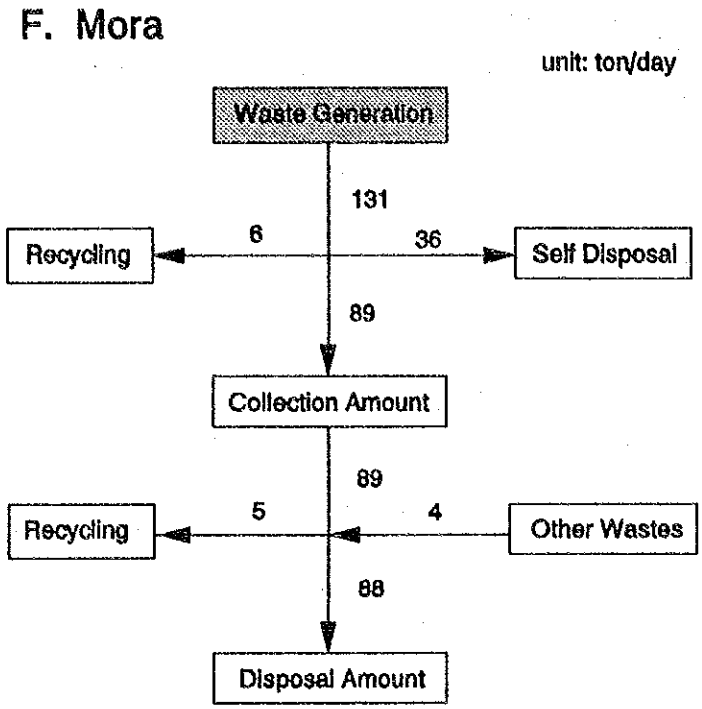



Figure J.1.1b Waste Stream Diagram of F. Mora in 2000

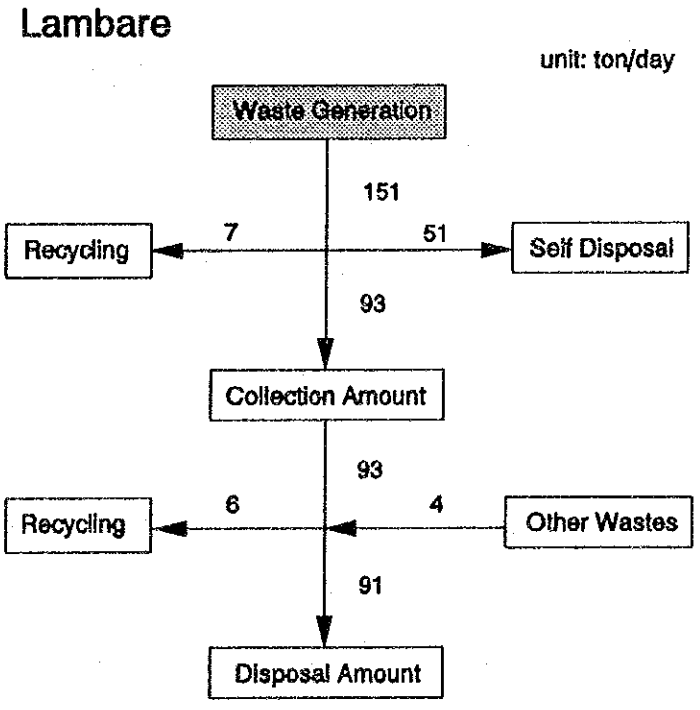



Figure J.1.1c Waste Stream Diagram of Lambare in 2000

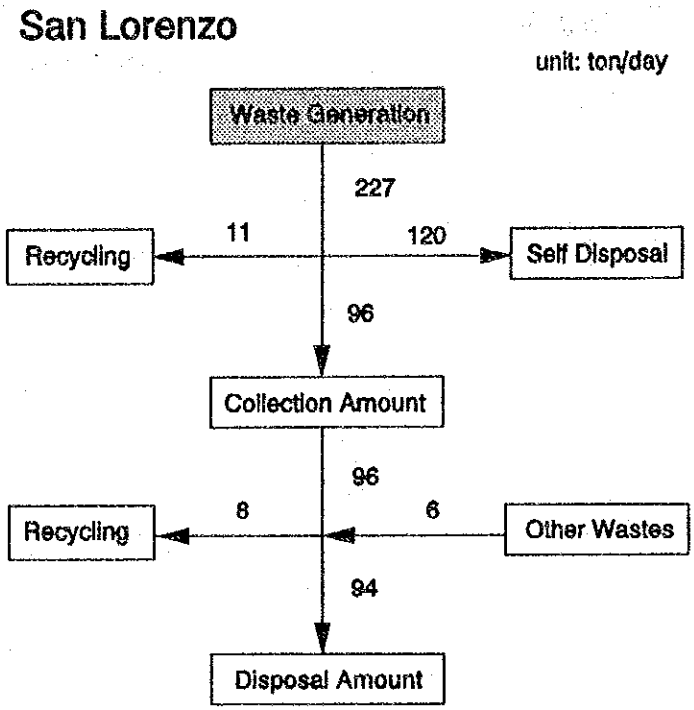



Figure J.1.1d Waste Stream Diagram of San Lorenzo in 2000

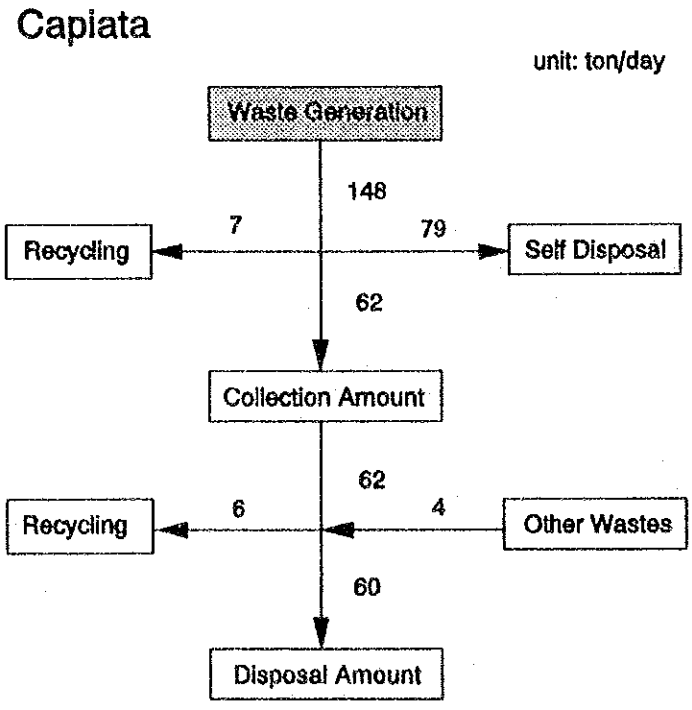



Figure J.1.1e Waste Stream Diagram of Capiata in 2000

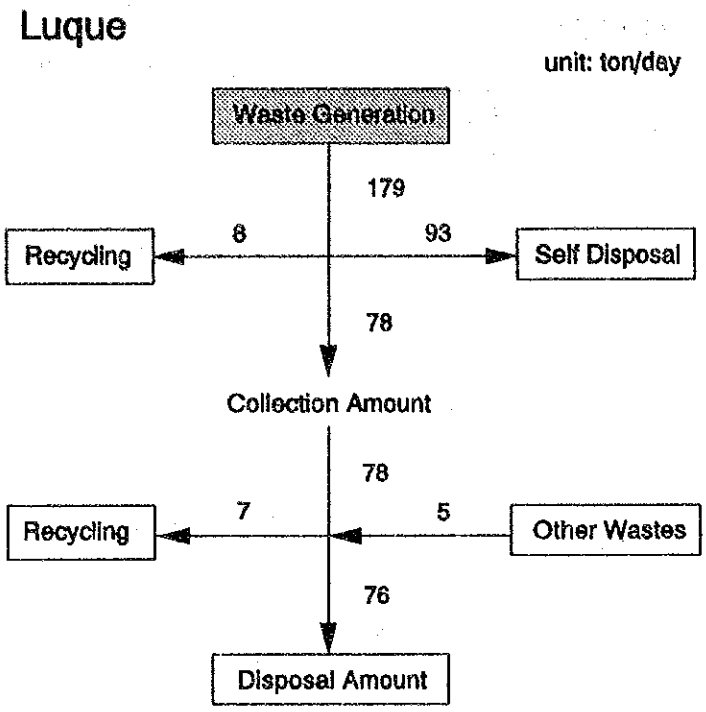



Figure J.1.1f Waste Stream Diagram of Luque in 2000

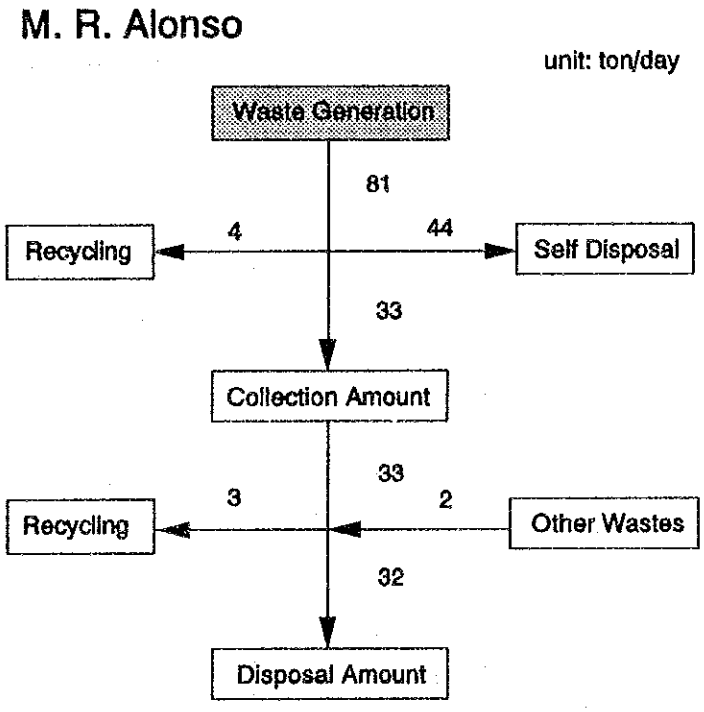



Figure J.1.1g Waste Stream Diagram of M.R. Alonso in 2000

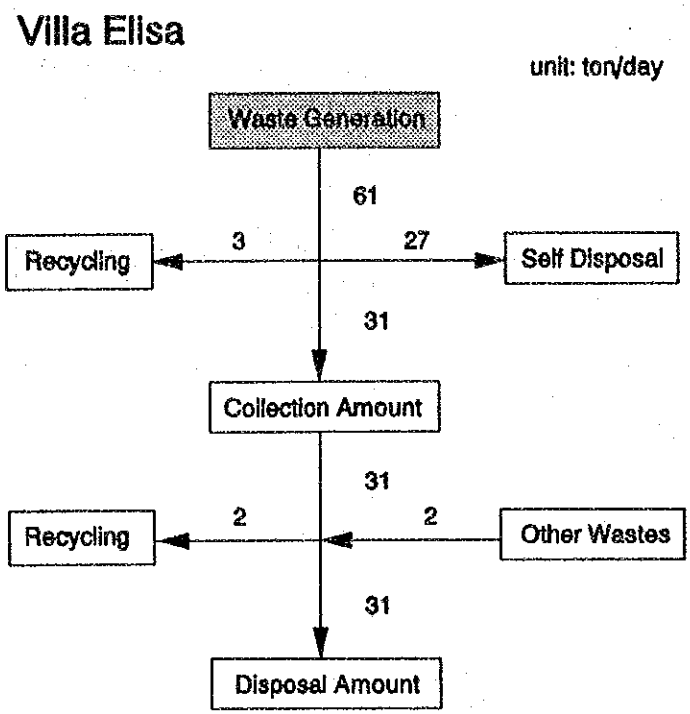



Figure J.1.1h Waste Stream Diagram of Villa Elisa in 2000

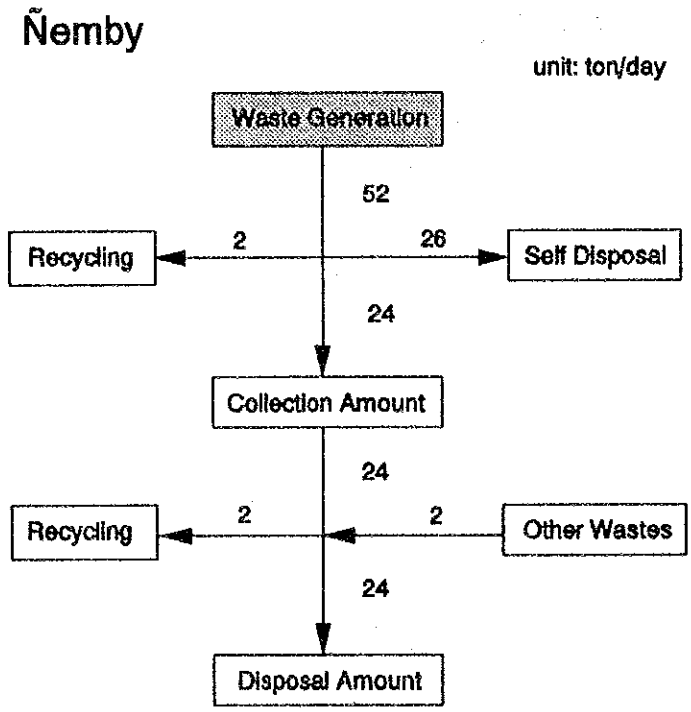



Figure J.1.1i Waste Stream Diagram of Nemby in 2000

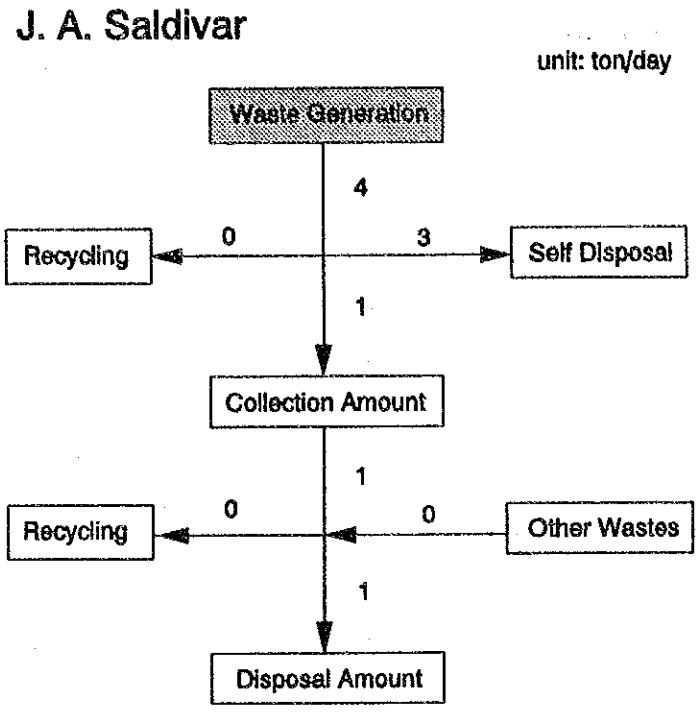



Figure J.1.1j Waste Stream Diagram of J.A. Saldivar in 2000

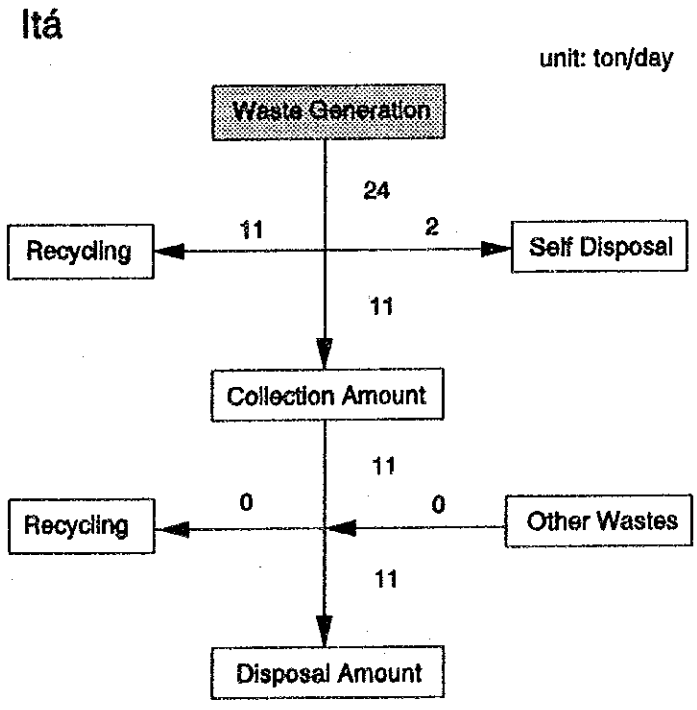



Figure J.1.1k Waste Stream Diagram of Ita in 2000

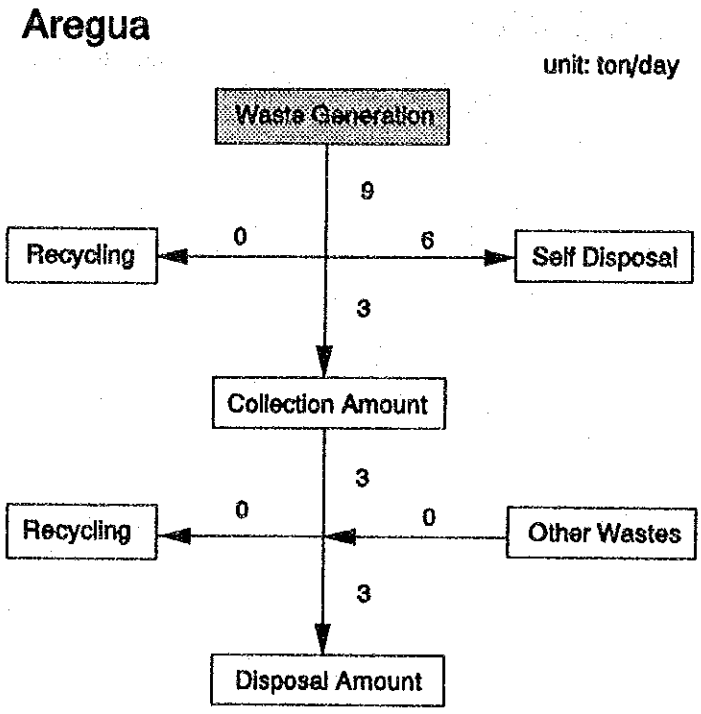



Figure J.1.1l Waste Stream Diagram of Arcgua in 2000

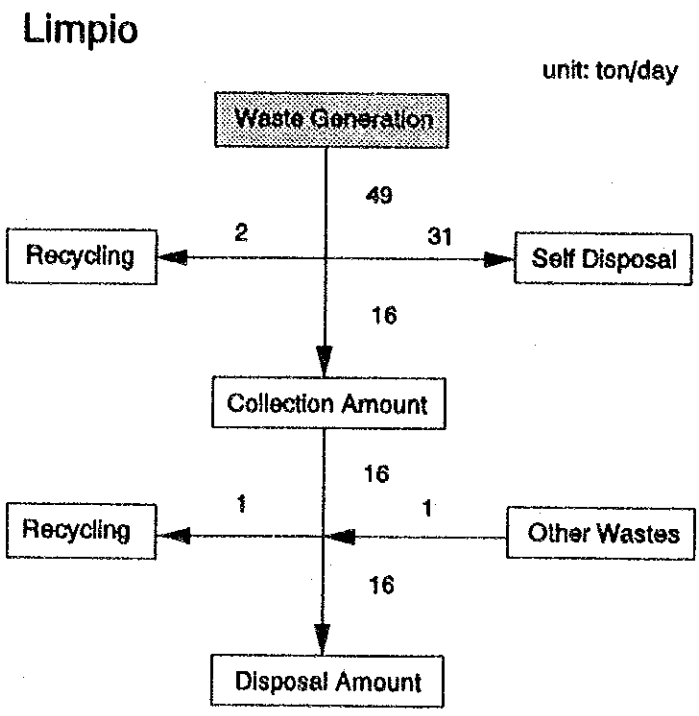



Figure J.1.1m Waste Stream Diagram of Limpio in 2000

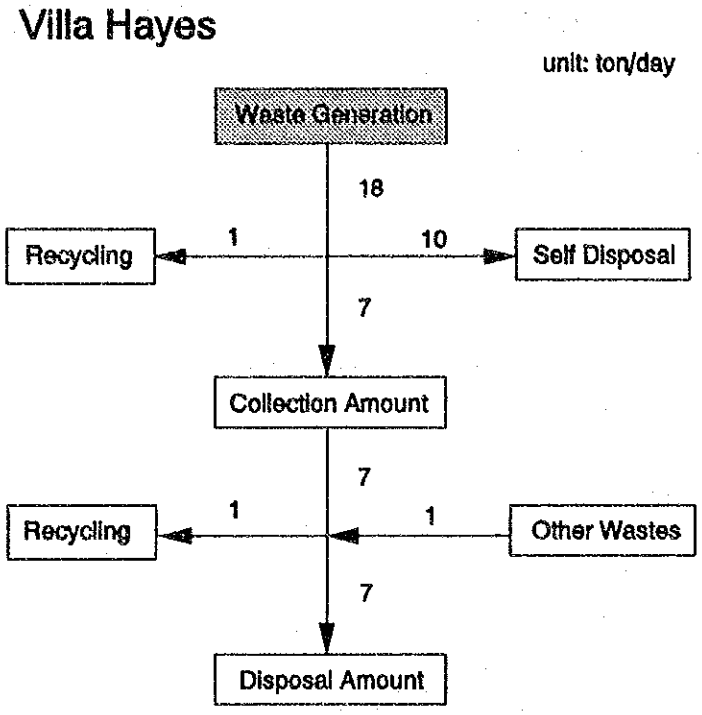



Figure J.1.1n Waste Stream Diagram of Villa Hayes in 2000

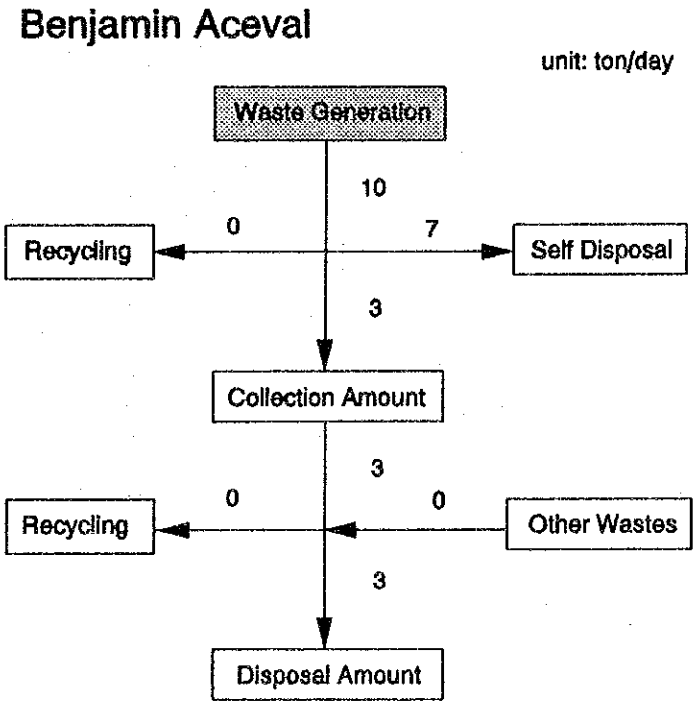



Figure J.1.1o Waste Stream Diagram of Benjamin Aceval in 2000

## J.1.2 Improvement of the Collection System for 15 Municipalities

### J.1.2.1 Discharge, Storage and Collection System

#### a. Objective wastes

The objective wastes dealt within the discharge, storage, collection and haulage plans are as follows;

- Household waste
- Commercial waste
- Market waste
- Institutional waste
- Street sweeping waste
- Hospital waste (non-infectious)

#### b. Discharge amount

The waste discharge amount in the year 2000 is shown in Table J.1.2.1a, J.1.2.1b and J.1.2.1c.

