## 3. Existing Site Description

### 3.1 New Parcel B

#### 3.1.1 Outline of New Parcel B

(1) Location

The new candidate disposal site is located on the left bank of Wawa River in the upstream section of Marikina River, 16km northeast of Quezon Circle. The site is located 14°42• 30• of north latitude and 121°11• 30• of east longitude. It is less than 1 km north of Parcel B and 4 to 5 km northwest of the existing San Mateo Landfill site (Parcel A).

(2) Land area

The candidate site measures 130.2ha and has the following coordinates.

| Boundary No. | Longitude (X) | North Latitude (Y) |
|---|---|---|
| 1 | 121°11'52" | 14°42'41" |
| 2 | 121°11'53" | 14°42'30" |
| 3 | 121°11'43" | 14°42'14" |
| 4 | 121°11'44" | 14°42'54" |
| 5 | 121°11'34" | 14°42'49" |
| 6 | 121°11'25" | 14°42'56" |
| 7 | 121°11'17" | 14°42'08" |
| 8 | 121°11'11" | 14°42'20" |
| 9 | 121°11'16" | 14°42'25" |
| 10 | 121°11'18" | 14°42'34" |
| 11 | 121°11'25" | 14°42'35" |
| 12 | 121°11'29" | 14°42'39" |
| 13 | 121°11'32" | 14°42'43" |
| 14 | 121°11'46" | 14°42'44" |

(3) Site Topography

The candidate site is in a valley (130ha) on the left bank (2.1km) of the upstream section of the Wawa Dam. The site has an elevation of approximately 180m and consists of 3 small valleys.

(4) Accessibility

The candidate site is located somewhere in between the existing San Mateo disposal site and Wawa village. To access the site from either direction, a road (approximately 9km) should be constructed. From the south, the site is 48km from central Metro Manila and can be accessed via the existing San Mateo disposal site, using the Marcos Highway and Cogeo Road. From the north, the site is also about 48km from central Metro Manila. It can be accessed by taking the Quezon Circle passing through Payatas, Rodriguez and Wawa. The fact that

the existing San Mateo disposal site can only be accessed from the southern route is a cause of traffic problems. To ensure the accessibility of the site from both directions, traffic congestion caused by the waste haulage vehicles will be relieved.

(5) Property Ownership

The new candidate disposal site, New Parcel B, is within the territory of NIPAS and is government owned. It is located, however, within Sitio Enigan, which consists of 75 households.

### 3.1.2 Proclamation of New Parcel B

The majority of New parcel B is located within the area restricted to development in the Marikina watershed. The development of a disposal site in the area would, therefore, require legal measures to exclude the site from development restrictions. The NIPAS law is quite significant as it is used as a basis for urban planning and land use development activities. Therefore, it would be impossible to request exclusion from this law.

On the other hand, partial exclusion for the existing San Mateo disposal site and Parcel B can be achieved by applying the special measures stipulated by the Presidential Decree.

With the cooperation of the study team, MMDA prepared the request for the exclusion of New Parcel B from development restrictions for the development of the final disposal site, and started proceedings to acquire the approval of DENR and the Presidential taskforce.

## 3.2 Natural Conditions of the Project Site

### 3.2.1 Topography

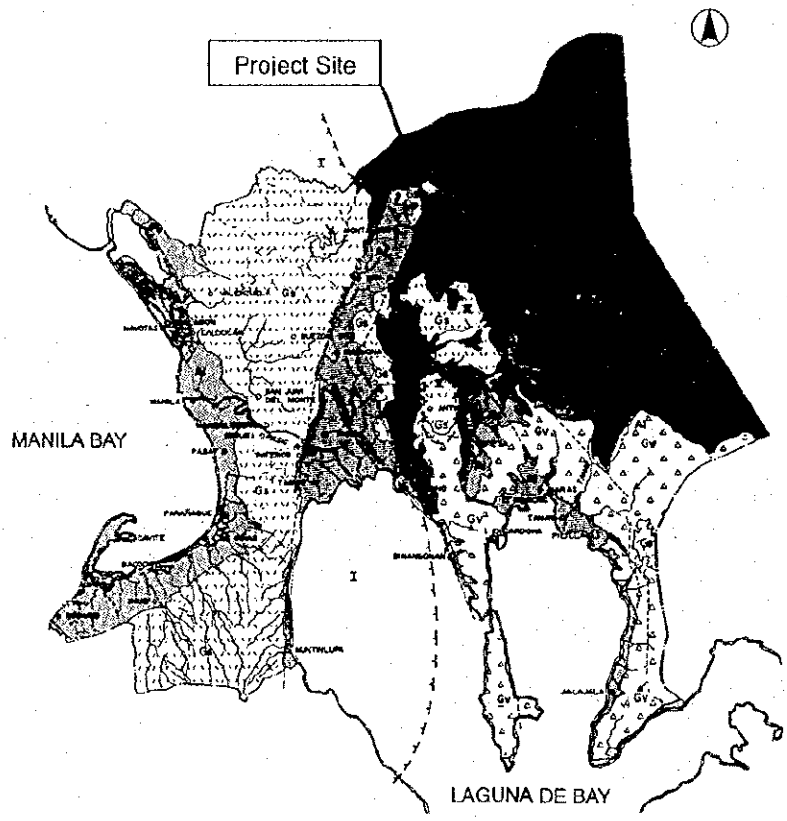
The project site has an undulating relief generally covered with bushes and trees. Few small creeks are found traversing the site all the way to the river. Drainage in the area is expected to lead to the river.

### 3.2.2 Geography

(1) Regional Geology

The project area generally lies along the western foothills of the Sierra Madre range (N-S direction) and to the east of the Marikina valley. According to the report of "Study For The Ground Water Development In Metro Manila" had been conducted by JICA in 1992, the fault is not found in the project site. (refer to Figure 3.2.1) The hills immediately east of the valley are underlain by metamorphosed lava flows with interbedded minor amounts of meta-clastics and ferruginous cherts. Layering or banding dips moderately to the east. This metamorphic series has been dated as pre-Tertiary in age.

Uncomformably overlying the metamorphic rocks are the steeply dipping Tertiary sedimentaries consisting of basalt conglomerate, sandstone, shales and limestone. Fossils contained in the limestone have been dated as Miocene. The main limestone ridge underlies the existing Wawa Dam. Immediately upstream of the limestone canyon, younger volcanic flows were observed resting on top of the Tertiary clastic. Further upstream of the dam towards the upper reaches of the Marikina River, pre-Tertiary metavolcanics and meta-clastics underlie the region.




Source: Study for the Groundwater Development in Metro Manila by JICA, July 1992

**Figure 3.2.1 Simplified Geologic Map**

(2) Results and Findings

The test pit investigations also showed that surface soils consist mainly of clayey silt (MH and ML) in the uppermost 1 meter depth, with medium to low plasticity. Natural moisture content of these soil types range from 19% to 37%, averaging 27%. Liquid limits range from 43% to 63%, averaging 55%. Plasticity index (PI) ranges from 11% to 29%, averaging 19%. Optimum moisture content (OMC) determined from laboratory compaction tests (Standard Proctor Test) for the clayey silt soils ranges from 21% to 35%, averaging 29%. Maximum dry density (MDD) averages 1.424 g/cc. Laboratory permeability tests of the clayey silt detected a permeability coefficient ranging from $1.326 \times 10^{-5}$ cm/s to $4.068 \times 10^{-5}$ cm/s. Such permeability coefficient value is categorized as impervious, indicating the existence of a naturally occurring impermeable barrier against seepage at the project site.

For the design of the foundation of structures, a very competent layer is found within the normal founding levels of footings for light to moderately loaded structure. Assuming a footing of 2 meters below existing ground surface, an allowable bearing capacity of 1.5 tons per square foot (1,614 g/cm$^2$) is recommended.

### 3.2.3 Weather

(1) Climate

The Philippines has two distinct seasons, extremely wet from June to September and quite dry from January to April. The geographical location of the area exposes it to the moist southwest monsoon, which brings excessive rainfall during the very wet months. This excessive rainfall conditions during this season is also attributed to the fact that the tropical cyclone season coincides with the peak of the monsoon.

(2) Rainfall

With a total of 162 rainy days/year, an annual mean rainfall of 2,561.0 mm is observed in the San Mateo Municipality. The first four months of the year are very dry compared with the monthly average during the rest of the year. The wettest months are the 3-month period from July to September, during which the monthly means exceed the 400 mm mark, and with only 7 dry days per month.

(3) Temperature

Mean temperature is low at 25.7 °C. The monthly mean temperature ranges from 24.1 °C in December to 27.3 degrees centigrade in May. The early mornings in December are the coolest; the minimum temperature averages 19.0 °C. On the other hand, the average temperature in early April afternoons is 33.4 °C.

(4) Relative Humidity

Mean annual relative humidity is 78%. It is most humid from July to September with the atmospheric moisture index soaring to 85 %. Monthly values dip to 66% in April.

### 3.3 Flora and Fauna

The proposed site is characterized by steep rolling hills. This topographic character prevents normal utilization of the area for economic purposes. The steep ravines along the sides of the proposed landfill site are covered with secondary growth of vegetation. The most trees in the primary impact zone are of non-dipterocarp species. There are no dipterocarp trees found in the identified study area. None were considered threatened, endangered or rare species. No dominant species of dipterocarp plants have been identified within the proposed site. This indicates low species diversity in the study area due to existing land use. The types of plants identified were mostly common species and part of secondary growth vegetation. The homogenous climatic condition in most sections of the study area has caused very minimal observable biodiversity patterns attributed to low altitude, rolling steep slopes and low soil fertility. The most dominant plant species are the grasses followed by ipil-ipil, mango and guava. Notable of these cultivated species are *santol, bayabas*, and *mangga*. No threatened, endangered or rare species of plants are identified in the project site.

No major rivers or surface water bodies are found within the proposed project site. Due to this, there were no freshwater fish species noted in the area. The past and existing land uses in the proposed project site likely affect wildlife species. Due to steep hills, no wildlife has been identified in the study area. Likewise, no endangered, threatened or rare species of animals have been identified here. Within the identified primary impact zone, no significant bird population was noted. During a number of ocular visits and conduct of vegetation survey, no birdcalls were heard along the main roads and trails around the proposed project site. Available secondary information indicated that there are no threatened, endangered or rare species of animals identified in the project sites.

## 3.4 Socio-Economic Conditions

### 3.4.1 Demography

Barangay San Rafael serves the project site. Its population comprise 15% of the total population of Rodriguez, the municipality where it belongs. It has a population of 10,548 in 1990 and 12,285 in 1995. Within a 10-year period, Bgy. San Rafael sustained a growth rate of 3.1% per year. This is just slightly lower than the growth rate of Rodriguez, which is 3.5% during the same period. Although the growth rate of Bgy. San Rafael and the municipality of Rodriguez is already high, it is still not as high as that of Metro Manila. Bgy. San Rafael is one of the most densely populated areas in the municipality of Rodriguez at 1,024 persons per sq. km, which is much higher than the municipality density. With a total land area of 108 sq. km, Rodriguez has only an average population density of 737 persons per sq. km.

The population of San Rafael is distributed among 2,660 households resulting in an average of 4.6 members per household. This household size is lower than the average for Metro Manila, which has 4.8 members. But in Sitio Enigan, the household size is much bigger at 5.9 members. The difference with the other impact areas reflects the highly agricultural economy of the project site and the households as the basic production unit. The household members of Bgy. San Rafael and Rodriguez municipality are dominated by males. In both the barangay and municipal levels, there are 102 males for every 100 females. The same ratio prevails over Sitio Enigan. This is reflective of its economic base where agriculture and industries predominate.

### 3.4.2 Housing Characteristics

All the households in Sitio Enigan own their houses while 94% do so in Bgy. San Rafael. This ownership ratio is high considering that in the municipality of Rodriguez, only 73 own their houses. None in Sitio Enigan and only 8% in Bgy San Rafael own their home lot. A large part of the barangay is a government watershed reservation and the land, until now, cannot be alienated. About 60% own their home lot in Rodriguez, or higher than the home lot ownership rate of Metro Manila, which is 57%. Those who do not own their home lot are mostly occupying them for free. In Sitio Enigan and Bgy. San Rafael, all non-homeowners are free occupants because the land is owned by the government. They only constitute 30% in the municipality of Rodriguez and 27% in the metropolis.

The type of housing structures likewise reflects the level of housing affordability. The more affordable housing is, the more households live in a single house. All of the families in Sitio Enigan and Bgy. San Rafael live in single detached units. About 89% of the households in Rodriguez and 61% in Metro Manila live in single detached houses.

### 3.4.3 Social Services

Households who use a toilet to dispose of their waste constitute 96% in Metro Manila, but only 90% have toilets in Sitio Enigan, 92% in Bgy. San Rafael and 91% in Rodriguez municipality. The most widely used toile facility in all impact areas is the water-sealed type. This is used by 50% in Sitio Enigan, 62% in Bgy. San Rafael, 76% in Rodriguez municipality and 90% in Metro Manila. The closed pit is still used by 40% in Sitio

Enigan. The main source of water in the Sitio and the Barangay is the pumpwell. This is used by 50% of the households in the Sitio and 42% in the Barangay. Around 21% of the households in the Sitio and 49% of the Barangay still obtain their drinking water from a dug well. In the case of Sitio Enigan, 20% still draw their drinking water from a spring. Around 44% of the households in the municipality enjoy running water from a faucet.

Most households in Sitio Enigan and Bgy. San Rafael take care of disposing their own garbage. Only households in the municipality and Metro Manila are served by garbage collection system. They constitute 28% in the municipality but 70% in the metropolis. Those who are outside the service area of the garbage collection system mostly burn their garbage. Those who use this mode of garbage disposal comprise 56% in the municipality and 19% in the metropolis as a whole.

Sitio Enigan is accessible from Sitio Wawa of San Rafael through a 3-km trail. The river can be used for navigation during rainy season although it may be too shallow during dry season. But there is no regular transport plying the river except for crossing the river in one portion of the trail. A 6-km earth road connects Sitio Wawa to the barangay center of San Rafael. In the Barangay Center, a barangay hall and a health center stand. These are the nearest government services to the households of Sitio Enigan. But most households in Sitio Enigan go to the municipal center of Rodriguez to obtain social services. The municipal center is easily accessible from the barangay center of San Rafael through a concrete road. Jeepneys ply the route at any time.

### 3.4.4 Employment and Income

The employment characteristics of the impact areas can be seen in the industry group where persons aged 15 years old and over work. In Sitio Enigan, agriculture, hunting and forestry are the main employers having 49% of the labor force. Services are the next biggest employer with 29%. The rest are employed in construction and trade. In Bgy. San Rafael, agriculture, hunting and forestry diminish in importance having only 14% of the labor force. Services take the upper hand with 60% of the labor force. Other bigger employers are trade, mining and quarrying.

In Rodriguez Municipality, the employment characteristics has become more diversified. While services are still the top employer at 26%, this is closely followed by manufacturing, employing 22%. Trade and utilities (electricity, gas, and water) take the third place at 17%. Agriculture, hunting and forestry are relegated to a lower place at 13%.

Unemployment in Sitio Enigan and San Rafael stands at 8%. It is higher than the metropolitan unemployment rate, which is six percent. The metropolis also enjoys much higher income than the two impact areas. While the average family income in Metro Manila is P14,467/month, it is only P4,083/month in Bgy. San Rafael and P3,050/month in Sitio Enigan.

# 4. Preliminary Design

## 4.1 Design Condition

### 4.1.1 Landfill Site Development

(1) Planed Disposal Amount

The disposal volume for landfill design is forecasted as shown in the table below. Apparent specific gravity of the incoming waste and disposal waste (compacted waste) are used 0.4ton/$m^3$ and 0.8 ton/$m^3$ respectively. A reduction in the disposal amount by composting is not considered in the design. Furthermore, a required volume of the covering soil is assumed 15% of the disposal waste volume.

**Table 4.1.1 Waste Disposal Amount Used for Planning**

| Year | unit | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| Daily amount | t/day | 5,456 | 6,030 | 6,467 | 6,904 | 7,341 | 7,778 |
| Daily incoming volume | m3/day | 13,640 | 15,075 | 16,167 | 17,260 | 18,352 | 19,445 |
| Daily disposal volume | m3/day | 6,820 | 7,537 | 8,084 | 8,630 | 9,176 | 9,723 |
| Daily covering soil | m3/day | 1,023 | 1,131 | 1,213 | 1,294 | 1,376 | 1,458 |
| Annual disposal volume | m3/year | 2,489,256 | 2,751,110 | 2,950,516 | 3,149,922 | 3,349,328 | 3,548,733 |
| Annual covering soil | m3/year | 373,388 | 412,666 | 442,577 | 472,488 | 502,399 | 532,310 |
| Accumulated waste volume | m3 | 2,489,256 | 5,240,366 | 8,190,882 | 11,340,804 | 14,690,131 | 18,238,865 |
| Accumulated covering soil | m3 | 373,388 | 786,055 | 1,228,632 | 1,701,121 | 2,203,520 | 2,735,830 |
| Total disposal volume | m3 | 2,862,645 | 6,026,421 | 9,419,514 | 13,041,924 | 16,893,651 | 20,974,694 |

(2) Landfill Site Structure

The project area is estimated at 130.2 ha, consisting of three valleys with a total height differential of 180 m. The design of the landfill site is based on a phased landfilling method that will require construction of three dikes at the bottom of each valley to reduce the generation of leachate (refer to Figures 4.2.1 and 4.2.2). By dividing the project area into the three zones, each active landfill area can be utilized effectively, and the storm-water drainage systems can be easily established, thereby the scale of leachate treatment facilities can be minimized through the reduction of leachate generation.

(3) Drainage System

Inflow of storm-water to the landfill area will be prevented as much as possible. The storm-water from the surrounding areas will be collected by an open drain system, which shall be placed around the landfill area. A horizontal drainage system will be installed in the landfill area to collect the storm-water and divert it to the vertical drain. Perforated pipes will be placed along the present creeks to collect groundwater and to prevent its seepage into the landfill layers.

(4) Leachate Treatment System

- Design Treatment Capacity

The design treatment capacity is decided based on the rainfall data taken over the last 20 years. The design capacity of the leachate treatment facilities is set at 1,400 $m^3$/day, under a condition of maximum use of active landfill area, comparing the treatment volume to the storage volume inside the landfill area with the most effective treatment volume (refer to Figures. 4.1.1 and 4.1.2).

