9.4 Recommendations for Industrial Wastewater Management

9.4.1 Conclusions of the Industrial Waste Survey

Wastewater generation amount in Granada is estimated at 1,045,000 m^3/year, about 920,000 m^3/year of which are generated by industries in the CIIU3523 category (soap, detergent, shampoos, etc.).

On the other hand, industries in the CIIU3231 category (tanneries) generate about 55,000 m^3/year of wastewater containing high levels of organic and hazardous compounds such as chromium. Therefore, immediate countermeasures should be taken in Granada to prevent these industries from further adversely affecting the environment.

Since the legislation established is new, it lacks detailed regulations and technical instructions. At present, therefore, industrial wastewater is mostly discharged without treatment to the environment, and is consequently one of the major factors that deteriorate USE.

9.4.2 Recommendations for the Improvement of Industrial Wastewater Management

Industrial wastewater is generated and discharged as a result of industrial production activities. Therefore, industries should bear the cost for its safe management/disposal based on the "polluter-pays-principle (PPP)".

From a technical viewpoint, the following are considered key solutions to the problem:

- Reduction of wastewater generation amount and pollutional load by adopting highly rationalized production techniques.
- On-site wastewater management by industries.
- Industrial wastewater management/disposal by a third party (i.e. private contractors).

It is therefore necessary that relevant authorities take the required administrative measures for industrial wastewater management. Since the enforcement of Decree 33-95 will greatly contribute to this issue, a system that would promote coordination between the industries and the authorities in facilitating appropriate industrial wastewater management should be established.

Strategies to improve the current management system are summarized in Table 9-2.

9.5 Recommendations for Stormwater Management

9.5.1 Inundation Damage in Granada City

The Team investigated areas in the city identified as major inundation prone areas by the counterpart. The table below summarizes inundation damage and its causes in the four inundation prone areas in the city.

- Inundation damage

  Inundation of houses and the outbreak of diseases after the flood were observed. Compared with Leon and Chinandega, only a few areas were affected by inundation and damage was minor.

- Inundated area

  Inundated areas are located in the contraction part of rivers and drainage canals or in areas in partly leveled sections of a steep slope.

- Cause of inundation

  Even though a drainage canal is provided, inundation occurs as the flow of the river from the upstream to the downstream is obstructed by sudden change in terrain, i.e. steep to gentle gradients.

9.5.2 Recommendations for Inundation Mitigation

To mitigate inundation in Granada, it is necessary to: ① conduct basic investigation such as topographic survey; ② formulate drainage improvement plans for channels with insufficient downflow capacities; and ③ secure financial resources for the drainage improvement projects. However, under current circumstances, it is financially, technically and in view of human resources, difficult for Granada Municipality to conduct all these works alone. Therefore, the Study reviewed the current institutional system for stormwater management (i.e. the municipality is currently responsible for construction, operation and maintenance of stormwater facilities), and proposed appropriate institutional systems for stormwater management (separate institutional system for macro-drainage and micro-drainage). The study then proposed a planning guideline for stormwater management in line with the institutional system.

9.6 Outline of Municipal Solid Waste Management M/P

9.6.1 Selection of Municipal SW Final Disposal Site

Localization of a new municipal SW final disposal site is an urgent and inevitable issue for Granada Municipality for it municipal SWM.

Granada City presented the following 2 locations as candidate future final disposal sites for municipal SW.

Site-A: **Buena Vista**

Located north of the city, about 6km from the city center.

Site-B: **San Jose de la Viuda**

Located about 1.4km north of INAA's oxidation lagoon, which is northeast of the city and on Carretera los Malacos.

The Study Team reviewed available data and information regarding these candidate sites, conducted field reconnaissance, and assessed the candidate sites based on the "evaluation items for site selection" presented in Section 4.2.2, Chapter 4 of this report. The table below summarizes the evaluation.

Table 9-7: Summary of Evaluation of Future Final Disposal Candidate Sites

Comparative Evaluation Item	"BV"	"SJV"	Remarks
1. Possibility of Land Acquisition	0	0	possibility of land acquisition should be assured before Phase III
2. Possibility of Neighborhood Consensus	- -	0	residents along the access road
3. Compatibility with Development Plan	0	0	
4. Environmental Acceptability			
i. groundwater contamination	-	0	prevention measures required
ii. flood risk	0	0	
iii. social impacts	- - -	0	residents along the access road
iv. Fauna and Flora	0	-	prevention measures required
5. Economic Feasibility			
i. Land Area Available and Acquisition Cost	0	0	
ii. Access Road Improvement Cost	- - -	0	bridges, culverts, pavement, etc.
iii. Construction Cost	0	0	
iv. Operation and Maintenance Cost	- - -	0	especially leachate treatment and its destination
Ranking	2nd	1st	

Note: BV: Buena Vista
SJV: San Jose de la Viuda
0: equal to the other, or baseline to the other
-: disadvantage
- -: considerable disadvantage
- - -: extreme disadvantage

Based on the evaluation, the Team proposed that San Jose de la Viuda be subject to the F/S. After examining the Team's proposal for site selection (see P/R (2)), Granada Municipality decided to select Site-B (San Jose de la Viuda) as the new municipal SW final disposal site.

9.6.2 Outline of Municipal SWM M/P

The outline of the municipal SWM M/P is shown in the table below.

Table 9-8: Outline of Municipal SWM M/P for Granada

Item	Present (1996)	2000	F/S (2005)	M/P (2010)
FORECAST ON KEY ELEMENTS				
Projected service area	14.3 km^2	14.3 km^2	14.3 km^2	14.3 km^2
Population in the study area	76,250	97,078	114,760	135,106
Waste generation amount	57.1 tons/day	76.6 tons/day	97.5 tons/day	123.4 tons/day
Waste discharge amount	43.2 tons/day	59.5 tons/day	78.2 tons/day	102.0 tons/day
Waste collection amount	35.4 tons/day	48.8 tons/day	70.4 tons/day	102.0 tons/day
Final disposal amount	36.9 tons/day	50.2 tons/day	72.7 tons/day	104.5 tons/day
Coverage rate (waste amount)	82.0 %	82 %	90 %	100 %
Coverage rate(population)	63.0 %	63 %	89 %	100 %
Service population	48,037	61,159	101,843	135,106
Non-service population	28,213	35,919	12,917	0
Length of road swept	35 km	35 km	40 km	47 km

Item	Present (1996)	2000	F/S (2005)	M/P (2010)
PARTICULARS OF THE PLAN				
1.Collection & Transport				
Collection system	Curb collection	Curb collection	Curb, Point collection	Curb, Point collection
No. of collection vehicles	Tractor:2, Dump truck : 1, Truck:3	Tractor:2, Dump truck : 1, Truck:3	Compactor truck: 7, Tipper truck:1, Wheel loader : 1	Compactor truck:9, Tipper truck:1, Wheel loader : 1
Transportation system	Direct transport	Direct transport	Direct transport	Direct transport
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of personnel	32	32	34	42
Unit cost of collection	C$110.2/ton	C$99.8/ton	C$100.4/ton	C$92.6/ton
2. Street sweeping				
Cleaning method	Manual	Manual	Manual	Manual
Length of road	49 km	-	-	-
Length of road swept	35 km	35 km	40 km	47 km
Responsible authority	Municipal Service Department	Municipal Service Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
Number of personnel	30	30	30	30
Unit cost of street sweeping	C$1.09/m	C$21/km	C$21/km	C$21/km
Equipment used	Broom, shovel, handcart	Broom, shovel, handcart	Broom, shovel, handcart	Broom, shovel, handcart
3. Intermediate treatment	None in particular	None in particular	Not required apart from on-site & community based ones.	Not required apart from on-site & community based ones.
4. Recycling				
Recycling Amount				
At generation point	5.0 tons/day	6.7 tons/day	8.5 tons/day	10.8 tons/day
At landfill	0.5 tons/day	0.7 tons/day	0.0 tons/day	0.0 tons/day
Recycling system	Not organized recycling	Not organized recycling	Segregation of wastes for recycling to be promoted.	Segregation of wastes for recycling to be promoted.
5. Final disposal				
Disposal method/level	Open Dumping	Controlled Tipping (Level 1)	Sanitary Landfill (Level 4)	Sanitary Landfill (Level 4)
Disposal site	La Joya	La Joya	San Jose de la Viuda	San Jose de la Viuda
Site area	3 ha	3 ha	6 ha	6 ha
Distance of site from generation center	5 km	5 km	5 km	5 km
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of personnel	1	2	10	10
Charge for Disposal	C$24/ton	-	-	-
Unit disposal cost	C$4.26/ton	C$7.9/ton	C$153.8/ton	C$143.2/ton
Main equipment	Bulldozer: 1 (rental : occasional use)	Bulldozer: 1	Bulldozer:1, Tipper truck:1, Excavator:1, Sprinkler truck:1	Bulldozer:1, Tipper truck:1, Excavator:1, Sprinkler truck:1

Item	Present (1996)	2000	F/S (2005)	M/P (2010)
6. Maintenance of Vehicles and Equipment				
Maintenance shop	1	1	1	1
Responsible authority	Municipal Shop	Municipal Shop	A new workshop	A new workshop
No. of employees	3	3	-	-
7. Operation				
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
Number of personnel	63	-	-	-
Type of operation	Municipal operation	Municipal operation	Municipal operation	Municipal operation
8. Finances				
City budget	C$14,327,000	C$17,957,000	C$22,918,000	C$27,617,000
Cleansing department budget	C$1,431,000	C$1,479,000	C$4,226,000	C$5,479,000
Management of service recipients	Through a register	Existing system	Department of Administration and Finance	Department of Administration and Finance
Fee collection method	Door to door	-	-	-
Rate of fee collection	16.3 %	70.0 %	82.5 %	95.0 %
Revenue	C$106,000	C$532,000	C$2,419,000	C$3,394,000
9. Contract to Private Sector Method of contract	None	None	To be examined	To be examined

9.7 Recommendations for Industrial Solid Waste Management

9.7.1 Conclusions of the Industrial Solid Waste Survey

Industrial solid waste (ISW) generation amount in Granada is estimated at about 1,000 tons/year, the smallest of the 3 cities. The industries in the CIIU3111 category (livestock slaughtering, meat production) are the main sources of ISW generation in Granada, generating about 50% of the total ISW in Granada. Solid waste from these industries mainly consists of organic compounds. Industries in Granada that are most likely to generate hazardous waste are those under the CIIU3231 category (i.e. tanneries). These industries make up about 10% of the total ISW generation in Granada.

Industrial solid waste in Granada is mostly disposed of in the municipal solid waste dumping site without any control and order.

9.7.2 Recommendations for the Improvement of ISWM

Industrial solid waste (ISW) result from industrial production activities. Therefore, as in industrial wastewater management (IWWM), the cost for the safe management/disposal of industrial solid waste should be borne by the industries, based on the polluter-pays-principle (PPP).

From a technical viewpoint, the following are considered key solutions to the problem:

- Reduction of ISW generation amount and pollutional load by adopting highly rationalized production techniques.

- Establishment of appropriate management/disposal technologies and systems for each ISW category.

A key issue in ISWM is the management of hazardous ISW. The exclusive operation of facilities for the management and/or disposal of hazardous ISW should be urgently established. Until this is realized, authorities are recommended to practice the following measures in the management of hazardous ISW:

- Industries shall be required to practice waste minimization, on-site treatment, and storage of hazardous IW.
- Utilization of existing facilities (e.g. incineration in cement kilns) shall be examined for hazardous IW treatment. Industries shall be obliged to take the necessary actions (e.g. cement kiln utilization) if they generate hazardous wastes to which such treatment is applicable. In case it is not applicable, the industries shall be obliged to store hazardous ISW.
- Avoid mixed disposal of ISW and domestic SW in the municipal disposal site by establishing a monitoring system to prevent hazardous ISW disposal. Industries proven as non-generators of highly hazardous ISW are allowed to dispose their wastes in the municipal landfill site.

In this regard, the formulation and enforcement of legislation relevant to the management and disposal of ISW are very important and urgently required.

9.8 Recommendations for Medical Solid Waste Management

9.8.1 Conclusion obtained from the Survey on Medical Waste Management

The table below shows the forecast on present and future medical SW generation in Granada based on the questionnaire survey, in line with the medical SW classification proposed by the Team.

Table 9-9: Forecast on Present and Future Medical SW Generation

Unit: kg/day

Waste Classification	1996	2000	2005	2010
Risky Waste*1	48.0	61.1	72.2	85.1
Hazardous Waste*2	1.6	2.0	2.4	2.8
Special Waste*3	0.6	0.8	1.0	1.1
(Sub-total)	50.2	63.9	75.6	89.0
Common Waste*4	49.1	62.5	73.9	86.9
Total	99.3	126.4	149.5	175.9

Note: The classification is proposed by the Team.

*1: Infected waste (sharps, blood, used dressing, etc.), infected waste from laboratories, waste from patients with infections and wastewater.
*2: Chemical waste (medicines, disinfectants, solvents, etc.), radioactive waste.
*3: Ash from incinerator, sludge.
*4: Office waste, kitchen waste, packing waste, bulky waste, garden waste, DWW.

The majority (67 %) of the medical institutions separate medical waste at the source of generation. However, only some medical institutions practice separate haulage; the rest practice mixed haulage on-site. Most medical wastes stored on-site are collected by municipal services. Some infectious wastes are incinerated in a primitive manner (open burning).

Medical wastewater is either discharge into the sewer or a soak pit without treatment by institutions surveyed.

9.8.2 Recommendation for the Improvement of Medical Waste Management

In order to establish an appropriate medical waste management (medical WM), MINSA should take a leading role in defining the classification of medical waste and should enforce handling guidelines (i.e., code of practice) for different medical wastes. Consequently, medical institutions should be obligated to practice appropriate medical WM according to the code of practice (e.g., separate collection and haulage of hazardous/infectious medical waste). Furthermore, a commercial system for medical WM should be formulated in order to secure appropriate treatment/disposal of hazardous/infectious medical waste by the private sector.

In order to realize the above-mentioned plan, it is indispensable to establish an administrative institution which promotes, instructs, oversees, and regulates the execution of appropriate management for medical waste. Furthermore, the separation of infectious and non-infectious waste at the generation source should be assured, and education for workers including collection workers should be provided without exception, in order to practice appropriate collection, treatment, and disposal of separated hazardous/ infectious medical waste. Institutions such as SILAIS should take leading roles in taking these actions.

9.9 Institutional Improvement Proposals for the Implementation of the USE Master Plan

9.9.1 Introduction

Organizational and institutional improvements, that are proposed in this study, are outlined in the following items:

- Basic organization charts for the municipality.
- Specific organizational functions.
- Instructions and regulations.
- Strategies for collaboration among the institutions.

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 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 low income citizens 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 improvements. 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 coordinate 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 9-1, 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.

9.9.2 Proposed Organizational Structure

The overview of the proposed organizational structure is illustrated in Figure 9-1 to Figure 9-5.