Table J.1.2.1a Waste Discharge Amount of Highly Urbanized Municipalities in the year 2000

unit : ton/day

| Type of Waste | Asuncion | F.D.L.Mora |
|---|---|---|
| - Household waste | 404.0 | 72.0 |
| - Commercial waste | 76.9 | 16.2 |
| - Market waste | 31.0 | 0.0 |
| - Institutional waste | 1.7 | 0.2 |
| - Street sweeping waste | 76.4 | 0.8 |
| - Hospital waste (non-infectious) | 14.8 | 0.0 |
| Total | 604.8 | 89.2 |

Table J.1.2.1b Waste Discharge Amount of Urbanized Municipalities in the year 2000

unit : ton/day

| | Lambare | San Lorenzo | Capiata | Luque | M.R. Alonso | Villa Elisa |
|---|---|---|---|---|---|---|
| – Household waste | 81.8 | 71.0 | 50.6 | 59.4 | 26.3 | 26.8 |
| – Commercial waste | 9.9 | 18.3 | 10.9 | 16.2 | 6.4 | 4.0 |
| – Market waste | 0.0 | 5.9 | 0.0 | 0.0 | 0.0 | 0.0 |
| – Institutional waste | 0.2 | 0.3 | 0.2 | 0.3 | 0.1 | 0.1 |
| – Street sweeping waste | 0.7 | 0.8 | 0.2 | 1.6 | 0.2 | 0.4 |
| – Hospital waste (non-infections) | 0.0 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 |
| Total | 92.6 | 96.4 | 61.9 | 77.6 | 33.1 | 31.3 |

Table J.1.2.1c Waste Discharge Amount of Less Urbanized Municipalities in the year 2000

unit: ton/day

| | Nemby | J.A. Saldivar | Ita | Aregua | Limpio | Villa Hayes | B.Aceval |
|---|---|---|---|---|---|---|---|
| – Household waste | 17.2 | 0.7 | 7.3 | 1.7 | 8.1 | 6.2 | 1.9 |
| – Commercial waste | 6.2 | 0.4 | 2.4 | 1.3 | 7.0 | 0.9 | 0.9 |
| – Market waste | 0.0 | 0.0 | 1.2 | 0.0 | 0.5 | 0.0 | 0.0 |
| – Institutional waste | 0.1 | 0.0 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 |
| – Street sweeping waste | 0.1 | 0.0 | 0.4 | 0.2 | 0.1 | 0.2 | 0.2 |
| – Hospital waste (non-infections) | 0.0 | 0.0 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 |
| Total | 23.6 | 1.1 | 11.5 | 3.2 | 15.9 | 7.5 | 3.0 |

## c. Storage system

### ca. Storage system

The proposed storage system is summarized in Table J.1.2.1d.

Table J.1.2.1d Proposed Storage System

| Category of Wastes | HUM | UM | LUM |
|---|---|---|---|
| Household Waste | Plastic Bags | Plastic Bags | Plastic Bags |
| Commercial Waste | Plastic Bags | Plastic Bags | Plastic Bags |
| Market Waste | 1.0m$^3$ Containers | Plastic Bags | Plastic Bags |
| Institutional Waste | 1.0m$^3$ Containers | Plastic Bags | Plastic Bags |
| Street Sweeping Waste | 1.0m$^3$ Containers | Plastic Bags | Plastic Bags |
| Hospital Waste (Non-infectious) | 1.0m$^3$ Containers | Plastic Bags | Plastic Bags |

### cb. Required number of containers

The number of containers required is calculated by the following formula;

$$Qc = Qw \times 7/Qd/E/ASG \text{ (unit)}$$

Qc : Number of containers required (unit)
Qw : Waste collection amount (ton/day)
Qd : Number of working days per week = 6 (days)
E : Rate of efficiency = 0.8
ASG : Apparent Specific Gravity = 0.2

Consequently, the number of required containers for Asuncion and F.Mora is calculated as follows:

| Municipality | Total Number (unit) | For Street Sweeping (unit) |
|---|---|---|
| Asuncion | 1,109 | 555 |
| F.Mora | 8 | 8 |

### d. Collection system

### da. Collection system

The proposed collection system is summarized below.

| Municipalities | Collection vehicle | Type of receptacle |
|---|---|---|
| Highly Urbanized Municipalities | 15.3 $m^3$ Compactor | Plastic bags and 1.0$m^3$ Public Containers |
| Urbanized Municipalities | 15.3 $m^3$ Compactor | Plastic Bags |
| Less Urbanized Municipalities | 10 $m^3$ Dump Truck | Plastic Bags |

### db. Calculation of required number of collection vehicles

### dba. Assumptions

For the calculation of the required number of collection vehicles, the following assumptions were made:

- Daily collection amount(Q): as shown in Table J.1.2.1e
- Working hour: 8 hours/day
- Transportation speed:
  - with T/S
    - for collection 20 km/hr
    - for transportation 40 km/hr
  - without T/S
    - within the urban area 20 km/hr
    - outside of the urban area 40 km/hr
- Unit collection time:
  - .Compactor 25 min./ton
  - .Compactor with container 9 min./ton
  - .Dump truck 25 min./ton
- Operation rate of vehicles: 90 %
- Efficiency rate of containers: 80 %
- Loading amount of a collection vehicle:
  - .Compactor = 15.3 $m^3$ x 0.9 x 0.5 ton/$m^3$ = 6.88 ton/vehicle
  - .Dump truck = 10 $m^3$ x 0.9 x 0.2 ton/$m^3$ = 1.80 ton/vehicle
- Daily collection amount

  As set up before, the annual working days is 297 days. Thereby, the daily collection amount for each municipality is calculated below.

Table J.1.2.1e Daily Collection Amount of Each Municipality in the year 2000

unit: ton/day

| | Compactor (13$m^3$) + Container (1$m^3$) | Compactor (13$m^3$) | Dump Truck (10$m^3$) | Total |
|---|---|---|---|---|
| Asuncion | 152 | 591 | - | 743 |
| F.Mora | 1 | 108 | - | 109 |
| Lambare | - | 114 | - | 114 |
| San Lorenzo | - | 118 | - | 118 |
| Capiata | - | 76 | - | 76 |
| Luque | - | 96 | - | 96 |
| M.R.Alonso | - | 41 | - | 41 |
| Villa Elisa | - | 38 | - | 38 |
| Nemby | - | - | 29 | 29 |
| J.A.Saldivar | - | - | 1 | 1 |
| Ita | - | - | 14 | 14 |
| Aregua | - | - | 4 | 4 |
| Limpio | - | - | 20 | 20 |
| Villa Hayes | - | - | 9 | 9 |
| B.Aceval | - | - | 4 | 4 |

### dbb. Collection time and amount per trip

With the Time & Motion (T & M) study conducted in August 1993 and 5 months' data obtained by the truck scale at Cateura Landfill, the average time sharing of each work and amount of waste collected by a 13 $m^3$ compactor truck was acquired. Based on the results of the 13$m^3$ compactor, the collection time and amount per trip for the proposed 15.3 $m^3$ compactor truck and 10 $m^3$ dump truck was calculated below.

Table J.1.2.1f Collection Time and Amount of Compactor (15.3 $m^3$) and Dump Truck (10 $m^3$) per Trip unit: minute

| Items / Type of Vehicles | Collection | Haulage * | Dumping | Others | Required Time per Trip | Amount of Waste per Trip |
|---|---|---|---|---|---|---|
| Compactor 15.3 $m^3$ | 170<br>25 min./ton | 50 | 13 | 32 | 265 | 6.88 ton |
| Compactor 15.3 $m^3$<br>+ Container | 55<br>9 min./ton | 50 | 13 | 32 | 150 | 6.88 ton |
| Dump Truck 10 $m^3$ | 45<br>25 min./ton | ? | 13 | 32 | ? | 1.80 ton |

Note: The haulage time differs for each municipality. In the case of the Cateura landfill for Asuncion Municipality, it was 50 minutes.

### dbc. Calculation of haulage distance

Haulage distances from the collection area to the transfer stations and/or final disposal sites are measured based on the present topographic maps of scale 1/50,000 and tabulated in Table J.1.2.1g.

Table J.1.2.1g Haulage Distances

| | With T/S | | Without T/S |
|---|---|---|---|
| | Collection Area to T/S (L1) | T/S to Landfill (L2) | Collection Area to Landfill (L3) |
| HUM | | | |
| 1. Asuncion | 7.4, (8.9) | 24.5, (26.8) | 7.4 + 24.5 = 31.9 |
| 2. F.Mora | 6.5, (14.5) | 24.5, (26.8) | 6.5 + 24.5 = 31.0 |
| UM | | | |
| 3. Lambare | – | – | 15.0 |
| 4. San Lorenzo | – | – | 15.0 |
| 5. Capiata | – | – | 15.0 |
| 6. Luque | – | – | 15.0 |
| 7. M.R.Alonso | – | – | 15.0 |
| 8. Villa Elisa | – | – | 15.0 |
| LUM | | | |
| 9. Nemby | – | – | 15.0 |
| 10. J.A.Saldivar | – | – | 15.0 |
| 11. Ita | – | – | 15.0 |
| 12. Aregua | – | – | 15.0 |
| 13. Limpio | – | – | 22.1 |
| 14. Villa Hayes | – | – | 20.3 |
| 15. B.Aceval | – | – | 30.5 |

Note: The figure in parentheses is for Vinas-cue T/S while without it is for Madame Lynch Avenue T/S.

### dbd. Calculation of required vehicles

The number of vehicles required are calculated using the formula below based on the above-mentioned assumptions. One spare vehicle is added to every 10 vehicles required to obtain the total number of vehicles for Asuncion and AMUAM.

#### i. For primary collection vehicles

**<Without container>**

**Qrv = 1.1 x Qwd/Qucd**
**Qucd = Quct x (8/Tt/60)**
**Tt = Tuc x Quct + 2 x (L1/S1) x 60 + Td + To**

Qrv: Required number of vehicles (unit)
Qwd: Daily waste collection amount (ton/day)
Qucd: Unit collection amount per vehicle per day (ton/day)
Quct: Unit collection amount per vehicle per trip (ton) = 6.88 ton/trip
Tt: Required time per trip (minute)
Tuc: Unit collection time (minute/ton) = 25 minutes/ton

L1: Distance from collection area to T/S (km)
S1: Transportation speed (km/hour) = 20 km/hour
Td: Dumping time (minutes) = 13 minutes
To: Other work time (minutes) = 32 minutes

**<With container>**

**Qrv = 1.1 x Qwd/Qucd**
**Qucd = Quct x (8/Tt/60)**
**Tt = Tuc x Quct + 2 x (L1/S1) x 60 + Td + To**

Qrv: Required number of vehicles (unit)
Qwd: Daily waste collection amount (ton/day)
Qucd: Unit collection amount per vehicle per day (ton/day)
Quct: Unit collection amount per vehicle per trip (ton) = 6.88 ton/trip
Tt: Required time per trip (minute)
Tuc: Unit collection time (minute/ton) = 8 minutes/ton
L1: Distance from collection area to T/S (km)
S1: Transportation speed (km/hour) = 20 km/hour
Td: Dumping time (minutes) = 13 minutes
To: Other work time (minutes) = 32 minutes

**ii. For haulage vehicles from transfer station**

**Qrv = 1.1 x Qtd/Qucd**
**Qutd = Qutt x (8/Tt/60)**
**Tt = Tul + 2 x (L2/S1) x 60 + Td + To**

Qrv: Required number of vehicles (unit)
Qtd: Daily waste transfer amount (ton/day)
Qutd: Unit transfer amount per vehicle per day (ton/day)
Qutt: Unit transfer amount per vehicle per trip (ton)
For compaction container = 35 ton/trip
For open top container = 31.5 ton/trip
Tt: Required time per trip (minute)
Tul: Unit loading time (minutes) = 10 minutes/ton
L2: Distance from T/S to the Chaco-i landfill (km) = 24.5 km
S1: Transportation speed (km/hour) = 40 km/hour
Td: Dumping time (minutes) = 15 minutes
To: Other work time (minutes) = 5 minutes

**iii. For direct haul vehicles**

**<Compactor without container>**

**Qrv = 1.1 x Qwd/Qucd**
**Qucd = Quct x (8/Tt/60)**
**Tt = Tuc x Quct + 2 x (L1/S1) x 60 + Td + To**

Qrv: Required number of vehicles (unit)
Qwd: Daily waste collection amount (ton/day)
Qucd: Unit collection amount per vehicle per day (ton/day)
Quct: Unit collection amount per vehicle per trip (ton) = 6.88 ton/trip
Tt: Required time per trip (minute)
Tuc: Unit collection time (minute/ton) = 25 minutes/ton
L1: Distance from collection area to the landfill (km)
S1: Transportation speed (km/hour)
within the urban area = 20 km/hour
outside of the urban area = 40 km/hour
Td: Dumping time (minutes) = 13 minutes
To: Other work time (minutes) = 32 minutes

**<Compactor with container>**

**Qrv = 1.1 x Qwd/Qucd**
**Qucd = Quct x (8/Tt/60)**
**Tt = Tuc x Quct + 2 x (L1/S1) x 60 + Td + To**

Qrv: Required number of vehicles (unit)
Qwd: Daily waste collection amount (ton/day)
Qucd: Unit collection amount per vehicle per day (ton/day)
Quct: Unit collection amount per vehicle per trip (ton) = 6.88 ton/trip
Tt: Required time per trip (minute)
Tuc: Unit collection time (minute/ton) = 8 minutes/ton
L1: Distance from collection area to the landfill (km)
S1: Transportation speed (km/hour)
within the urban area = 20 km/hour
outside of the urban area = 40 km/hour
Td: Dumping time (minutes) = 13 minutes
To: Other work time (minutes) = 32 minutes

**<Dump truck>**

**Qrv = 1.1 x Qwd/Qucd**
**Qucd = Quct x (8/Tt/60)**
**Tt = Tuc x Quct + 2 x (L1/S1) x 60 + Td + To**

Qrv: Required number of vehicles (unit)
Qwd: Daily waste collection amount (ton/day)
Qucd: Unit collection amount per vehicle per day (ton/day)
Quct: Unit collection amount per vehicle per trip (ton) = 1.80 ton/trip
Tt: Required time per trip (minute)
Tuc: Unit collection time (minute/ton) = 25 minutes/ton
L1: Distance from collection area to landfill (km)
S1: Transportation speed (km/hour)
within the urban area = 20 km/hour
outside of the urban area = 40 km/hour
Td: Dumping time (minutes) = 13 minutes
To: Other work time (minutes) = 32 minutes

The required number of vehicles is calculated as shown below.

Table J.1.2.1h Required Number of Vehicles in 2000

| Type of Vehicle / Municipalities | Compactor Truck 15.3 $m^3$ (Unit) | Dump Truck 10 $m^3$ |
|---|---|---|
| **1.Asuncion** | **59** | **0** |
| **2.AMUAM** | **53** | **17** |
| F.Mora | 9 | - |
| Lambare | 9 | - |
| San Lorenzo | 9 | - |
| Capiata | 6 | - |
| Luque | 8 | - |
| M.R.Alonso | 4 | - |
| Villa Elisa | 3 | - |
| Nemby | - | 5 |
| J.A.Saldivar | - | 0.2 |
| Ita | - | 2 |
| Aregua | - | 1 |
| Limpio | - | 4 |
| Villa Hayes | - | 2 |
| B.Aceval | - | 1 |
| **Spare Vehicles** | 5 | 1.8 |

**dc. Required number of drivers and workers**

According to the present collection crew, 1 driver and 3 workers will be assigned to 1 collection vehicle including spare vehicles.

### J.1.2.2 Street Sweeping System

**a. Street sweeping system**

**aa. Sweeping system**

The present manual sweeping system is planned to be continued due to the following reasons:

- high unemployment ratio in the Study area; and
- poor road conditions such as relatively narrow streets, low asphalt and concrete pavement rate, poor condition of storm water drains and curb stones, lack of parking areas, etc..

**ab. Storage system**

As for the storage system of swept waste, the 1.0 $m^3$ public containers are proposed for HUM and plastic bags for UM and LUM.

**b. Calculation of required equipment and workers**

**ba. Proposed sweeping length and amount of swept waste**

The length of street swept and amount of swept waste are planned as shown in Table J.1.2.2a.

**bb. Required number of equipment**

The number of containers required for the swept waste is calculated in the previous section and as shown in Table J.1.2.2a.

The required number of collection vehicles for collection of swept waste is calculated in the previous section with the other MSW, because collection of swept waste is planned to be conducted by the Waste Collection Section of each

municipality.

### bc. Required number of sweepers

The required number of sweepers is calculated in accordance with the following assumptions and as shown in Table J.1.2.2a.

- As for Asuncion Municipality, the number of personnel of the Street Sweeping Section is calculated based on the existing number (160 persons in 1994).
- As for the other 14 municipalities, the required number of sweepers is calculated based on the figure of 1 km/sweeper/day which is the average in the other Latin American countries.

Table J.1.2.2a Sweeping Length and Amount of Swept Waste

| Items / Municipalities | Sweeping Length (km) | Amount of Swept Waste (ton/day) | Required Number of Containers (units) | Required Number of Sweepers (persons) |
|---|---|---|---|---|
| HUM | | | | |
| 1. Asuncion | 300 | 76.4 | 555 | 164 |
| 2. F.Mora | 20 | 0.8 | 8 | 20 |
| UM | | | | |
| 3. Lambare | 17 | 0.7 | - | 17 |
| 4. San Lorenzo | 21 | 0.8 | - | 21 |
| 5. Capiata | 6 | 0.2 | - | 6 |
| 6. Luque | 40 | 1.6 | - | 40 |
| 7. M.R.Alonso | 6 | 0.2 | - | 6 |
| 8. Villa Elisa | 9 | 0.4 | - | 9 |
| LUM | | | | |
| 9. Nemby | 3 | 0.1 | - | 3 |
| 10. J.A.Saldivar | 1 | 0.0 | - | 1 |
| 11. Ita | 10 | 0.4 | - | 10 |
| 12. Aregua | 5 | 0.2 | - | 5 |
| 13. Limpio | 3 | 0.1 | - | 3 |
| 14. Villa Hayes | 5 | 0.2 | - | 5 |
| 15. B.Acoval | 6 | 0.2 | - | 6 |

### J.1.2.3 Recycling

#### a. Introduction

"Recycling" is the reutilization of non-valuable materials as resources or refers to the collection and reproduction of these for effective reuse. Recycling reduces the waste generation amount and decreases consumption of natural resources. Therefore, with increase in waste generation, recycling is expected to play a very important role in municipal solid waste management in the future.

According to the survey results on the present recycling system conducted by the Team, the present recycling system mainly established by the private sector functions well. The recycling business, however, is not stable, as it is easily influenced by the fluctuating market prices of salvaged materials.

#### b. Strategy

There are many types of recycling activities. There are profitable recycling activities and non-profitable activities. Profitable recycling activities should be executed by private companies with support from the local administration and the public for stability. Non-profitable recycling activities should be initiated by the administration, and public cooperation must be utilized as much as possible.

