2) Collection and transport systems in the PCA

The collection service in the PCA will be entrusted mainly to the municipal government and partially to the private sector. These zones will, therefore, have a "mixed type" collection.

a. In regular service areas

- Door to door and/or station system for the private sector
- Station and Block (including bell collection) systems for the municipal government

b. Station and Block system in marginal areas

The collection service will be assigned solely to the municipal government, and suitable collection systems will be combination of Station and Block collection systems

Observation on the container collection system: This system should be used carefully taking into account the surrounding conditions of the area in question (cf. Feasibility Study).

8.2 Planning of Final Disposal

(1) Improvement of "El Trebol" disposal site

Improvement of "El Trebol" disposal site is to be executed though a controlled landfill, and as for the construction method, "down slope" method was selected and the landfilling and soil covering are to be executed from the gully bottom. For this controlled landfill, the necessary facilities and equipment are planned as follows:

1) Construction of common facilities

Ground and internal road preparation.
The existing main road is to be paved with asphalt.
The slope is to be constructed to the gully bottom.

2) Construction of administration facility

Fence repair and extension
Operator's shed
Oil tank yard
Workshop
Parking area
3 gates

3) Operational equipment

Bulldozers
Shovel loaders
Truck scale

4) Environmental protection fcility

Submerged pump (for leachate recirculation)
Leachate reserve pond with dam
Aerators
Rain water drainage system

(2) The planning of a new landfill site at "Las Guacamayas"

The new landfill at "Las Guacamayas" has to be a sanitary landfill from the beginning.

The construction method is the "down slope" method and the landfilling and soil covering are to be executed from the gully bottom.

For this sanitary landfill, the necessary facilities and equipment are planned as follows:

1) Construction of common facility

Internal road construction in the landfill site.
Slope construction.
Ground preparation in the landfill site.

2) Construction of administration facility

Fence and 2 gates
Operator's shed
Oil tank yard
Workshop
Parking area

3) Operational equipment

Bulldozers
Back hoe
Truck scale

4) Environmental protection facility

Submerged pump (for leachate recirculation)
Leachate reserve pond with dams
Aerators
Rain water drainage system

(3) Costs

The costs required for the landfill construction, equipments' purchase and their operation and maintenance expenditures, which are related to improvement and opening of final disposal sites are as follows;

Table 9 Costs for Final Disposal

(Unit: Q/Yen)

Final disposal site	Construction	Equipment	Operation
Controlled landfill of El Trebol	1,513,400	11,711,800	26,164,730
Sanitary landfill of Las Guacamayas	8,119,000	12,836,500	16,612,420
Total	9,632,400	24,548,300	42,777,150

9. Financial Planning

9.1 Cost Estimation

The additional costs required for the implementation of the programs proposed by the Master Plan are as follows (summationed from 1992 to 2000):

	(US$)	(Q)
Capital costs	9.1 million	45.4 million
Operating costs	9.2 "	45.9 "
Total	18.3 "	91.3 "

Note: Exchange rate 5Q/US$ as of Feb., 1991 with 1991 prices

9.2 Case Study

Two cases are considered below:

(1) Assuming an interest rate of 8% for a domestic loan
(2) Assuming an interest rate of 4% for a foreign loan

The ratio of the DLP's budget to the municipal budget which stands at about 10% in 1991, have to be increased as follows to cover the necessary cost:

(1) Interest of 8%: 21.38% (24.14%)
(2) Interest of 4%: 20.47% (23.19%)

Note: Average ratio from 1992 to 2000
( ) indicates the maximum ratio

The foreign soft loan seems to be preferable for the municipality.

9.3 Necessary Budget

Therefore, the "DLP" has to spend on average Q11.8 million per year as opeation cost, while the municipality must pay an average of Q4.1 million per year as debt service until the year 2000.

10. Program for the Implementation of the Master Plan

10.1 The Main Constituent of the Project

The main constituent implementing this master plan is the Municipality of Guatemala. DLP, in charge of cleansing service, must reinforce the organization and will be responsible for executing the plan. That organizational improvement within the Municipal Office must be carried out without delay. Regional adjustment and cooperation will be attempted by the establishment of CMDS, Metropolitan Solid Waste Committee including autonomous bodies in Guatemala or in Metropolitan areas such as Mixco City.

10.2 Implementation Plan

The most urgent projects in the Master Plan for the years up to 2000 will be completed by 1996. The collection ratio will be drastically improved through organizational improvement of the Municipality, improvement in collection equipment, and concessions to private collectors, and projects for the improvement of final disposal sites and equipment distribution will be carried out at the same time.

In the meantime, the Master Plan will be reviewed and corrected, and execution plans for the second half of the term and a long-range plan for years after 2000 will be developed.

The long-range plan is to educate residents and urge them to cooperate with the waste disposal plan. Another aim will be to improve the knowhow and operating efficiency of employees by carrying out employee training.

The schedule for the implementation of these projects is shown in Table 8.

10.3 Financial Plan

As shown in Table 8, the Master Plan will require an increase in the sanitation budget from the present 10% to 23% of the Municipal expenditures. To make this possible, services that are currently extended free of charge, such as street and market cleaning and final disposal, will be made chargeable with the additional revenue to be spent on new operations.

The capital expenditures, including those for the collection equipment, will be financed through government subsidies, low-interest loans from abroad, and foreign grant aid. Through these efforts, the Master Plan will be implemented.