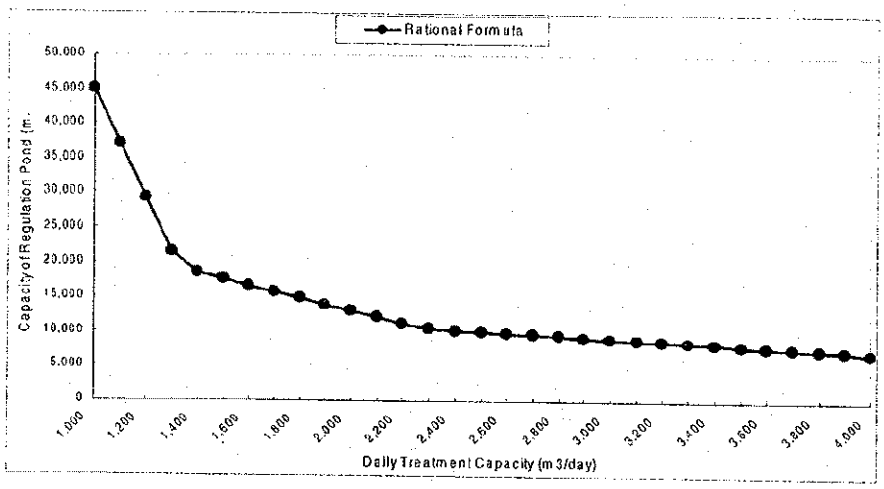



**Figure 4.1.1 Storage and Treatment Volume**

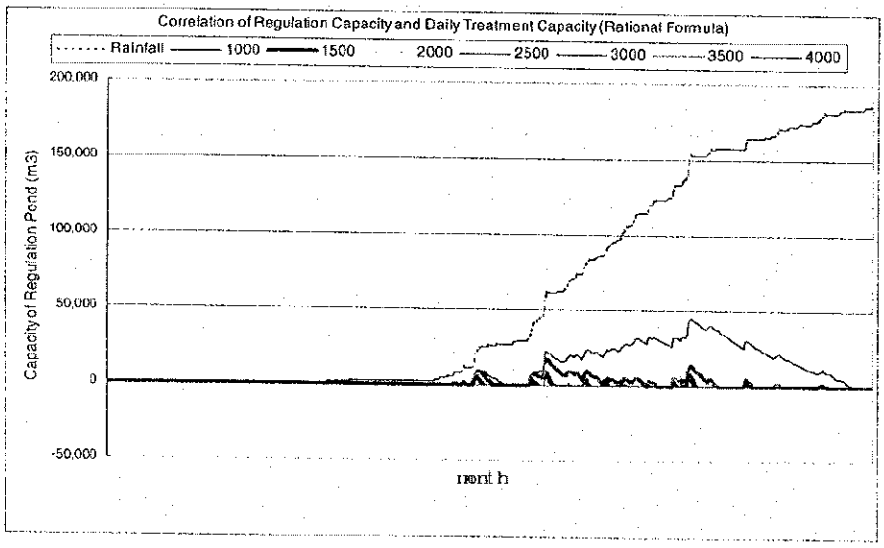



**Figure 4.1.2 Regulation Capacity and Daily Treatment Volume**

- Design Influent Quality

The design quality of influent leachate is shown in the following table considering lowest values obtained by JICA study and EMB.

**Table:4.1.2 Leachate Quality**

| Parameters | Unit | Recorded Value |
|---|---|---|
| 1. Color (PCU) | PCU | > 3,000 |
| 2. pH (range) | | 8.2 |
| 3. $BOD_5$ | mg/l | 15,000 |
| 4. COD | mg/l | 1,200 |
| 5. Total suspended solids (TSS) | mg/l | 136 |
| 6. T-Hg | µg/l | < 0.01 |
| 7. Cd | mg/l | < 0.003 |
| 8. As | mg/l | < 0.001 |
| 9. $Cr^{6+}$ | mg/l | < 0.01 |
| 10. Pb | mg/l | < 0.02 |
| 11. PCB | mg/l | < 0.001 |
| 12. Phenols | mg/l | 0.036 |
| 13. Oil/grease (petroleum ether extract) | mg/l | 3.5 |
| 14. Total Coliform Bacteria | MPN/100ml | > 1,600 |

Source: The JICA Study

- Design Effluent Quality
  The design effluent quality shall be set to strictly satisfy the standard value established in the Philippines (see table below).

**Table 4.1.3 Effluent Standards: Conventional and Other Pollutants in Protected Inland Water Supply**

| Parameters | Units | Category II | |
|---|---|---|---|
| | | Standard A | Standard B & SB |
| 1. Color | PCU | 150 | 100 |
| 2. Temperature | • | 3 | 3 |
| 3. pH (range) | | 6.0 – 9.0 | 6.0 – 9.0 |
| 4. COD | | 100 | 60 |
| 5. Settlement of solids | Mg/l | 0.3 | 0.3 |
| 6. $BOD_5$ (20• ) | mg/l | 50 | 30 |
| 7. Total suspended solids (TSS) | mg/l | 70 | 50 |
| 8. Total dissolved solids (TDS) | mg/l | 1,200 | 1,000 |
| 9. Surfactants (MBAS) | mg/l | 5.0 | 2.0 |
| 10. Oil/grease (petroleum ether extract) | mg/l | 5.0 | 5.0 |
| 11. Phenolic substances (phenols) | mg/l | 0.1 | 0.05 |
| 12. Total coliforms | MPN/100ml | 5,000 | 3,000 |

- Treatment Method

  The plan includes a circulation system in which the collected leachate circulates between the landfill waste and the anaerobic lagoons in the dry season. In addition, the system, shall be install with sand filtration and active carbon treatment systems for the final phase of leachate treatment to obtain a better effluent quality.

  The division of leachate flow into two equal streams of 700m$^3$/d is proposed; each stream is shown below.

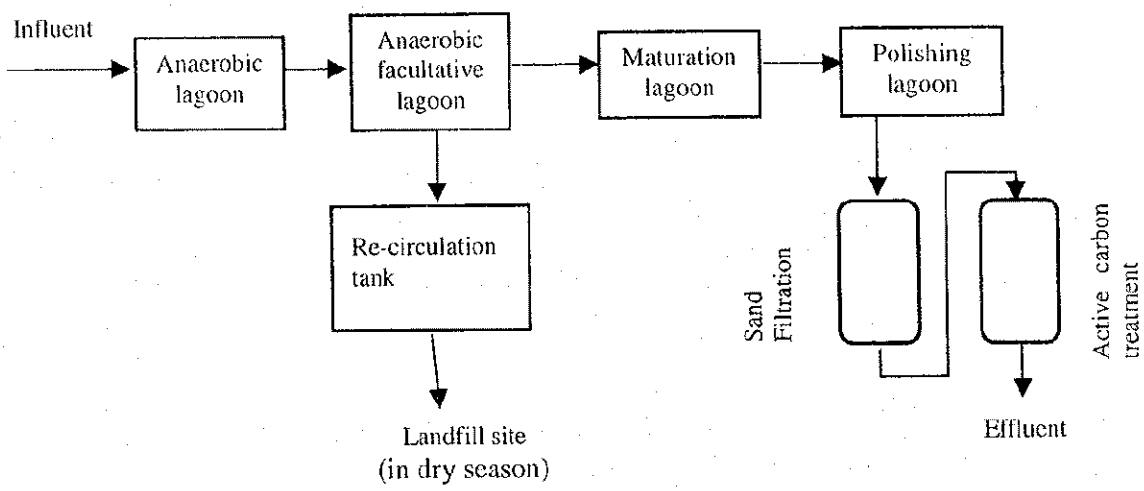



**Figure 4.1.3 Leachate Treatment Method**

(4) Administrative facilities

The following buildings to be planned at the administration compound are designed under Philippine Standards.

- Administration Building
- Storage House
- Repair House
- Control House for Weigh Bridge

### 4.1.2 Access Road

(1) Design Traffic Volume

The projection of traffic volume on the designed access road was made, based on the following assumptions:

- A maximum traffic volume in the year 2010 is taken as the design traffic volume;
- Passenger vehicles shares 20% of all the traffic volume; and
- All the waste haulage vehicles are assumed to be 40m$^3$ container vans or the equivalent.

(2) Design Criteria

The design should follow the "Design Guidelines, Criteria, and Standards for Public Works and Highways". The main criteria are summarized below:

| | | |
|---|---|---|
| a. | Average Daily Traffic | : 1,000 to 2,000 vehicles |
| b. | Design speed | : 40 km/hr |
| c. | Minimum radius | : 50 m |
| d. | Maximum grade | : 8.0 % |
| e. | Pavement width | : 7.0 m |
| f. | Shoulder width | : 1.0 m |
| g. | Superelevation | : 10 % |

(3) Design policy

As an access road is used for transportation of the waste generated in Metro Manila, it should not be closed. From this point of view, the road structure should be proof against all weathers and strong enough to prevent a disaster.

The risk of the slope collapsing due to heavy rain is high because this road is planned in the steep mountainous area. Therefore, the access road is planned to be constructed on the cutting bed, and minimized an embanked sub-grade. A turfing is proposed as a slope protection mainly, a masonry wall or concrete retaining wall will be considered to the necessary section. A suitable drainage system will be planned along the road to prevent a erosion caused by rainwater.

### 4.1.2 Operation and Maintenance

The following are the basic conditions for operation and periodic maintenance of the landfill site:

- Waste receiving and land filling will be undertaken for 6 years.
- Waste receiving and land filling will be done 24 hours a day (three shifts of 8 hours works), 7 days a week.
- Two sets of vehicles for landfill use will be provided, and each set will have an 8-hour shift.
- Soil covering work will be done for 8 hours during the day, 7 days a week.
- Soil needed for covering will be obtained at the site, and the excavation work will be done for 8 hours during the day, 7 days a week.
- Monitoring will be conducted by a private inspection bodies.
- Monitoring will be continued for 15 years after closing the landfill site. Inspections needed for every item of the environmental management procedure will be implemented at the same point once a month.

## 4.2 Preliminary Design

### 4.2.1 Landfill Site Development

(1) Main facilities

Final disposal site should be a facility that a certain amount of waste can be landfilled with a method to prevent leachate spillage to the out side, scattering waste, the breeding of flies, odor for conservation of the human life. At the same time, the landfilled method should be considered a stabilization of the disposed waste and a reduction of leachate generation. Therefore, the final disposal site should have functions such as storage, seepage control, leachate treatment.

To secure the functions, following facilities are planned.

- Storage: Main dike, dividing dike
- Seepage control: Clay Liner
- Treatment: Leachate treatment plant

Daily soil covering and movable fence are considered to control waste scattering and odor.

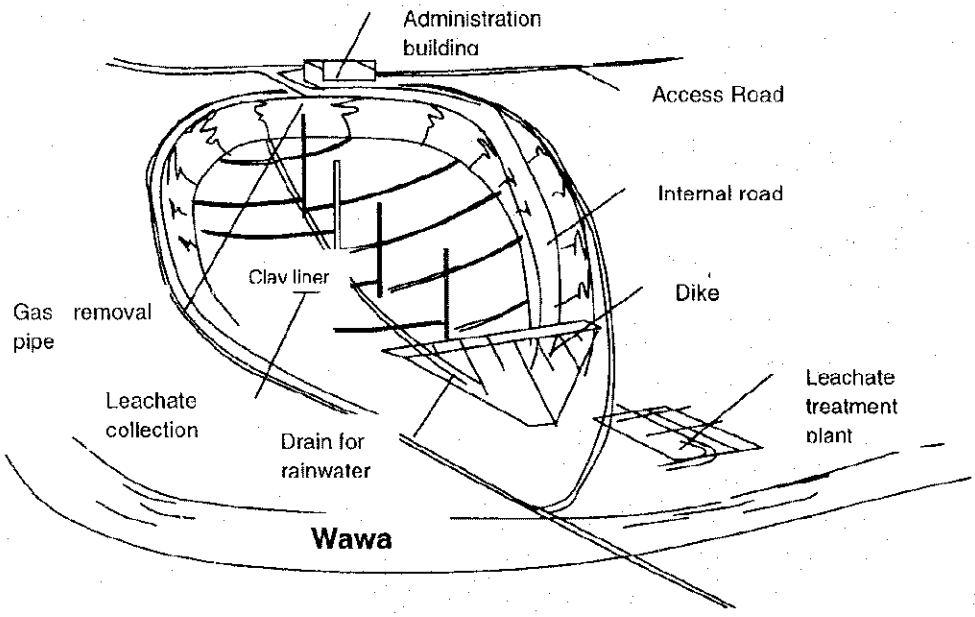



**Figure 4.2.1 Design Concept of New Sanitary Landfill**

(2) Landfill concept

Landfill is planned to be done in three phases, valley by valley, to minimize generation of the leachate. However, waste will be landfilled from the bottom of the valley to the upstream.

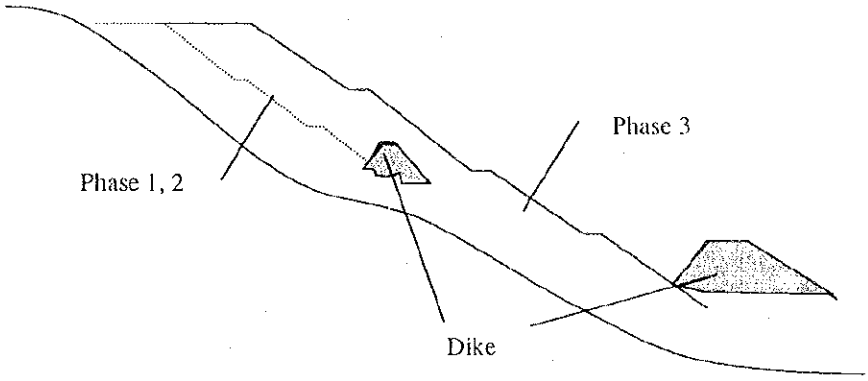



**Figure 4.2.2 Phased Landfill Operation**

(3) Earth works

Basically, required filling soil for the construction of the new landfill site will be managed within the project site.

(4) Internal road

Internal road for unloading the waste is planned from the access road to the bottom of each valley through weigh-bridge in the administration area. An approach road to the active area will be constructed according to the landfill procedure. Most part of the internal road will be finally covered by disposed waste, so that a maintenance road for the leachate treatment facilities will be constructed on the filled up waste.

(5) Lining

Since the permeability of the top soil obtained in the project site is from $1.461 \times 10^{-5}$ to $2.814 \times 10^{-5}$, which is small enough to cut the seepage of leachate, a clay liner is proposed for seepage control of the leachate generated in the disposed waste. As a structure of clay liner will be decided based on the results of additional geological analysis to be conducted in the detailed design stage, 50 cm thick at the bottom and 30 cm at the slope are considered for liner on the preliminary design.

(6) Drainage

A drain will be installed along the edge of the landfill area to prevent inflow of the rainwater. The drainage system for rainwater surrounding the active area is planned considering that an annual landfill area is a minimum unit. In addition to the rainwater drain, drainpipe for infiltration water will be installed under the clay liner.

A phased construction of the drainage facilities according to the landfill plan will be adopted to decrease a initial investment.

(7) Leachate collection

A perforated pipe will be installed on the clay liner to collect a leachate generated in the disposed waste. This perforated pipe has a function to collect a landfill gas.

(8) Leachate treatment plant

A leachate treatment facilities is planned to have a function to improve the quality of raw leachate to the effluent quality stipulated.

(9) Building works

The following buildings are planned in the administrative area.

- Administration Building
  For the MMDA Stuff
  Meeting room for 30 persons
  Contractor's room
  Generator room
  Water tank
- Weigh house
  2 operators with computers
- Store house
  Disinfectant and sterilizer
  Spare parts for equipment
- Repair shop
  Repair space for the landfill equipment
- Tire washing poor and washing spray

(10) Supplementary works

- Electricity
- Water supply etc.

(11) Monitoring facilities

Monitoring wells will be constructed at a down stream side of the main dike to monitor a seepage of leachate through analysis of the groundwater quality.

### 4.2.2 Access road

About 300 to 500m width of road corridor was identified by the basic alignment study conducted by using the 1 to 10,000 topographic maps. Aerial topographic mapping with 1:2,000 scale was done for this corridor.

The preliminary design of the access road was conducted using these aerial maps.

(1) Typical Cross Section

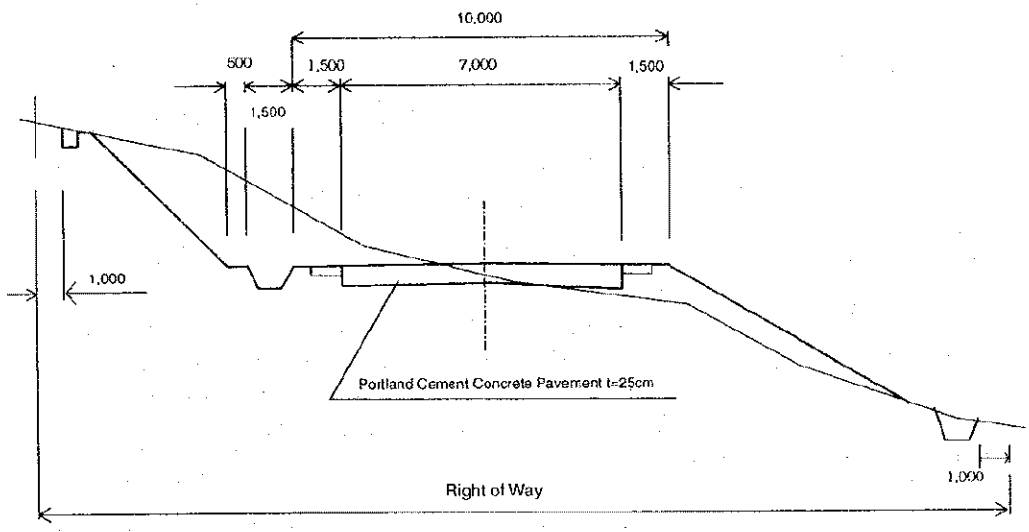



**Figure 4.2.3 Typical Cross Section**

(2) Horizontal alignment

Horizontal alignment is planned in combination with a vertical alignment. Also, the alignment is routed to avoid the existing houses as much as possible. Consequently, distance between the administration gate of proposed landfill site and the existing San Mateo SLF is 6.9km and between it and the north east end of the town of the Rodriguez is 8.4km.

(3) Vertical alignment

Maximum gradient of the access road is 7.69% in the new construction section between Wawa and San Mateo SLF site, and 8.0% in the improvement section between Cogeo Road and San Mateo SLF site.

(4) Pavement

Pavement structure shown in the following figure is adopted considering the heavy traffic. 20cm thickness of a subbase course is adopted based on the assumption that the CBR value of subgrade is more than 6%. If the CBR is less than 6%, the

thickness of subbase course will be 30cm. However, the pavement structure should be decided according to the results of CBR test in the detailed design stage.

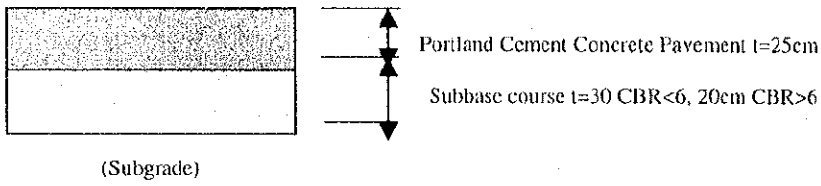



**Figure 4.2.4 Pavement Structure**

(5) Drainage

To avoid a damage caused by the rain, a drainage system is designed carefully. A side ditch to be placed along the road is prepared in almost whole section. For crossing the creak, pipe culvert and concrete box culverts are adopted.

