ANNEX G

Industrial Waste Management Survey

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G Industrial Waste Management Survey

G.1 Objectives of the Survey

a. Objectives of the Survey

Objective of this survey was intended to generally understand the present situation of industrial waste management (from generation to final disposal) in 3 cities. The amount and type of industrial waste generated from major industries in each respective city, and its treatment and/or disposal methods applied were investigated through an interview survey.

b. Limitations of the Survey

The types and features of industrial waste generated are widely diversified and generation amount also differs widely depending upon industrial category and/or integrity of technology employed in the production. Therefore, if all types and amount of industrial waste actually generated were surveyed in such a manner, that was employed for the municipal SW amount survey, (see Annex F) a considerable amount of time and cost was required for it. Furthermore, it was quite possible that some factories may have rejected the survey saying that composition of their industrial waste is confidential in order to stop industrial secrets being broken. Consequently, it was nearly impossible to carry out field investigations of the actual amount and composition of industrial waste. Therefore, a survey of identifying and understanding the present situation of industrial waste were proceeded through the questionnaire.

The Study also employed a questionnaire survey for 10 representative factories in each respective city. The outcome of this Industrial Waste Survey is based on the two major conditions:

1. Data and information are all obtained from factories' declaration only; and
2. Samples are about 10 major factories in each respective cities.

The outcome in hand regarding industrial waste is conditional. Although industrial waste survey has such an intrinsic difficulty in practice, the survey method employed here in the Study is common in many countries including Japan.

G.2 Method of the Survey

a. Work Flow of the Survey

The Industrial Waste Survey is carried out in accordance with the work flow indicated in Figure G-1.

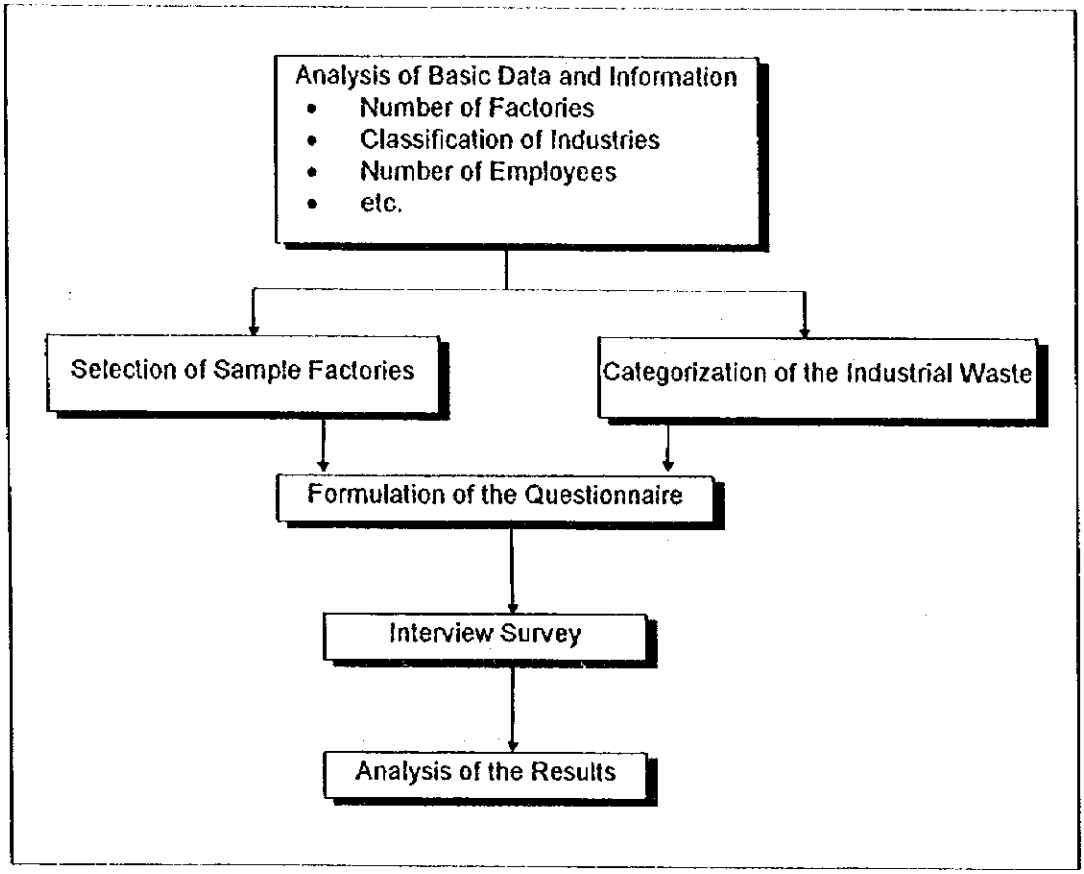

Figure G-1: Work Flow of the Industrial Waste Survey

b.2 Selection of Sample Factories

As for selection of sample factories, the major factories in each respective city are listed (Table G-1, Table G-2, Table G-3) by the counterpart, then the discussion was extended for selecting 10 representative factories in each city. Factories selected for the survey are listed in Table G-4.

The major products of the sample factories are categorized in accordance with the CIIU (International Standardized Industrial Classification) code. Industrial classification for the sample factories in the study follows the CIIU code of major products.

Table G-1: List of Factories in Leon

CIIU	Name of Companies	Nos. of Employee	Main Products
3115	GRUPO INDUSTRIAL AGROSA	229	Oil, Soap, Flour
3115	JABON EL HOGAR	15	Soap factory.
3115	SUC. ENRIQUE MANTICA BERIO S.A.	26	Sesame
3116	CUKRA INDUSTRIAL S.A.	120	Peanuts production.
3116	ENABAS	26	Grain
3121	ENISAL	28	Salt production
3121	FLAVIO VALLADARES S.A (ALASKA)	10	Ice production
3121	CELSA, S.A.	10	Soap production
3132	EMBOTELLADORA FLORES	11	Bottling Company
3132	EMBOTELLADORA LACAYO	14	Bottling Company.
3219	CONFECCIONES INDUSTRIALES ESTELA SALGADO	15	
3231	TENERIA BATAAN S.A.	100	Leather Production
3231	TENERIA BAYARDO SALINAS ROJAS	30	Tannery. Leather production.
3231	TENERIA LOS LEONES	50	Tannery. Leather production.
3232	MARROQUINERIA CENTROAMERICANO (MACASA)	24	Leather Company
3412	CARTONICA	113	Cardboard boxes
3512	FORMULADORA INTERNACIONAL AGRICOLA S.A.	14	Pesticides and Fertilizer
3512	SERVICIO AGRICOLA GURDIAN S.A.	22	Pesticides and Fertilizer
3522	LABORATORIO DIVINA S.A.	60	Pharmaceutical Products.
3551	REENCAUCHADORA MODERNA	23	Realignment of tires
3691	LADRILLERIA MODERNA	20	Brick and Tile production.
3691	LADRILLERIA ROSARIO	10	Brick and Tile production
3691	LADRILLERIA SAN FELIPE	10	Brick and Tile production.
3691	ORONTE GALLO CARDOZA	20	Brick and Tile production.
3699	YESOS DE NICARAGUA	25	Chalk production.
3822	IMPLEMENTO AGRICOLA S.A.	50	Production of Agriculture Equipment.
3839	BATERIAS ROLAC S.A.	37	Batteries
Total Number of Employee		1,112	

Table G-2: List of Factories in Chinandega

CIIU	Name of Companies	Nos. of Employee	Main Products
3111	AVICOLA GUADALUPE (POULTRY FARM)	20	Chickens
3111	MATADERO MUNICIPAL.	14	Beef and Pork slaughter
3111	PORCINA SAN BENITO (PIG FARM)	52	Pork meat
3114	EMPACADORA ECUANICA (SHRIMP FACTORY)	202	Shrimp processing company
3115	AMOLONCA.	Closed	Decorticate of Sesame.
3115	GRACAS Y ACEITES S.A.	111	Oil Factory
3115	INVERCIONES (Santa Fe)	28	Sesame
3116	INDUSTRIAS LA VIRGEN ALPHA	11	Peanuts processing
3116	INSDUSTRIA GENIMA S.A. (FLOUR COMPANY)	80	Flour and Bran
3116	MANICERA, S.A.	348	Peanuts production
3116	SEMILLA Y PROCESOS S.A. (SEMPRO)	320	Peanuts
3122	ALIMENTOS MEJORADOS S.A. (ALMESA)	60	Animal Food
3131	FABRICA DE LICORES Bell.	Closed	Rum and Alcohol production.
3512	INSECTICIDA SAN CRISTOBAL (INSECTICIDE CONPANY)	20	Pesticides and Fertilizer
Total Number of Employees		1,266	

Table G-3: List of Factories in Granada

CIIU	Name of Companies	Nos. of Employee	Main Products
3111	AVICOLA SAN FELIPE S.A (POULTRY)	101	Chickens
3115	INDUSTRIA NACIONAL AGRICOLA	43	Decorticator
3122	MOLINOS DE NICARAGUA S.A (MONISA)	175	Wheat and Animal food
3211	TEXTILES DEL LAGO S.A (TEXLASA)	79	Tread and Texture
3219	AGROTEX S.A.	10	T-shirt
3231	REPTILES DE NICARAGUA (REPTINIC)	26	Leather and Reptiles Skin
3411	IUCASA	63	Toilet paper
3412	CORTONOSOL	15	Solid Cardboard's
3522	INDUSTRIAS FARMACEUTICAS CEGUEL S.A.	98	Products pharmaceutics
3523	E. CHAMORRO Y CIA, LTD.	100	Soap
3523	PREGO	110	Soap production
Total Number of Employees		820	

Table G-4: List of Selected Factories

Location.	No.	CIIU	Name of Companies	Nos. of Employee	Main Products
Leon	1	3839	BATERIAS ROLAC S.A.	37	Batteries
	2	3116	ENABAS	26	Grain
	3	3115	SUC. ENRIQUE MANTICA BERIO S.A.	26	Sesame
	4	3232	MARROQUINERIA CENTROAMERICANO	24	Leather Company
	5	3115	GRUPO INDUSTRIAL AGROSA	229	Vegetable oil, Soap, Flour
	6	3412	CARTONICA	113	Cardboard boxes
	7	3231	TENERIA BATAAN S.A.	100	Leather Production
	8	3551	REENCAUCHADORA MODERNA	23	Realignment of tires
	9	3512	FORMULADORA INTERNACIONAL AGRICOLA S.A.	14	Pesticides and Fertilizer
	10	3512	SERVICIO AGRICOLA GURDIAN S.A.	22	Pesticides and Fertilizer
Chinandega	1	3115	INVERCIONES ALPHA	28	Sesame
	2	3111	PORCINA SAN BENITO	52	Pork meat
	3	3122	ALIMENTOS MEJORADOS S.A.	60	Animal Feed
	4	3115	GRASAS Y ACEITES S.A.	111	Vegetable oil
	5	3114	EMPACADORA ECUANICA	202	Shrimp processing
	6	3111	AVICOLA GUADALUPE	20	Chickens meat
	7	3512	INSECTICIDA SAN CRISTOBAL	20	Pesticides and Fertilizer
	8	3116	SEMILLA Y PROCESOS S.A.	320	Peanuts
	9	3116	MANICERA, S. A.	348	Peanuts production
	10	3116	INSDUSTRIA GENIMA S.A.	80	Flour and Bran
Granada	1	3219	AGROTEX S.A.	10	T-shirt
	2	3211	TEXTILES DEL LAGO S.A.	79	Tread and Texture
	3	3523	E. CHAMORRO Y CIA, LTD.	100	Soap, Vegetable oil
	4	3523	PREGO	110	Soap production
	5	3111	AVICOLA SAN FELIPE S.A.	101	Chickens
	6	3412	CORTONOSOL	15	Solid Cardboard's
	7	3122	MOLINOS DE NICARAGUA S.A.	175	Wheat and Animal feed
	8	3231	REPTILES DE NICARAGUA	26	Tannery
	9	3411	IUCASA	63	Toilet paper
	10	3522	INDUSTRIAS FARMACEUTICAS CEGUEL S.A.	98	Medicine

c. Categorization of ISW (Industrial Solid Waste)

Since a common industrial waste classification is not clearly established in Nicaragua, the Team employed a categorization of 24 ISW, based on the ISW classification employed in Japan and a classification used in JICA's ISWM study in Chile by the Team, as shown in the Table G-5.

Table G-5: Category of ISW

No.	Type of Waste	No.	Type of Waste
1	Ash, combustion residue	13	Carcasses
2	Dust	14	Glass and ceramics
3	Slag from melting	15	Metal and scrap
4	Sludge	16	Paper and cardboard
5	Asbestos	17	Plastics
6	Acid	18	Rubber
7	Alkalis	19	Textile
8	Oily waste	20	Leather
9	Chemical residue	21	Wood
10	Waste from food production	22	Construction and demolition waste
11	Waste similar to domestic waste	23	Water
12	Animal manure	24	Others

d. Formulation of Questionnaire

The questionnaire form for respective ISW shown in Table G-5 and is organized to identify, for example:

- Generation amount
- Nature
- Characteristic
- Temporary storage method
- Storage period
- Treatment method
- Disposal method
- Disposal amount, and
- Transportation method.

Respective survey items listed above are categorized as shown in Table G-6. Factories' consciousness regarding the cost burden of ISW treatment/disposal are also surveyed. (Survey questionnaire used are affixed in Chapter 3 of Data Book Volume V).

Table G-6: Survey Item

Item	Contents
Nature	Solid, Liquid, Semi-dry, Gas
Characteristic	Organic, Inorganic, Corrosive, Explosive, Reactive, Toxic, Putrescible, Non-biodegradable
Temporary storage method	Garbage bag, Dustbin, Tank, Drum, Pit, Lagoon, Open air, Others
Temporary storage period	Daily, Weekly, Monthly, Annually
Treatment method	Burn, Crushing, Compaction, Dehydration, Neutralization, Bio-decomposition, Others
Disposal method	Landfill, Recycle, Unknown, Sold to the others, Discharge to sewer, Municipal landfill, Discharge to environment, Others
Transportation method	Municipality, Contractor, Own means

G.3 Result of the Survey

a. Effective Sample

The Team and the counterpart organized factory visit surveys to the industries listed in Table G-4. However the visits were rejected by one factory in Chinandega and one in Granada. The total number of factories actually surveyed resulted 28 factories, comprising:

- Leon 10 factories
- Chinandega 9 factories
- Granada 9 factories

Table G-7 shows the 28 factories surveyed.

Table G-7: List of Surveyed Factories

Location	No.	CIIU	Name of Companies	Nos. of Employee	Main Products
Leon	1	3839	BATERIAS ROLAC S.A.	37	Batteries
	2	3116	ENABAS	26	Grain
	3	3115	SUC. ENRIQUE MANTICA BERIO S.A.	26	Sesame
	4	3232	MARROQUINERIA CENTROAMERICANO	24	Leather Company
	5	3115	GRUPO INDUSTRIAL AGROSA	229	Vegetable oil, Soap, Flour
	6	3412	CARTONICA	113	Cardboard boxes
	7	3231	TENERIA BATAAN S.A.	100	Leather Production
	8	3551	REENCAUCHADORA MODERNA	23	Realignment of tires
	9	3512	FORMULADORA INTERNACIONAL AGRICOLA S.A.	14	Pesticides and Fertilizer
	10	3512	SERVICIO AGRICOLA GURDIAN S.A.	22	Pesticides and Fertilizer
	Total Number of Employees			614	

Location	No.	CIIU	Name of Companies	Nos. of Employee	Main Products
Chinandega	1	3115	INVERCIONES ALPHA	28	Sesame
	2	3111	PORCINA SAN BENITO	52	Pork meat
	3	3122	ALIMENTOS MEJORADOS S.A.	60	Animal Feed
	4	3115	GRASAS Y ACEITES S.A.	111	Vegetable oil
	5	3114	EMPACADORA ECUANICA	202	Shrimp processing
	6	3111	AVICOLA GUADALUPE	20	Chickens meat
	7	3512	INSECTICIDA SAN CRISTOBAL	20	Pesticides and Fertilizer
	8	3116	SEMILLA Y PROCESOS S.A.	320	Peanuts
	9	3116	INSDUSTRIA GENIMA S.A.	80	Flour and Bran
	Total Number of Employees			893	
Granada	1	3219	AGROTEX S.A.	10	T-shirt
	2	3211	TEXTILES DEL LAGO S.A.	79	Tread and Texture
	3	3523	E. CHAMORRO Y CIA, LTD.	100	Soap, Vegetable oil
	4	3111	AVICOLA SAN FELIPE S.A.	101	Chickens
	5	3412	CORTONOSOL	15	Solid Cardboard's
	6	3122	MOLINOS DE NICARAGUA S.A.	175	Wheat and Animal feed
	7	3231	REPTILES DE NICARAGUA	26	Tannery
	8	3411	IUCASA	63	Toilet paper
	9	3522	INDUSTRIAS FARMACEUTICAS CEGUEL S.A.	98	Medicine
	Total Number of Employees			667	
Total Number of Employees				2,174	

Also the final sample number of Granada was eight factories, because one factory did not provide satisfactory answer were not obtained from one factory(No.6, CIIU 3122, MOLINOS DE NICARAGUA S.A) .

Table G-8 shows the sample ratio (i.e., the ratio that the samples count for total) in terms of factory number. The sample ratio for 3 cities total counts for 54% of the total factories number in 3 cities. Table G-9 shows the sample ratio in terms of factory employees number. The sample ratio for 3 cities counts for 63% of the total numbering factory employees in the 3 cities.

Table G-8: Sample Ratio 1 (number of factories)

	Sample	Whole	Ratio
Leon	10	27	37 %
Chinandega	9	12	75 %
Granada	8	11	73 %
Total	27	50	54 %

Table G-9: Sample Ratio 2 (number of employees)

	Sample	Whole	Ratio
Leon	614	1,112	55 %
Chinandega	893	1,266	71 %
Granada	492	820	60 %
Total	1,999	3,198	63 %

b. Waste Generation Ratio and Disposal Method

The outcome of the survey was analyzed in a wide range. Findings are listed below. (Detailed analyses results are presented in Chapter 3 of Data Book Volume V.)

b.1 Waste Generation Ratio

The waste generation ratio was derived as kg/employee/year. The "waste generation ratio of kg/employee/year" is calculated was summits: to sum up waste amount generated in terms of "CIIU Category" and "ISW Category" in each city, and actual employee in sample factories are assumed as population.

