

1 Outline of the Study

1.1 Background

The Republic of Nicaragua, located in Central America, has a population of 3.9 million and spans an area of about 130,000km². It has suffered two major earthquakes in 1931 and 1972, and has been plagued by civil war that started in 1979 and lasted a decade. These recent events, unfortunately, have led to a decline in the standards of infrastructure, social services and the socio-economic make-up.

In Nicaragua, the principal cities are the focal points of important economic activity and thus attract large number of migrants from the rural communities, resulting in a very sharp population increase. However, the inferior infrastructure and dilapidated equipment have made it difficult to manage aspects of the urban sanitation. Improper wastewater treatment practices have led the decline in the quality of surface and ground water resources. While poor solid waste collection and illegal disposal have resulted in the debasement of the urban environment. Cases of water-related diseases are rife and it is increasingly obvious that the cities are unable to cope with the environmental degradation. To further exasperate the problem, the financial capabilities are limited as well as there being a lack of environmental measures for major industries. Therefore, the formulation of remedial measures for urban sanitation environment (hereinafter referred to as the USE) of the three cities is urgently required.

Under these conditions, the Government of Nicaragua requested the Japanese Government to implement a development study on the improvement of the USE of the principal cities in Nicaragua; Leon, Chinandega and Granada, in September 1994. In response to the request, the Government of Japan decided to conduct the Study on the Improvement of the USE of the Principal Cities in the republic of Nicaragua. Accordingly, the Japan International Cooperation Agency (JICA), the official agency responsible for the implementation of the Japanese Government technical cooperation programs, undertook the Study, in close cooperation with the authorities concerned Nicaraguan authority (INIFOM). Subsequently Kokusai Kogyo Co., Ltd. was selected by JICA as the consultant of the Study.

1.2 Objectives and Scope of the Study

1.2.1 Objectives of the Study

The objectives of this Study are:

- 1) To conduct a basic study of the USE in the principal cities of Leon, Chinandega, and Granada, which are important cities next to the capital in order to improve USE.
- 2) To formulate a comprehensive Master Plan (M/P) of USE improvement for the target year of 2010 for a selected city from three principal cities mentioned above.
- 3) To conduct a feasibility study on the priority projects selected from the M/P.

- 4) To transfer technology to the Nicaraguan counterparts during the course of the Study.

1.2.2 The Study Areas

The Study areas consist of urban areas in Leon, Chinandega, Granada. The areas and populations of these cities are; Leon, 19.1km² with the population of 123, 865, Chinandega, 16.1 km² with the population of 97,387, and Granada, 14.3 km² with the population of 71,783 according to the census taken on the population in 1995. The locations of the cities and the areas subject to the Study are shown on the location maps shown at the beginning of this report.

1.2.3 Study Fields

The Study covered the fields of (i) water supply (ii) stormwater/wastewater, and (iii) solid waste management in the three principal cities.

In the study area, fundamentally, stormwater and wastewater are treated separately, furthermore wastewater is divided into domestic and industrial wastewater. Optimum treatment methods differ for each type of wastewater. Therefore the term "sewage" is defined as follows in the Study.

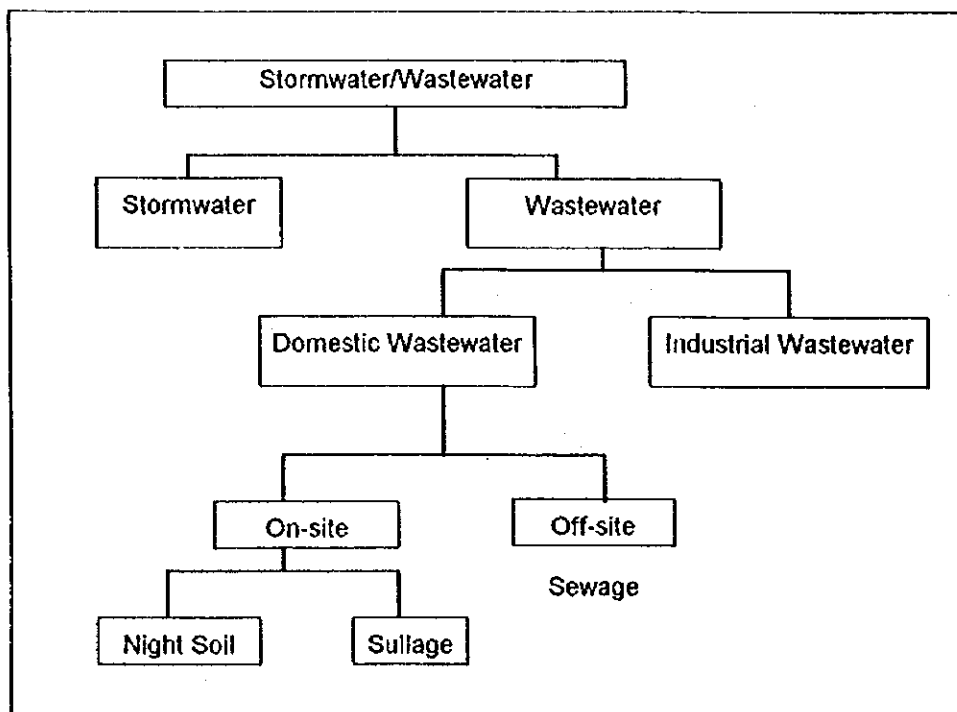


Figure 1-1: Definition of Sewage in this Study

1.3 Basic Policy of the Study

The following basic policy was established by the Study Team in order to carry out the Study successfully.

a. Workable Plan and Appropriate Technology

The Study Team formulated the most workable M/P and Conceptual M/Ps in close cooperation with the Nicaraguan counterparts. Efforts were made to adopt the most viable technical and institutional measures technology most appropriate for the F/S of the priority projects, considering the limited financial capability of the project executing bodies (i.e., Granada Municipality and INAA Region IV). Furthermore, the Study and the formulated plans are intended to support and lead public service providers concerned with the USE in these three cities to be independent.

b. Joint Study

Study Team suggested Nicaraguan counterpart to carry out a joint study for positive results. Active participation and cooperation from Nicaraguan side was requested especially in the following work by the Study Team.

- Public Opinion Survey (POS)
- Water Pollution Loading Survey (WPLS)
- Waste Amount and Composition Survey (WACS)
- Industrial and Medical Wastes Survey (IMWS)
- Implementation of Pilot Projects
- Formulating organizational and Institutional Improvement Plan

c. Utilization of Local Consultants

Considering the characteristics of the USE improvement in the Study, it is essential to carry out technology transfer through the Study not only to counterparts on the Nicaraguan side, but also to local consultants. Especially, surveys such as the public opinion survey (POS), water quality survey, water pollution loading survey, the environmental surveys for a future solid waste disposal site, should to be continued by the Nicaraguan side even after the Study is completed, and therefore require technology transfer.

Hence, local consultants and contractors in Nicaragua fully joined in this Study in order to: conduct the Study successfully within the given time frame; formulate an M/P which is applicable to the local conditions and carry out the technology transfer.

1.4 Key Assumptions

The following key assumptions were used in this Study.

a. M/P and Conceptual M/P

a.1 Socio-economic Conditions

Leon City

Items	Unit	1995	2000	2005	2010
1. Population					
City population	Person	161,530	224,295	257,084	292,511
Population of the Study Area	Person	123,865	183,519	213,156	245,421
Increase of population in the areas subject to the Study	%/year	8.18	3.04	2.86	
2. Economic					
GRDP (Leon City)	C\$ million	700.7	924.1	1,179.4	1,421.2
Annual growth rate of GRDP	%/year	6.0	5.0	3.8	
Budget of the municipality	C\$ 1,000	32,213	42,482	54,219	65,335
Income level	C\$/year	15,708	13,972	15,353	16,068

Chinandega City

Items	Unit	1995	2000	2005	2010
1. Population					
City population	Person	117,037	136,076	155,523	176,359
Population of the Study Area	Person	97,387	115,393	133,753	153,444
Increase of population in the areas subject to the Study	%/year	3.45	3.00	2.78	
2. Economic					
GRDP (Chinandega City)	C\$ million	657.0	866.5	1,105.9	1,332.6
Annual growth rate of GRDP	%/year	6.0	5.0	3.8	
Budget of the municipality	C\$ 1,000	14,604	19,260	24,581	29,620
Income level	C\$/year	14,772	16,410	18,069	18,979

Granada City

Items	Unit	1995	2000	2005	2010
1. Population					
City population	Person	96,996	126,307	147,830	171,618
Population of the Study Area	Person	71,783	97,078	114,760	135,106
Increase of population in the areas subject to the Study	%/year	6.22	3.40	3.32	
2. Economic					
GRDP	C\$ million	247.0	325.7	415.7	500.9
Annual growth rate of GRDP (Granada City)	%/year	6.0	5.0	3.8	
Budget of the municipality	C\$ 1,000	13,071	17,240	22,000	26,511
Income level	C\$/year	15,300	15,228	16,494	16,863

a.2 Water Supply and Sewer System Coverage and Waste Collection Rate

	^{*1} 1995 Water Supply Coverage (% of population)	^{*1} 1995 Sewerage System Coverage (% of population)	^{*2} 1996 Waste Collection Rate (% of population)
Leon	92.2%	55.3%	80.0%
Chinandega	74.0%	33.6%	51.0%
Granada	89.7%	21.9%	63.0%

Note: ^{*1} Source: INAA Performance Indicators

^{*2} The figures are based on the "Waste Amount and Composition Survey" carried out by the Study Team.

b. Feasibility Study (Granada City only)

b.1 Life Span of Equipment and Facility

Item	Life Span (year)	Scrap Value (%)
Vehicles and Heavy Equipment	7	10
Machinery	15	0
Building	30	0

Note: The life span of civil works and facilities other than building depends on the period of its operation.

b.2 Executing Body and Financial Sources for F/S-1: Municipal Solid Waste Management System Improvement Project

Item	Year	Present (August 1997)	F/S (2005)	M/P (2010)
1. Executing Body		Municipal Service Dept.	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
2. Operation System of Collection Service		Direct operation by City	Direct operation by Municipality, but partly using contracting-out system	Direct operation by Municipality, but partly using contracting-out system
3. Operation of Disposal Site La Joya San Jose de la Viuda		Granada Municipality None	Closed Granada Municipality	Closed Granada Municipality
4. Fee Collection Fee Fee Collection Method Fee Collection Rate		Directly collected by City 16.3%	Joint billing with water bill 96%	Joint billing with water bill 96%
5. Household Waste Fee Rate		Three fee levels (5, 10, C\$ 15/household/month in accordance with collection areas)	Three fee levels (5, 10, C\$15/household/month in accordance with collection service level)	Three fee levels (5, 10, C\$15/household/month in accordance with collection service level)
6. Source of Finance Municipality Budget Apportion (C\$ 1,000) Waste Collection Fee (C\$ 1,000)		1,980 138	3,348 2,200	4,031 2,651

b.3 Executing Body and Financial Sources for F/S-2: Model Community Integrated USE Improvement Project

Item	Project	Water Supply	Waste Collection	Domestic Wastewater	Rain Water Drainage
1. Contents of Project		Expansion of service to meet demands of increasing population	Expansion of waste collection service by point collection system	Improving domestic wastewater treatment by collective treatment system per several households to several tens of households	Improving the drainage by utilizing road surface
2. Executing Body		INAA	Granada Municipality	INAA	Granada Municipality
3. Financial Sources for Facility Construction		INAA's budget	Municipality's budget, Waste collection fee, Grant aid	INAA's budget, Grant aid	Municipality's budget, Grant aid
4. Operation & Maintenance Cost		INAA's budget	Municipality's budget, waste collection fee	INAA's budget, Cost sharing by the residents	Municipality's budget, Cost sharing by the residents
5. Fee Collection Rate		Water supply fee 96%	Waste collection fee 96 (16.3') %	Sewerage system fee 96%	None None

Note: *Fee collection rate in 1997.

1.5 Work Process of the Study

The Study commenced in July 1996 and will be completed in February 1998 based on the S/W concluded in November 1995. This Study consists of the following three phases:

Phase I: Basic Study (from July 1996 to December 1996)

Phase II: Formulation of a Master Plan (M/P) (from January 1997 to May 1997)

Phase III: Feasibility Study (F/S) on the First Priority Projects (from June 1997 to February 1998)

Phase I: The Basic Study was carried out in the three major cities in Nicaragua, namely, Leon, Chinandega and Granada. Granada City was selected as a priority city based on the results of the Basic Study.

Phase II: USE M/P was formulated for Granada City, the priority city, and USE Conceptual M/Ps were formulated for Leon and Chinandega respectively.

Phase III: The following surveys have been carried out.

1. Examination of the technical system suggested in the M/P, and the implementation of the pilot projects to obtain basic data for the preliminary design of the F/S.
2. Implementation of the F/S on the first priority projects selected from USE M/P for Granada City.

1.6 Member of the Study Team

The JICA Study Team consisted of the members listed below.