According to the experiences of neighboring countries such as Brazil and Argentina, recycling plants are not profitable. Upon careful consideration of the limited financial resources and a considerable number of scavengers, the introduction of a recycling facility shall be carefully examined in order to avoid conflict with the present private sector.

#### c. Planned Recycling Activities

##### ca. Administrative support for private recycling businesses

###### caa. Introduction

Private recycling businesses highly depend on the market price of a reusable material. Market prices usually fluctuate in very wide ranges, making the recycling business unstable.

Private recycling business activities are very important because they contribute to the reduction of the generated amount of waste and consumption of raw materials. Therefore, the expansion of the private recycling business should be promoted.

Since fluctuating demands for and selling prices of reusable materials greatly obstruct the development of private recycling businesses, the municipalities should control and stabilize market conditions.

**cab. Method**

- The municipalities shall bring about a demand for recycled paper by imposing the use of recycled paper in all government institutions.
- The municipalities shall provide the private recycling companies with public spaces for installation of containers, collection stations for reusable materials, etc., free of charge.
- The municipalities shall provide opportunities to the private recycling companies to advertise free of charge.
- Promotion of recycling activities outside the municipal landfills in order to prohibit scavenging inside.

**cb. Promotion of public cooperation initiated by the administration**

**cba. Introduction**

Most recycling activities are not so profitable mainly due to high cost of collection work. Public cooperation is, therefore, most effective in minimizing collection cost.

According to the public opinion survey result, nearly 100% of the interviewees indicated willingness to cooperate in recycling activities. Their willingness to cooperate should be utilized for the collection of recyclable materials. In December 1993, the Asuncion Municipality commenced a pilot separate collection of recyclables. Although present public cooperation is still insufficient for the new system, this practice should be expanded considering financial capability of each municipality.

In order to promote public cooperation in the collection of recyclable materials, the municipality should establish incentives to stimulate and motivate the public. The cost for such activities might be cheaper than the cost for treatment of wastes.

**cbb. Method**

- To organize events for MSWM promotion and education.

- To invite citizens and students to MSWM facilities.

### cc. Introduction of on-site composting of household waste

#### cca. Introduction

Composting is technically the simplest method for utilization of waste. In order to maintain acceptable quality of compost, it is essential to supply only qualified organic wastes after segregation. Segregation is too difficult to be satisfactorily executed in a largely populated town. However the on-site composting method is easy to apply for wastes of detached houses as well as the initial investment being little. Good quality compost can be produced depending on the householder's efforts on segregation, because the producer of waste will also be the compost user. The introduction of on-site composting method to the detached houses is effective for the reduction of waste generation amount.

#### ccb. Method

An on-site composting container will be installed in the yard. The householder discharges kitchen wastes into the on-site composting container and leaves it until it decomposes. Compost may be utilized as soil conditioners in the householder's yard.

On-site composting requires:

- the sorting of organic wastes in the kitchen
- the provision of a standard model closed compost container for each household, or several for each block of flats.

The microbiological process is accelerated by adding water to the container so as to keep the dry matter content in the range of 300 to 500 kg per ton of waste.

The contents have to be aerated by mixing them occasionally, a handling technique that also accelerates compost formation with substantial microbial heat production.

The generation of offensive odor is also avoided by mixing the contents.

#### ccc. Suggestions

For on-site composting, it is recommended that only vegetable wastes should be used.

The following materials are normally acceptable:

- vegetable wastes from the kitchen
- flowers, including roots and soil
- coffee grounds and tea leaves including possible paper filters
- fruit waste
- bread waste
- eggs hells
- paper used for drying etc. in kitchen
- wastes from small domestic animals

The microbial process is accelerated by adding small amount of wooden chips, small branches produced from hedge trimming etc.

Other similar materials may be used, but meat wastes as well as fish, sauces and similar wastes should be avoided.

Adding meat wastes enhances the possibility of odor production, and attracts rodents.

If meat wastes are to be added, compost containers should be placed in a steel net to keep out, and the composting matter has to be mixed more frequently.

### J.1.2.4 Equipment Operation and Maintenance

#### a. Design Conditions

#### aa. Introduction

Proper maintenance and correct operational procedures of the vehicles and equipments are the keys for a sustainable and enduring municipal solid waste management system.

In the municipalities of the Asuncion Metropolitan Area, several problems are observed related to the lack of maintenance and control over the vehicles and equipments used in solid waste management activities.

Therefore, in this chapter ways to improve the current situation and the methods and procedures of maintenance and operation are presented that shall be implemented in order to assure the proper use and enduring life, as well as maximum

efficiency of the vehicles and equipments in the solid waste management activities.

The chapter consists of equipment operation and maintenance plans for Asuncion and AMUAM.

### ab. Design conditions

The design conditions applied to the study are described below.

- The operation and maintenance works of equipment and vehicles for MSWM are conducted in accordance with the following work share.

Table J.1.2.4a Operation and Maintenance Works of Equipment and Vehicles for MSWM

| Work Items / Use of Equipment | Operation | Maintenance & Repair |
|---|---|---|
| 1. Collection | Each Municipality | Asuncion for their Equipment<br>AMUAM for the other 14 Municipalities |
| 2. Street Sweeping | Each Municipality | Asuncion for their Equipment<br>AMUAM for the other 14 Municipalities |
| 3. Transfer Operation<br>Transfer Station<br>Transfer Vehicles | <br>AMUAM<br>AMUAM | <br>AMUAM<br>AMUAM |
| 4. Final Disposal<br>Chaco-i<br>Unidentified Inter-Municipal | <br>AMUAM<br>AMUAM | <br>AMUAM<br>AMUAM |

- Consequently in this chapter, the improvement plan of the present workshop for Asuncion and the establishment of a new workshop for AMUAM were conducted.

## b. Asuncion

### ba. Organizational Structure

Presently, the Street Sweeping Department and the Collection and Disposal Department are under the Environmental Bureau while the Transport and Workshop Department is under the Administrative Bureau. For a better functioning and assistance to the vehicles allocated to the collection and sweeping services, it is advocated that part of the Transport and Workshop Department be under the

Environmental Bureau and render maintenance and operation assistance only to the vehicles assigned to the various departments under the Environmental Bureau.

Today, there are three Divisions in the Transport and Workshop Department:

- Transport Division
- Workshop Division
- Production Division

In the new proposed structure, we will exclude the Production Division with the License Plate and Carpentry Sections, and the Body Repairing and Painting, Sheet Metal Work, Lathe and Upholstery Sections will be under the Workshop Division. The Automobile Electricity Section will be transferred from the Transport Division to the Workshop Division (refer to Figure J.1.2.4a).

Another alteration which is quite important, because it is the primordial factor for a sound and swift maintenance service, is that the supply of replacement parts shall be under the Transport and Workshop Department.

These changes will provide maintenance services for all equipment, allocated to the Environmental Bureau, and vehicles in street sweeping and waste collection which in turn shall improve their efficiency and productivity in SWM activities.

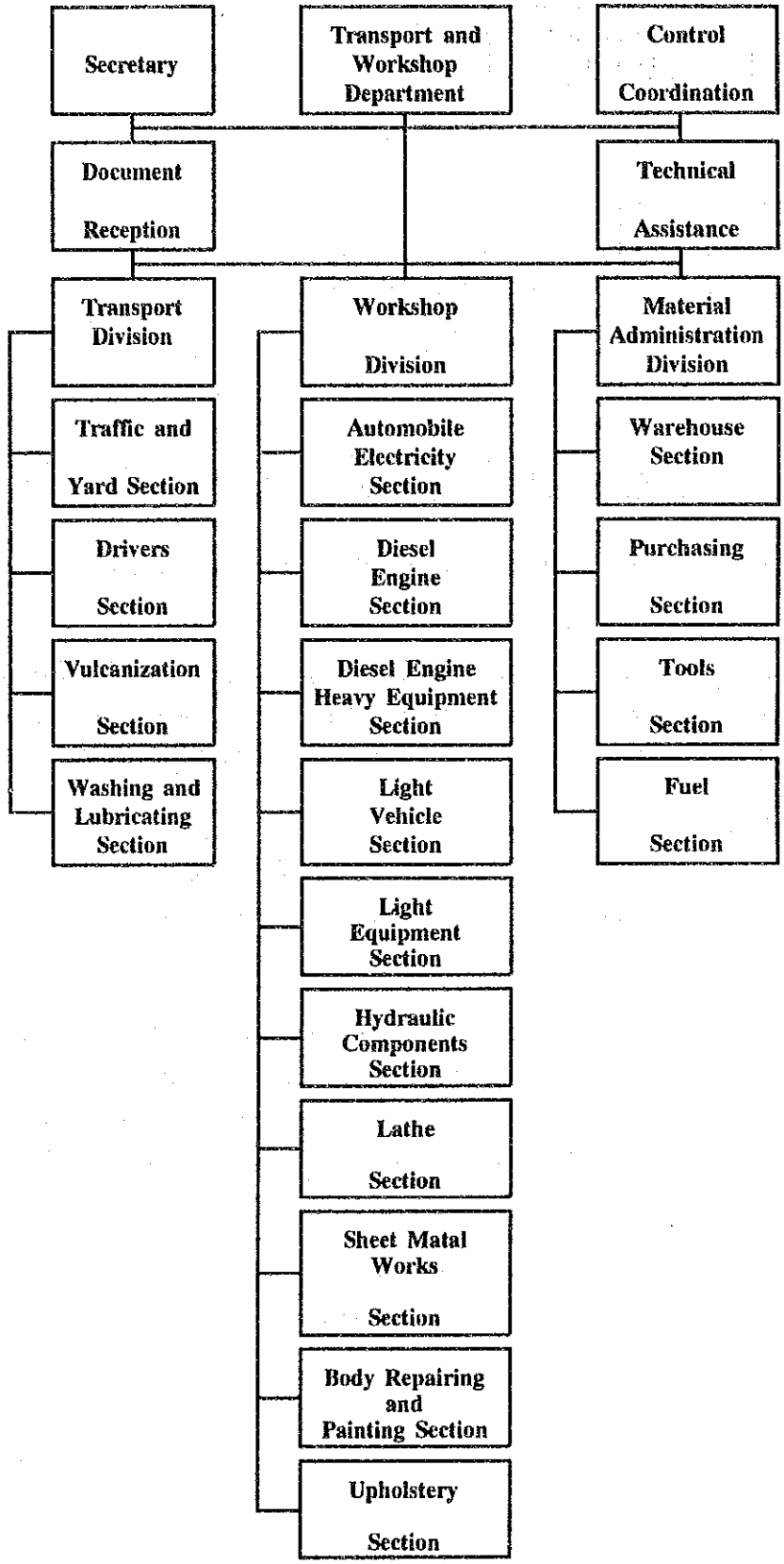



Figure J.1.2.4a Proposed Organizational Chart of Transport and Workshop Department

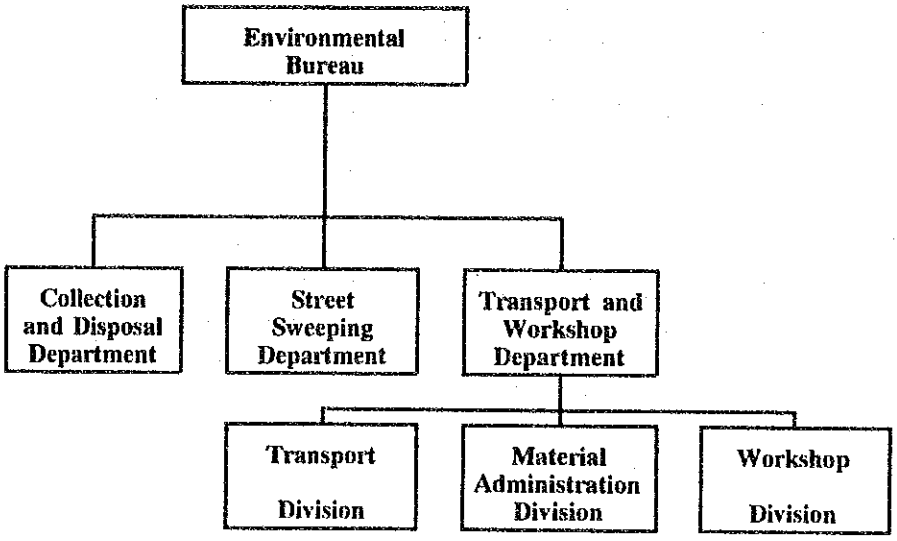



Figure J.1.2.4b Proposed Organizational Chart of the Environmental Bureau

The exclusion of part of the Production Division from the Transport and Workshop Department will be very productive so that the vehicle maintenance, can be intensified, as well as the sections related to the equipment maintenance.

The transfer of the Automobile Electricity Section from the Transport Division to the Workshop Division will also give greater assistance to the equipment related to the technical aspects of maintenance. The Motorcycle Section will be eliminated because of the small number of these vehicles in urban cleaning.

The Material Administration Division that is proposed to be under the Transport and Workshop Department will bring advantages to the functioning of the maintenance services as it will be acting according to the maintenance work objectives so that delays in the purchase and replacement of the parts for the equipment under repair will be avoided.

The description of the services to be developed by the several sections of the Transport and Workshop Department is as follows:

| | |
|---|---|
| **Internal Transport Division** | |
| **Traffic and Yard Section** | This section is in charge of distribution of vehicles to the drivers and workers. The document which permits the exit of the vehicles and controls the services will be filled in this section. It is also in charge of the vehicle reception at the end of the workday. |
| **Drivers Section** | This section is in charge of the drivers and the operators of the Transport and Workshop Department. This section uses the drivers to the Traffic and Yard Section in order to give them authorization to work with the vehicles. |
| **Vulcanization Section** | This is the section where the tirework services are conducted. Tires and tire tube repairs and also the assembling and dismantling are done. |
| **Washing and Lubrication Section** | The vehicles that are used to collect the garbage are daily washed in this section. Lubrication services are carried out through a service order according to an established program. |
| **Workshop Division** | |
| **Automobile Electricity Section** | The assembling and dismantling services of the electrical components of vehicles as well as lanterns and headlight repair and fixture services are done in this section. Components such as starting engines, generators etc. are repaired in the workbenches of the section. |
| **Diesel Engine Section** | Truck repair services are done in this section. The vehicle components are dismantled and assembled in the storage shed and are recovered on the workbenches. |
| **Diesel Engine Heavy Equipment Section** | The repair services of the heavy equipment used on the sanitary landfill and cleaning operations are done in this section. The services are executed in the storage shed and on the workbenches. |
| **Light Vehicle Section** | Simple maintenance services of the vehicles used in the urban cleaning and other bodies of the Environment Directory are done in this section. This section will also give assistance to motorcycles. |
| **Light Equipment Section** | Repair services on the weeder, and mechanical saw repair services are done in this section. |
| **Hydraulic Component Section** | Recovering services of the pump, valve, drive, hydraulic cylinder used in waste collection equipment and machines will be done in this section. |
| **Lathe Section** | In this section, several parts are manufactured using the power lathe for repairing the vehicles and machines which are under Transport and Workshop Department. |
| **Workshop Division (cont.)** | |
| **Sheet Metal Works Section** | This section is in charge of the recovering services on body and equipment of the waste collection vehicles and heavy machines. Sheet Metal Works and soldering services are done in this section. |
| **Body repairing and Painting Section** | Body repairing services of the vehicles are done in this section, as well as the painting services. |
| **Upholstery Section** | The recovering services of the seats and upholsteries of the vehicles are accomplished in this section. |
| **Materials Administration Division** | |
| **Warehouse Section** | This section is in charge of the storage of all material and parts used in the equipment maintenance. In this section, if there is no material in store, the process of buying parts is conducted. |
| **Purchasing Section** | The purchase of all materials and parts for the maintenance services of the Transport and Workshop Department is done in this section. |
| **Tools Section** | The tools that are lent to the staff in other sections of the Transport and Workshop Department are kept in this section. |
| **Fuel Section** | It is in charge of supplying fuel, lubricant oil and grease. |

**baa. New Procedures in the Materials Administration Division**

The following are suggestions in order to change and accelerate the part and material purchasing system for the vehicle and machine maintenance allocated in the Transport and Workshop Department of the Environment Bureau of Asunción municipality.

Spare parts will be divided into two types; the ones that are frequently used and in a regular cycle, and the others that are rarely used without a predetermined period.

The parts that are often used should be kept in stock in the warehouse. The purchases will be done through public bidding giving the technical specification and well-renowned brand in order to obtain products of good quality.

The parts rarely used will be bought when needed.

A new system shall be implemented to facilitate the parts reception system in the Transport and Workshop Department. The process aim is to keep the stock at the supplier instead of in the stockroom, avoiding a great capital loss from purchasing material that is not frequently used.

Valuation will be conducted and a bidding will be done in order to supply all the required items of a vehicle. The winner firm will present a list of all parts with the unitary prices and a deadline of 48 hours in order to deliver any item related to the parts on the list. Purchasing of original material from the manufacturers shall be conducted, such as engine parts, gearboxes and differentials etc..

Detached bidding will be done for specific items derived from factories, and etc..

Some parts for general use could still be acquired through the current system of three budgets and direct purchasing from the supplier who presents the lowest price. Parts for general use that are not in stock, in the storeroom, shall be bought in specific stores, such as, roller-bearing, seals, filter elements, belts, electrical components etc..

**bb. Improvement Plan of the Present Workshop**

**bba. Improvement of layout**

When the diagnosis was done, it was observed that the work conditions in several sections were inadequate and the distribution plan was not functional because of

the integration of the maintenance and transport services, and, in relation to medical and dental services, there was a great number of people receiving service that were not workers.

The conceptual layout of the workshop includes the grouping of the Transport Division services on the one side of the site and the Workshop Division on the other as in Figure J.1.2.4c. This is to avoid mechanics and workers having to walk great distances, hence losing time, for simple operations such as requesting for parts and acquiring them. The gate control and staff control shall be placed near the entrance.

1. Gate Control
2. Cloakroom and Bathroom for drivers and employees of the Transport Division
3. Transport Division/Traffic and Yard Section – First Floor
4. Materials administration Division – Second Floor
5. Vulcanization Section
5A. Tires Storehouse
6. Washing and Lubricating Section
7. Canteen
8. Warehouse Section
9. Purchasing Section
10. Tools Section
11. Fuels Section
12. Cloakroom and Bathroom for Mechanics
13. Transport and Workshop Department
14. Workshop Division
15. Technical Sector
16. Diesel Engine Section
17. Sheet Metal Works Section
18. Diesel Engine Heavy Equipment Section
19. Hydraulic Components Section/ Lathe Section
20. Automobile Electricity Section
21. Upholstery Section
22. Light Equipment Section
23. Light Vehicle Section
24. Pit for Maintenance
25. Body Repairing and Painting Section

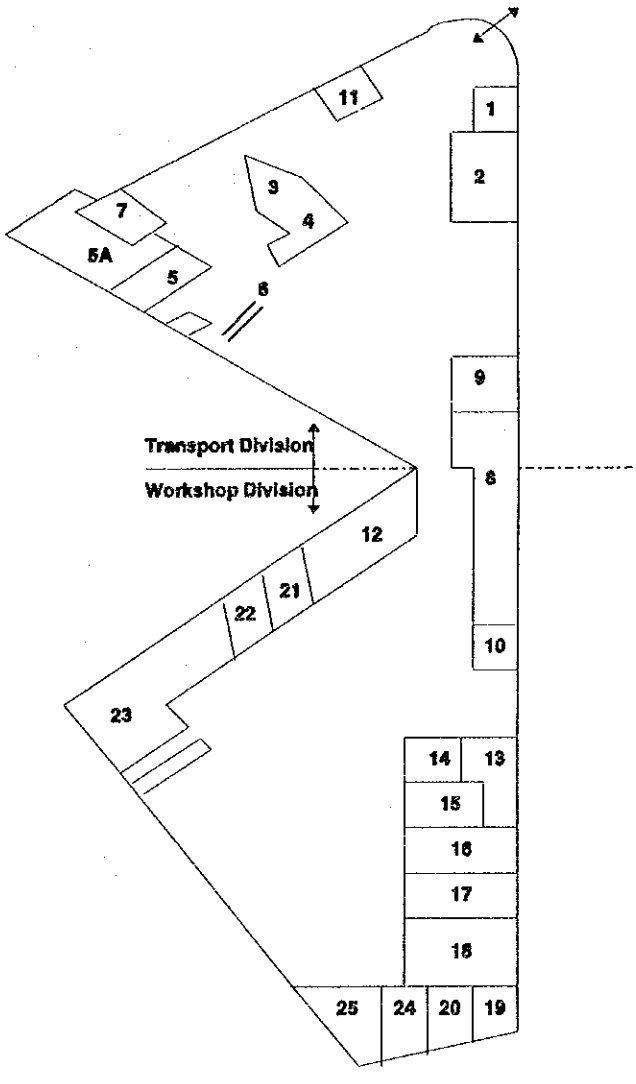



Figure J.1.2.4c Layout Improvement Plan of the Present Workshop

The place where the chief of the department used to stay will be occupied by the Material Division (2nd floor), and the 1st floor, where the Material Division and the Purchase Section used to be placed, will be occupied by the Transport Division.

The Vulcanization Section and the Tire and Tire Tube Storage Yard will be situated where the Carpentry and Motorcycle Sections used to exist. The covered area that was occupied by the Light vehicle Section will be removed. There, the pits and yards for the Washing and Greasing Section will be constructed.