The results are shown in Table G-11 to Table G-19. Since the "waste generation ratio' of industrial categories CIIU 3121, 3132, 3691, 3699, 3822 were not obtained from the survey, assumptions were made to produce the ratio for the industries based on the "generation ratio" obtained in similar industrial categories and on the Team's empirical data obtained in a study in Chile.

Table G-10: Waste Generation Amount at Surveyed Factories

Unit : ton/year

	Type of waste	Leon	Chinandega	Granada	Total
1	Ash, combustion residue	-	180.0	-	180.0
2	Dust	13.3	-	7.3	20.6
3	Slag from melting	-	-	-	-
4	Sludge	60.0	-	-	60.0
5	Asbestos	-	-	-	-
6	Acid	0.3	0.3	1.8	2.4
7	Alkalis	-	0.3	-	0.3
8	Oily waste	40.0	-	-	40.0
9	Chemical residue	12.2	-	1.5	13.7
10	Waste from food production	1,098.0	3,325.7	10.0	4,433.7
11	Waste similar to domestic waste	8.5	-	6.9	15.4
12	Animal manure	130.0	4.0	232.0	366.0
13	Carcasses	-	1.5	265.0	266.5
14	Glass and ceramics	-	-	-	-
15	Metal and scrap	97.0	20.0	0.2	117.2
16	Paper and cardboard	317.9	86.1	302.0	706.0
17	Plastics	9.0	10.0	0.2	19.2
18	Rubber	24.3	-	-	24.3
19	Textile	-	-	0.3	0.3
20	Leather	106.5	-	109.0	215.5
21	Wood	-	-	0.2	0.2
22	Construction and demolition waste	-	-	-	-
23	Water	65,630.0	5,525.9	561,935.0	633,090.9
24	Others	-	-	-	-
	Total	67,547.0	9,153.7	562,871.2	639,571.9
	Wastewater Total	65,630.0	5,525.9	561,935.0	633,090.9
	Solid Waste Total	1,917.0	3,627.8	936.2	6,481.0

Table G-11: Waste Generation Ratio in Leon(1)

	CIIU / Type of Waste	Waste Generation ratio (kg/employee/year)						
		3111	3114	3115	3116	3121	3122	3132
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	5.9	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	235.3	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	156.9	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	-	31.4	41,923.1	534.7	-	534.7
11	Waste similar to domestic waste	-	-	33.3	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	3.9	-	-	-	-
16	Paper and cardboard	-	-	19.6	-	0.5	-	0.5
17	Plastics	-	-	27.5	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	31,372.5	-	13,490.1	-	13,490.1
24	Others	-	-	-	-	-	-	-

Table G-12: Waste Generation Ratio in Leon(2)

	CIIU / Type of Waste	Waste Generation ratio (kg/employee/year)						
		3211	3219	3231	3232	3411	3412	3512
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	18.0	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	60.6
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	-	-	1,300.0	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-
16	Paper and cardboard	-	-	-	-	-	2,654.9	138.9
17	Plastics	-	-	-	-	-	-	55.6
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	27.0	-	-	-	-	-
20	Leather	-	-	960.0	435.6	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	300,000.0	-	-	244,513.3	-
24	Others	-	-	-	-	-	-	-

Table G-13: Waste Generation Ratio in Leon(3)

Type of waste \ CIIU		Waste Generation ratio (kg/employee/year)						
		3522	3523	3551	3691	3699	3822	3839
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	74.5	-	-	-	-	270.3	270.3
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	18.4	-	-	-	-	8.1	8.1
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	270.3	270.3
10	Waste from food production	102.0	-	-	-	0.4	-	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	19.9	-	-
15	Metal and scrap	-	-	-	68.6	-	2,594.6	2,594.6
16	Paper and cardboard	1,122.4	-	57.4	61.7	0.5	178.4	178.4
17	Plastics	-	-	-	20.5	-	-	-
18	Rubber	-	-	913.0	-	-	89.2	89.2
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	z30.6	-	-
23	Water	1,857.1	-	-	-	-	-	-
24	Others	-	-	-	-	-	-	-

Table G-14: Waste Generation Ratio in Chinandega (1)

Type of Waste \ CIIU		Waste Generation ratio (kg/employee/year)						
		3111	3114	3115	3116	3121	3122	3132
1	Ash, combustion residue	-	-	1,295.0	-	-	-	-
2	Dust	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	1.8	-	-	-	-
7	Alkalis	-	-	1.8	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	534.7	1,169.1	7,635.0	-	20.0	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	55.8	-	-	-	-	-	-
13	Carcasses	20.8	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	143.9	-	-	-	-
16	Paper and cardboard	-	0.5	575.5	-	-	-	-
17	Plastics	-	-	43.2	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	13,490.1	19,877.7	-	-	-	-
24	Others	-	-	-	-	-	-	-

Table G-15: Waste Generation Ratio in Chinandega (2)

	CIIU / Type of Waste	Waste Generation ratio (kg/employee/year)						
		3211	3219	3231	3232	3411	3412	3512
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-
16	Paper and cardboard	-	-	-	-	-	-	300.0
17	Plastics	-	-	-	-	-	-	200.0
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	-	-	-	-	1,892.5
24	Others	-	-	-	-	-	-	-

Table G-16: Waste Generation Ratio in Chinandega (3)

	CIIU / Type of Waste	Waste Generation ratio (kg/employee/year)						
		3522	3523	3551	3691	3699	3822	3839
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-
16	Paper and cardboard	-	-	-	-	-	-	-
17	Plastics	-	-	-	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	-	-	-	-	-
24	Others	-	-	-	-	-	-	-

Table G-17: Waste Generation Ratio in Granada (1)

Type of Waste \ CIIU		Waste Generation ratio (kg/employee/year)						
		3111	3114	3115	3116	3121	3122	3132
1	Ash, combustion residue	-	-	456.9	-	-	-	-
2	Dust	-	-	3.8	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	152.3	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	0.6	-	-	-	-
7	Alkalis	-	-	0.6	-	-	-	-
8	Oily waste	-	-	101.5	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	-	432.7	-	-	5.1	-
11	Waste similar to domestic waste	-	-	21.6	-	-	-	-
12	Animal manure	2,297.0	-	-	-	-	-	-
13	Carcasses	2,623.8	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	53.3	-	-	-	-
16	Paper and cardboard	-	-	215.7	-	-	-	-
17	Plastics	-	-	33.0	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	683,920.8	-	27,317.3	-	-	-	-
24	Others	-	-	-	-	-	-	-

Table G-18: Waste Generation Ratio in Granada (2)

Type of Waste \ CIIU		Waste Generation ratio (kg/employee/year)						
		3211	3219	3231	3232	3411	3412	3512
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	57.7	-	-	-	-
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	11.4	-	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	10.0	-
16	Paper and cardboard	-	-	-	-	3,047.6	-	-
17	Plastics	-	-	-	-	-	10.0	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	27.0	-	-	-	-	-
20	Leather	-	-	4,192.3	-	-	-	-
21	Wood	-	-	-	-	-	10.0	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	2,102,961.5	-	-	-	-
24	Others	-	-	-	-	-	-	-

Table G-19: Waste Generation Ratio in Granada (3)

	Type of Waste \ CIIU	Waste Generation ratio (kg/employee/year)						
		3522	3523	3551	3691	3699	3822	3839
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	74.5	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	18.4	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	102.0	-	-	-	-	-	-
11	Waste similar to domestic waste	-	60.0	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-
16	Paper and cardboard	1,122.4	-	-	-	-	-	-
17	Plastics	-	-	-	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	1,857.1	4,380,000.0	-	-	-	-	-
24	Others	-	-	-	-	-	-	-

c. Nature and Characteristic of Waste

c.1 Nature of Waste

The questionnaire of the survey categorized the nature of wastes into 4 types (i.e., solid state, liquid state, semi-dry state, gas state). The survey result should 3 types of state (solid, liquid, semi-dry). Table G-20 shows the categorized waste nature as a result of the survey. (The amount of industrial solid waste generation indicated in Table G-20 refers to amount of ISW generated in surveyed factories. Therefore, this amount differs from that indicated in section G.4.a.)

Table G-20: Nature of Waste

		Leon	Chinandega	Granada	Total
Liquid	Amount (t/y)	65,680	5,527	561,938	633,145
	Share (%)	10.4	0.9	88.7	100.0
Semi-dry	Amount (t/y)	60	4	-	64
	Share (%)	93.8	6.2	-	100.0
Solid	Amount (t/y)	1,807	3,623	933	6,363
	Share (%)	28.4	56.9	14.7	100.0
Total (1)	Amount (t/y)	67,547	9,154	562,871	639,572
	Share (%)	10.6	1.4	88.0	100.0

c.2 Characteristic of Waste

c.2.1 General Characteristic of Waste

The questionnaire of the survey categorized the characteristics of solid wastes firstly into "organic" and "inorganic" and further categorized into 6 types (i.e., corrosive, explosive, reactive, toxic, putrescible, non-biodegradable) The result indicated 5 types (corrosive, non-biodegradable, putrescible, toxic, reactive). Table G-21 shows the categorized waste characteristics as a result of the survey. (the team judges that "no answer" in the question of the waste characteristic being non-hazardous IW. Meanwhile, the amount of industrial waste generation indicated in Table G-21 refers to amount of IW generated in surveyed factories. Therefore, this amount differs from that indicated in section G.4.a.)

Whereas, Table G-22 shows a characteristic-wise "percentage" of waste generation in the 3 respective cities. Table G-23 shows a characteristic-wise "percentage" of waste generation against the total industrial waste generation from the 3 cities'. The outcome of the survey revealed that:

- If "corrosive", "toxic", and "reactive" declared from factories are defined as "hazardous waste", about 87% of ISW generated in 3 cities. (See Table G-23.)
- "Hazardous waste" generation in each city to the total "hazardous waste" generation in 3 cities counts for 11.8% in Leon, 0.04% in Chinandega, and 88.16% in Granada. Granada shows the highest contribution to the total generation of "hazardous waste". (See Table G-22)
- "Hazardous waste" as a city total counts for 98%, 3%, and 88% respectively in Leon, Chinandega, and Granada. (See Table G-23)

Table G-21: Characteristic of Waste

unit : ton/year

		Hazardous				Putrescible	Non-biodegradable	No Answer	Total(2)
		Corrosive	Toxic	Reactive	Sub-total				
Inorganic	Leon	8,000.3	27,752.8	-	35,753.1	-	61.0	-	35,814.1
	Chinandega	20.0	10.0	-	30.0	-	-	-	30.0
	Granada	1.8	1.5	-	3.3	-	182.3	7.3	192.9
	Total	8,022.1	27,764.3	-	35,786.4	-	243.3	7.3	36,037.0
Organic	Leon	-	30,144.1	-	30,144.1	1,098.0	28.0	462.8	31,732.9
	Chinandega	180.0	38.1	0.3	218.4	2,919.7	6.0	5,979.6	9,123.7
	Granada	-	492,677.0	-	492,677.0	69,583.0	-	418.3	562,678.3
	Total	180.0	522,859.2	0.3	523,039.5	73,600.7	34.0	6,860.7	603,534.9
Total	Leon	8,000.3	57,896.9	-	65,897.2	1,098.0	89.0	462.8	67,547.0
	Chinandega	200.0	48.1	0.3	248.4	2,919.7	6.0	5,979.6	9,153.7
	Granada	1.8	492,678.5	-	492,680.3	69,583.0	182.3	425.6	562,871.2
	Total	8,202.1	550,623.5	0.3	558,825.9	73,600.7	277.3	6,868.0	639,571.9

Table G-22: Share of Waste Characteristic (1)

Unit : %

		Hazardous				Putrescible	Non-biodegradable	No Answer	Total
		Corrosive	Toxic	Reactive	Sub-total				
Inorganic	Leon	99.73	99.96	-	99.91	-	25.07	-	99.38
	Chinandega	0.25	0.04	-	0.08	-	-	-	0.08
	Granada	0.02	0.01	-	0.01	-	74.93	100.00	0.54
	Total	100.0	100.0	-	100.0	-	100.0	100.0	100.0
Organic	Leon	-	5.77	-	5.76	1.49	82.35	6.75	5.26
	Chinandega	100.00	0.01	100.00	0.04	3.97	17.65	87.16	1.51
	Granada	-	94.23	-	94.20	94.54	-	6.10	93.23
	Total	100.00	100.00	100.00	100.0	100.00	100.00	100.00	100.00
Total	Leon	97.54	10.51	-	11.80	1.49	32.10	6.74	10.56
	Chinandega	2.44	0.01	100.00	0.04	3.97	2.16	87.06	1.43
	Granada	0.02	89.48	-	88.16	94.54	65.74	6.20	88.01
	Total	100.00	100.00	100.00	100.0	100.00	100.00	100.00	100.00

Table G-23: Share of Waste Characteristic(2)

Unit : %

		Hazardous				Putrescible	Non-biodegradable	No Answer	Total
		Corrosive	Toxic	Reactive	Sub-total				
Inorganic	Leon	22.34	77.49	-	99.83	-	0.17	-	100.00
	Chinandega	66.67	33.33	-	100.00	-	-	-	100.00
	Granada	0.93	0.78	-	1.71	-	94.50	3.78	100.00
	Total	22.26	77.04	-	100.00	-	0.68	0.02	100.00
Organic	Leon	-	94.99	-	94.99	3.46	0.09	1.46	100.00
	Chinandega	1.97	0.42	0.00	2.39	32.00	0.07	65.54	100.00
	Granada	-	87.56	-	87.65	12.37	-	0.07	100.00
	Total	0.03	86.63	0.00	86.66	12.19	0.01	1.14	100.00
Total	Leon	11.84	85.71	-	97.55	1.63	0.13	0.69	100.00
	Chinandega	2.18	0.53	0.00	2.71	31.90	0.07	65.32	100.00
	Granada	0.00	87.53	-	87.53	12.36	0.03	0.08	100.00
	Total	1.28	86.09	0.00	87.37	11.51	0.04	1.07	100.00

c.2.2 Wastewater and Solid Waste

Table G-24 shows the outcome of the wastewater and solid waste generation amount in the 3 cities. These outcome of the survey revealed that:

- Approximately 99 % is industrial wastewater and the remainder (approximately 1 %) is solid waste in the 3 cities.
- If "corrosive", "toxic", and "reactive" declared from factories are defined as "hazardous waste", about 88% of industrial wastewater generated in 3 cities.

Table G-24: Wastewater and Solid Waste

		Wastewater		Solid Waste		Total	
		Amount (t/y)	Ratio	Amount (t/y)	Ratio	Amount (t/y)	Ratio
Leon	Hazardous	65,630.0	100.0	267.2	13.9	65,897.2	97.6
	Non-hazardous	0	0	1,649.8	86.1	1,649.8	2.4
	Total	65,630.0	100.0	1,917.0	100.0	67,547.0	100.0
	Ratio (%)	97.2		2.8		100.0	
Chinandega	Hazardous	37.9	0.7	210.5	5.8	248.4	2.7
	Non-hazardous	5,488.0	99.3	3,417.3	94.2	8,905.3	97.8
	Total	5,525.9	100.0	3,627.8	100.0	9,153.7	100.0
	Ratio (%)	60.4		39.6		100.0	
Granada	Hazardous	492,677.0	87.7	3.3	0.4	492,680.3	87.5
	Non-hazardous	69,258.0	12.3	932.9	99.6	70,190.9	12.5
	Total	561,935.0	100.0	936.2	100.0	562,871.2	100.0
	Ratio(%)	99.8		0.2		100.0	
Total	Hazardous	558,344.9	88.2	481.0	7.4	558,825.9	87.4
	Non-hazardous	74,746.0	11.8	6,000.0	92.6	80,746.0	12.6
	Total	633,090.9	100.0	6,481.0	100.0	639,571.9	100.0
	Ratio(%)	98.9		1.1		100.0	

c.3 Temporary Storage Method

Table G-25 shows the outcome of the "Temporary Storage Method" from factories in the 3 cities. The category of "Others" mainly consists of "wastewater" (i.e., wastewater in Leon is 38,000ton/year out of 38,097.3 ton/year or 99.7%, and in Granada 561,935ton/year out of 562,200.0 ton/year or 99.9%). In practice, the wastewater is discharged into rivers and/or the sewer system without any "temporary storage". (The amount of industrial solid waste generation indicated in the table refers to the amount of ISW generated in surveyed factories. Therefore, this amount differs from that indicated in section G.4.a.)

