CHAPTER 16

WASTE COLLECTION WORKER SURVEY

16. WASTE COLLECTION WORKER SURVEY

16.1 Objectives

The objectives of the Waste Collection Worker Survey is to evaluate the present working and health conditions of waste collection workers.

16.2 Methodology

16.2.1 Interview Targets

The Waste Collection Worker Survey was conducted by interview survey with a total of 60 collection workers at the San Mateo landfill (15 interviewees), Payatas open dumpsite (30 interviewees) and Las Piñas Transfer station (15 interviewees)

16.2.2 Outlines of Questionnaire

The outline of the Questionnaire is as follows:

- intervicc's data
- employer's data
- income
- health conditions
- general information

The Questionnaire sheet is attached in Chapter 7 in the Data Book.

16.3 Results

16.3.1 Introduction

The obtained data from the Recycling Opinion Survey are presented in Chapter 7 in the Data Book.

The Basurero or garbage collector survey had the objective of bringing to discussion the working conditions of these workers in Metro Manila, as well as getting the perception of these individuals on the systems and methods of solid waste management in the region.

The knowledge derived from this survey shall be used not only to guide the enhancement of the working conditions of the basureros but also to give inputs to the institutional and technical proposals to improve the present solid waste services provision.

16.3.2 Profile of the workers

Majority of the basureros in Metro Manila is married young persons: only 24% are single and 90% of the surveyed individuals belong to the 20-39 years age interval. Coherently, almost all the workers (92%) have 6 or fewer years working as garbage collectors.

About 40% of the respondent's work for public government, and the other 60% for private concerns, hired by government, all of them full time employees.

The salary perceived by the majority of the basureros is quite low: 53% get less than $3.000 pisos per month, and this situation may explain why 71% of them also sell recyclable, in order to complement their earnings, on an average of $150 pisos per day.

Of course, most of them (63%) are not satisfied with their income, which is not the sole source of family resources for 68% of the interviewed. Most common situation (78%) is the wife also bringing money to home.

16.3.3 Working relations and conditions

Most of the workers (63%) do not have any fringe benefits, but 73% reported that they have insurance for medical care and sick leave.

All the basureros are full time employees reporting 8 hours or more of work per day. The work is done usually without protective gear: only 15% use boots, 5% gloves and 8% masks.

About half of those interviewed work on collector trucks, and the other half on 10 or 6 wheeler open truck, most of then (95%) saying that the garbage truck they use is appropriate for their work.

The lack of protective gear and training is reflected in the rate of accidents among the workers: 1/3 of the interviewed reported suffering one or more accident in the last 12 months. When on illness or accident leave, only 46% said that they continued to receive their salary.

Only 7% have reported to be in a job-training seminar, while 98% of those that have been trained (73% of the total) said they had "on the job training"

16.3.4 Self perception of the work

Amazingly, all the respondents expressed their satisfaction with their garbage collection job, although 90% of them expressed the view that their job should be eased if there were more "public cooperation" and 68% would like to have a better salary.

About half of the basureros interviewed said that garbage collection could be improved with more and better collection trucks, and 86% believe that public participation would also help the overall efficiency of their task.

Public participation would mean, storing the refuse properly in the opinion of 61% of the respondents and presenting it timely for 49% (answers not exclusive)

Only 7% think that less garbage should be produced and 19% recommend that the refuse should be separated into wet and recyclable.

Most of them also think that the garbage collection activity in their LGU is good (39%) or fair (54%) and almost all say that the garbage truck is appropriate for the job.

Finally, 88% rate their job performance as good (80%) or excellent (8%)

16.3.5 Conclusion and recommendations

Job conditions of the basureros, these very important workers, should be enhanced in Metro Manila in order to support any service improvement program.

A basic procedure would be to raise their salary to a minimum acceptable so that they ought not segregate recyclable for selling and complement their wage.

Protective gear and training should also be provided, in order to reduce the rate of accidents they are subject and to increase their work efficiency.

Improvement of their relations with the community should also be envisaged, since they are the main linkage of the public service with the producers of the waste, and therefore those that could more easily instruct the people how to contribute to the enhancement of the present conditions of the solid waste management services.

CHAPTER 17

JUNK SHOP SURVEY

17. JUNK SHOP SURVEY

17.1 Objectives

The objective of the Junk Shop Survey is to study activities of junks shops and prices of recycled materials.