The canteen will remain in the same place. Part of the storage shed, where the material storage yard and the License Plate Section were located, which shall be transferred from the Transport and Maintenance Department, should be broken down in order to enlarge the vehicle parking lot. The remainder of the same storage shed shall house the Purchasing Section.

The warehouse will stay in the same place; part of its workshop will be placed in the Transport Division area, and the other, in the Workshop Division area. The Fuel Section will be next to the gate, opposite to the Drivers Section.

Where the site narrows, a gate will be put in order to physically divide the areas that are occupied by different divisions.

The Workshop Division and the Transport and Workshop Department office will be located in the largest area of the site.

The Tool Section will remain in the same place next to the warehouse. Opposite them, near the wall that divides the area of the Transport and Workshop Department from the Cancer Institute, will be the changing rooms and showers for the workers. The Upholstery Section and the Light Equipment Section will remain in the same place.

The Light Vehicle Section will also stay in the same storage shed. Opposite it, next to the wall that separates the Department from the Calle Rio Paraná, the following sections shall be placed: Office of the Chief of the Transport and Workshop; Department and Office of the Chief of the Workshop Division, where the medical and dental cabinets are located and the Workshop Division and Light Equipment Section.

In the large and already existing storage shed, the technical sectors will be placed together with the machines, tools and workshop, in order to recover several vehicle components, such as brake drum lathe, brake lining riveter, bench electric grinder, universal drilling rack for axles, bench for gearbox, differential gear jack, engine

positioner, wood-and-steel covered workbenches, 150 ton hydraulic press, electrical heater, injection nozzle test and tool cabinet.

These technical sectors will be placed where the Vulcanization Section is presently located. The Diesel Engine Equipment Section, in the same storage shed will remain in the same place where it is presently, and next to it, the Sheet Metal Works Section will be located. The Heavy Machine Section will also remain in the same storage shed. In the area between the large storage shed and the wall that separates the Department from Parque Caballero, a cover will be constructed in order to shelter the following sections: Hydraulic Component Section and Lathe Section, Automobile Electricity Section and Body Repairing and Painting Section.

Also under this cover, a pit for quick services on the vehicles will be constructed.

**bbb. Machines and Tools**

An inventory of existing machines and tools at the Asunción municipality workshop, as well as recommendations for the acquisition of further ones are presented overlay.

| MACHINES AND TOOLS | | | |
|---|---|---|---|
| **Existing** | | **To Be Acquired** | |
| **Automobile Electricity Section** | | | |
| Battery Charger | – 1 | Ampermeter | – 1 |
| Voltmeter | – 1 | Water Purifier (Deionizer) | – 1 |
| Battery Hydrometer | – 1 | Generator Test | – 1 |
| Welding Machine | – 1 | Machinist Vise No. 8 | – 1 |
| Armature Tester | – 1 | Booster Cable | – 1 |
| | | Circuit Tester | – 1 |
| | | Wire Stripper | – 1 |
| | | Polyethylene Funnel | – 1 |
| | | Battery Syringe | – 1 |
| | | Hand Tools Box | – 5 |
| **Diesel Engine Section** | | | |
| Hydraulic Press | – 1 | Universal Drilling Machine 1" | – 1 |
| Hydraulic Hanger | – 1 | Bench Electric Grinder | – 1 |
| Hand Tools Box | –10 | Machinist Vise No. 8 | – 2 |
| | | Bench | – 2 |
| **Smithy Section** | | | |
| Machinist Vise | – 1 | High Speed Abrasive CVT off Machine | – 1 |
| Bench | – 1 | Bench Electric Grinder | – 1 |
| Welding Machine | – 3 | | |
| Oxy–Acetylene Welding | – 2 | | |
| **Diesel Engine Heavy Equipment Section** | | | |
| Air Compressor | – 1 | Bench Electric Grinder | – 1 |
| Hand Tools Box | – 2 | Hand Tools Box | – 1 |
| Tools Board | – 1 | | |
| Socket Wrench 3/4 Set | – 1 | | |
| Socket Wrench 1/2 Set | – 1 | | |
| Cambinatia Wrench | – 1 | | |
| Machinist Vise | – 1 | | |
| **Light Equipment Section** | | | |
| Bench | – 2 | Machinist Vise No. 8 | – 1 |
| Hand Tools Box | – 1 | | |
| **Light Vehicle Section** | | | |
| Machinist Vise | – 1 | Bench | – 1 |
| Bench | – 1 | Bench Electric Grinder | – 1 |
| | | Hand Tools Box | – 1 |
| **Lathe Section** | | | |
| Engine Lathe | – 1 | | |
| Bench Electric Grinder | – 1 | | |
| Machinist Vise | – 1 | | |
| **Body Repairing and Painting Section** | | | |
| Oxy–Acetylene Welding | – 1 | Bench Electric Grinder | – 1 |
| Shearing Machine | – 1 | Machinist Vise No. 8 | – 1 |
| Polisher | – 1 | Hand Tools Box | – 1 |
| Spray Gun | – 1 | Compressed Air Outlet | – 1 |
| **Voholstery Section** | | | |
| Bench | – 1 | Sewing Machine | – 1 |
| Olo Sewing Machine | – 1 | Hand Tools Box | – 1 |

| MACHINES AND TOOLS | | | |
|---|---|---|---|
| **Existing** | | **To Be Acquired** | |
| **Hydraulic Components Section** | | | |
| | | Bench | – 2 |
| | | Adjustable Pipe Wrench | – 1 |
| | | Machinist Vise No. 10 | |
| | | Hand Tools Box | – 2 |
| **Vulcanization Section** | | | |
| Air Compressor | – 1 | Automatic Tire Inflator | – 1 |
| Hot Catch Clamp | – 1 | Tire Bead Breaker (Air Type) | – 1 |
| Wire Bush Bench Electric | – 1 | Tire Spreader (Air Type) | – 1 |
| Portable Hydraulic Pack | – 3 | Wheel Balance | – 1 |
| Hydraulic Garage Pack | – 1 | | |
| Hand Tools (Various) | | | |
| **Tools Section** | | | |
| Electric Drill | – 1 | Screw Clamp (Various) | |
| Torque Wrench | – 1 | Compression Gauge | – 1 |
| Gear Puller | – 3 | Pressure Gauge | – 1 |
| Open End Wrench (Various) | | Air Impact Wrench with Impact Socket | – 1 |
| Box Wrench (Various) | | Impact Wrench Holder | – 1 |
| Plier and Grip Plier (Various) | | Drain Plug Wrench | – 2 |
| Adjustable Wrench | – 3 | Oil Filter Wrench | – 2 |
| Adjustable Pipe Wrench | – 2 | Adjustable Hack Saw Frame | – 3 |
| Screw Driver (Various) | | Hack Saw Blade (Various) | |
| Ball Peen Hammer | – 2 | Drill Set | – 2 |
| Adjustable Hacksaw Frame | – 2 | Surface Plate | – 1 |
| | | Electric Soldering | – 1 |
| | | Chisel and Punch Set | – 1 |
| | | V Block (Various) | |
| | | Vernier Caliper | – 1 |
| | | Outside Micrometer | – 1 |
| | | Iron Bench Level | – 1 |
| | | Rigid Rack (Various) | |
| | | Transmission Pack | – 1 |
| **Technical Section** | | | |
| | | Brake Drum Lathe | – 1 |
| | | Brake Lining Riveter | – 1 |
| | | Bench Electric Grinder | – 1 |
| | | Universal Drilling 1" | – 1 |
| | | Rack for Axle | – 1 |
| | | Bench | – 5 |
| | | Differential Gear Pack | – 1 |
| | | Hydraulic Press to 150 ton | – 1 |
| | | Bench for Gear Box | – 1 |
| | | Steel Covered Bench | – 1 |
| | | Machinist Vise No. 8 | – 1 |
| | | Engine Positioner | – 1 |
| | | Tools Cabinet | – 1 |
| | | Injection Nozzle Tester | – 1 |
| | | Electrical Heater | – 1 |

A summary of the machines and tools to be acquired is presented ahead as well a table showing the special tools needed for the maintenance job of the new VW trucks.

| Municipality of Asuncion - Transport and Workshop Department Machinet and Tools to be Acquired | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Autom. Electricity Section | Diesel Engine Section | Smithy Section | Diesel Engine Heavy Equip. Section | Light Equip. Section | Light Vehicle Section | Body Repairing and Painting Section | Upholstery Section | Hydraulic Compon. Section | Vulcaniz Section | Tools Section | Technical Section |
| Ampermeter | 1 | | | | | | | | | | | |
| Water Purifier | 1 | | | | | | | | | | | |
| Generator Test | 1 | | | | | | | | | | | |
| Machinist Vise 8 | 1 | 2 | | | 1 | | 1 | | | | | 1 |
| Booster Cable (set) | 1 | | | | | | | | | | | |
| Circuit Tester | 1 | | | | | | | | | | | |
| Wire Stripper | 1 | | | | | | | | | | | |
| Polyethylene Funnel | 1 | | | | | | | | | | | |
| Battery Syringe | 1 | | | | | | | | | | | |
| Universal Drilling Machine | | 1 | | | | | | | | | | 1 |
| Bench Electric Grinder | | 1 | 1 | 1 | 1 | 1 | 1 | | | | | 1 |
| Bench | | 2 | | | | 1 | | | 2 | | | 5 |
| High Speed Abrasive Cuf-off Machine | | | 1 | | | | | | | | | |
| Hydraulic Press 150t | | | | | | | | | | | | |
| Sewing Machine | | | | | | | | 1 | | | | |
| Adjustable Pipe Wrench | | | | | | | | | 1 | | | |
| Machinist Vise 10 | | | | | | | | | 1 | | | |
| Automatic Tire Inflator | | | | | | | | | | 1 | | |
| Tire Bead Breaker (Air Type) | | | | | | | | | | 1 | | |
| Tire Spreader (Air Type) | | | | | | | | | | 1 | | |
| Wheel Balance | | | | | | | | | | 1 | | |
| Screw Clamp | | | | | | | | | | | Several | |
| Compression Gauge | | | | | | | | | | | 1 | |
| Pressure Gauge | | | | | | | | | | | 1 | |
| Air Impact Wrench | | | | | | | | | | | 1 | |
| Drain Plug Wrench | | | | | | | | | | | 1 | |

| Municipality of Arnachan – Transport and Workshop Department Machines and Tools to be Acquired | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Autom. Electricity Section | Diesel Engine Section | Smithy Section | Diesel Engine Heavy Equip. Section | Light Equip. Section | Light Vehicle Section | Body Repairing and Painting Section | Upholstery Section | Hydraulic Compon. Section | Vulcaniz Section | Tools Section | Technical Section |
| Oil Filter Wrench | | | | | | | | | | | 1 | |
| Ball Peen Hammer | | | | | | | | | | | 2 | |
| Adjustable Hack Saw Frame | | | | | | | | | | | 3 | |
| Hack Saw Blade | | | | | | | | | | | Several | |
| Drill Set | | | | | | | | | | | 2 | |
| Surface Plate | | | | | | | | | | | 1 | |
| Electric Soldering Iron | | | | | | | | | | | 1 | |
| Chisel and Punch Set | | | | | | | | | | | 1 | |
| V Block | | | | | | | | | | | Several | |
| Vernier Caliper | | | | | | | | | | | 1 | |
| Outside Micrometer | | | | | | | | | | | 1 | |
| Iron Bench Level | | | | | | | | | | | 1 | |
| Rigid Rack | | | | | | | | | | | Several | |
| Hand Tools Box | 5 | | | | 1 | 1 | 1 | 1 | 2 | | | 1 |
| Brake Drum Lathe | | | | | | | | | | | | 1 |
| Brake Lining Riveter | | | | | | | | | | | | 1 |
| Rack for Axle | | | | | | | | | | | | 1 |
| Differential Gear Jack | | | | | | | | | | | | 1 |
| Bench for Gear Box | | | | | | | | | | | | 1 |
| Steel Covered Bench | | | | | | | | | | | | 1 |
| Engine Positioner | | | | | | | | | | | | 1 |
| Tools Cabinet | | | | | | | | | | | | 1 |
| Injection Nozzle Tester | | | | | | | | | | | | 1 |
| Electrical Heater | | | | | | | | | | | | 1 |
| Transmission Jack | | | | | | | | | | | 1 | |

| Special Tools to Be Acquired for VW 2H 220 (6x4) Truck in Asuncion Municipality | | | | | | |
|---|---|---|---|---|---|---|
| | Engine Service | Chassis Service | | | | |
| | | Wheel Cube | Bear Brake | Differ-ential | Geral Box | Parts In The Cabin |
| Easel fitting No. 3375194 | 1 | | | | | |
| Calibrator to Verify Protusion No. ST545 | 1 | | | | | |
| Clamp Fixation of the Cylinder Line No. 3376944 | 1 | | | | | |
| Fitting Cylinder Liner Mandil No. ST1229 | | | | | | |
| Slide Jumper No. 3376617 | 1 | | | | | |
| Extractive Seat of Injet Valves No. 3377396 | 7 | | | | | |
| Extracting Seat of Exhaust Valves No. ST1276-1 | 1 | | | | | |
| Manual Retation Tool No. 337731 | 1 | | | | | |
| Injection Valve Extractive No. 3822482 | 1 | | | | | |
| Extracting of the Cylinder Liner No. 3376015 | 1 | | | | | |
| Tool to Find the Crankoase Blow (with Bore of 302") No. 3375780 | 1 | | | | | |
| T85T 1104A ou T85T1104B | | 1 | | | | |
| T85T 2262-A | | | 1 | | | |
| T85T 4017-A | | | | 1 | | |
| T85T 4295-A | | | | 1 | | |
| T85T 4205-A | | | | 1 | | |
| T85T 4676-A | | | | 1 | | |
| T85T 4666-A | | | | 1 | | |
| T85T 4615-A | | | | 1 | | |
| T85T 4625-A | | | | 1 | | |
| T85T 4209-C | | | | 1 | | |
| T85T 4625-B | | | | 1 | | |
| T85T 4625-D | | | | 1 | | |
| T85T 4615-B | | | | 1 | | |
| T85T 4625-C | | | | 1 | | |
| T85T 4209-B | | | | 1 | | |
| T78T 7C236-A | | | | | 1 | |
| T78T 7025-B | | | | | 1 | |
| T85T 7085-A | | | | | 1 | |
| Special Allen Wrench Set (Star Wrench) | | | 16D | | | 1 |

### bc. Fleet of the Transport and Workshop Department

Because of the suggested alterations in the structure of the Transport and Workshop Department, several vehicles will be transferred from the Workshop, only leaving behind the ones that assist the various bodies of the Environmental Bureau.

The fleet then will be composed of the following vehicles:

| | | |
|---|---|---|
| – | Compactor trucks | 50 |
| – | Dump trucks and others | 17 |
| – | Sweeping trucks | 4 |
| – | Heavy machines | 16 |
| – | Pick up and Vans | 18 |
| – | Motorcycles | 8 |
| | **Total** | **113** |

The former fleet, not including all vehicles and machines acquired in the last bid, consisted of 148 vehicles and machines and 46 motorcycles.

If the 100 vehicles and equipment purchased in 1993 were all annexed to the Transport and Workshop Department settlements, they would be completely inundated leading to the reduction in vehicle operation and also the maintenance services. This is why the decision was made to change the organizational structure of the Transport and Workshop Department.

### bd. Human Resources

In this part, the concepts for guiding the proceedings related to the human resources in operation and maintenance services in the Transport and Workshop Department will be presented.

#### bda. Staff Planning

It is advisable to adopt the following standards for staff planning:

– *Drivers and Machine operators*

The ideal number of laborers is 25% more than the increase in vehicles and equipment, taking into account the work shifts.

This increase is to compensate absences, holidays, incapacitation, temporary

dismissals and so on.

- *Maintenance Staff*

A system of 1 worker to every 3 vehicles.

These standards can be useful for a draft or evaluations of staff planning. However, for a more efficient, high performing service, these indicators will act as a foundation for improved plans.

In the former structure, all the vehicles and machines of the municipality were allocated in the Transport and Workshop Department, where there were 148 vehicles and 46 workers with a proportion of 3.21 vehicles per worker. This figure is very close to the value for the proposed plan.

In the new allocation, there will be 105 vehicles and machines (excluding the 8 motorcycles). Considering the system of 3 vehicles per employee, in the proposed workshop there shall be 35 persons. These 35 employees would be placed in the following sections of the Workshop Division.

| WORKSHOP DIVISION | |
|---|---|
| **Sections** | **Employees** |
| Automobile Electricity Section | 5 |
| Diesel Engine Section | 10 |
| Heavy-Engine Equipment Section | 5 |
| Light Vehicle Section | 4 |
| Hydraulic Components Section | 2 |
| Lathe Section | 1 |
| Smithy Section | 4 |
| Body Repairing and Painting Section | 3 |
| Upholstery Section | 1 |
| **Total** | **35** |

The Light Equipment Section has not been considered because the equipment used is atypical to other vehicles and machines. Nonetheless, this section will need two mechanics.

The workers of the Transport Division would be distributed in the following sections:

| TRANSPORT DIVISION | |
|---|---|
| **Sections** | **Employees** |
| Vulcanization Section | 4 |
| Washing and Lubrication Section | 5 |
| **Total** | **9** |

### bdb. Work Schedule

The current work schedule shall be maintained. The drivers will have their schedule established according to the work shift in which they are allocated. Maintenance staff will work from 6 a.m. to 1 p.m..

On a normal work-day, it is recommended that the extra-works be done through direct request when any extra-work is needed.

### bdc. Work Security

The basic rules of work security should be always observed. The section, division and department chiefs will be in charge of the execution of them. Frequent meetings should be held between the administrative staff, chiefs and the security personnel. The topics to be discussed in these meetings shall be on supply of proper uniforms, safety shoes and other individual protective equipment for the workshop staff, and any accidents which may have occurred since the last gathering.

The minimum requirement for the workshop staff, to be allocated by the department, are as follows:

- Aprons, leather gloves and face guards for the welders to carry out electrical repairs.
- Eye protectors for the body repair workers to carry out oxyacetylene welds.
- Filter face guards for the painters.
- Antiskid shoes for all Workshop staff maintenance.
- Uniform made from durable woven material; suitable to the local climatic conditions.

The following precautions are recommended in relation to the safety of the workers:

- To use filter face guards when the painters carry out their spray gun tasks.

- To put moveable isolation panels, where the electrical welding is carried out, in order to protect the other employees, who are nearby, from blinding light emitted during the operation.
- To put security warnings in the Workshop at appropriate areas.
- To install proper fire-extinguisher in the Workshop, in order to fight possible fires of different kinds, such as ones caused by electrical sparks and fuel ignition.

**bdd. Training**

In relation to staff training, the Transport and Workshop Department directory should plan courses in some of the following areas:

- Self-defense course for the drivers.
- Regulations for vehicles, drivers and transport supervisors.
- Accident notification procedures for the drivers and transport supervisors.
- Methods, techniques and procedures to execute daily systematic inspection, including the necessary forms for drivers, mechanics and transport supervisors.
- Gaining of experience in the dealing with the designated vehicles for drivers.
- New program of advanced training courses on the vehicles and new equipment etc..

In order to execute these courses, the department's technical staff should be prepared to act as teachers. Also, the participation and the support of the manufacturers can be requested so that they provide manuals and films etc..

- For the maintenance staff, the Transport and Workshop Department chief should request to the manufacturers to provide the following basic courses:

  . Lubrication
  . Engine revision and adjustment
  . Front axle and leaf springs
  . Back axle
  . Transmission (clutches, gearboxes and differentials)
  . Break systems
  . Electrical systems
  . Adjustments in the hydraulic system
  . Recovering of the hydraulic pumps
  . Recovering of the hydraulic commands and valves
  . Recovering of the hydraulic cylinders

**be. Vehicle and Machine Identification**

In order to achieve a sound operational control of the vehicles, a numeric identification, as in the format below, shall be painted on both the sides and the rear of the truck bodies.

| | | |
|---|---|---|
| X X - | X X - | X X |
| (1) | (2) | (3) |

a) *The first two numbers (1), represent the specific identification digit established for groups of identical vehicles or equipments, such as:*

01 - Automobiles, Jeeps
02 - Pick-ups
03 - Vans
04 - Dump Truck
05 - Flat Bed Truck
06 - Water Tank Truck
07 - Compactor Truck
08 - Road Sweeper
09 - Fuel Tank and Lubrication Truck
10 - Hoist Truck
11 - Roll on - Roll off Truck
12 - Wheel Loader
13 - Bulldozer
14 - Excavator
15 - Wheel Tractor
16 - Motor Grader
17 - Motorcycle
18 - Mobile Workshop
19 - Trailer Truck

b) *The next two numbers (2) represent:*

- The cargo capacity in m3, in the case of the compactor trucks, dump trucks, flat bed trucks, water tank trucks, etc..
- The number of passengers, in the case of automobiles, jeeps, pick-ups, vans, etc.
- The cargo capacity in tons, in the case of the hoist truck.
- The model, in the case of equipments.

Example:

0714 – identifies a compactor truck, of 14 m3 capacity.
1304 – identifies a caterpillar bulldozer, model D4

c) *The last two numbers (3) represent the identification figure in chronological order of the vehicle and machines purchased from at the beginning of the operation.*

Example:

07 14 10 – identifies the tenth compactor truck of capacity $14m^3$.

**bf. Plan and Procedures of Operation and Maintenance**

The key factors in vehicle and equipment maintenance procedures, in general, as well as in the SWM field have already been presented. In this section the basic recommendations for maintenance of the trucks and equipment being acquired are presented as well as the operational procedures to be followed by the drivers and mechanics.