Table 10 Implementation Schedule (1990 - 2000)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Organization, Finance												
Organization, Institution				Working Group			Reschedule of Mater Plan					
Community Education				Metropolitan Committee of Solid Waste (CMDS)								
Personnel Training												
Concession to Priv. Collectors												
(Numbers of Zone)				(1)	(3)	(3)	(4)	(4)				
(Zone Number)				11	5-6-12	8-9-10	1-2-3-4	7-13-14-15				
Equipment Maintenance												
(Efficiency of Collection Vehicles)		(82.6%)			(90.0%)							
DLPM's share in Municipal Budget		10.5	9.7	13.3	19.0	18.9	19.1	21.9	22.2	22.7	23.2	23.0
Operation												
Collection												
Domestic waste to be collected	t/wd	820	862	904	946	988	1,031	1,078	1,125	1,172	1,219	1,267
Projected collection quantity of domestic waste	t/wd	483	575	667	759	850	942	1,007	1,072	1,137	1,202	1,267
Coverage	%	(58.9%)					(91.4%)					(100%)
	(%)	67.6%					85.4%					86.4%
Recycling Percentage	(%)	5	5.4	5.8	6.2	6.6	7.0	7.2	7.4	7.6	7.8	8.0
Vehicles Replacement plan												
Compactor truck				18			19					
Dump truck				4			2					
Final Disposal		1,211	1,320	1,429	1,537	1,646	1,758	1,840	1,920	2,002	2,081	2,162
a. Improvement of El Trebol												
. Waste quantity to be disposed	(t/wd)	1,211	1,320	1,429	1,055	1,117	1,182	1,229	1,274	1,320	1,364	1,409
. Equipment				Bull=1			Bull=2			Bull=3		
. Environment				Sc	La				Sc	Lc		
b. New landfill Las Guacamayas												
. Waste quantity to be disposed	(t/wd)	0	0	0	482	529	576	611	646	682	717	753
. Equipment				Bull=6			Bull=1					
. Environment				Sc	Lc							

Sc = Soli Covering
La = Leachate aeration
Lc = Leachate circulation
Bull = Bulldozers

III. FEASIBILITY STUDY

1. Identification of Priority Projects

The policies to be implemented in stages by the year 2000 have been set out in the above Master Plan. Among these, there are some first priority projects requiring urgent implementation.

It is believed that these projects must be achieved by 1995 at the latest. Their feasibility have been assessed and the study results are shown in the following.

The subjects of these projects are as follows:

(1) Expansion of collection service coverage, particularly in marginal areas.

(2) Sanitary final disposal of solid waste through the conversion of "El Trebol" dump site into a controlled landfill and the opening, as soon as possible, of a new sanitary landfill.

(3) Institutional development of municipal public cleansing services, including planning, organizational and financial aspects, and the fundamental reorganization and systematization of dual municipal and private collection services.

2. Pilot Test

2.1 Container experiment

The collecting and transporting operations in the study area are handled primarily by private collection companies, who collect waste on a door-to-door basis. The container collection method has been suggested because if the private companies are granted a concession for collecting operations, it will be difficult to carry out a door-to-door collection in some areas especially in marginal areas.

Therefore, it has been suggested that the use of containers would serve to improve the efficiency of collecting waste in the city especially in marginal areas. This experiment was carried out to satisfy the need of exploring the possibility of fixed-point collection by placing containers around Guatemala City.

Thus, the purpose of this experiment was to study the possibility of fixed-point collection through the use of containers set at various sites to see if residents would use these containers to dispose of their waste. This experiment was conducted from January 1991 to the end of March 1991. The containers were placed in five marginal areas around Guatemala City. The residents showed an extremely positive reaction, to this collection system; however, some of the private collection companies pointed out that such a system would interfere with their business.

The introduction of the fixed-point container collection method is technically effective, but it is likely to adversely affect private collection companies. For that reason, its introduction should be planned only after fully examining the scope of their business areas.

Furthermore the containers use is effective as long as DLP supports it with an intensive community education

program live the one performed in this experiment.

2.2 Video Program

Waste collection in marginal area cannot be carried out without the cooperation of the residents. To obtain this cooperation, sanitation education was considered. Because many of the residents in the marginal area are illiterate, we prepared three different video programs (for women, children, and workers), geared toward inducing more attention to the sanitary environment in general, and to health aspects in particular.

The video experiment was conducted in March 1991 to determine whether the residents would be receptive to sanitation education through video programs. In this way the likelihood of residents' cooperation could also be evaluated.

The video programs cited cholera as a disease that could result indirectly from inappropriate waste management. This proved very effective because it so happened that at the same time, cholera was running rampant through Central and South America.

It was concluded that the video presentation had a favorable impact on residents, and proved to be successful. Both the contents and the expressions were easy for them to understand. This project reconfirmed that audio-visual educator using videos would be effective in areas where there is a high percentage of illeteracy. Sanitary education programs including video presentations should be promoted actively and continuously to improve public awareness of hygiene, which will also favorably work for the relations between the residents and the municipality.

2.3 Preventive Maintenance Experiment

The equipment-related problems in Guatemala City include inadequate maintenance and a lack of any preventive maintenance program. For example, equipment obtained through overseas aid has failed to stand extended periods of use because of the lack of proper equipment maintenance. As a result, this has created a major bottleneck in the city's management of cleansing service.

To improve waste collection services will require that the utilization rate of vehicles be improved and that their service life be lengthened. Therefore, we experimented on preventive maintenance to determine its effectiveness and to evaluate the importance of maintenance programs and general maintenance organization.

These experiments were conducted at the repair shop of DLPM over a period of about one month. During these experiments, the following four items were examined:

(1) Preventive Maintenance

The necessary infrastructure covering special tools and minor equipment are prepared to permit monthly maintenance to at least 24 vehicles.

(2) Personnel Training

A short course was introduced to provide knowledge on preventive maintenance and minor repairs. The mechanics and assistants, which attended this course, were also trained to fill out inspection sheets.

(3) Preventive Maintenance Manual

Preparation of preventive maintenance manual is necessary. It will serve as an information source for

mechanics that have attended the special training course. It will also serve to aid in the training of new personnel joining the maintenance section.