(6) Bridge

20m and 40m span of the bridges standardized are considered for crossing the comparatively big creak. Concrete pre-stressed piles are considered for the foundation. Pre-stressed concrete I beam is adopted for the superstructure.

(7) Miscellaneous works

Curb and gutter, guardrail and post, traffic signs etc. are included in the miscellaneous works. There is a plan to construct a sidewalk along the carriageway in the section where the houses are concentrated to protect pedestrians from the waste haulage vehicles.

(8) Others

From the environmental point of view, a tree planting along the road is also considered to mitigate a impact on the scenery.

### 4.2.3. Operation and Maintenance of Sanitary Landfill

(1) Operational Organization

Sanitary landfill should be properly operated and maintained to minimize environmentally negative impacts as well as to make best use of the limited land area. In general, the sanitary landfill has to have three functions as characterized below:

1) Storage and Treatment Facility for Solid Waste: to secure enough storage capacity at an adequate place, and to transform solid waste rapidly to its natural state after decomposition and stabilization;
2) Environmental Conservation of the Site and Its Surroundings: to treat leachate and bio-decomposition gas so as not to cause environmental pollution; and

3) Returnable Facility to the Public: to be opened to the public after completion of the sanitary landfill.

In order to assure the above functions, properly organized operation unit should be formed under MMDA. The structure of the operation unit is proposed as shown in Figure 4.2.5 by assuming that the operation is carried out by MMDA and its contractor for the operation. MMDA is expected to supervise the performance of the contractor by type of the following three activities:

1) Landfill operation and consecutive civil work
2) Maintenance of facilities and vehicles
3) Environmental monitoring

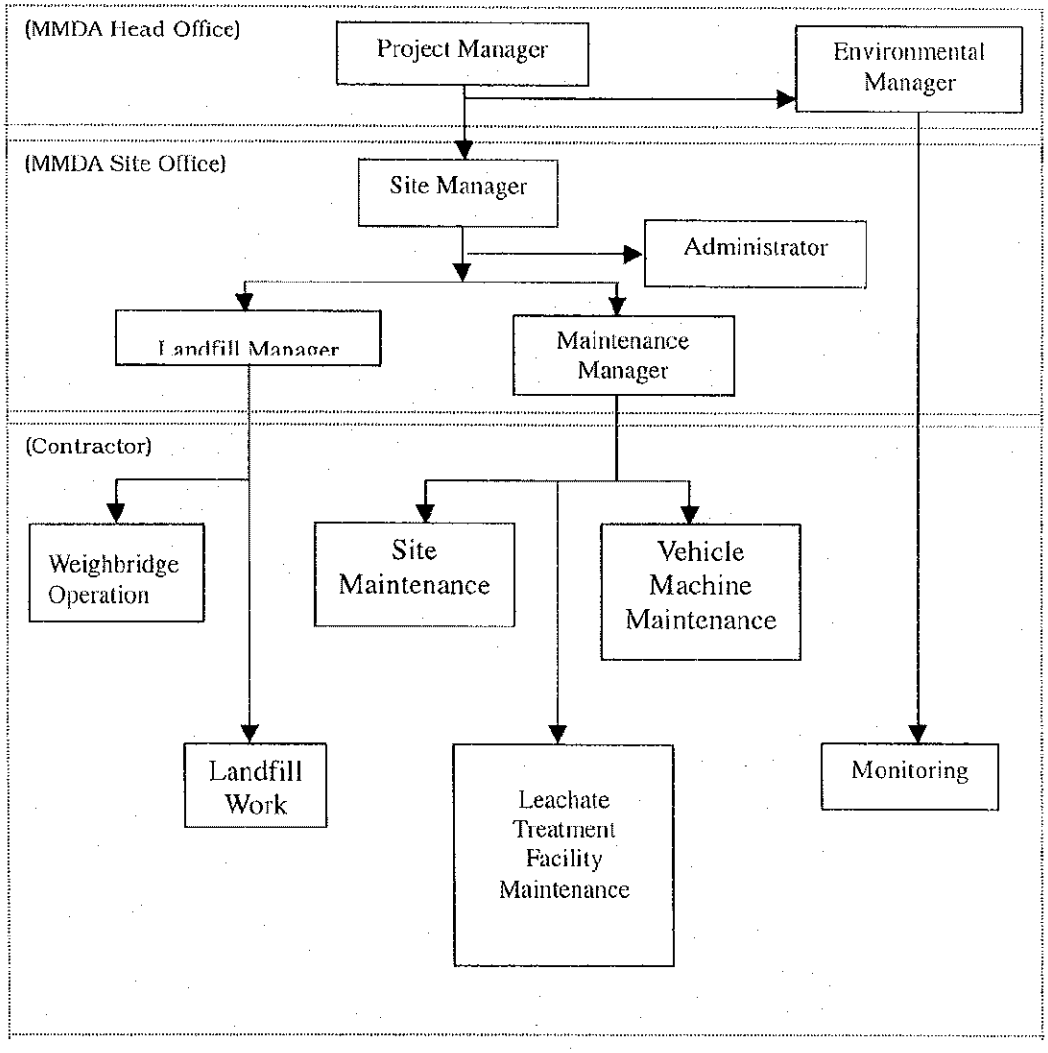



**Figure 4.2.5 Organizational Structure of Landfill Operation**

Environmental monitoring can be contracted separately from the other activities until the effect of sanitary landfill is recognized as good enough to satisfy the initially set up design concept. In case the monitoring is ordered to the other neutral entity, the matter should be handled by the MMDA head office. The daily operation on site is properly contracted to a single entity which can answer all the works required (refer to Figure 4.2.5).

(2) Recommended Operation Measure

Landfill operation should be carried out to achieve the principal characteristics of sanitary landfill taking into account the following items.

a) Control of Incoming waste
Waste control and monitoring of waste being carried into the landfill site are very important in order to: 1) carry out smooth operations and efficient works of landfill; 2) maintain adequately facilities of the site; 3) check noxious waste being brought to protect the environment within the landfill area and surrounding areas; and 4) obtain basic data for collection of fee for solid waste management. To this end, the incoming waste monitoring system is recommended to be installed together with truck weighing scales. Particular emphasis should be placed on checking noxious waste at the weighing yards.

b) Maintenance of Facilities
Facilities and equipment within the landfill site must be well operated all the time with daily and preventive maintenance to mitigate accident-causing defects. In case of an earthquake or heavy rains, an investigation of the facilities should be promptly carried out. Facilities requiring periodic maintenance are as follows:

1) Dike
- Surface of dikes
- Location of dikes
- Others

2) Water Interception (Earth Lining)
3) Drainage Facilities
4) Leachate Collection Facilities
5) Leachate Treatment Facilities
6) Waste Control and Monitoring Facilities
7) Landfill Gas Collection Facilities
8) Access and Inner Roads
9) Other related facilities

c) Management of Landfill Work
Adequate management of the landfill work must be undertaken to stabilize the landfill site and to control the quantity and quality of leachate and landfill gas. A management manual, therefore, is required for a proper landfill work. It should contain the following items:

1) Landfill Work Plans:
   - Long term landfill plan, i.e. by month, by year, and by area
   - Monthly landfill plan by division
   - Daily assigned areas for waste dumping
   - Thickness of waste spreading and times of crashing and compacting
   - Plan and work of soil covering
   - Proper material and thickness of covering soil by purpose
   - Plan of excavation, haulage and storage of covering soil needed

2) Method of Landfill
   - Size of the cell for a daily landfill
   - Order of landfill
   - Work method of soil covering

3) Operating hours of landfill work at 3 shifts, 24 hours a day, and soil covering work at 8 hours at daytime

4) Operation and Maintenance of Landfill Vehicles and Machinery
   - Pre- and post-inspection of vehicles and machinery, as well as periodic maintenance work
   - Layout plan of the main and distribution roads meeting with landfill plans
   - Road design considering safety, workability and easiness of maintenance

5) Management of Landfill Form and Settlement
   - Survey of landfill form and measurement of settlement volume
   - Recording and filing of data
   - Data management (collection, filing and storage) for landfill work performance

6) Safety Control on Site
   - Traffic Safety Control with installation of traffic signs and selection of operating vehicles and machinery meeting with site conditions
   - Safety Control for Landfill Work, with respect to:
     - Countermeasures for landfill gas leakage
     - Countermeasures for oxygen deficiency in pipes and manholes
     - Rules for treatment of chemicals being used
   - Safety of Workers
     - Conduct safety drills and health education programs
     - Medical check ups of workers

d) Environmental Management and Monitoring

The environmental impact of leachate and landfill gas on the site and the surrounding area should be minimized not only during the period of operation

but also even after its closure up to conversion to another land use. Therefore, the periodic environmental monitoring should be implemented for a long period of time. The following environmental items need to be monitored and assessed, as shown in Table 4.2.1. The results should be reviewed with feedback to the operational manner, and filed in the long-term.

1) Leachate (Quantity and quality)
2) Water discharged (Quantity and quality)
3) Landfill Gas
4) Ground Water (Quality)
5) Odor
6) Noise and Vibration (Noise, vibration and traffic volume)

**Table 4.2.1 Environmental Items to be Monitored and Required Frequency of Tests**

| Monitoring Item | Measurement Item | No. of Location | Frequency of Test | Total no. of Tests | Remark |
|---|---|---|---|---|---|
| 1. Leachate | Quantity & Quality | 2 | (2x12) / year | 48 | 21years |
| 2. Water Treated | Quantity & Quality | 2 | (2x12) / year | 48 | 21years |
| 3. Landfill Gas | Quantity & Quality | 10 | (2x12) / year | 48 | 21years |
| 4. Ground Water | Quality | 3 | 12 / year | 36 | 21years |
| 5. Odor | Density | 4 | 2 / year | 8 | During landfill operation |
| 6. Noise & Vibration | Noise, Vibration, and Traffic Volume | 4 | 2 / year | 8 | During landfill operation |

(e) Landfill Operation

The landfill site will be opened 24 hours a day, 7 days a week. Three shifts of 8 hours work per day should be adopted for the smooth operation of receiving and dumping of waste. Shifting will be from 8:00 a.m. to 4:00 p.m. for the first shift, 4:00 p.m. to 12:00 p.m. for the second shift and 12:00 p.m. to 8:00 a.m. for the third shift. Working hours at MMDA head office and others at site office will be 8 hours from 8:00 a.m. to 4:00 p.m. The working shift proposed is shown in Table 4.2.2

**Table 4.2.2 Proposed Working Shift of the landfill Site**

| Working Time | | 8 a.m. - 4 p.m. | 4 p.m. - 12 p.m. | 12 p.m. - 8 a.m. | Remarks |
|---|---|---|---|---|---|
| MMDA Head Office | | • | | | Project Manager, Environmental Manager |
| Site Office | Site Manager | • | | | |
| | Landfill Manager | • | • | • | Receiving of Waste Landfill Work |
| | Maintenance Manager | • | | | |
| | Administrator | • | | | |

## 4.3 Quantities Estimates

### 4.3.1 New Sanitary Landfill Site

(1) New sanitary landfill Construction

| Work Items | Unit | 1 phase | 2 phase | 3 phase | Total |
|---|---|---|---|---|---|
| 1 EARTH WORKS | | | | | |
| 1.1 Clearing & Grubbing | ha | 45.00 | 19.50 | 30.00 | 94.50 |
| 1.2 Excavation | $m^3$ | 2,551,000 | 1,065,500 | 1,641,500 | 5,258,000 |
| 1.3 Embankment | | 700,000 | 300,000 | 560,000 | 1,560,000 |
| 1.4 Earth lining | | 450,000 | 195,000 | 300,000 | 945,000 |
| 2 SLOPE PROTECTION | | | | | |
| 2.1 Cutting | sq.m | 450,000 | 195,000 | 300,000 | 945,000 |
| 2.2 Embankment | sq.m | 30,000 | | 60,000 | 90,000 |
| 3 PAVEMENT WORKS | | | | | |
| 3.1 Pavement | sq.m | 17,500 | 12,600 | 20,600 | 50,700 |
| 4 DRAINAGE WORKS | | | | | |
| 4.1 Concrete open drain | m | 3,150 | 1,350 | 4,710 | 9,210 |
| 4.2 Concrete pipe | m | 5,400 | 3,700 | 6,500 | 15,600 |
| 5 LEACHATE COLLECTION WORKS | | | | | |
| 5.1 LC pipe | m | 2,900 | 0 | 0 | 2,900 |
| 6 CULVERT | | | | | |
| 6.1 Box culvert | m | 7,900 | 3,030 | 18,400 | 29,330 |
| 7 MISCELLANEOUS WORKS | | | | | |
| 7.1 Guard fence | m | 5,000 | | | 5,000 |
| 7.2 Guardrail (A) | m | 2,500 | 1,800 | 3,500 | 7,800 |
| 7.3 Road lighting | km | 2.5 | 1.8 | 3.5 | 7.8 |
| 7.4 Electricity supply | km | 2.5 | 1.8 | 3.5 | 7.8 |
| 7.5 Ventilator for leachate monitoring | ls | 2 | 2 | 2 | 6 |
| 8 ENVIRONMENTAL MITIGATION WORKS | | | | | |
| 8.1 Leachate treatment plant | ls. | 1 | | | 1 |
| 8.2 Gas extraction pipe | m | 5,000 | 5,000 | 10,000 | 20,000 |
| 8.3 Planting tree | No. | 75,000 | | | 75,000 |
| 9 BUILDING WORKS | | | | | |
| 9.1 Administration building | ls. | 3 | | | 3 |
| 9.2 Scale house | ls. | 2 | | | 2 |
| 9.3 Installation of weigh bridge | ls. | 2 | | | 2 |

(2) Construction of the Leachate Treatment Facilities

| Items | Unit | Estimated Quantity |
|---|---|---|
| 1. Earthworks | | |
| a. Excavation | | |
| Aerated Faculative Lagoon | cu. m | 35,424.00 |
| Anaerobic Lagoon | cu. m | 4,096.00 |
| Maturation Lagoon | cu. m | 2,703.36 |
| Polishing Lagoon | cu. m | 2,605.44 |
| Sand Filtration and Activated Charcoal | cu. m | 4,480.00 |
| b. Scarify, grade surface wet down loosened layer and compact soil | sq. m | 19,594.00 |
| Adjustment for slopes: | | |
| Aerated Faculative Lagoon | sq. m | 1,889.28 |
| Anaerobic Lagoon | sq. m | 288.64 |
| Maturation Lagoon | sq. m | 185.78 |
| Polishing Lagoon | sq. m | 178.79 |
| Sand Filtration and Activated Charcoal | sq. m | 0.00 |
| 2. Concrete WorksConcrete Pavement | cu. m | 631.50 |
| 3. Reinforcement bar Works | tons | 20.74 |
| 4. HPDE Liner (100 mil Thk) | sq. m | 18,822.81 |

(3) Access Road

| Items | | Unit | Quantities |
|---|---|---|---|
| 1. EARTH WORKSEARTHWOKS | | | |
| 100 | Clearing and Grubbing | ha. | 50 |
| 101-1 | Unsuitable Excavation | cu. m. | 349,478 |
| 101-2 | Surplus Common Excavation | cu. m. | 2,203,838 |
| 101-3 | Surplus Rock Excavation (Rippable / Soft) | cu. m. | 944,502 |
| 102 | Structure Excavation | cu. m. | 4,094 |
| 103-1 | Embankment from Common Excavation | cu. m. | 277,157 |
| 103-2 | Embankment from Rock | cu. m. | 69,289 |
| 104 | Subgrade Preparation | sq. m. | 102,000 |
| 2. PAVEMENT WORKS | | | |
| (Subbase and Base Course) | | | |
| 200 | Aggregate Subbase, t=10cm | cu. m. | 4,454 |
| 201 | Crushed Aggregate Base Course, t=200mm | cu. m. | 58,998 |
| (Surface Course) | | | |
| 202 | Aggregate / Gravel Surface Course, t=50mm | sq. m. | 58,000 |
| 203 | Asphalt Concrete Pavement, t=50mm | sq. m. | 3,090 |
| 204 | Portland Cement Concrete Pavement, t=250mm | sq. m. | 136,039 |
| 3. DRAINAGE AND SLOPE PROTECTION | | | |
| 300-1 | Reinforced Concrete Pipe, 910mm | m. | 716 |
| 300-2 | Reinforced Concrete Pipe, 1070mm | m. | 212 |
| 300-3 | Reinforced Concrete Pipe, 1220mm | m. | 40 |
| 300-4 | Reinforced Concrete Pipe, 1370mm | m. | 129 |
| 301-1 | Reinforced Concrete Pipe, 1520mm | m. | 40 |
| 301-2 | Reinforced Concrete Box Culvert, 2000x2000mm | m. | 42 |
| 301-3 | Reinforced Concrete Box Culvert, 2500x2500mm | m. | 44 |
| 302 | Curb Inlet Manhole,1200x1200mm | each | 34 |
| 303-1 | Catch Basin, 1200x1200mm | each | 38 |
| 303-2 | Catch Basin, 1500x1500mm | each | 8 |
| 303-3 | Catch Basin, 1800x1800mm | each | 2 |
| 304 | Cleaning and Reconditioning of Existing Drainage Structures | | LS |
| 305 | Grouted Riprap Side Ditches / Canal, t=200m | sq. m. | 52,394 |
| 306 | Grouted Slope Protection, t=300m | sq. m. | 10,016 |
| 307 | Stone Masonry Retaining Wall | cu. m. | 7,776 |
| 308 | Reinforced Concrete Retaining Wall | cu. m. | 6,541 |
| 319 | Gabions | cu. m. | 800 |
| 4. MISCELLANEOUS ROADWAY STRUCTURES | | | |
| 400 | Curb and Gutter | m. | 1,020 |
| 401 | Sidewalk, t=50mm | sq. m. | 1,530 |
| 402 | Guardrail and Post | m. | 6,510 |
| 403 | Road Traffic Signs and Pavement Markings | | LS |
| 404 | Sprigging (turfing) | sq. m. | 138,600 |
| 5. ENVIRONMENTAL PROTECTION WORKS | | | |
| 500 | Tree Planting, ht=1.50m | each | 100 |
| 6. BUILDING WORKS | | | |
| 600 | Weigh Bridge (Supply and Installation) | lot | 1 |

### 4.3.2 Operation and Maintenance

(1) Basic Volume

Basic volume of operation and maintenance works for sanitary landfill is shown below.