**bfa. Operational Procedures**

**i. Type of truck**

Volkswagen chassis truck 24220 (6X4), equipped with Cummins 6 CT 83 L turbo charge engine (max. power 215 cv)

a) *Procedures before starting the engine*

- Check lubricant oil level. Add oil if necessary.
- Check coolant level of the cooling system. Add clean water if necessary.
- Check radiator. Clean it (outside) if necessary.
- Check seat belts and tires.

b) *Procedures after starting the engine*

- Check indicators on the control panel.
- Check possible leaks (oil, water and air pressure).
- Check air pressure of the brake system and it's effectiveness.
- Check chassis suspension (springs, axles, etc.).

- Check the lights.
- Drain off the water from the air tank.
- Warm up the engine progressively until it reaches operating temperature (80°C).

c) *Procedures during operation*

- Examine the indicator lights in the control panel carefully.
- Be alert and aware of abnormal sounds.

**ii. Type of collection equipment**

Colectomatic 4000 compactor collector

a) *Procedures on route*

- Check the outlet power connection – (should be disconnected)
- Check the position of the ejection panel – (should be placed close to the cabin)

b) *Procedures during collection operation*

- Connect the outlet power at the beginning of operation.
- Place the ejection panel at the back of the cabin before beginning compaction.
- Keep the engine at half speed. Do not use pieces of wood or other materials to speed up the engine. RPM of the hydraulic pump should be from 1000 to 1200.
- During the collection operation, gear should be in first position.
- The operator should never rest their foot on the clutch pedal.
- During the compaction operation (loading the chamber), open the packing blade and descend the slide panel (first phase of compaction); After filling the refuse chamber, close the packing blade and lift the slide panel (second phase of compaction).
- Do not exceed the maximum permitted load.
- Do not transport waste in the charging unit.
- Do not try to compact after the maximum load is reached.

b.1) *Operation of dump containers*

. Turn on the outlet power.
. Lock the lateral axles of the container in the equipment

handles.

- Move the corresponding lever to dump the container.
- Load and compact the wastes into the refuse chamber.
- Move the appropriate lever to descend the container.
- Unshackle the lateral shaft handles and remove the container.
- Disconnect the outlet power.

c) *Dump operation*

- Connect the outlet power.
- Release the holds of the tailgate.
- Lift the tailgate to its maximum height.
- Turn on the ejector panel to discharge the wastes.
- Lower the tailgate.
- Lock the tailgate.
- Disconnect the outlet power.

**bfb. Maintenance**

The maintenance services of the new vehicles can be classified as Extramunicipal Services and Intramunicipal Services.

**i. Extramunicipal Maintenance Services**

The extramunicipal maintenance services shall be made in the representatives of the chassis manufacturer and of collection equipment manufacturer. For the Volkswagen truck the representative in Asuncion is DIESA–Av. Dr. Eusebio Ayala 3785, Asuncion.

New vehicles and equipments have a guarantee from the manufacturer under a "Warranty Term", for a defined period of time. This period is usually 8 months for the chassis and 6 months for the collection equipment. This warranty is granted only if the buyer follows the maintenance program, which means all the lubricating and routine checks.

The vehicles and equipments acquired by the municipality of Asuncion have an Operation and Maintenance Handbook where information on performance, operation and maintenance procedures can be found.

Also, these equipments and vehicles and entitled to a "free delivery service" and a "free overhaul" at a maximum fixed time. Concerning the Volkswagen chassis

the Delivery service is made at 10,000 km and the overhaul service at 20,000 km and for the collection equipment the delivery and the overhaul services are made at three and six months of operation respectively.

The overhaul and delivery services are free of charge, except to the washing and cleaning, lubrication services, oil and spare parts replaced due to normal wear and tear.

Concerning the mechanic components of the chassis such as the engine, gear box, rear axle, etc., are also covered by the different manufacturers, once confirmed that the vehicles have undergo the prescribed program of lubrication and maintenance. For engines, the usual warranty covers 12 months of operation.

In respect to the "extramunicipal" maintenance it should be reminded that from time to time there are promotional advantages supplied by the representatives, ie. special discounts for the purchase of parts and for services.

**ii. Intramunicipal maintenance services.**

The "intramunicipal" maintenance services will be made in the Transportation Department Workshop, where there are appropriate resources.

These maintenances will be executed in connection with the "extramunicipal" maintenance during the warranty period, referring basically to the regular lubrications as recommended by the manufacturers.

These "intramunicipal" maintenances shall be made based on the "Preventive Maintenance Plans" specific to each kind of chassis and equipment presented as follows:

a) *Preventive Maintenance Plans* eg. Volkswagen truck 24220 (6X4)

a.1.) *Lubrication and maintenance*

Every 250 service hours or monthly (equivalent to 10,000 km)

- Engine: drain and refill oil and replace filter.
- Remove and clean water/oil separator filter.
- Clean the filter of the fuel injection pump.
- Check the oil level of the gear box.
- Check the oil level of the steering box.
- Check the oil level of the differential.

- Check the oil level of the clutch.
- Check the oil level of the electrical reduction box.
- Check the battery electrolyte level.
- Check coolant level of the cooling system.
- Clean the exterior of the radiator.
- Clean the pre-cleaner and the filter with a compressed air stream.
- Clean the filters of the fuel filter.
- Pulverize the spring leaves with lubricant oil.
- Lubricate the brushings and pins of the spring leaves.
- Lubricate the front axle.
- Lubricate the universal joints of the transmission axle.
- Lubricate the door hinges and locks.
- Lubricate the pedal brushings and pins.
- Lubricate the universal joints of the steering system.
- Remove and clean the breather of the differential.
- Lubricate the driving action axle of the clutch's ball bearing.
- Clean and fasten the battery terminals and cover with vaseline.
- Drain off any water from the air tank.

a.2) *Maintenance every 500 service hours or two months, equivalent to 20,000 km:*

- Change the fuel filter.
- Change the air filter.
- Check the air pressure of the break system.
- Drain off any water from the air tank.
- Check for any leaks in the break system.
- Check the break linings, adjust it and test it (both the foot brake and the hand brake).
- Fasten the clamps of the spring leaves (front and rear).
- Check the air pipes between the air filter and the manifold.
- Fasten the engine's external bolts and screws.

a.3) *Maintenance every 1500 service hours or six months, equivalent to 60,000 km*

Engine

- Check fuel injection pump.

- Check fuel injection valve.
- Check lubricant oil level of the fuel injection pump.
- Check tubes.
- Check belts.
- Check for leaks at the cooling system.
- Check for leaks at the fuel system.
- Check valve lash. Adjust if necessary.
- Drain and clean the cooling system, refill with coolant.

Electrical System

- Check start motor, generator, front and rear lamps, brake lights, windshield wipers.

Brake System

- Remove and clean the security relief valve of the air tank.
- Fasten screws of the air compressor.

Transmission

- Adjust the clutch and check it's efficiency.
- Check the central ball bearing of the transmission axle.
- Check the oil level of the gear box.
- Check the oil level of the differential.
- Check the oil level of the electrical reduction box.

Chassis

- Check the shock absorbers.
- Check the engine supports.
- Fasten the screws of the spring leaves supports, spring leaves clamps, transmission and all other chassis parts.
- Check the central pins of the spring leaves.
- Check the positions of: crankcase fill pipe cap, radiator cap, fuel tank cap, batteries plug, brake oil cap, clutch oil cap.
- Drain off any water sediment from the fuel tank.
- Grease the wheel bearings.

Steering System

- Check steering axle bushing and pins.
- Check steering wheel.
- Change the oil of the hydraulic steering system.
- Change the filter of the hydraulic steering system.

b) *Plans for the preventive maintenance* eg. Compaction equipment Colectomatic 4000

b.1) *Every 10 service hours or daily*

- Wash the equipment.
- Check the oil level of the hydraulic system. Add oil if necessary using the same type and manufacturer of the oil previously used.

b.2) *Every 50 service hours or weekly*

Lubricate with high pressure grease pump:

- bushings and pins of the tail gate,
- bushings and pins of the hydraulic cylinders to the tailgate elevation system,
- locks of the tailgate,
- bushings and pins of the hydraulic cylinders of the sliding panel,
- bushings and pins of the hydraulic cylinders of the packing blade,
- pivots of the slide panel,
- universal joints of the outlet power gear,
- bearings of the packing blade, and
- lateral bushings and pins of the dump container system.

Lubricate with a brush:

- splices of the transmission axle,
- cylinder shafts,
- guide rail of the ejector panel,
- bars of the slide panel, and
- lateral guides of the bars of the slide panel.

Lubricate with oil:

. bushings and pins of the operation levers.

Check the assemblage of the equipment to the chassis.

b.3) *Every 250 hours or monthly*

. Check the pressure in the hydraulic system.
. Check the wear bars of the slide panel.

b.4) *Every 1500 service hours or 6 months*

. Clean the filters of the hydraulic system.
. Check the pump of the hydraulic system.
. Check roller, bushing and pins of the ejector panel.

b.5) *Every 3000 service hours or one year*

. Drain off and wash the hydraulic oil tank. Add oil, if necessary fill the oil tank, using the same type and manufacturer of the oil previously used.
. Change the filters of the hydraulic system.
. Check the hydraulic system and the electrical–pneumatic system.

**bg. Control system**

Control means the activity of comparing the real results with the preview ones in order to find the existing errors and take the necessary proceedings in order to correct them.

The controls hold two fundamental purposes:

- to get daily information of the vehicle and equipment use
- to get data which permit to preview the operational cost

To get a better information analysis which is obtained with a good control system, we suggest the division of the data obtaining system in three groups:

- data of administrative interest
- data of operational interest

– consumption data

### bga. Administrative Control

This control is related to the employees who work in the Transport and Maintenance Department:

#### i. Attendance/Absenteeism Control

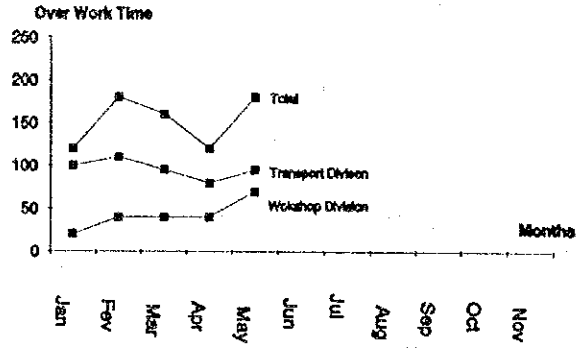
This control should be carried out using time clock and individual time cards to register entrance, exit and overwork time. The administrative sectors will be in charge of controlling all employees of the Transport and Maintenance Department. The division chiefs should verify the attendance daily and take the necessary administrative action in relation to the absent workers.
The time card data will be sent to the Staff Sector at the end of each month. This proceeding permits to the division chiefs to have a better idea about the employees under their control.

#### ii. Overtime Work Control

One must be aware of the necessity in controlling the expenses and in order to achieve this the Transport and Maintenance Department shall hold the permanent control of the monthly overtime of all the employees. This will be obtained through the keeping of time cards.

The overtime work control will be done by the administrative sectors of the divisions, identifying the workers that have worked overtime and the reasons for it.

The directory of the department shall elaborate monthly producing a graphic control of the overtime work done within the Transport and Maintenance Divisions, as follows:



### iii. Accident Control

For the machine and vehicle accident control, a proper form, like the accident list presented later should be used. This list has the objective of providing the administrative and legal sectors with the necessary information to define responsibilities and hence the decisions to be taken.
The form should be filled in by the chief of the Transport Division who should personally go to the site of accident to make the necessary investigations.

Two copies of this form should be filled. The first copy will be sent to the legal service to investigate and determine the culprit. If the driver is guilty, the administration will take the necessary measures (temporary dismissals etc.).

The other one is for the Transport Division, if the driver is not guilty, the legal service will communicate in writing to the department of its conclusions and take other measures against those in the wrong.

### iv. Driver Report

The information obtained from the accident reports shall be recorded in the driver report form, as in the sheet presented later. The document will be filed by the administration sector of the transport division in order to obtain a profile on the drivers' performances.

Periodically, the chief of Transport Division should examine this report and if there are any collerations between certain drivers and repetitive accidents, where the guilty party is the worker, actions shall be taken in order to dismiss that individual from duty on the ground of poor performances.

## bgb. Operational Control

### i. Daily Transport Form

This is the fundamental record for basic operation and maintenance control. Those responsible for vehicle distribution shall note down the necessary information and hand the file to the driver with the vehicle. The driver then inscribes the corresponding sections at the end of the shift returns the document to the "Traffic and Yard" section.

This document shall include the identification of the vehicle and the driver, information on the tasks for the day, such as starting time, arrival time at the yard, distance covered, load, where the tasks took place, together with the hour and

position of the odometer of each vehicle.
The user of the vehicle shall record the time and the place where he receives the vehicle and the time and place where he returns it.

This form has the advantage of keeping a record of the operations with details of time and place.

If there are accidents or complaints, this document can be used as reference for previous case histories.

The daily control for the use by the drivers of the shall be made on the Daily Transport Form, where the name of the driver, their ID number, and the vehicle identification number shall be recorded. Up to their return the driver shall be responsible for the Daily Transport Form.

The Form shall then be cleared by the transport Division Chief, and sent to the Workshop Division immediately.

**ii. Load Control**

The control of the load carried by the vehicles is of paramount importance to the collection services management, as well as to the transport area.

This control allows the knowledge of whether the vehicles are operating with the designated loads or not.

In the case of the collection vehicles, the knowledge of the load transported by the collection trucks have an additional importance. This is due to the fact that this information enables equal distribution of collection routes in a defined area of the city.

The drivers shall be informed of the load values given in the vehicle manufacturer's instruction in order to avoid overloading of the equipment.

This control will be made, utilizing the scale located at the gate of the Cateura landfill.

Information about loads transported are of great managerial importance to the collection department as well as to the transport and workshop department, since customary overloads are the main sources of problems with shafts, springs, differentials, transmission, etc.

### iii. Tachographies

Another component of the operational control are the round graphical records made by tachographies.

The tachography is a device containing a timer and is installed in the cockpit of the vehicle, at the dashboard. This device records many operational data in the daily cycle, such as:

- beginning and finish time of the daily journey
- operating speeds during the daily journey
- time of vehicle being inoperable or out of order, in hours and minutes
- record of distance covered by the vehicle.

The setting up of the tachography and the recording its data is simple and cost effective.

Another advantage of this equipment is that the records can be used as a legal proof in case of an accident enabling the officials to see what time the accidents occurred and the speed in which the vehicle was travelling in order to get a more accurate picture.

Readings of the records shall be made in the traffic and yard section and a summary of findings will be sent to the control coordination.

### iv. Delays and breakdowns

Another operational control is the one related to delays and breakdowns. This control gives an indirect evaluation of the vehicles maintenance. A graphical form of the findings shall be drawn so to allow a rapid assessment of the situation.

Initially this job shall be made based on daily information. After the initial period, routine observations may be made based only on the days when the work load is heavier ie. mondays and tuesdays.

The total delay intervals at the exit of the vehicles from the workshop and the total idle hours due to breakdowns shall be recorded.

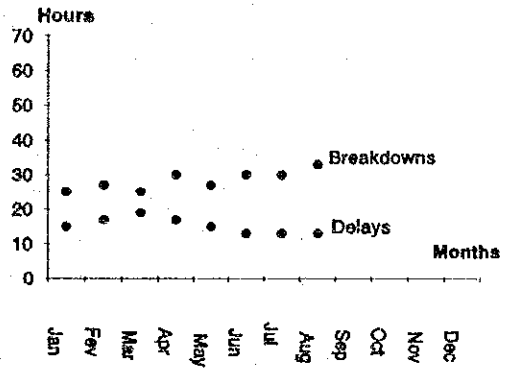
If an inactive vehicle is replaced by a different one, the time interval between the vehicle breakdown and the commencement of the substitute operation shall be recorded. The information obtained will be displayed on a graph, where different types of vehicles (used in collection, street cleaning, etc..) will be identified

separately.

After a period of time, six months for example, it will be possible to gain an overall view of the situation, inferring from bad to excellent.

Between 60 and 70 → Worst

In the 50's → Bad
Between 30 and 40 → Regular
Between 20 and 30 → Good
In the 10's → Excellent




## v. Tire Repair Control

Any transport-based activities must establish rigid control on the tires of vehicles. Therefore, strict observation on the tire use and repair shall be implemented.

The aim of this control is to analyze and find which vehicles are more prone to suffer tire problems and the number of punctures for each driver.

The tire repair control form, as shown below, shall be filled by the tire shop and sent to the control coordination to be analyzed.

| TRANSPORT AND WORKSHOP DEPARTMENT | | | | | (date) |
|---|---|---|---|---|---|
| **Vehicle Identification** | **Tire Type** | **Tire Number** | **Tire Manufacturer** | **Repair Time** | **Driver Identification** |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

### vi. Technical History of Vehicle or Equipment

The record file or technical file shall comprise the life history of the vehicle or equipment.

In this file, all the information concerning the vehicles or equipment, obtained from the various controls, shall be inscribed. It is to be updated for each operation and repair service, especially regarding the engine as it is the most fundamental and expensive component of the vehicle or equipment.

### vii. Fuel Consumption Control

Supervision of the transport operation activities shall include the control over fuel and lubricant consumption. The main responsibility over fuel and lubricants belong to the fuel section and the Materials Division. These offices then send the fuel indicators to the Control Coordination, which is under the Transportation and Workshop Department.

Based on these indicators, from the Transport Division, a conventional representation of the monthly consumption amount shall be established, if possible, for every vehicle or equipment. Regulation on the fluctuations of fuel and lubricant consumption can be made based on these amounts.

The consumption of each vehicle or equipment is obtained daily through the Daily Transport Form, which is filled for each one.

All the anomalous consumptions detected shall be investigated and verified with the Transport Division.

### viii. Tire and Tube Tire Control

Tire and tubes purchasing and use control of any fleet shall comply to strict norms. The existence of several tire manufacturers with their own specifications and numbering makes the control difficult. Because of this, it is necessary to use identification brands.

These brands, made using a hot iron, shall leave the imprint of the Transport and Workshop Department initials and sequential numbering. Another advantage of this procedure is to refrain the thieving of tires.

The control of the tires shall be conducted on paper, as in the form shown below; any information shall be inscribed regarding new tires handed over to the

Workshop from the storehouse in the Materials Administration Division.

| IDENTIFICATION BRAND CONTROL | | | | | | |
|---|---|---|---|---|---|---|
| Date of Branding | Tires | | | | | Obser-vations |
| | Nº of Manu-facturer | Control Nº | New or Recapped | Nº of Plies | Date of Deliver | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**Note:** In the Column " Observations" the name of those requesting the tires as well as any other information that it is considered important shall be inscribed.

Another control that shall be made is concerned with the tire and tire tube assembly in the vehicle or equipment.

For this control a "Tire Replacement" form shall be used which will be filled by the vulcanization section. This form, after being filled will also be sent to the Control Coordination.

Sending tires to be recapped shall be controlled through a form where the name of the manufacturer, the serial number of the manufacturer and the identification number of the Transport and Workshop Department will be recorded.

In order to conduct the control of tire maintenance efficiently, it is advisable to inspect them for all the damages prior to recapping.

This inspection shall be conducted using a special equipment which "opens" the tires (tire spreader).

| TIRES REPLACEMENT | | | | |
|---|---|---|---|---|
| **VEHICLE OR EQUIPMENT** | | | | **Removed tire sent to:** |
| No. | | Odometer: | | |
| **Removed Tire** | | | | |
| Brand Name | Manuf. NΩ | NΩ of plies | Control NΩ | **Description of repairs** |
| | | | | |
| Tube removed – ☐ Yes or ☐ No | | | | |
| **Tire Replaced** | | | | **Observations** |
| Brand Name | Manuf. NΩ | NΩ of plies | Control NΩ | |
| | | | | |
| New tube used – ☐ Yes or ☐ No | | | | **Signature of officer** |

### ix. Battery Control

The batteries shall also have an identification number engraved, due to its value and the simplicity of its removal from the equipment or vehicle, making it succeptable to theft.

All batteries shall be engraved with a mark that identifies the Transport and Workshop Department. This engraving shall be made in the Automobile Electricity Section. This procedure allows the identification between new and old batteries. It is important that from time to time the engraving format is changed so that a counterfeit engraving can easily be detected.

The form presented below, on completion, will also be sent to the control coordination.

| BATTERY SUBSTITUTION | | | | | Date |
|---|---|---|---|---|---|
| **Vehicle Identification** | | | | | **Reason for Substitution** |
| Serial NΩ | | Odo/hour meter | | | ☐accident |
| **Removed Battery** | | | | | ☐imperfection |
| Brand Name | Type | Volts | NΩ of Plates | Id. NΩWP WPCC OMSPE CPRO | ☐weakness |
| | | | | | ☐flat |
| | | | | | ☐replacement |
| **Battery Replaced** | | | | | ☐for overhaul |
| Brand Name | Type | Volts | NΩ of Plates | Id. NΩ | ☐other reasons |
| | | | | | |
| Functionary: | | | | | |

## x. Lubrication Control

The supervision of lubricants shall be made by the Control Coordination of the Transport and Workshop Department through a form used by each vehicle.

The date, kilometers covered, oil and grease used, filters replaced, etc., shall be recorded.