Name	Task/Responsibility
Susumu SHIMURA	Team Leader & Urban Sanitation Environment Plan
Hiroshi KATO	Industrial Wastewater Management & Sewage Treatment Plan
Takeshi TOMIYASU	Solid Waste Management Plan
Ermani de SOUZA COSTA	Water Supply and Sewerage Plan (1)
Gustavo MARTINEZ	Water Supply and Sewerage Plan (2)
Masaharu KINA	Urban Planning/Pilot Campaign
Tadaya YAMAMOTO	Community Participation & Environmental Assessment
Kunio FUJIWARA	Hydrogeology Analysis (1)
Carlos VALLE G.	Hydrogeology Analysis (2) & Environmental Surveys
Jose Felicio HADDAD	Organizational and Institutional Development Plan & Legislation
Kozo BABA	Financial and Economic Analysis
Hiroto HOSAKA	Facility Design & Cost Estimation (1)
Ikuo MORI	Facility Design & Cost Estimation (2)
Precha CHUNTAKORN	Field Surveys
Masami HAYASHI	Administrative Coordinator

2 Present Condition of USE and Selection of a First Priority City

2.1 Profile of the Study Areas

Nicaragua consists of three geographical zones: Pacific Coastal, Central and Atlantic. These zones are further divided into nine regions, administrated by the central government. Furthermore, each region consists of some Departments (Departamentos). However, political and administrative governmental entities are only the Central Government and Municipalities (Region VII and VIII are exceptional). These three cities are located in the Pacific Coastal Zone. Leon and Chinandega belong to Region II whereas Granada belongs to Region IV. Leon, Chinandega and Granada Municipalities are respectively on Leon, Chinandega and Granada Department (Departamentos).

Leon Municipality covers an area of 820 km² with the population of 161,530 (according to the 1995 census) and is the second biggest city in Nicaragua after Managua, the capital. It is the focal point of economic and industrial activities in Region II. Chinandega Municipality (area: 647 km², population: 117,037) is also located in Region II being the fourth biggest city in Nicaragua. The same census shows that Granada Municipality (area: 531 km², population 96,996) ranks as the sixth biggest city and the economic and industrial focal point of Region IV.

The climate in these three municipalities is tropical. Generally the year is divided into two seasons, namely rainy season (from May to October) and dry season (from November to April). Annual precipitation averages about 1,220 mm in Leon, 1,920 mm in Chinandega, and 1,517 mm in Granada. More than 90% of the annual rainfall occurs in the rainy season in these three cities.

The fiscal year of the municipalities is from January to December. In Leon, actual municipal revenue in 1995 was 32.21 million cordobas, 14.6 million cordobas in Chinandega, and 13.07 million cordobas in Granada. Consequently the municipal revenue per person is extremely limited, being C\$ 199 (2,490 yen) per capita in Leon, C\$ 125 (1,560 yen) per capita in Chinandega, and C\$ 135 (1,650 yen) per capita in Granada.

2.2 Field Investigations

The following surveys were carried out in order to identify and understand specific features and key indicators of the USE in the three principal cities:

- Public Opinion Survey (POS)
- Water Quality Survey (rainy season and dry season)
- Water Pollution Loading Survey (WPLS)
- Waste Amount and Composition Survey (rainy season and dry season)
- Industrial Waste Survey (IWS)
- Medical Waste Survey (MWS)

- Inundation Damage Survey

a. Public Opinion Survey (POS)

The results of the POS which polled 240 households (80 households in each city), revealed the following views of residents.

- Additional willingness-to-pay (WTP), expressed by the residents who are already receiving services for water supply, sewerage system, and waste collection for the service improvement is very low and it could be concluded that the present WTP for present services is very near the residents' maximum ability to pay for the services.
- In general, the semi-urban area has more USE problems and greater dissatisfaction toward sanitation services, according to the sampling area (urban, semi-urban, commercial) comparison.

b. Water Quality Survey (WQS)

Three wells in each respective city, which serve as water supply sources, were sampled. River water was also sampled upstream and downstream of the lagoon effluent outfall for respective sewage treatment plants in the cities. The survey indicated slight contamination of some wells in Granada City, which serve as water supply source. Contamination of underground water either by leachate from the La Joya disposal site or by wastewater discharged from the tanneries is highly anticipated.

c. Water Pollution Loading Survey (WPLS)

The Water pollution loading survey was carried out in residential areas, factories, markets, and offices in the three cities. In the residential areas, the survey was carried out in regard to the income level of the residents (high, middle, and low income level). The results show that BOD loading rates were approximately 50 to 59 g/person/day, which coincide with the rate used for the design of sewage treatment plants in the city of Chinandega, 52g/person/day.¹

d. Waste Amount and Composition Survey (WACS)

Waste amount and composition surveys were conducted twice (rainy season and dry season) in the three cities. The following table shows the average waste generation rate found through the surveys.

Table 2-1: Waste Generation Ratio (1996)

Category	Sub-Category	Unit	Average Generation Ratio
Household Waste		g/person/day	675
Commercial Waste	Restaurant	g/restaurant/ day	15,109
	Others	g/shop/day	1,676
Institutional Waste		g/person/day	98
Market Waste		g/shop/day	2,827
Street Sweeping Waste		g/km/day	36,677

¹ Final Report of Study and Design for Rehabilitation of Pumping station and Stabilization Lagoon of Sewerage Service in city of Chinandega, INAA-BID, October 1992.

e. Industrial Waste Survey

Questionnaires were carried out on 10 representative factories in each city after due consultation with the counterparts. Based on the 24 categories of industrial solid waste (ISW) proposed by the Study Team, the aim of the questionnaires was to determine the amount of waste generated and disposed; characteristics of the waste; storage, treatment, and disposal methods. And haulage methods. From the questionnaire results, ISW generation rates (per employee) were calculated, and the total industrial waste generated waste then determined by using the number of employees per industry (CIU). See the table below.

Table 2-2: Estimated Industrial Waste Generation Amount

Unit: ton/year

	Leon	Chinandega	Granada	Total
Industrial Wastewater	91,200	5,500	1,044,500	1,141,200
Industrial Solid Waste	7,400	6,400	1,000	14,800
Total Industrial Waste Amount	98,600	11,900	1,045,500	1,156,000

f. Medical Waste Survey (MWS)

Questionnaires were carried out on 17 representative medical institutions (5 in Leon, 6 in Chinandega, and 6 in Granada) after due consultation with the counterparts. Based on the medical waste categories proposed by the Study Team, the aim of the questionnaires was to determine the amount of medical waste generated and disposed; characteristics of the waste; storage, treatment, and disposal methods; and haulage methods. From the questionnaire results, medical waste generation rates (per bed) were calculated, and the total medical waste generated waste the determined by using the number of beds per medical institution. See the table below.

Table 2-3: Estimated Medical Waste Generation Amount

Unit : ton/year

	Leon	Chinandega	Granada	Total
Risky Waste	54.5	13.5	9.9	77.9
Hazardous Waste (Chemical, Radioactive)	2.3	1.1	0.6	4.0
Common Waste	50.8	20.5	9.1	80.4
Total Medical Waste Amount	107.6	35.1	19.6	162.3

g. Inundation Damage Survey

Two households from areas within the respective municipalities considered prone to inundation were surveyed. The number of households surveyed and those damaged by inundation are shown in the table below.

Table 2-4: Survey Results

City	Inundation Prone Areas		Households Interviewed	
	Surveyed	Damage Reported	Surveyed	Damage Reported
Leon	15	15	30	28
Chinandega	10	8	20	15
Granada	3	3	6	6
Total	28	26	56	49

2.3 The Present USE

First of all, relevant organizations and their jurisdictions regarding USE are summarized in Table 2-5 in order to understand the present condition of USE in Nicaragua. Then, current water supply management, domestic wastewater management, industrial wastewater management, stormwater management, and solid waste management of three cities are summarized in Tables 5-2, 5-3, 5-4, 5-5, 5-6 in the Volume II: Main Report for the M/P and Conceptual M/Ps.

Table 2-5: Relevant Organizations and their Jurisdictions regarding USE

Fields Items	WATER SUPPLY	WASTE WATER			SOLID WASTE				
		Domestic Wastewater		Industrial	Stormwater	Domestic SW	Industrial		Medical
		On-site	Off-site				NHW	HW	
Consolidation of Regulations/ Norms	INAA	MNSA Municipality	INAA MARENA (2)	MARENA INAA	Municipality MNSA	MARENA MNSA Municipality	MARENA MNSA Municipality	MARENA MNSA	MARENA MNSA
Monitoring and Guidance	INAA	MNSA Municipality	MARENA INAA	MARENA INAA (6)	Municipality MNSA	MNSA Municipality	MARENA MNSA Municipality	MARENA MNSA	MARENA MNSA
Financial Management	Decree 32-95	N. E.	Decree 32-95	Decree 32-95	N. E.	Municipality	Generator (8) Municipality	Generator (8)	N. E.
Permission for Facility Construction	INAA (1) MARENA (2) MCT (3)	MNSA Municipality	MARENA (2X5) INAA (6) MCT (3)	MARENA (2X5) INAA (6)	N. E.	MARENA (2) Municipality	MARENA (2) Municipality (7)	MARENA Municipality (7)	MARENA MNSA Municipality (7)
Planning of Projects	INAA/ ENACAL	Generator Municipality (4)	INAA/ ENACAL MCT (3)	Generator INAA/ ENACAL MARENA (5)	Municipality	Municipality	Municipality Generator	Generator	Generator
Implementation of Projects	INAA/ ENACAL	Generator Municipality (4)	INAA/ ENACAL	Generator INAA/ ENACAL	Municipality	Municipality	Municipality Generator	Generator	Generator

Note : (1) Technical aspect (4) If a collective project (7) Land usage
 (2) Environmental aspect (5) Discharge into natural waterway (8) Not expressed but traditionally: expressed for mining
 (3) Politic evaluation (6) Discharge in sewage system N.E. = Not Established
 NHW = Non-hazardous Waste NIW = Non-infectious waste
 HW = Hazardous Waste

2.4 Evaluation of the Present Conditions of USE

2.4.1 Water Supply Management

The coverage rate of potable water supply in the areas, of the three cities subject to the Study, ranges from 74% to 92%. Present figures for Leon and Granada exceed the national average coverage for urban areas. (i.e., 80.7% in 1995)² Moreover, they exceed the INAA's planned national urban coverage for 2002 (i.e., 85%). As for the water consumption in the three cities, it ranges from 139 to 148 liter/person/day. These rates exceed or are equal to the national average for urban areas (i.e., 139 liter/person/day). Although problems of low water pressure remain in some areas, these figures (coverage and consumption) indicate the water supply management in the study areas have achieved a certain satisfactory level of service.

The institutional system of INAA, which exercises authority over water supply systems, is well organized. With aid from foreign countries, including Japan, nationally, the average water supply coverage of 55.2% (1995) extremely high for a developing country. In the principal cities in Nicaragua, most households have taps, even in the urban fringe area (UFA), which is composed of low income residents. This can be valued as the outcome of the story efforts made by the Nicaraguan Government and people concerned with INAA. Moreover, water charges collected make up 98% of the total bill, implying that INAA is financially sound.

2.4.2 Wastewater and Stormwater Management

a. Domestic Wastewater Management

As for domestic wastewater management, although the sewer coverage of Granada (22 %) is below the national average for urban areas (34.2% in 1995), Chinandega (34 %) is equal to it and Leon (55 %) surpasses it. The rate of Leon even exceeds INAA's planned national coverage in 2002 (i.e. 40 %). Consequently, it can be said that the current sewer coverage of Chinandega and Leon are at a reasonable level.

Regarding no-sewer areas, the night soil is in general managed properly by means of septic tanks, latrines, etc. 7.4%, 10.6%, and 10.9% respectively in Leon, Chinandega, and Granada do not have toilet systems.

The sullage in the no-sewer areas is generally discharged to roadsides and watercourses without treatment, despite the several experimental efforts observed in Leon City. This is one of the causes for the deterioration of the USE.

Although INAA's authority includes sewer systems as well as water supply systems, sewer coverage is very low compared with water supply coverage. In comparison with other developing countries, water consumption and water supply coverage are extremely high in these three cities so that the treatment of the generated wastewater is a critical issue for the USE, which needs to be solved urgently. Moreover, the collection rate of sewerage charges is 98%, same as water supply, as it is collected jointly with the water charges. Therefore, INAA's sewer management is also financially sound. However, the fees are partially collected from areas where sewer

² Normalization Management of INAA (July/96)

systems are not yet provided. So sewer systems to these areas should be provided urgently.

As a result, INAA actively pursuing financing (e.g., from IDB) for studies and also sewer system expansions based on existing long-term plans. However, for recently populated UFAs, there exist no plan (sewer provision or other alternatives) for domestic wastewater management.

Hence, in order to improve of domestic wastewater treatment rate (including UFA) in the future, considerable financial burden sharing will be required.

b. Industrial Wastewater Management

Even though 88% of industrial wastewater in three cities contains "hazardous substances" to a varying degrees, 99% is discharged into sewers/watercourses or soaks into the ground without treatment. The proportions of industrial wastewater generation by Leon, Chinandega, and Granada are 10%, 1%, and 89% respectively. Granada, the city with the smallest population, generates a great amount of industrial wastewater, which consequently is discharged into the public water courses and/or soaks into the ground without treatment.

Since legislation regarding industrial wastewater has only been established recently, detailed regulations and technical instructions to support it have not yet been prepared. Moreover, MARENA's organizational system is insufficient to regulate or administer industrial wastewater. Dischargers are not aware of the necessity to control the generation of wastewater and discharge it following appropriate treatment. As a result, currently industrial wastewater is discharged without treatment, ignoring its effects on the environment. Thus it is becoming a major cause of USE deterioration. In order to establish a suitable industrial wastewater management system, factory improvements and the enforcement of regulations at every level are vital. However, priority should be given to the establishment of controls (by factories) and monitoring (by authority) of hazardous industrial wastewater (e.g., chromium effluent).

c. Stormwater Drainage Management

In addition to the outcome of the Inundation Damage Survey, the POS showed that 25 to 28% of citizens suffer from inundation in their daily lives. Consequently, it is revealed that stormwater drainage management is of great concern for citizens. Especially in the northern area of Chinandega, where flooding along the highway to Somotillo, observed by the Team was significant and caused considerable damage (to both roads and houses) to the community. The causes for the inundation damage are as follows:

- The main cause is the insufficient drainage capacity of existing drains and also it is partly due to the construction of inappropriate facilities.
- Moreover, there are some cases where damage is caused by poor maintenance of drains such as clogging of channels.
- Furthermore, changes in run-off characteristics of the catchment area resulting from the alteration of the land use (deforestation, construction of houses, etc.)

can be another cause. Especially, the was the case is Chinandega Municipality, mentioned above, where there is a relatively large watershed.