**Table 4.3.1 Basic Volume of Operation and Maintenance Works**

| Item | Unit | Volume | Remark |
|---|---|---|---|
| 1. Total of Solid Waste | $m^3$ | 1,824mil | 6 years |
| 2. Daily Work | | | |
| Daily Incoming Solid Waste | Ton | 6,700 | 0.4 ton/ $m^3$ |
| Daily Solid Waste Volume | $m^3$ | 16,750 | 1,040 $m^3$/hour |
| Covering Soil per day | $m^3$ | 1,250 | 160 $m^3$/hour |
| Soil excavated per day | $m^3$ | 1,250 | 160 $m^3$/hour |

(2) Number and Kind of Vehicles Needed

The number and kind of vehicles needed for daily work are decided based on the method of operation and maintenance of the landfill site and the volume of incoming waste. The number and kind of vehicles needed are shown in Table 4.3.2

**Table 4.3.2 Number of Vehicles Needed for Daily Operation and Maintenance**

| Work Item | Kind of Vehicle | Number | Remark |
|---|---|---|---|
| I. for MMDA | | | |
| 1 Management | 4 x4 Service Pick-Up | 2 | |
| II. for Contractor | | | |
| 1 Maintenance Work | | | |
| Daily inspection | 4 x4 Service Pick- Up | 1 | |
| Haulage | Truck (2t class) | 1 | |
| Maintenance | Power Shovel (0.2m3 bucket) | 1 | |
| 2 Landfill Work | | | |
| Spread | Crawler Tractor with dozer blade(32t class) | 7 | |
| Crush/Compaction | Steel Wheel Compactor (32t class) | 4 | 2x2sets |
| Water Spread | Water Tank Truck (3m3 class) | 2 | 1x2sets |
| 3 Soil Cover Work | | | |
| Excavating | Power Shovel• 1.0m3 bucket• | 3 | |
| Loading | Front-end Loader• 1.5m3 bucket• | 3 | |
| Haulage | Dump Truck• 11t,6.0m3• | 10 | |
| Spread/Compaction | Crawler Tractor with dozer blade (32t class) | 4 | |

(3) Number of MMDA employees and workers

The number of MMDA employees and workers needed for daily operation and maintenance of the landfill site is shown in Table 4.3.3.

**Table 4.3.3 Number of MMDA Employees and Workers**

| | Employee and Worker | Head | Remarks |
|---|---|---|---|
| I. MMDA | 1. MMDA Main Office | | |
| | Project Manager | 1 | |
| | Environmental Manager | 1 | |
| | 2. Site Office | | |
| | Site Manager | 1 | |
| | Landfill Manager | 3 | 3 shifts (1x3) |
| | Maintenance Manager | 1 | |
| | Administrator | 2 | |
| | Driver | 2 | |
| | | | |
| II. Contractor | 1. Waste Receiving Work | | 3 shift |
| | Weighbridge Operator | 6 | 2x3 |
| | Spotter | 6 | 2x3 |
| | 2. Landfill / Soil Covering Work | | |
| | Site Manager | 1 | |
| | Foreman | 3 | 1x3 shift |
| | Driver (Tractor) | 36 | 12x3 shift |
| | (Compactor) | 6 | 2x3 shift |
| | (Water Tank Truck) | 3 | 1x3 shift |
| | Driver (Power Shovel) | 3 | |
| | (Loader) | 2 | |
| | (Dump Truck) | 10 | |
| | (Tractor) | 4 | |
| | 4. Maintenance Work | | |
| | Assistant Worker | 10 | |

## 4.4 Cost Estimates

### 4.4.1 Initial Investment Cost

The initial investment cost for New Landfill development and access road is presented in Table 4.4.1. The project cost is estimated using the October 1998 price. A land acquisition and compensation cost are not considered because the project site is located in the national land.

**Table 4.4.1 Initial Investment Cost for New Landfill Development and Access Road**

(unit: ,000 pesos)

| Items | New Landfill Site | Access Road | Total |
|---|---|---|---|
| 1. Earth Works | 1,560,208 | 574,256 | 2,134,464 |
| 2. Slope Protection | 62,460 | 65,420 | 127,880 |
| 3. Pavement Works | 50,244 | 134,413 | 184,657 |
| 4. Drainage Works | 48,778 | 4,031 | 52,809 |
| 5. Leachate Collection | 6,463 | | 6,463 |
| 6. Culvert | 419,265 | 1,708 | 420,973 |
| 7. Environmental Mitigation Works | 223,976 | 457 | 224,433 |
| 8. Building Works | 24,084 | | 24,084 |
| 9. Miscellaneous works | 21,254 | 25,049 | 46,303 |
| 10. Bridge Works | | 24,667 | 24,667 |
| Sub total –1 | 2,416,732 | 830,001 | 3,246,733 |
| 11. Engineering Services (10%of st-1) | 241,673 | 83,000 | 324,673 |
| 12. Contingency (20% of st-1 & 11) | 531,681 | 182,600 | 714,281 |
| Sub total –2 | 773,354 | 265,600 | 1,038,955 |
| Grand total (st-1 +st-2) | 3,190,086 | 1,095,601 | 4,285,688 |

### 4.4.2 Operation and Maintenance Cost

(1) Usual Facilities Maintenance

In addition to the first investment, internal road, gas vent, drain and soil covering should be installed according to the landfill phase in the landfill site. These costs should be prepared during operation period and the cost is estimated as follows.

**Table 4.4.2 Facilities Maintenance Cost**

| Items | Quantities | Unit | Cost (,000 pesos) |
|---|---|---|---|
| 1. Internal road | 150,000 | M | 360,000 |
| 2. Gas removal facilities | 225,000 | M | 337,500 |
| 3. Drainage | 4,200 | M | 84,000 |
| 4. Slope protection | 600,000 | $M^2$ | 42,000 |
| 5. Soil covering | 2,760,000 | $M^3$ | 469,200 |
| Total | | | 1,292,700 |

(2) Annual O & M Cost

Table 4.4.3 presents the average annual landfill operation cost under the assumption that the landfill operation is commissioned to the private contractor. Therefore, the equipment cost means rental fee including fuel and insurance.

**Table 4.4.3 Annual Landfill Operation Cost**

| Item | Sub Item | Quantity | Unit Cost ( Pesos. ) | Cost ( 1,000 Pesos) | Remark |
|---|---|---|---|---|---|
| I. Expenditure | 1. MMDA Emproyee | | | | 6 years |
| | • Project manager | 1 | 16,000 | 192 | |
| | • Environmental manager | 1 | 16,000 | 192 | |
| | • Site manager | 1 | 16,000 | 192 | |
| | • Landfill manager | 3 | 12,000 | 432 | |
| | • Maintenance manager | 1 | 12,000 | 144 | |
| | • Administrator | 2 | 12,000 | 288 | |
| | • Driver | 2 | 9,500 | 228 | |
| | sub – total | | | 1,668 | |
| | 2. Contractor | | | | 6 years |
| | • Weightbrige operator | 3 | 8,000 | 288 | |
| | • Spotter | 3 | 7,200 | 259 | |
| | • Site manager | 1 | 16,000 | 192 | |
| | • Foremane | 3 | 12,000 | 432 | |
| | • Landfill guide | 9 | 6,800 | 734 | |
| | • Operator | 51 | 8,000 | 4,896 | |
| | • Driver (Water Tank Truck) | 3 | 9,500 | 342 | |
| | • Driver (Dump Truck) | 10 | 9,500 | 1,140 | |
| | • Labor | 4 | 6,000 | 288 | |
| | • Leachate facility operator | 1 | 8,500 | 102 | 15 years |
| | sub – total | | | 8,674 | |
| | total ( 1 ) | | | 10,342 | |
| II.Vehicle (including fuel) | 1. For management (MMDA) | | | | 6 years lease |
| | • 4x4 Service Pick-up | 2 | 55,000 | 1,320 | |
| | sub – total | | | 1,320 | |
| | 2. For Operation | | | | 6 years lease |
| | • 4x4 Service Pick-up | 1 | 55,000 | 660 | monthly |
| | • Truck (2t class) | 1 | 460 | 3,974 | hourly |
| | • Power Shovel (0.2m3 bucket) | 1 | 880 | 7,603 | hourly |
| | • Crawler Tractor (32t class) | 7 | 1,875 | 129,600 | hourly |
| | • Compactor (32t class) | 4 | 1,950 | 67,392 | hourly |
| | • Water Tank Truck (3m3 class) | 2 | 790 | 13,651 | hourly |
| | • Power Shovel (1.0m3 bucket) | 3 | 1,150 | 29,808 | hourly |
| | • Front-end Loader (1.5m3 bucket) | 3 | 1,285 | 33,307 | hourly |
| | • Dump Truck (11t, 6.0m3) | 10 | 650 | 56,160 | hourly |
| | sub – total | | | 342,156 | |
| | total ( 2 ) | | | 343,476 | |
| III. Monitoring | | | | | 21 years |
| | 1. Leachate | 48 | 12,000 | 576 | |
| | 2. Water Treated | 48 | 12,000 | 576 | |
| | 3. Landfill Gas | 48 | 12,000 | 576 | |
| | 4. Ground Water | 36 | 12,000 | 432 | |
| | 5. Odor | 48 | 5,000 | 240 | |
| | 6. Noise & Vibration | 8 | 110,000 | 880 | |
| | total ( 3 ) | | | 3,280 | |
| Grand Total | total ( 1 ) + ( 2 ) + ( 3 ) | | | 357,098 | |

### 4.4.3 Summary of Project Cost

Table 4.4.4 summarizes the investment and O&M cost. After completion of the landfill operation, leachate will be generated in the heap of disposed waste. Therefore, it is assumed that the leachate treatment plant will be operated until 2015 and the monitoring will be done by the end of 2030.

## Table 4.4.4 Summary of Investment and O&M Cost for New Parcel B Sanitary Landfill Site and Access Road

(unit: million Peso)

| | Total Cost | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010-2015 | 2016-2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1 CONSTRUCTION** | | | | | | | | | | | | | |
| 1-1 Construction of New Parcel B | 3,190 | 96 | 638 | 1,228 | 1,228 | | | | | | | | |
| 1-2 Construction of Access Road | 1,096 | 33 | 219 | 422 | 422 | | | | | | | | |
| Sub Total (1) | 4,286 | 129 | 857 | 1,650 | 1,650 | | | | | | | | |
| **2 OPERATION & MAINTENANCE** | | | | | | | | | | | | | |
| 2-1 Periodical Facilities Construction | 1,293 | | | | | 210 | 212 | 214 | 219 | 219 | 219 | | |
| 2-2 Operation & Maintenance | 1,284 | | | | | 214 | 214 | 214 | 214 | 214 | 214 | | |
| 2-3 Leachate Treatment | 133 | | | | | 14.75 | 14.75 | 14.75 | 14.75 | 14.75 | 14.75 | 14.75 | - |
| 2-4 Monitoring | 112 | | | | | 17.86 | 17.86 | 17.86 | 17.86 | 17.86 | 17.86 | 1.30 | 0.65 |
| Sub Total (2) | 2,822 | | | | | 456.71 | 458.71 | 460.71 | 465.71 | 465.71 | 465.71 | 16.05 | 0.65 |
| Grand Total | 7,108 | 129 | 857 | 1,650 | 1,650 | 456.71 | 458.71 | 460.71 | 465.71 | 465.71 | 465.71 | 16.05 | 0.65 |

# 5 Implementation Plan

## 5.1 Implementation Schedule

The implementation schedule of the Project is presented in Figure 5.1.1.

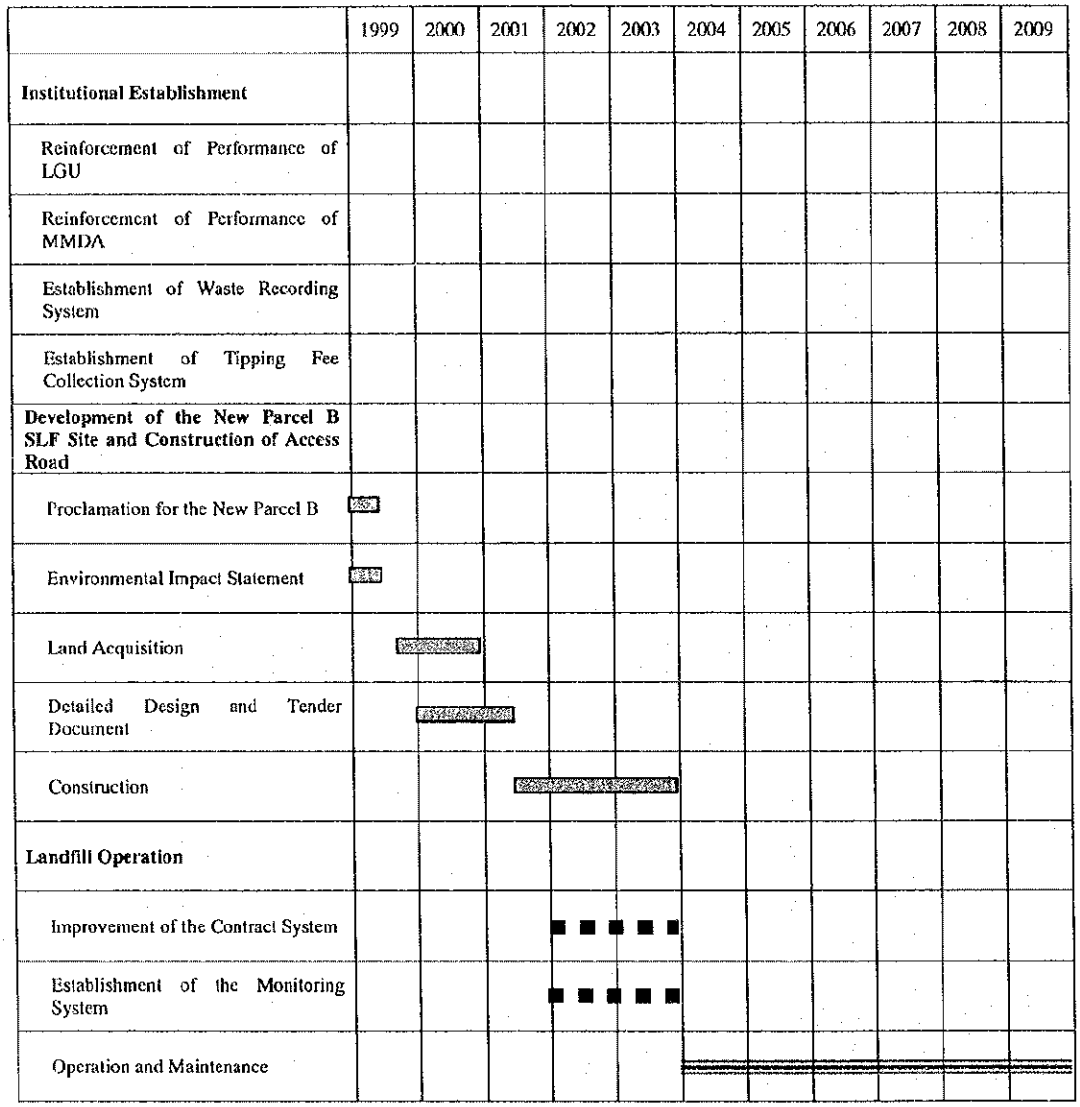



**Figure 5.1.1 Implementation Schedule**

## 5.2 Management and Institution

### 5.2.1 Institutional Arrangement

(1) Implementing Agencies

The target project of New Parcel B Sanitary Landfill consists of two major components: one is construction of sanitary landfill site and another is construction and rehabilitation of access road. In historical point of view, these works were undertaken by DPWH at first and completed by MMDA in Carmona and existing San Mateo. Both agents, though involved in the construction of preceding sanitary landfill sites, have achieved only the partial function of sanitary landfill sites, consequently caused long lasting complaints of neighbors against the facilities. Therefore, the implementing organization should be established carefully in order to avoid the repetition of previous incomplete experiences.

Road construction is main task of DPWH and construction of landfill site as well, however, these two tasks were shared with MMDA in NCR. Apparently the former task seems to be suitably implemented by DPWH because it has a lot of experience in this field including those funded by international organization. On the other hand, the construction work of landfill site has a special nature which needs recurrent construction work in the course of landfill operation. The daily landfill operation is considered to be a part of MMDA's responsibility so that the successive part of construction is suitably undertaken by MMDA though the initial preparation of site is completed by DPWH.

Considering the background of the target project, the study team recommends to establish a joint implementing body between DPWH and MMDA. Combining the partial experiences of two agencies and filling up the partner's weakness each other, the joint implementing body will be functioning better than the case either of them alone undertakes this project. Furthermore, involvement of DPWH in this project may enables dissemination of sanitary landfill throughout the country because it has a lot of potential projects in its territory of nationwide branch offices.

The joint implementing body is expected to work for both execution of the project and adjustment between its mother organization in the form of their participation. The coverage of the joint implementing body should be extended to a certain part of the preparation stage after the feasibility study as shown in Fig.6.1.1. This process derives from the assumption that bilateral soft loan is introduced to the main fund demand of the target project. The basic demarcation recommended is as follows:

1) Land acquisition and protection should be undertaken by MMDA alone
2) Compensation scheme should be undertaken mainly by MMDA at the presence of LGUs in NCR
3) Each process from ECC clearance to construction should be undertaken jointly by MMDA and DPWH

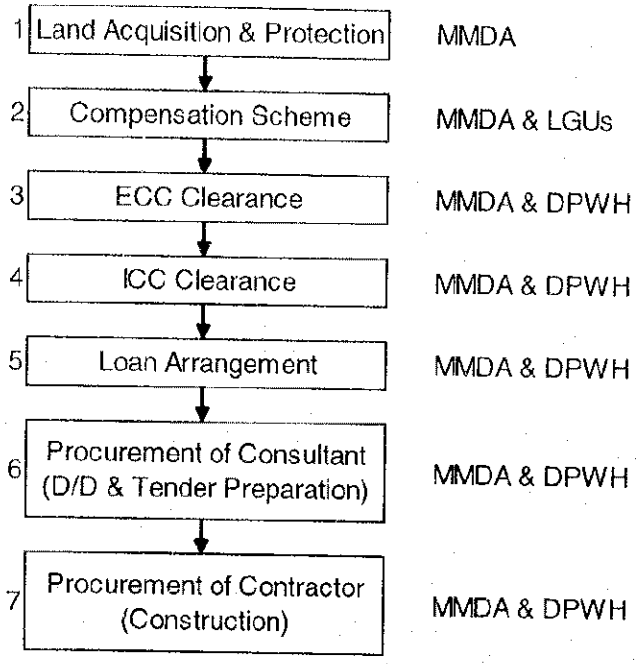



**Figure 5.2.1 Preparation Process of Project by the Commencement**

(2) Procurement of Consultant and Contractor

The procurement procedure under bilateral loan is quite different from MMDA's traditional routine for the selection of contractor. International soft loan agencies usually requests the borrower of a big project to conduct pre-qualification (PQ) and International Competitive Bid (ICB). The evaluation criteria for PQ and bid need concurrence of the loan agencies to secure a systematic evaluation. DPWH is familiar with the process for the soft loan projects and the fact is another reason why a joint implementing body is recommended to cover the major part of project implementation.