The control coordination delegated and determines which vehicle equipment needs to be served under the washing and lubrication section. The washing and lubrication section, in turn, inform to the control coordination of all the services that were done and the materials used.

For the sound implementation of the lubricant supervision plan, it is imperative for all the vehicles and equipment to have working odometers. However, if this is not feasible it is possible to estimate the mileage from the hours spent at work or even the fuel consumption in that period.

## xi. Repair Order

The repair order is an essential document for maintenance works because it enables

the control of operational costs.

This document shall be used in all the preventive maintenance services, emergency maintenance services and for all the repairs in general.

The following are suggestions for items or topics to be covered in the Repair Order Form.

- *Services to be Done*

  This section will be completed when the vehicle is inspected.

- *Services to be Made at Private Shops*

  Describes the services to be made in private shops, due to its complexity (engine overhaul, armature repair, radiator repair, etc.)

- *Materials Employed*

  This section will contain the list of parts that were used in the repair services.

- *Labor Efficiency*

  This field is for registering the time spent on the repair services (beginning and end of each operation)

- *Cost of The Services*

  This field is to be filled by an officer of the Workshop Division, showing all the costs of the materials and labor used in the repair.

The Repair Order must be left in a plastic envelop placed in a visible area of the vehicle under repair, so to ease the recording of the information.

After the conclusion of the repair services and the filling of all sections, the Service Order shall be sent to the Coordination Control where it will be stored together with the vehicle technical history.

### xii. Service Identification

A sample of the service identification sheet is presented below, that shall be placed on the wind shield of the vehicle that is waiting to be serviced. This sheet is used to provide a visual control of the services that have to be made.

| SERVICE IDENTIFICATION | | | |
|---|---|---|---|
| **Id. Nº :** _____ | | | |
| **Repair Order Nº:** _____ | | **Date:** __/__/__ | |
| ☐ | Engine | ☐ | Hydraulic Overhaul |
| ☐ | Cabinet Repair | ☐ | Painting |
| ☐ | Equipment Repair | ☐ | Upholstering |
| ☐ | Chassis | ☐ | Glassworks |
| ☐ | Mechanical Overhaul | ☐ | Repair |
| ☐ | Electrical Overhaul | ☐ | |

### bh. Fleet Renewal

There were 35 compactor trucks in the transportation and workshop department. The purchase of 15 new trucks adds up to 50 trucks in total.

The use of these trucks in waste collection and street sweeping activities are presented below.

| Compactor Trucks to be Used in Garbage Collection | | | |
|---|---|---|---|
| **License Plate** | **Manufacturer** | **Model / Year** | **Equipment** |
| 110 | M. Benz | 1514/88 | Usimeca 12m³ |
| 117 | M. Benz | 1514/89 | Sitta 6000-10m³ |
| 130 | M. Benz | 1513/87 | Usimeca 12m³ |
| 131 | M. Benz | 1513/87 | Usimeca 12m³ |
| 132 | M. Benz | 1513/87 | Usimeca 12m³ |
| 133 | M. Benz | 1513/87 | Usimeca 12m³ |
| 134 | M. Benz | 1513/87 | Usimeca 12m³ |
| 136 | M. Benz | 1514/89 | Sitta 6000-10m³ |
| 137 | M. Benz | 1514/89 | Sitta 6000-10m³ |
| 138 | M. Benz | 1514/89 | Sitta 6000-10m³ |
| 139 | M. Benz | 1514/89 | Sitta 6000-10m³ |
| 106 | Volkswagen | 24220/94 | Collectomatic 4000-15m³ |
| 109 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 112 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 113 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 140 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 141 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 142 | Volkswagen | 24220/94 | Collectomatic 4000-15m³ |
| 143 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 144 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 145 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 146 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 147 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 147 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 148 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 149 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| 159 | Volkswagem | 24220/94 | Collectomatic 4000-15m³ |
| **TOTAL:** | **26 Compactor Trucks** | | |

| Compactor Trucks to be Used in Street Cleansing | | | |
|---|---|---|---|
| License Plate | Manufacturer | Model / Year | Equipment |
| 114 | M. Benz | 1113/82 | Bicupiro |
| 115 | M. Benz | 1113/82 | Bicupiro |
| 116 | M. Benz | 1113/82 | Bicupiro |
| 118 | M. Benz | 1113/82 | Bicupiro |
| 119 | M. Benz | 1113/82 | Bicupiro |
| 120 | M. Benz | 1513/84 | Bicupiro |
| 121 | M. Benz | 1513/84 | Bicupiro |
| 122 | M. Benz | 1513/84 | Bicupiro |
| 123 | M. Benz | 1513/84 | Bicupiro |
| 124 | M. Benz | 1513/84 | Bicupiro |
| 125 | M. Benz | 1513/84 | Bicupiro |
| 126 | M. Benz | 1513/84 | Bicupiro |
| 127 | M. Benz | 1513/84 | Bicupiro |
| 128 | M. Benz | 1513/84 | Bicupiro |
| 129 | M. Benz | 1513/84 | Bicupiro |
| **TOTAL:** | **15 Compactor Trucks** | | |

| Compactor Trucks to be Transferred to AMUAM | | | |
|---|---|---|---|
| License Plate | Manufacturer | Model / Year | Equipment |
| 101 | M. Benz | 1113/80 | Bicupiro |
| 102 | M. Benz | 1113/80 | Bicupiro |
| 103 | M. Benz | 1113/80 | Bicupiro |
| 104 | M. Benz | 1113/80 | Bicupiro |
| 105 | M. Benz | 1113/80 | Bicupiro |
| 107 | Fiat | 140/84 | Bicupiro |
| 108 | Fiat | 140/81 | Bicupiro |
| 111 | M. Benz | 1114/79 | Bicupiro |
| 135 | M. Benz | 1113/82 | Bicupiro |
| **TOTAL:** | **9 Compactor Trucks** | | |

All the collection trucks working in street sweeping activities have exceeded their "economical life" span, thus, they shall be replaced by ten new vehicles. Two of the old ones shall be maintained as spare.

The vehicles used in the collection services are under seven year old, therefore, they shall be replaced by other compactor trucks after 1995 as follows:

1996 → 15 vehicles
1997 → 15 vehicle
1998 → 11 vehicles

These trucks, after replacement, may be used in street sweeping activities, because the burden if lighter than the collection services.

The fifteen trucks that went into operation in 1994 will remain in service until 2001.

The five vehicles bought in 1995 shall be substituted in the year 2002 and the remaining six bought in 1996 and 1997, will be replaced in 2004. The demographic growth and the increase in solid waste production has not been taken into account, generating a greater demand for collection services.

Vehicles that have reached their economic life span may be overhauled to be used to render services in the less urbanized municipalities. This is because the services in these municipalities are lighter due to less generation of waste, and also the reconditioning and the use of these vehicles will be considerably economical than the purchase of new ones.

This may be arranged through the AMUAM, an organization already established for rendering coordination and improvement services to the municipalities of the study area.

Overhaul services may be made at private shops or at the workshop of the Transport and Workshop Department of the municipality of Asuncion. In the latter case the repair costs shall be recorded separately from the other services.

**bi. Technical Stock of Components**

At the time of the survey, there were only two Mercedes Benz engines stocked as spares.

The technical stock of components is fundamental for reducing the time lost while the vehicles are under repair.

The immediate availability of spare parts is equally as important as substitute vehicle accessibility for inoperable equipment.

Suggestions for components to be stocked are as follows:

Mercedes Benz collection trucks → 26 units

- Engines 2 units
- Gear Box 1 unit
- Differential 1 unit
- Outlet Power 2 units
- Generator 2 units
- Starter 2 units
- Injection Pump 2 units
- Radiator 2 units
- Water Pump 2 units
- Front Axle 2 units
- Windshield wiper 2 units
- Brake valve 4 units (there are already 3)
- Front spring leaf 4 units
- Rear spring leaf

The collection equipments installed on the Mercedes Benz chassis are made by different manufacturers. This situation makes it more difficult to have a suitable stock of components.

These equipments are made by:

- USIMECA 6 units
- SITTA 6000 5 units
- BICUPIRO 15 units

A proposal for the stock of components for these equipments are (one component for each manufacturer):

- Hydraulic Pump
- Hydraulic cylinders of different models
- Hydraulic drives
- Valves

The fifteen new Volkswagen 24220 (6X4) trucks shall have their spare components at the time when their guarantee will be over.

- The spare components that shall be acquired are:

  . Cummins engine, 6CT83l Turbo 1 unit
  . Gear Box 1 unit

| | | |
|---|---|---|
| . | Differential | 1 unit |
| . | Outlet power | 1 unit |
| . | Generator | 1 unit |
| . | Starter | 1 unit |
| . | Injection Pump | 1 unit |
| . | Radiator | 1 unit |
| . | Turbo Charger | 1 unit |
| . | Water Pump | 1 unit |
| . | Front Axle | 1 unit |
| . | Windshield wiper | 1 unit |
| . | Brake valve | 2 units |
| . | Front spring leaf | 2 units |
| . | Rear spring leaf | 2 units |
| . | Transmission | 2 units |
| . | Clutch | 2 units |

Concerning the 15 COLECTOMATIC 4000 assembled to the Volkswagen chassis 24220, the spare components also will be necessary as the guarantee runs out.

The components that should be bought are the following:

| | | |
|---|---|---|
| – | Hydraulic Pump | 1 unit |
| – | Cylinders | 1 of each type |
| – | Hydraulic Drive | 1 unit |
| – | Valve | 1 unit |

**bj. Fleet Painting**

Concerning notices on environmental sanitation, there is a lack of visible messages on the MSWM fleet and in the other services belonging to the Environmental Bureau. The vehicles are also void of information on consumer queries departments, hence it is suggested that the Environment Bureau promotes a public contest for choosing a new painting pattern for the fleet, old or new.

**c. Establishment of a New Workshop for AMUAM**

**ca. Present situation**

In February 1994 AMUAM had four vehicles and four earth moving equipments. The maintenance of these vehicles and equipments are made at private shops or by the Asuncion Municipality. These vehicles and equipments are shown below:

| AMUAM Vehicles and Equipments | | |
|---|---|---|
| Type of vehicle/equipment | Manufacturer | Model |
| Dump Truck | Mercedes-Benz | - |
| Dump Truck | Mercedes-Benz | - |
| Flat Bed Truck | Mercedes-Benz | 1313 |
| Flat Bed Truck | Mercedes-Benz | 1313 |
| Motor Grader | Caterpillar | 120-B |
| Motor Grader | Caterpillar | 120-B |
| Bulldozer | Caterpillar | D-4 |
| Wheel Loader | Caterpillar | 930 |

### cb. Need of a workshop

The present operation and maintenance capability of the AMUAM is very limited, because it does not have any maintenance workshop.

The establishment of the repair, maintenance and back-up services will help the effective use of the equipment and vehicles.
In order to achieve efficient operation and maintenance system for the equipment to be supplied, a maintenance shop is planned.

### cc. Equipment for maintenance and repair service

According to the design conditions, the minimum equipment and vehicles required for maintenance and repair service at the proposed AMUAM workshop will be as follows:

| Type of Equipment | Unit | Number | |
|---|---|---|---|
| 1. Collection | | | |
| Compactor $15m^3$ | unit | | 53 |
| Dump tuck $10m^3$ | unit | | 17 |
| 2. Street Sweeping | | | |
| Container $1m^3$ | unit | | 8 |
| 3. Transfer Station | | | |
| Closed trailer $50m^3$ | unit | | 9 |
| Open trailer $70m^3$ | unit | | 2 |
| 4. Final Disposal | | Chaco-i | Unidentified |
| Bulldozer 21ton | units | 6 | 4 |
| Backhoe $0.7m^3$ | units | 1 | 1 |
| Dump Truck 10ton | units | 2 | 1 |
| Water Tanker | units | 1 | 1 |
| Excavator | units | 1 | 1 |
| Pickup | units | 1 | 1 |

### cd. Design of a workshop

#### cda. Site

Although a site for the proposed workshop is not identified, the workshop shall be constructed at the place with the following conditions:

- good access
- gravity center of 14 municipalities other than Asuncion
- if possible, nearby or within the AMUAM headquarters
- required area will be around 1 ha including a space for the vehicle depot

#### cdb. Buildings

The workshop consists of the following structures, as shown in Figure J.1.2.4d and J.1.2.4e.

- main building;
- inspection pit; and

- storage for washing equipment.

The functions of the above are described in Table J.1.2.4b

### cdc. Maintenance equipment

The equipment and tools will be furnished for the maintenance and repair of the vehicles and equipment, thereby ensuring their sufficient operating rate. It is desirable, therefore, that periodical maintenance and repair at an appropriate interval be carried out using these equipment and tools.

Basically, the maintenance and repair of motor vehicles can be largely done by ordinary tools including, open-end wrench, offset box wrench, and other types of wrenches, pliers, screw driver, hammer, etc.. In addition to supply of the ordinary tools equipment and tools is to be furnished to allow the maintenance of landfill equipment, thereby ensuring a wide range of maintenance and repair service.

Particular emphasis is placed on those which can be used to dismantle assemble and measure component parts of the engine and power train. In addition, portable types of equipment and tools were selected to assure the convenience of the works.

Consequently the following equipment is planned for the maintenance of vehicles and landfill equipment.

Table J.1.2.4b Functions and Equipments of Workshop

| Items in the Shed | Function | Main Equipment |
|---|---|---|
| 1. Office | - Administration<br>- Management of drivers, operators and internal workers<br>- Control and filling of maintenance and catalogs<br>- Management of vehicles and equipment<br>- Control of fuel, spare parts, tools, oil and tire<br>- Cost management of operation management and repair<br>- Vehicles and equipments' key control | - Time recorder<br>- Filing Cabinet |
| 2. Parts and Tools Storage | - Control and storage of spare parts, oils, machines and tools | - Heavy duty shelf<br>- Parts shelf<br>- Oil stand<br>- Tool board<br>- Tool shelf |
| 3. Vehicle/Equipment Maintenance | - Regular inspection and maintenance on engine transmission, differential, axles, brakes, springs, torque converter, tracks, etc.. | - Bench<br>- Hand tools<br>- Nozzle tester |
| 4. Electrical Services | - Inspection and charge of battery<br>- Inspection and repair in starter engines, generators, etc.. | - Battery charger<br>- Battery tester |
| 5. Welding and Body Repairing Services | - General services of the chassis and body of the vehicles and equipment | - Welding machine<br>- Oxy-acetylene welding<br>- Spray gun |
| 6. Tire Service | - Inspection and repair of tire and tire tube | - Air compressor<br>- Hot patch clamp<br>- Hydraulic jack<br>- Tire repair set |
| 7. Washing and Lubricating Service in an Inspection Pit | - Inspection of vehicles and equipments<br>- Washing and lubricating<br>- Loading and unloading of equipment | - High pressure grease pump<br>- High pressure water pump<br>- Hot water high pressure car washer |

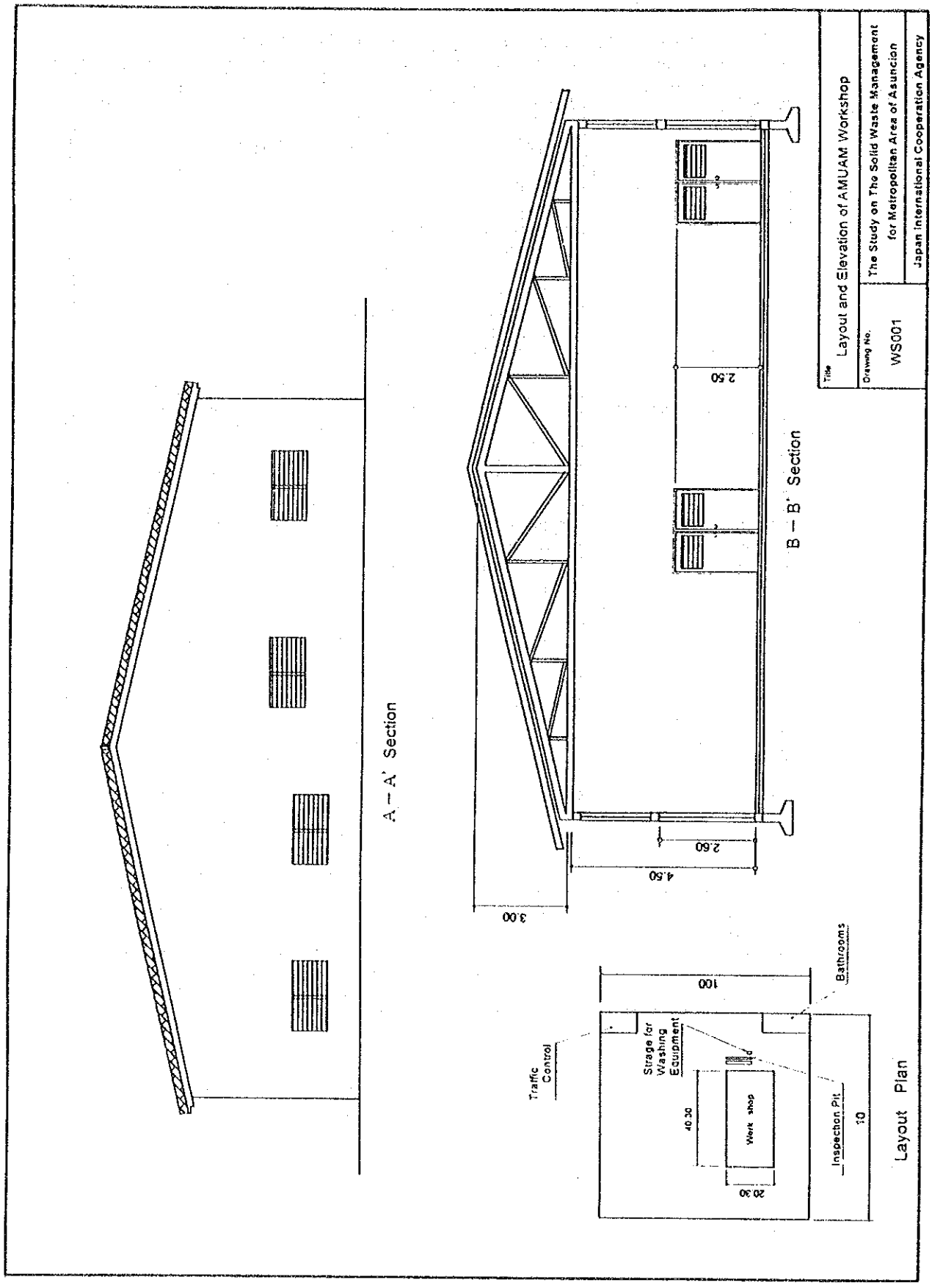



Figure J.1.2.4d Layout and Elevation of AMUAM Workshop

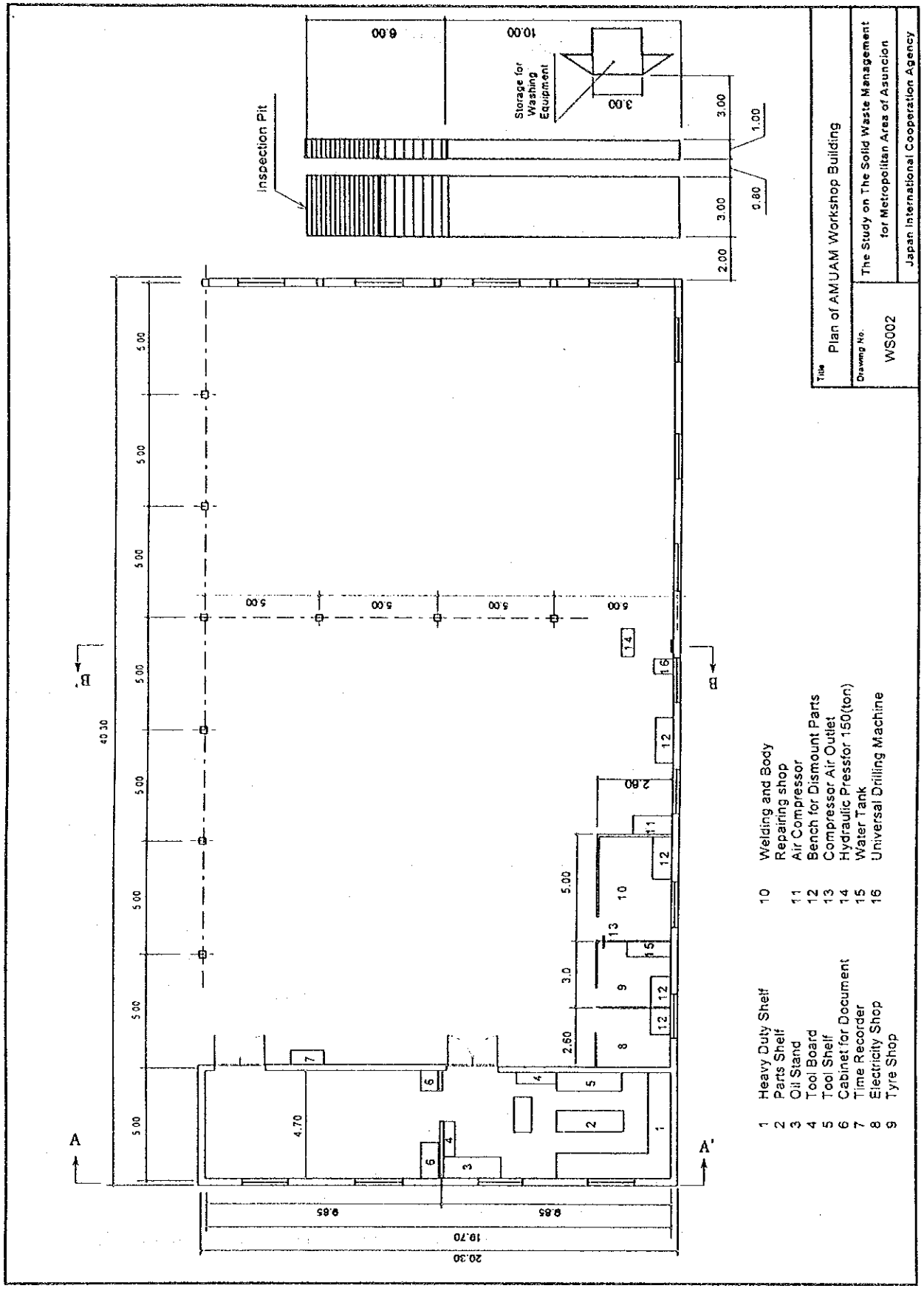



Figure J.1.2.4e Plan of AMUAM Workshop Building

i. For the mechanical servicing of vehicles:

Bench
Bench electric grinder
Machinists vice No.8

ii. For the electricity services:

Bench
Machinists vice No.8
Booster cable
Battery syringe
Battery hydrometer
Battery tester
Circuit tester
Wire stripper
Polyethylene funnel

iii. For the welding services:

Bench
Welding Machine
Bench electric grinder
Machinist vice No.8
Iron anvil

iv. For the body repairing and painting services:

Compressed air outlet
Ox-acetylene welding
Shearing machine
Polisher
Spray gun

v. For the tire repair services:

Compressed air outlet
Cross rim wrench
Air impact wrench with impact socket and impact wrench holder
High power wrench
Wheel nut wrench
Tire service tool set

Hot patch clamp
Wire bush bench
Hydraulic jack for 30 ton
Hydraulic jack for 15 ton
Hydraulic garage jack
Bench
Chuck gauge

vi. For the lubricating and greasing services, (besides the construction of the inspection pit):

High pressure grease pump
High pressure water pump
Hot water high pressure car washer
Compressed air outlet

vii. General tools

Small parts and tools stored in the shed with tools of general use to be lent to the mechanics. These tools are as follows:

Electric drill
Adjustable wrench
Adjustable pipe wrench
Grip plier
Plier
Ballpeen hammer
Screw drivers
Allen wrenches (Hex wrench)
Socket wrench set 3/4
Socket wrench set 1/2
Gear puller
Screw clamp
Open end wrench
Box wrench
Rigid wrench
Combination wrench
Compression gauge
Hydraulic gauge
Hydraulic hanger
Nozzle tester
Air impact wrench with impact socket and impact wrench holder

Drain plug wrench
Oil filter wrench
Oil measure
Adjustable hacksaw frame
Hacksaw blade
Drill set
Solder
Surface plate
Tool set portable type
Tool set heavy duty type
Grease gun
Torque wrench
Electric soldering iron
Chisel and punch set
V block
Vernier caliper
Outside micrometer set
Steel rule
Iron bench level
Garage lamp

Equipment and tools to be acquired by the proposed workshop are tabulated in Table J.1.2.4c.