(4) Preventive Maintenance Program

As an experiment, a short preventive maintenance program consisting of daily and monthly inspections was implemented. This program lasted for one month and showed positive results. The work was temporarily halted when an entity centralizing maintenance work on all municipal vehicles was established. The conclusion reached is that a preventive maintenance program to be implemented by the DLP would be feasible, and its application toward improving the operation rate of vehicles, as well as their effective life, would prove to be very beneficial.

3. Collection in Marginal Areas

(1) Determination of marginal areas

Marginal areas include 1) collection non-served areas in the ECA, 2) non-served areas in the PCA and 3) self-disposal areas in the IA.

(2) Fundamental concept for solving the problem.

The collection problem in marginal areas can only be solved over the whole framework of the Solid Waste Management; that is, it can only be settled in connection with the improvement of collection services in the whole study area.

(3) Means of solving the collection problem in marginal areas

The concrete and practicable means include the following;

1) Maximum utilization of existing manpower, both municipal and private.

2) Maximum utilization of available collection vehicles.

3) Admitting and accepting the actual dual collection system.

4) Readjusting the foregoing elements to meet the requirements of present circumstances.

5) Increasing operation efficiencies of collection, such as increasing the rate of vehicle operation, improving loading efficiency, improving the number of trips, increasing the utilization coefficient of

municipal vehicles, etc.

6) Implementing the zone concession to the private collectors with full responsibility for collecting all waste in the conceded service area.

7) Expand the ECA, where the private collectors work exclusively, as much as possible to allow the municipal government to carry out collection services effectively at PCA.

The following measures should be applied when using containers:

8) The containers should be placed in marginal areas in the strict sense of the term, and not in "mixed government-private collection areas."

9) Cooperation should be obtained from the residents living in those areas where containers will be placed. In this respect is very important the support of the DLP's community education program.

(4) Allocation of collection responsibility

1) Concession receiving private collectors for marginal areas in ECA.

2) Exclusive municipal government activity in marginal areas in PCA .

(5) Equipment required for the municipal collection service

To make collections in marginal areas really viable, it is necessary to determine the required number of municipal collection vehicles; for this purpose, a vehicle purchasing or replacement plan has been elaborated, as the following table shows. This table

reveals that the DLPM or "DLP" will be capable of using its existing fleet of collection vehicles for the purpose in question.

Table 11 The Plan for Vehicle Replacement

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Market & Sweeping Waste Amount (t/n.d)	192	197	202	207	211	217	222	227	231	236	240
Domestic waste Amount (PCA) (t/w.d)	240	238	235	233	231	228	223	218	213	208	203
(ECA) (t/w.d) *1	108	110	109	85	67	39	29	14	0	0	0
Amount to be collected total (t/w.d)	540	545	546	525	509	484	474	459	444	444	443
Compaction vehicles actual number	31(36)	31	17+			0					
Renewal			14								
Purchase			4			19					
(Sub-total)	31(36)	31	35+	35+	35+	37	37	37	37	37	37
Dump trucks (convoy service)	3(4)		0								
Renewal			4								
Purchase						2					
(Sub-total)	3	3	4	4	4	6	6	6	6	6	6
Trip number (Nocturnal service included)											
Domestic waste collection	1.47	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Convoy service	8	10	10	10	10	10	10	10	10	10	10
Average load (t/truck) Domestic	4.5	5.6	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
Convoy	1.9	2.2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Expected wasted amount (t/w.d) Domestic	204.4	260	315	315	315	332	333	333	333	333	333
Convoy	45.6	66	100	100	100	150	150	150	150	150	150
	(250)	(326)	(415)	(415)	(483)	(483)	(483)	(483)	(483)	(483)	(483)
Waste amount supposed to be non-collected	290	219	131	110	84	---	---	---	---	---	---

4. Final Disposal Site

To prepare the improvement plan for "El Trebol" disposal site and the construction plan for a new sanitary landfill site at "Las Guacamayas", an over-all assessment was necessary. This assessment included the questions of the improvement or construction of access road, control facilities, machinery for the landfill operations, and the introduction of technical knowledge about landfill. In addition, financial considerations to facilitate the plans also had to be assessed.

After considering all of the above, the plan was determined to be feasible.

The following is an outline of the plan on which the Feasibility Study was carried out:

4.1 Improvement of the "El Trebol" Disposal Site

(1) Divide the present landfill operation site into two areas by fence. One is for the dumping operation area, and the other one is for preservation area which is covered with soil.

(2) Since landfill operations can be classified into unloading operations for the private collection vehicles and local government collection vehicles, the collection of sellable items by scavengers, the compaction of solid waste by heavy machinery, and the covering of the compacted waste with soil, two solid waste unloading sites for private collection companies, one for local government collectors, and a soil storage site will be set up. Then it is determined to allow scavengers to work at the unloading sites for private collectors. Moreover, since the solid waste unloading sites for private collectors will be designated at two locations, the two places can be used interchangeably

on a day-to-day basis in order to avoid conflicts between scavengers and bulldozer operation, and secure safe operation.

(3) Consideration will be given to prevent increases in the number of scavengers and reduce their number over the passage of time by giving them permits (for a fixed duration) to engage in the collection of sellable items.

(4) Install truck scale at the entrance to weigh solid waste.

(5) Rainwater in the upper portion of the landfill site will be drained by installing a drainage structure. This will lessen the amount of leachate.

(6) Passage ways at the site will be constructed to control incoming and outgoing trucks, thereby securing traffic safety.

(7) The main road for carrying in solid waste just outside of the existing fence will be paved to secure sanitary and safe operations during the rainy season.

(8) A solid waste sliding slope about 200 meters long, 35 meters wide, and at an angle of about 30% from the dumping site to the bottom will be constructed. Solid waste and soil will be pushed on the slope to the bottom by six bulldozers, and another bulldozer will carry out controlled landfill at the bottom of the gully. Cobble stones will be piled up on the slope with 2 meter width to facilitate the ventilation of generated gas and drainage of leachate.

(9) A makeshift pond will be built on the bottom of the gully and aeration treatment of leachate will be carried out with a portable aerator.