17.2 Methodology

17.2.1 Interview Targets

The Junk Shop Survey was conducted by telephone interview with junk shop owners/operators. Out of the selected 339 junk shops 84 junks shops were contacted and interviewed. However, several interviewees not cooperative, and did not diclose prices of recyclables etc.

Of the remaining 255 junk shops, 241 could not be reached because of wrong telephone number or telephone out of order, and the remaining could not be contacted due to other reasons.

17.2.2 Outlines of Questionnaire

The outline of the Questionnaire is as follows:

- Junk shop data
- Data on purchasing and sales of recyclables
- Prices for various kinds of recyclables

The Questionnaire sheet is attached in the end of this chapter.

17.3 Results

17.3.1 Introduction

The obtained data from the Junk Shop Survey are presented in Chapter 8 in the Data Book.

38 of the interviewed junk shops gave information related to the buying and selling price of different items (hereinafter referred to as Category A). An additional16 Junk shops gave only incomplete information without prices (hereinafter referred to as Category B).

17.3.2 Source of Recycled Items

The handled items are bought from collectors in around 70% of the responding junk shops in Category A, and in around 60% of the responding junk shops in Category B. In Category A, other important sources of recyclables are factories and plants (around 40%) and other junk shops (25%). In Category B, recyclables are bought from

factories and plants in around 20% of the responding junk shops, and from other junk shops in around 45% of the responding junk shops.

17.3.3 Buyers of recycled items

In both Category A and B, the buyers of recyclables are other junk shops and dealers in around 70-75% of the responding junk shops, and factories in around 45% of the responding junk shops.

17.3.4 Recycled Items

Many of the surveyed junk shops deal both with glass bottles of different kinds and glass cullets. Generally the volume of glass bottles handled is much larger than the volume of glass cullets.

Many of the surveyed junk shops deal with news paper, cartoon and copied paper. The volumes of news paper and cartoon are in same order of magnitude in Category A, while the volume of copied paper handled is smaller. In category B, one junk shop are handling large volumes of both news paper, cartoon and copied paper.

The handling of plastic bags made of polyethylene is very limited. The average prices given in the table below are therefore not reliable. A majority of the junk shops in Category A and some of the junk shops in category B, on the other hand, handle other plastic products made of polypropylene.

The metal most commonly handled by the junk shops is ferrous metal. However, some junk shops also handle relatively large volumes of aluminum and copper.

A summary of the volumes of different items handled and their prices are given in Table 1. The Selling Price refers to the price charged by collectors etc. when sold to the junk shop. The Buying Price refers to the price when dealers, factories etc. buy items from the junk shop. The mark-up refers to the increase in buying price over selling price and reflects the junk shops revenue on the different items.

From the large variations in volumes it is evident that most items are handled both by small junk shops dealing with many different kinds of items and large junk shops specializing in some items. Furthermore, it is likely that some of the junk shops handling large volumes are secondary dealers buying large amounts from other junks shops.

Table 17.1 Summary of Results from Junk Shop Survey

RECYCLED ITEM	VOLUME kg	SELLING PRICE Pesos/kg	BUYING PRICE Pesos/kg	REVENUE Pesos/kg	MARK-UP %
Glass Bottles	200 — 50,000	0.15 — 1.85	0.40 — 2.20	0.25 — 0.35	166 — 19
Glass Cullet	50 — 5,000	0.9	1.45	0.55	61
News Paper	20 — 300,000	1.1	1.6	0.5	45
Cartoon	335 — 700,000	0.45	0.8	0.35	78
Copied Paper	120 — 300,000	1.15	1.9	0.75	65
Plastic Bags	100 — 2,000	2.0	4.65	2.65	132
Other Plastics	4 — 20,000	4.9	6.25	1.35	28
Ferrous Metals	100 — 450,000	2.45	3.0	0.55	22
Aluminum	33 — 30,000	16.6	20.5	3.9	23
Copper	50 — 30,000	38	43	5	13
Lead	10 — 30,000	6.7	9.3	2.6	39

A common view of the interviewed junk shop owners is that imported scrap materials, especially paper and cartoon, reduce the market prices for these materials, and thereby cause big losses for the junk shop owners.