Table G-25: Temporary Storage Method in Factories

			Drum Bin	Garbage bag	Open air	Lagoon	Pit	Tank	Others	Total
Amount (ton/year)	Water	Leon	-	-	-	-	27,630.0	-	38,000.0	65,630.0
		Chinandega	2,725.0	-	2,763.0	-	37.9	-	-	5,525.9
		Granada	-	-	-	-	-	-	561,935.0	561,935.0
		Total	2,725.0	-	2,763.0	-	27,667.9	-	599,935.0	633,090.9
	Solid	Leon	426.0	1.8	1,122.9	-	247.2	21.8	97.3	1,917.0
		Chinandega	10.1	1.2	3,452.1	2.4	-	-	162.0	3,527.8
		Granada	25.1	232.3	221.9	-	-	192.0	265.0	936.2
		Total	461.2	235.3	4,796.9	2.4	247.2	213.8	524.3	6,481.0
	Total	Leon	426.0	1.8	1,122.9	-	27,877.2	21.8	38,097.3	67,547.0
		Chinandega	2,735.1	1.2	6,215.1	2.4	37.9	-	162.0	9,153.7
		Granada	25.1	232.3	221.9	-	-	192.0	562,200.0	562,871.2
		Total	3,186.2	235.3	7,559.9	2.4	27,915.1	213.8	600,459.3	639,571.9
Share (%)	Water	Leon	-	-	-	-	42.1	-	57.9	100.0
		Chinandega	49.3	-	50.0	-	0.7	-	-	100.0
		Granada	-	-	-	-	-	-	100.0	100.0
		Total	0.4	-	0.4	-	4.4	-	94.8	100.0
	Solid	Leon	22.2	0.1	58.6	-	12.9	1.1	5.1	100.0
		Chinandega	0.3	0.0	95.1	0.1	-	-	4.5	100.0
		Granada	2.7	24.8	23.7	-	-	20.5	28.3	100.0
		Total	7.1	3.6	74.1	0.0	3.8	3.3	8.1	100.0
	Total	Leon	0.63	0.01	1.66	-	41.27	0.03	56.40	100
		Chinandega	29.88	0.01	67.90	0.03	0.41	-	1.77	100
		Granada	0.01	0.04	0.04	-	-	0.03	99.88	100
		Total	0.50	0.04	1.18	0.00	4.36	0.03	93.89	100

c.4 Temporary Storage Period

Table G-26 shows the "temporary storage period". (Meanwhile, the amount of industrial solid waste generation indicated in the table refers amount of ISW generated in the surveyed factories. Therefore, this amount differs from that indicated in section G.4.a.)

Table G-26: Temporary Storage Period

Unit Amount : ton/year, Share : %

		Annually	Monthly	Weekly	Daily	Total
Amount	Leon	3.0	103.3	1,245.2	66,195.8	67,547.0
	Chinandega	-	-	3,331.2	5,822.5	9,153.7
	Granada	-	193.2	125.6	562,552.5	562,871.2
	Total	3.0	296.5	4,702.0	634,570.8	639,571.9
Share	Leon	0.00	0.15	1.85	98.00	100.0
	Chinandega	-	-	36.39	63.61	100.0
	Granada	-	0.03	0.02	99.95	100.0
	Total	0.00	0.05	0.73	99.22	100.0

d. Waste Treatment and Disposal Method

d.1 Waste Treatment Method

Table G-27 shows outcome with regard to "Waste Treatment Method" in the surveyed factories. It indicates that only Chinandega's ratio of "no treatment" is very low. This could be mainly due to the high ratio of "dehydration" (i.e., 29.77%) and "burning" (i.e., 32.8%). However, dehydration in Chinandega refers only to a method where industrial wastewater is partially evaporated in a lagoon. And also "burning" refers to open burning. (Where the amount of industrial solid waste generation indicated in the table refers amount of ISW generated in surveyed factories. Therefore, this amount differs from that indicated in section G.4.a.)

Table G-27: Waste Treatment Method

			Bio-decomposition	Burn	Compaction	Dehydration	Neutralization	No-treatment	Others	Total
Amount (ton/year)	Water	Leon	-	-		-	-	65,630.0	-	65,630.0
		Chinandega	-	-	-	2,725.0	-	2,800.9	-	5,525.9
		Granada	-	-	-	-	-	561,935.0	-	561,935.0
		Total	-	-	-	2,725.0	-	630,365.9	-	633,090.9
	Solid	Leon	2.0	7.0	10.0	-	0.2	1,897.5	0.3	1,917.0
		Chinandega	2.4	3,002.8	-	-	-	622.6	-	3,627.8
		Granada	109.9	192.0	-	-	-	634.3	-	936.2
		Total	114.3	3,201.8	10.0	-	0.2	3,154.4	0.3	6,481.0
	Total	Leon	2.0	7.0	10.0	-	0.2	67,527.5	0.3	67,547.0
		Chinandega	2.4	3,002.8	-	2,725.0	-	3,423.5	-	9,153.7
		Granada	109.9	192.0	-	-	-	562,569.3	-	562,871.2
		Total	114.3	3,201.8	10.0	2,725.0	0.2	633,520.3	0.3	639,571.9
Share (%)	Water	Leon	-	-	-	-	-	100.0	-	100.0
		Chinandega	-	-	-	49.3	-	50.7	-	100.0
		Granada	-	-	-	-	-	100.0	-	100.0
		Total	-	-	-	0.4	-	99.6	-	100.0
	Solid	Leon	0.1	0.4	0.5	-	0.0	99.0	0.0	100.0
		Chinandega	0.1	82.7	-	-	-	17.2	-	100.0
		Granada	11.7	20.5	-	-	-	67.8	-	100.0
		Total	1.8	49.4	0.2	-	0.0	48.6	0.0	100.0
	Total	Leon	0.00	0.01	0.02	-	0.00	99.97	0.00	100.0
		Chinandega	0.03	32.80	-	29.77	-	37.40	-	100.0
		Granada	0.02	0.03	-	-	-	99.95	-	100.0
		Total	0.02	0.50	0.00	0.43	0.00	99.05	0.00	100.0

d.2 Waste Disposal Method

Table G-28 shows the outcome with regard to "Waste Disposal Method" in the surveyed factories. It indicates that 98% of the total generated waste are disposed into the environment.(e.g., river) Table G-30 shows the outcome with regard to "Solid Waste Disposal Method" in surveyed factories. It indicates that 78% of the total generated solid waste are disposed to landfill and half of it deposed to municipal landfill site. (Where the amount of industrial solid waste generation indicated in the table refers to the amount of ISW generated in surveyed factories. Therefore, this amount differs from that indicated in section G.4.a.)

Table G-31 shows the outcome with regard to "Hazardous Waste Disposal Method" (defined c.2) in the surveyed factories. It indicates that 99% of the total generated waste are disposed into the environment.(e.g., river) Hazardous waste mostly consist of industrial wastewater.

Table G-33 shows the outcome with regard to "Hazardous Solid Waste Disposal Method" (defined c.2) in surveyed factories. It indicates that 95% of the total generated waste are disposed into landfill site.(60% of this is disposed to municipal landfill site)

Table G-28: Waste Disposal Method

Unit Amount : ton/year, Share : %

		Discharge to Environment	Discharge to Sewer System	Landfill	Municipality Landfill	Recycle	Sold to Other	Others	Total
Amount	Leon	57,660.8	8,000.0	227.8	1,258.4	96.0	299.3	0.2	67,542.5
	Chinandega	5,651.0	1.2	1,548.1	404.0	-	9.0	37.9	7,651.2
	Granada	561,754.5	182.0	-	312.1	-	375.3	96.5	562,720.4
	Total	625,066.3	8,183.2	1,775.9	1,974.5	96.0	683.6	134.6	637,914.1
Share	Leon	85.37	11.85	0.34	1.86	0.14	0.44	-	100
	Chinandega	73.86	0.02	20.23	5.28	-	0.12	0.5	100
	Granada	99.83	0.03	-	0.06	-	0.07	0.02	100
	Total	97.99	1.28	0.28	0.31	0.02	0.11	0.02	100

Table G-29: Wastewater Disposal Method

Unit Amount : ton/year, Share : %

		Discharge to Environment	Discharge to Sewer System	Landfill	Municipality Landfill	Recycle	Sold to Other	Others	Total
Amount	Leon	57,630.0	8,000.0	-	-	-	-	-	65,630.0
	Chinandega	5,488.0	-	-	-	-	-	37.9	5,525.9
	Granada	561,753.0	182.0	-	-	-	-	-	561,935.0
	Total	624,871.0	8,182.0	-	-	-	-	37.9	633,090.9
Share	Leon	87.8	12.2	-	-	-	-	-	100.0
	Chinandega	99.3	-	-	-	-	-	0.7	100.0
	Granada	100.0	0.0	-	-	-	-	-	100.0
	Total	98.7	1.3	-	-	-	-	0.0	100.0

Table G-30: Solid Waste Disposal Method

Unit Amount : ton/year, Share : %

		Discharge to Environment	Discharge to Sewer System	Landfill	Municipality Landfill	Recycle	Sold to Other	Others	Total
Amount	Leon	30.8	-	227.8	1258.4	96	299.3	0.2	1,912.5
	Chinandega	163	1.2	1548.1	404	-	9	-	2,125.3
	Granada	1.5	-	-	312.1	-	375.3	96.5	785.4
	Total	195.3	1.2	1,775.9	1,974.5	96.0	683.6	96.7	4,823.2
Share	Leon	1.61	-	11.91	65.80	5.02	15.65	0.01	100
	Chinandega	7.67	0.06	72.84	19.01	-	0.42	-	100
	Granada	0.19	-	-	39.74	-	47.78	12.29	100
	Total	4.05	0.02	36.82	40.94	1.99	14.17	2.01	100

Table G-31: Hazardous Waste Disposal Method

Unit Amount : ton/year, Share : %

		Discharge to Environment	Discharge to Sewer System	Landfill	Municipality Landfill	Recycle	Sold to Other	Others	Total
Amount	Leon	57,651.3	8,000.0	131.8	13.4	-	-	0.2	65,796.7
	Chinandega	0.5	-	-	210.0	-	-	37.9	248.4
	Granada	492,678.5	-	-	1.8	-	-	-	492,680.3
	Total	550,330.3	8,000.0	131.8	225.2	-	-	38.1	558,725.4
Share	Leon	87.62	12.16	0.2	0.02	-	-	-	100
	Chinandega	0.2	-	-	84.54	-	-	15.26	100
	Granada	100	-	-	0	-	-	-	100
	Total	98.5	1.43	0.02	0.04	-	-	0.01	100

Table G-32: Hazardous Wastewater Disposal Method

Unit Amount : ton/year, Share : %

		Discharge to Environment	Discharge to Sewer System	Landfill	Municipality Landfill	Recycle	Sold to Other	Others	Total
Amount	Leon	57,630.0	8,000.0	-	-	-	-	-	65,630.0
	Chinandega	-	-	-	-	-	-	37.9	37.9
	Granada	492,677.0	-	-	-	-	-	-	492,677.0
	Total	550,307.0	8,000.0	-	0.0	-	-	37.9	558,344.9
Share	Leon	87.8	12.2	-	-	-	-	-	100.0
	Chinandega	-	-	-	-	-	-	100.0	100.0
	Granada	100.0	-	-	-	-	-	-	100.0
	Total	98.6	1.4	-	-	-	-	0.0	100.0

Table G-33: Hazardous Solid Waste Disposal Method

Unit Amount : ton/year, Share : %

		Discharge to Environment	Discharge to Sewer System	Landfill	Municipalit y Landfill	Recycle	Sold to Other	Others	Total
Amount	Leon	21.3	-	131.8	13.4	-	-	0.2	166.7
	Chinandega	0.5	-		210.0	-	-	-	210.5
	Granada	1.5	-		1.8	-	-	-	3.3
	Total	23.3	-	131.8	225.2	-	-	0.2	380.5
Share	Leon	12.77	-	79.07	8.04	-	-	0.12	100
	Chinandega	0.24	-	-	99.76	-	-	-	100
	Granada	45.45	-	-	54.55	-	-	-	100
	Total	6.12	-	34.64	59.19	-	-	0.05	100

d.3 Transportation Method

Table G-34 shows the outcome with regard to "Waste Transportation Method" in surveyed factories, and Table G-35 shows the outcome with regard to "Solid Waste Transportation Method" in surveyed factories. It indicates that 94% of the total dispose waste are transported by "Own means".

Table G-34: Waste Transportation Method

Unit Amount : ton/year, Share : %

		Municipality	Own means	Total
Amount	Leon	10.5	67,136.7	67,147.1
	Chinandega	-	7,642.2	7,642.2
	Granada	232.0	562,113.1	562,345.1
	Total	242.5	636,892.0	637,134.4
Share	Leon	0.02	99.98	100
	Chinandega	0	100	100
	Granada	0.04	99.96	100
	Total	0.04	99.96	100

Table G-35: Solid Waste Transportation Method

Unit Amount : ton/year, Share : %

		Municipality	Own means	Total
Amount	Leon	10.5	1,506.6	1,517.1
	Chinandega	-	2,116.3	2,116.3
	Granada	232	178.1	410.1
	Total	242.5	3,801.1.0	4,038.5
Share	Leon	0.7	99.3	100.0
	Chinandega	0	100.0	100.0
	Granada	56.6	43.4	100.0
	Total	6.0	94.0	100.0

G.4 Findings of the Survey

a. Present Waste Generation Amount

Table G-36 shows the estimated total industrial waste generation in 3 cities. The total industrial waste generation for each are estimated by extrapolating the "generation ratio" to total employees in the 3 cities as listed in Table G-1, Table G-2, and Table G-3, Table G-37 to Table G-48 shows waste generation amount in the respective city by CIIU.

The survey results indicate:

- Total industrial waste generation in 3 cities ranges around 1,156,000 ton/year.
- "Industrial wastewater" counts for 99% of the industrial waste generation (i.e., 1,142,000 ton/year) and the rest, i.e., 14,800 ton/year is solid waste.

- In comparing the 3 cities, Granada counts for the most and it reaches 1,046,000 ton/year. Furthermore, 99.9% of Granada's waste generation amount (i.e., 1,045,000 ton/year) is "industrial wastewater". Its major polluting sources are industries in CIIU 3523 (i.e., soap production) and the "industrial wastewater", which is counts for 920,000 ton/year.

- Industrial solid waste generated other than "industrial wastewater" in 3 cities counts for 14,800ton/year. In comparing the 3 cities, Leon counts for the most and it reaches 7,400 ton/year; most of the generated waste is "Waste from food production"(i.e., 12,300 ton/year).

Table G-36: Waste Generation Amount in 1996

Type of waste	Present Waste Generation Amount (ton/year)			
	Leon	Chinandega	Granada	Total
Ash, combustion residue	-	180	20	200
Dust	33	-	8	40
Slag from melting	-	-	-	-
Sludge	64	-	7	70
Asbestos	-	-	-	-
Acid	2	0	2	4
Alkalis	-	0	-	0
Oily waste	42	-	4	47
Chemical residue	26	-	2	27
Waste from food production	6,175	6,067	30	12,271
Waste similar to domestic waste	9	-	14	23
Animal manure	234	5	232	471
Carcasses	-	2	265	267
Glass and ceramics	1	-	-	1
Metal and scrap	231	20	3	253
Paper and cardboard	398	86	311	796
Plastics	11	10	2	22
Rubber	29	-	-	29
Textile	0	-	0	1
Leather	183	-	109	292
Wood	-	-	0	0
Construction and demolition waste	1	-	-	1
Water	91,197	5,526	1,044,910	1,141,632
Others	-	-	-	-
Total	98,634	11,896	1,045,917	1,156,447
Wastewater Total	91,197	5,526	1,044,910	1,141,633
Solid Waste Total	7,437	6,370	1,007	14,814

Table G-37: West Generation Amount in 1996 (three cities total) (1)

unit : ton/year

	Type of Waste \ CIIU	3111	3114	3115	3116	3121	3122	3132
1	Ash, combustion residue	-	-	200	-	-	-	-
2	Dust	-	-	2	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	70	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	0	-	-	-	-
7	Alkalis	-	-	0	-	-	-	-
8	Oily waste	-	-	47	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	108	190	11,916	26	2	13
11	Waste similar to domestic waste	-	-	10	-	-	-	-
12	Animal manure	237	-	-	-	-	-	-
13	Carcasses	267	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	23	-	-	-	-
16	Paper and cardboard	-	0	95	-	-	-	-
17	Plastics	-	-	15	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	69,076	2,725	12,408	-	648	-	337
24	Others	-	-	-	-	-	-	-
	Total	69,580	2,833	13,059	11,916	673	2	351

Table G-38: West Generation Amount in 1996 (three cities total)(2)

unit : ton/year

	Type of waste \ CIIU	3211	3219	3231	3232	3411	3412	3512
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	3	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	2	-	-	-	2
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	1	-	-	-	-	-	-
12	Animal manure	-	-	234	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	0	-
16	Paper and cardboard	-	-	-	-	192	300	11
17	Plastics	-	-	-	-	-	0	6
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	1	-	-	-	-	-
20	Leather	-	-	282	11	-	-	-
21	Wood	-	-	-	-	-	0	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	108,677	-	-	27,630	38
24	Others	-	-	-	-	-	-	-
	Total	1	1	109,198	11	192	27,931	57

Table G-39: West Generation Amount in 1996 (three cities total)(3)

unit : ton/year

	Type of waste \ CIIU	3522	3523	3551	3691	3699	3822	3839	Total
1	Ash, combustion residue	-	-	-	-	-	-	-	200
2	Dust	12	-	-	-	-	14	10	40
3	Slag from melting	-	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-	70
5	Asbestos	-	-	-	-	-	-	-	-
6	Acid	3	-	-	-	-	0	0	4
7	Alkalis	-	-	-	-	-	-	-	0
8	Oily waste	-	-	-	-	-	-	-	47
9	Chemical residue	-	-	-	-	-	14	10	27
10	Waste from food production	16	-	-	-	-	-	-	12,271
11	Waste similar to domestic waste	-	13	-	-	-	-	-	23
12	Animal manure	-	-	-	-	-	-	-	471
13	Carcasses	-	-	-	-	-	-	-	267
14	Glass and ceramics	-	-	-	-	1	-	-	1
15	Metal and scrap	-	-	-	4	-	130	96	253
16	Paper and cardboard	177	-	1	4	-	9	7	796
17	Plastics	-	-	-	1	-	-	-	22
18	Rubber	-	-	21	-	-	5	3	29
19	Textile	-	-	-	-	-	-	-	1
20	Leather	-	-	-	-	-	-	-	292
21	Wood	-	-	-	-	-	-	-	0
22	Construction and demolition waste	-	-	-	-	1	-	-	1
23	Water	293	919,800	-	-	-	-	-	1,141,632
24	Others	-	-	-	-	-	-	-	-
	Total	502	919,813	22	9	1	171	126	1,156,447

Table G-40: Waste Generation Amount in 1996 (Leon)(1)

unit : ton/year

	Type of waste \ CIIU	3111	3114	3115	3116	3121	3122	3132
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	2	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	64	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	42	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	-	9	6,121	26	-	13
11	Waste similar to domestic waste	-	-	9	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	1	-	-	-	-
16	Paper and cardboard	-	-	5	-	-	-	-
17	Plastics	-	-	7	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	8,471	-	648	-	337
24	Others	-	-	-	-	-	-	-
	Total	-	-	8,609	6,121	673	-	351