In order to maximize the capability of the municipality, without disturbing its normal operations, the organizational reform should be supervised and assisted by an expert in organization methods and personnel training. The expert should be supported by a legal advisor and be offered a high ranking position in the mayor's staff.

The existing international cooperation advisor should also be involved in the modification of the organizational structure, in view of the international cooperation projects that are involved with the municipality. The main departments that would be reshuffled and modernized, when the M/P is executed, are as follows:

1. Bureau of Urban Environmental Maintenance

- Department of Refuse Collection and Public Area Cleaning
- Department of Vehicles and Equipment

2. Bureau of Public Works and Services

- Department of Public Construction and Maintenance (in particular the Urban Maintenance Section)

3. Bureau of Municipal Planning and Projects

- Cadastre Department
- Department of Urban Development
- Department of Private Constructions

4. Bureau of Administration and Finance

- Department of Finance (in particular, the Budget Control, Tax Collection and Audit Sections)
- Department of Purchase and Contracts (under and assistant director).

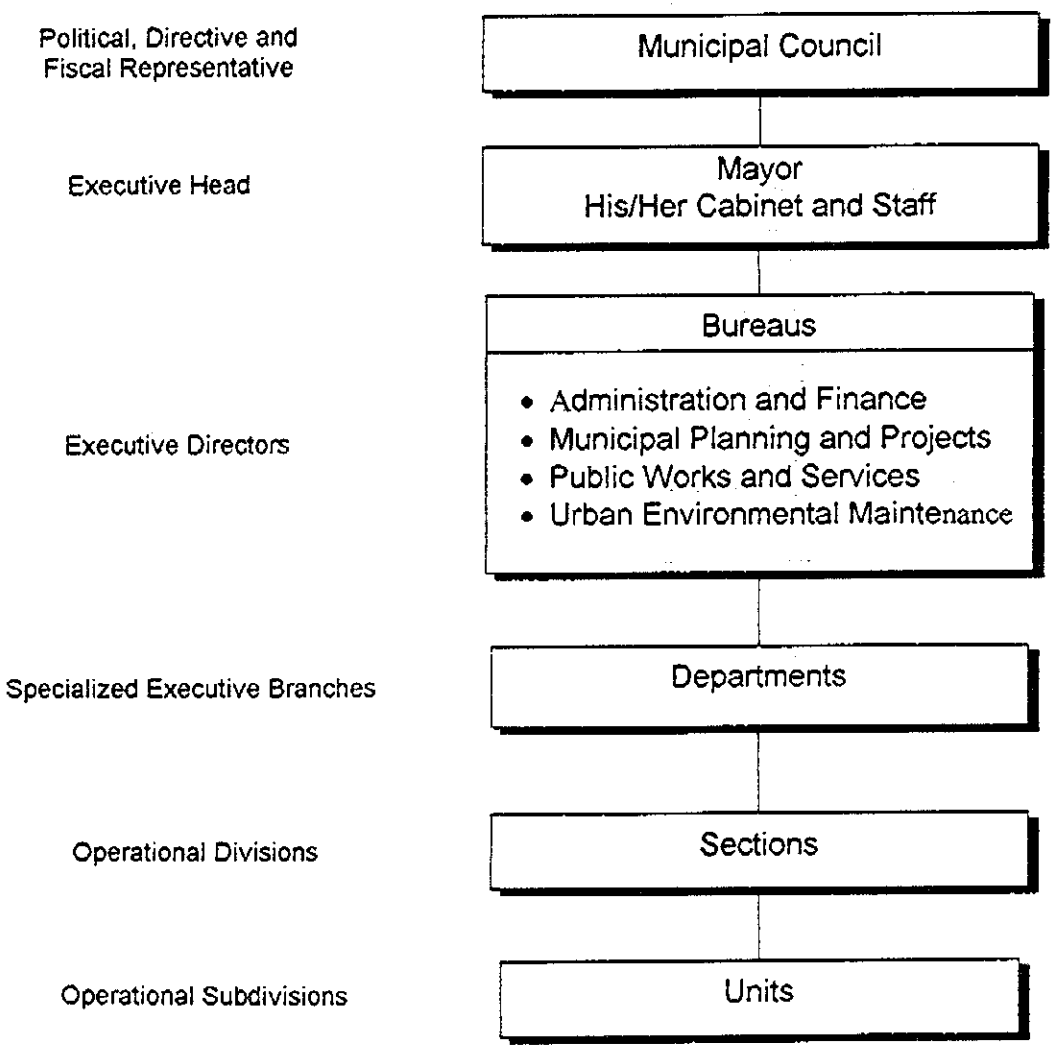


Figure 9-1: General Organization of the Municipal Administration

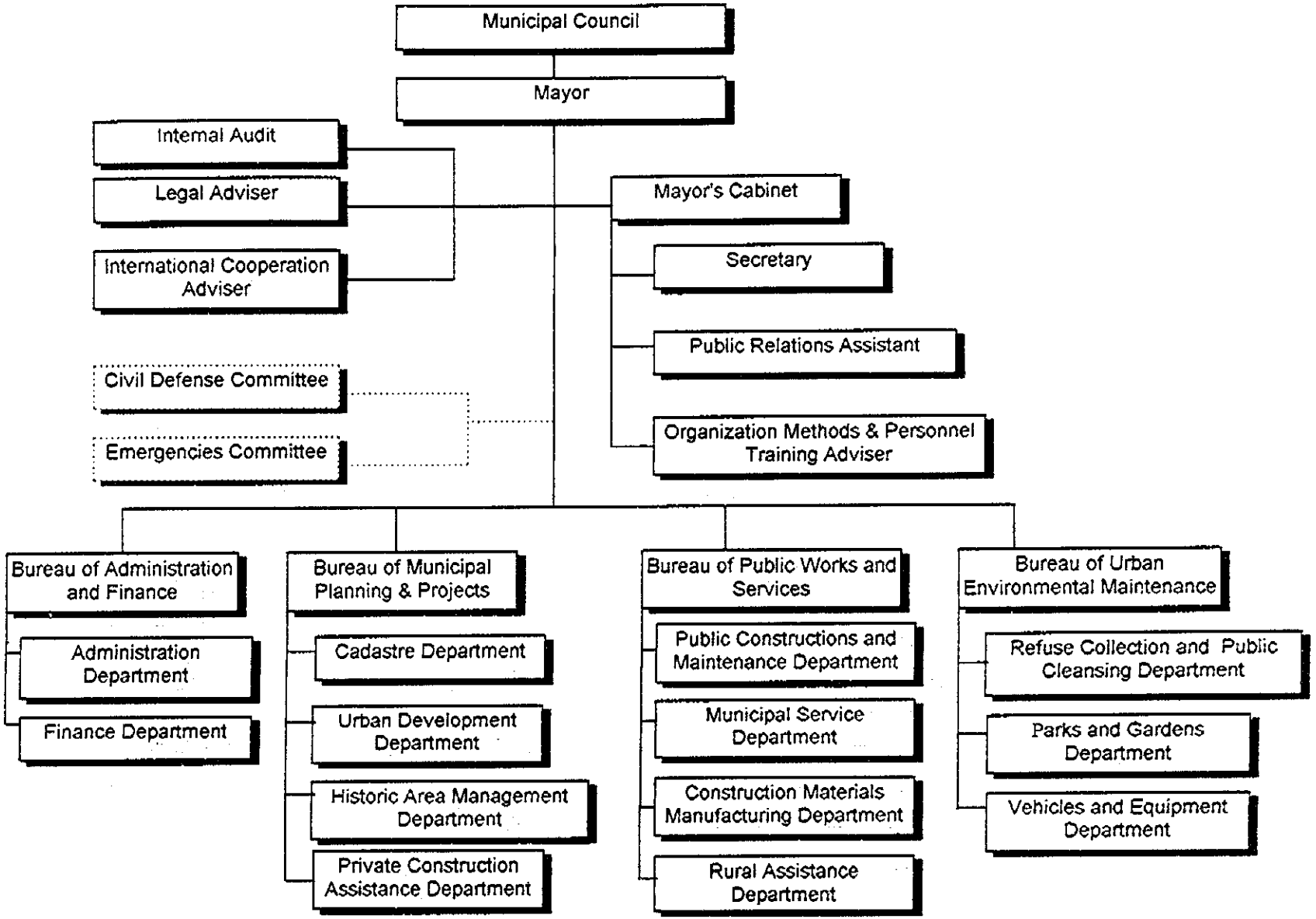


Figure 9-2: General Organizational Structure

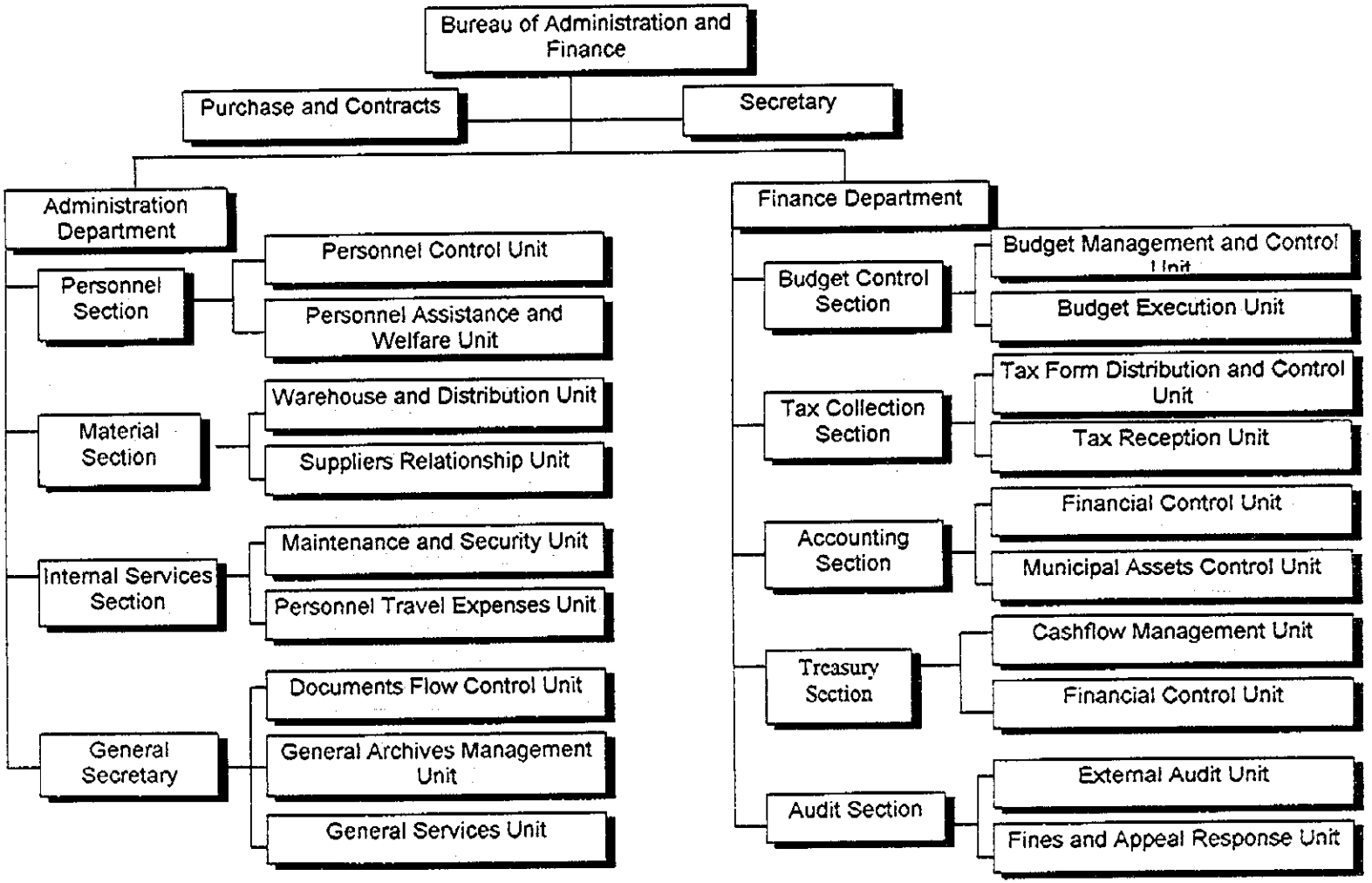


Figure 9-3: Organizational Structure of the Bureau of Administration and Finance

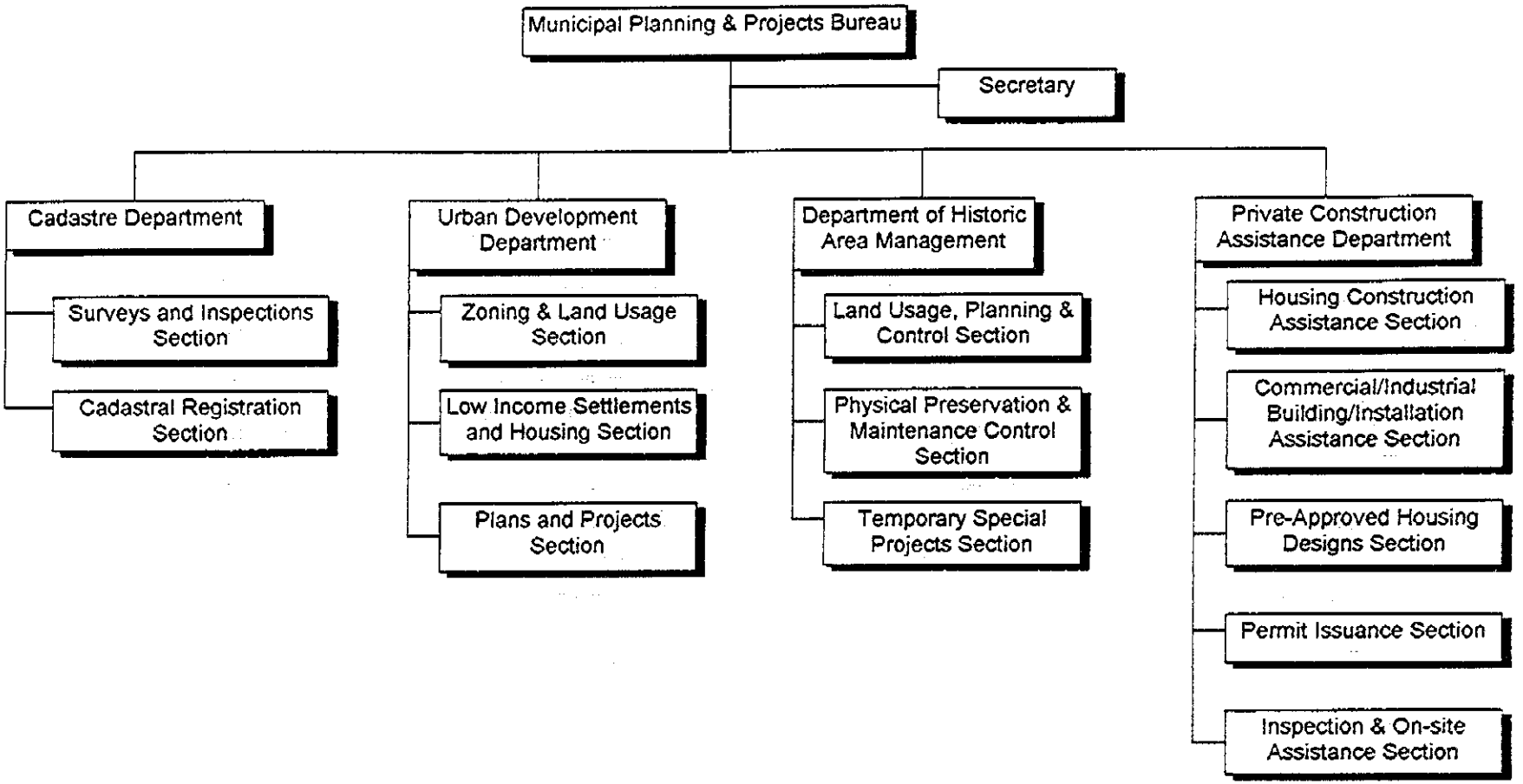


Figure 9-4: Organizational Structure of the Bureau of Municipal Planning and Projects