The reason why the municipalities can not effectively deal with inundation damage is because no framework for the improvement of stormwater treatment have yet to be established.

- Stormwater drainage management plan has not formulated.
- There are no guidelines for formulating stormwater management plans.
- Organizational systems necessary for formulating stormwater drainage management plans and improving them are not yet fully established in the respective cities.
- Financial resource to construct or maintain stormwater drainage management facilities is not sufficient.

Moreover, some drainage channels cross over into other municipalities (Macro-drainage). Since macro-drainage plans need to take into account wide areas, it is desirable for the central government as the coordinating institution, to administer the plan. However, in reality, each city formulates drainage plans only for their own municipality. That is to say, it is necessary to examine and establish systems which respectively administer and manage micro-drainage (which covers only its own municipality) and macro drainage (which spans watersheds of other cities).

Regarding micro-drainage, although jurisdiction over stormwater drainage management (the municipality) and wastewater management (INAA) is clearly defined, a number of operational and administrative problems arise due to the connection of stormwater to wastewater sewers and vice-versa. As a solution to these problems, it is indispensable for both INAA who administer wastewater and the respective municipalities which administer stormwater to fully understand each other's plans and coordinate them.

2.4.3 Solid Waste Management

a. Municipal SWM

As for municipal solid waste management, varying levels of refuse collection system (i.e., collection rate in Leon, Chinandega, and Granada being 80%, 51%, and 63% respectively) exists in each city, despite poor collection vehicles and equipment. However, given that there are high occurrences of illegal dumping (Leon: 9.0 ton/day, Chinandega 8.9 ton/day, and Granada 7.8 ton/day) and citizen's complaints expressed through the POS (Leon 58%, Chinandega 28%, and Granada 43% replied that waste negatively impacts their daily lives), further improvement of the collection system are required in these three cities.

On the other hand, final disposal systems are very poor in the three cities. Especially the locations of the final disposal site. Serious negative impacts not only on USE (e.g., agricultural land contamination in Leon, river water contamination in Chinandega, underground potable water source contamination in Granada, etc.), but also landscape deterioration due to waste in Leon. The construction of new final

disposal sites in appropriate locations should be given priority in regard to municipal solid management in the three cities.

The major cause of the poor municipal SWM technical system of illustrated by the practices and location of disposal sites rests with the weak institutional system. The collection rate of the waste collection fee, which is a vital source of finance for the operation of municipal solid waste management, is extremely low being 36.5% in Leon, 27.9% in Chinandega, and 16.3% in Granada. Moreover, institutional system of each city is not sufficient, and especially, planning of SWM (including service improvement) is non-existent, except in Leon. It can be said that this leads to the inappropriate location of the disposal sites. Public education and participation are indispensable for sound municipal solid waste management. However, campaign activities related to the enhancement of public awareness in order to gain residents' cooperation is insufficient.

b. Industrial SWM

The total generation amount of industrial solid waste (ISW) in the three cities is estimated to be 12,000 ton/year (33 ton/day), where municipal SW generation was estimated to be 235 ton/day. The generation of ISW is small in comparison with "industrial wastewater". A majority of ISW could potentially become a source of organic contamination. Seven percent of present ISW generated is assumed as "hazardous" and is disposed of in municipal landfill sites, etc. without any controls.

The administrative system to monitor and give guidance to industries regarding ISW as well as the legislation to regulate it, are not established yet as was observed in the section on industrial wastewater management. Dischargers do not realize the importance of controlling the industrial waste generation and its proper treatment. The establishment of an appropriate ISWM system requires improvements in every aspect.

Whereas non-hazardous ISW has, in general, smaller possibility of causing non-restorable serious environmental pollution, hazardous waste may possibly cause such serious environmental pollution. Therefore, considering that shortages of financial and human resources in administrative bodies do not allow for effective management over the disposal treatment of ISW, the establishment of management and monitoring system for hazardous waste shall be given a priority.

c. Medical SWM

Medical SWM plans do not exist either at the national or municipal level. Neither is their a "code of practice" for medical SW consisting mainly of infectious and hazardous waste. That is to say, the administrative system to promote appropriate medical SWM and to monitor and give guidance is not established yet.

The majority of infectious/hazardous medical waste, not separated in many medical institutions, is collected and disposed by municipal services. Education and/or training of employees in medical institutions are not being provided or is limited only to the induction period.

The important thing in regarding medical SWM is how to establish an appropriate management system for infectious/hazardous medical waste, where the amount is very small, but very dangerous. Not only the establishment of legislative and

administrative systems, which regulate, monitor and give a guidance on medical SWM, but also the establishment of a system to encourage waste separation and treatment of the wastes by each medical institution is urgent and vital.

2.5 Selection of the First Priority City

2.5.1 Criteria for Selection of the First Priority City

a. Objectives of Selecting a First Priority City

The objectives of the selection of a first priority city are:

- To concentrate the limited resources and time of the Study into one city (from the 3 geographically distant) for the formulation of an M/P and an F/S, in order to complete the Study in the most effective manner, in view of the Japanese Government aid's policy which supports self-help efforts of recipient countries; and
- To formulate conceptual M/Ps to level sufficient to encourage self-help efforts of the other two cities for formulating M/P and F/S by themselves.

In other words, even though the formulation of M/P and execution of F/S are limited to the first priority city, the Study should contribute to the improvement of the urban sanitary environment (USE) of three cities which is the original objective of the Study.

b. Evaluation Items

Based on the above objectives, principal evaluation items for the selection were set up as shown in the table below after due consultation with counterparts.

Table 2-6: Structure of Evaluation Items for the Selection of the First Priority City

Principal Evaluation Items	Key Evaluation Components	Detailed Evaluation Elements
Needs in formulating M/P	<ol style="list-style-type: none"> 1. Urgent needs in improvement of the USE (seriousness of current outstanding problems) 2. Absence of plans 3. Problems caused by the lack of the plans 4. Planning deficiency 	<ol style="list-style-type: none"> 1. Contamination of drinking water and surface/ground water, inundation, public nuisance (offensive odor, etc.), outstanding adverse impacts on fishery/agriculture, landscape, tourism, fauna/flora, needs expressed by citizen. 2.1 City development M/P 2.2 Water supply sector 2.3 Sewage sector (sewerage and other domestic wastewater, industrial wastewater, stormwater management) 2.4 SWM sector (municipal, industrial and medical SWM) 3.1 No industrial wastewater management plan 3.2 No stormwater management plan 3.3 No SWM plans 4.1 Resource insufficiency in municipality's planning (manpower and budget of planning department) 4.2 External planning supports (foreign and institutional assistance)
Economic Benefits expected	<ol style="list-style-type: none"> 1. Economic benefits expected in USE sectors 2. Economic benefits expected other than in USE sectors 	<ol style="list-style-type: none"> 1.1 Prevention of future losses and remediation (contamination of drinking water and surface/ground water, inundation, public nuisance) 2.1 Prevention of future losses (fishery/agriculture, landscape, tourism, fauna/flora)
Social Welfare Contribution	<ol style="list-style-type: none"> 1. Social equity 2. Health indicators 	<ol style="list-style-type: none"> 1.1 Coverage rate of water supply, sewerage, toilets, refuse collection and stormwater drainage 1.2 Foreign aid and subsidy from central government per citizen 1.3 USE expenditure in sector per citizen 1.4 Beneficial impact on vulnerable people (GDP, unemployed rate, etc.) 2.1 Neonatal and maternal mortality rate 2.2 Morbidity/mortality rate of major epidemics 2.3 Health damage due to poor USE facilities
Capability to implement Relative Projects	<ol style="list-style-type: none"> 1. Financial capability of executing body and citizen 2. Administrative implementation capability 	<ol style="list-style-type: none"> 1.1 Financial capability of executing body (budgets, etc.) 1.2 Financial capability of citizens (tax payment, willingness to pay according to the POS) 2.1 Administrative capability of municipality 2.2 Administrative capability of receiving foreign/domestic support

2.5.2 Selection of a First Priority City

a. Evaluation Principles

Because there are various authorities involved with the USE improvement plans, one of evaluation method could be to evaluate the necessity of an M/P on the basis of view points from the authorities. While the M/P includes several sectors such as water supply and sewerage, that are not under the jurisdiction of the municipality, the M/P itself aims to improve the USE in the selected city. Therefore, this evaluation examined to the comparative situation of the three cities.

Meanwhile, the information on which this evaluation is based was obtained by the Team during the First Work in Nicaragua (i.e., presented in the Progress Report (1) and related comments from counterparts).

Furthermore, it is not intended that evaluation items cover all aspects of the three cities and limited so far as to what are related to the USE situation in three cities.

b. Outcome of the Evaluation

The outcome of the evaluation is classified into the following three cases and analyzed. Respective cases assume different point weighting.

Case-1	Point weighting rule follows that of Progress Report (1): Needs for formulating M/P (50 points), Economic benefit expected (20 points), Social welfare contribution (20 points), and Capability to implement relative projects (10 points).
Case-2	4 principal evaluation items receive equal weighting i.e.: Needs for formulating M/P (25 points), Economic benefit expected (25 points), Social welfare contribution (25 points), and Capability to implement relative projects (25 points).
Case-3	Without weighting on principal evaluation items, all "detailed evaluation elements" receive same weighting.

The result of the evaluation is as follows;

Case 1	Granada 71.9, Chinandega 60.9, Leon 56.3
Case 2	Granada 65.7, Leon 59.0, Chinandega 55.3
Case 3	Granada 82, Chinandega 71, Leon 64

From the above results, the Study Team proposed Granada City as the First Priority City, and Nicaraguan side agreed with this proposal.

3 M/P and Conceptual M/Ps for USE

3.1 Difference between M/P and Conceptual M/P

The USE M/P was formulated for Granada City, selected as the priority city, and conceptual USE M/Ps were formulated for Leon and Chinandega. As stated in Section 2.5.1 above, the objectives of the conceptual M/P's is to encourage Leon and Chinandega to formulate an M/P and then carry out an F/S of priority projects on their own. The difference between an M/P and the conceptual M/P formulated in the Study is summarized below.

- 1) Regarding water supply management, there is no difference between the M/P and conceptual M/P as these plans are based on the existing plans of INAA.
- 2) Regarding the wastewater management and the municipal solid waste management, the following items are examined in M/P, but not in the conceptual M/P.
 - Site selection and layout plan for major facilities, ;
 - Preliminary design of the facility and equipment;
 - Cost estimation for M/P;
 - Examination of financial plan;
 - Evaluation of M/P
- 3) Regarding industrial waste management (both wastewater and solid waste), medical waste management, and stormwater management, only recommendations for their improvements were given in both the M/P and conceptual M/Ps.

3.2 USE Conceptual M/P for Leon

3.2.1 Planning Framework

a. Goals

The principal goal of the conceptual M/P for Leon is to improve the urban sanitation environment (USE) of Leon City by the target year 2010. Leon is the major economic and population center of Region II.

Through the improvement of the USE in Leon City, the plan aims to:

- ◆ Promote the citizens' well-being;
- ◆ Support sustainable development of the city; and
- ◆ Contribute to the growth of the regional economy.

b. Targets

Target years were set as follows:

Master Plan: Year 2010

Feasibility Study: Year 2005

In order to achieve the principal goals of the M/P, target figures in the three major USE sectors are set up as indicated in the table below.

Table 3-1: Target Figures of Technical System (Leon City)

	Present(1995/96)	F/S(2005)	M/P(2010)
Water Supply Coverage	92.2 %	85 %	85 %
Domestic Wastewater Treatment			
Sewer coverage	55.3 %	60 %	65 %
On-site system coverage	2.1 %	7 %	12 %
Latrine only system	35.2 %	29 %	23 %
No system	7.4 %	4 %	0 %
Waste Collection Coverage			
Collection rate of all waste	86.7 %	95 %	100 %
Collection rate of household waste	80.0 %	94 %	100 %

Note: The INAA established a target water supply coverage rate of 85% for the whole urban population. The target figure is set up in accordance with the INAA's target. Consequently, the coverage rates for the year 2005 and 2010 is lower than 92.2%, the rate of 1995/1996. However, the supplied population in 2005 will be about 1.6 times more than that in 1995/1996 and that in 2010 will be about 1.8 times.

c. Strategies

Strategies to reach the goals and targets should, in practice, be deployed in a stepwise manner toward the target year of 2010. Therefore, it is recommended herewith to divide the period to the target year of 2010 into three phases.