CHAPTER 18

COMPARISON OF WASTE REGULATIONS AND ORDINANCES IN METRO MANILA

18. COMPARISON OF WASTE REGULATIONS AND ORDINANCES IN METRO MANILA

Ordinances and regulations for handling of waste etc. exist both on a Metro Manila level and on a LGU level. A comparison of provisions in the MMDA Regulation and the LGU Ordinances is given in the attached tables.

In MMDA Regulation No. 96-009, implementing rules, regulations and guidelines are given for the handling of waste etc. The regulation is intended to be valid for all Metro Manila. The LGU Ordinances are intended to be valid only within the respective LGU.

As can be seen in the attached tables, the coverage and level of detail in the MMDA Regulation, which was enacted later than the LGU Ordinances, are generally much more extensive than in the LGU Ordinances. However, there are also examples where LGU Ordinances contain specifications or regulations not covered in the MMDA Regulation.

PROVISION	MMDA	Calookan	Las Pinas	Makati	Malabon	Mandaluyong	Manila	Marikina	Muntinlupa	Navotas	Paranaque	Pasay	Pasig	Pateros	Quezon City	San Juan	Tagig	Valenzuela
General Cleanliness and Sanitary Conditions																		
Requirement to maintain cleanliness of frontage and immediate surroundings	◉		●	●		●					●	●			●	○		●
Requirement to clean frontages of residential and commercial establishments at least one hour prior to scheduled inspection by MMDA, LGU or Barangay officials	◉																	
Prohibition of urination, defecation and spitting in public places	◉												●		●			
Prohibition to display posters etc. in open places etc.	◉																	
Requirement for property owners and residents to keep the portion of esteros abutting their property clean							⊗											
Prohibition of dark, grey smoke emission from vehicles and factories and other offensive smells		⊗							⊗								⊗	
Waste Handling and Disposal																		
Requirement to keep roads etc. clear from all kinds of obstructions,	◉																	
Requirement to flatten and tie cardboard etc.before putting them out for collection	◉																	
Prohibition of littering and dumping of waste etc. in public places, waterways etc. and immediate surroundings	◉		●	●	●	●	●	●	●			●	●	●	●	●	●	
Prohibition to bring out garbage etc. before arrival of authorized garbage trucks	◉					●						●					●	
Prohibition to place, or dump construction debris, junk vehicles etc. in any part of the road etc. or in sidewalks which may impede vehicular or pedestrian traffic.	◉																	
Requirement to sort waste in bio-degradable and non bio degradable fraction				⊗			⊗					⊗			⊗			
Requirement to dispose of waste at residence through sorting, burying or incineration														●				
Requirement to launch an educational campaign in all schools on solid waste disposal														●				
Requirements for handling and disposal of medical waste									⊗							⊗		
Waste Receptacles																		
Requirement to provide receptacles for waste	◉			●	●		●		●			●	●	●	●	●	●	
Requirement to dispose residential waste and yard waste, including street sweepings, in separate receptacle	◉																	
Requirement for waste receptacles to contain garbage generated under a 72 hour period	◉																	
Prohibition to place garbage bins etc. in front of any residential or commercial establishment	◉																	
Requirement to provide trash cans along major throughafares		⊗																
Waste Collection																		
Prohibition of unauthorized entering into a contract or offering of waste collection services	◉																	
Prohibition of all forms of scavenging.	◉											○						●
Requirement to register push carts used for garbage and recyclables collection				⊗								⊗						
Regulations for time and place of waste collection												⊗						⊗