Table G-41: Waste Generation Amount in 1996 (Leon) (2)

unit : ton/year

	Type of waste	3211	3219	3231	3232	3411	3412	3512
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	3	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	2
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	-	-	234	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-
16	Paper and cardboard	-	-	-	-	-	300	5
17	Plastics	-	-	-	-	-	-	2
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	0	-	-	-	-	-
20	Leather	-	-	173	11	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	54,000	-	-	27,630	-
24	Others	-	-	-	-	-	-	-
	Total	-	0	54,410	11	-	27,930	9

Table G-42: Waste Generation Amount in 1996 (Leon)(3)

unit : ton/year

Type of waste \ CIIU	3522	3523	3551	3691	3699	3822	3839	Total
1 Ash, combustion residue	-	-	-	-	-	-	-	-
2 Dust	5	-	-	-	-	14	10	32.8
3 Slag from melting	-	-	-	-	-	-	-	-
4 Sludge	-	-	-	-	-	-	-	r
5 Asbestos	-	-	-	-	-	-	-	-
6 Acid	1	-	-	-	-	0	0	1.8
7 Alkalis	-	-	-	-	-	-	-	-
8 Oily waste	-	-	-	-	-	-	-	42.4
9 Chemical residue	-	-	-	-	-	14	10	25.7
10 Waste from food production	6	-	-	-	-	-	-	6,174.5
11 Waste similar to domestic waste	-	-	-	-	-	-	-	9.0
12 Animal manure	-	-	-	-	-	-	-	234.0
13 Carcasses	-	-	-	-	-	-	-	-
14 Glass and ceramics	-	-	-	-	1	-	-	0.5
15 Metal and scrap	-	-	-	4	-	130	96	230.9
16 Paper and cardboard	67	-	1	4	-	9	7	398.1
17 Plastics	-	-	-	1	-	-	-	10.6
18 Rubber	-	-	21	-	-	5	3	28.8
19 Textile	-	-	-	-	-	-	-	0.4
20 Leather	-	-	-	-	-	-	-	183.3
21 Wood	-	-	-	-	-	-	-	-
22 Construction and demolition waste	-	-	-	-	1	-	-	0.8
23 Water	111	-	-	-	-	-	-	91,196.8
24 Others	-	-	-	-	-	-	-	-
Total	190	-	22	9	1	171	126	98,633.9

Table G-43: Waste Generation Amount in 1996 (Chinandega)(1)

unit : ton/year

	Type of waste \ CIIU	3111	3114	3115	3116	3121	3122	3132
1	Ash, combustion residue	-	-	180.0	-	-	-	-
2	Dust	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	0.3	-	-	-	-
7	Alkalis	-	-	0.3	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	108.0	162.5	5,795.0	-	1.2	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	4.8	-	-	-	-	-	-
13	Carcasses	1.8	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	20.0	-	-	-	-
16	Paper and cardboard	-	0.1	80.0	-	-	-	-
17	Plastics	-	-	6.0	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	2,725.0	2,763.0	-	-	-	-
24	Others	-	-	-	-	-	-	-
	Total	7	2,833	3,212	5,795	-	1	-

Table G-44: Waste Generation Amount in 1996 (Chinandega)(2)

unit : ton/year

	Type of waste \ CIIU	3211	3219	3231	3232	3411	3412	3512
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	-	-	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-
16	Paper and cardboard	-	-	-	-	-	-	6.0
17	Plastics	-	-	-	-	-	-	4.0
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	-	-	-	-	37.9
24	Others	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	48

Table G-45: Waste Generation Amount in 1996 (Chinandega)(3)

unit : ton/year

	Type of waste \ CIIU	3522	3523	3551	3691	3699	3822	3839	
1	Ash, combustion residue	-	-	-	-	-	-	-	180.0
2	Dust	-	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-	0.3
7	Alkalis	-	-	-	-	-	-	-	0.3
8	Oily waste	-	-	-	-	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-	-
10	Waste from food production	-	-	-	-	-	-	-	6,066.7
11	Waste similar to domestic waste	-	-	-	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-	4.8
13	Carcasses	-	-	-	-	-	-	-	1.8
14	Glass and ceramics	-	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-	20.0
16	Paper and cardboard	-	-	-	-	-	-	-	86.1
17	Plastics	-	-	-	-	-	-	-	10.0
18	Rubber	-	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-	-
23	Water	-	-	-	-	-	-	-	5,525.9
24	Others	-	-	-	-	-	-	-	-
	Total	-	-	-	-	-	-	-	11,895.9

Table G-46: Waste Generation Amount in 1996 (Granada)(1)

unit : ton/year

	Type of waste \ CIIU	3111	3114	3115	3116	3121	3122	3132
1	Ash, combustion residue	-	-	19.6	-	-	-	-
2	Dust	-	-	0.2	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	6.5	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	4.4	-	-	-	-
9	Chemical residue	-	-	-	-	-	-	-
10	Waste from food production	-	-	18.6	-	-	0.9	-
11	Waste similar to domestic waste	-	-	0.9	-	-	-	-
12	Animal manure	232.0	-	-	-	-	-	-
13	Carcasses	265.0	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	2.3	-	-	-	-
16	Paper and cardboard	-	-	9.3	-	-	-	-
17	Plastics	-	-	1.4	-	-	-	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-
20	Leather	-	-	-	-	-	-	-
21	Wood	-	-	-	-	-	-	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	69,076.0	-	1,174.6	-	-	-	-
24	Others	-	-	-	-	-	-	-
	Total	69,573	-	1,238	-	-	1	-

Table G-47: Waste Generation Amount in 1996 (Granada) (2)

unit : ton/year

	Type of waste \ CIIU	3211	3219	3231	3232	3411	3412	3512
1	Ash, combustion residue	-	-	-	-	-	-	-
2	Dust	-	-	-	-	-	-	-
3	Slag from melting	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-
5	Asbestos	-	-	-	-	-	-	-
6	Acid	-	-	-	-	-	-	-
7	Alkalis	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-
9	Chemical residue	-	-	1.5	-	-	-	-
10	Waste from food production	-	-	-	-	-	-	-
11	Waste similar to domestic waste	0.9	-	-	-	-	-	-
12	Animal manure	-	-	-	-	-	-	-
13	Carcasses	-	-	-	-	-	-	-
14	Glass and ceramics	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	0.2	-
16	Paper and cardboard	-	-	-	-	192.0	-	-
17	Plastics	-	-	-	-	-	0.2	-
18	Rubber	-	-	-	-	-	-	-
19	Textile	-	0.3	-	-	-	-	-
20	Leather	-	-	109.0	-	-	-	-
21	Wood	-	-	-	-	-	0.2	-
22	Construction and demolition waste	-	-	-	-	-	-	-
23	Water	-	-	54,677.0	-	-	-	-
24	Others	-	-	-	-	-	-	-
	Total	1	0	54,788	-	192	1	-

Table G-48: Waste Generation Amount in 1996 (Granada)(3)

unit : ton/year

	Type of waste	3522	3523	3551	3691	3699	3822	3839	Total
1	Ash, combustion residue	-	-	-	-	-	-	-	19.6
2	Dust	7.3	-	-	-	-	-	-	7.5
3	Slag from melting	-	-	-	-	-	-	-	-
4	Sludge	-	-	-	-	-	-	-	6.5
5	Asbestos	-	-	-	-	-	-	-	-
6	Acid	1.8	-	-	-	-	-	-	1.8
7	Alkalis	-	-	-	-	-	-	-	-
8	Oily waste	-	-	-	-	-	-	-	4.4
9	Chemical residue	-	-	-	-	-	-	-	1.5
10	Waste from food production	10.0	-	-	-	-	-	-	29.5
11	Waste similar to domestic waste	-	12.6	-	-	-	-	-	14.4
12	Animal manure	-	-	-	-	-	-	-	232.0
13	Carcasses	-	-	-	-	-	-	-	265.0
14	Glass and ceramics	-	-	-	-	-	-	-	-
15	Metal and scrap	-	-	-	-	-	-	-	2.5
16	Paper and cardboard	110.0	-	-	-	-	-	-	311.3
17	Plastics	-	-	-	-	-	-	-	1.6
18	Rubber	-	-	-	-	-	-	-	-
19	Textile	-	-	-	-	-	-	-	0.3
20	Leather	-	-	-	-	-	-	-	109.0
21	Wood	-	-	-	-	-	-	-	0.2
22	Construction and demolition waste	-	-	-	-	-	-	-	-
23	Water	182.0	919,800.0	-	-	-	-	-	1,044,909.6
24	Others	-	-	-	-	-	-	-	-
	Total	311	919,813	-	-	-	-	-	1,045,916.7

a.1 Nature and Characteristic of Waste

Table G-49 shows estimated waste generation amount of respective cities by the nature and characteristics of the waste (i.e., wastewater, solid waste, hazardous waste, non-hazardous waste).

Table G-49: Nature and Characteristic of Generated Waste

		Leon (t/y)	Chinandega (t/y)	Granada (t/y)	Total (t/y)
Wastewater	Hazardous	91,197	39	916,386	1,007,622
	Non-hazardous	0	5,487	128,524	134,011
	Total	91,197	5,526	1,044,910	1,141,633
Solid Waste	Hazardous	1,034	370	3	1,407
	Non-hazardous	6,403	6,000	1,004	13,407
	Total	7,437	6,370	1,007	14,814
Total		98,634	11,896	1,045,917	1,156,447

a.1.1 Wastewater

If "corrosive", "toxic", and "reactive" substances declared from factories are defined as "hazardous waste", it is about 88% of ISW generated in 3 cities.

a.1.2 Solid Waste

If "corrosive", "toxic", and "reactive" substances declared from factories are defined as "hazardous waste", it is about 10% of ISW generated in 3 cities.

b. Present Waste Treatment Amount

Table G-50 shows estimated waste treatment amount.

Table G-50: Waste Treatment Amount in 1996

Unit : ton/year

City \ Method		Bio-decomposition	Burn	Compac-tion	Dehyd-ration	Neutrli-zation	No-treatment	Others	Total
Water	Leon	-	-	-	-	-	91,197.0	-	91,197.0
	Chinandega	-	-	-	2,725.0	-	2,801.0	-	5,526.0
	Granada	-	-	-	-	-	1,044,910.0	-	1,044,910.0
	Total	-	-	-	2,725.0	-	1,138,908.0	-	1,141,633.0
Solid	Leon	7.4	29.7	37.2	-	-	7,362.7	-	7,437.0
	Chinandega	6.4	5,268.0	-	-	-	1,095.6	-	6,370.0
	Granada	117.8	206.4	-	-	-	682.8	-	1,007.0
	Total	131.6	5,504.1	37.2	-	-	9,141.1	-	14,814.0
Total	Leon	7.4	29.7	37.2	-	-	98,559.7	-	98,634.0
	Chinandega	6.4	5,268.0	-	2,725.0	-	3,896.6	-	11,896.0
	Granada	117.8	206.4	-	-	-	1,045,592.8	-	1,045,917.0
	Total	131.6	5,504.1	37.2	2,725.0	-	1,148,049.1	-	1,156,447.0

b.1 Wastewater

Estimated wastewater generation amount is around 1,142,000 ton/year, of which 1,140,000 ton /year is discharge into public water bodies and/or sewer systems without treatment.

b.2 Solid Waste

Estimated solid waste generation amount is around 14,800 ton/year, of which 5,500 ton/year is openly burned in the factories, and the remainder, around 9,100 ton/year, is untreated.

c. Present Waste Disposal Amount

The volume of waste reduced on intermediate treatment is not declared at factories. Therefore, the estimation of waste volume reduced on intermediate treatment is based on the following assumptions.

- Actual dehydration is evaporated and/or infiltrated into ground by lagoon system. Therefore disposal method is categorized "Discharge into Environment". Therefore assumed same generation amount as disposal amount.
- Amount neutralized is marginal (i.e., 0.2ton/year). Therefore this is neglected. (i.e., volume reduction ratio is 0%)
- Volume reduction from "Combustion" and "Bio-degradation" is assumed to be 50%, based on the visual observation at the factory survey.

Table G-51 shows the outcome of estimated waste disposal amount and Table G-52 shows estimated hazardous waste disposal amount.

Table G-51: Waste Disposal Amount in 1996

unit : ton/year

	City	Discharge into Environment	Discharge to Sewer System	Landfill	Municipality Landfill	Others	Disposal Total	Recycle	Sold to Other	Recycle Total	Reduction	Total
Water	Leon	80,071.0	11,126.0	-	-	-	91,197.0	-	-	-	-	91,197.0
	Chinandega	5,487.3	-	-	-	38.7	5,526.0	-	-	-	-	5,526.0
	Granada	1,044,910.0	-	-	-	-	1,044,910.0	-	-	-	-	1,044,910.0
	Total	1,130,468.3	11,126.0	-	-	38.7	1,141,633.0	-	-	-	-	1,141,633.0
Solid	Leon	119.5	-	883.8	4,882.0	0.8	5,886.1	372.4	1,161.1	1,533.5	17.4	7,437.0
	Chinandega	286.2	2.1	2,718.3	709.4	-	3,716.0	-	15.8	15.8	2,638.2	6,370.0
	Granada	1.6	-	-	335.7	103.8	441.1	-	403.7	403.7	162.2	1,007.0
	Total	407.3	2.1	3,602.1	5,927.1	104.6	10,043.2	372.4	1,580.6	1,953.0	2,817.8	14,814.0
Total	Leon	80,190.5	11,126.0	883.8	4,882.0	0.8	97,083.1	372.4	1,161.1	1,533.5	17.4	98,634.0
	Chinandega	5,773.5	2.1	2,718.3	709.4	38.7	9,242.0	-	15.8	15.8	2,638.2	11,896.0
	Granada	1,044,911.6	-	-	335.7	103.8	1,045,351.1	-	403.7	403.7	162.2	1,045,917.0
	Total	1,130,875.6	11,128.1	3,602.1	5,927.1	143.3	1,151,676.2	372.4	1,580.6	1,953.0	2,817.8	1,156,447.0

Table G-52: Hazardous Waste Disposal Amount

unit : ton/year

	City	Discharge to Environment	Discharge to Sewer System	Landfill	Municipality Landfill	Recycle	Sold to Other	Others	Total
Water	Leon	80,071	11,126	-	-	-	-	-	91,197
	Chinandega	-	-	-	-	-	-	39	39
	Granada	916,386	-	-	-	-	-	-	916,386
	Total	996,457	11,126	-	-	-	-	39	1,007,622
Solid	Leon	132	-	818	83	-	-	1	1,034
	Chinandega	1	-	-	369	-	-	-	370
	Granada	1	-	-	2	-	-	-	3
	Total	86	-	487	833	-	-	1	1,407
Total	Leon	80,203	11,126	818	83	-	-	1	92,231
	Chinandega	1	-	-	369	-	-	39	409
	Granada	916,387	-	-	2	-	-	-	916,389
	Total	996,543	11,126	487	833	-	-	40	1,009,029

c.1 Wastewater

Industrial Wastewater if mostly discharged into public water bodies and/or sewer systems without treatment.

c.2 Solid Waste

Industrial solid waste disposal methods are:

- Mean value of intermediate treatment ratio for the 3 cities is 38%. Intermediate treatment ratios for the 3 cities are Leon 1%, Chinandega 83%, and Granada 32%.
- 68% of generated solid waste is dumped at the landfill site of which a half is disposed at the municipal landfill site.
- Disposal ratios at municipal landfill site are Leon 38%, Chinandega 19%, and Granada 76%.
- Mean recycle ratio for the 3 cities is 13%, and the ratios for each city are Leon 21%, Chinandega 0.2%, and Granada 40%.

d. Present Waste Transportation Amount

Table G-53 shows the estimated amount of each transportation method based on the factory survey. The transportation methods for the 3 cities are "Own means" 97%, and "Municipality" 3%.

Table G-53: Waste Transportation Amount in 1996

		Municipality	Own means	Total
Wastewater (ton/year)	Leon	-	91,197	91,197
	Chinandega	-	5,526	5,526
	Granada	-	1,044,910	1,044,910
	Total	-	1,141,633	1,141,633
Solid Waste (ton/year)	Leon	41	5,845	5,886
	Chinandega	-	3,716	3,716
	Granada	250	191	441
	Total	291	9,752	10,043
Total (ton/year)	Leon	41	97,042	97,083
	Chinandega	-	9,242	9,242
	Granada	250	1,045,101	1,045,351
	Total	291	1,151,385	1,151,676

e. Present Waste Flow

The present industrial waste flow is presented below.