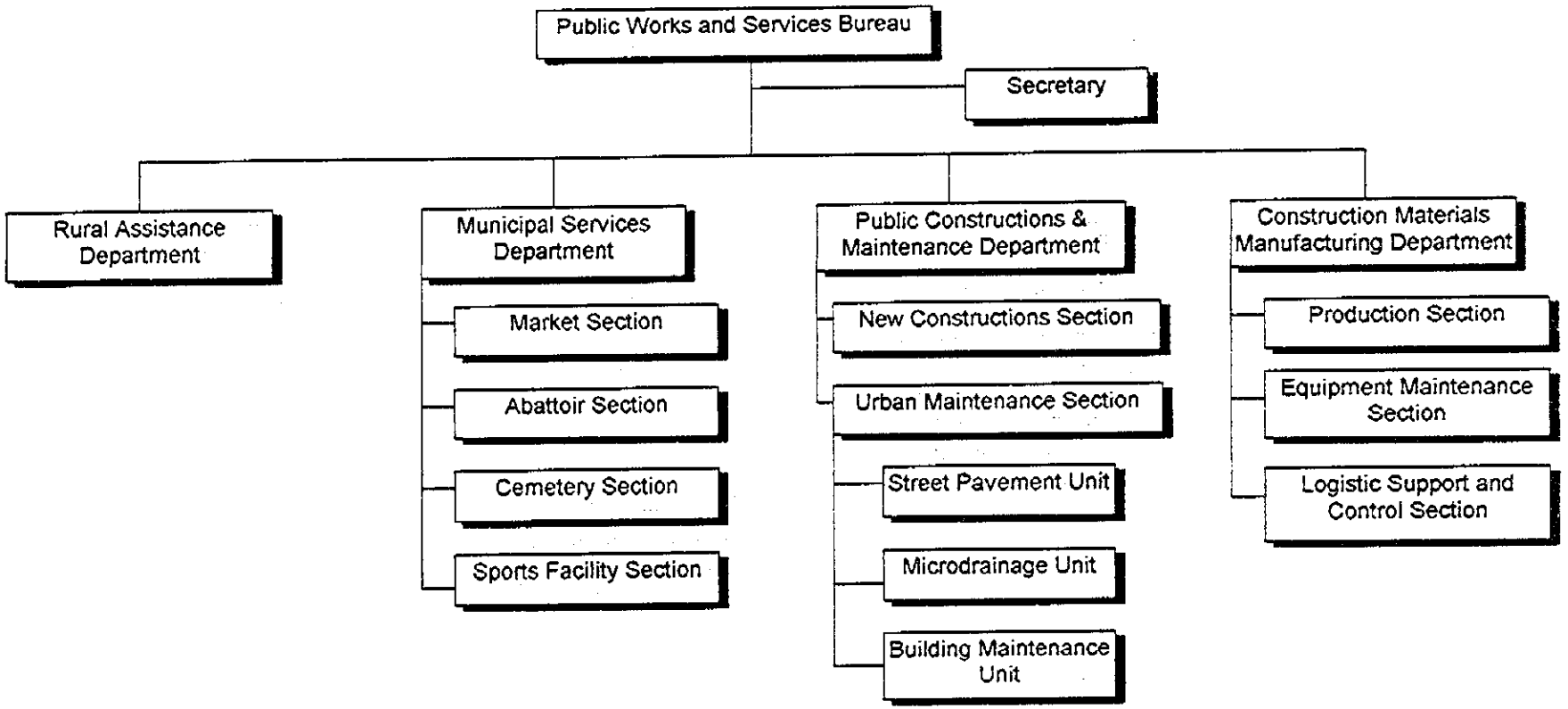


Figure 9-5: Organizational Structure of the Bureau of Public Works ad Services

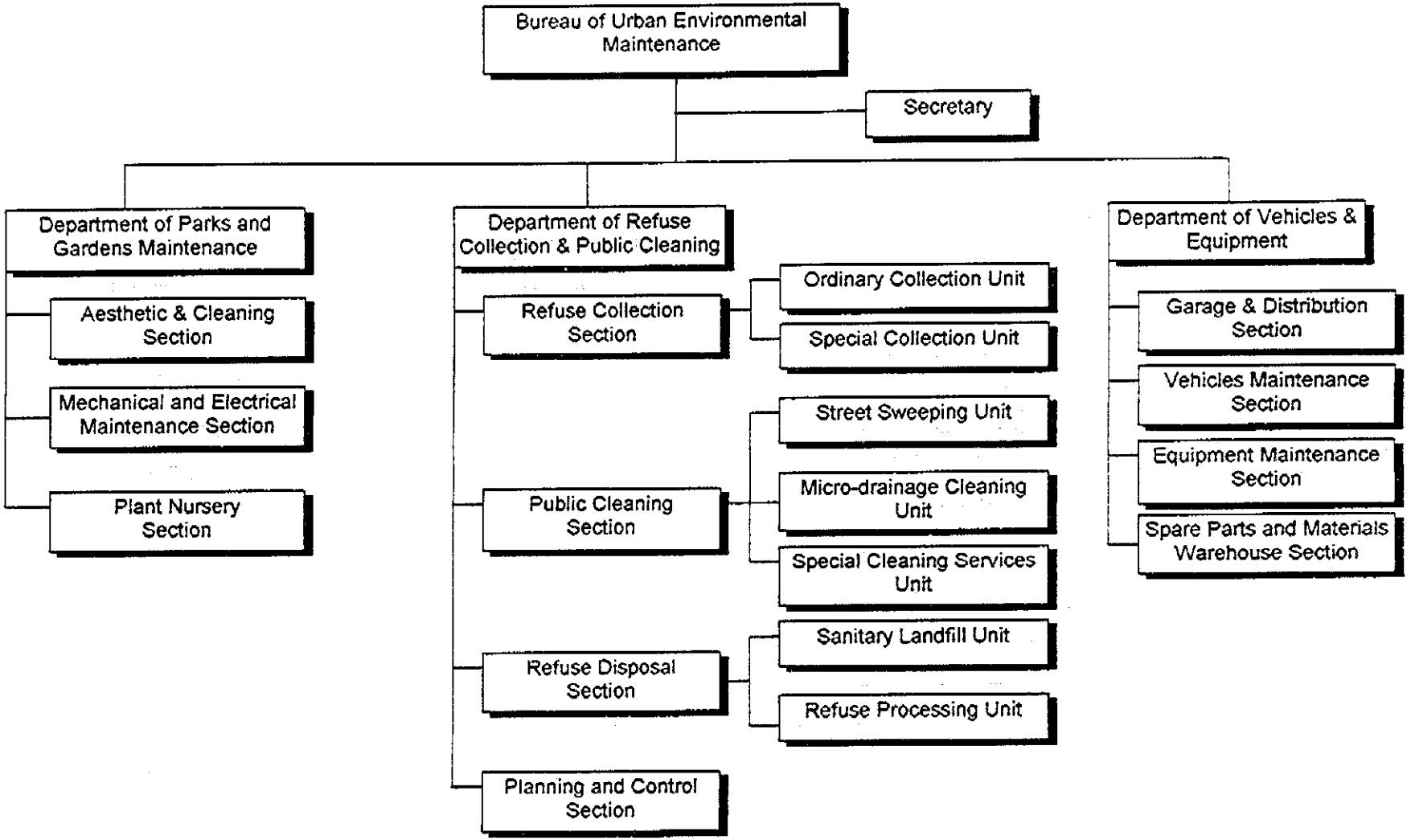


Figure 9-6: Organizational Structure of the Bureau of UEM

9.9.3 Specific Organizational Functions

Municipal Council

- To establish policies and guidelines to manage the regional and economic resources within the municipality.
- To supervise the administrative duties of the Mayor.

Mayor

- To hold the highest executive power in the municipality; also to perform duties established by the Municipal Council.

Mayor's Cabinet

- To establish and continuously improve norms, procedures and administrative tasks in the municipality.
- To assist the mayor to supervise and coordinate the executive directors.
- To execute administrative tasks directly related with the mayor and his/her staff.
- To establish and maintain a good relationship with the media; listen and respond to positive criticisms or complaints made by citizens.

Internal Audit

- To establish financial regulations and procedures that might affect the municipal economy.
- To review the financial and/or economic performance of the municipality.

Legal Adviser

- To give advise on regulations related to administrative and civil law that can be applied to other administrative acts of the mayor's office.
- To objectively scrutinize and revise contracts and conduct other legal administrative duties.
- To defend the municipality judicially, as a mayor's representative.

International Cooperation Adviser

- To establish a relationship with foreign organizations that are willing to cooperate, directly or through national institutions.
- To act as a representative in committees that coordinate international cooperation agreements.
- To evaluate the performance and results of each cooperation agreement.

Civil Defense Committee

- To plan and execute emergency procedures and protect national security (the committee is established and operations are executed by the national army with the cooperation of municipalities).

Emergency Committees

- To plan and execute disaster relief during natural disasters and maintain public safety in emergencies (these committees are temporary task forces established in cooperation with other public and private institutions whenever there is a natural disaster such as earthquakes, floods, and droughts).

Bureau of Administration and Finances

- To perform all the administrative duties of the municipality.
- To manage material and human resources, as well as provide internal and logistic support.
- To centralize and conduct inquiries into all formal requests to the municipality made by the citizens; to inform them of the current stage in their inquiry and the authority's decision.
- To prepare the municipal budget according to the directors' proposals and with the mayor's approval.
- To control the municipal budget.
- To undertake accounting of income and expenditure, and the management of municipal assets.
- To plan and execute the collection of taxes, credits, and fines.
- To keep the accounts and impose sanctions, as defined in the ordinance.

Bureau of Municipal Planning and Projects

- To maintain the cadastre updated.
- To define zones and establish the conditions for urban land use.
- To establish and control settlement plans and housing projects for poorer citizens.
- To develop municipal plans and projects.
- To control the development of the historic area and supervise constructions.
- To prepare technical instructions (related to residential and non-residential construction projects) for the general populace based on regulations and instructions of the responsible authorities (municipal or others).
- To scrutinize and prepare standardized designs that will be approved for low income housing.
- To establish construction permits and user permits, as well as to execute the required inspections.
- To instruct and assist the citizens with respect to location, construction, and modification of properties.

Bureau of Public Works and Services

- To install and maintain public assets and systems in the municipality, with the exception of parks and gardens.
- To manage factories making construction materials.
- To manage all the municipal services, except those that are contracted out.
- To attend the needs of the rural area in terms of development and provision of services, under a special program by the municipality.

Bureau of Urban Environmental Maintenance

- To plan, execute and control all urban cleansing operations: waste collection (residential and non-residential), cleaning of public places, and final disposal of municipal waste.
- To maintain aesthetic standards, cleaning and management of parks, gardens, and public forests as well as operating the plant nursery.
- To provide, distribute, control and maintain the municipal vehicles, machines, and other equipment.

9.9.4 Enhancement of the Human Resources

The organizational structure of the municipality must be supported by skilled personnel, implying that the available personnel must be trained to perform various functions. An expert in organization methods and training should prepare and introduce the personnel improvements, so that a continuous training program can be implemented without disturbing the normal work flow of the municipality. The expert could be an external specialist and should be given a high ranking position, as proposed in the organizational chart outlined in Figure 9-2.

The M/P proposes the following training programs for municipal personnel involved in USE improvements.

Bureau of Municipal Planning and Projects

The personnel will receive training on specialized information in the following areas:

- Formulation of the cadastre.
- Planning of urban developments.
- Assistance of private construction projects.

Professional and operational training on collection and evaluation of documents, plans, projects and regulations should be provided; also on reviewing and supplementing any deficiencies in the data available. The ultimate aim is to establish a simple but effective municipal planning structure in Granada, mainly regarding:

- Zoning & land usage
- Low income settlements and housing
- Instructions on building houses
- Pre-approved housing designs

- Instructions on the construction of commercial and industrial buildings or installations
- Issuing permits
- Inspections & on-site assistance

Bureau of Urban Environmental Maintenance

The managerial training program for personnel of the Department of Waste Collection and Public Area Cleaning should cover the criteria and goals for the USE, employee motivation strategies as well as operation and cost monitoring and control.

The personnel of the Department of Vehicles and Equipment should undergo managerial training on the criteria for vehicles and equipment usage, as well as the control of their operation, maintenance and costs.

Operational training should cover the following items.

- Planning and control of operational, maintenance and service costs.
- Planning and control of vehicles and equipment maintenance as well as maintenance costs.
- MSW collection (regular collection services).
- Primary vehicle maintenance.

Bureau of Administration and Finance

The personnel of the Bureau of Administration and Finance should undergo operational as well as general training on:

- Management of the municipal and departmental budgets.
- Efficient tax collection methods.
- Improved methods of obtaining information such as statistical data and reports from field surveys conducted.

9.9.5 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, aiming to achieve a better **strategy** to control the sanitary conditions in the city.

(a) To centralize all the information that is frequently accessed by citizens in the municipality (e.g. the manager of cleansing services, constructors of DWW treatment facilities, and the beneficiaries of the sanitary services);

(b) To offer information to the citizens as a clear and simple instruction using understandable language so that every body could use it.

(c) To exchange data among the authorities that offer services to the population, aiming to effectively expand the provision of services as well as improve the methods of collecting service fees.

The municipality would have to create legal and technical norms in order to:

- support the system of permits that are mentioned above (with INAA, MINSA, and MARENA)
- support MSW (with MINSA), medical waste (with MINSA and MARENA) and industrial waste management (with MARENA).
- support the administrative duties related to the microdrainage system (with INAA, MARENA and MINSA)
- share duties and responsibilities for the micro-drainage system: i.e. streams, lakes, river basins (with INIFOM, MARENA, INAA, MCT)
- manage the domestic wastewater produced in the urban area (with MINSA, INAA)
- manage the wastewater produced from commercial and industrial buildings in the urban area (with MINSA, INAA).