A joint Committee to control the project implementation is proposed with a structure shown in Figure 5.2.2. The committee is expected to decide the will of the proponent in implementation of the project. Major duties of the committee lies in selection of contract partners, quality control, schedule control, budget control, clearance of legal requirement like ECC and ICC, compensation deal, public relations particularly with affected local communities and other necessary matters. The basic agreement between MMDA and DPWH should be made to have the consensus of task demarcation before the establishment of joint committee.

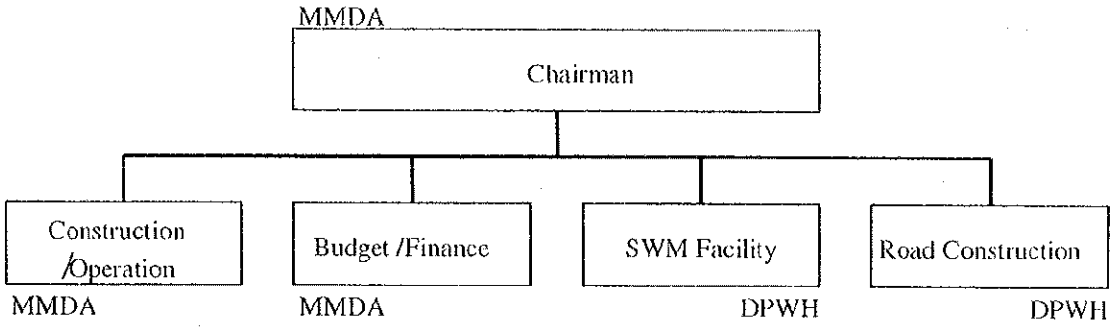



**Figure 5.2.2 Proposed Composition of Joint Committee for Implementation**

(4) Land Acquisition and Protection

Project site of New Parcel B is contained in the Marikina Watershed Management Area, so that the land acquisition means to get a presidential proclamation to exclude the site from the area with the definite purpose of slid waste disposal. This process does not need any purchase of land, however, there needs removal of illegal residents and cultivated plants like rice within the project site. A small village called as Sitio Inigan of Barangay San Rafael, Municipality Montalban is situated immediate downstream of a tributary flowing out of the project site and a certain number of houses seems to be involved in the project site.

When the presidential proclamation is announced, the responsibility of management of the land is transferred from DENR to MMDA. Thereafter MMDA needs to remove the residents within the boundary and compensate the crops there to the owners. According to the experience of MMDA in the two previous landfill sites, MMDA ordered contractors to negotiate the stakeholders and to solve all the matters related to compensation in place of MMDA. The contractor settled the removal of residents and properties by paying money. The cost spent for the settlement was reimbursed by MMDA as part of construction contract. This measure seems quite a time saving way if it works well, otherwise MMDA must prepare a complete set of relocation program which forms a part of the project. There is no more time remaining to prepare the program therefore MMDA can not help taking the same manner as previous practice again.

Another risk in land acquisition lies in an intentional immigration of new squatters into the project site. Organized squatters can rush into a site in a few days after the president proclaims the site to be provided to the project. Once the site is occupied by those people, the process of implementation will be endangered because the removal of organized illegal residents requires a lot of additional time and money to be spent. The similar case recently happened at a NHA housing project site in San Jose del Monte, Bulacan. This implies MMDA, as the potential land manager, needs to be ready to protect the project site from invasion of new squatters prior to the proclamation by the president Estrada. The attack of organized squatters seems

well prepared and sometimes violent so that the protection measure should be prepared in both legal and physical points of view.

(5) ECC Clearance

ECC (Environmental Compliance Certificate) is an indispensable milestone of the project. ECC is issued by evaluating EIS (Environmental Impact Statement) and designated attachments. The preparation of EIS is the responsibility of the project proponent, MMDA and partly DPWH. The proponent should contract qualified persons or consultants accredited by DENR which is defined as "eligible preparers". EIS preparers are obliged to attend the scoping session by DENR Administrative Order 96-37 Procedural Manual. In other words, eligible preparers who attended the scoping session should undertake the preparation of EIS successively.

Within two months from the date the ECC is issued, the proponent should organize MMT (Multi-partite Monitoring Team) and establish EMF (Environmental Monitoring fund) automatically and possibly is requested by DENR to establish EGF (Environmental Guarantee Fund). The proponent should prepare MOAs (Memorandum Of Agreement) to establish MMT and EGF. Stake holders of MMT and EGF are slightly different each other, however, the following core members are commonly nominated as designated parties to sign the MOAs. Two different MOAs can be incorporated into one comprehensive MOA

a. DENR
b. Proponent
c. LGUs (province, municipality, barangay)
d. representatives from the affected communities)

The local stakeholders of MOA are overlapping with those of compensation scheme. Therefore it is recommended that above mentioned ECC related process is conducted together with compensation scheme stated in the preceding section. The sooner commencement of dialogue with local community, the better understandings all the stakeholders can share. It is desirous to start the both process soon after the identification of affected communities around the project site.

ECC related process requires timely budget provision by the proponent as shown below:

(1) MMT
a. EMF (Environmental Monitoring Fund), a replenishable cash fund to bear all the regular operation cost of the team and manpower support services, training, equipment, communications, transportation and accommodations of the members.

b. Employment of professional consultants

(2) EGF

a. Cash Fund, a replenishable fund to bear all the regular guarantee activity

b. Trust Fund, disbursed only for the compensation when the above cash fund can not be accommodated

### 5.2.2 Establishment of Tipping Fee Collection System

(1) Target of Fee Imposition

Additional fund source required to keep the sound operation of sanitary landfill is proposed as tipping fee imposed on the beneficiary residents in NCR. Business enterprises are commonly imposed of a fee for solid waste collection though the amount is not necessarily adequate to cover the necessary figure. The fee level should be reviewed in connection with that to be imposed on households. The target of tipping fee introduction is ordinary residents who remain uncharged any official fee for SWM at present. The rate of people who expressed the willingness to pay for SWM in addition to taxes was quite small. Furthermore, the affordable level which was presented by those who said to pay the additional fee was by far less than 160 pesos, which is thought to be a necessary amount by MMDA. It is important that the fee is an indispensable burden to be shared by citizens as the cost for clean environment which is somehow achieved by well organized human efforts. The organized human efforts inevitably consumes a certain amount of money which should be borne by those who generate the solid waste.

(2) Responsible Body of Fee Collection

As for the execution body of fee collection, LGU is considered to be the suitable agency because its activities of SWM is conducted closely to the residents. Residents can appreciate the performance of LGUs directly; that enables residents to consider the necessity of tipping fee in connection with the effect of SWM performed in front of them. In addition, LGUs have broader channels of communication with residents than MMDA and much more than private contractors. In this respect, it is better to collect the fee through the administrative route: the bill is issued by LGU and delivered to the residents directly or by way of barangay office. Indirect collection system like combined bill with water charge or electricity charge is not recommended because people will lose the way to connect their appreciation of performance with the payment.

(3) Principle of Imposition

Existing charging method of collection fee to business enterprises is usually proportional to the size of premises. This method suggests the impartial charging is achieved by determining the fee proportionally to the load of collection service. On the other hand, it is almost impossible to measure the waste volume individually in the course of collection. In case the size of family is adopted as the proportional parameter of collection load, people's efforts to reduce the waste discharge are not appreciated. People will lose incentive for material recycling and waste reduction

with the parameter of family size. To keep the incentive to reduce waste discharge, the proportional charging is still suitable to the households if we have a reasonable parameter of collection load.

Among various method of proportional charging adopted in Europe and Japan, designated containers or bags are recommendable to the LGUs in NCR. Designated containers or bags are exclusively allowed to discharge waste to the municipal collection routine. The containers can be used repeatedly for long time, however, the bags can serve for discharge only one time. The fee can be charged as the rental fee or registration fee of designated containers or the sale of bags by municipalities who deliver the waste collection service. Residents may choose appropriate size and number of containers or bags based on the estimated volume of waste they discharge and the frequency of collection service they receive. The detail of application of this method varies by LGUs due to different management system, however, above mentioned charging system is considered applicable to each LGU in NCR.

(4) Manner of Introduction

The consciousness of people observed in the questionnaire survey to the residents in NCR implies that the imposition of tipping fee should be introduced carefully. The willingness to pay on the other hand depends on the achievement of SWM so that a good performance of collection and successive process of SWM is quite important. The commencement of fee collection may give a compulsory impression to the people so that the sufficient explanation is necessary in advance. MMDA and LGUs are therefore pursue the better SWM system at the minimum cost and demonstrate the intention clearly to the residents together with the necessity of fee imposition. The billing is to be periodical at an interval of one month or several months according to the capacity of the section in charge of fee collection. To prevent the "free riding", some measures to enforce the payment is desirably developed as part of fee collection procedure.

### 5.2.3 Compensation Scheme to Local Community

Neighboring communities to the project site are more or less affected by the construction and operation of sanitary landfill however it is designed to mitigate negative effects. Relevant municipalities are Antipolo, San Mateo and Montalban in Rizal Province. Immediate neighbors in the said municipalities are all initially illegal residents in the state-owned land, but they have the same right to claim the compensation for inconvenience caused by a public facility as legitimate residents according to the legal system of this country. Based on this recognition, an "improvement compensation package" is recommended as stated in Chapter 5 of the Master Plan.

The "improvement compensation package" intends to mitigate uneven share of benefit and burden derived from collective solid waste dumping in a specific location. People in NCR enjoy benefit only owing to periodical waste collection and disposal far away

from their residence. Local communities in the three municipalities in Rizal province may suffer to the contrary from the negative impact by disposal of solid waste brought from outside. This package is offered to local communities so as to compensate the unavoidable negative impacts foreseen.

To establish the "improvement compensation package", a "community relations ad hoc committee" should be set up by the attendance of MMDA representatives, LGU officials and community leaders belonging to the affected municipalities. The package may include the construction of infrastructure and subsidy for the affected communities within an extent the committee recognizes appropriate to compensate the disadvantages the communities undergo and affordable for LGUs in NCR. The discussion in the tripod committee shall lead to a "package compensation deal" which shall be incorporated in New Parcel B Sanitary Landfill project and accordingly budgeted.

## 6. Project Evaluation

The development of the New Parcel B SLF site is evaluated from the technological, social, environmental, economic and financial viewpoints.

### 6.1 Technical Evaluation

#### 6.1.1 Development of the New Parcel B

(1) Groundwater contamination

The soil at the project site is not very permeable. There are also no geological faults in the project site. If the clay liner is appropriately installed, groundwater resources can be protected from leachate intrusion.

(2) Self-sufficiency in covering material

The required volume of covering soil for the sanitary landfill operation is estimated at 2.8 million $m^3$ (refer to Table 4.1.1). On the other hand, the construction of the New Parcel B SLF site has produced a residue of exactly the same amount. Therefore, the required covering soil can be provided from within the project site.

(3) Improvement of runoff water quality

Only the treatment of BOD was considered in the development of the San Mateo and Carmona SLD sites. In addition to BOD, the treatment for SS (suspended solids) and COD are considered in this project through the installation of a sand filter tank and activated carbon treatment tank.

#### 6.1.2 Access Road Construction

(1) Anti-disaster

The access road should not be closed for solid waste management services in Manila to continue. This access road has to be constructed by a large scale cutting partially because it is planned in a steep mountainous area. To avoid traffic congestion due to land collapse or erosion, sufficient slope protection and an efficient drainage system are considered.

(2) Compensation

There are several houses on the proposed route in Sitio Wawa and Bgy. Pintong Bocaue. Removal of these houses would be inevitable for the construction. However, the executing agency of the project should compensate the people involved especially in consideration of public cooperation, which is vital to the successful implementation of the project.

## 6.2 Social Evaluation

Proposed project of a new sanitary landfill in adjacent town is apparently favorable to the residents in NCR who are exempted to keep contact with the garbage once they discharge their waste to collection routine. The problem is shifted to the residents of project site, final disposal site and access road. The project is therefore divided into two parts: one is the urgent improvement of existing landfill site particularly leachate treatment and the other is the construction of new sanitary landfill and improvement of access road. Some direct neighbors of existing disposal site will be surely escaped from adverse effect of leachate by installation of new treatment plant, which is proposed as urgent scheme. The whole neighbors may still undergo some inconvenience due to heavy traffics of haulage vehicles and dumping operation, however, they can claim the compensation through the package deal scheme. Uneven benefit of the residents between NCR and the project site must be solved through the contribution of NCR residents, then the bottleneck of SWM can be barely settled from now on.

## 6.3 Environmental Evaluation

The construction and operation of new sanitary landfill including access road will have a potential to affect the environment around the site.

At construction site, resettlement problem, air pollution, water pollution and noise will occur by construction works. However, the adequate compensation program and countermeasures will be implemented, therefore the impacts will be minimized.

At operation stage, air pollution, offensive odor, water pollution and noise be occurred by operation of sanitary landfill and transportation. However, the adequate facility with adequate design will be established, therefore the impacts will be minimized.

On the other hand, the operation of new sanitary landfill will reduce the various problems caused by solid waste in Metro Manila. Therefore, the implementation of the new sanitary landfill project is evaluated to produce favorable results totally.

## 6.4 Financial Evaluation

### 6.4.1 General

In Metro Manila, the SWM cost is currently financed through the general budget of MMDA and LGUs and the mechanism of current cost burden is shown in Figure 6.4.1. Basically, MMDA finances the costs of the final disposal sites, while the LGUs finance the collection and haulage costs.

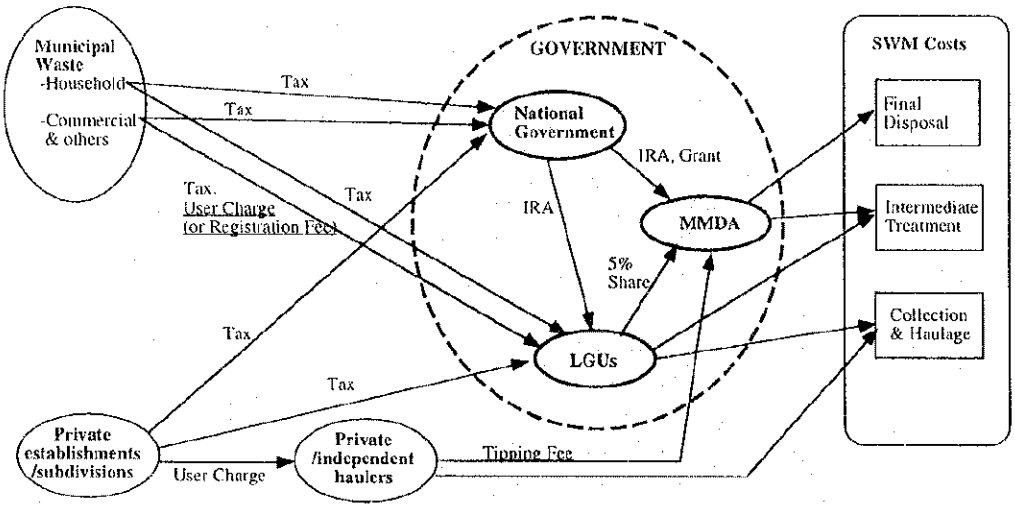



**Figure 6.4.1 SWM Cost Burden in Metro Manila**

In MMDA, the operation and maintenance costs of final disposal are financed through the current budget including inter-governmental transfers such as IRA and mandatory contributions of the component LGUs. In addition, MMDA obtains the funds for the capital investment of the final disposal sites through the grants from the central government.

On the other hand, the LGUs have the funds mostly through local tax, property tax and IRA and 5 % of their budget revenue less IRA is transferred to MMDA. The user charges on the business waste or the registration fee of the business establishments partly recover the costs of the SWM of LGUs, however, the rate of charges is too low to recover the costs.

As the cost burden of SWM is linked in this manner, it is insufficient to discuss independently the cost recovery of the development costs of the New Parcel B in Pintong Bocaue in the financial evaluation. In this section, therefore, the financing sources of the inland final disposal proposed in Master Plan will be discussed in the context of the proposed institutional framework and the viability of the development of the New Parcel B in Pintong Bocaue will be evaluated. Consequently, the effects and affordability of the LGUs and the households to shoulder the additional costs of the New Parcel B in Pintong Bocaue will be examined.

### 6.4.2 Development of Inland Final Disposal and Cost Recovery during Master Plan Period

Table 6.4.1 summarizes the required fund of Master Plan from 1998 to 2010 by implementing body. The total SWM costs, including the initial investment cost and the operation and maintenance costs, have been estimated at 80,0000 million pesos and the average SWM cost of the collected waste per ton is calculated at about 2,080 pesos in 1997 prices.

**Table 6.4.1 Required Fund (1998 - 2010) and Implementing Body of Master Plan**

Unit: million pesos

| Implementing | Initial Allocation of Required | | | | |
|---|---|---|---|---|---|
| | Total | Central Gov't | MMDA | | LGUs |
| | | | MMDA | BOT | |
| 1 Technical System | | | | | |
| Collection & Haulage | 12,800 | | | | 12,800 |
| Transfer Station | | | | | |
| Las Pinas | 800 | | | | 800 |
| Marikina | 2,200 | | | | 2,200 |
| Fort Bonifacio | 1,600 | | | | 1,600 |
| Manila | 1,700 | | | | 1,700 |
| Compost Plant | | | | | |
| Pintong Bocaue | 1,700 | | | 1,700 | |
| Sea Landfill Site | 1,800 | | | 1,800 | |
| Recycle Center | 600 | | | | 600 |
| Incineration Plant | 19,000 | | | 19,000 | |
| Final Disposal | | | | | |
| Pintong Bocaue | 15,900 | | 15,900 | | |
| Sea Landfill | 17,300 | | | 17,300 | |
| San Mateo | 2,100 | | 2,100 | | |
| Total (Technical System) | 77,500 | 0 | 18,000 | 39,800 | 19,700 |
| 2 Institutional Measure | 200 | | | | |
| 3 Compensation | 2,300 | | | | |
| Grand Total | 80,000 | | | | |

Source: Table 7.2.1 in Chapter 7, Master Plan Report

In the Master Plan, the sanitary inland landfill and sealandfill with the incineration have been proposed for the final disposal. The final disposal in inland sanitary landfill has been recommended for implementation under the conventional formation of MMDA and DPWH, while the new formation including BOT scheme need to be established for the implementation of the incineration plant and sealandfill.

For the development and operation and maintenance of the inland final disposal, an amount of 18,000 million pesos or the unit cost at about 550 pesos per ton has been required in 1997 prices in the Master Plan.