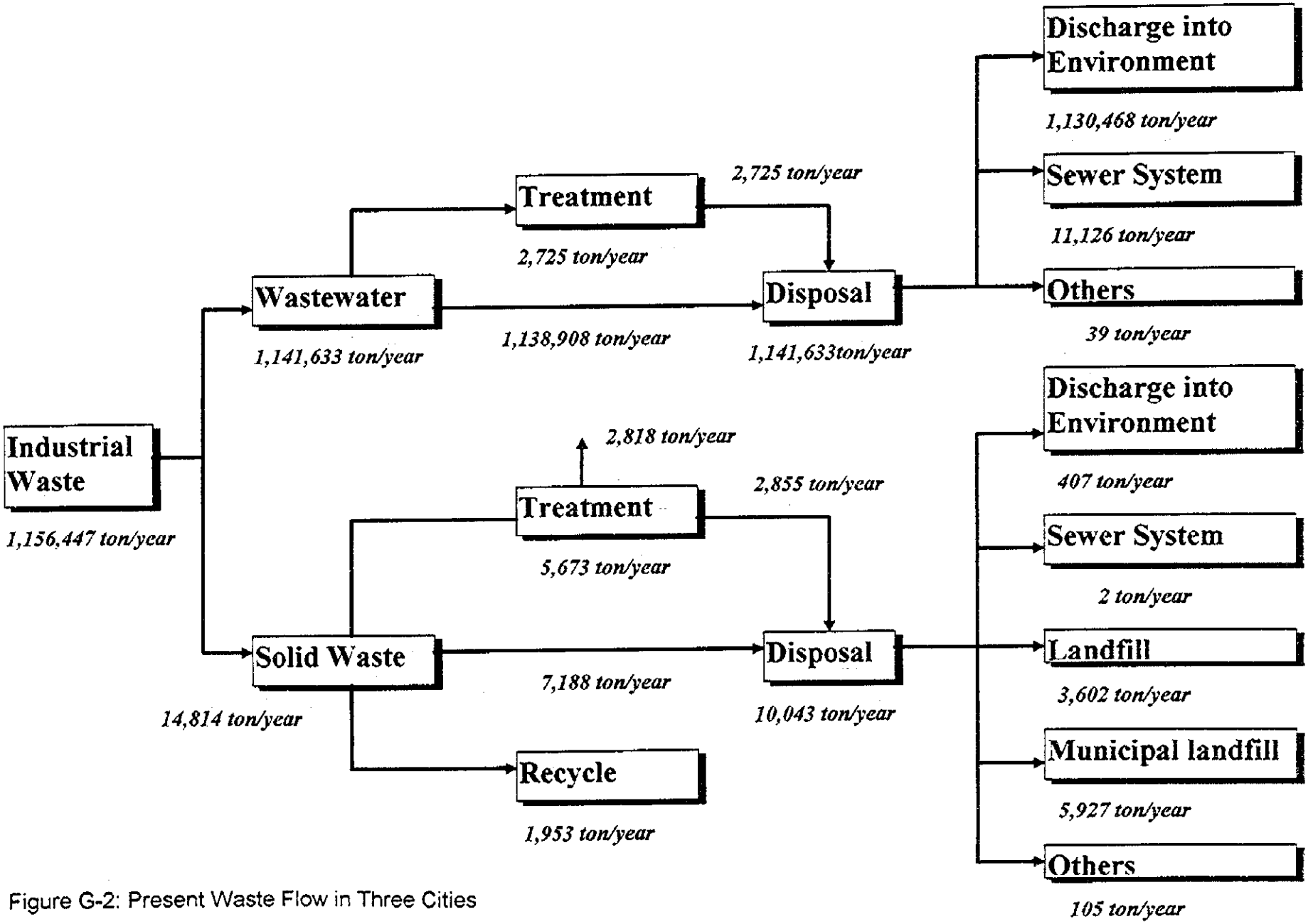

Figure G-2: Present Waste Flow in Three Cities

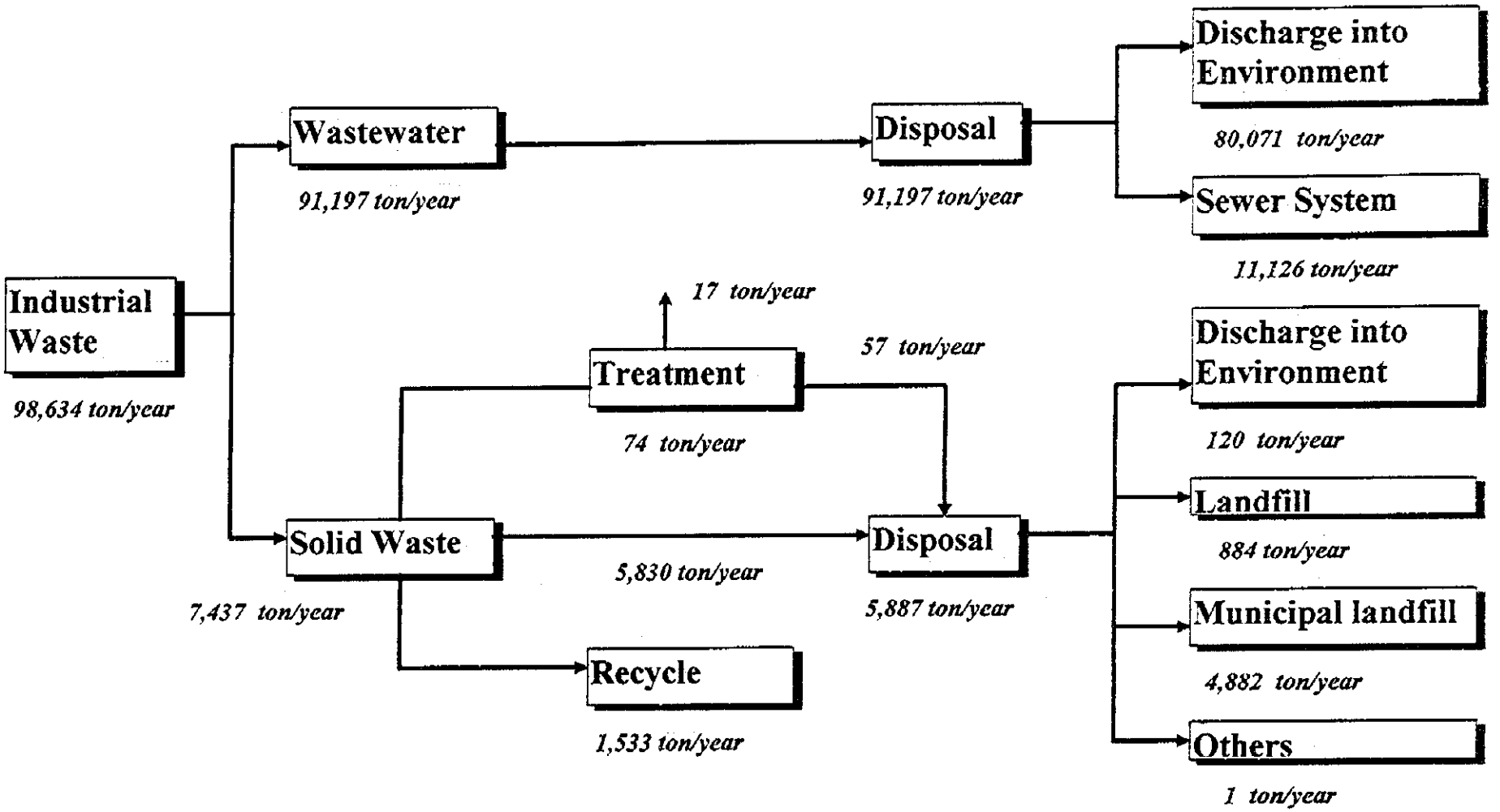

Figure G-3: Present Waste Flow in Leon

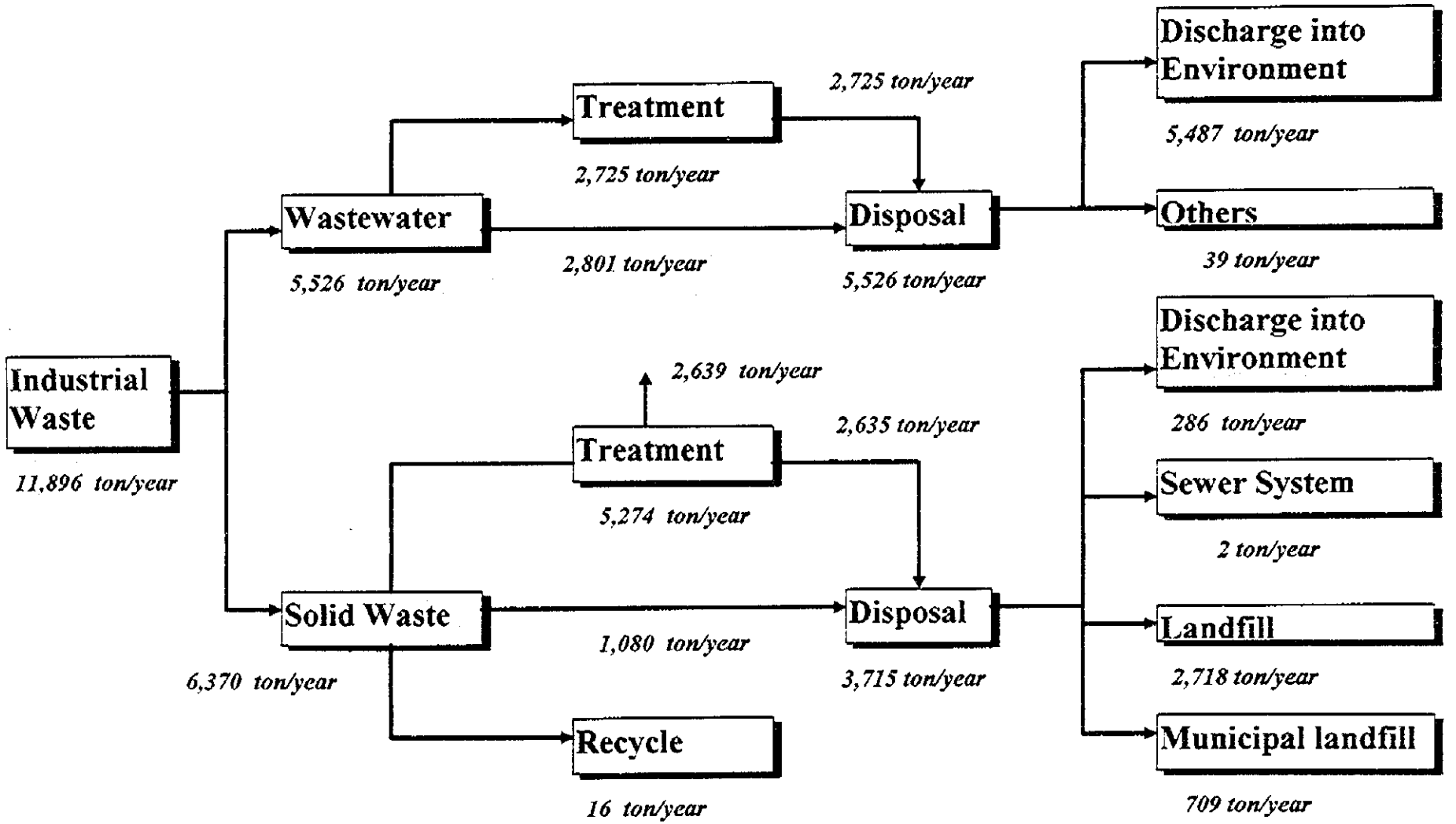

Figure G-4: Present Waste Flow in Chinandega

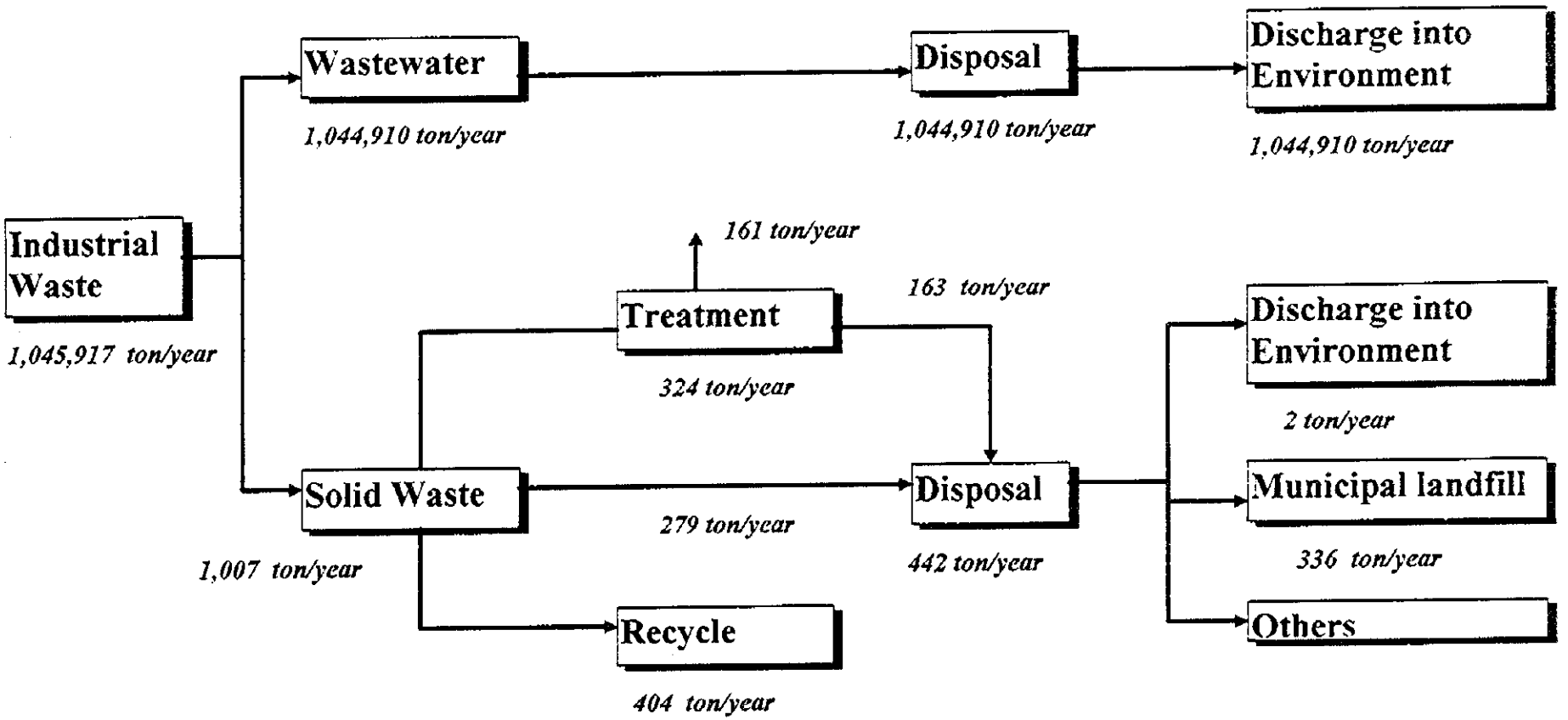

Figure G-5: Present Waste Flow in Granada

ANNEX H

Medical Waste Management Survey

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H Medical Waste Management Survey

H.1 Objectives and Limitation of the Survey

a. Objectives of the Survey

The objective of the survey is generally to understand the present situation of medical waste management (from generation to final disposal), especially about infectious waste and wastewater in the 3 cities. Amount and type of medical waste generated from medical institutions in respective cities, and its treatment and/or disposal methods applied are investigated through a questionnaire survey.

b. Limitation of the Survey

It is almost impossible to investigate actual amount and composition of medical waste in the same way as municipal solid waste, which is because medical waste includes infectious waste such as syringe needles, surgical needles knife and other operation related waste, dealing with medical waste actually exposes investigations to risk of secondary infection. Therefore, a questionnaire survey is normally used as a survey method on medical waste management, and also this was employed in this study.

However, due to a questionnaire survey to typical medical institutions, the survey results contain a certain limitation of the accuracy and its application.

H.2 Method of the Survey

a. Flow of the Survey

Figure H-1 shows the flow of the Method of Medical Solid Waste Management Survey.

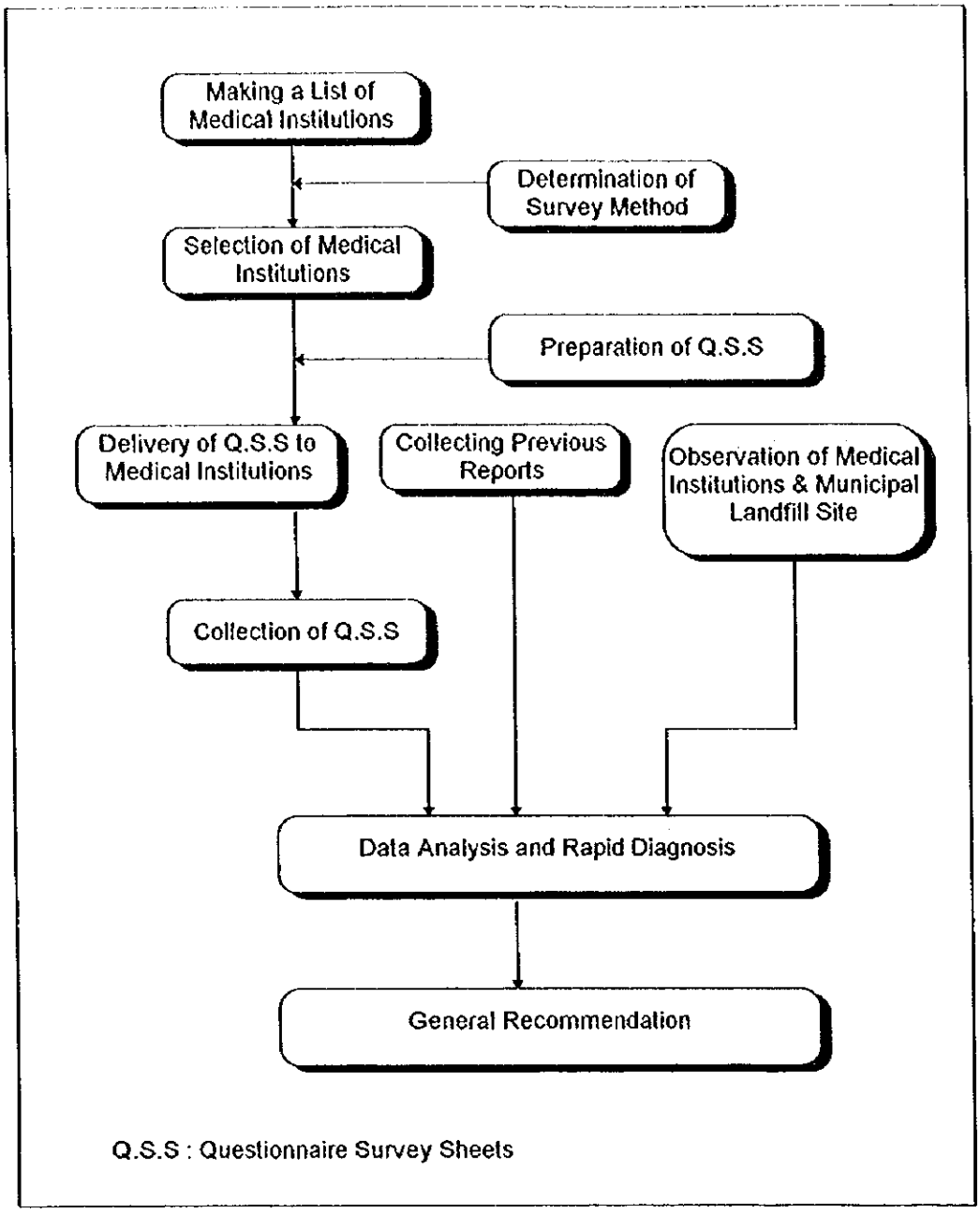

Figure H-1: Flow of the Medical Solid Waste Management Survey

b. Samples of Medical Institutions for the Survey

Since the population of 3 cities is 150,000 or less respectively, and at most 19 medical institutions are located in the study area of each city. It was judged therefore that the general conditions of the MSWM could generally be understood by the questionnaire survey to 5 or more major medical institutions in each city.