(10) At the end of the landfill site, a pond will be constructed with a concrete dam and a wire mat dam. Here, leachate will be sprayed with a pump onto the reclaimed land to be recirculated and allow an opportunity for its natural evaporation and oxidation.

(11) To implement the above plan, a vehicle pool for bulldozers and other heavy machinery, fueling facilities, and an office for the employees will be constructed at the site.

4.2 Plan for the Construction of a New Disposal Site at "Las Guacamayas"

(1) Prepare the following plans for the construction of a sanitary landfill site at Las Guacamayas.

Completely isolate the Las Guacamayas sanitary landfill site from the outlying residential areas, make the site off limits to the public, and keep scavengers and animals away thereby maintaining a good working environment at the site.

(2) Build a drainage ditch for rainwater around the site to prevent rainwater from flowing into the landfill.

(3) Build a level road and slope about 35 meters wide and 200 meters long at the site. Four bulldozers will use the road and slope to carry solid waste and soil down to the bottom of the gully.

The landfill process will begin at the bottom of the gully just as in the case of "El Trebol". These operations will be carried out by two bulldozers.

(4) At the bottom of the gully, a 24 meters wide and 920 meters long liner will be laid to prevent the pollution of groundwater by leachate.

(5) Spring water at the bottom of the gully will be discharged into the downstream through an aqueduct to lessen the amount of leachate.

(6) A makeshift pond will be built at the bottom of the gully, where an aeration treatment for leachate will be carried out with an aerator.

(7) A truck scale for collection vehicles, will be installed on the incoming road.

(8) Garbage will be covered every day with soil accumulated as a result of the construction of the landfill site, and with soil dug up from neighboring areas.

(9) At the site where sanitary landfill is expected to terminate, a pond with a concrete dam and a wire mat dam will be built to recirculate leachate.

(10) Generated gas will be discharged safely to prevent natural ignition.

(11) Utilization of reclaimed land

Any reclaimed land will be used to build parks or sports grounds for use by the residents of the surrounding areas.

5. Institutional Development

5.1 Proposed Organizational Structure

The proposed organizational structure is illustrated in Fig. 2. This organization incorporates all the planning, operation, maintenance, private collection, administration, community participation, training and evaluation systems and subsystems. This alternative offers the best opportunities to improve the administration of solid waste given the following criteria:

(1) It includes the formal and coordinated participation of Private Collectors, while avoiding social conflicts.

(2) It incorporates planning and evaluation systems.

(3) It promotes the continuing education of the community and its participation.

(4) It improves operational efficiency without increasing personnel.

(5) It allows for the fast and easy transition from the current DLPM to the proposed "DLP".

(6) Alternative which corresponds to Fig. 2A is only transitory one during the time of carrying out improvement works of "El Trebol".