Table 3-2: Strategies for the Realization of the USE M/P (Leon City)

Classification Phase	Technical Aspects	Institutional Aspects
Phase I (1998 - 2000) Preparation for Priority Projects Implementation	<p>Common Aspects</p> <ul style="list-style-type: none"> • An USE M/P should be urgently formulated and F/S on priority projects should be conducted along with the M/P. <p>Water Supply System</p> <ul style="list-style-type: none"> • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • In order to execute the priority projects (F/S projects), the required funds should be secured and the detailed design of the projects shall be conducted. • As for sewer areas, connection to sewers should be promoted, and system improvements necessary for maintaining the present sewer coverage (55.3%) should be provided. • As for the non-sewer areas, F/S for introducing on-site DWW treatment system should be carried out, referring PECM (Special Program for Model Community Integrated USE Improvement Project) in Granada. In order to prepare for such projects, public education program should be deployed to encourage citizens' environmental consciousness. <p>Stormwater Management</p> <ul style="list-style-type: none"> • Technical guidelines necessary for stormwater management should be prepared. • Basic investigations (e.g., topographical surveys) for inundation prone areas should be conducted for planning the improvement and recurring necessary funds. • Rain drainage in urban fringe areas (UFA) should be improved, referring PECM in Granada. <p>Municipal SWM</p> <ul style="list-style-type: none"> • A site for a future municipal SW final disposal site should be selected from some candidate sites. Its preliminary design and the environmental impact assessment (EIA) should be carried out. • In order to execute the priority projects (F/S 	<p>Common Aspects</p> <ul style="list-style-type: none"> • Regulations of wastewater discharge into sewer/public water body should be legally and practically enforced. • The municipality should provide norms and guidelines regarding USE to the citizens, from which citizens should easily understand appropriate sanitary practices and civil procedures. • Appropriate land use management should be further promoted along with the present urban development plan. Meanwhile, a cadastre of real property and public services should be established. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • Guidelines for appropriate on-site DWWM should be elaborated. • INAA, MINSA and the municipality should, referring PECM in Granada, coordinate to establish a steering committee for PECM in Leon necessary for introducing on-site DWW treatment system and to seek foreign and domestic grants for such projects. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Authoritative competency for stormwater management (planning, maintenance and repair) should be reviewed respectively for macro- and micro- drainage. • INAA, MINSA and the municipality should, referring PECM in Granada, coordinate to establish a steering committee for PECM in Leon necessary for improving rain drainage in UFA and to seek foreign and domestic grants for such projects. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Regulations on urban cleansing should be established to clarify municipality's powers (including placing penalties) and duties as well as citizen's rights and duties. • The municipality should improve

	<p>projects), the required funds shall be secured and the detailed design of the projects shall be conducted. Then, construction of the facilities and procurement of vehicles and equipment shall be done.</p> <ul style="list-style-type: none"> Technically satisfactory level of sanitary landfill operation should be maintained in the present landfill until its closure, in order to reduce the pollution impacts to the environment. Meanwhile, illegal dumping should be reduced through improved collection services. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> Based on the "polluter pays principle", industries should be instructed to implement appropriate on-site management of their solid/liquid wastes and residual water. <p>Medical Waste Management</p> <ul style="list-style-type: none"> Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be promoted. 	<p>collection of municipal taxes and charges for the services.</p> <p>Industrial Waste Management</p> <ul style="list-style-type: none"> Waste classification suited for Nicaraguan authorities' present IWM should be established. Management of hazardous waste should be prioritized. Inventory of factories and their waste generation should be made for identifying ISW and IWW. With regard to ISWM and IWW, authorities should be empowered to conduct administrative measures such as monitoring, supervision and guidance. <p>Medical Waste Management</p> <ul style="list-style-type: none"> Classification of medical waste should be established. Code of practice for respective medical waste categories should be formulated.
<p>Phase 2 (2001 - 2005) Priority Projects Implementation</p>	<p>Water Supply System</p> <ul style="list-style-type: none"> The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> Facilities and equipment provided in Phase-1 should be operated and maintained appropriately. In order to prepare for M/P projects, designs and funds recruitment for the projects should be prepared. Then, facilities construction should be implemented. Sewer provision should be improved to attain the target coverage of 60%. In the non-sewer area citizens' participation in the "model communities integrated USE improvement" projects should be substantiated in order to sustain the projects in affordable and appropriate levels. Meanwhile coverage rate of on-site system should be raised to 7%. <p>Rain Water Management</p> <ul style="list-style-type: none"> Drainage should be improved in accordance with Flood Damage Area Improvement Plan. Integrated Arroyo Management Plan 	<p>Common Aspects</p> <ul style="list-style-type: none"> The norms and guidelines regarding USE provided by the municipality should be demonstrated through public education programs in order for the citizens to practice appropriate sanitation measures and civil procedures. The urban development plan should be further utilized to guide and to restrict the land use, in order to maintain a preferable urban environment (e.g., protect potable water sources of the city, regulate industrial activities and NIMBY facilities in designated areas). The cadastre of real property and public services, perhaps applying crossed subsidies, should be utilized for establishing the management system on USE services and also promoting a Beneficiary-Pay Principles for the services. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> PECM steering committee should further seek foreign and domestic grants for constructing on-site DWW treatment projects.

	<p>(comprising: land use regulation; catchment conservation with reforestation; and drainage channel improvement) should be formulated.</p> <ul style="list-style-type: none"> • Rain drainage in UFA should be further improved through PECM. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Facilities and vehicles acquired in Phase-1 should be appropriately operated and maintained. • Technically satisfactory level of sanitary landfill operation should be maintained in the new landfill. Meanwhile, illegal dumping should be further reduced through improved collection services. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • On-site ISWM and IWWM should be further strengthened. • Treatment/disposal by private sectors, mainly for hazardous waste, should be implemented. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be obligated. • Treatment/disposal of hazardous/infectious medical waste should be implemented by private sectors. 	<p>Rain Water Management</p> <ul style="list-style-type: none"> • Respective institutional system (e.g. funds, design guidelines) for macro- and micro-drainage should be established. • PECM steering committee should further seek foreign and domestic grants for constructing rain drainage facilities. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Authorities should encourage recycling activities by waste generators and private recyclers. However, the administrative support should be such a manner with least financial burden on authorities. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Legislative framework to obligate appropriate IWM (e.g., manifest system) should be established. • With regard to ISWM and IWWM, authorities should practice administrative measures (e.g., monitoring, supervision and guidance) and apply penalties (if necessary) against illegal measures by industries. • Formulation of commercial mechanism for appropriate treatment/disposal should be promoted. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Code of Practice on medical waste management should be enforced.
<p>Phase 3 (2006 - 2010) M/P Projects Implementation</p>	<p>Water Supply System</p> <ul style="list-style-type: none"> • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • The M/P projects should be reexamined and implemented, with reference to the outcome of the priority projects (F/S projects). • As for sewer area, the off-site system should be consolidated to maintain target coverage of 65% of the population. • As for no sewer area, the on-site system should be consolidated to maintain target coverage of 12% of the population. 	<p>Common Aspects</p> <ul style="list-style-type: none"> • Public education programs related with the norms and guidelines regarding USE provided by the municipality should be deployed widely. • The urban development plan should be put in practice to restrict the land use, in order to maintain a preferable urban environment. Meanwhile the plan should serve for planning USE services corresponding to the urban expansion and the population increase therein. <p>Water Supply System</p> <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • PECM steering committee should raise

	<ul style="list-style-type: none"> • As for area served with "model communities integrated USE improvement" projects, self-help of communities should be employed in operation and maintenance of the facilities. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Reforestation, drainage improvement works, etc. should be implemented in accordance with Integrated Arroyo Management Plan. • Rain drainage facilities in UFA should be further constructed through PECM. <p>Municipal SWM</p> <ul style="list-style-type: none"> • The M/P projects should be reexamined and implemented, with reference to the outcome of the priority projects (F/S projects). • Satisfactory municipal SWM both technically and environmentally should be continued. In maintaining 100% waste collection rate, illegal dumping should be eradicated. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Industries should take initiatives for introducing "waste minimization and cleaner production" technologies for their production. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate collection, treatment and disposal should be practiced for all medical waste (including hazardous and infectious ones). 	<p>funds for constructing on-site DWW treatment projects, from water and wastewater charges collected.</p> <p>Rain Water Management</p> <ul style="list-style-type: none"> • PECM steering committee should raise funds for constructing rain drainage facilities, from automobile taxes etc. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Introduction of separate collection system should be examined in order to promote waste minimization and resource recovery from waste. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Authorities should promote introduction of "cleaner production" mainly for factories that generate hazardous waste. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate control, treatment and disposal of medical waste should be enforced in line with the Code of Practice for Medical Waste Management.
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3.2.2 USE Conceptual M/P for Leon

a. Forecast of Future USE Service Demands

Based on the target figures of technical system in Leon City indicated in Table 3-1, future demands forecast with regard to respective sectors related with USE was carried out and the result was summarized below.

Table 3-3: Forecast of Future USE Service Demands (Leon City)

Item	Present	(2000)	F/S(2005)	M/P (2010)
1. Area and Population	(year 1995)			
Area				
City total (km ²)	820	820	820	820
Projected Service Area (km ²)	19.1	27.0	35.0	43.0
Population				
City total	161,530	224,295	257,084	292,511
Service Projected Area	123,865	183,519	213,156	245,421

Item	Present	(2000)	F/S(2005)	M/P (2010)
2. Water Supply System	(year 1995)			
Water supply coverage area	14.4 km ²			
Supplied population	114,199	155,991	181,183	208,784
Coverage (to population)	92.2%	85 %	85 %	85 %
Water production (m ³ /y)	10,599,899	18,418,995	19,983,385	19,718,395
Water production rate (l/p./day)	254.3	324(267*)	259 (213*)	259 (213*)
Efficiency	58 %	60 %	65 %	75 %
Water consumption rate (m ³ /y)	6,185,190	11,051,470	12,834,130	14,789,070
Water consumption ratio (l/p./day)	148.4	194(160*)	194 (160*)	194 (160*)
3. Domestic Wastewater System	(year 1995)			
3.1. Sewer System Area				
Served area	9.45 km ²			
Service population	68,510	101,486	129,280	159,658
Coverage (to population)	55.3 %	55.3 %	60.2 %	65 %
Treated amount (m ³ /day)	15,515	16,136	20,504	25,321
3.2 No-Sewer System Area				
On-site system coverage	2,601 person, 2.1 %	3,854 person 2.1 %	14,920 person 7 %	29,450 person 12 %
Latrine system coverage	43,588 person 35.2%	64,599 person 35.2 %	62,029 person 29 %	56,447 person 23 %
No system	9,166 person 7.4 %	13,580 person 7.4 %	7,887 person 4 %	0 0 %
4. Municipal SWM	(year 1996)			
Population in the study area	133,997	183,519	213,156	245,421
Waste generation amount (ton/day)	102.1	147.5	186.6	230.7
Waste discharge amount (ton/day)	67.9	101.1	132.6	169.9
Waste collection amount (ton/day)	58.9	87.7	126.0	169.9
Final disposal amount (ton/day)	60.0	88.3	128.9	173.0
Coverage (to waste amount) (%)	86.7	87	95	100
Coverage (to population) (%)	80.0	80	94	100
Served population	107,198	146,816	200,436	245,421
Non served population	26,799	36,703	12,720	0
Length of sweeping served road (km)	55	55	107	135
5. Medical SWM	(Year 1996)			
Medical waste generation	295 kg/day	399 kg/day	463 kg/day	533 kg/day
Non-hazardous waste generation	139 kg/day	188 kg/day	218 kg/day	251 kg/day
Infectious waste generation	151 kg/day	204 kg/day	237 kg/day	273 kg/day
Other hazardous waste generation	5 kg/day	7 kg/day	8 kg/day	9 kg/day

Note *: These figures exclude commercial and industrial water use.

b. Economic and Financial Indicators

Key economic and financial indicators employed in the Conceptual M/P are shown in Table 3-4.

Table 3-4: Economic and Financial Indicators in the Conceptual M/P (Leon City)

	Unit	1995	2000	2005	2010
GRDP	C\$ million	700.7	924.1	1,179.4	1,421.2
Numbers of households	Units	21,907	32,481	37,727	43,437
Average Income per household	C\$/year	15,708	13,972 ^{*1}	15,353	16,068
Budget of INAA Region II (Leon)	C\$ 1,000	17,926	21,614	24,578	28,170
Budget of Leon Municipality	C\$ 1,000	32,213	42,482	54,219	65,335

Note: *1 Since growth rate (between 1995 and 2000) of household numbers is considerably larger than the growth rate of GRDP, average income per household is forecast to decline substantially between 1995 and 2000.

c. Conceptual M/P

Based on the planning framework and the planning indicators (e.g., forecast key indicators, and economic and financial indicators) above, the USE Conceptual M/P for Leon was summarized in Chapter 10 in Main Report for the M/P and Conceptual M/Ps: Volume II.

3.2.3 Recommendations

a. Formulation of M/P and Implementation of F/S

The USE Conceptual M/P outlined herewith should serve as a solid base for formulating a M/P. Therefore, it is necessary that Leon Municipality should formulate a USE M/P based on the conceptual M/P, and carry out an F/S for priority projects identified in the M/P in order to justifying the project realization.

b. Improvement of Regulations, Instructions, and Administrative Guidelines

In order to improve administrative ability of the Municipality, it is extremely important to establish regulations and technical guidelines to support it. There are "individual" norms and "combined" norms in these regulations and technical guidelines. This is stated in the "Institutional improvement proposal" in the M/P for Granada. Leon Municipality should establish necessary regulations and technical guidelines in cooperation with institutions related with Central Government in order to improve USE, referring to this proposal.

c. Improvement of Organizational System

It is indispensable to strengthen organizational system of the Municipality in order to promote the improvement of USE, which covers diverse areas, with limited budget and human resources. This point is stated in "Institutional Improvement Proposal" in the M/P for Granada, and "Organizational System Improvement Proposal for the implementation of priority projects". Leon Municipality should improve its

organizational system in order to promote the improvement of USE, referring to this proposal.

d. Construction of A New Municipal SW Disposal Site

USE of Leon Municipality has various problems. Among others, the location of present municipal SW disposal site (ruin the beauty of the city, contamination of agricultural land, etc.) requires an urgent solution. Therefore, Granada Municipality should construct a new Municipal SW disposal site as soon as possible and close present disposal site, adopting the site selection methods, planning, and EIA etc. adopted by the Study Team in the SJV A New Municipal SW Disposal Site Development Project for Granada Municipality.

e. Improvement of USE in UFA

In Leon Municipality, UFA spreads around the city center, which is relatively improved areas, as is the case in Granada City. USE of UFA is not established sufficiently except for water supply system. Improvement of USE of UFA is the important issue to realize social fairness and stability. Therefore, Leon Municipality should promote the improvement of USE of UFA, referring to the "On-site Domestic Wastewater Treatment System Improvement Project" and "Rain Water Drainage Project" adopted by the Study Team for "Model community Integrated USE Improvement Project" for Granada Municipality.