Table H-1: Selected medical institutions for questionnaire survey

Owner	Category	Leon	Chinandega	Granada	Total
Public	Hospital	2	2	1	5
	C/S	2	2	3	7
	Others	0	1	1	2
Private		1	1	1	3
Total		5	6	6	17

b.1 Medical Institutions in 3 cities

The list of medical institutions of the Study area is given in Table H-2 for Leon, Table H-3 for Chinandega and Table H-4 for Granada, respectively. Their locations are shown in Figure H-2 for Leon, Figure H-3 for Chinandega and Figure H-4 for Granada.

Table H-2: List of Medical Institutions in Leon

	Name of Institution	Type	Owner	Questionnaire survey
1	Centro de Salud Mantica	C/S	public	
2	Puesto Medico Primero de Mayo	PM	public	
3	Puesto Medico Benjamin Zeledon	PM	public	
4	Puesto Medico Oscar Perez Casar	PM	public	
5	Puesto Medico Denis Tenorio	PM	public	
6	Puesto Medico William Fonseca	PM	public	
7	Centro de Salud Peria Maria Norori	C/S	public	xxx
8	Puesto Medico Villa de Julio	PM	public	
9	Puesto Medico La Arrocera	PM	public	
10	Puerto Medico El Calvarito	PM	public	
11	Puesto Medico El Recreo	PM	public	
12	Puesto Medico Santa Ana	PM	public	
13	Centro de Salud Sutiava	C/S	public	
14	Puesto Medico La Provincia	PM	public	
15	Puesto Medico Walter Ferrety	PM	public	
16	Sanitorio Rosario Lacayo	Sanitarium	private	xxx
17	Asistencia Medica de Occidente	C/S	public	xxx
18	Clinica Infantil San Vicente de Paul	Clinic	private	xxx
19	Hospital Escuela Dr. Oscar Danilo Rosales A.	Hospital	public	xxx

Table H-3: List of Medical Institutions in Chinandega

	Name of Institution	Type	Ownership	Questionnaire survey
1	Puesto de Salud Pedro Joaquin Chamorro	PS	public	
2	Puesto de Salud Guadalupe	PS	public	
3	Puesto de Salud El Calvario	PS	public	
4	Centro de Salud Municipal	C/S	public	
5	Puesto de Salud 12 de Septirmbre	PS	public	
6	Hospital Mauricio Abdalah	Hospital	public	xxx
7	Puesto de Salud Roberto Gonzales	PS	public	
8	Silais	C/S	public	
9	Hospital Espana	Hospital	public	xxx
10	Centro de Salud Roberto Cortez Montealegre	C/S	public	xxx
11	Centro de Salud Villa 15 de Julio	C/S	public	xxx
12	Clinica de Asistencia Medica de Occidente	Hospital	private	aaa
13	Puesto de Medico Mauricio Martinez	PM	public	xxx
14	Centro de Medico Flor de Sacuanjoche	Clinic	public	xxx

Note: aaa: Survey on Training and Instructions for Medical Solid Waste Management was conducted.

Table H-4: List of Medical Institutions in Granada

	Institution	Type	Ownership	Questionnaire Survey
1	Hospital San Juan de Dios	Hospital	public	xxx
2	Centro de Salud Jorge Sinforoso Bravo	C/S	public	xxx
3	Centro de Salud Pedro Juaquin Chamorro	C/S	public	xxx
4	Centro de Salud Heroes Y Martines	C/S	public	xxx
5	Puesto de Salud Villa de Sandino	PS	public	
6	Puesto de Salud El Rosario	PS	public	
7	Puesto de Salud El Caracolito	PS	public	
8	Puesto de Salud Pancasan	PS	public	
9	Puesto de Salud El Diamante	PS	public	
10	Laboratorio Regional Centro Epidenioulogico)	Laboratory	Parastatal (public)	xxx
11	Hospital Privado Cocibolca	Hospital	private	xxx

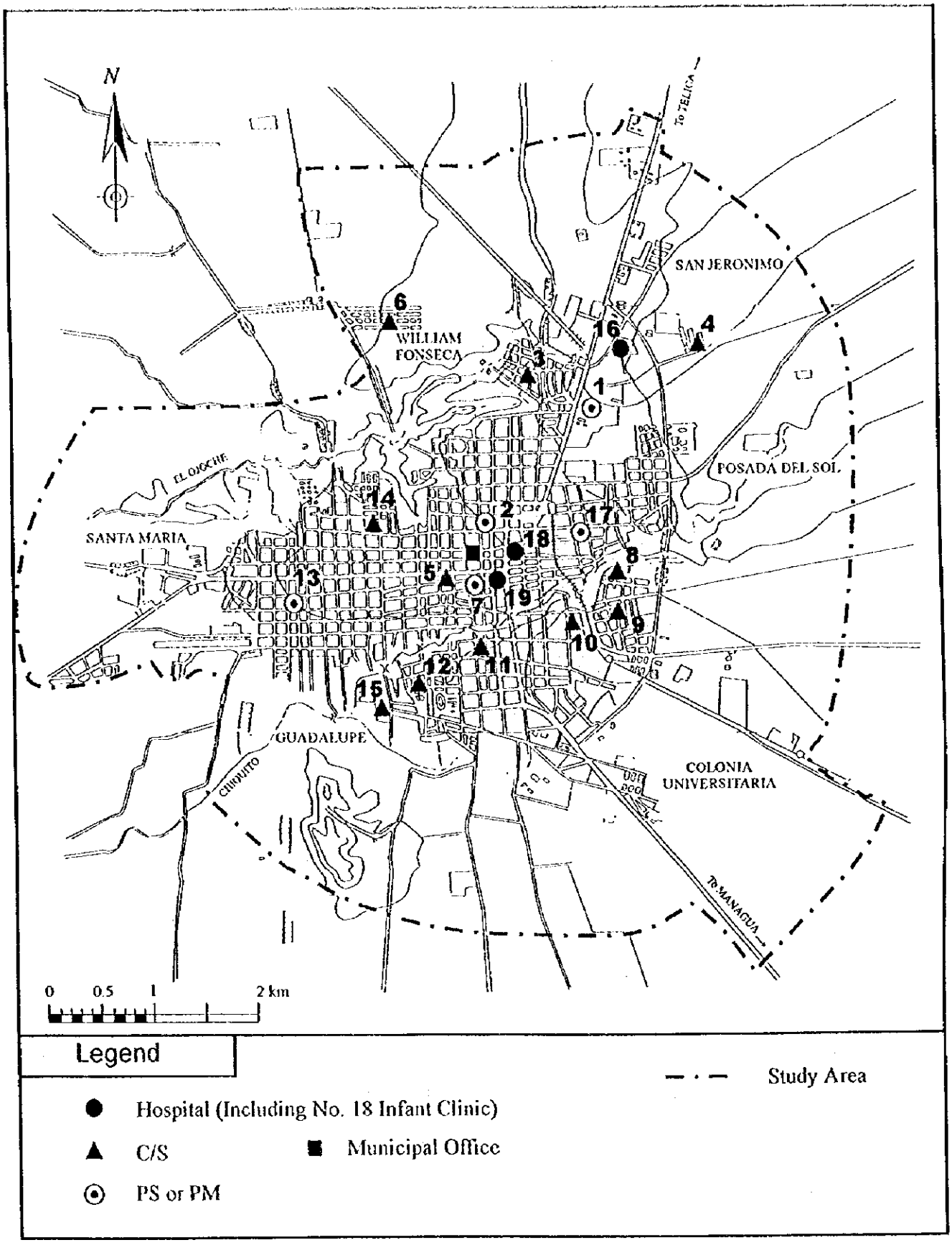

Figure H-2: Location of Medical Institutions in Leon

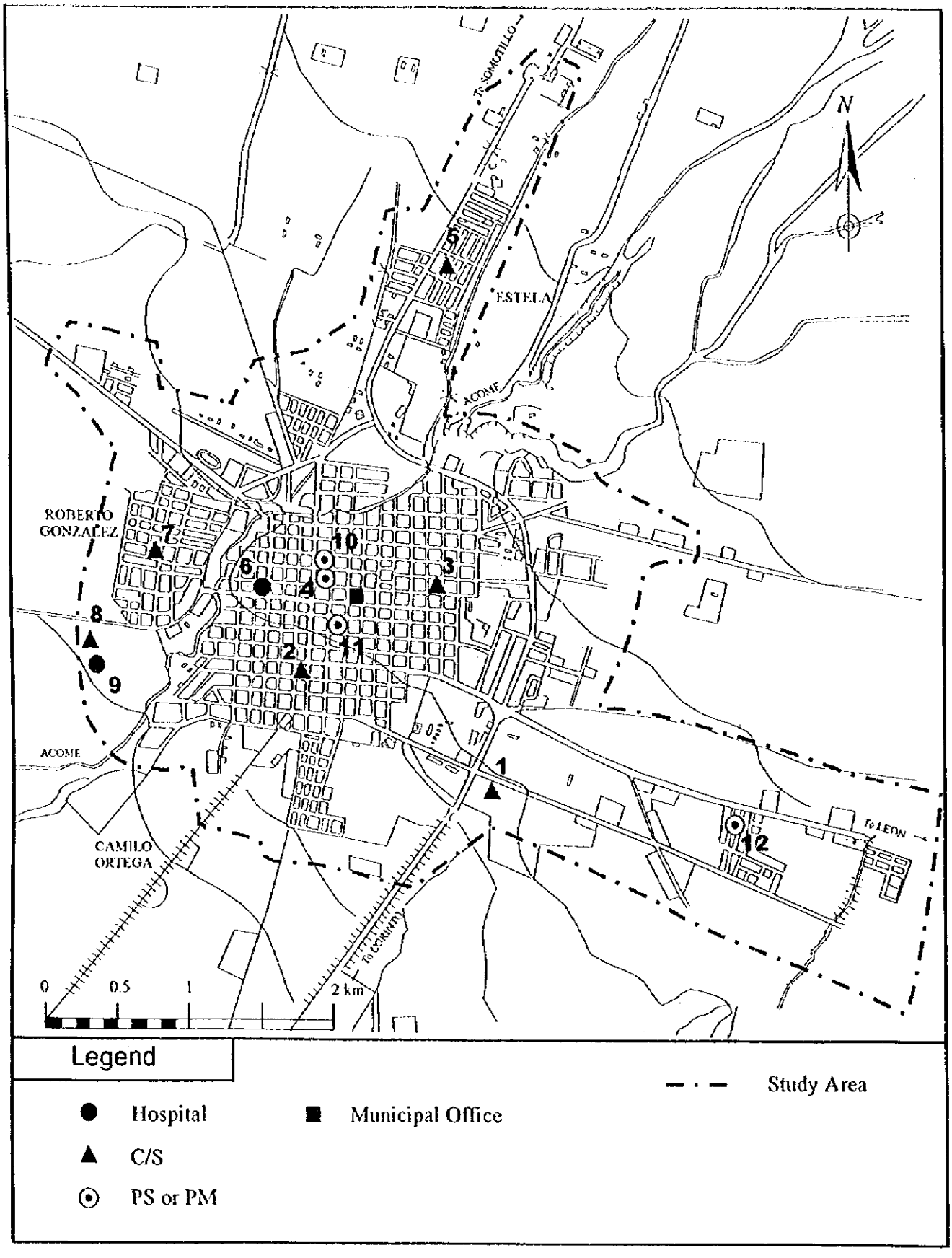

Figure H-3: Location of Medical Institutions in Chinandega

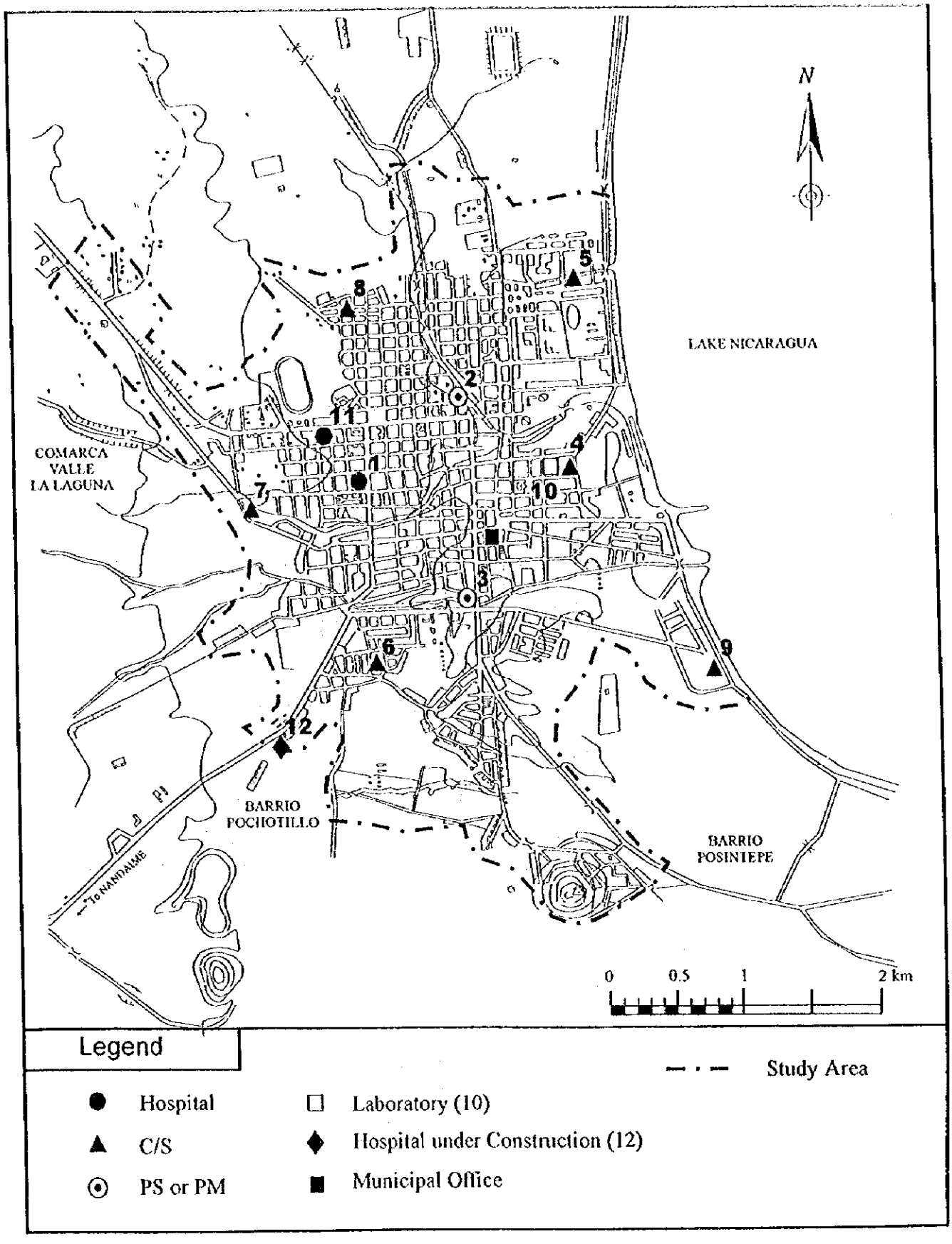

Figure H-4: Location of Medical Institutions in Granada

c. Classification of Medical Waste

Waste generated at medical institutions might be basically categorized into two, namely, infectious/hazardous waste and common (domestic) waste for the study as shown in Table H-5.

Common waste is not hazardous. Meanwhile, infectious/hazardous waste should be handled and controlled with care.

Table H-5: Classification of medical wastes

Classification	Infection/ Hazard	Samples of Waste
1.Risk Waste	with	a. waste with an infection(sharp(syringe) needles, surgical knives, cartridges, broke glasses etc.) b. blood (human blood, serum, plasma and blood products etc.), blood sustained and etc. c. infected waste from laboratories, waste from infectious disease patients and wastewater
2. Animal Waste from Laboratory	with	a. carcass used for experiment etc.
3.Hazardous Waste	with	a. chemical waste(medicines, drugs etc.) b. radio active waste and etc.
4.Common (domestic) Waste	without	a. office waste(paper, plastic, floor sweeping waste) b. kitchen waste(food, food wrapping, metal can,), packing waste, bulky waste(flower), garden waste c. domestic wastewater(from laundries etc.)
5. Special Waste	with	a. ash from incinerator, sludge etc.

H.3 Present Situation of Medical Waste Management

a. Present Situation Found through Interviews

a.1 Government Organization and Medical Waste Collection Service

Ministry of Health(MINSA) is the only organization responsible for dealing with medical solid waste management. However, the three municipalities have been handling collection service of domestic waste generated from medical institutions located in the urban area.