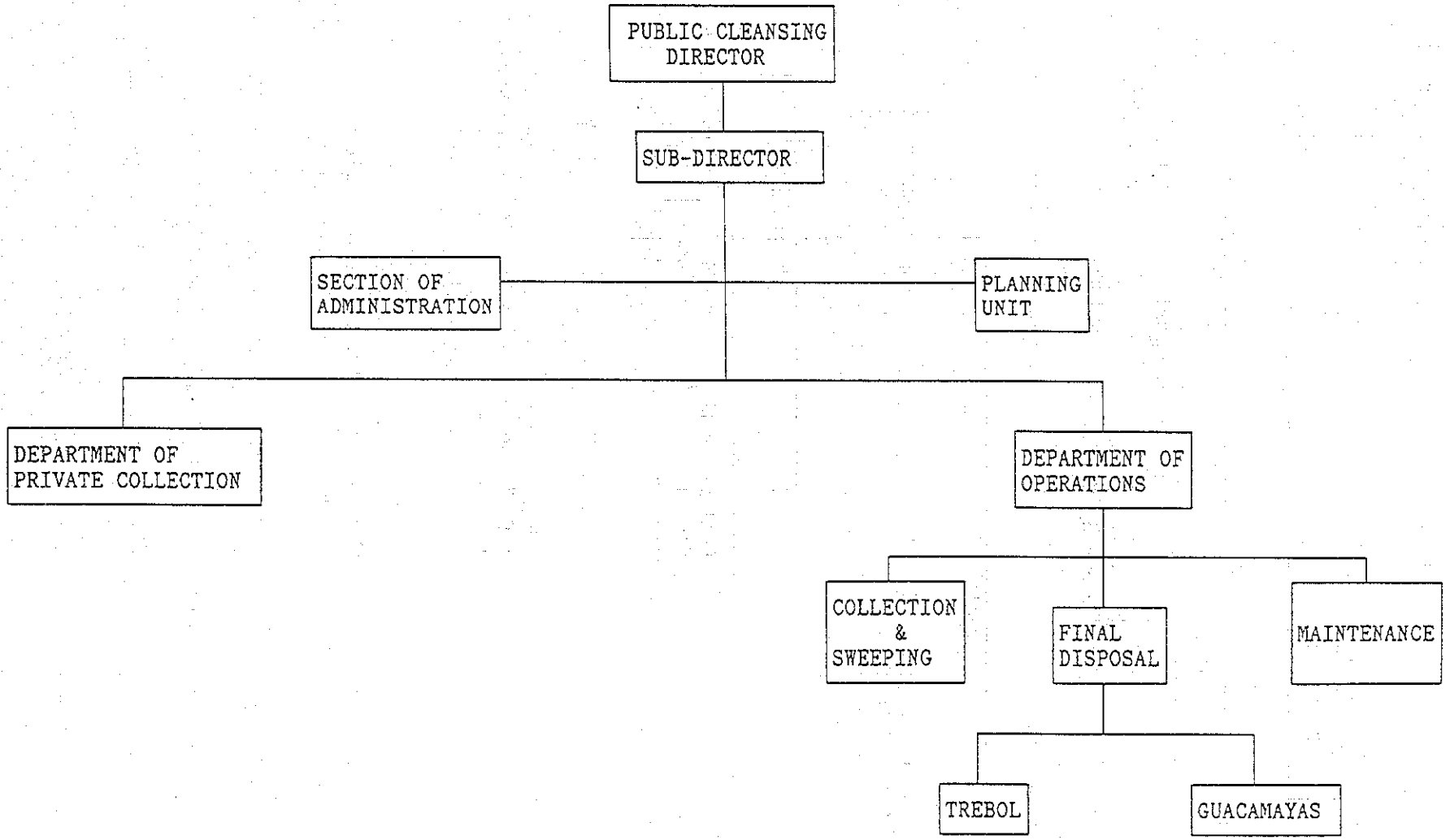

Fig. 2 Chart for the Public Cleansing Bureau DLP

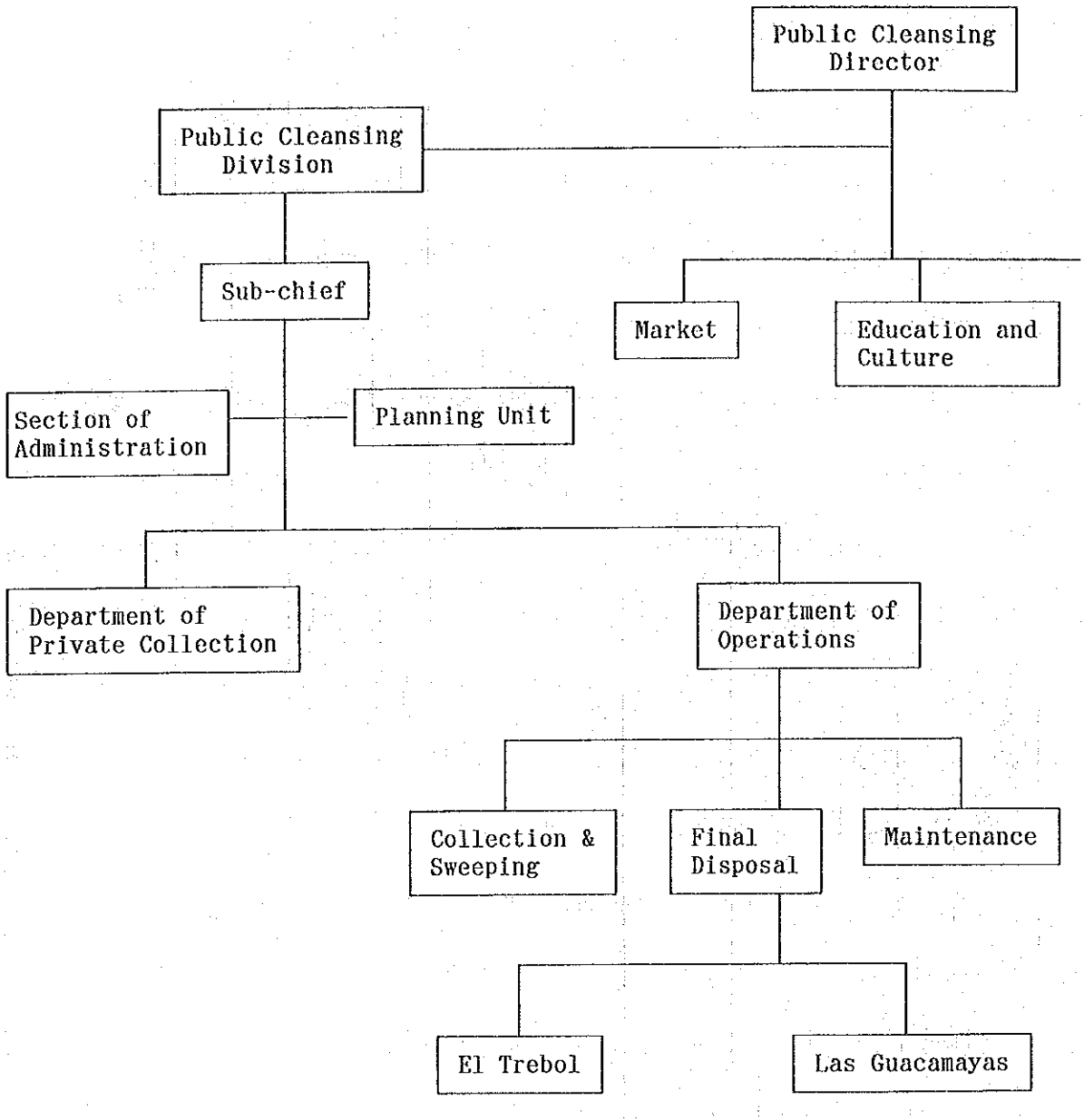

Fig. 2A Chart for the Public Cleansing Division, DLP

5.2 Concessions to Private Collectors

(1) Concession process

1) Zones

Consists of 20 zones in Guatemala City, 3 zones in Mixco, and one zone in Chinaulta, Villa Nueva and Villa Canales. Total: 26 zones.

2) Basic conditions for granting concessions

Granting a concession to carry out collection services will make a private collector responsible for the collection of all garbage and waste produced within a specified area; however, it is necessary to prohibit collectors from collecting or transporting hazardous waste. It is also necessary to define the various duties the collectors will be entrusted with; define the various conditions for cancellation of the concession; and clarify the sanctions to be imposed in case of any violation or breach of contract.

3) Criteria determining the granting of concessions

a. The zones should be included in ECA.

b. The number of clandestine open dumps in the zone should be large.

c. Potential profitability of the zone should be high.

d. Possibility of conflicts among private collectors should be minimal.

4) Process of granting concessions

The proper procedures shall be elaborated by the Municipal Department of Justice.