Table J.1.2.4c Equipment and Tools to be acquired by AMUAM

| | Vehicle Maintenance | Electrical Services | Welding and Body Repairing Services | Tire Service | Washing & Lubricating Service | Tools Storage |
|---|---|---|---|---|---|---|
| Bench | 1 | 1 | 1 | 1 | | |
| Bench Electric Grinder | 1 | | 1 | | | |
| Machinist Vise No 8 | 1 | 1 | 1 | | | |
| Battery Quick Charger | | 1 | | | | |
| Booster Cable | | 1 | | | | |
| Battery Hydrometer | | 1 | | | | |
| Battery Tester | | 1 | | | | |
| Battery Syringe | | 1 | | | | |
| Circuit Tester | | 1 | | | | |
| Wire Stripper | | 1 | | | | |
| Polyethylene Funnel | | 1 | | | | |
| Welding Machine | | | 1 | | | |
| Iron Anvil | | | 1 | | | |
| Oxy-Acetylene Welding | | | 1 | | | |
| Shearing Machine | | | 1 | | | |
| Polisher | | | 1 | | | |
| Spray Gun | | | 1 | | | |
| Air Compressor | | | | 1 | | |
| Cross Rim Wrench | | | | 1 | | |
| Air Impact Wrench | | | | 1 | | |
| High Power Wrench | | | | 1 | | |
| Wheel Nut Wrench | | | | 1 | | |
| Tire Service Tool Set | | | | 1 | | |
| Hot Patch Clamp | | | | 1 | | |
| Wire Bush Bench | | | | 1 | | |
| Hydraulic Jack -30 t | | | | 1 | | |
| Hydraulic Jack -15 t | | | | 1 | | |
| Hydraulic Garage Jack | | | | 1 | | |
| Chuck Gauge | | | | 1 | | |
| High Pressure Grease Pump | | | | | 1 | |
| High Pressure Water Pump | | | | | 1 | |
| Hot Water High Pressure Car Washer | | | | | 1 | |
| Electric Drill | | | | | | 1 |
| Adjustable Pipe Wrench | | | | | | 1 |
| Adjustable Wrench | | | | | | 1 |
| Grip Plier | | | | | | 1 |
| Plier | | | | | | 1 |
| Ball Peen Hammer | | | | | | 1 |
| Screw Driver | | | | | | 1 |
| Allen Wrench Set (Hex Wrench) | | | | | | 1 |
| Socket Wrench Set 3/4 | | | | | | 1 |
| Socket Wrench Set 1/2 | | | | | | 1 |
| Gear Puller | | | | | | several |
| Screw Clamp | | | | | | several |
| Open End Wrench | | | | | | several |
| Box Wrench | | | | | | several |
| Rigid Rack | | | | | | 4 |
| Combination Wrench | | | | | | several |
| Compression Gauge | | | | | | 1 |
| Hydraulic Gauge | | | | | | 1 |
| Hydraulic hanger | | | | | | 1 |
| Nozzle Tester | | | | | | 1 |
| Drain Plug Wrench | | | | | | 1 |
| Oil Filter Wrench | | | | | | 1 |
| Oil Measure | | | | | | 1 |
| Adjustable Hack Saw Frame | | | | | | 2 |
| Hack Saw Blade | | | | | | several |
| Drill Set | | | | | | 1 |
| Solder | | | | | | several |
| Surface Plate | | | | | | 1 |
| Tool Set Portable Type | | | | | | 1 |
| Tool Set Heavy Duty Type | | | | | | 1 |
| Grease Gun | | | | | | 1 |
| Torque Wrench | | | | | | 1 |
| Electric Soldering Iron | | | | | | 1 |
| Chisel and Punch Set | | | | | | 1 |
| V Block | | | | | | 4 |
| Vernier Caliper | | | | | | 1 |
| Outside Micrometer Set | | | | | | 1 |
| Steel Rule | | | | | | 1 |
| Iron Bench Level | | | | | | 1 |
| Garage Lamp | | | | | | 1 |

### ce. Staff planning

The personnel for the operation of the proposed maintenance shop are:

| | | |
|---|---|---|
| - | Manager | 1 person |
| - | Assistant manager | 1 person |
| - | Clerk | 5 persons |
| - | Mechanic | 7 persons |
| - | Driver | 3 persons |
| - | Workers | 15 persons |
| | **Total:** | **32 persons** |

### cf. Operation and maintenance of equipment

A control system (operation and maintenance) of equipment is prepared and described in the previous section (for Asuncion). The operation and maintenance system of equipment is basically the same as for Asuncion. The following documents are necessary for the controlling services in the workshop and the model sheets are prepared below.

- Daily transport bulletin
- Worksheet
- Repair order
- Supplied materials
- Labor use
- Daily control of vehicle consumption
- Lubrication control

| DAILY TRANSPORT FORM | No. |
|---|---|
| | Date |

| | | | |
|---|---|---|---|
| Chassis | | ID No.: | |
| Equipment | | ID No.: | |
| Driver | | Name | |
| | | ID No.: | |
| Provision | | Litter | Odometer/Hourmeter |
| Chassis | Fuel | | |
| | Oil | | |
| Equipment | Fuel | | |
| | Oil | | |
| | Hydraulic Fluid | | |

I received the vehicle at .....hs....min.
Odometer.....Km.
Driver

I returned the vehicle at .....hs....min.
Odometer.....Km.
Controller

| Driver's Inspection | Good | Bad | Regular |
|---|---|---|---|
| Tires | | | |
| Lights | | | |
| Steering | | | |
| Brakes | | | |

Breakdowns and Events

To be filled by the User

The vehicle arrived at .....hs.....min.
Odometer.....Km.
Place & Service

The vehicle went back at .....hs.....min.
Odometer.....Km.
Place & Service

| Workers | | |
|---|---|---|
| Supervisor | Signature | Time |
| | | |

Rest Time

| Place | Hr | Min | Hr | Min | Odometer |
|---|---|---|---|---|---|
| | | | | | |

## Work Sheet

| Places | Beginning | | | | | | | End | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | hr | | min | | Odom | | | hr | | min | | Odom | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |

* Write the three last numbers of the Odometer

Transported Load

| Type | Weight (Kg) |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

| Repair Order | | | | Repair Order No. | | Service Order No. | |
|---|---|---|---|---|---|---|---|
| Vehicle / Equipment | | | | | | | |
| ID Number | | License No | | Odometer/Hourmeter | | Date | |
| | | | | | | | |
| Chassis No | Model | Manufacturer Year | Vehicle Manufacturer | Equipment Manufacturer | | Type | Manufacturer Year |
| | | | | | | | |

Necessary Repairs

| a. Mechanical | | b. Electrical | c. Others |
|---|---|---|---|
| ( ) Water Pump | ( ) Engine | ( ) Ampermeter | ( ) Upholstery |
| ( ) Fuel Pump | ( ) Auxiliary Engine | ( ) Battery | ( ) Body Repairing |
| ( ) Gear Box | ( ) Radiator | ( ) Generator | ( ) Sheet Metal Works |
| ( ) Carburetor | ( ) Seals | ( ) Fuel Control | ( ) Painting |
| ( ) Torque converter | ( ) Preventive Maintenance | ( ) Oil Control | ( ) Lathing |
| ( ) Final drive | ( ) Bearings | ( ) Temperature Control | ( ) Glasses |
| ( ) Steering box | ( ) Brake System | ( ) Wiper | ( ) ———— |
| ( ) Differential | ( ) Injection Line | ( ) Starting System | ( ) ———— |
| ( ) Steering System | ( ) Compressed Air System | ( ) Light System | d. Hydraulic |
| ( ) Clutch | ( ) Turbo Charger | ( ) Spark Plug | ( ) Pump |
| ( ) Transmission | ( ) ———— | ( ) Odometer | ( ) Cylinders |
| ( ) Back Axle | ( ) ———— | ( ) ———— | ( ) Drivers |
| ( ) Leakages | ( ) ———— | ( ) ———— | ( ) Seals |
| ( ) Final Drive | ( ) ———— | ( ) ———— | ( ) Tubes |
| ( ) Blade | ( ) ———— | ( ) ———— | ( ) Valves |
| ( ) Blade bracket | ( ) ———— | ( ) ———— | ( ) Motor |
| ( ) Tracks | ( ) ———— | ( ) ———— | ( ) Leakages |
| ( ) Springs | ( ) ———— | ( ) ———— | ( ) ———— |

**Services made in Workshop Department**

**Services made in External Workshops**

| Item | Name | Out | | Return | | Cost |
|---|---|---|---|---|---|---|
| | | Date | Date | Date | Date | |
| | | | | | | |
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| | | | | | | |

| Receive the vehicle/ equipment for repair | | Services Finished At. . . . . .hs. | | Receive the vehicle/ equipment with the services made Odometer/ Timer | |
|---|---|---|---|---|---|
| Date | Signature | Date | Signature | Date | Signature |

## Supplied Materials

| Date | Quantity | Specifications | Cost |
|---|---|---|---|
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## Labor Use

| Sec-tion | ID.No. | Date | Beginning Time | Ending Time | Final Time | Sec-tion | ID.No | Beginning Time | Ending time | Final time | Date |
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| Total Working Hours : | | | | | | | | | | | |

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|---|---|
| Total Material : | |
| Total Used Manpower : | |
| Sub - Total : | |
| External Services : | |
| General Total : | |

| |
|---|
| Driver's Name : |
| ID. Number : |

| Daily Control of Vehicle Consumption | | | | | | | | | | | | ID. N° : |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Day | Fuel Diesel Gas Alcohol | | Odometer | | Total Kilo–meter | | | | | | | |
| | Daily | Accu. | Start | Re–turn | | SAE 30 | SAE 40 | SAE 90 | SAE 140 | Hydry Oil | Grease | Brake oil |
| 01 | | | | | | | | | | | | |
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| 04 | | | | | | | | | | | | |
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| 31 | | | | | | | | | | | | |
| Tot | | | | | | | | | | | | |
| Fuel Cost | | Average | | | | Lubricant Oil Cost | | | | | | |

| Lubrication Control | | | | | | | | | | | | | | | | | | | | | | | | | | | | | Vehicle Code: | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Lubricant Oil | | Injection Pump | | Steering Box | | Hydraulic Steering | | Gear Box | | Differen-tial | | Hydraulic System | | Radiator | | Brake System | | Greasing | | Lubricant Filter | | Fuel Filter | | Hydraulic Filter | | Dry Filter | | Km | Next Re-vi-sion |
| | S.A.E | Lt | S.A.E | Lt | S.A.E | Lt | Type | Lt | S.A.E | Lt | S.A.E | Lt | Type | Lt | Type | Lt | Type | Lt | Type | Kg | No | Qty | No | Qty | No | Qty | No | Qty | | |
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### J.1.2.5 Inter-municipal Unidentified Final Disposal Site

#### a. Introduction

It is generally recognized that a sanitary landfill is the basic element of modern solid waste management. Thus, it is acknowledged that the majority of waste has to be disposed of even if efforts are provided to reuse the waste. As a priority step towards modern solid waste management, it is recommended to strengthen the landfill activity which minimizes environmental impact.

Since it is not feasible to operate a final disposal site appropriately unless the waste amount received is large, the inter-municipal final disposal sites, which will be localized within 15 km from discharger municipalities, are planned to be established for municipalities which are too far to transport their waste economically to the proposed Chaco-i site.

As the location of inter-municipal disposal sites has not been decided at this moment, a prelimimary design for an inter-municipal landfill was carried out based on the assumptions described below.

#### b. Design Conditions

#### ba. Target Operation Level of Landfilling

Target Level : Level 2 in 2000
Level 3 in 2006

#### bb. Commencement of Sanitary Landfill Operation

The operation of the new final disposal site is planned to commence at the beginning of 1997.

#### bc. Estimated Amount of Waste Disposed in the Unidentified Disposal Site

The inter-municipal unidentified disposal site is assumed to receive waste discharged from the following nine municipalities.

- Lambare
- San Lorenzo
- Capiata

- Luque
- Villa Elisa
- Nemby
- Saldivar
- Ita
- Aregua

Table J.1.2.5a Estimated Daily Amount of Waste Disposed in Unidentified Disposal Site unit: ton/day

| Year | Municipalities as dischargers | | | | | | | | | Daily Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lam-bare | San Lorenzo | Capiata | Luque | Villa Elisa | Nemby | Sald-ivar | Ita | Aregua | |
| 1994 | 63 | 15 | 10 | 11 | 15 | 3 | 0 | 2 | 0 | 119 |
| 1995 | 68 | 28 | 18 | 22 | 18 | 7 | 0 | 4 | 1 | 164 |
| 1996 | 72 | 41 | 27 | 33 | 20 | 10 | 0 | 5 | 1 | 210 |
| 1997 | 77 | 55 | 35 | 44 | 23 | 14 | 1 | 7 | 2 | 255 |
| 1998 | 82 | 68 | 43 | 54 | 26 | 17 | 1 | 8 | 2 | 300 |
| 1999 | 86 | 81 | 52 | 65 | 28 | 21 | 1 | 10 | 3 | 346 |
| 2000 | 91 | 94 | 60 | 76 | 31 | 24 | 1 | 11 | 3 | 391 |
| 2001 | 103 | 113 | 74 | 96 | 38 | 29 | 1 | 13 | 4 | 472 |
| 2002 | 115 | 133 | 89 | 116 | 45 | 34 | 2 | 15 | 4 | 552 |
| 2003 | 128 | 152 | 103 | 136 | 53 | 39 | 2 | 17 | 5 | 633 |
| 2004 | 140 | 171 | 117 | 155 | 60 | 44 | 2 | 19 | 5 | 714 |
| 2005 | 152 | 191 | 132 | 175 | 67 | 49 | 3 | 21 | 6 | 794 |
| 2006 | 164 | 210 | 146 | 195 | 74 | 54 | 3 | 23 | 6 | 875 |

### bd. Required Capacity of Landfill Sections

The disposal site should be constructed section by section and it is said that the duration of one section is from 3 to 5 years.

Therefore, the landfill section which is planned to be used until 2006 in the Master Plan is proposed to be divided into 3 sections, the 1st section is for 1997 till 2000 2nd section for 2001 till 2003 and 3rd for 2004 till 2006.

The estimated annual amount of waste disposed in the un-identified site are presented in Table J.1.2.5b.

Table J.1.2.5b Estimated Annual Amount of Waste Disposed in the Unidentified Disposal Site

| | Year | Waste Disposed | |
|---|---|---|---|
| | | Daily Total | Annual Total |
| Before opening the new disposal site | 1994 | 119 | 43,435 |
| | 1995 | 164 | 59,982 |
| | 1996 | 210 | 76,528 |
| | sub-total | 493 | 179,945 |
| L1 | 1997 | 255 | 93,075 |
| | 1998 | 300 | 109,622 |
| | 1999 | 346 | 126,168 |
| | 2000 | 391 | 142,715 |
| | sub-total | 1,292 | 471,580 |
| L2 | 2001 | 472 | 172,158 |
| | 2002 | 552 | 201,602 |
| | 2003 | 633 | 231,045 |
| | sub-total | 1,657 | 604,805 |
| L3 | 2004 | 714 | 260,488 |
| | 2005 | 794 | 289,932 |
| | 2006 | 875 | 319,375 |
| | sub-total | 2,383 | 869,795 |
| Total | | 5,825 | 2,126,125 |

The required capacity of the landfill section is determined by the following equation.

$$V = V1 + V2$$

V1 = waste volume to be dumped
V2 = required volume of soil for covering the waste dumped

In order to calculate the required capacity of landfill sections, the following assumptions were set up.

- The required amount of soil for covering waste dumped is 25 % of the waste dumped in volume.
- The unit weight of the waste compacted in a landfill is 0.8 ton/$m^3$.

The required capacity of landfill sections are presented in Table J1.2.5c.

Table J.1.2.5c Required Capacity of Landfill Section

| Section | Period | Waste Disposed | | V2 Soil ($m^3$) | V Required Capacity |
|---|---|---|---|---|---|
| | | Weight (ton) | V1 Volume ($m^3$) | | |
| L1 | 1997 - 2000 | 471,580 | 589,475 | 147,369 | 736,844<br>Say 800,000 |
| L2 | 2001 - 2003 | 604,805 | 756,006 | 189,002 | 945,008<br>Say 1,000,000 |
| L3 | 2004 - 2006 | 869,795 | 1,087,243 | 271,811 | 1,359,054<br>Say 1,400,000 |

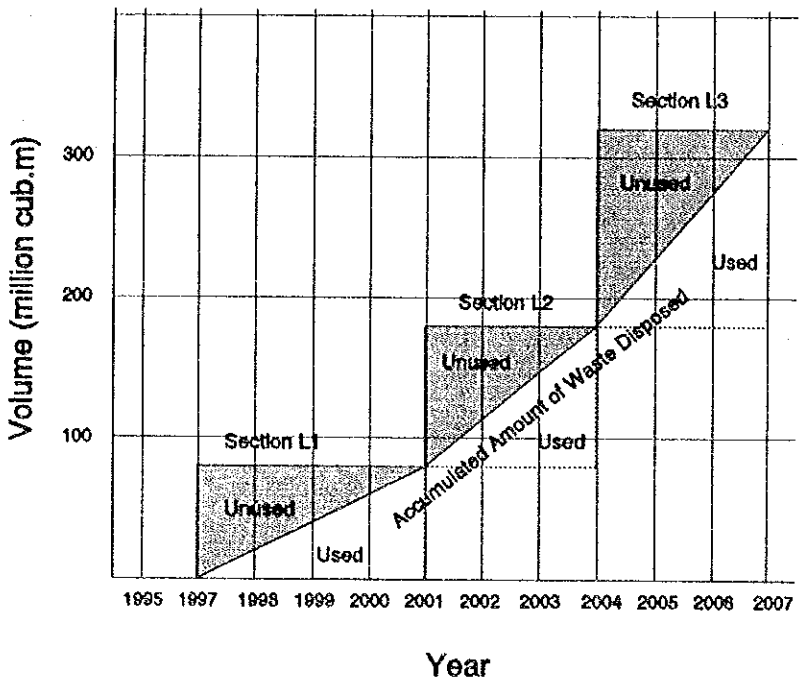


Figure J.1.2.5a Stage Construction Plan of the Final Disposal Site

### c. Design of Facilities

The design of the facilities to be used are the same as that described in section J.1.4.

### d. Technical Description

The technical descriptions of facilities to be adopted depend on the sanitary operation level of the proposed disposal site. The required facilities for the 2nd and 3rd level of sanitary operation are summarized in Table J.1.2.5d.