9.9.6 Recommended Regulations, Instructions and Administrative Guidelines

The study team recommends the following instructions and administrative guidelines for the authorities.

a. INAA

i. Instructions on Potable Water Connection and Services

Where there is a water supply network in the area: the costs and administrative procedures for contracting out services, the technical requirements for connecting to

INAA's network and the instructions must be specified and different for residential, commercial and industrial buildings.

ii. Instructions on Connection of the Wastewater to the Sewer

Where there is a sewage network in the area: the costs and administrative procedures for contracting out services, the technical requirements for connecting to INAA's network and the instructions must be specified and different for residential, commercial and industrial buildings.

Through the permit system the municipality should enforce and instruct the citizens, during the construction of their houses, to connect them to the sewer network, if it passes by the property.

INAA, the municipality and MINSA should implement a program to connect houses that are already built next to the sewer network, at affordable prices for the residents.

iii. Instructions on Wastewater On-site Treatment and Disposal Facility

Even where there are no sewers in the street, citizens still require adequate treatment for their wastewater and a disposal facility. Therefore, a facility should be built/installed according to INAA's technical instructions. INAA may recommend or enforce individual or collective systems, depending on each unique situation. A Municipal Ordinance may enforce the appropriate recommendation.

INAA should build and/or operate collective facilities. In any case, INAA should operate sludge collection services from on-site facilities (both individual septic tanks or soak away pits and collective systems), and should provide inspection/maintenance services for them. The municipality and MINSA should plan and cooperate with INAA to find the most appropriate on-site solutions for treating domestic wastewater generated from very poor communities where the sanitary and social conditions are most affected.

b. MINSA

i. Guidelines for On-site Medical Solid Waste Management

MINSA should establish a classification for medical SW, procedures for handling said waste, equipment, organization and required qualifications of the personnel who will be in charge of the medical SW. These concepts should be presented as instructions that should be further consolidated in a regulation or "code of practice", initially targeting medical institutions and laboratories.

The municipality may collect and dispose of non-hazardous medical waste that are separated/classified by medical institutions prior to discharge. However, radioactive and hazardous (excluding infectious and sharps) waste should be regulated by MARENA.

ii. Instruction on Connection of the Wastewater to the Sewer

In the sewer connection program, MINSA (together with INAA and the municipality) should primarily give clear explanations to the public and provide sanitary education.

iii. Instructions on On-Site Wastewater Treatment and Disposal Facility

Even where there are no sewers in the street, citizens still require adequate treatment of their wastewater and a disposal facility. Therefore, a facility should be built/installed

according to INAA's technical instructions. INAA may recommend individual or collective systems, depending on each unique situation. A Municipal Ordinance may enforce the appropriate recommendation.

MINSA and the municipality should plan and cooperate with INAA to find the most appropriate local solutions for treatment of domestic wastewater generated from very poor communities where the sanitary and social conditions are most affected.

c. MARENA

i. Guidelines for Industrial Waste Management

MARENA should establish a classification of industrial waste, procedures to classify and segregate them and on-site storage methods. Disposal of such wastes should also be clearly defined. MARENA should recommend a basic internal organizational structure for industries concerning on-site management of all generated waste.

MARENA should monitor and establish adequate conditions for collection and disposal of non-hazardous industrial waste by the municipality.

MARENA should promote market oriented incentives for private investment in collection and/or disposal of hazardous and non-hazardous ISW. It is recommended that MARENA study and organize a registry of industrial categories and the types of waste generated. Subsequently, an inventory of Nicaraguan industries, the IW generated, and common practices for ISW management should also be prepared. These elements mentioned above are pre-conditions for regulating the IW problems in practice.

Finally, a very simple and realistic waste classification should be established that should not be based on difficult or sophisticated analytical methods, but it should be based on the actual human and technical resources of Nicaragua.

ii. Guidelines for Management of Hazardous Products

MARENA should collect technical information on hazardous products and their waste, and also the amount of these products imported/manufactured in Nicaragua, in order to evaluate the situation.

MARENA should also organize and maintain an inventory of manufacturers and importers of hazardous products and begin to monitor its flow.

iii. Guidelines for Drainage Systems, Classification and Responsibilities

Micro-drainage, as part of streets, roads, and public areas should be the responsibility of the municipality and MCT (roads and adjacent public areas are under MCT jurisdiction);

Macro-drainage are permanent fluvial course and seasonal streams that should be under the responsibility of MARENA (normative, inspections, penalties) and MCT (works and maintenance).

iv. Guidelines for Discharge of Wastewater into Waterways

MARENA should regulate wastewater flow into streams and dry river beds, i.e., wastewater from domestic, industrial, institutional and any other sources discharged into the macro-drainage system.

d. MCT

i. Guidelines on Urban Road Drainage

The MCT should establish regulations on the use of micro-drainage along urban roads under its jurisdiction, and provide instructions for the citizens through the municipality.

ii. Instruction on Constructions along Urban Roads

The MCT should instruct and regulate construction projects that could affect the roads under its jurisdiction.

e. MUNICIPALITY

i. Guideline on Solid Waste Collection/Disposal, and Cleaning of Public Streets

The municipality should distribute a complete set of regulations and specific instructions to the citizens on acceptable behavior related to SW and littering of public areas.

ii. Guideline for Usage of the Micro-drainage System

The municipality should regulate the discharge of wastewater into the micro-drainage system and supply technical instructions for connections, as well as prohibiting and punishing those who dispose SW into it.

iii. Regulations on Urban Zoning and Land Usage

The municipality should revise and enact regulations, this process should begin with the improvement of access to information for the public, by publicizing plans and instructions on zoning, suitability and requirements for locating of private constructions.

iv. Regulation and Registration of Buildings

The municipality should review and prepare regulations, but it should begin by improving access to information for the public by publicizing instructions on location of new buildings and sanitation facilities. Connection to the sewer or collective systems, requirements for sanitation systems and standards should be reviewed. Information on requirements for other public services should also be provided through a public information system.

The municipality should review and prepare a Permit System that would comprise: (a) Construction Permit for housing, commercial and industrial buildings or installations; and (b) User Permit for buildings/installations. Using this system, the municipality should immediately submit data to the Cadastre Department, which should supply relevant data to other public services and the Finance Department of the municipality.

The municipality should prepare scale models and drawings for pre-approved designs for low-cost housing; these buildings must also be inspected and registered.

The municipal administration should review and improve its cadastre, in order to supply data for all municipal services and financial sectors. It should also discuss land use and compatibility with other public services.

9.10 Evaluation of the USE M/P

Master plans on water supply management, DWWM and municipal SWM were evaluated from technical, social, environmental, financial and economic standpoints.

9.10.1 Technical Evaluation

It has been examined whether the technical systems proposed in the Study are compatible and enforceable in terms of facilities construction, operation and maintenance, in comparison with the technical skills of Granada Municipality and the INAA, who shall be the main executing bodies of the proposed technical systems.

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

- Sullage on-site collective treatment/disposal.
- Sanitary landfill at the municipal waste disposal site.

In this regard, the workability of these 2 technical systems was examined through the pilot projects in the 3rd Study Work in Nicaragua.

9.10.2 Social Evaluation

The social evaluation was carried out taking into consideration the MP's contribution to social equality and justice as well as social acceptability.

Sewer and waste collection service rates in Granada are presently inferior to other principal cities in Nicaragua. USE improvement under these sectors by realizing the MP for Granada may also justify social welfare contribution.

All technical systems proposed other than the sullage on-site collective treatment/disposal and sanitary landfill examined through pilot projects were evaluated to be socially compatible and enforceable, since they are commonly practiced in Granada as well as other cities in Nicaragua.

The acceptability of the two technical systems specified in Section 9.10.1 was examined in terms of ease in gaining neighborhood consensus and cooperation for their application through the pilot projects in the 3rd Study Work in Nicaragua. The pilot projects were implemented together with the public campaign.

9.10.3 Environmental Evaluation

It has been evaluated that the favorable environmental impacts from the implementation of the M/P far outweigh the adverse impacts.

An environmental survey was carried out in the 3rd Study Work in Nicaragua to determine the adverse environmental impacts of the new municipal landfill in SJV, planned in line with the M/P. Consequently mitigation measures for adverse environmental impacts were proposed.

9.10.4 Financial Evaluation

For the financial evaluation of the M/P, the annual expenditure and revenue of the Granada Municipality and the INAA Region IV were compared to determine their financial standing. As a result of the evaluation, the following assumptions were made:

1. The present charge for water supply services will be raised in proportion to the increase in the service operation cost from year 2001.
2. The average WTP (willingness to pay) expressed in the POS (Public Opinion Survey) by those who are presently not receiving DWW collection services is assumed as the charges to be paid by households from 2001. Charges for industries are assumed to be 30% of the water charges defined in (1.) above.
3. The average WTP expressed in the POS by those who are presently covered and not covered by the SW collection services is assumed as the charges to be paid by households from 2001. Charges for waste collection services for industries and commercial institutions are 100% of the service operation cost.

Table 9-10: Forecast on Balance in Project Revenue & Expenditure

Unit : C$1,000

		1995	Average in 2001 - 2005	Average in 2006 - 2010	Total of 2001 - 2010
New projects only (*1)	Water Supply		-1,324	-748	-10,356
	DWWM				
	Off-site system		-468	-713	-5,907
	On-site system		-1,327	-3,486	-24,068
	SWM		-4,083	-5,569	-48,256
All projects (existing and new projects)	Water Supply	2,257	2,558	3,133	28,455
	DWWM	1,161	60	-2,344	-11,419
	Off-site system	1,161	1,388	1,142	12,649
	On-site system (*3)		-1,327	-3,486	-24,068
	INAA total (*2)	3,418	2,618	789	17,036
	SWM (*4)	-1,239	-4,083	-5,569	-48,256

The above table indicates the following:

*1: The revenue from new beneficiaries alone cannot cover the costs of the new projects.

*2: Although INAA's total revenue from all existing and new projects is greater than its expenditures, the operation of the on-site DWWM system will incur a huge deficit on its gross finances.

*3: To attain a balance in the finances for the operation of DWWM systems, the charges for sewers and collective on-site systems should be raised from 2006 to 2010, or the provision of the on-site system be extensively delayed (or lower the provision rate until 2010).

*4: To attain a balance in the finances for municipal SWM, Granada Municipality needs to secure funds about 4.5 times the present SWM budget to finance operations from 2006 and 2010 (20.7% of the municipal budget is required; present budget for SWM is 10.0% of the municipal budget).

On the other hand, whether the charges assumed in the M/P are appropriate or not for citizens was reexamined in view of their ability to pay. The results show that the charges for 2006 to 2010 account for about 4.8% of the average household income. It is necessary to check whether the citizens can afford to pay more (from 3.3% to 4.8% in future), or establish other alternatives to alleviate the burden (i.e. cheaper yet appropriate technologies).

Finding solutions to this problem was one of the key issues pursued in the 3rd Study Work in Nicaragua.

9.10.5 Economic Evaluation

The results of the economic evaluation indicate the following benefits: WTP of those who are presently not covered by the services and favorable impacts of an improved environment (e.g. public health improvement, rise in property value, more tourists).

The "economic internal rate of return (EIRR)" and "cost benefit ratio at 0% discount rate (B/C)" were calculated for the 3 cases below.

Case-1: Benefits are equal to WTP expressed in the POS in 3 cities;

Case-2: Benefits are defined to equal to an aggregate of the above WTP benefits and beneficial impacts of environmental improvement (expressed in terms of benefit per household); and

Case-3: Benefits are defined to equal to the current charges that citizens are paying to the executing bodies (the municipality and INAA).

Table 9-11: 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$29.35/month		C$45.50/month	
	n.a.	0.5013	- 2.1%	0.8458	12.3%	1.6899
DWWM (Off-site)	C$8.32/month		C$21.96/month		C$19.67/month	
	n.a.	0.5989	7.0%	1.5811	2.1%	1.1742
DWWM (On-site)	C$8.32/month		C$28.79/month		C$19.67/month	
	- 2.2%	0.4505	6.4%	1.5586	- 0.4%	0.9087
Municipal SWM	C$6.48/month		C$16.15/month		C$7.38/month	
	n.a.	0.4076	0.4%	1.0161	n.a.	0.4409

The evaluation resulted in the following:

- WTP for DWW services is comparatively high. Therefore, the DWWM project was given priority in the M/P implementation.
- Considering various intangible benefits (e.g., preservation of natural resources and ecology of Lake Nicaragua, prevention of potable water resource pollution, protection of fishing grounds, foreign/domestic investment promotion), the M/P implementation is deemed to contribute to national economic growth.

9.10.6 Overall Evaluation

The technical and social evaluations were carried out through pilot projects, to determine the applicability of the systems proposed in the M/P. Overall, however, the M/P (except for the issues subject to the evaluation) is deemed to be appropriate.

The environmental and economic evaluations indicate that the implementation of the M/P is appropriate in view of its impacts on the environment and national economy.