(2) Schedule of concession granting:

1) One zone 1992
2) Three zones 1993
3) Three zones 1994
4) Four zones 1995
5) Four zones 1996
6) Other possible concession zones 1997 - 2000

(3) Supervision and control of concessions

Concessions will be monitored, supervised and controlled by the "DLP", especially regarding the following points:

1) Complete collection of solid waste within the concession zone.

2) Transportation of collected solid waste to the final disposal sites designated by the "DLP"

3) Prohibition of hazardous waste collection

4) Control on the exclusive use of vehicles authorized by the "DLP", and other controls such as control of fees imposed on users.

6. Finance

6.1 Cost Estimation

Besides the actual budget for public cleansing, which totals 6.7 million Q for 1991, additional expenses necessary to implement the priority projects to the year 1995 (capital expenses, operating expenses) are estimated to be as follows: (Capital expenses are based on an assumed 4% interest rate.)

	1992	1993	1994	1995
Operations	2.8	3.9	3.9	4.2
Debt service	0	3.9	3.8	3.7
Total	2.8	7.8	7.7	7.9

Note: Unit = million Q

6.2 Necessary Budget

The DLP's required budgets are estimated at Q9.5 million for 1992, Q14.5 for 1993, Q14.4 for 1994 and Q14.6 for 1995.

6.3 New Revenue Sources

As an adequate necessary and new revenues for "DLP", a road sweeping fee, a market cleansing fee and a final disposal fee can be considered. Besides, it is necessary to consider increasing the "Boleto de ornato (working tax)". In this way, about Q4.7 million per year can be generated.

Revenue increase through the charging of fees for street cleaning services: About Q1.1 million/year

Revenue increase through the charging of fees for market cleaning services: About Q1.4 million /year

Revenue increase through the charging of fees for final disposal services: About Q1.2 million/year

Revenue increase through the charging of fees for the "Boleto de Ornato": About Q1 million/year

Total: About Q4.7 million/year

Accordingly, it is understood that the additional operating costs can be recovered by the new revenue sources mentioned above. (The budget for public cleansing service shares 20 - 40% of total municipal budget in other Latin American municipalities, but in case of municipality of Guatemala, this share is only 10%)

On the other hand, it is possible to reduce the debt service if the following efforts are made:

a. To receive necessary machines and equipments from foreign governments as international cooperation.

b. To allot the subsidy from Central Government (8% of National Budget) to civil constructions at the landfill sites and so on.

The financial feasibility is, therefore, confirmed.

7. Assessment of the Proposed Project

7.1 Socio-Economic Aspects

(1) Some personnel from other divisions in the municipality will, in principle, be transferred to DLP to provide workers, who are necessary to improve the organization, collection and final disposal. Therefore, the number of municipal workers will remain stable and labor costs will not increase.

(2) The concession method will reduce excessive competition among private collectors and generally stabilize their businesses. Furthermore, the replacement of their collection vehicles will become easier.

(3) A Cost-Benefit Analysis has proved that the municipality should be responsible for collecting solid waste in PCA which cannot be served by private collectors because of its low potential profitability.

7.2 Institutional Aspects

(1) The institutional organization is feasible since there will be no increase in bureaucracy.

(2) The organizational restructuring is realistic and viable, and can be carried out immediately, since it will continue to be a municipal office.

(3) The new organization will ensure the continuity, improvement and extension of the coverage of collection services, especially in marginal areas, and formalize relations with private collectors.

(4) The new organization will improve the efficiency of services through a planning and evaluation system to be established.

(5) The new organization will handle strategic planning over the long term, allowing for the study of possible sanitary landfill sites; and recovery and recycling programs, etc.

(6) The education and community participation programs will take priority because they will ensure permanent achievements, including the reduction of service costs.

(7) Economy of scale at the metropolitan level for final disposal and private collectors will be achieved.

(8) The proposed institutional organization will ensure that no social problems arise.

7.3 Technical Aspects

(1) Collection and transport:

The collection from marginal areas in ECA will be covered by the private collection service under a full responsibility of private collectors and based on zone concessions to them, and the collection from marginal areas in PCA will be covered by municipal service which will increase its capacity to attend PCA through an improvement of an entire collection system of the metropolitan area. Since a regular service in self-disposal areas in PCA is practically impossible, it will be settled according to "on-site" principle under a due municipal guidance. Equipments required, distribution of personnel to be assigned and waste amount to be collected have been estimated to evaluate a realistic viability of the plan, and the conclusion is that collection from marginal areas will be feasible without any drastic increase in equipments and personnel, except replacement of vehicles. Implementation of preventive maintenance will be very

useful for collection efficiency.

The introduction of containers would be extremely effective; however, the cooperation of residents will be indispensable whether it is handled by local government or by private collectors. It is important to be fully aware of the need to seek cooperation.

It is also important to collect garbage more often than usual to win the confidence of the residents.

Introduction of fixed-point collection through the use of containers will have to be implemented without the local government pressuring private collectors within their sphere of operations. This will prove to be an effective method only if it is introduced with following careful consideration of private collectors' sphere of operations.

(2) Final disposal

After careful study of landfill method of "El Trebol" and "Las Guacamayas", it was concluded that "El Trebol" to be a controlled landfill, and "Las Guacamayas" to be a sanitary landfill. However, as for technical method, the same landfilling method selected out of three alternatives was decided to apply on both gullies. The method is to make a down slope to the gully bottom and to landfill from the bottom.

Based on this basic policy, the necessary facilities such as administration facility, operational equipment, environmental protection facility etc. were planned depending on proper conditions of "El Trebol" and "Las Guacamayas". This planning was confirmed to be feasible from technical, economic and environmental viewpoints.

7.4 Environmental Aspects

By granting concessions to private collectors, and by promoting the educational program on sanitation, and by shortening the distance of solid waste transportation by opening a new sanitary landfill, the number of clandestine open dumpings will decrease, and general sanitary conditions will greatly improve.