At present, officially government organization do not extend infectious/hazardous medical waste collection service to medical institutions not only in Managua, but also in the three cities. Thus, almost all of the medical institutions have been obliged to burn the medical wastes in the open on their premises or to dispose of medical wastes to the final disposal site through municipal collection service.

a.2 Cancellation of Incinerator Installation Program for Infectious / hazardous Waste in the Whole Country

The European Community (EC) approved the program for installation of incinerators in 5 Central American countries in November 1993. In Nicaragua, the project was scheduled to start from Managua to the rest of the country. However, due to financial troubles among the 5 countries , the program was canceled without much progress.

b. Present Situation Found through Review of the Existing Survey

b.1 Managua SWM study Report by JICA

There is a report on the improvement of the solid waste management system with a target year of 2010 for a Master Plan and 2005 for the Feasibility Study for the city of Managua in May 1995 prepared by JICA and Kokusai Kogyo Co., Ltd. In the report, general recommendation was given on medical SWM, based upon field surveys.

b.2 Report on the Management of Hospital Solid Waste Treatment Carried Out by Municipality of Chinandega (Proyecto El Manejo del Tratamiento (la disposicion) de Desechos Solidos Hospitalarios)

The municipality of Chinandega, which felt the danger of infection through medical waste, for example, Hepatitis C (HepC) and acquired immunodeficiency syndrome(HIV-AIDS), started to collect hypodermic needles, from two large hospitals and incinerate them in a small pit inside the final disposal site of the municipality. The municipality of Chinandega has been extending this type of MSWM service as follows:

First step : 2 hospitals (already started)

Second step : 6 Health center(C/S) and 2 health posts(P/S)

Third step: Clinics, laboratories and pharmacies in the urban area

c. Present Situation of the Medical Institutions

c.1 Hospitals

Hospitals provide with much better medical service to citizens than other medical institutions. They carry out major operations. There are 2 public and 1 private hospitals in Leon and Chinandega, however, in Granada, there is only one of each. At present, 1 hospital is under construction in Granada by the grant aid scheme of the Japanese government (JICA).

c.2 Health Center (C/S)

C/S provides with the primary medical services. Their service is normally restricted within narrow limits, such as minor operations. There are two types of C/S. One is equipped with inpatient beds, the other is without inpatient facilities. All of the C/S's are owned by the Government.

c.3 Health Post (P/M and P/S)

There are two types of health posts giving only primary medical care to patients. The difference between the two is that one is visited by a medical doctor (P/M) and the other which is nurses (P/S). They are owned by the Government, and produce only a small amount of waste.

c.4 Sanitarium, Clinic

A sanitarium provides care for invalids, especially of convalescents and the chronically sick. Private sectors own clinics, which normally have a smaller number of inpatient beds than government hospitals.

H.4 Questionnaire

a. Questionnaire Sheets Prepared

A questionnaire survey sheet to the medical institutions, containing the following, was prepared.

- Details of Medical institution
- Generation of medical waste
- Collection of wastes
- Treatment of medical waste
- Disposal
- Training and instructions
- Opinion on future improvement of medical waste management

b. Result of Questionnaire Survey

b.1 Details of Medical Institutions

b.1.1 Medical Institutions in Leon

A questionnaire survey was carried out on five typical medical institutions(2 hospitals, 1 sanitarium, C/S, and 1 clinic). The largest hospital is public Oscar Danilo Rosales with 328 inpatients beds and 107 medical doctors, which carries out major surgery 4,911 times/year. The second largest Asistencia Medica del Occidente does only 150 major surgery per year. Medical solid waste is produced mainly from these hospitals.

b.1.2 Medical Institutions in Chinandega

A questionnaire survey was carried out on 7 medical institutions (2 hospitals, 2 C/S, 2 clinics, and 1 P/M). The largest hospital is public Maulicia abdalah with 167 inpatient beds and 66 medical doctors, which carries out 1,427 major surgery. The second largest public Espana, which opened in 1995, carries out 672 major surgery with 120 inpatient beds. The two clinics provide only either 10 or 16 inpatient beds, which indicates smaller generation of medical waste.

b.1.3 Medical Institutions in Granada

A questionnaire survey was carried out on 6 medical institutions (2 hospitals, 3 C/S, 1 laboratory) .There are 2 hospitals providing major and minor surgery. The largest hospital is public San Juan de Dios with 144 inpatient beds and 68 medical doctors, which carries out 1,765 major and 1,126 minor surgery. The second largest private Cocibolca hospital carries out 220 major surgery operation with 25 inpatient beds.

b.2 Separation of Infectious/Hazardous Medical Solid Waste at Generation Source

The condition of medical waste separation is summarized as shown in Table H-6. About 80 % of the institutions answered "mixed" or "partial". Two institutions answered "complete separation" in Granada but, one of them is a laboratory.

Table H-6: Conditions of Separation of Infectious/hazardous Medical solid waste

Separation	Leon	Chinandega	Granada	Total	%
a) No(Mixed)	1	0	2	3	17.65
b) No(Partial)	4	6	2	12	70.59
c) Yes(Complete)	0	0	2	2	11.76
Grand Total	5	6	6	17	100

Hospital Espana dispose of blood products into the sewerage treatment plant. It was built in 1995 under the grant aid of the Spanish Government. The Hospital is located about 500-600m from the municipal final disposal site, which allows many flies to fly to swarm around the institution is believed that many flies carry bacteria to the Hospital.

b.3 Treatment MSW

b.3.1 Incineration

Incineration of medical waste has been rapidly developed in Japan and a part of European countries, because it contributes to stabilize medical waste by physically changing them from septic organic substances to inorganic substances and to make bacteria with a cause of disease die out at high temperature.

Table H-7 shows that 8 medical institutions provide incineration for infectious wastes, but the incineration system varies from primitive burning at open air to a temperature controlled incinerator which is located in Chinandega.

Medical institutions without incineration normally dispose of risky medical waste at the municipal final disposal site through municipal collection service.

Syringe needle wastes in Chinandega have been disposed of systematically under the guidance of a JOCV volunteer.

Table H-7: Incineration Method by City

City	With Incineration				Without Incineration	Total
	Mechanical*1	Primitive				
	Incinerator Controlled	Furnace*2	Open Air*3 of Premise			
			Inside	Outside		
Chinandega	1	2	0	0(6)*4	3	6
Leon	0	0	1	1	3	5
Granada	0	1	2	0	3	6
Total	1	3	3	1	9	17
Share(%)	5.9	17.6	17.6	5.9	52.9	100.0

Note:
*1 mechanical incinerator with temperature control
*2 primitive furnace without any control
*3 primitive incineration at open air of their own premises which sometimes give air pollution to the surrounding people
*4 Values in ( ) show number of institutions that incinerate only syringe needles waste.

b.3.2 Other Methods

The autoclaving (steam disinfection) is basically utilized for the reuse of medical tools. Autoclave is used for reuse of gloves in a hospital in Chinandega. Autoclaving is rarely provided with for the purpose of disinfection.

Chemical medicine(phenol) is used for disinfection of wastes of needles and glasses in a hospital of Granada.

b.4 External Collection of Wastes

Most of the institutions in Leon receive municipal collection services.

b.5 Final Disposal

All the medical SW are disposed of at municipal final disposal sites in the 3 cities.

b.6 Recycling

Very few medical institutions carry out recycling of medical SW.

b.7 Training and Instructions for Medical Solid Waste Management

b.7.1 Medical Institutions in Leon

1) Written Instructions

The presence of written instruction in medical institutions are shown in Table H-8. Half of the institutions have no written instructions.

Table H-8: Written Instructions in Three Cities

Answer	Leon	Chinandega	Granada	Total	%
Yes	1	5	2	8	44.44
No	3	2	4	9	50.00
No Answer	1	0	0	1	5.56
Grand total	5	7	6	18	100

2) Frequency of Training

The frequency of training in the medical institutions is shown in Table H-9. 80 % of the institutions provide training either "never" or "at the beginning of employment" .

Table H-9: Frequency of training in the medical institutions in 3 cities

Answer	Leon	Chinandega	Granada	Total	%
at the beginning of employment.	1	5	4	10	55.55
once/month	0	1	0	1	5.56
once/year	0	0	1	1	5.56
Never	3	1	1	5	27.77
No Answer.	1	0	0	1	5.56
Grand total	5	7	6	18	100

b.7.2 Opinion on Improvement of the Medical Solid Waste Management by Medical Institution

b.7.2.1 Satisfaction of the Collection Service

In Leon, all institutions are dissatisfied with the current municipal collection service. In Chinandega, 2 out of 7 institutions are satisfied with the municipal collection service, but the remaining 5 are not. In Granada, 5 out of 6 medical institutions are not satisfied with the municipal collection service (refer to Table H-10, Table H-11,Table H-12).

Table H-10: Opinion Sanitation with the Current Waste Collection Service in Leon

City	Leon
Name of the Institution	**Are you satisfied with the current waste collection service offered, please give the reasons.**
Sanitarium "Rosario Lacayo"	Not satisfied, system is deficient.
Asistencia Medica del Occidente	-No, I think the recollection service should be daily, with mote technical improvement. -Giving chats to the population. -Improve the recollection service, to be more efficient
Hospital Escuela Dr. Oscar Danilo Rosales A.	-No, there should be a classification and disinfecting system prior to final disposal.
Infantile Clinic, Sanvicente de Paul	-No, because the waste accumulates.
Centro de Salud Perla Maria Norori	No, because: -There is no training for the workers regarding medical waste management. -There is no adequate collection, manipulation and elimination of waste, which is dangerous for the workers and the population.

Table H-11: Opinions on Satisfaction with the Current Waste Collection Service in Chinandega

City	Chinandega
Name of the Institution	**Are you satisfied with the current waste collection service offered, please give the reasons.**
Puesto Medico "Muricio Martinez"	No, because it is a deficient system. -Teach the way to dispose the waste. -Direct coordination between Municipality and the City. -A specific date for collection. -Special containers for each waste.
Health Care Center Villa 15 de Julio	-There should be an incinerator for each center, because it is a rural area and actually there is no recollection service.
Clinica de Asistencia Medica de Occidente	-It's necessary to improve on waste recollection and provide the centers with incinerators.
Centro Medico Flor de Sacuanjoche	-No, because the actual system is contaminating the environment and collection workers.
Hospotal Mauricio Abdalah	We are not satisfied but we adapt ourselves to the situation, we would like to have a better collection and management service for domestic and hazardous waste before they leave the institution.
Hospotal Espana	-Yes, because we have collection every day which avoids the accumulation of waste and fly's breading.
Health Care Center Roberto Cortez Montealegre	-We are satisfied with this type of control to avoid any types of infectious epidemic.

Table H-12: Opinion Satisfaction with the Current Waste Collection Service in Granada

City	Granada
Name of the Institution	**Are you satisfied with the current waste collection service offered, please give the reasons.**
Centro de Salud Heroes y Martires	No, because is not an adequate system.
Hospital Privado Cocibolca	Satisfied with the frequency of visits.
San Juan de Dios Hospital	No, we are not satisfied with the actual waste management.
Centro de Salud Pedro Joaquin Chamorro	No, I am not satisfied, because this system is not adequate, it only comes 3 times per week, it should be daily. Also were the Municipal D.S is located is not adequate it should be remove.
Centro Epedemiologico Inter-Silais (Regional Laboratory)	No, there should be a better collection service because the present system is putting people at risk.
Ministerio de Salud	No, we need an incinerator to stop contaminating other types of waste.

b.7.2.2 Opinion for the Improvement of Municipal Collection Service

There are many opinions on the improvement of the municipal collection service, because many institutions are dissatisfied with the current service. The most common opinions were regarding periodic collection service, segregation of waste, educating medical personnel and collection workers, modernizing collection and haulage equipment, and relocation of disposal site .(Refer to Table H-13, Table H-14, Table H-15).

Table H-13: Opinion of Improvement on Collection Service in Leon

City	Leon
Name of the Institution	**How could the Municipality or the private company that collects your waste improve their service?**
Saniarium "Rosario Lacayo"	-With the municipal recollection. -With an incinerator. -With qualifying the personnel, in charge of the waste management.
Asistencia Medica del Occidente	-Education the people, regarding waste collection.
Hospital Escuela Dr. Oscar Danilo Rosales A.	
Infantile Clinic, Sanvicente de Paul	-Collecting daily.
Centro de Salud Perla Maria Norori	-With a periodic collection and adequate classification, transportation and posterior elimination. -Constant education of the collection workers and the population regarding waste management.

Table H-14: Opinions of Improvement on Collection Service in Chinandega

City	Chinandega
Name of the Institution	**How could the Municipality or the private company that collects your waste improve their service?**
Puesto Medico "Muricio Martinez"	-Complying with the established collection and days supplying adequate equipment to the workers of the collection service.
Health Care Center Villa 15 de Julio	-Provide a municipal collection service.
Clinica de Asistencia Medica de Occidente	-Have day to day collection. -The collection method should be adequate on behalf of the municipality.
Centro Medico Flor de Sacuanjoche	-Providing adequate protection equipment for the workers. That would avoid the accumulation of waste in the institution. -Implementation of a more appropriate recollection system.
Hospotal Mauricio Abdalah	-With the necessary equipment to provide this service, at present they only have one tractor and one open trailer both of which are in a state of disrepair.
Hospotal Espana	-Keep the same service they have.
Health Care Center Roberto Cortez Montealegre	-In my opinion there should be a container truck with an internal compactor to avoid contamination of the environment.

Table H-15: Opinions of improvement on Collection Service in Granada

City	Granada
Name of the Institution	**How could the Municipality or the private company that collects your waste improve their service?**
Centro de Salud Heroes y Martires	-The major should worry more about waste management and try to improve the collection service.
Hospital Privado Cocibolca	-
San Juan de Dios Hospital	-Obtain adequate equipment, training and maintenance is also needed for a good collection service.
Centro de Salud Pedro Joaquin Chamorro	-Changing the actual collection system and relocating the D.S.
Centro Epedemiologico Inter-Silais (Regional Laboratory)	-Changing the actual collection system and modernizing their equipment, also educating the institutions, industries and workers in management of dangerous waste.
Ministerio de Salud	-Increasing the collection days.

b.8 Awareness of Medical Institutions on MSWM

b.8.1 Awareness of the Present Medical Solid Waste Management Inside Medical Institutions

Although 5 (29.4%) of 17 medical institutions are not aware of problems, remaining 12 (70.6%) institutions are aware of some problems on the present solid waste management **inside the institutions**. In comparison of 3 cities, all medical institutions in Leon are conscious of the problems.

b.8.2 Awareness of the Present Medical Solid Waste Management in the City

Regarding awareness of the present medical solid waste management **in the city**, 4 (23.5%) institutions are not conscious of problems, but 13(76.5%) are conscious of some problems on the management.

b.8.3 Authorities' Institutional Improvement Required

The medical institutions mainly pointed out problems being: lack of legislation and regulations; lack of supervision and control by authorities; lack of fund for proper management; and lack of guidelines for actual handling of medical waste.

b.9 Present Situation of Treatment and Disposal Method

b.9.1 Treatment Method

As shown in Table H-16, almost all of medical institutions (94%) discharge without any treatment. Only 1 hospital (6%) located in Chinandega discharge the wastewater into river after treatment by septic tank.

Table H-16: Treatment of Current medical wastewater

Unit : number

Treatment	Without Treatment	With Treatment	Total
		Septic Tank	
Chinandega	5	1	6
Leon	5	0	5
Granada	6	0	6
Total	16	1	17
Share(%)	94.1	5.9	100

b.9.2 Disposal Method

Medical Waste are disposed of at 3 destination as shown in Table H-17: sewer, soak pit or public watercourses depending on the location of institutions. Most of them (about 74%) use sewer and about 20% use soak pit. Remaining 6% discharge into river after treatment by septic tank.

Table H-17: Disposal of wastewater of institutions

Unit : number

Treatment	Without			With	Total
Disposal Method	Discharge into Sewer	Partially Sewer and Partially Soak Pit	Discharge into Soak Pit	Septic Tank to River	
Chinandega	4	0	1	1	6
Leon	4	1	0	0	5
Granada	4	0	2	0	6
Total	12	1	3	1	17
Share (%)	70.6	5.9	17.6	5.9	100

b.9.3 Present Conditions on Medical Wastewater Management

b.9.3.1 Water Sources

All the medical institutions relies on INAA for their water supply. They do not use other water sources.

b.9.3.2 Medical Wastewater Quality

No medical institutions measure the quality of wastewater in the medical institutions.

b.9.3.3 Ideas on Collection System of Future Medical Waste by Medical Institutions

Most institutions are aware of necessity of standardization of collection system, preferably by establishing a standard collection systems for all institutions generating medical solid waste.

b.9.3.4 Future Internal Treatment

The survey shows each institution are well aware of the necessity to arrange its own internal treatment in the future.

b.9.3.5 External Treatment by the Medical Institutions

Regarding ideas on external treatment by medical institutions, their ideas are introduction of incinerators and replacement by safe disposal at a dedicated sanitary landfill.

b.9.3.6 Obstacles Improving the Present System

As for the improvement of the present system, financial constraints are mainly expressed as the constraints. Meanwhile, some institutions are not conscious of their difficulty to improve the system.

b.9.3.7 Inspection on the Wastewater Quality by Medical Institutions

Decree No.33-95 provides that medical institutions have an obligation to inspect the quality of wastewater. However, no institutions have been carrying out the designated inspections.

H.5 Medical Waste Generation Survey

a. Classification of Medical Waste

Waste generated at medical institutions might be basically categorized into two, namely, infectious/hazardous waste and common (domestic) waste for the study as shown in Table H-5.

Common waste is not hazardous. Meanwhile, infectious/hazardous waste should be handled and controlled with care.

b. Estimation of Generation Ratio of Medical Waste in 3 cities

Present generation ratio of medical waste in 3 cities is shown in Table H-18, being based on the raw data of questionnaire survey.

Table H-18: Generation ratio by the Type of Medical Waste in 3 Cities

City		Leon	Chinandega	Granada	Total
Number of Beds		538	327	175	1,040
Surveyed Medical Institution		5	6	6	17
Generation amount by Waste Type (kg/bed/day)	Risk	0.278	0.113	0.274	0.665
	Hazardous	0.009	0.009	0.009	0.027
	Common	0.259	0.172	0.281	0.712
	Special	0.003	0.000	0.003	0.006
Total		0.549	0.294	0.567	1.410

c. Key Indicators for the Forecast

Key indicators for forecast of medical wastes in 3 cities are shown in Table H-19.