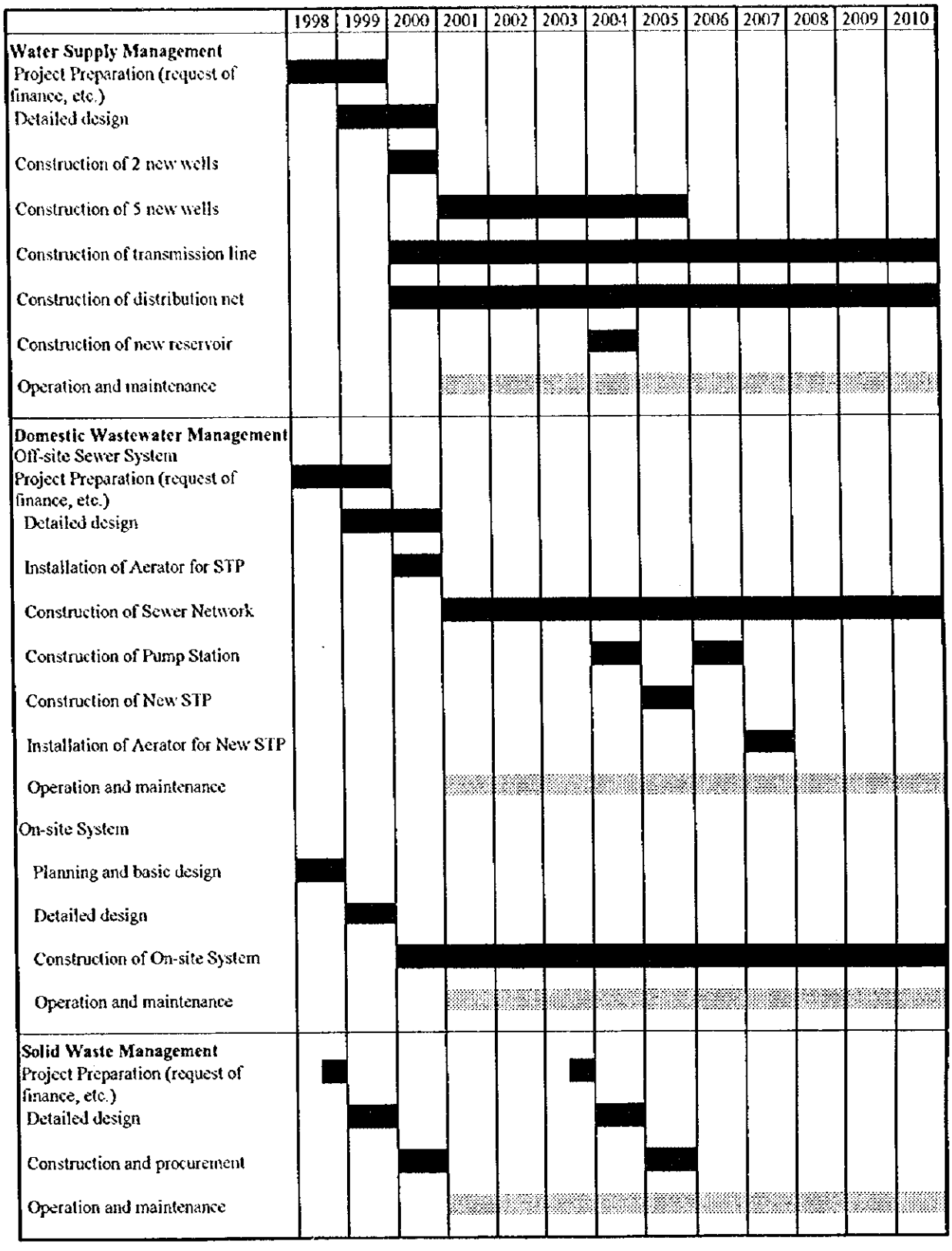
On the other hand, the financial evaluation revealed that the M/P implementation will:① increase the citizens' share of the service operation cost, and ② increase the municipality's financial difficulties. Therefore, the financial capability of the citizens and the municipality, and measures to alleviate the financial burden were reexamined in the F/S phase (3rd Study Work in Nicaragua) along with the following.

- Review the schedule of DWWM implementation (revision of target figures).
- Review of level of technology required for the new municipal landfill (necessity of impermeable liner).
- Review of costs of facilities proposed in the M/P to be constructed through pilot projects.

9.10.7 Implementation Plan

The M/P was carried out in accordance with the schedule shown in the table below.

Table 9-12: Schedule of M/P



CHAPTER 10

USE Conceptual M/P for Leon

10 USE Conceptual M/P for Leon

This USE conceptual M/P was prepared to serve as a basis for the formulation of a substantial M/P. Therefore, Leon Municipality should formulate a USE M/P based on this conceptual M/P, and carry out the F/S for priority projects to be identified in the M/P in order to realize USE improvements.

10.1 Planning Frameworks for a USE Conceptual M/P

10.1.1 Goals, Targets and Strategies

a. Goals

The principal goal of the Conceptual Master Plan for Leon is to improve the Urban Sanitation Environment (USE) of Leon City, by the target year 2010, where people and major economic activities of Region II are centered.

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

- **promote the citizens' well-being.**
- **support sustainable development of the city.**
- **contribute to regional economic growth.**

The goals of the Master Plan are as follows:

1. Improvement of public health in the city.
2. Reduction of health hazards in and around the city.
3. Protection of natural resources and environment (e.g., groundwater resources and ecology).
4. Encourage the public to be more environmentally aware.
5. Increase the provision of USE services (i.e., water supply, sewer system, SW collection, etc.) at affordable and appropriate levels.
6. Establishment of self-sustainable management systems for USE services.
7. Establishment of a "beneficiary-pays-principle" (BPP) under which service recipients pay for USE services.
8. Development and promotion of community participation in USE systems.

9. Adoption of satisfactory measures for the protection of environmental and public health in the operation and maintenance of USE facilities.

10. Prevention of pollution caused by industrial wastewater and solid waste.

11. Establishment of appropriate legislation, regulations and guidelines on USE through modifications and revisions of existing ones.

12. Establishment of a coordination system for the city and national institutions concerning USE management.

b. Targets

Target years are set as follows:

Master Plan: Year 2010

Feasibility Study: Year 2005

In order to achieve the principal goals, the target figures for the 3 major sectors that constitute USE were set as indicated in the table below.

Table 10-1: Target Figures for the Technical System in Leon

	Present (1995/96)	F/S (2005)	M/P (2010)
Water Supply Coverage	92.2 %	85 %	85 %
Domestic Wastewater Treatment			
Sewer system coverage	55.3 %	60 %	65 %
On-site system coverage	2.1 %	7.0 %	12 %
Latrine only system	35.2 %	29 %	23 %
No system rate	7.4 %	4 %	0 %
Waste Collection Coverage			
Overall waste collection rate	86.7 %	95 %	100 %
Household waste collection rate	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

Strategic actions to attain the goals and targets should, in practice, be introduced step by step toward the target year 2010. Therefore, it is recommended to divide the period up to the target year into 3 phases.

Table 10-2: Strategies for the Realization of the USE Master Plan

Classification Phase	Technical Aspects	Institutional Aspects
Phase 1 **(1998 - 2000) Preparation for Priority Projects Implementation**	**Common Aspects** • An USE M/P should be urgently formulated and F/S on priority projects should be conducted along with the M/P. **Water Supply System** • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. **Domestic Wastewater System** • 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 (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. **Stormwater in Water Management** • Technical guidelines necessary for storm water 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. **Municipal SWM** • 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	**Common Aspects** • 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. **Domestic Wastewater System** • 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. **Stormwater Management** • Authoritative competency for storm water 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. **Municipal SWM** • 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

	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. **Industrial Waste Management** • Based on the "polluter pays principle", industries should be instructed to implement appropriate on-site management of their solid/liquid wastes and residual water. **Medical Waste Management** • Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be promoted.	collection of municipal taxes and charges for the services. **Industrial Waste Management** • 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 IWWM, authorities should be empowered to conduct administrative measures such as monitoring, supervision and guidance. **Medical Waste Management** • Classification of medical waste should be established. Code of practice for respective medical waste categories should be formulated.
Phase 2 **(2001 - 2005) Priority Projects Implementation**	**Water Supply System** • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. **Domestic Wastewater System** • 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%. **Stormwater Management** • Drainage should be improved in accordance with Flood Damage Area Improvement Plan.	**Common Aspects** • 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. **Domestic Wastewater System** • PECM steering committee should further seek foreign and domestic grants for constructing on-site DWW treatment projects.

	• 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. **Municipal SWM** • 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. **Industrial Waste Management** • On-site ISWM and IWWM should be further strengthened. • Treatment/disposal by private sectors, mainly for hazardous waste, should be implemented. **Medical Waste Management** • 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.	**Stormwater Management** • 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. **Municipal SWM** • 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. **Industrial Waste Management** • 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. **Medical Waste Management** • Code of Practice on medical waste management should be enforced.
Phase 3 **(2006 - 2010) M/P Projects Implementation**	**Water Supply System** • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. **Domestic Wastewater System** • 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.	**Common Aspects** • 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. **Domestic Wastewater System** • PECM steering committee should raise funds for constructing on-site DWW

	• 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. **Stormwater Management** • 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. **Municipal SWM** • 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. **Industrial Waste Management** • Industries should take initiatives for introducing "waste minimization and cleaner production" technologies for their production. **Medical Waste Management** • Appropriate collection, treatment and disposal should be practiced for all medical waste (including hazardous and infectious ones).	treatment projects, from water and wastewater charges collected. **Stormwater Management** • PECM steering committee should raise funds for constructing rain drainage facilities, from automobile taxes etc. **Municipal SWM** • Introduction of separate collection system should be examined in order to promote waste minimization and resource recovery from waste. **Industrial Waste Management** • Authorities should promote introduction of "cleaner production" mainly for factories that generate hazardous waste. **Medical Waste Management** • Appropriate control, treatment and disposal of medical waste should be enforced in line with the Code of Practice for Medical Waste Management.

10.1.2 Forecast on Future Demands for USE Services

The table below summarizes the forecast on future demands for respective USE sectors, as key indicators.

Table 10-3: Forecast on Future Demands for USE Services

Item	Present	(2000)	(2005)	M/P (2010)
1. Area and Population	(year 1995)			
Area				
Total (km^2)	820	820	820	820
Projected Service Area (km^2)	19.1	27.0	35.0	43.0
Population				
Total	161,530	224,295	257,084	292,511
Projected Service Population	123,865	183,519	213,156	245,421
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 (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 (m^3/y)	6,185,190	11,051,470	12,834,130	14,789,070
Water consumption rate (l/p./day)	148.4	194(160*)	194 (160*)	194 (160*)
3. Domestic Wastewater System	(year 1995)			
3.1. Areas with sewers				
Service area	9.45 km^2			
Service population	68,510	101,486	129,280	159,658
Coverage (population)	55.3 %	55.3 %	60.0 %	65 %
Treated amount (m^3/day)	15,515	16,136	20,504	25,321
3.2 Areas without sewers				
On-site system coverage	2,601 persons, 2.1 %	3,854 persons 2.1 %	14,920 persons 7.0 %	29,450 persons 12 %
Latrine system coverage	43,588persons 35.2%	64,599persons 35.2 %	62,029 persons 29.0 %	56,447 persons 23 %
No system	9,166 persons 7.4 %	13,580 persons 7.4 %	7,887 persons 4.0 %	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 (waste amount) (%)	86.7	87	95	100
Coverage (population) (%)	80.0	80	94	100
Service population	107,198	146,816	200,436	245,421
Non service population	26,799	36,703	12,720	0
Length of road swept (km)	55	55	117	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 figure exclude commercial and industrial water use.

10.1.3 Other Planning Considerations

a. Economic and Financial Conditions

Key economic and financial indicators employed in the conceptual M/P were calculated based on the following conditions. Table 10-4 shows the summary of the calculations.

- **Gross regional domestic product (GRDP) in 1995**: The Nicaraguan authorities were not able to provide the GRDP of Leon Department. Therefore, the regional product ratio (Leon Department total product/total national product) for each industrial category is assumed equal to the *regional income ratio* (Leon Department total income/total national product). For the calculation of *regional income ratio* of each industrial category, the national and regional INSSBI data (number of people covered by the social security system and their average income) were used. The contribution of the industrial sector to the GDP was multiplied by the *regional income ratio* to compute the GRDP. The growth rate of GRDP in Leon Department is assumed to be equal to the GDP growth rate.
- **Municipal budget**: Municipal budget is assumed to increase in proportion to the GRDP growth.
- **Household income**: Total household income in Leon in 1995 was assumed based on the data provided by the Ministry of Labor. It is estimated that the growth rate of total household income is in proportion to the product of the "GRDP growth rate" and "increase in average number of persons per household". It is estimated that the average number of persons per household in Leon will grow slightly from 5.654 persons/household in 1995 to 5.65 persons/household in 2000, in accordance with the existing INAA plan.
- **Budget of INAA Region II (Leon)**: It is estimated that the ratio of "INAA Region II (Leon) budget" to "INAA national budget" will remain the same as in 1995.

Table 10-4: Economic and Financial Indicators in the M/P

	Unit	1995	2000	2005	2010
GRDP	C$ million	323.7	426.9	544.8	656.5
Number of households	Numbers	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: Since growth rate (between 1995 and 2000) in number of households is considerably larger than the growth rate of GRDP; average income per household substantially declines from 1995 to 2000.

10.2 Outline of Water Supply Conceptual M/P

The present water supply coverage rate in Leon is about 92%, more than the INAA target coverage (85%) for 2005 and 2010. This rate presently covers almost all of the urban population in Leon. Even with the predicted increase in population, the proper maintenance of the present water supply system and its expansion could help to attain the future water supply target. Therefore, the Study's M/P on water supply was made in

accordance with the plan of the INAA. The table below summarizes the outline of the water supply conceptual M/P.

Table 10-5: Outline of Water Supply Conceptual M/P for Leon

Item	Present (1995)	(2000)	(2005)	M/P (2010)
FORECAST ON KEY INDICATORS				
Projected service area	19.1 km^2	27.0 km^2	35.0 km^2	43.0 km^2
Projected service population	123,865	183,519	213,156	245,421
Water supply coverage area	14.4 km^2			
Supplied population	114,199	155,991	181,183	208,784
Coverage rate (population)	92.2 %	85 %	85 %	85 %
Number of connections	20,198	27,609	32,068	36,953
Water production amount (m^3/y)	10,599,899	18,418,995	19,983,385	19,718,395
Water production rate (l/p./d)	254.3	324(267*)	351 (246*)	259 (213*)
Efficiency rate	58 %	60 %	65 %	75 %
Water consumption amount	6,185,190m^3/y	11,051,470m^3/y	12,834,130 m^3/y	14,789,070 m^3/y
- Domestic use	86.3 %	82.5 %	82.5 %	82.5 %
- Commercial use	3.2 %	13.2 %	13.2 %	13.2 %
- Industrial use	0.2 %	1.6 %	1.6 %	1.6 %
- Others	10.3 %	2.7 %	2.7 %	2.7 %
Water consumption rate (l/p./d)	148.4	194 (160*)	194 (160*)	194 (160*)
PARTICULARS OF THE PLAN				
1. Water source				
Type of water source	Groundwater	Groundwater	Groundwater	Groundwater
Number of wells	8	13	13	13
Data on wells				
- Total pump capacity	502 liters/sec	877 liters/sec	930 liters/sec	930 liters/sec
- Total production amount (m^3/y)	10,599,899	18,418,995	19,983,385	19,718,000
2. Disinfection				
System	Line injection	Line injection	Line injection	Line injection
Method	Chlorination	Chlorination	Chlorination	Chlorination
3. Water transmission and distribution facilities				
Method	Mainly direct connection	Mainly direct connection	Mainly direct connection	Mainly direct connection
Distribution reservoir				
Number of reservoirs	3	5	6	7
Total volume of reservoir	9,000 m^3	14,350 m^3	21,825 m^3	18,480 m^3
Total length of network	193.3 km		267.5 km	558.4 km
4. Operation and maintenance of facilities				
Responsible authority	INAA Region II Leon branch office	INAA Region II Leon branch office	INAA Region II Leon branch office	INAA Region II Leon branch office
Type of operation	Direct	Direct	Direct	Direct
Number of personnel	82 (incl. sewage)			
5. Finances				
INAA annual budget (C$1,000/year, incl. sewage)	302,605	364,859	414,897	475,532
Regional bureau budget (C$1,000/year, incl. sewage)	17,926	21,614	24,578	28,170
Water charges				
- For household	C$1.96/ m^3			
- Others	C$3.57/ m^3			
Collection method	Direct collection			
Collection rate	98 %			
Revenue from water charges (C$1,000/year)	15,244			

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

10.3 Outline of Domestic Wastewater Management Conceptual M/P

The Study's DWWM conceptual M/P was planned for:

- projected sewer areas in 2010 (INAA projection)
- areas without sewers in 2010.