In order to recover the cost of the disposal, MMDA has the following four potential options to finance:

- grants from the central government for the capital investment cost of the final disposal site;

- the LGUs Contributions (5% Share to MMDA) which is currently provided with the stable remittance, as the chargeable amount is disbursed to MMDA from the DBM deducted from the individual IRA of 17 LGUs;
- tipping fees at disposal sites; and
- user charges from households;

Grants from the Central Government:

In the assumption of the cost recovery of the final inland disposal site, the grants of the central governments are eliminated from the potential funds of sources, since the possibility to obtain the grants from the central government is not stable and continuos. Furthermore, because of the responsibilities of MMDA and the LGUs for providing the SWM services and the autonomous SWM by MMDA and LGUs, the options of funds are assumed to be financed within MMDA and the LGUs.

LGUs Contributions to MMDA (5 % Share to MMDA)

Provided the whole LGUs Contributions could be consumed for the expenditure of final inland disposal of waste, an amount of 312 pesos per ton is available to be allocated in 1998 as shown in Table 6.4.2. The amount is, therefore, insufficient to recover the full costs of final inland disposal: 550 pesos per ton and furthermore, the whole amount of the Contributions can not be consumed only for the SWM services but also for the transportation and traffic services, flood control and sewerage management services, etc.

**Table 6.4.2 LGUs Contribution and Waste Amount**

| | 1998 | |
|---|---|---|
| Waste Amount of Final Inland Disposal | 4,191 | ton per day |
| | 1,529,715 | ton per year |
| LGUs Contribution | 476.99 | million pesos |
| LGUs Contribution per Final Disposal Amount | 312 | pesos per ton |

Source: MMDA Budget in 1998 and JICA Study Team

Tipping Fees at Disposal Sites

On the other hand, if MMDA could impose the tipping fee at a rate of 550 pesos per ton to every waste for inland disposal, the costs could be fully recovered.

In August 1998, Metro Manila Council approved the imposition and collection of the service fees from private contractors for the use of MMDA-operated sanitary landfill facilities and the following rates of fees are authorized:

| | |
|---|---|
| 4 Wheeler Truck (Canter Type) | 150 pesos per trip |
| 6 Wheeler Truck | 350 pesos per trip |
| 10 Wheeler Truck | 430 pesos per trip |

The fees are collected from private/independent haulers serving private establishment and subdivisions, while the contractors dependent on LGUs are not imposed. As the capacity of 10 Wheeler Truck is 15 m3, tipping fee is calculated at 28.5 pesos per m3 or

approximately 100 pesos per ton, which will recover less than one fifth of the unit cost of the Master Plan.

The reasonable rate of tipping fees may encourage the LGUs' efforts to reduce the amount of waste to some extent when tipping fees are charged based on volume or weight of waste, however, the charging may also encourage illegal dumping of the contractors without any effective enforcement of illegal dumping.

Cost Recovery of the Final Inland Disposal during Master Plan (A Option)

For the cost recovery of the project, the compromise between appropriation of the current budget of MMDA and the imposition of user charges such as tipping fees and garbage fee would be practical.

Table 6.4.3 shows one of the options to recover the full costs (18,000 million pesos) of the projects proposed in the Master Plan under the following assumptions of the financing:

- to impose tipping fees on *industrial waste* at a rate of 550 pesos per ton from 1999 so as to recover the full cost of final disposal for industrial waste;
- to impose tipping fee on *municipal waste* at Pintong Bocaue at a rate of 300 from 2002 so as to recover approximately a half of the disposal cost of municipal waste and the fees are imposed on the waste collected by the LGUs including the contractors dependent on the LGUs and the private/independent haulers; and
- to appropriate half of the LGUs' contributions to SWM.

As shown in Table 6.4.3, 6.4.4 and Figure 6.4.2, the amount of 18,206 million pesos of the cost is estimated to recover by the revenue of 18,416 million pesos and the FIRR is estimated at 0.4%. The cost of the final inland disposal is recovered from the financing under the above assumptions, though the opportunity cost of capital is not taken into account.

**Table 6.4.3 Cost Recovery of Inland Disposal of Master Plan by MMDA (An Option)**

Unit: million pesos

| | - 2000 | 2001-2005 | 2006-2010 | 2011-2015 | Total |
|---|---|---|---|---|---|
| Cost | 1,109 | 8,578 | 8,270 | 250 | 18,206 |
| Revenue | 742 | 4,542 | 6,467 | 6,667 | 18,416 |
| Tipping Fees from Industrial Waste | 217 | 643 | 799 | 921 | 2,579 |
| Tipping Fees from Municipal Waste at the New Disposal Site | 0 | 2,282 | 3,505 | 3,017 | 8,804 |
| Appropriation from LGU contribution | 525 | 1,616 | 2,163 | 2,729 | 7,033 |
| Balance | -367 | -4,036 | -1,803 | 6,417 | 210 |
| Cumulative Balance | | -4,403 | -6,207 | 210 | 210 |
| FIIR of Balance | | | | | 0.40% |

Source: JICA Study Team

Note: Cost includes the O & M cost until 2015 and the revenues include the revenue from the disposal waste until 2015, as the site is designed for the capacity of the waste amount until 2015.

Table 6.4.4

## Disposal Waste, Inland Disposal Costs and Cost Recovery by MMDA (One Option)

### (1) Disposal Waste excluding Sea Landfill

| | 1998-2010 | 1998-2015 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Daily Disposal Amount (ton/day) | | | 4,191 | 4,483 | 4,774 | 5,140 | 5,506 | 5,872 | 6,238 | 5,980 | 6,287 | 6,595 | 6,902 | 7,209 | 5,017 | 5,177 | 5,340 | 5,507 | 5,677 | 5,851 |
| (Pintong Bocaue) | | | (0) | (0) | (0) | (0) | (2,753) | (3,872) | (6,238) | (5,980) | (6,287) | (6,595) | (6,902) | (7,209) | (5,017) | (5,177) | (5,340) | (5,507) | (5,677) | (5,851) |
| Annual Disposal Amount (ton/year) | 27,080,408 | 37,137,090 | 1,529,836 | 1,636,174 | 1,742,510 | 1,876,100 | 2,009,690 | 2,143,280 | 2,276,870 | 2,182,627 | 2,294,792 | 2,406,993 | 2,519,157 | 2,631,358 | 1,831,023 | 1,889,543 | 1,949,234 | 2,010,118 | 2,072,221 | 2,135,565 |

* In the Master Plan the final disposal sites are designed to have the capacity to be disposal the waste until 2015 and Pinton Bocaue will be utilized from the middle of 2002.

### (2) Cost

| | | 1998-2010 (mil. pesos) | 1998-2015 (mil. pesos) | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Final Inland Disposal | San Mateo | 2,023 | 2,023 | 33 | 122 | 608 | 750 | 443 | 67 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Pintong Bocaue | 15,934 | 16,183 | 0 | 0 | 345 | 345 | 2,589 | 2,589 | 897 | 897 | 1,073 | 321 | 325 | 4,256 | 2,295 | 50 | 50 | 50 | 50 | 50 |
| | Total | 17,957 | 18,206 | 33 | 122 | 954 | 1,095 | 3,032 | 2,656 | 897 | 897 | 1,073 | 321 | 325 | 4,256 | 2,295 | 50 | 50 | 50 | 50 | 50 |

* Unit Disposal Cost at Pingtan Bocaue 551 pesos

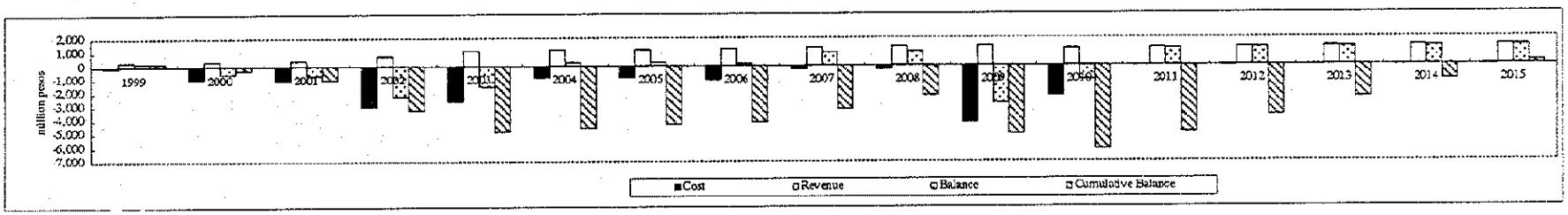
### (3) Revenue for Financing

| | 1998-2010 | 1998-2015 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1. Tipping Fee from Industrial Waste** | | | | | | | | | | | | | | | | | | | | |
| Tipping Fee (pesos/ton) Peso550 | | | | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 | 550 |
| Disposal Waste per Day | | | 491 | 523 | 558 | 584 | 611 | 639 | 669 | 700 | 730 | 761 | 794 | 828 | 864 | 881 | 899 | 917 | 935 | 954 |
| Annual Disposal Waste | 3,194,894 | 4,868,863 | 179,064 | 190,971 | 203,670 | 213,118 | 223,004 | 233,349 | 244,173 | 255,500 | 266,486 | 277,944 | 289,895 | 302,359 | 315,360 | 321,667 | 328,101 | 334,663 | 341,356 | 348,183 |
| Annual Tipping Fee (million pesos) | 1,656 | 2,579 | | 105 | 112 | 117 | 123 | 128 | 134 | 141 | 147 | 153 | 159 | 166 | 173 | 177 | 180 | 184 | 188 | 192 |
| **2. Tipping Fee for Municipal Waste at Pintong Bocaue from LGUs** | | | | | | | | | | | | | | | | | | | | |
| Tipping Fee (pesos/ton) Peso300 | | | | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |
| Disposal Waste per Day | | | 0 | 0 | 0 | 0 | 2,753 | 5,872 | 6,238 | 5,980 | 6,287 | 6,595 | 6,902 | 7,209 | 5,017 | 5,177 | 5,340 | 5,507 | 5,677 | 5,851 |
| Annual Disposal Waste | 19,290,943 | 29,347,625 | 0 | 0 | 0 | 0 | 1,004,845 | 2,143,280 | 2,276,870 | 2,182,627 | 2,294,792 | 2,406,993 | 3,519,157 | 2,631,358 | 1,831,023 | 1,889,543 | 1,949,234 | 2,010,118 | 2,072,221 | 2,135,565 |
| Annual Tipping Fee (million pesos) | 5,787 | 8,804 | 0 | 0 | 0 | 0 | 301 | 643 | 683 | 655 | 688 | 722 | 756 | 789 | 549 | 567 | 585 | 603 | 622 | 641 |
| **3. Appropiation from 5% Share** | | | *a | | | | | | | | | | | | | | | | | |
| LGUs Contributions (5% share) | 9,085 | 14,542 | 477 | 508 | 541 | 573 | 608 | 644 | 683 | 724 | 767 | 813 | 862 | 914 | 969 | 1,008 | 1,048 | 1,090 | 1,133 | 1,179 |
| Appropriation to SWM 50% | 4,304 | 7,033 | | 254 | 271 | 287 | 304 | 322 | 342 | 362 | 384 | 407 | 431 | 457 | 484 | 504 | 524 | 545 | 567 | 589 |
| Total Revenue | 11,750 | 18,416 | 0 | 359 | 383 | 404 | 728 | 1,094 | 1,159 | 1,157 | 1,219 | 1,282 | 1,346 | 1,413 | 1,207 | 1,248 | 1,289 | 1,332 | 1,376 | 1,422 |

*a: Budget in 1998 and the future growth is estimated based on the Economic Framework by JICA M/P

### (4) Balance

| | | 1998-2015 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Balance | | 210 | -33 | 237 | -571 | -691 | -2,304 | -1,563 | 262 | 260 | 146 | 961 | 1,022 | -2,844 | -1,088 | 1,198 | 1,239 | 1,282 | 1,326 | 1,372 |
| Cumulative Balance | | | -33 | 204 | -367 | -1,058 | -3,362 | -4,925 | -4,663 | -4,403 | -4,258 | -3,297 | -2,275 | -5,119 | -6,207 | -5,009 | -3,770 | -2,488 | -1,161 | 210 |
| FIRR 0.4% | | | | | | | | | | | | | | | | | | | | |



User Charge from Households

In the meantime, instead of imposing tipping fees on municipal waste at a rate of 300 pesos per ton, the collection of the user charges from the households is considered as another option. User charge at a rate of 20 - 25 pesos per family per month could obtain the same funds to recover the costs as the tipping fees, assuming that the daily garbage generation per person amounts to 500 g and one family consists of five members. However, based on the results of the Public Opinion Survey conducted by MMDA-JICA in 1997, the willingness to pay garbage charge is low in Metro Manila (refer to Box 6.1). The results revealed the following:

- One fourth of families are willing to pay fees for garbage collection, of which 40% are willing to pay less than 20 pesos per month, 23% will pay more than 20 pesos and others made no response as to the amount.
- Households that have no willingness to pay cited two reasons: 1) Municipality/City should bear the cost (74%); and 2) Service is very poor (25%).

The willingness to pay of the households will be motivated by the adequate collection services in their areas, while the benefits from disposal services will provide the impacts on the external environmental quality and public health. Therefore, the garbage fees of households should be imposed as garbage collection and haulage charges by the LGUs and that would be more reasonable and acceptable by households and, at the same time, encourage the efforts of the LGUs to provide better services to households.

Assuming the full cost recovery of the Master Plan for the services from collection to final disposal stage through user charges, 156 pesos per family per month is required to collect. As shown in Table 6.4.5, the amount is more than twice as the affordability of household in the low income group, which has been discussed in the Master Plan. In terms of the willingness to pay, the results of survey referred above reveal that 19 families, or 1.3% of the total 1,423 respondents, are thinking to pay more than 100 pesos per family per month.

**Table 6.4.5 User Charge of Household and Affordability to Pay**

| | |
|---|---|
| Average SWM cost per ton | 2,080 pesos/ton |
| Average household waste generation | 500 g/person/day |
| Household waste generation in 2000 (500 x 5 persons x 30 days) | 75,000 g/family/month |
| Average SWM cost per household per Month (2,080 x 0.075 t) | 156 pesos/family/month |
| Affordability of household to pay for SWM (1 % of disposal household income for low income group in Manila) | 80 pesos/family/month |

Source: JICA Study Team

As proposed in the Master Plan, in order to recover the cost of the proposed projects/programmes, an additional 0.12% of the GRDP is required to consume for the SWM in Metro Manila. For the additional sources of the fund, three alternatives have been proposed as follows:

- LGUs appropriate, as a whole, an additional 5% (15% of total revenue) for the SWM through the current budget of the LGUs.
- LGUs pay tipping fee at the disposal fee at the rate of 730 pesos per ton
- Imposition of garbage fees on households at the rate of 40 pesos per month per household

LGUs will be required an additional burden for SWM services, whether for the final disposal by MMDA or for the collection and haulage services of their own responsibility. Imposition of user charge of households is indispensable to obtain the additional and autonomous revenues independent from other expenditures in the budget of the LGUs.

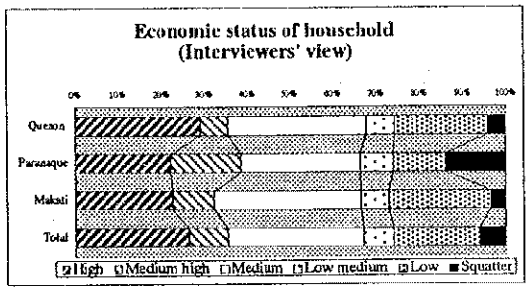
## Box 6.1: Results of Public Opinion Survey on Garbage Fee

# Garbage Fee

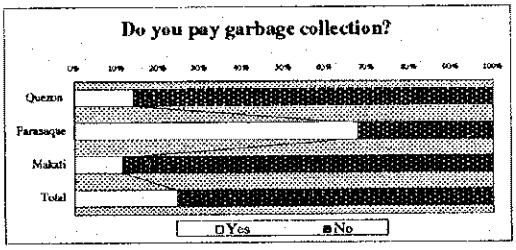
## Public Opinion Survey

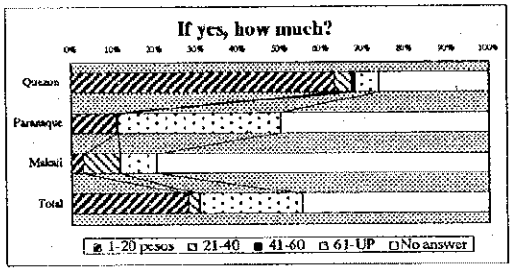
MMDA-JICA, 1997

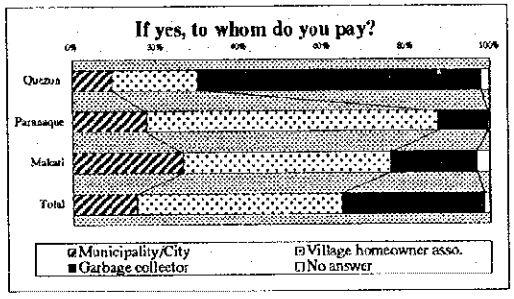
| Interviewee: | Quezon | 897 | Pranaque | 300 | Makati | 300 | Total | 1,497 |
|---|---|---|---|---|---|---|---|---|



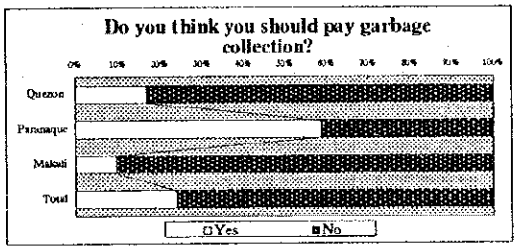

### *Present Situation*

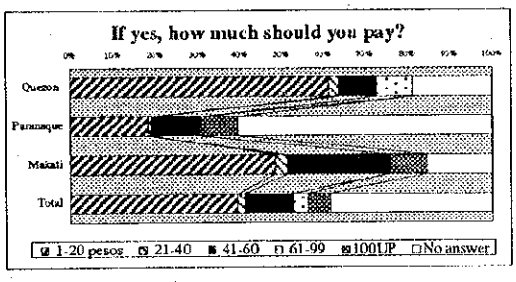


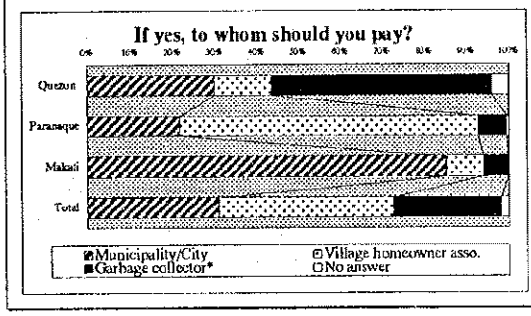




### *Willingness to Pay*



### 6.4.3 Financial Evaluation of New Sanitary Landfill Development Project (New Parcel B at Pingtong Bocaue)

#### (1) General Assumptions

For the financial evaluation of the Project the general assumptions have been taken into account as follows:

- Costs and revenues are estimated using the prices as of the end of October 1998 and inflation is not taken into account to calculate the FIRR of the Project.

