33.3	2.1	Waste collection work	21	32	2	5 pl.	10	10	3.29
7:35- 8:25	50	38.5	5.2	Collection area to Suchy Las							
8:25- 8:45	20	39.1	0.6	Unloading waste							
3rd trip 8:45- 9:15	30	68.6	29.5	Suchy Las to collection area							
9:15-11:05	25	69.6	1.0	Waste collection	21	77	15	5 pl.	16.4	16.4	3.58
11:05-11:20	110	69.6	0	Breakfast							
11:20-12:00	40	87.6	18.0	Collection area to Suchy Las							
12:00-12:15	15	88.2	0.6	Unloading waste							
12:15-12:45	30	05.6	17.4	Suchy Las to Gorecka Garage							

Table E.6.6-9 Data of Time and Motion Survey No.6

Date : 30 June 1992
Weather : Sunny
Collection area : Osiedle Przyjazni
Crew : Driver-1
Type of vehicle : Armroll type, STAR
Working hour : 12:45 to 17:30 = 4 h 45 m
Number of trip : 4 trips
Waste amount collected: 1st trip - 1.59 ton
2nd trip - 1.24 ton
3rd trip - 1.39 ton
4th trip - 1.21 ton
Total 5.43 ton
Productivity : 5.43 ton / 1 man / 4 h 45 m = 1.143 ton/man/hour

Trip No.	Time from - to	Duration min.	Meter km	One trip km	Activity	St No-	Waste Quantity ton
	12:45-13:00	15	0		Inspection, Preparation		
1	13:00-13:10	10	2.0	2.0	Garage to collection point		
	13:10-13:15	5	2.0	0	Loading container	1	
	13:15-13:38	23	11.2	9.2	Travel to Suchy Las		
	13:38-13:55	17	11.8	0.6	Disposal waste		1.59
2	13:55-14:15	20	21.0	9.2	Suchy Las to collection point		
	14:15-14:25	10	21.0	0	Loading container	2	
	14:25-14:39	14	29.6	8.6	Travel to Suchy Las		
	14:39-15:00	21	30.2	0.6	Disposal waste		1.24
3	15:00-15:35	35	42.3	12.1	Suchy Las to collection point		
	15:35-15:40	5	42.3	0	Loading container	3	
	15:40-16:00	20	53.5	11.2	Travel to Suchy Las		
	16:00-16:05	5	54.1	0.6	Disposal waste		1.39
4	16:05-16:30	25	63.4	9.3	Suchy Las to collection point		
	16:30-16:40	10	63.4	0	Loading container	3	
	16:40-17:00	20	74.0	10.6	Travel to Suchy Las		
	17:00-17:10	10	74.6	0.6	Disposal waste		1.21
	17:10-17:30	20	80.5	5.9	Return to garage		

Table E.6.6-10 Data of Time and Motion Survey No.7

Date : 29 June 1992
Weather : Warm night
Collection area : Glowgowska Street
Crew : 1 Driver for road sweeper and 1 for water tank car
Type of vehicle : Road Sweeper and 1.15 m^3 Water tank car
Diesel consumption : 19.2 km / 61 l = 0.31 km/l
Working hour : 20:00 to 4:00 = 6 h 00 m
Number of trip : 2 trips
Waste amount collected: 1st trip - 0.35 ton
2nd trip - 0 ton
Productivity : 350 kg + 60 kg / 7.2 km = 56.9 kg/km

Trip No.	Time from - to	Duration min.	Total D. km	One trip km	Activity
	20:00 - 21:30	90	0		Repairing
1	21:30 - 22:00	30	0.6	0.6	Travel to Hydrant, Charging water
	22:00 - 22:10	10	1.3	0.7	Travel to the street swept
	22:10 - 01:30	200	8.5	7.2	Sweeping work
	01:30 - 01:42	12	12.0	3.5	Travel to Sanitech site
	01:42 - 01:48	6	12.0	0	Disposal waste 0.35 ton
2	01:48 - 01:55	7	12.6	0.6	Travel to Hydrant
	01:55 - 02:05	10	12.6	0	Charging water
	02:05 - 04:00	115	19.2	6.6	Machine Breakdown, Repair End sweeping work

ANNEX F

PRESENT MUNICIPAL SOLID WASTE MANAGEMENT

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