Areas without sewers refer to:

- areas where water supply is provided (about 20% of the urban population).
- areas where water supply is not provided (about 15% of the urban population).

The table below summarizes the outline of the DWWM conceptual M/P.

Table 10-6: Outline of the Domestic Wastewater Conceptual M/P for Leon

Item	Present (1995)	(2000)	(2005)	M/P (2010)
FORECAST ON KEY INDICATORS				
Projected service area	19.1 km^2	27.0 km^2	35.0 km^2	43.0 km^2
Projected service population	123,865	183,519	213,156	245,421
Areas with sewers	55.3 %	55.3 %	60 %	65 %
Areas without sewers	44.7 %	44.7 %	40 %	35 %
On-site system	2.1 %	2.1 %	7 %	12 %
Soak pit and/or Latrine system	35.2 %	35.2 %	29 %	23 %
No system	7.4 %	7.4 %	4 %	0 %
PARTICULARS OF THE PLAN				
1. Areas with sewers				
Service area	9.45 km2			
Service population	68,510	101,486	128,320	159,658
Number of connections	12,117	17,962	22,712	28,258
Coverage rate (population)	55.3 %	55.3 %	60.2 %	65 %
Length of pipeline	83.5 km		182.5 km	259.3 km
Number of pump stations	1	1	1	1
Sewage production per capita	226.5 l/p/d	159 l/p/d	159 l/p/d	159 l/p/d
1.1 Sewage treatment plant (STP)				
Number of STP	2	3	3	3
Name of the STP	Subtiava, El Cocal	Subtiava, El Cocal, San Isidro	Subtiava, El Cocal, San Isidro	Subtiava, El Cocal, San Isidro
Treatment method	Facultative lagoon	Aerated lagoon	Aerated lagoon	Aerated lagoon
Treatment capacity (m^3/day)				
Subtiava	6,400	6,696	8,535	10,520
El Cocal	1,600	5,293	6,745	8,314
San Isidro	-	4,147	5,260	6,486
Total	**8,000**	**16,136**	**20,540**	**25,321**
Intake amount (annual mean value) (m^3/day)				
Subtiava	11,286	6,696	8,535	10,520
El Cocal	4,230	5,293	6,745	8,314
San Isidro	-	4,147	5,260	6,486
Total	**15,516**	**16,136**	**20,540**	**25,321**

Item	Present (1995)	(2000)	(2005)	M/P (2010)
Intake water quality (mg/l)				
BOD	300-340	370	370	370
S S	238-340	320	320	320
COD	500-600	680	680	680
Treated water quality				
BOD	80-160	90	90	90
S S	90-180	80	80	80
COD	220-600	180	180	180
Discharge point				
Subtiava	Rio Chiquito	Rio Chiquito	Rio Chiquito	Rio Chiquito
El Cocal	Rio Chiquito	Rio Chiquito	Rio Chiquito	Rio Chiquito
San Isidro	-	Rio Pochote	Rio Pochote	Rio Pochote
1.2 Operation and maintenance				
Responsible authority	INNA Region II Leon branch office		INNA Region II Leon branch office	INNA Region II Leon branch office
Number of personnel	82 (incl. water supply)			
Finances				
INAA annual budget (C$1,000/year, incl. water)	302,605	364,859	414,897	475,532
Regional bureau budget (C$1,000/year, incl. water)	10,173	21,614	24,578	28,170
Sewage charge	30% of total charge			
Charge collection method	Direct collection			
Collection rate	98 %			
Revenue from sewage charges (C$1,000/year)	2,682			
2. Areas without sewers				
On-site System	2.1 %	2.1 %	7.0 %	12 %
Soak pit and/or Latrine System	35.2 %	35.2 %	29.0 %	23 %
No system	7.4 %	7.4 %	4.0 %	0 %
Facilities of On-site system	Septic tank	Septic tank	Septic tank and collective system	Septic tank and collective system
Responsible authority	INAA, MINSA, Municipality	INAA, MINSA, Municipality	INAA, MINSA, Municipality	INAA, MINSA, Municipality
Legislation	-		To be established	To be established

10.4 Recommendations for Industrial Wastewater Management

10.4.1 Conclusions of the Industrial Waste Survey

Wastewater generation amount in Leon is estimated at 91,000m^3/year, about 54,000 m^3/year of which are generated by industries in the CIIU3231 category (tanneries) and contain high levels of organic and hazardous compounds such as chromium. Therefore immediate countermeasures should be taken in Leon to prevent these industries from further adversely affecting the environment.

Since the legislation established is new, it lacks detailed regulations and technical instructions. At present, therefore, industrial wastewater is mostly discharged without treatment to the environment, and is consequently one of the major factors that deteriorate USE.

10.4.2 Recommendations for the Improvement of Industrial Wastewater Management

Industrial wastewater is generated and discharged as a result of industrial production activities. Therefore, industries should bear the cost for its safe management/disposal based on the "polluter pays principle (PPP)".

From a technical viewpoint, the following are considered key solutions to the problem:

- Reduction of wastewater generation amount and pollutional load by adopting highly rationalized techniques.
- On-site wastewater management by industries.
- Industrial wastewater management/disposal by a third party (i.e. private contractors).

It is therefore necessary that relevant authorities take the required administrative measures for industrial wastewater management. Since the enforcement of Decree 33-95 will greatly contribute to this issue, a system that would promote coordination between the industries and the authorities in facilitating appropriate industrial wastewater management should be established.

Strategies to improve current management system are summarized in Table 10-2.

10.5 Recommendations for Stormwater Management

10.5.1 Inundation Damage in Leon City

The Team investigated areas in the city identified as major inundation prone areas by the counterpart. The table below summarizes inundation damage and its causes in the fifteen inundation prone areas in the city.

- Inundation damage

  Inundation of houses and the outbreak of diseases after the flood were observed. In comparison with Granada City, Leon suffered major damage.

- Inundated area

  The majority of the inundated areas are located in the outskirts of the city, on a slope between the city and the river. Most of these areas are without drainage canals and are located in a relatively low-lying land.

- Cause of inundation

  Since the land is low and because of the absence of drainage canals, flooding problems occur. Moreover, as the residents in these areas belong to the low income bracket, they use earthen floors which only make their houses susceptible to inundation damage.

10.5.2 Recommendations for Inundation Mitigation

Inundation in Leon mostly hits the city outskirts and areas along rivers. Most of these inundation prone areas developed as a result of increased migration from rural areas. Therefore, although the areas are provided with roads, they have no stormwater drainage.

Accordingly, it is necessary to: ① conduct basic investigation such as topographic survey, ② formulate drainage improvement plans for inundation prone areas, and ③ secure financial resources for the drainage improvement projects. However, under current circumstances, it is financially, technically and in view of human resources, difficult for Leon Municipality to conduct all these works alone. Therefore, the Study reviewed the current institutional system for stormwater management (i.e., the municipality is currently responsible for construction, operation and maintenance of stormwater facilities), and proposed appropriate institutional systems for stormwater management (separate institutional system for macro-drainage and micro-drainage). The study then proposed a planning guideline for stormwater management in line with the institutional system.

10.6 Outline of Municipal Solid Waste Management Conceptual M/P

The outline of the municipal SWM conceptual M/P is shown in the table below.

Table 10-7: Outline of Municipal SWM Conceptual M/P for Leon

Item	Present (1996)	2000	(2005)	M/P (2010)
FORECAST ON KEY ELEMENTS				
Projected service area	19.1 km^2	27.0 km^2	35.0 km^2	43.0 km^2
Population in the study area	133,997	183,519	213,156	245,421
Waste generation amount	102.1 tons/day	147.5 tons/day	186.9 tons/day	230.7 tons/day
Waste discharge amount	67.9 tons/day	101.1 tons/day	132.6 tons/day	169.9 tons/day
Waste collection amount	58.9 tons/day	87.7 tons/day	126.0 tons/day	169.9 tons/day
Final disposal amount	60.0 tons/day	88.3 tons/day	128.9 tons/day	173.0 tons/day
Coverage rate (waste amount)	86.7 %	87 %	95 %	100 %
Coverage rate (population)	80.0 %	80 %	94 %	100 %
Service population	107,918	146,816	200,436	245,421
Non-service population	26,799	36,703	12,720	0
Length of road swept	55 km	55 km	117 km	135 km
PARTICULARS OF THE PLAN				
1.Collection & Transport				
Collection system	Curb collection	Curb collection	Curb, Point collection	Curb, Point collection
No. of collection vehicles	Compactor: 5 (12 m^3) Dump truck : 2 (8 m^3, 6 m^3)	Compactor: 5 (12 m^3) Dump truck : 2 (8 m^3, 6 m^3)	Compactor truck, Tipper truck, Container truck	Compactor truck, Tipper truck, Container truck
Transportation system	Direct transport	Direct transport	Direct transport	Direct transport
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of personnel	45	-	-	-
Unit cost of collection	C$14/$m^3$	-	-	-

Item	Present (1996)	2000	(2005)	M/P (2010)
2. Street sweeping				
Cleaning method	Manual	Manual	Manual	Manual
Length of road	226 km	-	-	-
Length of road swept	55 km	55 km	117 km	135 km
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
Number of personnel	28	-	-	-
Unit cost of street sweeping	C$/m^3	-	-	-
Equipment used	Broom, shovel, handcart	Broom, shovel, handcart	Broom, shovel, handcart	Broom, shovel, handcart
3. Intermediate treatment	None in particular	None in particular	No requirement other than on-site & community based ones.	No requirement other than on-site & community based ones.
4. Recycling				
Recycling Amount				
At generation point	16.3 tons/day	23.5 tons/day	29.7 tons/day	36.6 tons/day
At landfill	1.4 tons/day	2.1 tons/day	0.0 ton/day	0.0 ton/day
Recycling system	Not organized recycling	Not organized recycling	Segregation of wastes for recycling to be promoted.	Segregation of wastes for recycling to be promoted.
5. Final disposal				
Disposal method/level	Open dumping	Controlled Tipping (Level 1)	Sanitary Landfill (Level 2 or more)	Sanitary Landfill (Level 2 or more)
Disposal site	Fortin de Acosasco	Fortin de Acosasco	a new landfill	a new landfill
Site area	-	-	-	-
Distance of site from generation center	4 km	4 km	- km	- km
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of personnel	2	-	-	-
Charge for Disposal	- C$/ton	-	-	-
Unit disposal cost	C$1.00/m^3	-	-	-
Main equipment	Bulldozer: 1	Bulldozer	Bulldozer, Tipper truck, Excavator, Sprinkler truck	Bulldozer, Tipper truck, Excavator, Sprinkler truck
6. Maintenance of Vehicles and Equipment				
Maintenance shop	2	2	2 Allocation of the work is promoted each other workshop.	2 Allocation of the work is promoted each other workshop.
Responsible authority	Municipal Service	Municipal Service	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of employees	8	-	-	-
7. Operation				
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environment Maintenance	Urban Environment Maintenance
Number of personnel	72 + task workers	-	-	-
Type of operation	Municipal operation	Municipal operation	Municipal operation	Municipal operation

Item	Present (1996)	2000	(2005)	M/P (2010)
8. Finances				
City budget	C$32,213,000	C$42,482,000	C$54,219,000	C$65,335,000
Cleansing department budget	C$2,741,000	-	-	-
Management of service recipients	Municipality	existing system	Department of Administration and Finance	Department of Administration and Finance
Fee collection method	Door to door and at the office	-	-	-
Rate of fee collection	Very low	-	-	-
Revenue	C$1,341,000			
9. Contract to Private Sector				
Method of contract	None	None	To be examined	To be examined

10.7 Recommendations for Industrial Solid Waste Management

10.7.1 Conclusions of the Industrial Solid Waste Survey

Industrial solid waste (ISW) generation amount in Leon is estimated at about 7,400 tons/year, the largest of the 3 cities. The industries in the CIIU3116 category (processing dry seeds from legumes) are the main sources of ISW generation in Leon, generating about 80% of the total ISW in Leon. Solid waste from these industries mainly consists of organic compounds and is not likely to contain hazardous substances. Industries in Leon that are most likely to generate hazardous waste are those in the CIIU3231 category (tanneries). These industries make up about 6% of the total ISW generation in Leon.

Industrial solid waste in Leon is mostly disposed of in the municipal solid waste dumping site without any control and order.

10.7.2 Recommendations for the Improvement of ISWM

Industrial solid waste (ISW) result from industrial production activities. Therefore, as in industrial wastewater management (IWWM), the cost for the safe management/disposal of industrial solid waste should be borne by the industries, based on the "polluter-pays-principle (PPP)".

From a technical viewpoint, the following are considered key solutions to the problem:

- Reduction of ISW generation amount and pollutional load by adopting highly rationalized production techniques.
- Establishment of appropriate management/disposal technologies and systems for each ISW categories.

A key issue in ISWM is the management of hazardous ISW. The exclusive operation of facilities for the management and/or disposal of hazardous ISW should be urgently established. Until this is realized, authorities are recommended to practice the following measures in the management of hazardous ISW.

- Industries shall be required to practice waste minimization, on-site treatment, and storage of hazardous IW.

- Utilization of existing facilities (e.g. incineration in cement kilns) shall be examined for hazardous IW treatment. Industries shall be obliged to take the necessary action (e.g. cement kiln utilization) if they generate hazardous wastes to which such treatment is applicable. In case it is not applicable, the industries shall be obliged to store the hazardous IW.
- Avoid mixed disposal of ISW and domestic SW in the municipal disposal site by establishing a monitoring system to prevent hazardous ISW disposal. Industries proven as non-generators of highly hazardous ISW are allowed to dispose their wastes in the municipal landfill site.

In this regard, the formulation and enforcement of legislation relevant to the management and disposal of ISW are very important and urgently required.

10.8 Recommendations for Medical Solid Waste Management

10.8.1 Conclusion obtained from the Survey on Medical Waste Management

The table below shows the forecast on present and future medical SW generation in Granada based on the questionnaire survey, in line with the medical SW classification proposed by the Team.

Table 10-8: Forecast on Present and Future Medical SW Generation

Unit: kg/day

Waste Classification	1996	2000	2005	2010
Risky Waste*1	149.3	201.7	234.4	269.8
Hazardous Waste*2	4.8	6.5	7.5	8.7
Special Waste*3	1.6	2.2	2.4	2.8
(Sub-total)	155.7	210.4	244.3	281.3
Common Waste*4	139.1	187.9	218.4	251.4
Total	294.8	398.3	462.7	532.7

Note: The classification is proposed by the Team.
*1: Infected waste (sharps, blood, used dressing, etc.), infected waste from laboratories, waste from patients with infections and wastewater.
*2: Chemical waste (medicines, disinfectants, solvents, etc.), radioactive waste.
*3: Ash from incinerator, sludge.
*4: Office waste, kitchen waste, packing waste, bulky waste, garden waste, DWW.