3.3 USE Conceptual M/P for Chinandega

3.3.1 Planning Framework

a. Goals

The principal goal of the Conceptual M/P for Chinandega is to improve the USE of Chinandega City, a focal point of economic and industrial activities of Region II, by the target year 2010.

Through the improvement of the USE in Chinandega, the plan aims to:

- ◆ Promote the citizens' well-being;
- ◆ Support Sustainable development of the city; and
- ◆ Contribute to the growth of the regional economy.

b. Targets

Target years were set based on the S/W of the Study as follows:

Master Plan: Year 2010

Feasibility Study: Year 2005

In order to achieve the principal goals, target figures in the three major USE sectors are set as indicated in the table below.

Table 3-5: Target Figures of Technical System (Chinandega City)

	Present(1995/96)	F/S(2005)	M/P(2010)
Water Supply Coverage	74.0%	85%	85%
Domestic Wastewater Treatment			
Sewer coverage	33.6%	49.3%	65%
On-site system coverage	4.0%	8.0%	12%
Latrine only system	51.8%	37.4%	23%
No system	10.6%	5.3%	0%
Waste Collection Coverage			
Collection rate of all waste	81.6%	90%	100%
Collection rate of household waste	51.0%	88%	100%

c. Strategies

Strategies to reach goals and targets should, in practice, be deployed in a stepwise manner toward the target year of 2010. Therefore, it is recommended herewith to divide the period to the target the year of 2010 into three phases.

Table 3-6: Strategies for the Realization of USE M/P (Chinandega City)

Classification Phase	Technical Aspects	Institutional Aspects
Phase 1 (1998 - 2000) Preparation for Priority Projects Implementation	<p>Common Aspects</p> <ul style="list-style-type: none"> A USE M/P should be urgently formulated and F/S on priority projects should be conducted along with the M/P. <p>Water Supply System</p> <ul style="list-style-type: none"> The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> In order to execute the priority projects (F/S projects), the required funds should be secured and the detailed design of the projects shall be conducted. As for sewer areas, connection to sewers should be promoted, and system improvement necessary for maintaining the present sewer coverage (33.6%) should be provided. As for the non-sewer areas, F/S for introducing on-site DWW treatment system should be carried out, referring PECM (Special Program for Model Community Integrated USE Improvement Project) in Granada. In order to prepare for such projects, public education program should be deployed to encourage citizens' 	<p>Common Aspects</p> <ul style="list-style-type: none"> Regulations on wastewater discharge into sewers/public water bodies should be legally and practically enforced. The municipality should provide norms and guidelines regarding USE to the citizens, so that citizens should easily understand appropriate sanitary practices and civil procedures. Urban development plan of the city (at least including the land use regulations) should be prepared. Meanwhile, a cadastre for real property and public services should be established. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> Guidelines for appropriate on-site DWWM should be elaborated. INAA, MINSA and the municipality should, referring PECM in Granada, coordinate to establish a steering committee for PECM in Chinandega necessary for introducing on-site DWW treatment system and to seek foreign and domestic grants for such projects. <p>Rain Water Management</p> <ul style="list-style-type: none"> Authoritative competency for

	<p>environmental consciousness.</p> <p>Rain Water Management</p> <ul style="list-style-type: none"> • Technical guidelines necessary for stormwater management should be prepared. • Basic investigation (e.g., topographic survey) for inundation prone area should be conducted for planning the improvement and recruiting necessary funds. • Rain drainage in urban fringe areas (UFA) should be improved, referring PECM in Granada. <p>Municipal SWM</p> <ul style="list-style-type: none"> • A site for a future municipal SW final disposal site should be selected from some candidate sites. Its preliminary design and the environmental impact assessment (EIA) should be carried out. • In order to execute the priority projects (F/S projects), the required funds shall be secured and the detailed design of the projects shall be conducted. Then, construction of the facilities and procurement of vehicles and equipment shall be done. • Technically satisfactory level of sanitary landfill operation should be maintained in the present landfill until its closure, in order to reduce the pollution impacts to the environment. Meanwhile, illegal dumping should be reduced through improved collection services. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Based on the "polluter pays principle", industries should be instructed to implement appropriate on-site management of their solid/liquid wastes and residual water. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be promoted. 	<p>stormwater management (planning, maintenance and repair) should be reviewed respectively for macro- and micro- drainage.</p> <ul style="list-style-type: none"> • INAA, MINSA and the municipality should, referring PECM in Granada, coordinate to establish a steering committee for PECM in Chinandega necessary for improving rain drainage in UFA and to seek foreign and domestic grants for such projects. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Regulations on urban cleansing should be established to clarify municipality's powers (including placing penalties) and duties as well as citizen's rights and duties. • The municipality should improve collection of municipal taxes and charges for the services. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Waste classification suited for Nicaraguan authorities' present IWM should be established. Management of hazardous waste should be prioritized. • Inventory of factories and their waste generation should be made for identifying ISW and IWW. • With regard to ISWM and IWW, authorities should be empowered to conduct administrative measures such as monitoring, supervision and guidance. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Classification of medical waste should be established. Code of practice for respective medical waste categories should be formulated.
<p>Phase 2 (2001 - 2005) Priority Projects Implementation</p>	<p>Water Supply System</p> <ul style="list-style-type: none"> • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • Facilities and equipment provided in Phase-1 should be operated and maintained 	<p>Common Aspects</p> <ul style="list-style-type: none"> • The norms and guidelines regarding USE provided by the municipality should be demonstrated through public education programs in order for the citizens to practice appropriate sanitation measures and civil procedures.

	<p>appropriately.</p> <ul style="list-style-type: none"> • In order to prepare for M/P projects, designs and funds recruitment for the projects should be prepared. Then, facilities construction should be implemented. • Sewer provision should be improved to attain the target coverage of 49%. • In the non-sewer area citizens' participation in the "model communities integrated USE improvement" projects should be substantiated in order to sustain the projects in affordable and appropriate levels. Meanwhile coverage rate of on-site system should be raised to 8%. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Drainage should be improved in accordance with Flood Damage Area Improvement Plan. • Integrated Arroyo Management Plan (comprising: land use regulation; catchment conservation with reforestation; and drainage channel improvement) should be formulated. • Rain drainage in UFA should be further improved through PECM. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Facilities and vehicles acquired in Phase-I should be appropriately operated and maintained. • Technically satisfactory level of sanitary landfill operation should be maintained in the new landfill. Meanwhile, illegal dumping should be further reduced through improved collection services. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • On-site ISWM and IWWM should be further strengthened. • Treatment/disposal by private sectors, mainly for hazardous waste, should be implemented. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be obligated. • Treatment/disposal of hazardous/infectious medical waste should be implemented by private sectors. 	<ul style="list-style-type: none"> • The urban development plan should be put in practice to guide and to restrict the land use, in order to maintain a preferable urban environment (e.g., protect potable water sources of the city, regulate industrial activities and NIMBY facilities in designated areas). • The cadastre of real property and public services, perhaps applying crossed subsidies; should be utilized for establishing the management system on USE services and also promoting a Beneficiary-Pay Principles for the services. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • PECM steering committee should further seek foreign and domestic grants for constructing on-site DWW treatment projects. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Respective institutional system (e.g. funds, design guidelines) for macro- and micro-drainage should be established. • PECM steering committee should further seek foreign and domestic grants for constructing rain drainage facilities. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Authorities should encourage recycling activities by waste generators and private recyclers. However, the administrative support should be such a manner with least financial burden on authorities. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Legislative framework to obligate appropriate IWM (e.g., manifest system) should be established. • With regard to ISWM and IWWM, authorities should practice administrative measures (e.g., monitoring, supervision and guidance) and apply penalties (if necessary) against illegal measures by industries. • Formulation of commercial mechanism for appropriate treatment/disposal should be promoted. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Code of Practice on medical waste management should be enforced.
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Phase 3 (2006 - 2010) M/P Projects Implementation	<p>Water Supply System</p> <ul style="list-style-type: none"> • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • The M/P projects should be reexamined and implemented, with reference to the outcome of the priority projects (F/S projects). • As for sewer area, the off-site system should be consolidated to maintain target coverage of 65% of the population. • As for no sewer area, the on-site system should be consolidated to maintain target coverage of 12% of the population. • As for area served with "model communities integrated USE improvement" projects, self-help of communities should be employed in operation and maintenance of the facilities. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Reforestation, drainage improvement works, etc. should be implemented in accordance with Integrated Arroyo Management Plan. • Rain drainage facilities in UFA should be further constructed through PECM. <p>Municipal SWM</p> <ul style="list-style-type: none"> • The M/P projects should be reexamined and implemented, with reference to the outcome of the priority projects (F/S projects). • Satisfactory municipal SWM both technically and environmentally should be continued. In maintaining 100% waste collection rate, illegal dumping should be eradicated. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Industries should take initiatives for introducing "waste minimization and cleaner production" technologies for their production. <p>Medical Waste Management</p> <p>Appropriate collection, treatment and disposal should be practiced for all medical waste (including hazardous and infectious ones).</p>	<p>Common Aspects</p> <ul style="list-style-type: none"> • Public education programs related with the norms and guidelines regarding USE provided by the municipality should be deployed widely. • The urban development plan should be put in practice to restrict the land use, in order to maintain a preferable urban environment. Meanwhile the plan should serve for planning USE services corresponding to the urban expansion and the population increase therein. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • PECM steering committee should raise funds for constructing on-site DWW treatment projects, from water and wastewater charges collected. <p>Rain Water Management</p> <ul style="list-style-type: none"> • PECM steering committee should raise funds for constructing rain drainage facilities, from automobile taxes etc. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Introduction of separate collection system should be examined in order to promote waste minimization and resource recovery from waste. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Authorities should promote introduction of "cleaner production" mainly for factories that generate hazardous waste. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate control, treatment and disposal of medical waste should be enforced in line with the Code of Practice for Medical Waste Management.
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3.3.2 USE Conceptual M/P for Chinandega

a. Forecast of Future USE Service Demands

Based on the target figures of the technical system in Chinandega City, indicated in Table 3-5, future projectile demands with regard to respective sectors related with USE was carried out and the result is summarized below.

Table 3-7: Forecast of Future USE Service Demands (Chinandega City)

Item	Present	(2000)	F/S(2005)	M/P (2010)
1. Area and Population	(year 1995)			
Area				
City total (km ²)	647	647	647	647
Projected Service Area (km ²)	16.1	16.1	16.1	16.1
Population				
City total	117,037	136,076	155,523	176,359
Projected Service Area	97,387	115,393	133,753	153,444
2. Water Supply System	(year 1995)			
Water supply coverage area	7.5 km ²			
Supplied population	72,077	98,084	113,753	130,427
Coverage rate (population)	74.0 %	85 %	85 %	85 %
Water production amount(m ³ /year)	5,083,403	9,264,065	10,738,665	12,320,210
Water production ratio (l/p./day)	193.2	259(213*)	259 (213*)	259 (213*)
Efficiency rate	72 %	75 %	75 %	75 %
Water consumption amount (m ³ /y)	3,657,990	6,948,140	8,054,258	9,239,975
Water consumption ratio (l/p./day)	139.0	194(160*)	194 (160*)	194 (160*)
3. Domestic Wastewater System	(year 1995)			
3.1. Sewer System Area				
Service area	2.57 km ²			
Service population	32,752	38,772	65,940	99,739
Coverage rate (population)	33.6 %	33.6 %	49.3 %	65 %
Treated amount	6,591 m ³ /day (*Inflow volume)	6,165 m ³ /day	12,277 m ³ /day	15,818 m ³ /day
3.2 No-Sewer System Area				
On-site system (per person)	3,895	4,616	10,699	18,413
	4.0 %	4.0 %	8.0 %	12 %
Latrine system (per person)	50,774	59,774	50,025	35,292
	51.8 %	51.8 %	37.4 %	23 %
No system (per person)	10,232	12,232	7,089	0
	10.6 %	10.6 %	5.3 %	0 %
4. Municipal SWM	(year 1996)			
Population in the study area	100,748	115,393	133,753	153,444
Waste generation amount (ton/day)	76.2	92.2	114.9	141.9
Waste discharge amount (ton/day)	48.4	60.4	78.2	100.2
Waste collection amount (ton/day)	39.5	49.3	70.4	100.2
Final disposal amount (ton/day)	40.5	50.3	72.0	101.9
Coverage rate (% of waste amount)	81.6	82	90	100
Coverage rate (% of population)	51.0	51	88	100
Service population	51,382	58,851	118,088	153,444
Non served population	49,366	56,542	15,665	0
Length of road swept (km)	45	45	52	60

Item	Present	(2000)	F/S(2005)	M/P (2010)
5. Medical SWM	(year 1996)			
Medical waste generation	96 kg/day	109 kg/day	127 kg/day	146 kg/day
Non-hazardous waste generation	56 kg/day	64 kg/day	74 kg/day	85 kg/day
Infectious waste generation	37 kg/day	42 kg/day	49 kg/day	56 kg/day
Other hazardous waste generation	3 kg/day	3 kg/day	4 kg/day	5 kg/day

Note * : The figures excludes commercial and industrial water use.

b. Economic and Financial Indicators

- Key economic and financial indicators employed in the economic and financial evaluation in the Conceptual M/P are shown in Table 3-8.