Table H-19: Key Indicators of the Medical Institutions in 3 Cities

		1996	2005	2010
Population (urban area)	Leon	133,997	213,156	245,421
	Chinandega	100,748	133,753	153,444
	Granada	76,250	114,760	135,106
	Total	310,995	461,669	533,971
Number of Beds for Inpatients	Leon	538	856	986
	Chinandega	327	434	498
	Granada	175	263	310
	Total	1,040	1,553	1,794
Population/Bed	Leon	249		
	Chinandega	308		
	Granada	436		
	Average	299		

d. Generation Amount

d.1 Medical Solid Waste Generation Amount

Generation amount of medical SW in 3 cities is estimated as shown in Table H-20.

Table H-20: Generation Amount of Medical SW by City in 1996

City	Category	Leon	Chinandega	Granada	Total
Population		133,997	100,748	76,250	310,995
Risky Waste (kg/day)	Risk Waste*1	149.3	36.9	48.0	234.2
	Hazardous Waste*2	4.8	3.0	1.6	924
	Special Waste*3	1.6	0.03	0.6	2.2
	Subtotal	155.7	39.9	50.2	245.8
Common Waste (kg/day)*4		139.1	56.2	49.1	244.4
Grand Total (kg/day)		294.8	96.1	99.3	490.2

Note : *1 waste with a infection (sharps, bloody, bloody sustained and etc.), infected waste from laboratories, waste from infectious disease patients and wastewater and etc.
*2 Chemical waste (Medicines, drugs, etc.), radio active waste and etc.
*3 ash from incinerator, sludge and etc.
*4 office waste, kitchen waste, packing waste, bulky waste, garden waste, domestic wastewater and etc.

d.2 Medical Wastewater Generation Amount

Generation amount of medical wastewater is estimated as shown in Table H-21.

Table H-21: Generation Amount of Medical WW by City in 1996

	Leon	Chinandega	Granada
Population	1133,997	100,748	76,250
Waste Consumption (ton/day)	223.0	207.6	98.0
Wastewater Generation (ton/day)	178.4	166.1	78.4

ANNEX I

Inundation Damage Survey

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I Inundation Damage Survey

I.1 Objectives of the Survey

The objective of this survey was to roughly understand the extent of damage due to inundation in the three cities: Leon, Chinandega and Granada.

I.2 Method of the Survey

The local staff, under the supervision of the Study Team, conducted a questionnaire survey from September to October 1996, at the end of the rainy season.

a. Sampling Number and Survey Area

Two families were chosen from each area within the municipalities predisposed to inundation. With a total of 28 such areas, the total number of interviewed families was 56. The areas proned to inundation (survey areas) are shown in Figure I-1, Figure I-2 and Figure I-3.

Table I-1: Sampling Number

City	Inundation Prone Areas	Interviewee
Leon	15	30
Chinandega	10	20
Granada	3	6
Total	28	56

b. Survey Items

The questionnaire used for this survey is attached to Annex E. The survey items are as follows:

- experience of inundation
- frequency
- depth of inundation
- duration of inundation
- degree of damage caused by inundation

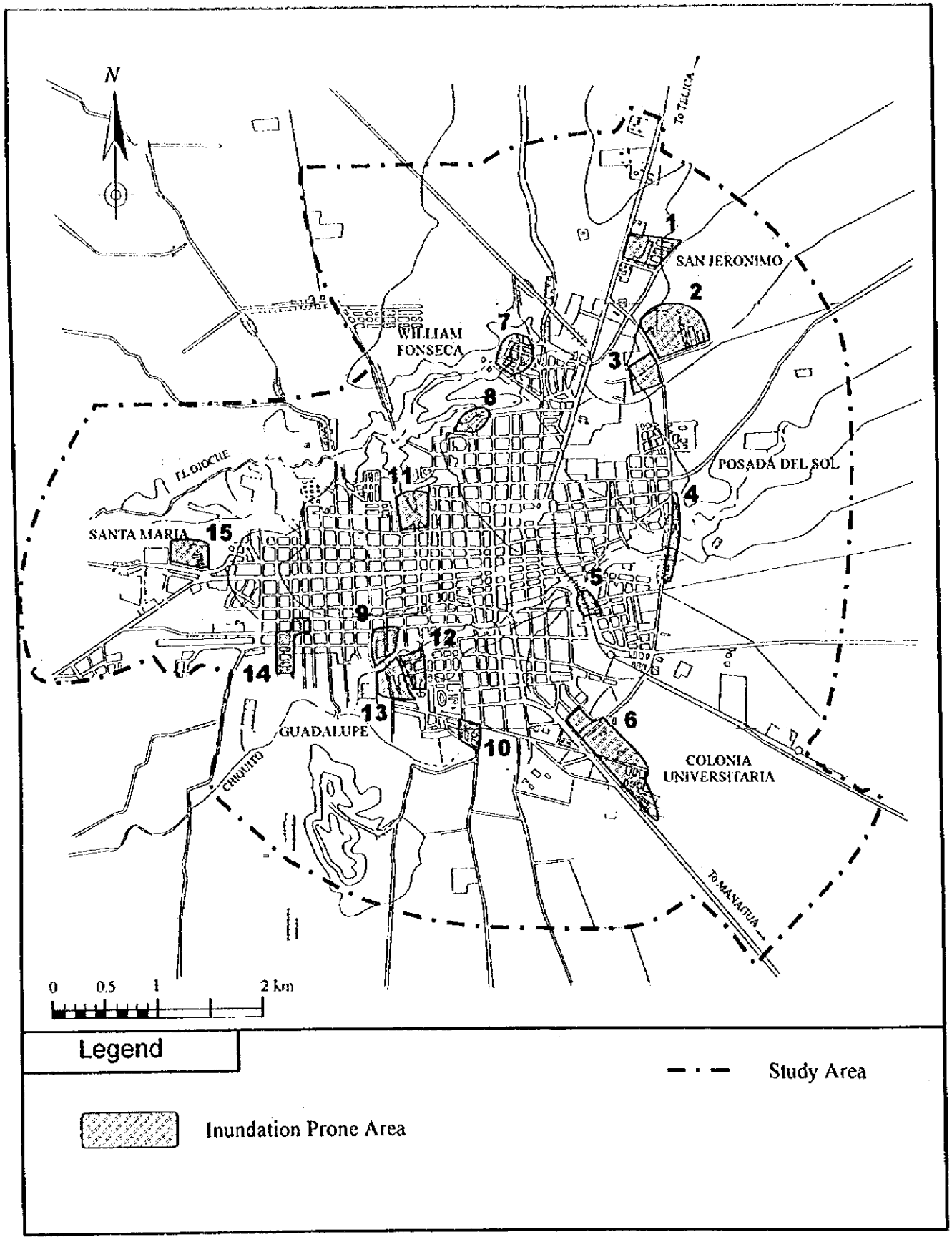

Figure I-1: Location Map of Inundation Prone Areas in Leon

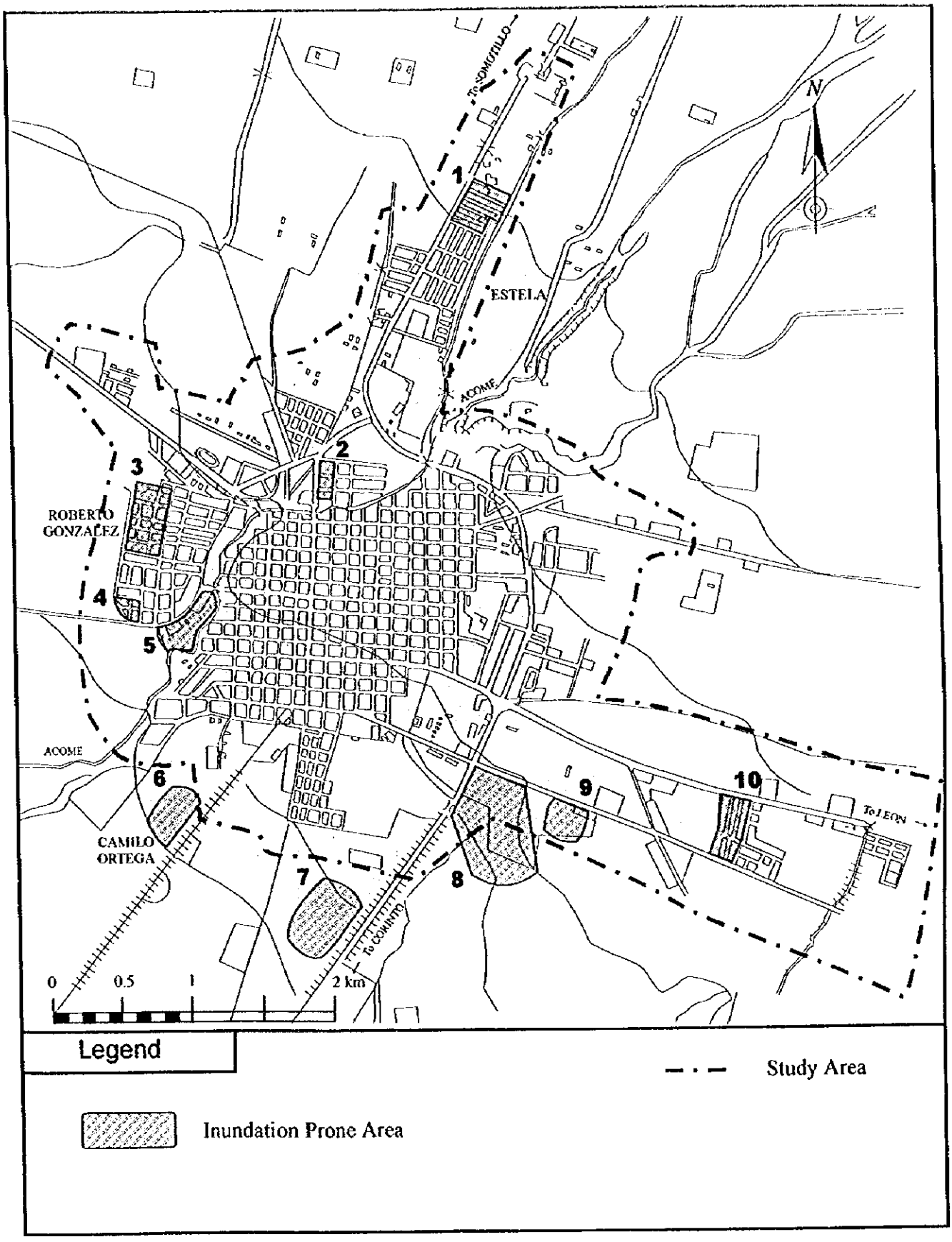

Figure I-2: Location Map of Inundation Prone Areas in Chinandega

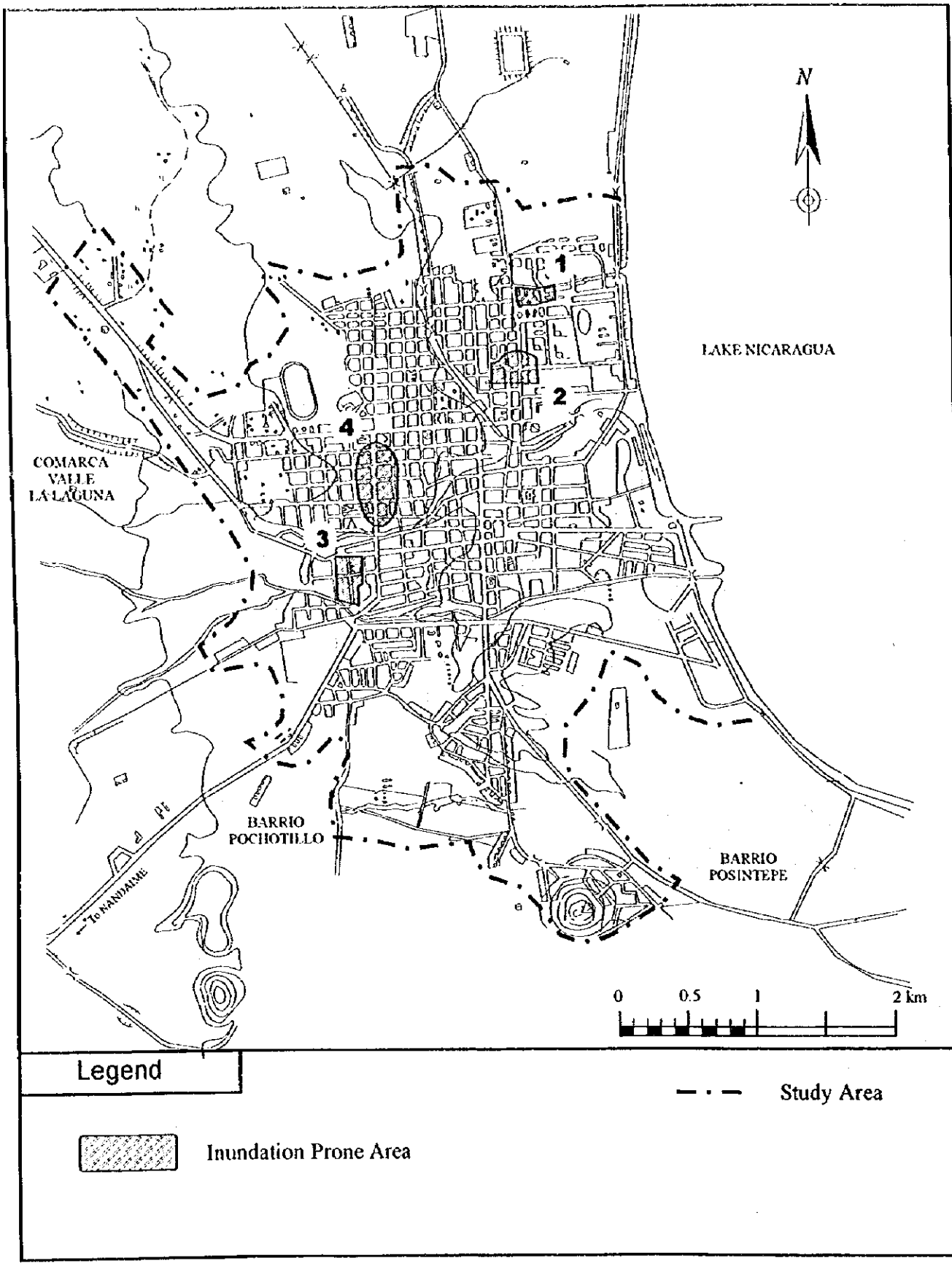

Figure I-3: Location Map of Inundation Prone Areas in Granada

I.3 Results of the Survey

Of the 56 families interviewed, 49 have had inundation damage, and all had suffered from inundation more than twice a year.

The depth of inundation varies from 5cm to 100cm. A considerable majority (78%, or 38/49) replied that inundation continues for 1 to 6 hours. Of the 38 interviewees, 26 answered 1 to 3 hours, and 12 answered 3 to 6 hours. Meanwhile, a certain number (16%, or 8/49) of interviewees answered an inundation duration of more than 24 hours.

A great majority (96%, or 47/49) answered that their houses were damaged by inundation, but the number of interviewees who reported damage to household goods only totaled 13 (27%, 13/49).

Almost half of the interviewees (47%, or 23/49) answered that they have suffered from diseases which were mainly the cold, malaria and dengue fever caused by inundation.

As for businesses damaged by inundation, only one interviewee confirmed any damage. The majority of the interviewees (67%, or 33/49) stated losses of C$ 0 to 500, a considerable number (24%, or 12/49) stated losses worth C$ 500 to 1,000, and 4 interviewees reported damage worth C$ 1,000 to 5,000.

I.4 Findings of the Survey

- All areas prone to inundation suffer from inundation more than twice a year.
- Inundation mainly continues for 1 to 6 hours.
- Almost all houses in these areas were damaged by inundation.
- Many people relate inundation with disease.

The survey was not able to determine which of the prone areas were seriously and slightly damaged due to limitations in sampling. There was a conflict in answers given by the interviewees. Although most answered that their houses were damaged by inundation, many interviewees did not perceive the damage as needing financial compensation. In the 2nd Study Work in Nicaragua, a survey will be carried out to clarify these issues.

a. Area Classification

The inundation prone areas surveyed are basically classified as below.

Table I-2: Inundation Prone Area Classification

Principal Classification	Detailed Classification	Features
1. Areas with drainage channels (mainly located in the urban area)	1.1 These areas are located downstream of a larger catchment area	1.1 Large amount of water flows into these areas from the hinterland catchment area. These areas usually experience considerable flood damage.
	1.2 These areas are located in a smaller drainage basin, which mostly overlaps with the study area.	1.2 Inundation occurs because the drainage channels in these areas are small or clogged with waste. The damage is comparatively small.
2. Areas without drainage channels (mainly located in the urban fringe)	2.1 Flood plains (i.e., inside river banks)	2.1 Flooding occurs when the water level of the river or stream rises due to heavy rain.
	2.2 Others	2.2 These areas are located in low lying areas and lack of road and roadside drains intensifies the damage.

The countermeasures against each type of inundation are shown below.

[Classification: 1.1]

An integrated river system management plan (including a reforestation plan, a drainage basin improvement plan, etc.) would be an ideal countermeasure for these areas. However, it would be physically impossible to carry out such a countermeasure in this Study, as it requires considerable time and resources to acquire the vast amount of base data (e.g., rainfall, river regime, land use).

[Classification: 1.2 and 2.2]

A storm water drainage plan mainly consisting of a drainage basin plan (to determine the design rainfall, and the scale of drainage channels) would be ideal for areas classified under 1.2 and 2.2, and this work will be simpler than that of the integrated river system management plan. However, it would be impossible to conduct this countermeasure in this Study, because it requires certain base data (e.g., detailed topographical maps) and a substantial amount of time. Currently the cities have no detailed topographic maps.

[Classification: 2.1]

Administrative measures such as prohibiting construction of houses in flood plains (i.e., riverside lands) or demanding people to leave from riverside lands, would be applicable for these areas.