The majority (80%) of the medical institutions separate medical waste at the source of generation. However, only some medical institutions practice separate haulage; the rest practice mixed haulage on-site. Most medical wastes stored on-site are collected by municipal services. Some infectious wastes are burnt in the open in Leon.

Medical wastewater is either discharged into the sewer or a soak pit without treatment by institutions surveyed.

10.8.2 Recommendation for the Improvement of Medical Waste Management

In order to establish an appropriate medical waste management (medical WM), MINSA should take a leading role in defining the classification of medical waste and should enforce handling guidelines (i.e., code of practice) for different medical wastes. Consequently, medical institutions should be obligated to practice appropriate medical WM according to the code of practice (e.g., separate collection and haulage of hazardous/infectious medical waste). Furthermore, a commercial system for medical WM should be formulated in order to secure appropriate treatment/disposal of hazardous/infectious medical waste by the private sector.

In order to realize the above-mentioned plan, it is indispensable to establish an administrative institution which promotes, instructs, oversees, and regulates the execution of appropriate management for medical waste. Furthermore, the separation of infectious and non-infectious waste at the generation source should be assured, and education for workers including collection workers should be provided without exception, in order to practice appropriate collection, treatment, and disposal of separated hazardous/ infectious medical waste. Institutions such as SILAIS should take leading roles in taking these actions.

CHAPTER 11

USE Conceptual M/P for Chinandega

11 USE Conceptual MP for Chinandega

This USE conceptual M/P was prepared to serve as a basis for the formulation of a substantial M/P. Therefore, Chinandega Municipality should formulate a USE M/P based on this conceptual M/P, and carry out the F/S for priority projects to be identified in the M/P in order to realize USE improvements.

11.1 Planning Frameworks for a USE Conceptual M/P

11.1.1 Goals, Targets and Strategies

a. Goals

The principal goal of the Conceptual Master Plan for Chinandega is to improve the Urban Sanitation Environment (USE) of Chinandega City, by the target year 2010, where people and major economic activities of Region II are centered.

Through the improvement of USE in Chinandega city, **the Plan aims to:**

- **promote the citizens' well-being.**
- **support sustainable development of the City.**
- **contribute to regional economic growth.**

The goals of the Master Plan are as follows:

1. Improvement of public health in the city.
2. Reduction of health hazards in and around the city.
3. Protection of natural resources and environment (e.g., underground water resources and ecology).
4. Encourage the public to be more environmentally aware.
5. Increase the provision of USE services (i.e., water supply, sewer system, SW collection, etc.) at affordable and appropriate levels.
6. Establishment of self-sustainable management systems for USE services.
7. Establishment of a "beneficiary-pays-principle" (BPP) under which service recipients pay for USE services.
8. Development and promotion of community participation in USE systems.

9. Adoption of satisfactory measures for the protection of environmental and public health in the operation and maintenance of USE facilities.

10. Prevention of pollution caused by industrial wastewater and solid waste.

11. Establishment of appropriate legislation, regulations and guidelines on USE through modifications and revisions of existing ones.

12. Establishment of a coordination system for the city and national institutions concerning USE management.

b. Targets

Target years are set as follows:

Master Plan: Year 2010

Feasibility Study: Year 2005

In order to achieve the principal goals, the target figures for the 3 major sectors that constitute USE were set as indicated in the table below.

Table 11-1: Target Figures for the Technical System in Chinandega

	Present (1995/96)	F/S (2005)	M/P (2010)
Water Supply Coverage	74.0%	85%	85%
Domestic Wastewater Treatment			
Sewer system coverage	33.6%	49.3%	65%
On-site system coverage	4.0%	8.0%	12.0%
Latrine only system	51.8%	37.4%	23.0%
No system rate	10.6%	5.3%	0%
Waste Collection Coverage			
Overall waste collection rate	81.6%	90%	100%
Household waste collection rate	51.0%	88%	100%

c. Strategies

Strategic actions to attain the goals and targets should, in practice, be introduced step by step toward the target year 2010. Therefore, it is recommended to divide the period up to the target year into 3 phases.

Table 11-2: Strategies for the Realization of the USE Master Plan

Classification Phase	Technical Aspects	Institutional Aspects
Phase 1 **(1998 - 2000) Preparation for Priority Projects Implementation**	**Common Aspects** • A USE M/P should be urgently formulated and F/S on priority projects should be conducted along with the M/P. **Water Supply System** • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. **Domestic Wastewater System** • 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' environmental consciousness. **Stormwater Management** • Technical guidelines necessary for storm water 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. **Municipal SWM** • 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	**Common Aspects** • 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. **Domestic Wastewater System** • 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. **Stormwater Management** • Authoritative competency for storm water 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 Chinandega necessary for improving rain drainage in UFA and to seek foreign and domestic grants for such projects. **Municipal SWM** • 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

	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. **Industrial Waste Management** • Based on the "polluter pays principle", industries should be instructed to implement appropriate on-site management of their solid/liquid wastes and residual water. **Medical Waste Management** • Appropriate on-site management (e.g., separation of hazardous/infectious medical waste from other waste) in institutions should be promoted.	charges for the services. **Industrial Waste Management** • 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 IWWM, authorities should be empowered to conduct administrative measures such as monitoring, supervision and guidance. **Medical Waste Management** • Classification of medical waste should be established. Code of practice for respective medical waste categories should be formulated.
Phase 2 **(2001 - 2005) Priority Projects Implementation**	**Water Supply System** • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. **Domestic Wastewater System** • 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 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%. **Stormwater Management** • Drainage should be improved in accordance with Flood Damage Area Improvement Plan. • Integrated Arroyo Management Plan	**Common Aspects** • 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 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. **Domestic Wastewater System** • PECM steering committee should further seek foreign and domestic grants for constructing on-site DWW treatment projects.

	(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. **Municipal SWM** • 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. **Industrial Waste Management** • On-site ISWM and IWWM should be further strengthened. • Treatment/disposal by private sectors, mainly for hazardous waste, should be implemented. **Medical Waste Management** • 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.	**Stormwater Management** • 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. **Municipal SWM** • 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. **Industrial Waste Management** • 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. **Medical Waste Management** • Code of Practice on medical waste management should be enforced.
Phase 3 **(2006 - 2010) M/P Projects Implementation**	**Water Supply System** • The water supply system should be consolidated to maintain target coverage of 85% for the increasing population. **Domestic Wastewater System** • 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-	**Common Aspects** • 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. **Domestic Wastewater System** • PECM steering committee should raise funds for constructing on-site DWW treatment projects, from water and

	help of communities should be employed in operation and maintenance of the facilities. **Stormwater Management** • 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. **Municipal SWM** • 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. **Industrial Waste Management** • Industries should take initiatives for introducing "waste minimization and cleaner production" technologies for their production. **Medical Waste Management** Appropriate collection, treatment and disposal should be practiced for all medical waste (including hazardous and infectious ones).	wastewater charges collected. **Stormwater Management** • PECM steering committee should raise funds for constructing rain drainage facilities, from automobile taxes etc. **Municipal SWM** • Introduction of separate collection system should be examined in order to promote waste minimization and resource recovery from waste. **Industrial Waste Management** • Authorities should promote introduction of "cleaner production" mainly for factories that generate hazardous waste. **Medical Waste Management** • Appropriate control, treatment and disposal of medical waste should be enforced in line with the Code of Practice for Medical Waste Management.

11.1.2 Forecast on Future Demands for USE Services

The table below summarizes the forecast on future demands for respective USE sectors, as key indicators.

Table 11-3: Forecast on Future Demands for USE Service in Chinandega

Item	Present	(2000)	(2005)	M/P (2010)
1. Area and Population	(year 1995)			
Area				
Total (km^2)	647	647	647	647
Projected Service Area (km^2)	16.1	16.1	16.1	16.1
Population				
Total	117,037	136,076	155,523	176,359
Projected Service Population	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 rate (l/p/day)	139.0	194(160*)	194 (160*)	194 (160*)
3. Domestic Wastewater System	(year 1995)			
3.1. Areas with sewers				
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 Areas without sewers				
On-site system (per person)	3,895	4,616	10,699	18,413
	4.0 %	4.0 %	8.0 %	12.0 %
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 service population	49,366	56,542	15,665	0
Length of road swept (km)	45	45	52	60
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 exclude commercial and industrial water use.

11.1.3 Other Planning Considerations

a. Economic and Financial Conditions

Key economic and financial indicators employed in the conceptual M/P were calculated based on the following conditions. Table 11-4 shows the summary of the calculations:

- **Gross regional domestic product (GRDP) in 1995**: The Nicaraguan authorities were not able to provide the GRDP of Chinandega Department. Therefore, the regional product ratio (Chinandega Department total product/total national product) for each industrial category is assumed equal to the *regional income ratio* (Chinandega Department total income/total national product). For the calculation of *regional income ratio* of each industrial category, the national and regional INSSBI data (number of people covered by the social security system and their average income) were used. The contribution of the industrial sector to the GDP was multiplied by the *regional income ratio* to compute GRDP. The growth rate of GRDP in Chinandega Department is assumed to be equal to the GDP growth rate.
- **Municipal budget**: Municipal budget is assumed to increase in proportion to the GRDP growth.
- **Household income**: Total household income in Chinandega in 1995 was assumed based on the data provided by the Ministry of Labor. It is estimated that the growth rate of total household income is in proportion to the product of the "GRDP growth rate" and "increase in average number of persons per household". It is estimated that the average number of persons per household in Chinandega will grow slightly from 5.751 persons/household in 1995 to 5.74 persons/household in 2000, in accordance with the existing INAA plan.
- **Budget of INAA Region II (Chinandega)**: It is estimated that the ratio of "INAA Region II (Chinandega) budget" to "INAA national budget" will remain the same as in 1995.

Table 11-4: Economic and Financial Indicators in the M/P

	Unit	1995	2000	2005	2010
GRDP	C$ million	506.8	668.4	853.1	1,028.0
Number of households	Nos.	16,934	20,103	23,302	26,732
Average income per household	C$/year	14,772	16,410[*1]	18,069	18,979
Budget of INAA Region II (Chinandega)	C$1,000	13,765	16,597	18,873	21,631
Budget of Chinandega Municipality	C$1,000	15,084	19,893	25,389	30,594

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

11.2 Outline of Water Supply Conceptual M/P

The present water supply coverage rate in Chinandega is about 74%. This rate presently covers most of the urban population in Chinandega. It is considered that the water

supply improvement plan of INAA for 2005 and 2010 could be realized if the required financing is secured. Therefore, the Study's M/P on water supply was made in accordance with the plan of INAA. The table below summarizes the outline of the water supply conceptual M/P.

Table 11-5: Outline of Water Supply Conceptual M/P for Chinandega

Item	Present (1995)	(2000)	(2005)	M/P (2010)
FORECAST ON KEY INDICATORS				
Projected service area	16.1 km^2	16.1 km^2	16.1 km^2	16.1 km^2
Projected service population	97,387	115,392	133,753	153,444
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 %
Number of connections	12,533	17,088	19,818	22,723
Water production amount (m^3/year)	5,083,403	9,264,065	10,738,665	12,320,210
Water production rate (l/p/d)	193.2	259(213*)	259 (213*)	259 (213*)
Efficiency rate	72 %	75 %	75 %	75 %
Water consumption amount (m^3/year)	3,657,990	6,948,140	8,054,258	9,239,975
- Domestic use	89.3 %	82.5 %	82.5 %	82.5 %
- Commercial use	5.1 %	13.2 %	13.2 %	13.2 %
- Industrial use	0.02 %	1.6 %	1.6 %	1.6 %
- Others	5.6 %	2.7 %	2.7 %	2.7 %
Water consumption rate (l/p/d)	139.0	194 (160*)	194 (160*)	194 (160*)
PARTICULARS OF THE PLAN				
1. Water source				
Type of water source	Groundwater	Groundwater	Groundwater	Groundwater
Number of wells	6	7	7	11
Data on wells				
- Total pump capacity	391 liters/sec	471 liters/sec	471 liters/sec	711 liters/sec
- Total production amount (m^3/y)	5,083,403	9,264,065	10,739,000	12,320,000
2. Disinfection				
System	Line injection	Line injection	Line injection	Line injection
Method	Chlorination	Chlorination	Chlorination	Chlorination
3. Water transmission and distribution facilities				
Method	Mainly direct connection	Mainly direct connection	Mainly direct connection	Mainly direct connection
Distribution reservoir				
Number of reservoirs	5	5	7	8
Total volume of reservoirs	9,100 m^3	9,100 m^3	14,730 m^3	17,620 m^3
Total length of network	112.7 km	112.7 km	130.5 km	138.7 km
4. Operation and maintenance of facilities				
Responsible authority	INAA Region II Chinandega branch office	INAA Region II Chinandega branch office	INAA Region II Chinandega branch office	INAA Region II Chinandega branch office
Type of operation	Direct	Direct	Direct	Direct
Number of personnel	45 (incl. sewage)			

Item	Present (1995)	(2000)	(2005)	M/P (2010)
5. Finances				
INAA annual budget (C$1,000/year, incl. sewage)	302,605	364,859	414,897	475,532
Regional bureau budget (C$1,000/year, incl. sewage)	13,765	16,597	18,837	21,631
Water charges				
- For household	C$1.73/ m^3			
- Others	C$4.30/ m^3			
Collection method	Direct collection			
Collection rate	98 %			
Revenue from water charges (C$1,000 /year)	12,235			

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

11.3 Outline of Domestic Wastewater Management Conceptual M/P

The Study's DWWM conceptual M/P was planned for:

- projected sewer areas in 2010 (INAA projection)
- areas without sewers in 2010.

Areas without sewers refer to:

- areas where water supply is provided (about 20% of the urban population).
- areas where water supply is not provided (about 15% of the urban population).

The table below summarizes the outline of the DWWM conceptual M/P.