Table 3-8: Economic and Financial Indicators in the Conceptual M/P
(Chinandega City)

	Unit	1995	2000	2005	2010
GRDP	C\$ million	657.0	866.5	1,105.9	1,332.6
Numbers of households	Nos.	16,934	20,103	23,302	26,732
Average Income per household	C\$/year	14,772	16,410**	18,069	18,979
Budget of INAA Region II	C\$ 1,000	13,765	16,597	18,873	21,631
Budget of Chinandega Municipality	C\$ 1,000	14,604	19,260	24,581	29,620

Note: Since growth rate (between 1995 and 2000) of household numbers is smaller than the growth rate of GRDP, average income per household substantially increases from 1995 to 2000.

c. Conceptual M/P

Based on the planning framework and the planning indicators (e.g., forecast key indicators and economic and financial indicators) above, the USE Conceptual M/P for Chinandega is summarized in Chapter 11 in the Main Report for the M/P and Conceptual M/Ps: Volume II.

3.3.3 Recommendations

a. Formulation of M/P and Implementation of F/S

The USE Conceptual M/P outlined below should serve as a base for formulating a substantial M/P. Therefore, it is necessitated that Chinandega Municipality should formulate an USE M/P based on this Conceptual M/P, and carry out F/S for priority projects identified in the M/P in order for justifying the project realization.

b. Improvement of Regulations, Instructions, and Administrative Guidelines

In order to improve administrative ability of the Municipality, it is extremely important to establish regulations and technical guidelines to support it. There are "individual" norms and "combined" norms in these regulations and technical guidelines (refer to "Institutional improvement proposal" in the M/P for Granada). Chinandega Municipality should establish necessary regulations and technical guidelines in cooperation with institutions related with the Central Government in order to improve USE, using this proposal as reference.

c. Improvement of Organizational System

It is indispensable to strengthen the organizational system of the municipality in order to promote the improvement of USE, covering a diverse area, with the limited budget and human resources (refer to "Institutional Improvement Proposal" in the M/P for Granada, and "Organizational System Improvement Proposal for the implementation of priority projects). Chinandega Municipality should improve its organizational system in order to promote the improvement of USE, using this proposal as reference.

d. Construction of a New Municipal SW Disposal Site

The USE of Chinandega Municipality suffers from various problems. Among others, the location of the present municipal SW disposal site (ruin the beauty of the city, contamination of agricultural land, etc.) requires an urgent solution. Therefore, Chinandega Municipality should construct a new Municipal SW disposal site as soon as possible and cease operation in the present disposal site, adopting the site selection methods, planning, and EIA etc. used by the Study Team in the "SJV A New Municipal SW Disposal Site Development Project for Granada Municipality".

e. Improvement of USE in UFA

In Chinandega Municipality, the UFA's spreads around the city center, which is a relatively improved area, as is the case in Granada City. The USE of UFA is not established sufficiently except for the water supply system. The improvement of the USE of UFA's is the most important issue to realize social equality and stability. Therefore, Chinandega Municipality should promote the improvement of the USE of UFA's, using the "On-site Domestic Wastewater Treatment System Improvement Project" and "Rain Water Drainage Project", adopted by the Study Team for the "Model Community Integrated USE Improvement Project" for Granada Municipality as reference.

3.4 USE M/P for Granada

3.4.1 Planning Framework

a. Goals

The principal goal of the M/P for Granada is to improve the USE of Granada City, a focal point of economic and industrial activities of Region IV, by the target year 2010.

Through the improvement of the USE in Granada City, the plan aims to:

- ◆ Promote the citizens' well-being;
- ◆ Support sustainable development of the city; and
- ◆ Contribute to the growth of the regional economies.

b. Targets

Target years were, in accordance with the S/W of the Study, set as follows:

Master Plan: Year 2010

Feasibility Study: Year 2005

In order to achieve the principal goals, target figures in three major sectors comprising USE were set as indicated in the Table below.

Table 3-9: Target Figures for the Technical System in Granada City

	Present(1995/96)	F/S(2005)	M/P(2010)
Water supply coverage	89.7 %	85 %	85 %
Domestic wastewater system			
Off-site sewer system	21.9 %	38 %	55 %
On-site system	1.6 %	10 %	17 %
Soak system	37.5 %	24 %	13 %
Latrine only system	28.1 %	22 %	15 %
No system	10.9 %	6 %	0 %
Municipal SWM			
Coverage rate (to waste amount)	82.0 %	90 %	100 %
Coverage rate (to population)	63.0 %	89 %	100 %

Note: The INAA established a target water supply coverage rate of 85% of the whole urban population. The target figure is set up in accordance with the INAA's target. Consequently, the coverage rates for the year 2005 and 2010 is lower than 89.7%, the rate of 1995/1996. However, the supplied population in 2005 will be about 1.6 times more than that in 1995/1996 and that in 2010 will be about 1.8 times.

c. Strategies

Strategic actions to reach the goals and targets should, in practice, be achieved in a stepwise manner toward the target year of 2010. Therefore, the period up to the target year of 2010 is recommended to be divided into three phases.

Table 3-10: Strategies for the Realization of USE Master Plan (Granada City)

Classification Phase	Technical Aspects	Institutional Aspects
Phase 1 (1998 - 2000) Preparation for Priority Projects Implementation	<p>Water Supply System</p> <ul style="list-style-type: none"> The water supply system should be consolidated to maintain a target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> In order to execute the priority projects (F/S projects), the required funds shall be secured and the detailed design of the projects shall be conducted. As for areas with sewers, connection to sewer should be promoted and system improvement necessary for maintaining the present sewer coverage (21.9%) should be provided. As for the non-sewer area, in order to prepare for "model communities integrated USE improvement" projects (PECM), public education programs should be encouraged to raise citizens' awareness of the environment. <p>Rain Water Management</p> <ul style="list-style-type: none"> Technical guidelines necessary for stormwater management should be prepared. Basic investigation (e.g., topographic survey) for inundation prone area should be conducted for planning the improvement and recruiting necessary funds. Rain drainage in urban fringe areas (UFA) should be improved through PECM. <p>Municipal SWM</p> <ul style="list-style-type: none"> In order to execute the priority projects (F/S projects), the required funds shall be secured and the detailed design of the projects shall be conducted. Then, construction of the facilities and procurement of vehicles and equipment shall be done. Technically satisfactory level of sanitary landfill operation should be maintained in the present landfill until its closure, in order to reduce the pollution impacts to the environment. Meanwhile, illegal dumping should be reduced through improved collection services. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> Based on the "polluter pays principle", 	<p>Common Aspects</p> <ul style="list-style-type: none"> Regulations of wastewater discharge into sewer/public water body should be legally and practically enforced. The municipality should provide norms and guidelines regarding USE to the citizens, which they should easily understand appropriate sanitary practices and civil procedures. Urban development plan of the city (at least including the land use regulations) should be prepared. Meanwhile, a cadastre of real property and public services should be established. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> Guidelines for appropriate on-site DWWM should be elaborated. INAA, MINSA and the municipality should coordinate to establish a steering committee for "Special Program for Model Community Integrated USE Improvement Project" (PECM) necessary for introducing on-site DWW treatment system and to seek foreign and domestic grants for such projects. <p>Rain Water Management</p> <ul style="list-style-type: none"> Authoritative competency for stormwater management (planning, maintenance and repair) should be reviewed respectively for macro- and micro- drainage. INAA, MINSA and the municipality should coordinate to establish a steering committee for PECM necessary for improving rain drainage in UFA and to seek foreign and domestic grants for such projects. <p>Municipal SWM</p> <ul style="list-style-type: none"> Regulations on urban cleansing should be established to clarify municipality's powers (including placing penalties) and duties as well as citizen's rights and duties. The municipality should improve collection of municipal taxes and

	<p>industries should be instructed to implement appropriate on-site management of their solid/liquid wastes and residual water.</p> <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be promoted. 	<p>charges for the services.</p> <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Waste classification suited for Nicaraguan authorities' present IWM should be established. Management of hazardous waste should be prioritized. • Inventory of factories and their waste generation should be made for identifying ISW and IWW. • With regard to ISWM and IWW, authorities should be empowered to conduct administrative measures such as monitoring, supervision and guidance. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Classification of medical waste should be established. Code of practice for respective medical waste categories should be formulated.
<p>Phase 2 (2001 - 2005) Priority Projects Implementation</p>	<p>Water Supply System</p> <ul style="list-style-type: none"> • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • Facilities and equipment provided in Phase-1 should be operated and maintained appropriately. • In order to prepare for M/P projects, designs and funds recruitment for the projects should be prepared. Then, facilities construction should be implemented. • Sewer provision should be improved to attain the target coverage of 38%. • In the non-sewer area citizens' participation in the "model communities integrated USE improvement" projects should be substantiated in order to sustain the projects in affordable and appropriate levels. Meanwhile coverage rate of on-site system should be raised to 10%. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Drainage should be improved in accordance with Flood Damage Area Improvement Plan. • Integrated Arroyo Management Plan (comprising: land use regulation; catchment conservation with reforestation; and drainage channel improvement) should be formulated. • Rain drainage in UFA should be further 	<p>Common Aspects</p> <ul style="list-style-type: none"> • The norms and guidelines regarding USE provided by the municipality should be demonstrated through public education programs in order for the citizens to practice appropriate sanitation measures and civil procedures. • The urban development plan should be put in practice to guide and to restrict the land use, in order to maintain a preferable urban environment (e.g., protect potable water sources in southern part of the city, regulate industrial activities and NIMBY facilities in designated areas). • The cadastre of real property and public services, perhaps applying crossed subsidies; should be utilized for establishing the management system on USE services and also promoting a Beneficiary-Pay Principles for the services. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • PECM steering committee should further seek foreign and domestic grants for constructing on-site DWW treatment projects. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Respective institutional system (e.g. funds, design guidelines) for macro-

	<p>improved through PECM.</p> <p>Municipal SWM</p> <ul style="list-style-type: none"> • Facilities and vehicles acquired in Phase-I should be appropriately operated and maintained. • Technically satisfactory level of sanitary landfill operation should be maintained in the new landfill. Meanwhile, illegal dumping should be further reduced through improved collection services. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • On-site ISWM and IWWM should be further strengthened. • Treatment/disposal by private sectors, mainly for hazardous waste, should be implemented. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be obligated. • Treatment/disposal of hazardous/infectious medical waste should be implemented by private sectors. 	<p>and micro-drainage should be established.</p> <ul style="list-style-type: none"> • PECM steering committee should further seek foreign and domestic grants for constructing rain drainage facilities. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Authorities should encourage recycling activities by waste generators and private recyclers. However, the administrative support should be such a manner with least financial burden on authorities. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Legislative framework to obligate appropriate IWM (e.g., manifest system) should be established. • With regard to ISWM and IWWM, authorities should practice administrative measures (e.g., monitoring, supervision and guidance) and apply penalties (if necessary) against illegal measures by industries. • Formulation of commercial mechanism for appropriate treatment/disposal should be promoted. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Code of Practice on medical waste management should be enforced.
<p>Phase 3 (2006 - 2010) M/P Projects Implementation</p>	<p>Water Supply System</p> <ul style="list-style-type: none"> • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • The M/P projects should be reexamined and implemented, with reference to the outcome of the priority projects (F/S projects). • As for sewer area, the off-site system should be consolidated to maintain target coverage of 55% of the population. • As for no sewer area, the on-site system should be consolidated to maintain target coverage of 17% of the population. • As for area served with "model communities integrated USE improvement" projects, self-help of communities should be employed in operation and maintenance of the facilities. <p>Rain Water Management</p> <ul style="list-style-type: none"> • Reforestation, drainage improvement works, 	<p>Common Aspects</p> <ul style="list-style-type: none"> • Public education programs related with the norms and guidelines regarding USE provided by the municipality should be deployed widely. • The urban development plan should be put in practice to restrict the land use, in order to maintain a preferable urban environment. Meanwhile the plan should serve for planning USE services corresponding to the urban expansion and the population increase therein. <p>Water Supply System</p> <p>Domestic Wastewater System</p> <ul style="list-style-type: none"> • PECM steering committee should raise funds for constructing on-site DWW treatment projects, from water and wastewater charges collected.

	<p>etc. should be implemented in accordance with Integrated Arroyo Management Plan.</p> <ul style="list-style-type: none"> • Rain drainage facilities in UFA should be further constructed through PECM. <p>Municipal SWM</p> <ul style="list-style-type: none"> • The M/P projects should be reexamined and implemented, with reference to the outcome of the priority projects (F/S projects). • Satisfactory municipal SWM both technically and environmentally should be continued. In maintaining 100% waste collection rate, illegal dumping should be eradicated. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Industries should take initiatives for introducing "waste minimization and cleaner production" technologies for their production. <p>Medical Waste Management</p> <p>Appropriate collection, treatment and disposal should be practiced for all medical waste (including hazardous and infectious ones).</p>	<p>Rain Water Management</p> <ul style="list-style-type: none"> • PECM steering committee should raise funds for constructing rain drainage facilities, from automobile taxes etc. <p>Municipal SWM</p> <ul style="list-style-type: none"> • Introduction of separate collection system should be examined in order to promote waste minimization and resource recovery from waste. <p>Industrial Waste Management</p> <ul style="list-style-type: none"> • Authorities should promote introduction of "cleaner production" mainly for factories that generate hazardous waste. <p>Medical Waste Management</p> <ul style="list-style-type: none"> • Appropriate control, treatment and disposal of medical waste should be enforced in line with the Code of Practice for Medical Waste Management.
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3.4.2 USE M/P for Granada

a. Forecast of Future USE Service Demands

Based on the target figures indicated in Table 3-9, future demands forecast with regard to respective sectors related with USE was carried out and the result was summarized below.