Furthermore, by converting the "El Trebol" dumping site into a controlled landfill, and by creating a new sanitary landfill, the adverse effects of final disposal on the environment will decrease, i.e., the amount of leachate, offensive odors, and smoke.

Although a new sanitary landfill will have a minor environmental impact, residents in neighboring areas are expected to receive substantially greater benefits than that, including:

(1) The prevention of soil erosion

Soil that is currently eroding at a rate of two meters per year can be controlled.

(2) The use of filled area

Parks and sports fields can be built and used by the residents of the surrounding areas.

(3) The reduction in the number of illegal dumping sites

The outbreak of offensive odors, harmful worms and diseases can be controlled.

On the basis of the above, it is safe to assume that this project will be effective in improving Guatemala City's

solid waste management, which in turn will contribute toward improving the city's environment.

Moreover, the project will not cause any serious adverse environmental impact on the vicinity of the final disposal site.

7.5 Overall Evaluation

As stated above, we have evaluated the feasibility of the three top-priority projects from social, economic, institutional, technical and environmental viewpoints.

As a result, we have come to the conclusion that each of the projects is feasible, although their feasibility would be preconditioned on the decision of the top management of the city government to strengthen the city's organization, systems and financial position regarding cleansing service, as well as the cooperation and assistance of SEGEPLAN, the Ministry of Public Health and Welfare and other related government agencies. Of course, economic assistance from overseas would also be necessary.

The following results could be realized by undertaking these projects:

1) Expansion of collection services to unserved community based on the approach of "concessions" of the service to the private sector.

2) Expansion of the municipal's collection services in marginal areas through the improvements of organization and equipment.

3) Enhancement of an opportunity to open a new landfill site by applying maximum efforts to improve El Trebol disposal site.

4) Improvement of transport efficiency and the control of clandestine open dumping through the use of more than one landfill site.

5) Establishment of a structure to ensure residents' cooperation in cleansing projects through the promotion of civil education programs.

These results would help to vigorously promote the solid waste management in the Metropolitan Area of Guatemala City. This would ensure improvement of sanitary conditions and a comfortable living environment for citizens.

8. Implementation Program

8.1 Solid Waste Collection in Marginal Areas

Discussions will begin immediately between the Municipality and the private sector to authorize private-sector collectors to engage in the garbage collection business. The working group in charge of DLP within the reorganized division that handles public sanitation will be in charge of this project.

The project will begin in a selected zone in 1992, and will gradually spread to other zones while actual results are complied. The collection service will be implemented in all 15 zones by 1996.

Meanwhile, DLP's working division will improve collection equipment and step up solid waste collection service in slums and other areas where collection by the private sector is difficult. Through these efforts, solid waste collection service in marginal areas will be drastically improved by 1996.

8.2 Improvements in Final Disposal

Improvement of El Trebol disposal site will begin immediately. Bulldozers and other necessary machinery will be reinforced while making full use of current personnel and the machinery already in operation. Improvement of facilities at El Trebol will be effective in winning the confidence and cooperation of the residents to the cleansing service, and will expedite the construction of the new disposal site at Guacamayas. As a result, an efficient transportation and disposal plan will be worked out for the two landfill sites by 1996, which should lead to a decline in illegal dumping.

8.3 Improvement of the Organizational System and Financing

The Municipal organizational improvement should be carried out as soon as possible to implement the above project. The same goes for the organization of a Metropolitan Waste Committee. The execution and management of each project will be carried out by this organization and its working group. They should be functioning by 1992 so that the organization can proceed with concessions, educating residents, and promoting the project with the cooperation of private enterprises and residents.

In terms of finance, a new source of revenue will be secured by establishing fees for street and market cleaning and by raising the labor tax. This additional revenue will be used to cover increased operating costs. To improve collection vehicles, bulldozers and other necessary equipment, it will be important to make requests to outside organizations and to apply for foreign grant aid.

The execution schedule will be shown in the form of a table.

Table 12 Implementation Schedule (1991-1996)

	1991	1992	1993	1994	1995	1996
1. Collection from marginal areas						
1) Zone concession to private collectors		Z11	Z5.6.12	Z8.9.10	Z1.2.3.4	Z7.13.14.15
2) Collection in ECA · Regular service areas (t/workday)	525	594	662	731	799	873
· Marginal areas (t/workday)	127	112	97	82	68	54
3) Collection in PCA · Regular service areas (t/workday)	89	121	153	185	217	216
· Marginal areas (t/workday)	162	127	92	57	21	17
· Self-disposal areas (On-site coll.)(t/workday)	74	79	85	90	95	101
4) Isolated areas (On-site coll. or disp.)	53	57	61	65	69	74
2. Final disposal						
1) Improvement of El Trebol Landfill Site						
Construction (Ground preparation access road etc.)						
Equipments (Bulldozer, Shovel loader, Pump etc.)		B-4,S-2, P-2			B-2	
2) Opening of a New landfill Site Las Guacamayas		Leachate Collection Ditch			Leachate Collection Ditch	
Construction (Ground preparation access road etc.)						
Equipments (Bulldozer, Back hoe loader, Pump etc.)		B-6,BH-2 P-2			B-1,BH-1	
3. Institutional and Financial Aspects						
1) Institutional Organization						
Formation of a Work Group	—					
Organization of Metropolitan Solid Waste Committee	—	—				
Review of the MP					—	
Preparation of a long-term plan						
2) Community Education and Participation						
Development of programs						
3) Personnel Training						
Establishment of a permanent training program						
Obtaining of financial aid from international organization						
4) Organizational aspects of private collection						
Approval of concessions and zones		—				
Gradual granting of concessions (Zone number)		11	5.6.12	8.9.10	1.2.3.4	7.13.14 15
5) Finance						
Study on increasing SWM's budget		—				
Obtaining of foreign of international subsidies		—				