- Foreign exchange rate as of the end of October 1998 is used during the whole period of the evaluation as follows:

  US$ = 40.35 pesos, 1.00 US$ = Japanese Yen 116.5 and 1.00 pesos = Japanese Yen 2.88

- Evaluation Period is assumed from 2000 to 2032 considering the cost allocation required for the environmental conservation until 2030 and the repayment conditions of the soft loans assumed until 2032.

- As the life period of the proposed facilities is assumed to be complete and the replacement costs is not required during the project life, the salvage values of the facilities are not taken into account.

- As the life period of the road is usually estimated to be 50 years, the depreciation cost of the access road is calculated based on the life period by the straight line method. After the completion of the disposal in the New Parcel B in 2009, the depreciation cost of the access road should be shouldered by the budget of the new site of the final disposal from 2010.

- The budget revenues of MMDA and the LGUs will correspondingly increase with the growth of the GRDP in Metro Manila projected in the planning framework in the Master Plan. Mandatory contribution to MMDA by the LGUs will be the same rate: 5% of the budget revenues of the LGUs less IRA during the project period

#### (2) Cost Components

Table 6.4.6 shows the capacity of waste disposal and the components of the development costs of the New Landfill Site of the New Parcel B in Pintong Bocaue by the following three phases:

- Construction phase: 2000 - 2003;
- Utilizing phase: 2004 - 2009; and
- Conservation phase: 2010 – 2030

The total project cost is estimated at 7,197 million pesos from 2000 to 2030, which includes the construction cost from 2000 to 2003, the operation and

maintenance costs during the utilizing period and the environmental conservation cost until 2030. The total amount of 13,913 thousand tons of waste or 20,000 thousand m3 including covering soil can be disposable on the site of the Project during the period from 2004 to 2009.

**Table 6.4.6 Disposal Amount and Project Cost**

Unit: million pesos

| | Phase | | | Total | |
|---|---|---|---|---|---|
| | Construction | Utilizing | Conservation | | |
| | 2000-2003 | 2004-2009 | 2010-2030 | | |
| I. Disposal Waste Amount | | | | | |
| Disposal Amount/Year (000 ton) | 0 | 13,913 | 0 | 13,913 | |
| Disposal Amount/Year (000 m3) | 0 | 17,391 | 0 | 17,391 | |
| Disposal Amount with Covering Soil (000 m3) | 0 | 20,000 | 0 | 20,000 | |
| II. Project Cost (million pesos) | | | | | |
| 1) Investment Cost | 4,286 | 0 | 0 | 4,286 | 59.5% |
| - New Parcel B | 3,190 | 0 | 0 | 3,190 | 44.3% |
| - Access Road | 1,096 | 0 | 0 | 1,096 | 15.2% |
| 2) Operation & Maintenance | 0 | 2,610 | 0 | 2,610 | 36.3% |
| - New Parcel B | 0 | 2,577 | 0 | 2,577 | 35.8% |
| - Access Road | 0 | 33 | 0 | 33 | 0.5% |
| 3) Leachate Treatment | 0 | 89 | 89 | 177 | 2.5% |
| 4) Monitoring | 0 | 107 | 17 | 125 | 1.7% |
| Total Cost | 4,286 | 2,806 | 106 | 7,197 | 100.0% |

Source: JICA Study

As discussed previously, the SWM is recurrent cost intensive. As shown in Table 6.4.6, the investment cost amounts to 60% of the total cost, while the share of recurring cost, such as operation and maintenance cost, leachate treatment cost and monitoring cost, amounts to 40 % of the total cost. As the share of recurring cost of SWM is very high compared with the common infrastructure developments, it is essential to obtain the stable and continuos funds to finance the recurring costs as well as the initial capital investment cost in the financing plan. Environmental costs, such as the leachate treatment and monitoring, costs shares 4.2% of the total cost.

The flow of cost and benefit shows unusual feature as the typical infrastructure projects where the projects require a huge investment costs in the initial stage and provide gradually the benefits afterwards for a long period. In this project, the capital investment is required during the first four (4) years from 2000 to 2003, the developed site is used for the waste disposal for six (6) years from 2004 to 2009 and after that it is continuously required to shoulder the cost in order to conserve the site under the environmentally acceptable level for more than 20 years.

Unit cost per disposal waste amount is calculated to be 449 pesos per ton as shown Table 6.4.7, which is lower than the average unit cost of 550 pesos per ton, estimated for the final inland disposal in the Master Plan period.

Table 6.4.7 Average Unit Project Cost per Disposal Waste

| | Total cost (2000 - 2030) (million pesos) | Unit cost (pesos per ton) |
|---|---|---|
| Project Cost | | |
| 1) Investment Cost | 4,286 | 239 |
| - New Parcel B | 3,190 | 229 |
| - Access Road | 1,096 | 10 |
| 2) Operation & Maintenance | 2,610 | 188 |
| - New Parcel B | 2,577 | 185 |
| - Access Road | 33 | 2 |
| 3) Leachate Treatment | 177 | 13 |
| 4) Monitoring | 125 | 9 |
| Total Cost | 7,197 | 449 |

Source: JICA Study Team
Note: The life period of the access road is taken into account to estimate the unit investment cost of the access road.

### (3) Economic Cost

The capital investment cost consists of the local and foreign currencies as shown in Table 6.4.8. The local currency and foreign currency are estimated at 1,747 and 2,539 million pesos, respectively and account for 41% and 59% of the total capital investment costs, respectively.

The investment cost of the project is converted into economic cost as shown in Table 6.4.9 taking into account of the shadow pricing as follows:

- Economic costs of the unskilled labor is estimated at 70% of the market prices according to NEDA's estimation;
- Value added tax are excluded from the cost; and
- The import duties are excluded from the costs of imported goods.

The shadow exchange rate is not considered as the imported goods are converted into pesos using the actual foreign exchange rate of the end of October 1998. The economic cost reduces to 3,646 million pesos or 85% of the market price of the Project after eliminating the transfer costs such as tax in the national economy and estimating the cost of unskilled labor at opportunity cost as shown in Table 6.4.9.

## Table 6.4.8 Portion of Local and Foreign Currency of Capital Investment Cost of the Project

Unit: million pesos

| | Total cost | Currency | | Components | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Local | Foreign | Equipment | | | Material | | | Labour | | |
| | | | | Total | L/C | F/C | Total | L/C | F/C | Total | L/C | F/C |
| Final Disposal Site | | | | | | | | | | | | |
| Construction | | 38% | 62% | | 20% | 80% | | 73% | 27% | | 95% | 5% |
| | 2,417 | 914 | 1,503 | 1,675 | 335 | 1,340 | 565 | 411 | 154 | 177 | 168 | 9 |
| Engineering Fee | | 10% | 90% | | | | | | | | 10% | 90% |
| | 242 | 24 | 218 | | | | | | | 242 | 24 | 218 |
| Contingency | | 35% | 65% | | 20% | 80% | | 73% | 27% | | 46% | 54% |
| | 532 | 188 | 344 | 335 | 67 | 268 | 113 | 82 | 31 | 84 | 38 | 45 |
| Subtotal | | 35% | 65% | | 20% | 80% | | 73% | 27% | | 46% | 54% |
| | 3,190 | 1,126 | 2,064 | 2,010 | 402 | 1,608 | 678 | 493 | 185 | 502 | 230 | 272 |
| Access Road | | | | | | | | | | | | |
| Construction | | 61% | 39% | | 36% | 64% | | 42% | 58% | | 89% | 11% |
| | 830 | 509 | 321 | 301 | 109 | 193 | 152 | 64 | 88 | 377 | 337 | 40 |
| Engineering Fee | | 10% | 90% | | | | | | | | 10% | 90% |
| | 83 | 8 | 75 | | | | | | | 83 | 8 | 75 |
| Contingency | | 57% | 43% | | 36% | 64% | | 42% | 58% | | 75% | 25% |
| | 183 | 104 | 79 | 60 | 22 | 39 | 30 | 13 | 18 | 92 | 69 | 23 |
| Subtotal | | 57% | 43% | | 36% | 64% | | 42% | 58% | | 75% | 25% |
| | 1,096 | 621 | 474 | 362 | 130 | 231 | 182 | 76 | 106 | 552 | 415 | 137 |
| Total | | | | | | | | | | | | |
| Construction | | 44% | 56% | | 22% | 78% | | 66% | 34% | | 91% | 9% |
| | 3,247 | 1,423 | 1,824 | 1,977 | 444 | 1,533 | 717 | 474 | 242 | 553 | 505 | 49 |
| Engineering Fee | | 10% | 90% | | | | | | | | 10% | 90% |
| | 325 | 32 | 292 | 0 | 0 | 0 | 0 | 0 | 0 | 325 | 32 | 292 |
| Contingency | | 41% | 59% | | 22% | 78% | | 66% | 34% | | 61% | 39% |
| | 714 | 291 | 423 | 395 | 89 | 307 | 143 | 95 | 48 | 176 | 107 | 68 |
| Total | | 41% | 59% | | 22% | 78% | | 66% | 34% | | 61% | 39% |
| | 4,286 | 1,747 | 2,539 | 2,372 | 533 | 1,839 | 860 | 569 | 291 | 1,054 | 645 | 409 |

Source JICA Study Team

## Table 6.4.9 Capital Investment Cost in Economic Prices

Unit: million pesos

| | Total cost | Components | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Equipment | | | Material | | | Labour | | | |
| | | Total | L/C | F/C | Total | L/C | F/C | Total | L/C | | F/C |
| | | | | | | | | | skilled | unskilled | |
| Final Disposal Site | | | | | | | | | | | |
| Construction | 2,043 | 1,412 | 305 | 1,107 | 501 | 374 | 127 | 130 | 77 | 45 | 8 |
| Engineering Fee | 242 | | | | | | | 242 | 24 | 0 | 218 |
| Contingency | 457 | 282 | 61 | 221 | 100 | 75 | 25 | 74 | 20 | 9 | 45 |
| Subtotal | 2,742 | 1,695 | 366 | 1,329 | 601 | 448 | 153 | 447 | 121 | 54 | 271 |
| Access Road | | | | | | | | | | | |
| Construction | 670 | 258 | 99 | 159 | 131 | 58 | 73 | 281 | 153 | 92 | 36 |
| Engineering Fee | 83 | | | | | | | 83 | 8 | 0 | 75 |
| Contingency | 151 | 52 | 20 | 32 | 26 | 12 | 15 | 73 | 32 | 18 | 22 |
| Subtotal | 904 | 310 | 118 | 191 | 157 | 69 | 88 | 437 | 194 | 110 | 133 |
| Total | | | | | | | | | | | |
| Construction | 2,713 | 1,670 | 404 | 1,267 | 632 | 431 | 200 | 412 | 230 | 137 | 44 |
| Engineering Fee | 325 | 0 | 0 | 0 | 0 | 0 | 0 | 325 | 32 | 0 | 292 |
| Contingency | 608 | 334 | 81 | 253 | 126 | 86 | 40 | 147 | 53 | 27 | 67 |
| Total | 3,646 | 2,004 | 484 | 1,520 | 758 | 518 | 240 | 884 | 315 | 165 | 404 |

Source: JICA Study Team

### (4) Financing Resources and Options

Under the same concept of the financing options, which has been examined in the previous section for the cost recovery of the final inland disposal proposed in the Master Plan, the viability of the New Sanitary Landfill Development Project in New Parcel B at Pingtong Bocaue will be evaluated. Furthermore, in order to finance the shortage of the cash flow for the initial investment of the Project, the provision of external financing sources is assumed. MMDA could obtain the funds through the following resources in the evaluation:

1) Tipping fees at the disposal site;
2) Garbage fees from household;
3) Current budget of MMDA through LGU contributions (5% share to MMDA); and
4) Soft loans at subsidized conditions.

Firstly, overall assumptions of funds are considered as follows:

1) Costs for the industrial waste are fully recovered through tipping fees and those costs should be shouldered by the final consumers through market mechanism;
2) Half of the total LGU contributions are allocated to the Project during the period of the Utilizing Phase from 2003 to 2009;
3) Operation and maintenance costs of municipal waste are financed through tipping fees collected from the LGUs;
4) 85 %of the capital investment cost is financed by the soft loans, and two typical types of loan conditions in Table 6.4.10 are examined: the Yen Loan for the environmental project and the typical loan by the multilateral development financing agencies;
5) Interest payments during the Construction Phase from 2000 to 2003 are financed by the current budget of MMDA; and
6) Environmental costs during the Conservation Phase from 2010 to 2030 are financed by the current budget of MMDA.

**Table 6.4.10 Conditions of Soft Loan**

| | Yen Loan | Multilateral Dev't Finance Agencies |
|---|---|---|
| Interest Rate | 1.3% | 6.0% |
| Repayment period | 30 years | 20 years |
| Grace period | 10 years | 5 years |

Note: Repayment period includes the grace period.

Secondly, four (4) options are assumed as shown in Table 6.4.11 based on the specific assumptions of two types of loan conditions and how to recover the remaining costs or the shortage of funds under the overall assumptions.

**Table 6.4.11 Four Options and Premises**

| | Type of Loan | Adjustment of Finance for Cost | |
|---|---|---|---|
| | | Appropriation of LGUs Contribution | Tipping Fees on Municipal Waste |
| Option 1 | Yen Loan | | - The rate of Tipping Fee is designed not only to recover O & M but also to finance the remaining funds required in order to recover the full cost of the Project |
| Option 2 | Yen Loan | - The LGUs Contributions are appropriated so as to finance the remining funds for the cost recovery of the Project | |
| Option 3 | Soft Loan from Multilateral Development Finance Agency | | - The rate of Tipping Fee is designed not only to recover O & M but also required in order to recover the full cost of the Project |
| Option 4 | Soft Loan from Multilateral Development Finance Agency | - The LGUs Contributions are appropriated so as to finance the remining funds for the cost recovery of the Project | |

Source: JICA Study Team

### (5) Evaluation of Financing Options

Table 6.4.12 shows the total project cost and the average unit cost per ton of disposal waste including the interest payment of the long-term loan during the project period from 2000 to 2032 in 1998 constant prices. The life period of the access road is taken into account for the estimation of the unit cost.

**Table 6.4.12 Total Cost and Unit Cost of the Project including Interest Cost of Long-term (1998 constant prices)**

| | Total Project cost (million peso) (2000 - 2032) | | | | Average Unit Project Cost per ton (peso per ton) | | | |
|---|---|---|---|---|---|---|---|---|
| | Option 1 & 2 | | Option 3 & 4 | | Option 1 & 2 | | Option 3 & 4 | |
| Construction cost | 4,286 | 53% | 4,286 | 44% | 239 | 48% | 239 | 40% |
| O & M | 2,610 | 32% | 2,610 | 27% | 188 | 38% | 188 | 32% |
| Leachate Treatment & Monitoring | 302 | 4% | 302 | 3% | 22 | 4% | 22 | 4% |
| Interest Payment | 923 | 11% | 2,623 | 27% | 51 | 10% | 146 | 25% |
| Total | 8,121 | 100% | 9,821 | 100% | 500 | 100% | 595 | 100% |

Source: JICA Study Team

Because of the different conditions of loans provided, the total interest payment amounts to 923 million pesos and 2,623 million pesos for Option 1 & 2 and Option 3 & 4, respectively. The share of interest payment of the unit cost is 10% and 25% Option 1 & 2 and Option 3 & 4, respectively.

The required amounts from the individual financing sources are estimated for the project life period from 2000 to 2032, based on the assumptions of four Options, in Table 6.4.13 and the conditions to recover those amounts through the individual financing sources are estimated in Table 6.4.14.

**Table 6.4.13 Financing Resources and Required Amount by Options (1998 constant prices)**

| Financing Sources | Option 1 | | Option 2 | | Option 3 | | Option 4 | |
|---|---|---|---|---|---|---|---|---|
| LGU contribution | 3,127 | 47% | 3,500 | 53% | 3,886 | 49% | 4,632 | 59% |
| Tipping fee (LGU) | 2,689 | 41% | 2,316 | 35% | 3,062 | 39% | 2,316 | 29% |
| Tipping fee (IDW) | 784 | 12% | 784 | 12% | 932 | 12% | 932 | 12% |
| Total | 6,600 | 100% | 6,600 | 100% | 7,880 | 100% | 7,880 | 100% |

Source: JICA Study Team

Note: The total costs in the table are different from the total costs in Table 6.4.12, as the life period of the access road is considered and the salvage value are excluded from the cost.