Table 3-11: Forecast of Future USE Service Demands (Granada City)

Item	Present	(2000)	F/S (2005)	M/P (2010)
1. Area and Population	(year 1995)			
Area				
City total (km ²)	531	531	531	531
Projected Service Area (km ²)	14.3	14.3	14.3	14.3
Population				
City total	96,996	126,307	147,830	171,618
Projected Service Area	71,783	97,078	114,760	135,106
2. Water Supply System				
Water supply coverage area	8.4 km ²	8.4 km ²	9.3 km ²	9.3 km ²
Supplied population	64,411	82,516	97,546	114,255
Coverage (to population)	89.7 %	85 %	85 %	85 %
Water production (m ³ /year)	6,107,590	9,742,945	10,631,355	10,847,800
Water production rate (l/p./day)	259.8	324	299	260
Efficiency	57%	60 %	65%	75%
Water consumption (m ³ /y)	3,454,251	5,845,840	6,910,545	8,135,850
Water consumption rate (l/p./day)	146.3	195 (160*)	195 (160*)	195 (160*)

Item	Present	(2000)	F/S (2005)	M/P (2010)
3. Domestic Wastewater System				
3.1. Sewer System Area				
Served area	2.0 km ²	2.0 km ²	3.7 km ²	5.6 km ²
Service population	15,706	21,260	44,125	74,266
Coverage (to population)	21.9 %	21.9 %	38.5 %	55%
Treated amount (m ³ /day)	2,592	3,402	7,060	11,883
3.2 No-Sewer System Area				
On-site system	1,122 person 1.6%	1,553 person 1.6%	11,555 person 10.1 %	23,110 person 17.1%
Soak system (sumidero)	26,917 person, 37.5%	36,356 person 37.5 %	27,817 person 24.2 %	16,879 person 12.5 %
Latrine system	20,188 person, 28.1%	27,298 person 28.1 %	24,991 person 21.8 %	20,851 person, 15.4 %
No system	7,850 person, 10.9 %	10,611 person 10.9 %	6,272 person 5.5 %	0 person 0 %
4. Municipal SWM	(year 1996)			
Population in the study area	76,250	97,078	114,760	135,106
Waste generation amount (ton/day)	57.1	76.6	97.5	123.4
Waste discharge amount (ton/day)	43.2	59.5	78.2	102.0
Waste collection amount (ton/day)	35.4	48.8	70.4	102.0
Final disposal amount (ton/day)	36.9	50.2	72.7	104.5
Coverage (to waste amount) (%)	82.0	82	90	100
Coverage (to population) (%)	63.0	63	89	100
Served population	48,037	61,159	101,843	135,106
Non served population	28,213	35,919	12,917	0
Length of sweeping served road (km)	35	35	40	47
5. Medical SWM				
Medical waste generation	99 kg/day	127 kg/day	149 kg/day	176 kg/day
Non-hazardous waste generation	49 kg/day	63 kg/day	74 kg/day	87 kg/day
Infectious waste generation	48 kg/day	62 kg/day	73 kg/day	86 kg/day
Other hazardous waste generation	2 kg/day	2 kg/day	2 kg/day	3 kg/day

Note: * These figures exclude commercial and industrial water use.

b. Economic and Financial Conditions

Key economic and financial indicators, which are to be employed in the M/P's economic and financial evaluations, are shown in Table 3-12.

Table 3-12: Economic and Financial Indicators in the M/P (Granada City)

	Unit	1995	2000	2005	2010
GRDP	C\$ million	247.0	325.7	415.7	500.0
Number of households	Units	12,651	16,709	19,752	23,254
Average Income per household	C\$/year	15,300	15,278 ^{*)}	16,494	16,883
Budget of INAA Region IV	C\$ 1,000	9,026	10,883	12,375	14,184
Budget of Granada Municipality	C\$ 1,000	13,071	17,240	22,000	26,511

Note: *) Since growth rate (between 1995 and 2000) of household numbers is slightly larger than the growth rate of GRDP, average income per household slightly decreases from 1995 to 2000.

c. Master Plan (M/P)

Based on the planning framework and the planning indicators (e.g., forecast key indicators and economic and financial indicators) above, the USE M/P for Granada is summarized in Chapter 9 in the Main Report for the M/P and Conceptual M/Ps: Volume II. The location of the principle facilities related with USE which is the precondition for the M/P is shown in Figure 3-1.

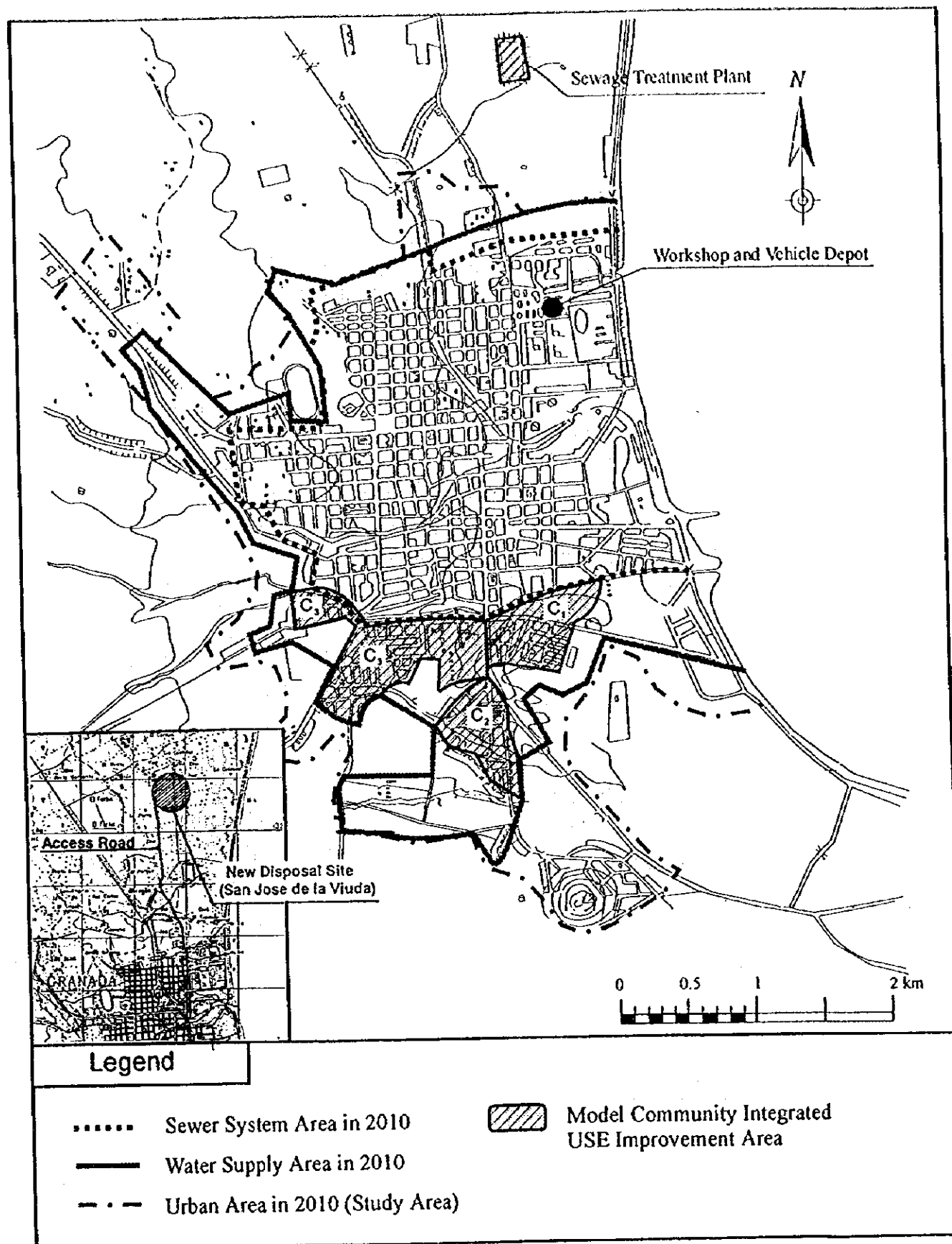


Figure 3-1: Location of USE Principle Facilities

d. Institutional Improvement Proposals for the Implementation of the USE Master Plan

d.1 Organizational Improvements for the Municipality

The municipality should be the main institution involved in the improvement of the USE and therefore must be capable of improving the organizational structure, legal framework and, in particular, training the personnel. Efforts have been made by the municipality, however, some areas still require improvements, particularly:

- Currently, only one bureau (Municipal Services Bureau) manages all municipal services related to USE and some public works. The responsibility of managing all these tasks is beyond the capability of the bureau; the personnel are not trained to administer individual services, resulting in the mayor's direct involvement in general managerial duties.
- For the improvement of USE, assistance of citizens on low income is essential through establishment of land use and housing norms, as well as provision of clear and simple instructions; this would require an adequate organizational structure and policy within the Municipal Planning and Projects Bureau.
- Improved fee collection rates and auditing are required through reasonable methods that do not rely on the discretion of individual collectors. This would require a capable Finance Department under the Bureau of Administration and Finance.
- A frequently updated cadastre is necessary in order to provide information for urban planning and USE improvement. It would be practical if the Cadastre Department and the Urban Development Department are under the same bureau, so that data can be exchanged readily.
- The mayor should be at liberty to co-ordinate and give directives to the executive directors of the bureaus; administrative tasks should be delegated to the staff of the Administration and Finance Bureau in order to free the mayor to perform executive duties.

A basic organizational structure is proposed for the municipality as shown in Figure 3-2, considering the various needs for improvement. The structure would have to be implemented gradually according to the plans and targets set, as well as human and financial resources available.

The organizational structure of the municipality must be supported by skilled personnel, implying that the available personnel must be trained to perform various functions.

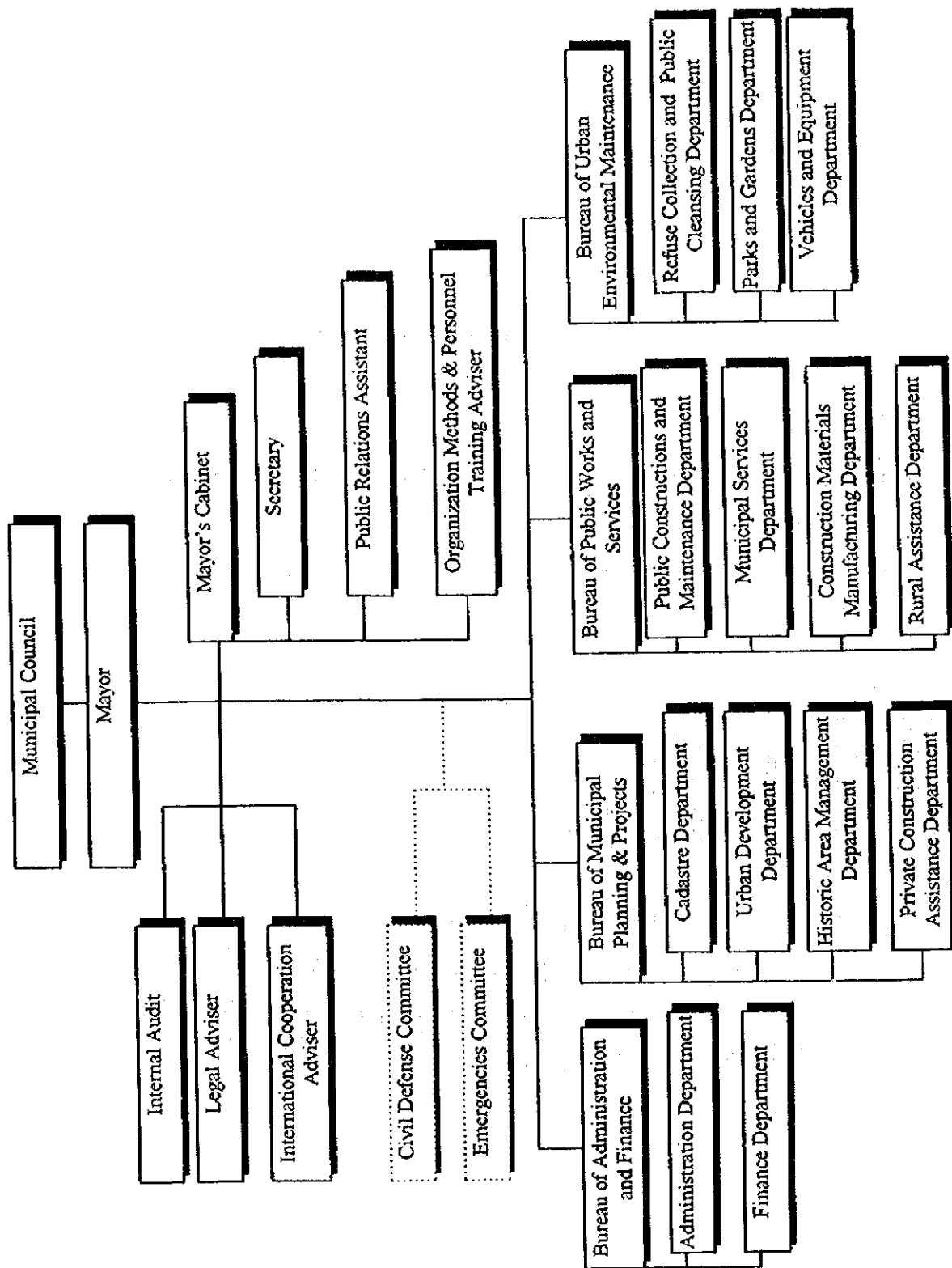


Figure 3-2: General Organizational Structure

d.2 Normative Improvement

Legal and technical norms play an extremely important role in supporting the administrative capability of the municipality. USE improvements would require the collaboration between the municipality and national institutions, through a well planned strategy, as well as public cooperation.