B : Bulldozor
P : Pump
S : Shovel Loader
BH : Back Hoe
Z : Zone

<Continue>

Table 12 Implementation Schedule (1991 - 1996): No. 2

	1991	1992	1993	1994	1995	1996
4. Investment Amount (Unit: Q1,000)						
1) Collection						
Compact car		4,950			5,225	
Damp car		700			350	
Installation of preventive maintenance of equipment		100				
Total		5,750			5,575	
2) Final Disposal						
Improvement of El Trebol						
Civil construction		1,329				
(Incl. Truck scale, Pump etc.)						
Acquisition of Heavy Machinery		5,744			2,674	
Total		7,073			2,674	
Opening of New Sanitary Landfill						
Civil Construction		5,491			954	-
(Incl. Truck scale and Pump etc.)						
Acquisition of Heavy Machine		9,807			-	2,230
Total		15,298			3,628	2,230
Total of Final Disposal		22,371			3,628	2,230
3) Total Amount of Investment		28,121			9,203	2,230

Appendix

The Organizational Structure and Members for the Study

The organizational structure for the study is shown as below.

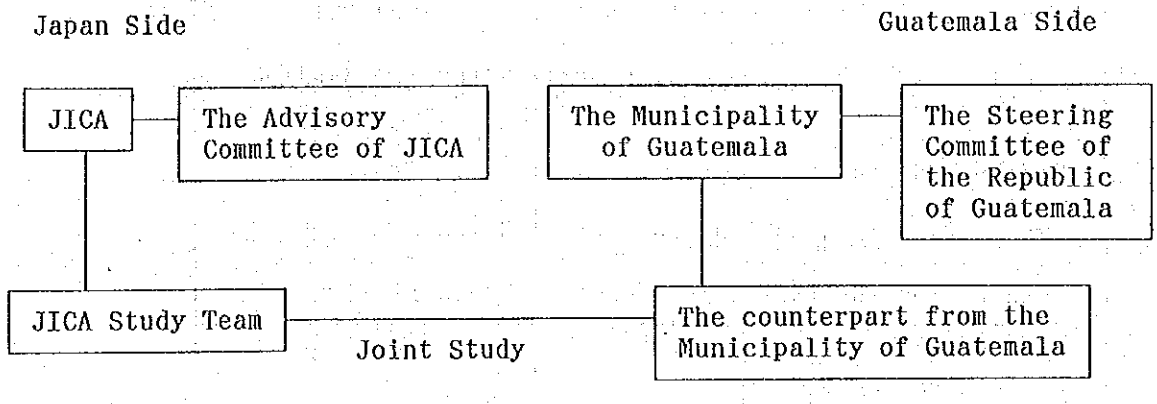

Fig. 3 The Organization Structure for the Study

1. JICA Study Team

SPECIALITY	NAME
Team Leader	Michio SAKAMOTO
Sub Leader (Planning of Collection/Transport)	Satoshi MAKIYAMA
Planniong of Collection/Transport	Akio KURAMOTI
Planning of Treatment and Disposal	Katsuhiro KAWAMURA
Urban Planning Institution/Contract	Keniti TAKASHIMA
Organization/Institution/Contract	GUIDO J. ACURIO
Organization/Institution/Contract	Masanori ITOH
Planning of Equipment Maintenance Management	JOSE ARELLANO
Designing of Facility	Mitsugu FUDAKA
Project Economist	Shigeru KIMURA
Environment/Sanitary Assessment	Tomoyuki KURODA
Analysis of Waste	Hiroshi SUMIKAWA

2. Guatemalan Counterpart

Name	Department	Institution
Ing. Julio Chavez	Industrial Control Dept.	Munic.
Sr. Alejandro Diaz de la Cruz	DLPM	Munic.
Arq. Wolfgang Gomez	Public Service Dept.	Munic.
Ing. Jose Molina	DLPM	Munic.
Arq. Olivia Chang	Architecture Official Planning	Munic.
Ing. Marco Turio Galvez	Institutional Development Dept.	Munic.
Licda. Anabella Ceballos	Administration Official Institutional Development Dept.	Munic.
Sr. Luis Fernando Flores	Official Cleansing Dept.	Munic.
Sr. Mario Jimenez	Planning Dept.	Empagua
Ing. Juan Manuel Mejia	Planning Dept.	Empagua
Sr. Mario Mendez	Official Public Service Dept.	Munic.
Lida. Leonor Rangel de Rivera	Official APT (Food for Work)	Munic.

3. Guatemalan Steering Committee Members

The members are as follows.

NAME	INSTITUTION	POSITION
Lic. S. Leal	MUNICIPALITY OF GUATEMALA	PUBLIC SERVICES DIRECTOR
Ing. J. Menaldo	SEGEPLAN	CONSULTANT
Ing. J. Guzmán	SEGEPLAN	CONSULTANT
Ing. G. Garcia	PUBLIC HEALTH AND SOCIAL WELFARE MINISTRY	DIRECTOR
Arq. G. Mayén	CONAMA	TECHNICAL ADVISER
Sr. B. Amézquita	MUNICIPALITY OF MIXCO	PUBLIC SVC DEPTO
Sr. M. Hernández	MUNICIPALITY OF VILLA NUEVA	PUBLIC SVC DEPTO
Ing. NAAMAN HERRERA	MUNICIPALITY OF VILLA NUEVA	PUBLIC SVC DEPTO

4. JICA Advisory Committee Members

SPECIALITY	NAME	POSITION
Chairman	Dr. S. NAITO	President Kanto Gakuin University
Treatment and Organization	Dr. M. TANAKA	Chief of Solid Waste Management Section The Institute of Public Health
Transport and Collectionon	Dr. K. SAKURAI	Environmental Sanitation Specialist Japan International Cooperation Agency
Management	Mr. K. FUKUI	Director (charged with technical development) Bureau of Solid Waste Problems TOKYO METROPOLITAN GOVERNMENT
Treatment and Disposal	Mr. M. SAWATI	Manager Public Cleansing Bureau, OSAKA CITY GOVERNMENT