**Table 6.4.14 Conditions to Recover Project Cost by Options**

| | Option 1 | Option 2 | Option 3 | Option 4 |
|---|---|---|---|---|
| - Share of the Prject Cost of LGUs Contributions | 50% | 58% | 50% | 66% |
| - Rate of Tipping Fee (Municipal Waste) | 218 peso/ton | 188 peso/ton | 248 peso/ton | 188 peso/ton |
| - Rate of Tipping Fee (Industrial Waste) | 500 peso/ton | 500 peso/ton | 595 peso/ton | 595 peso/ton |

Source: JICA Study Team

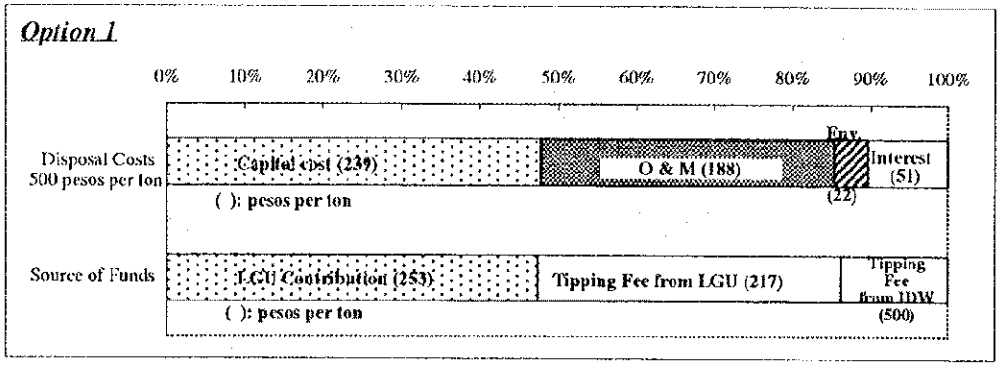
Under the assumptions of Option 1, 2, 3 and 4, it is required to recover the full cost of the Project as follows:

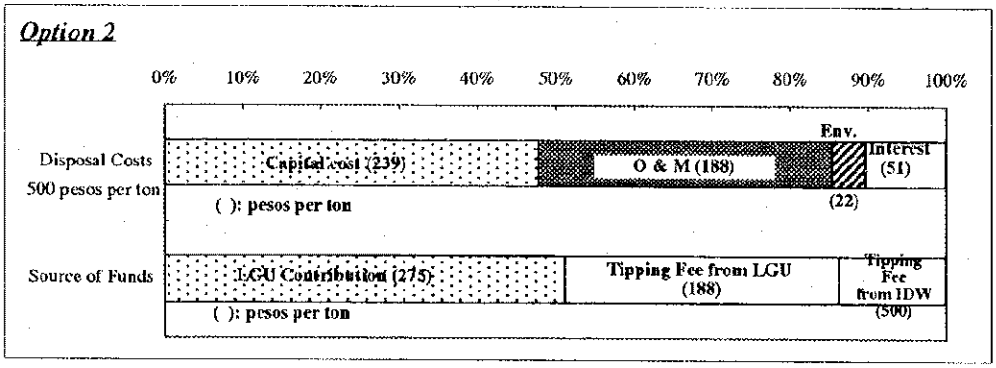
- The LGU Contributions are required to be appropriated to the Project at 50%, 58%, 50% and 66% for Option 1, 2, 3 and 4, respectively;
- As the operation and maintenance cost is estimated at 188 pesos per ton, the rate of tipping fee for the municipal waste is 188 pesos per ton for Option 2 and 4.
- Provided only a half of the LGU contributions is appropriated to the Project, the rate of tipping fee for the municipal waste should increase from 188 pesos per ton to 218 pesos per ton and 248 pesos per ton for Option 1 and Option 3, respectively.
- Rate of tipping fee for the industrial waste is 500 pesos per ton and 595 pesos per ton for Option 1 & 2 and Option 3 & 4, respectively, based on the unit cost calculated in Table 6.4.12

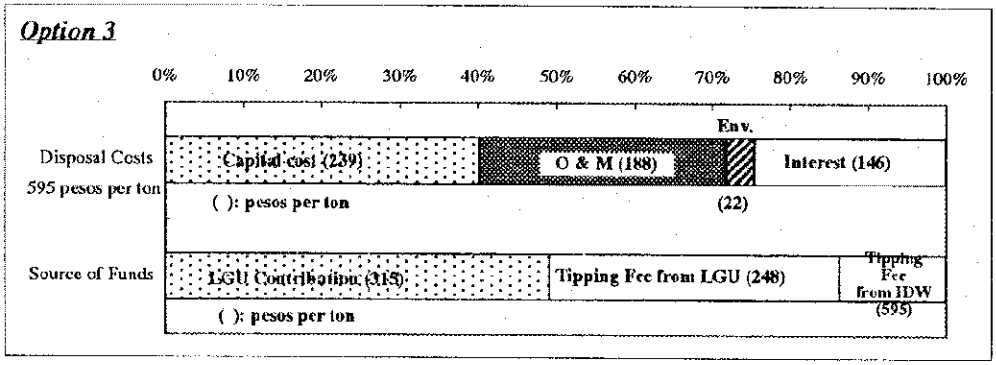
Figure 6.4.3 shows the component of the Project cost and the required funds of source by total amount and unit cost for four options.

In Option 1, it is required that the LGUs will finance the additional burden through tipping fee, while MMDA is required to appropriate the costs under the current expenditure allocation of budget. Option 2 requires MMDA and the LGUs

to generate the additional funds to allocate to the Project. The financing scheme of Option 2 will clarify the accountability of the Project cost between MMDA and LGUs than Option 1.



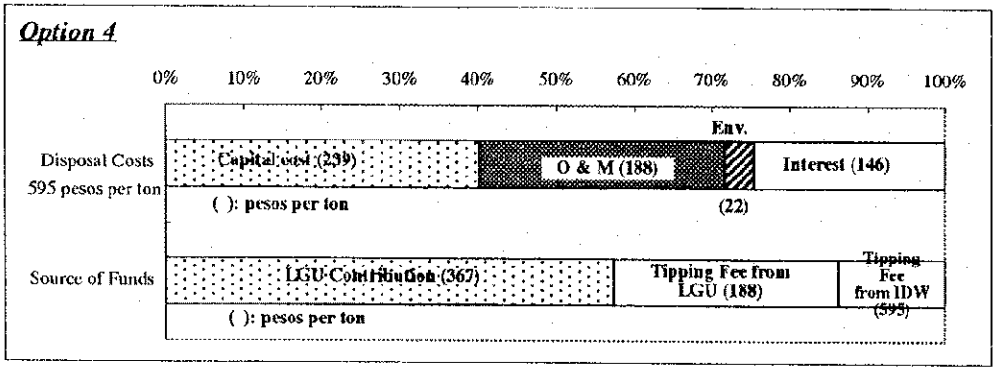




**Figure 6.4.2 Project Costs and Financing Source in Terms Total Amount and Unit Cost**

### (6) Proposed Financing Plan (Option 2)

Under the following assumptions, the cost, the financing source and the cash flow of the Project are estimated for Option 2 in Table 6.4.15:

1) Costs for the industrial waste are fully recovered through tipping fees at a rate of 500 pesos per ton;
2) Operation and maintenance costs of municipal waste are financed through tipping fee at a rate of 188 pesos per ton collected from the LGUs;
3) 58% of the LGU contributions are allocated to the Project instead of 50% at present;
4) 85% of the capital investment cost is financed by the Yen Loan under the following conditions: interest rate of 1.3% and repayment period of 30 years including the grace period of 10 years; and
5) Interest payments during the construction period and the costs of the leachate treatment and monitoring from 2010 to 2030 are financed by the MMDA budget through LGUs Contributions.

**Table 6.4.15 Costs, Financing Sources and Cash flow of the Project (Option 2)**

million pesos

| | | | 2000-2003 | 2004-2009 | 2010-2032 | Total |
|---|---|---|---|---|---|---|
| I | Investment Cost | (a) | 4,286 | 0 | 0 | 4,286 |
| | - New Parcel B | | 3,190 | 0 | 0 | 3,190 |
| | - Access Road | | 1,096 | 0 | 0 | 1,096 |
| II | Expenditure | (b) | 89 | 6,411 | 657 | 7,157 |
| | 1) Operation & Maintenance | (c) | 0 | 2,610 | 0 | 2,610 |
| | - New Parcel B | | 0 | 2,577 | 0 | 2,577 |
| | - Access Road | | 0 | 33 | 0 | 33 |
| | 2) Leachate Treatment & Monitoring | (d) | 0 | 196 | 106 | 302 |
| | 3) Depreciation | (e) | 0 | 3,322 | 0 | 3,322 |
| | 4) Interest Payment | (f) | 89 | 284 | 551 | 923 |
| III | Revenue to | (g) | 89 | 5,855 | 657 | 6,600 |
| | 1) LGUs Contributions | | 89 | 2,756 | 657 | 3,501 |
| | 2) Tipping Fee (Municipal Wste) | | 0 | 2,316 | 0 | 2,316 |
| | 3) Tipping Fee (IDW) | | 0 | 784 | 0 | 784 |
| IV | Long-term Loan | (h) | 3,643 | 0 | -3,643 | 0 |
| | Loan Disbursement | | 3,643 | 0 | 0 | 3,643 |
| | Repayment | | 0 | 0 | -3,643 | -3,643 |
| V | Cost Transfer for the Next Disposal | | | | 964 | 964 |
| | 1) Salvage Value of access | (i) | | | 964 | 964 |
| VI | Cash Flow | | | | | |
| | 1) Before Long-term | (g)-((a)+(i))-(c)- | -4,197 | 3,050 | 1,515 | 367 |
| | Before Long-term Loan | (g)-((a)+(i))-(c)- | -4,082 | 2,793 | 1,289 | 0 |
| | (in term of Present Value, r=1.3%) | Cumulative | -4,082 | -1,289 | 0 | |
| | 2) With Long-term Loan | (g)-((a)+(i))+(h)- | -643 | 2,765 | -2,679 | -556 |
| | With Long-term Loan | (g)-((a)+(i))+(h)- | -625 | 2,532 | -1,907 | 0 |
| | (in term of Present Value, r=1.3%) | Cumulative | -625 | 1,907 | 0 | |

Source: JICA Study Team

The revenue is assumed so as to balance the cash flow or to make the Net Present Value of the cash flow zero discounted by a rate of 1.3 %, which is the condition of the soft loan, during the project period between 2000 and 2032. As shown in the cash flow of Table 6.4.15, MMDA needs to allocate the fund to finance the shortage of 643 million pesos for 15 % of the initial investment cost during the period from 2000 to 2003, however, it will be recover by the revenue in 2004.

### 6.4.4 Further Considerations

#### (1) Operation and Maintenance Costs of the Access Road

The operation and maintenance cost of the access road is estimated at 5.5 million pesos per year and amount to 33 million pesos during the period from 2004 to 2009. In the financing plan, that cost is assumed to be shouldered by MMDA through the charges of tipping fee. There may be another argument to finance the operation and maintenance cost of access road, i.e. since the road will be maintained by DPWH, it is natural that the cost should be allocated from the budget of DPWH.

#### (2) Burden of SWM Costs on LGUs

Based on the institutional framework proposed in the Master Plan, LGUs have the responsibility for the management of collection and haulage including transfer station and the costs of the final inland disposal site have to be burden by LGUs. Whether directly or indirectly, LGUs have to shoulder the following cost of the SWM:

- collection and haulage costs;
- capital investment cost and operation and maintenance cost for transfer stations;
- costs for final disposal through tipping fees; and
- costs for final disposal through LGU contributions.

In the following section, the required budget of the SWM will be examined from the viewpoint of budgetary affordability of LGUs, whose wastes will be hauled at the inland landfill at Ping Tong Bocaue in the Master Plan.

The collection and haulage costs which have been estimated at 12,800 million pesos during the Master Plan Period in Metro Manila, which is 470 pesos per ton of the collected waste in 1997 prices.

Regarding the transfer station, it is proposed in the Master Plan to establish the LGU Cooperatives for its construction and operation by across several cities/municipalities. Fort Bonifacio and Marikina are the transfer stations that are proposed for the inland final disposal at Ping tong Bocaue. In the Cooperatives, the funds to recover the cost of transfer stations should be financed through the contributions from member LGUs. Table 6.4.16 examines an option to finance and recover the cost of the transfer stations in 2005, when the new transfer stations will be open. Budgetary contribution of member LGUs is determined in the estimation on the basis of the following assumptions:

- 60% of the cost financed by the equal rate against LGUs' budgetary revenue; and
- 40% of the cost financed by the proportional rate by the share of service-coverage population.

## Table 6.4.16 Cost Burdent of Transfer Stations under the LGUs' Cooperative in 2005

| Cooperative and member LGUs | Required funds of construction and O & M cost (1998-2010) (million pesos) a | Average unit cost of transfer St. per collected waste (pesos per ton) b | Municipal waste collection in 2005 Daily amount (ton) | Municipal waste collection in 2005 Annual amount (ton) c | Total cost allocation in 2005 (million pesos) d | Budget portion share: Budget revenue portion 60% (million pesos) e | Budget portion share: Budget revenue of LGUs in 2005 (million pesos) f | Budget portion share: Share of LGU budget g | Population portion share: Population portion 40% (million pesos) h | Population portion share: Population in 2005 (thousand) i | Population portion share: Waste collection coverage (%) j | Population portion share: Covered population (thousand) k | Population portion share: Cost per covered population (pesos) l | Total share: Total burden (P Mil) m | Total share: Share of total LGU budget n | Total share: Cost burden per ton (pesos) o |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fort Bonifacio Transfer St. | 1,600 | 243 | 1,130 | 412,410 | 100 | 60 | 9,480 | 0.6% | 40 | 1,913 | 99% | 1,900 | 21 | 100 | 1.1% | 243 |
| Makati | | | 392 | 142,949 | | 44 | 6,988 | 0.6% | 12 | 561 | 100% | 561 | 21 | 56 | 0.8% | 393 |
| Pateros | | | 27 | 9,870 | | 1 | 162 | 0.6% | 1 | 66 | 80% | 53 | 21 | 2 | 1.3% | 217 |
| Pasay | | | 265 | 96,780 | | 7 | 1,130 | 0.6% | 11 | 503 | 100% | 503 | 21 | 18 | 1.6% | 184 |
| Muntinlupa | | | 446 | 162,812 | | 8 | 1,200 | 0.6% | 17 | 783 | 100% | 783 | 21 | 24 | 2.0% | 148 |
| Marikina Transfer St. | 2,200 | 216 | 1,702 | 621,263 | 134 | 81 | 8,908 | 0.9% | 54 | 3,666 | 84% | 3,078 | 17 | 134 | 1.5% | 216 |
| Quezon (E) | | | 666 | 243,108 | | 28 | 3,085 | 0.9% | 22 | 1,376 | 90% | 1,238 | 17 | 49 | 1.6% | 204 |
| Pasig | | | 364 | 133,032 | | 20 | 2,161 | 0.9% | 12 | 663 | 100% | 663 | 17 | 31 | 1.4% | 234 |
| Mandaluyong | | | 245 | 89,487 | | 15 | 1,609 | 0.9% | 6 | 349 | 100% | 349 | 17 | 21 | 1.3% | 231 |
| San Juan | | | 78 | 28,583 | | 5 | 524 | 0.9% | 2 | 145 | 80% | 116 | 17 | 7 | 1.3% | 236 |
| Marikina | | | 158 | 57,652 | | 8 | 849 | 0.9% | 5 | 490 | 60% | 294 | 17 | 13 | 1.5% | 222 |
| Taguig | | | 190 | 69,401 | | 6 | 680 | 0.9% | 7 | 643 | 65% | 418 | 17 | 13 | 2.0% | 194 |

Note: a; Required fund for Transfer Station including construction cost and operation and maintenance costs during the Master Plan period from 1998 to 2010

b; As the Transfer Stations for the capacity of waste until 2015 are proposed to complete in 2004, the average unit cost is calculated using the total cost and the total amount of waste collection during the period from 2005 to 2015.

The operation and maintenance cost until 2015 and the salvage value of the transfer stations in 2015 are taken into account.

c; Municipal waste amount collected in 2005

d; Estimated total cost allocation is calculated by average unit cost (b) and municipal waste amount (c).

e; 60 % of the total cost of transfer station is estimated to be financed by the equal share of budget revenue of the member LGUs.

f; Budget revenues of LGUs are estimated based on the planning framework.

g; e / f; For example, it is 0.6 % of the LGUs' budget revenue should be allocated to burden by the member LGUs of Fort Bonifacio Transfer St. Cooperative.

h; 40 % of the total cost of transfer station is estimated to be financed by the proportional share of population of member LGUs.

i; Population is estimated based on the planning framework.

j and k; Collection coverage of waste and service-covered population are based on the planning goal of the Master Plan.

l; h / k

m; e + h

n; m / f

o; m / c

Every cost is estimated at constant prices in 1997

The budget portion share is 0.6 % and 0.9 % of the total budgetary revenues in the Fort Bonifacio and the Marikina Transfer Stations, respectively. On the other hand, the population portion share is 21 pesos and 17 pesos per service-covered population per year in the Fort Bonifacio and the Marikina Transfer Stations, respectively. As a whole, the cost burden of the transfer stations is estimated at 243 pesos and 216 pesos per ton in the Fort Bonifacio and the Marikina Transfer Stations, respectively. As far as the unit cost burden of the individual LGUs, it is highest in Makati: 393 pesos per ton and lowest in Muntinlupa: 148 pesos per ton. On the contrary, the share of the budget is lowest in Makati: 0.8 % and highest in Muntinlupa and Taguig: 2.0 %. The Lower-income LGUs can be subsidized from higher-income LGUs by the proposed cost-sharing mechanism of the Cooperatives. Nevertheless the SWM requires the lower income LGUs to shoulder the heavier cost in their budget.

Table 6.4.17 shows the total SWM costs of ten (10) LGUs that will haul the waste in the inland final disposal at Ping Tong Bocaue, New Parcel B in 2005 under the following assumptions:

- collection and haulage cost is estimated at 470 pesos per ton
- costs of transfer stations will be shared as shown in Table 6.4.16; and
- tipping fees at the final disposal will be imposed at a rate of 188 pesos per ton so as to recover the operation and maintenance cost.

**Table 6.4.17 Estimated SWM Cost Burden by LGUs in 2005**

| Cooperative and member LGUs | Municipal waste collection in 2005 | | Estimated Budget Revenue of LGUs in 2005 (million pesos) | SWM Costs in 2005 (million pesos) | | | | | Unit cost |
|---|---|---|---|---|---|---|---|---|---|
| | Daily amount (ton) | Annual amount (ton) | | Collection & haulage (470 pesos per ton) | Share for Cooperative transfer station | Tipping fee at Ping Tong Bocaue (188 pesos per ton) | Total SWM cost | Share of LGUs Budget Revenue | SWM cost per ton (pesos per ton) |
| Fort Bonifacio Transfer St. | 1,130 | 412,410 | 9,480 | 194 | 100 | 78 | 372 | 3.9% | 901 |
| Makati | 392 | 142,949 | 6,988 | 67 | 56 | 27 | 150 | 2.1% | 1,051 |
| Pateros | 27 | 9,870 | 162 | 5 | 2 | 2 | 9 | 5.3% | 875 |
| Pasay | 265 | 96,780 | 1,130 | 45 | 18 | 18 | 81 | 7.2% | 842 |
| Muntinlupa | 446 | 162,812 | 1,200 | 77 | 24 | 31 | 131 | 10.9% | 806 |
| Marikina Transfer St. | 1,702 | 621,263 | 8,908 | 292 | 134 | 117 | 543 | 6.1% | 874 |
| Quezon (E) | 666 | 243,108 | 3,085 | 114 | 49 | 46 | 209 | 6.8% | 862 |
| Pasig | 364 | 133,032 | 2,161 | 63 | 31 | 25 | 119 | 5.5% | 892 |
| Mandaluyong | 245 | 89,487 | 1,609 | 42 | 21 | 17 | 80 | 4.9% | 889 |
| San Juan | 78 | 28,583 | 524 | 13 | 7 | 5 | 26 | 4.9% | 894 |
| Marikina | 158 | 57,652 | 849 | 27 | 13 | 11 | 51 | 6.0% | 880 |
| Taguig | 190 | 69,401 | 680 | 33 | 13 | 13 | 59 | 8.7% | 852 |

Source: JICA Study Team
Note: Cost is estimated in constant prices in 1997

In Metro Manila, the LGUs currenly consume 11% of their budgets to the SWM on the average based on the results of the Financial Survey in 1996. In 2005, basen on the assumptions above, the shares will be from 2.1 % to 10.9% of the budget and the cost will be from 800 to 1,050 pesos per ton in term of unit cost per collected amount of waste. In Muntinlupa where the share of the budget is highest accounting for 10.9%, it would, however, be affordable by the efficient management of budget because Muntinlupa spent 18% of the budget for SWM in

1996 (refer to Table 2.11.3 in the Master Plan). In every LGU exept Taguig, the lower share of budget are required to consume to the SWM than the actual share in 1996 under the assumptions. Taguig has to allocate 8.7% in 2005 instead of 6% in 1996.