Table 11-6: Outline of the Domestic Wastewater Conceptual M/P for Chinandega

Item	Present (1995)	(2000)	(2005)	M/P (2010)
FORECAST ON KEY INDICATORS				
Projected service area	16.1 km^2	16.1 km^2	16.1 km^2	16.1 km^2
Projected service population	97,387	115,393	133,753	153,444
Areas with sewers	33.6 %	33.6 %	49 %	65 %
Areas without sewers	66.4 %	66.4 %	51 %	35 %
On-site system	4.0 %	4.0 %	8.0 %	12 %
Soak pit and/or Latrine system	51.8 %	51.8 %	37.4 %	23 %
No system	10.6 %	10.6 %	5 %	0 %
PARTICULARS OF THE PLAN				
1. Areas with sewers				
Service area	2.57 km^2			
Service population	32,752	38,772	77,412	99,739
Number of connections	5,695	6,755	13,486	17,376
Coverage rate (population)	33.6 %	33.6 %	49.3 %	65 %
Length of pipeline	45.5 km		141.2 km	

Item	Present (1995)	(2000)	(2005)	M/P (2010)
Number of pump stations	1	1	1	1
Sewage production per capita (l/p/d)	201.2	159	159	159
1.1 Sewage treatment plant (STP)				
Number of STP	1	1	1	1
Name of the STP	El Destino	El Destino	El Destino	El Destino
Treatment method	Facultative lagoon	Aerated lagoon	Aerated lagoon	Aerated lagoon
Treatment capacity	2,300 m^3/day	6,165 m^3/day	12,277 m^3/day	15,818 m^3/day
Intake amount (annual mean value)	6,591 m^3/day	6,165 m^3/day	12,277 m^3/day	15,818 m^3/day
Intake water quality (mg/l)				
BOD	360 - 480	360	360	360
S S	270 - 329	640	640	640
COD	594 -840	770	770	770
Treated water quality (mg/l)				
BOD	80 - 120	90	90	90
S S	136 - 220	80	80	80
COD	297 -440	180	180	180
Discharge point	Rio Acome	Rio Acome	Rio Acome	Rio Acome
1.2 Operation and maintenance				
Responsible authority	INNA Region II Chinandega branch office	INNA Region II Chinandega branch office	INNA Region II Chinandega branch office	INNA Region II Chinandega branch office
Number of personnel	45 (incl. Water supply)			
1.3 Finances				
INNA annual budget (C$1,000/year, incl. water)	302,605	364,859	414,897	475,532
Regional bureau budget (C$1,000/year, incl. water)	13,765	16,597	18,837	21,631
Sewage charge	30% of total charge			
Charge collection method	Direct collection			
Collection rate	98 %			
Revenue from sewage charges (C$1,000/year)	12,235			
2. Areas without sewers				
On-site system	4.0 %	4.0 %	8.0 %	12 %
Soak pit and/or Latrine system	51.8 %	51.8 %	37.4 %	23 %
No system	10.6 %	10.6 %	5.3 %	0 %
Facilities of On-site system	Septic tank	Septic tank	Septic tank and collective system	Septic tank and collective system
Responsible authority	INAA, MINSA, Municipality	INAA, MINSA, Municipality	INAA, MINSA, Municipality	INAA, MINSA, Municipality
Legislation	-	To be established	To be established	To be established

11.4 Recommendations for Industrial Wastewater Management

11.4.1 Conclusions of the Industrial Waste Survey

Wastewater generation amount in Chinandega is estimated at 5,500m^3/year. The bulk of this amount is generated by industries in the CIIU3114 (fish and other marine foods) and CIIU3115 (animal and vegetable oils) categories. The wastewater of these industries mainly contain organic compounds, oils and fat, and is, therefore, less likely to contain hazardous compounds. Industries highly likely to generate hazardous wastewater in Chinandega are those under the CIIU3512 category (fertilizer, insecticides, etc.), contributing about 1% of the total IWW generation in Chinandega.

Since the legislation established is new, it lacks detailed regulations and technical instructions. At present, therefore, industrial wastewater is mostly discharged without treatment to the environment, and is consequently one of the major factors that deteriorate USE.

11.4.2 Recommendations for the Improvement of Industrial Wastewater Management

Industrial wastewater is generated and discharged as a result of industrial production activities. Therefore, industries should bear the cost for its safe management/disposal based on the "polluter-pays-principle (PPP)".

From a technical viewpoint, the following are considered key solutions to the problem:

- Reduction of wastewater generation amount and pollutional load by adopting highly rationalized techniques.
- On-site wastewater management by industries.
- Industrial wastewater management/disposal by a third party (i.e. private contractors).

It is therefore necessary that relevant authorities take the required administrative measures for industrial wastewater management. Since the enforcement of Decree 33-95 will greatly contribute to this issue, a system that would promote coordination between the industries and the authorities in facilitating appropriate industrial wastewater management should be established.

Strategies to improve current management system are summarized in Table 11-2.

11.5 Recommendations for Stormwater Management

11.5.1 Inundation Damage in Chinandega

The Team investigated areas in the city identified as major inundation prone areas by the counterpart. The table below summarizes inundation damage and its causes in the 10 inundation prone areas in the city.

- **Inundation damage**

In addition to the inundation of houses and the outbreak of diseases after the flood, the destruction of roads and bridges was also observed. Inundation damage is the most serious of the three cities.

- **Inundated area**

The majority of the inundated areas in Chinandega are located in the outskirts of the city. Land in these areas is very low as it has been used for agriculture until recently. The infrastructure, e.g. drainage and roads, in these areas is the most underdeveloped of the three cities.

- **Cause of inundation**

Land is very low and due to the absence of drainage canals, flooding occurs. Moreover, as the residents in these areas belong to the low income bracket, they use earthen floors which only make their houses susceptible to inundation damage.

11.5.2 Recommendations for Inundation Mitigation

Inundation in Chinandega mostly hits the city outskirts and areas along the rivers. Most of these inundation prone areas developed as a result of increased migration from rural areas. Therefore, although the areas are provided with roads, they have no stormwater drainage.

Accordingly, it is necessary to: conduct basic investigation such as topographic survey, formulate drainage improvement plans for inundation prone areas, and secure financial resources for the drainage improvement projects. However, under current circumstances, it is financially, technically and in view of human resources, difficult for Chinandega Municipality to conduct all these works alone. Therefore, the Study reviewed the current institutional system for stormwater management (i.e., the municipality is currently responsible for construction, operation and maintenance of stormwater facilities), and proposed appropriate institutional systems for stormwater management (separate institutional system for macro-drainage and micro-drainage). The study then proposed a planning guideline for stormwater management in line with the institutional system.

11.6 Outline of Municipal Solid Waste Management Conceptual M/P

The outline of the municipal SWM conceptual M/P is shown in the table below.

Table 11-7: Outline of Municipal SWM Conceptual M/P for Chinandega

Item	Present (1995)	2000	F/S (2005)	M/P (2010)
FORECAST ON KEY ELEMENTS				
Projected service area	16.1km^2	16.1km^2	16.1km^2	16.1km^2
Projected service population	100,748	115,393	133,753	153,444
Waste generation amount	76.2 tons/day	92.2 tons/day	114.9 tons/day	141.9 tons/day
Waste discharge amount	48.4 tons/day	60.4 tons/day	78.0 tons/day	99.7 tons/day
Waste collection amount	39.5 tons/day	49.3 tons/day	70.2 tons/day	99.7 tons/day
Final disposal amount	40.5 tons/day	50.3 tons/day	71.8 tons/day	101.4 tons/day
Coverage rate (waste amount)	81.6 %	82 %	90 %	100 %
Coverage rate (population)	51.0 %	51 %	88 %	100 %
Service population	51,382	58,851	118,088	153,444
Non-service population	49,366	56,542	15,665	0
Length of road swept	45 km	45 km	52 km	60 km
PARTICULARS OF THE PLAN				
1.Collection & Transport				
Collection system	Curb collection, Public container collection	Curb collection, Public container collection	Curb collection, Point or Public container collection	Curb collection, Point or Public container collection
No. of collection vehicles	Tractors: 6, Container truck : 1, Container: 6	Tractors: 6, Container truck : 1, Container: 6	Compactor truck, Tipper truck, Container truck	Compactor truck, Tipper truck, Container truck
Transportation system	Direct transport	Direct transport	Direct transport	Direct transport
Responsible authority	Municipal Services and Administration Department	Municipal Services and Administration Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of personnel	37	-	-	-
Unit cost of collection	C$52.4/ton	-	-	-
2. Street sweeping				
Cleaning method	Manual	Manual	Manual	Manual
Length of road	91 km	-	-	-
Length of road swept	45 km	45 km	52 km	60 km
Responsible authority	Municipal Service and Administration Department	Municipal Service and Administration Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
Number of personnel	49	-	-	-
Unit cost of street sweeping	C$1.20/m	-	-	-
Equipment used	Broom, shovel, handcart	Broom, shovel, handcart	Broom, shovel, handcart	Broom, shovel, handcart
3. Intermediate treatment	None in particular	None in particular	No requirement other than on-site & community based ones.	No requirement other than on-site & community based ones.
4. Recycling				
Recycling Amount				
At generation point	8.5 tons/day	10.3 tons/day	12.8 tons/day	15.8 tons/day
At landfill	0.4 tons/day	0.5 tons/day	0.0 tons/day	0.0 tons/day
Recycling system	Not organized recycling	Not organized recycling	Segregation of wastes for recycling to be promoted.	Segregation of wastes for recycling to be promoted.

Item	Present (1995)	2000	F/S (2005)	M/P (2010)
5. Final disposal				
Disposal method/level	Open Dumping	Controlled Tipping (Level 1)	Sanitary Landfill (Level 2 or more)	Sanitary Landfill (Level 2 or more)
Disposal site	Municipal Landfill	Municipal Landfill	A new landfill	A new landfill
Site area	-	-	-	-
Distance of site from generation center	4 km	-	-	-
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of personnel	1	-	-	-
Charge for Disposal	- C$/ton	-	-	-
Unit disposal cost	C$5.89/m^3	-	-	-
Main equipment	Bulldozer: 1	Bulldozer: 1	Bulldozer, Tipper truck, Excavator, Sprinkler truck	Bulldozer, Tipper truck, Excavator, Sprinkler truck
6. Maintenance of Vehicles and Equipment				
Maintenance shop	1	1	1	1
Responsible authority	Municipal Service Department	Municipal Service Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
No. of employees	7	-	-	-
7. Operation				
Responsible authority	Municipal Services Department	Municipal Services Department	Urban Environmental Maintenance Bureau	Urban Environmental Maintenance Bureau
Number of personnel	87	-	-	-
Type of operation	Municipal operation	Municipal operation	Municipal operation	Municipal operation
8. Finances				
City budget	C$15,084,000	C$19,893,000	C$25,389,000	C$30,594,000
Cleansing department budget	C$2,086,230	-	-	-
Management of service recipients	Through a register	Existing system	Department of Administration and Finance	Department of Administration and Finance
Fee collection method	Door to door	-	-	-
Rate of fee collection	Very low	-	-	-
Revenue	C$106,000	-	-	-
9. Contract to Private Sector				
Method of contract	None	None	To be examined.	To be examined.

11.7 Recommendations for Industrial Solid Waste Management

11.7.1 Conclusions of the Industrial Solid Waste Survey

Industrial solid waste (ISW) generation amount in Chinandega is estimated at about 6,400 tons/year, the second largest of the 3 cities (Leon is the largest and Granada the smallest). The industries in the CIIU3116 category (processing dry seeds from legumes) are the main sources of ISW generation in Chinandega, generating about 80% of the

total ISW in Chinandega. Solid waste from these industries mainly consists of organic compounds and is not likely to contain hazardous substances. Industries in Chinandega that are most likely to generate hazardous waste are those in the CIIU3512 category (fertilizers, insecticides, etc.). These industries make up about 2% of the total ISW generation in Chinandega.

Industrial solid waste in Chinandega is mostly disposed of in the municipal solid waste dumping site without any control and order.

11.7.2 Recommendations for the Improvement of ISWM

Industrial solid waste (ISW) result from industrial production activities. Therefore, as in industrial wastewater management (IWWM), the cost for the safe management/disposal of industrial solid waste should be born by the industries, based on the "polluter-pays-principle (PPP)".

From a technical viewpoint, the following are considered key solutions to the problem:

- Reduction of ISW generation amount and pollutional load by adopting highly rationalized production techniques.
- Establishment of appropriate management/disposal technologies and systems for each ISW categories.

A key issue in ISWM is the management of hazardous ISW. The exclusive operation of facilities for the management and/or disposal of hazardous ISW should be urgently established. Until this is realized, authorities are recommended to practice the following measures in the management of hazardous ISW.

- Industries shall be required to practice waste minimization, on-site treatment, and storage of hazardous IW.
- Utilization of existing facilities (e.g. incineration in cement kilns) shall be examined for hazardous IW treatment. Industries shall be obliged to take the necessary action (e.g. cement kiln utilization) if they generate hazardous wastes to which such treatment is applicable. In case it is not applicable, the industries shall be obliged to store the hazardous IW.
- Avoid mixed disposal of ISW and domestic SW in the municipal disposal site by establishing a monitoring system to prevent hazardous ISW disposal. Industries proven as non-generators of highly hazardous ISW are allowed to dispose their wastes in the municipal landfill site.

In this regard, the formulation and enforcement of legislation relevant to the management and disposal of ISW are very important and urgently required.

11.8 Recommendations for Medical Solid Waste Management

11.8.1 Conclusion obtained from the Survey on Medical Waste Management

The table below shows the forecast on present and future medical SW generation in Granada based on the questionnaire survey, in line with the medical SW classification proposed by the Team.

Table 11-8: Forecast on Present and Future Medical SW Generation

Unit: kg/day

Waste Classification	1996	2000	2005	2010
Risky Waste*1	36.9	42.1	48.8	56.0
Hazardous Waste*2	3.0	3.4	4.0	4.6
Special Waste*3	0.03	0.03	0.04	0.05
(Sub-total)	39.9	45.5	52.8	60.7
Common Waste*4	56.2	64.1	74.4	85.4
Total	96.1	109.0	127.2	146.1

Note: The classification is proposed by the Team.
*1: Infected waste (sharps, blood, used dressing, etc.), infected waste from laboratories, waste from patients with infections and wastewater.
*2: Chemical waste (medicines, disinfectants, solvents, etc.), radioactive waste.
*3: Ash from incinerator, sludge.
*4: Office waste, kitchen waste, packing waste, bulky waste, garden waste, DWW.

All medical institutions surveyed separately handle hypodermic needles, which is promoted in collaboration with JOCV. Exclusive collection, management and disposal of infectious medical waste (e.g. hypodermic needles) are performed in Chinandega.

Medical wastewater is either discharged into the sewers or a soak pit without treatment by institutions surveyed, except one hospital newly established with the cooperation of the Spanish government.

11.8.2 Recommendation for the Improvement of Medical Waste Management

In order to establish an appropriate medical waste management (medical WM), MINSA should take a leading role in defining the classification of medical waste and should enforce handling guidelines (i.e., code of practice) for different medical wastes. Consequently, medical institutions should be obligated to practice appropriate medical WM according to the code of practice (e.g., separate collection and haulage of hazardous/infectious medical waste). Furthermore, a commercial system for medical WM should be formulated in order to secure appropriate treatment/disposal of hazardous/infectious medical waste by the private sector.

In order to realize the above-mentioned plan, it is indispensable to establish an administrative institution which promotes, instructs, oversees, and regulates the execution of appropriate management for medical waste. Furthermore, the separation of infectious and non-infectious waste at the generation source should be assured, and education for workers including collection workers should be provided without exception, in order to practice appropriate collection, treatment, and disposal of separated hazardous/ infectious medical waste. Institutions such as SILAIS should take leading roles in taking these actions.