Table J.1.2.5d System Combination of Sanitary Landfill and Operation

| Items | Level of Operation | |
|---|---|---|
| | 2nd | 3rd |
| **1. Site Development Works** | | |
| 1.1 Main Facilities | | |
| a. Enclosing Structure | | |
| i. Enclosing Dike | Necessary | Necessary |
| ii. Divider | Necessary | Necessary |
| b. Drainage System | | |
| i. Open Channel | Necessary | Necessary |
| ii. On-site Open Drain | Necessary | Necessary |
| iii. Culvert Drain | Necessary | Necessary |
| iv. Intercepter Drain for Reclaimed Area | Necessary | Necessary |
| c. Access | | |
| i. Asphalt Paved Road | Necessary | Necessary |
| ii. Gravel Road | Necessary | Necessary |
| iii. Descending Road | Necessary | Necessary |
| 1.2 Environmental Protection Facilities | | |
| i. Buffer Zone | Necessary | Necessary |
| ii. Litter Control Facilities | Necessary | Necessary |
| iii. Gas Removal Facilities | Necessary | Necessary |
| iv. Leachate Collection Facilities | | Necessary |
| v. Leachate Circulation Facilities | | Necessary |
| vi. Seepage Control Facilities | | Necessary |
| vii. Final Soil Cover | Necessary | Necessary |
| viii. Slope Turfing | Necessary | Necessary |
| 1.3 Buildings and Accessories | | |
| i. Site Office | Necessary | Necessary |
| ii. Store | | Necessary |
| iii. Truck Scale | Necessary | Necessary |
| iv. Safety Facilities | | Necessary |
| v. Utilities | Necessary | Necessary |
| vi. Monitoring System | Necessary | Necessary |

### cb. Area Necessary for the Inter-municipal Unidentified Disposal Site

The required area of the site is calculated as follows based on the following assumptions.

- the proposed landfill height: 5.0 m
- the efficiency of land use: 70 %
- the borrow area for coverage soil was excluded.

A = Required amount of waste disposed ÷ 0.7 ÷ 5.0
= 3,200,000 ÷ 0.7 ÷ 5.0
= 914,286 $m^2$ ..... say 100 ha

## e. Cost Estimation

### ea. Basic Conditions on Cost Estimation

The following assumptions were set up as the basic conditions for cost estimation.

- Land acquisition cost was excluded.
- An access road from the existing road to the landfill site was not taken into account. Only 100 m of access road at the entrance of the landfill was included in the cost estimation.
- A liner, as a seepage control facility, was included in the 3rd level disposal site because the geological data of the site was unknown.

### eb. Method of Cost Estimation

For the several different cases of landfill capacity, the investment cost and the operation and maintenance cost are estimated in accordance with the requirements described in the technical description. The Cost-Capacity Curve is drawn by using the data obtained from these estimations. Referring to the Cost-Capacity Curve, the cost for each municipality is estimated.

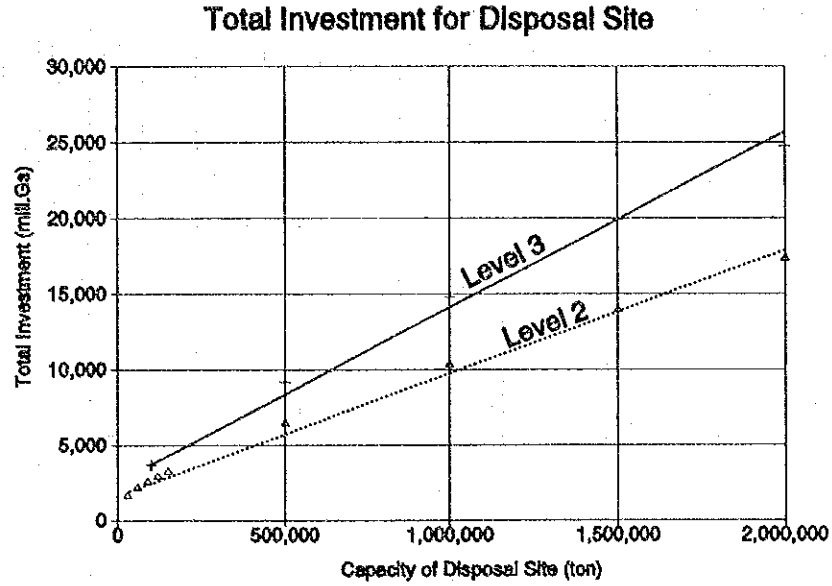


Figure J.1.2.5b Total Investment Chart for Final Disposal Site

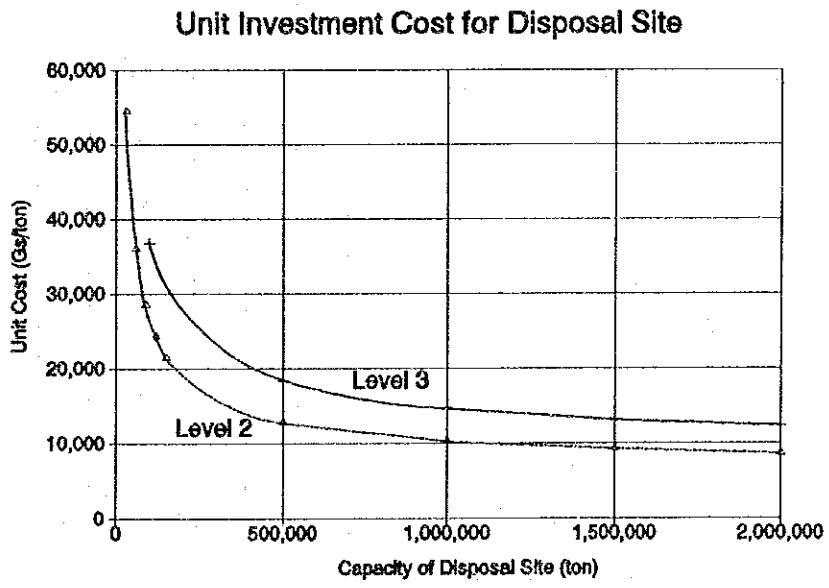


Figure J.1.2.5c Investment Chart per Ton for Landfill

According to Figures 1.2.5b and 1.2.5c, the construction cost of disposal site were estimated as shown in Table J.1.2.5e.

Table J.1.2.5e Construction Cost Schedule of Inter-municipal Unidentified Disposal Site unit: mill.Gs

| Year | Disposal Amount (ton) | Section L1 590,000 ton (800,000 m³) | | | | | Section L2 609,000 ton (1,000,000m³) | | | Section L3 870,000 ton (1,400,000 m³) | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Design | Initial Civil Work | Civil Work during operation | Building Work | Machinery | Design | Initial Civil Work | Civil Work during operation | Design | Initial Civil Work | Civil Work during operation | |
| 1995 | 59,982 | 250 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 250 |
| 1996 | 76,528 | 0 | 2,315 | 0 | 480 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 2,885 |
| 1997 | 93,075 | 0 | 0 | 784 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 784 |
| 1998 | 109,622 | 0 | 0 | 784 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 784 |
| 1999 | 126,168 | 0 | 0 | 784 | 0 | 0 | 260 | 0 | 0 | 0 | 0 | 0 | 1,044 |
| 2000 | 142,715 | 0 | 0 | 784 | 0 | 0 | 0 | 2,380 | 0 | 0 | 0 | 0 | 3,164 |
| 2001 | 172,158 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,320 | 0 | 0 | 0 | 1,320 |
| 2002 | 201,602 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,320 | 500 | 0 | 0 | 1,820 |
| 2003 | 231,045 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,320 | 0 | 4,500 | 0 | 5,820 |
| 2004 | 260,488 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,500 | 2,500 |
| 2005 | 289,932 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,500 | 2,500 |
| 2006 | 319,375 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,500 | 2,500 |
| Sub-total | | 250 | 2,315 | 3,136 | 480 | 180 | 260 | 2,380 | 3,940 | 500 | 4,500 | 7,500 | 25,261 |
| Total | | 6,181 | | | | | 6,580 | | | 12,500 | | | 25,261 |

### ecb. Operation and Maintenance Cost

In compliance with the design level of landfill, the estimated required quantities of equipment, labor and materials are presented in Table J.1.2.5f.

Table J.1.2.5f Estimated Quantities of O&M for Disposal Site

| Items | Description | unit | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Machinery | Bulldozer 21 ton | unit | 4 | 4 | 4 | 4 | 5 | 5 | 6 | 6 | 6 | 7 |
| | Backhoe 0.7 m3 | unit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Dump truck 10 t | unit | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| | Water tanker | unit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Traxcavator | unit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Pickup | unit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Labor | Foreman | men | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| | Truck scale operator | men | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| | Machine operator | men | 9 | 9 | 9 | 9 | 10 | 10 | 11 | 11 | 11 | 12 |
| | Mechanic | men | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | General worker | men | 3 | 3 | 4 | 4 | 5 | 5 | 5 | 6 | 6 | 6 |
| | Clerk | men | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 |
| | Watchman | men | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Material | Insecticide | LS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Diesel | kl | 522 | 522 | 522 | 522 | 522 | 590 | 590 | 590 | 590 | 658 |
| | Lubricant oil | LS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Miscellaneous | LS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Utility | Water | LS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Electricity | LS | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## J.1.3 Transfer Station at Madame Lynch Avenue

### J.1.3.1 Selection of the Site for the Transfer Station

#### a. Proposed site

Based on the recommendations made by the Study Team, the Supervisory Committee meeting for the discussion of the IT/R made a decision on the First Priority Projects which included the construction of transfer station(s).

In response to the decisions made by the Supervisory Committee, the Paraguayan side identified the following two candidate sites for the transfer station as shown in Figure J.1.3.1a:

- Vinas Cue Site
- Madame Lynch Avenue Site

#### b. Field survey

In response to the decision, the Study Team conducted the following field surveys. The results of the survey is presented in Annex D.

i. Topographic survey
ii. Geological survey
ii. Environmental survey
  - water quality survey
  - ambient survey
  - noise survey
  - traffic volume survey
  - land use survey

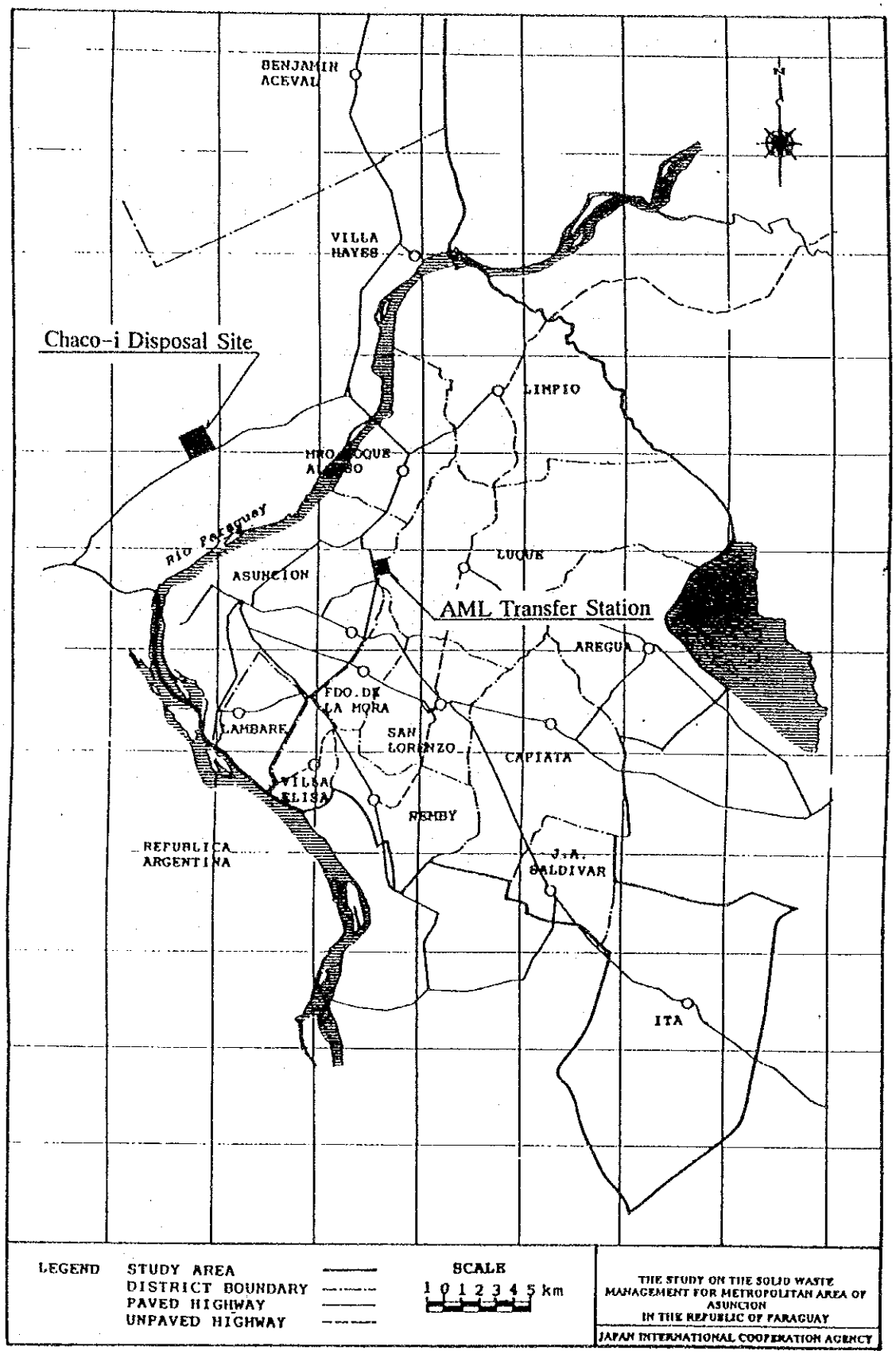


Figure J.1.3.1a Location Map of Candidate Site(s) for MSWM Facilities

### c. Comparison of the two proposed sites

#### ca. Conceptual design

Since the purpose of the introduction of a transfer station is for the reduction of transportation cost, a comparison study was made to select the most economic location among the two proposed site.

A conceptual design for the two proposed stations was made. The major differences of the two stations regarding cost are summarized below.

Table J.1.3.1a Major Difference between VC T/S and AML T/S

| Items \ Sites | Vinas Cue (VC) T/S | Madame Lynch Avenue (AML) T/S |
|---|---|---|
| 1. Topography | Gentle slope | Flat |
| 2. Access Road | Improvement of alignment is required | No special requirements |
| 3. Distance | | |
| 3-1. From collection area to T/S | | |
| – For Asuncion | 8.9 km | 7.4 km |
| – For F. Mora | 14.5 km | 6.5 km |
| 3-2. From T/S to Chaco-i Landfill | 26.8 km | 24.5 km |

#### cb. Cost comparison

Based on the conceptual design, a cost comparison was made and tabulated in Table J.1.3.1b and J.1.3.1c.

Table J.1.3.1b Cost of Vinas Cue Transfer Station

Unit: million Gs/year

| | Number of Required Units | Investment (million Gs) | Operation and Maintenance Cost | | | |
|---|---|---|---|---|---|---|
| | | | Depreciation | Maintenance | Fuel & Lub. | Personnel Expense |
| 1. Collection | | | | | | |
| Compactor(15.3m³) | 72 | 11,578 | 1,654 | 1,737 | 594 | 2,310 |
| Container(1.0m³) | 1,117 | 1,302 | 260 | 0 | 0 | 0 |
| Sub-total (1) | - | 12,880 | 1,914 | 1,737 | 594 | 2,310 |
| 2. T/S | | | | | | |
| Transfer Vehicles | 11 | 3,689 | 527 | 664 | 138 | 150 |
| Facilities | 1 | 2,552 | 98 | 84 | 0 | 125 |
| Sub-total (2) | - | 6,241 | 625 | 748 | 138 | 275 |
| Total (1)+(2) | | | 2,539 | 2,485 | 732 | 2,585 |
| Total | - | 19,121 | 8,341 | | | |

Table J.1.3.1c Cost of Madame Lynch Avenue Transfer Station

Unit: million Gs/year

| | Number of Required Units | Investment (million Gs) | Operation and Maintenance Cost | | | |
|---|---|---|---|---|---|---|
| | | | Depreciation | Maintenance | Fuel & Lub. | Personnel Expense |
| 1. Collection | | | | | | |
| Compactor(15.3m³) | 68 | 10,952 | 1,565 | 1,643 | 474 | 2,110 |
| Container(1.0m³) | 1,117 | 1,302 | 260 | 0 | 0 | 0 |
| Sub-total (1) | - | 12,254 | 1,825 | 1,643 | 474 | 2,110 |
| 2. T/S | | | | | | |
| Transfer Vehicles | 11 | 3,689 | 527 | 664 | 127 | 150 |
| Facilities | 1 | 1,732 | 60 | 52 | 0 | 125 |
| Sub-total (2) | - | 5,421 | 587 | 716 | 127 | 275 |
| Total (1)+(2) | | | 2,412 | 2,359 | 601 | 2,385 |
| Total | - | 17,675 | 7,757 | | | |

As clearly shown in the Tables, the investment cost of Vinas Cue (VC) T/S is 8.2% more expensive than that of the Madame Lynch Avenue (AML) T/S. As for the operation and maintenance cost, the VC T/S is also 8.0% higher than the AML T/S.

### cc. Comparison of environmental aspects

The Vinas Cue proposed site is located at the edge of the compound of the Botanical Garden of Asuncion Municipality. The Garden is a very valuable forest remaining in the Municipality. In the Botanical Garden, there is a nature museum, zoo and an athletic field. A lot of people (average 19,000 persons/month) visit and enjoy the garden.

On the other hand, the Madame Lynch Avenue proposed site is located in the military compound where no special land use is observed. At present, there appears to be a buffer zone or reserved area for future use.

"The Waterfront Development Plan in Asuncion" is being prepared under the auspice of the Inter-American Development Bank. According to the Plan being prepared, the Botanical Garden in the proposed Vinas Cue site will be expanded to the river side. In addition, the present access road to the site will also be transferred to the river side, so that the present approach route will not be able to be used in the future. Furthermore, there is no consensus obtained among not only the administration of the Asuncion Municipality but also the citizens.

As for the AML proposed site, there is no specific plan for future use. The only problem which may arise will be the attaining of permission from the Ministry of National Defense.

Consequently, we concluded that the Vinas Cue proposed transfer station site is not suitable from a social environmental view point.

### cd. Selection of the site

Based on the comparisons made on the investment cost, operation and maintenance cost and environmental aspects, the Team concluded that the Madame Lynch Avenue site is more suitable than the Vinas Cue site. Consequently, a preliminary design for the AML T/S was conducted.

### J.1.3.2 Preliminary Design of AML T/S

#### a. Design of capacity requirement

##### aa. Method of transfer operation

Since the street sweeping waste is generally heavier than the other MSW, as widely operated in the neighborhood countries (Brazil), the method of transfer operation is divided into the following systems in accordance with the type of waste to be transferred.

- Direct re-loading to open trailer for street sweeping waste
- Indirect re-loading to closed trailer for MSW other than street sweeping waste

##### ab. Calculation of transfer waste amount

In order to start planning, the transfer waste amount of the transfer station shall be calculated. The total transfer waste amount in the year 2000 of the cities of Asuncion and F.Mora is calculated at 694 ton/day. The breakdown of the transfer waste amount was conducted and tabulated in the Table below.

Table J.1.3.2a Transfer Waste Amount Unit: ton/day

| Items / Municipality | To Open Trailer | To Closed Trailer | Total |
|---|---|---|---|
| Asuncion | 76 | 529 | 605 |
| F.Mora | 1 | 88 | 89 |
| Total | 77 | 617 | 694 |

##### ac. Determination of capacity requirements

The capacity requirement of each transfer station is calculated in the following manner:

- Average daily transfer waste amount of the transfer station in the year 2000 is assumed as 694 ton/day.
- The annual working days and working hours are set up as 297 days/year and

8 hours/day.

- If the allowance for daily and monthly fluctuation of waste is set up at 1.15, the required capacity of the transfer station according to the above-mentioned method is calculated and tabulated in the Table below.

Table J.1.3.2b Capacity Requirement for AML T/S

Unit: ton/hour

| Items / Municipality | To Open Trailer | To Closed Trailer |
|---|---|---|
| Asuncion | 13.4 | 93.5 |
| F.Mora | 0.2 | 15.5 |
| Total | 13.4 | 109.0 |
| Design Capacity | 15 | 110 |

**b. Calculation of required number of transfer vehicles**

**ba. Assumptions**

For the calculation of the required number of transfer vehicles, the following assumptions were set up:

- Daily transfer amount (Qtd): as shown in Table J.1.3.2b
- Working hour: 8 hours/day
- Transportation speed: 40 km/hour
- Haulage distance: 24.5 km
- Rate of operation of vehicles: 100% for Closed Trailer
  90% for Open Trailer
- Loading amount of a transfer vehicle:
  Closed trailer = $50m^3$ x 1.0 x 0.6 ton/$m^3$ = 30.0 ton/vehicle
  Open trailer = $70m^3$ x 0.9 x 0.4 ton/$m^3$ = 25.2 ton/vehicle

**bb. Calculation of required vehicles**

The required number of vehicles is calculated by the formula shown below.

**Qrv = 1.1 x Qtd/Qutd**
**Qutd = Qutt x (8/Tt/60)**
**Tt = Tul + 2 x (L2/S1) x 60 + Td + To**