The M/P proposes to divide "individual" norms that are exclusive to the municipality and "combined" norms shared with other national authorities; both must be established simultaneously or according to an agreement between the municipality and national authorities.

Improvement of the "Individual" Norms

The norms for the following items should be reviewed and realized, taking into account that the legality must be completed within a year after the publication of this report.

- Zoning & Land Usage
- Low Income Settlement and Housing
- Cadastre
- Permit system for the construction or installation of buildings and facilities, and usage of residential and non-residential buildings.
- Permit issuance for pre-designed low income housing.
- Inspection and assistance during the construction of low income settlements.
- Collection and disposal of municipal solid waste and the cleaning of streets.
- Usage of the microdrainage system

Improvement of the "Combined" Norms

The municipality should negotiate and cooperate with other national authorities that are involved in the USE, in order to review and establish the following instructions and administrative guidelines for the authorities.

d.3 Recommended Regulations, Instructions and Administrative Guidelines

INAA

- Instructions on Potable Water Connection and Services
- Instructions on Connection of the Wastewater to the Sewers
- Instructions on the On-site Wastewater Treatment and Disposal Facility

MINSA

- Guidelines for On-site Medical Solid Waste Management
- Instruction on Connection of the Wastewater to the Sewers
- Instructions on the On-Site Wastewater Treatment and Disposal Facility

MARENA

- Guidelines for Industrial Waste Management
- Guidelines for Management of Hazardous Products

- Guidelines for Drainage Systems, Classification and Responsibilities
- Guidelines for Discharge of Wastewater into Waterways

MCT

- Guidelines on Urban Road Drainage
- Instruction on Constructions along Urban Roads

MUNICIPALITY

- Guideline on Solid Waste Collection/Disposal, and Cleaning of Public Streets
- Guideline for Usage of the Micro-drainage System
- Regulations on Urban Zoning and Land Usage
- Regulation and Registration on Buildings

e. Project Cost

The project cost necessary to carry out the M/P is shown in the table below.

Table 3-13: Project Cost for M/P

Unit : C\$ 1,000

Item	year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	total
Project cost													
Water supply		7,306	7,551	7,811	8,076	8,349	8,420	8,698	8,987	9,288	8,070	-	82,554
Sewerage system													
Off-site		4,105	4,107	4,107	4,107	4,107	4,107	4,107	4,107	4,107	4,107	0	41,068
On-site		3,189	3,189	3,189	3,191	3,191	3,191	3,190	3,190	3,191	3,191	0	31,902
Total (sewerage system)		7,294	7,296	7,296	7,298	7,298	7,298	7,297	7,297	7,298	7,298	0	72,970
Municipal SW													
Improvement of refuse collection		8,429	853	0	67	853	853	67	7,930	853	67	0	19,972
Final disposal site		38,589	0	0	0	0	8,000	0	3,597	0	0	0	50,186
Total (Municipal SW)		47,018	853	0	67	853	8,853	67	11,527	853	67	0	70,158
Stormwater drainage improvement		1,357	1,357	1,357	1,357	1,357	1,357	1,357	1,357	1,357	1,357	0	13,570
Total (project cost)		62,975	17,067	16,464	16,798	17,657	25,928	17,419	29,168	18,794	16,792	0	239,252
Operation & Maintenance cost													
Water supply		0	178	358	546	741	942	1,145	1,355	1,572	1,796	1,991	10,622
Sewerage system													
Off-site		0	633	740	855	975	1,103	1,238	1,380	1,530	1,690	1,867	12,011
On-site		0	58	116	174	232	290	348	406	484	522	580	3,190
Total (sewerage system)		0	691	856	1,029	1,207	1,393	1,586	1,786	1,994	2,212	2,447	15,201
Municipal SW													
Improvement of refuse collection		0	1,898	2,066	2,066	2,066	2,232	2,399	2,399	2,567	2,567	2,567	22,827
Final disposal site		0	450	458	462	468	477	498	507	514	523	533	4,890
Total (Municipal SW)		0	2,348	2,524	2,528	2,534	2,709	2,897	2,906	3,081	3,090	3,100	27,717
Stormwater drainage improvement		0	7	14	20	27	34	41	47	54	61	68	373
Total (Operation & Maintenance cost)		0	3,222	3,752	4,123	4,509	5,078	5,669	6,094	6,701	7,159	7,608	53,913
Total		62,975	20,279	20,216	20,921	22,366	31,006	23,088	35,262	25,495	23,951	7,608	293,165

3.4.3 Evaluation of the USE M/P

M/Ps on water supply management, DWWM and municipal SWM are evaluated from technical, social, environmental, financial and economic aspects.

a. Technical Evaluation

It is examined herewith whether or not the technical systems proposed in the Study are compatible and enforceable in view of technical aspects such as facility construction, operation and maintenance, in comparison with prevalent technical levels of Granada City and INAA Region IV who shall be the main executing bodies of the proposed technical systems.

All technical systems proposed, except for two systems listed below, are evaluated to be technically compatible and enforceable, since they match the technologies commonly practiced in Granada or other cities in Nicaragua.

- Domestic wastewater on-site collective treatment/disposal; and
- Sanitary landfill at municipal waste disposal site.

The evaluation on these two technical systems is summarized in the technical evaluation section of the F/S, based on the result of the pilot projects.

b. Social Evaluation

The social evaluation was carried out in view of its "contribution to social equality and justice" and "whether or not the M/P is socially acceptable".

The sewer system coverage rate and waste collection rate in Granada are presently inferior to other principal cities in Nicaragua. USE improvements in those sectors, by realizing the M/P for Granada, may also contribute to social fairness.

All technical systems proposed other than the two systems mentioned above (domestic wastewater on-site collective treatment/disposal and sanitary landfill) are evaluated to be socially compatible and enforceable, since they are commonly practiced in Granada Municipality or other cities in Nicaragua. In this regard, these two technical systems proposed were examined as to whether they are socially acceptable or not (in other words, whether understanding and cooperation from the residents can be attained or not) in the social evaluation section of the F/S, based on the result of pilot projects.

c. Environmental Evaluation

The results of the evaluation indicate that the total benefits on the environment should far outweigh the negative impacts by implementing the M/P. The only environmentally negative impact envisaged by implementing the M/P is that of SJV A New Municipal SW Disposal Site Development Project to the surrounding areas. Its environmental evaluation is summarized as a result of EIA of the project.

d. Financial Evaluation

As for the financial evaluation, annual expenditure and income of each of the executing bodies (i.e., Granada Municipality and INAA Region IV) were compared in order to examine the financial conditions. The following assumptions were made in the evaluation for future charges:

1. Regarding the charges which will be collected from the household for water supply and domestic wastewater treatment (off-site and on-site), average charges paid in 1997 will be continued from 2001 onwards.
2. Average unit rates of water supply and sewer system charges paid by the industries in 1997 (C\$ 5.47 /m³ for water supply and C\$ 1.70 /m³ for the sewer system) will be continued as the unit rates paid from 2001 onwards.
3. Household refuse collection charges planned for the three different collection service levels (C\$15/household/month, C\$10/household/month, C\$5/household/month) will be applied and paid.
4. Specific charges were set for refuse collection fee from the companies to collect 100% of treatment costs (collection, transportation, and final disposal).

Table 3-14: Forecast of Income-Expenditure Balance of Respective Projects

Unit : C\$ 1,000

		1995	Average of 2001 - 2005	Average of 2006 - 2010	Total of 2001 - 2010
New projects only	Water Supply	n.a.	-3,605	-4,149	-38,769
	Wastewater				
	Off-site system	n.a.	-734	-912	-8,230
	On-site system	n.a.	-475	-1,177	-8,263
	SWM	n.a.	-3,336	-3,330	-32,827
All projects (existing and new projects)	Water Supply	3,169	2,546	2,002	22,740
	Wastewater				
	Off-site system	405	-63	-241	-1,520
	On-site system	n.a.	-475	-1,177	-8,263
	INAA total **	1,318	-71	-1,393	-4,072
	SWM (%)***	-1,325 (10.1)	-5,577 (27.9)	-5,917 (24.0)	-57,468 (25.7)

Note: * Breakdown of INAA's income-expenditure into the water supply section and wastewater section based on its 1996 figures.
 ** This shows amount after deduction of general administration costs.
 *** The figures in parenthesis indicate the ratio of the SWM expenditure to the municipality's budget.

The forecast of income-expenditure balance above revealed the following:

- 1: The costs of the new projects can not be covered only by new beneficiaries. The reason why INAA Region IV is in the black at present is not because water supply and sewer system projects are profitable, but because the INAA's property constructed before (such as water supply and sewer facility), represents asset values and leads to a balanced budget financing.
- 2: When income and expenditure of existing and new projects are combined for water supply and wastewater treatment (off-site only) projects, the balance is positive (i.e., income is greater than the expenditure). However, the total FIRR of INAA Region IV is only 1.7%. Therefore, it is not possible to allocate some of the small profit to the on-site projects.

- 3: If an income-expenditure balance should be kept only for wastewater (off-site and on-site) projects, a large increase in wastewater charges from 2001 onward is inevitable. Furthermore, implementation of on-site system projects need to be extended gradually.
- 4: In order to maintain the income-expenditure balance of the SWM³ system, Granada Municipality should secure a budget amount approximately 4.5 times of the present SWM budget, which will count for about 24.0% of the total municipal budget in 2006 to 2010. In other words, the burden of the SWM expenditure on the municipal budget will be more than double in this period (from 10.1% present to 24.0% average of 2006-2010).

On the other hand, the appropriateness of the charge assumed in the M/P for residents was reexamined in comparison with residents' ability to pay. It turned out that the charges from 2006 to 2010 accounted for about 4.2% of the average household income with 1% increase from now. Therefore, whether the additional financial share of burden is affordable or not for residents, and/or alternatives to alleviate the burden (i.e., cheaper but appropriate technologies) should be examined.

e. Economic Evaluation

Benefits in terms of the economic evaluation comprise: the amount of WTP by those who are presently not served; and beneficial impacts on the environment (e.g., public health improvement, property value rise, increased consumption by tourists).

The "Economic internal rate of return (EIRR)" and "cost benefit ratio at 0% discount rate (B/C)" are calculated for the three cases, as shown below.

- Case-1: Benefits are defined as equal the WTP expressed in the POS in the 3 cities;
- Case-2: Benefits are defined as equal to the aggregate of the above WTP and beneficial impacts on environment (expressed in terms of benefit per household); and
- Case-3: Benefits are defined as equal to charges that citizens are paying to the executing bodies (the municipality and INAA).

Table 3-15: Economic Evaluation for 3 Cases

	Case-1 WTP		Case-2 WTP plus Environmental Benefits		Case-3 Present Charges	
	EIRR	B/C	EIRR	B/C	EIRR	B/C
Water Supply M/P	C\$ 14.90 /month		C\$ 29.38/month		C\$ 49.8/month	
	n.a.	0.3130	- 2.8%	0.7993	13.2%	1.6663
DWWM	C\$ 8.32/month		C\$ 21.96/month		C\$ 16.7/month	
(Off-site)	n.a.	0.5068	5.8%	1.4890	-0.8%	0.9316
DWWM	C\$ 8.32/month		C\$ 17.67/month		C\$16.7/month	
(On-site)	n.a.	0.2122	2.6%	1.3635	n.a.	0.4260
Municipal SWM	C\$ 6.48/month		C\$ 16.15/month		C\$ 10.50/month	
	n.a.	0.3865	-1.4%	0.7238	n.a.	0.5184

³ as projected in the M/P in 2006 to 2010.

The following points became clear in the economic evaluation above:

- In case-1, the cost of each project (i.e., water supply, domestic wastewater treatment, municipal SW management) exceeds each project benefit.
- In case-2, only benefits in domestic wastewater treatment project exceed the project cost, not in other projects.
- In case-3, only in the water supply project, the benefits exceed the project cost.
- In view of the above outcome, unless various intangible benefits (e.g., conservation of Lake Nicaragua and its environment, prevention of potable water pollution, fishery conservation, and, promotion of foreign and domestic investment into the local economy) are considered, the implementation of the M/P can not be judged to be feasible from a national economic perspective. However, as there are several intangible benefits, it is beneficial to carry out the M/P projects.

f. Total Evaluation

Technical and social evaluations confirmed that the implementation of the M/P was appropriate except for some points to be further examined. These points (i.e., whether the two technical systems proposed are technically appropriate and socially acceptable or not) were examined through the pilot projects and the results were summarized in the project evaluation of the F/S.

Environmental and economic evaluations confirmed that the implementation of the M/P was appropriate from the viewpoint of the environment and national economy.

On the other hand, the financial evaluation revealed that the implementation of the M/P will induce increase in the financial burden on residents, and the municipality's financial difficulties. Therefore, whether these financial cost sharing is possible or not was examined in the F/S and the result was summarized as the financial evaluation.

3.5 Implementation plan

The M/P is planned to be carried out in accordance with the schedule as shown in the table below.

Table 3-16: Schedule of M/P

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Water Supply Management													
Project Preparation (request of finance, etc.)													
Detailed design													
Construction of 2 new wells													
Construction of 5 new wells													
Construction of the transmission line													
Construction of the distribution net													
Construction of new reservoir													
Operation and maintenance													
Domestic Wastewater Management													
Off-site Sewer System													
Project Preparation (request of finance, etc.)													
Detailed design													
Installation of the aerator at STP													
Construction of the sewer network													
Construction of the pump station													
Construction of the sew STP													
Installation of the aerator at the new STP													
Operation and maintenance													
On-site System													
Project Preparation (request finance, etc.)													
Detailed design													
Construction of the On-site System													
Operation and maintenance													
Solid Waste Management													
Project Preparation (request of finance, etc.)													
Detailed design													
Construction and procurement													
Operation and maintenance													