PROVISION	MMDA	Caloocan	Las Pinas	Makati	Malabon	Mandaluyong	Manila	Marikina	Muntinlupa	Navotas	Paranaque	Pasay	Pasig	Pateros	Quezon City	San Juan	Tagig	Valenzuela
Cleanliness and Waste Disposal on Public Utility Vehicles etc.																		
Requirement to maintain public utility vehicles clean and sanitary	◉						●											
Requirement to provide sufficient number of waste receptacles in public vehicles	◉					●	●			●				●				
Waste Scattering from Transport Vehicles etc.																		
Requirement of commercial and transport vehicle operators etc. to provide adequate cover of their load to prevent spill, scatter etc.	◉																	
Prohibition of spill, scatter or littering from commercial and transport vehicles of different kind.	◉																	
Implementation and Supervision of the Regulation																		
Calls for creation of a separate environmental task group, under MMDA, to carry out regular inspections of strategic areas of Metro Manila	◉					o	o											o
Permit LGU's to organize and train their own environmental enforcers	◉					●												
Calls for the help of Barangay officials in the implementation and enforcement of the regulation	◉					o		●				●				●		
Permit NGO's to participate in monitoring and enforcement after proper training	◉																	
Provides guidelines for the conduct and time of inspection	◉					o												
MMDA shall formulate the implementing guidelines/systems relative to issuance of Environmental Violation Receipts, payment of fines etc.																		
Deputizes elementary and high school students for apprehension of Ordinance violators			⊗															
Penalties																		
Issuance of a environmental citation ticket to violators of the ordinance	◉		●	●							●						●	
Violators of the regulation are imposed fines of 500.00 to 1000.00 Pesos, and/or render either one to three days community service or three to seven days imprisonment	◉	●	●	●	●	o	o	o	o	●	o	●	o	●	●	o	●	●
In case of failure to pay the fine, the violator might risk a fine of 2000.00 Pesos or from seven days to one months imprisonment	◉			o													o	
In addition to environmental regulation violation penalties, an additional hauling fee of 200.00 Pesos per m^3 has to be paid for transport of illegally dumped bulky waste, factory/construction debris etc.	◉																	
In addition to environmental regulation violation penalties, an additional towing fee of 1500.00 Pesos has to be paid for transport of junk vehicles etc.	◉																	
Penalties may be imposed outright against the violator without the need to file a case in the court, if the apprehending officer is from MMDA	◉		o								o							
If the apprehending officer is not from MMDA, and in cases of deferred payment, the violator is required to tender payment at MMDA within three days	◉																	
In case the violator fails or is unable to pay the fine or render the community service, the matter will be elevated to the Prosecutors Office	◉																	

PROVISION	MMDA	Caloocan	Las Pinas	Makati	Malabon	Mandaluyong	Manila	Marikina	Muntinlupa	Navotas	Paranaque	Pasay	Pasig	Pateros	Quezon City	San Juan	Tagig	Valenzuela
Disposition of Fines																		
Specifies that collected fines should be distributed to the LGU where the violation was committed in case the apprehending officer is an LGU employee	◉					○		○										
If the apprehending officer is working for MMDA, the fines should be divided equally between MMDA and the LGU	◉																	
Specifies that MMDA enforcement personnel shall receive 10% of all the fines collected by MMDA	◉							○										
Elementary or high school students making an apprehension are entitled to 25% of the fines			⊗															
Specifies that part of the fines shall accrue to the Barangay where the apprehension was made							⊗											
Specifies a division of collected fines between the City, the barangay and the apprehending team												⊗						⊗
Specifies that fines should be placed in a special fund											⊗	⊗				⊗		

◉ Provision in MMDA Regulation

● Provision in LGU Ordinance corresponding to provision in MMDA regulation

○ Provision in LGU Ordinance with some similarity to provision in MMDA Regulation

⊗ Provision in LGU Ordinance

CHAPTER 19

SITE VISITS AT PNR QUARRRIES IN THE PROVINCES OF QUEZON AND CAMARINES SUR

ITINERARY

June 5: Car transport from Manila to Candelaria City, Quezon Province
Site visit at PNR Candelaria quarry
Car transport to Port Junction, Ragay City, Camarines Sur Province
Site visit at PNR Port Junction stock pile area
Car transport to Banga Caves, Ragay City
Site visit at PNR Banga Caves quarry
Car transport to Naga City, Camarines Sur

Overnight stay in Naga

June 6: Car transport from Naga to Iriga City
Site visit at PNR Iriga quarry
Car transport from Iriga to Manila

ATTENDANTS

Engr. Varquez, PNR (up to Lucena)
Mr. Padua, PNR
Ms. Millan, MMDA
Mr. Syquimsiam, MMDA
Mr. Byström, JICA Study Team

SUMMARY AND CONCLUSIONS

The site visits revealed that the four PNR sites in Quezon and Camarines Sur Provinces can not be utilized for development into landfills serving Metro Manila. The main reason is that the size of the sites, and the associated potential landfill volumes, are much too small to motivate the relatively large investments required for landfill development and systems for transport of waste from Manila to the sites.

The Iriga site is located just next to the municipal ground water pumping station, supplying water for Iriga City. Therefore, landfill operations can not be considered on this site.

It is preliminary believed, however, that landfills which could serve nearby communities possibly could be developed in Candelaria, and maybe also in Port Junction, should there be a need for additional landfill capacity in these communities.

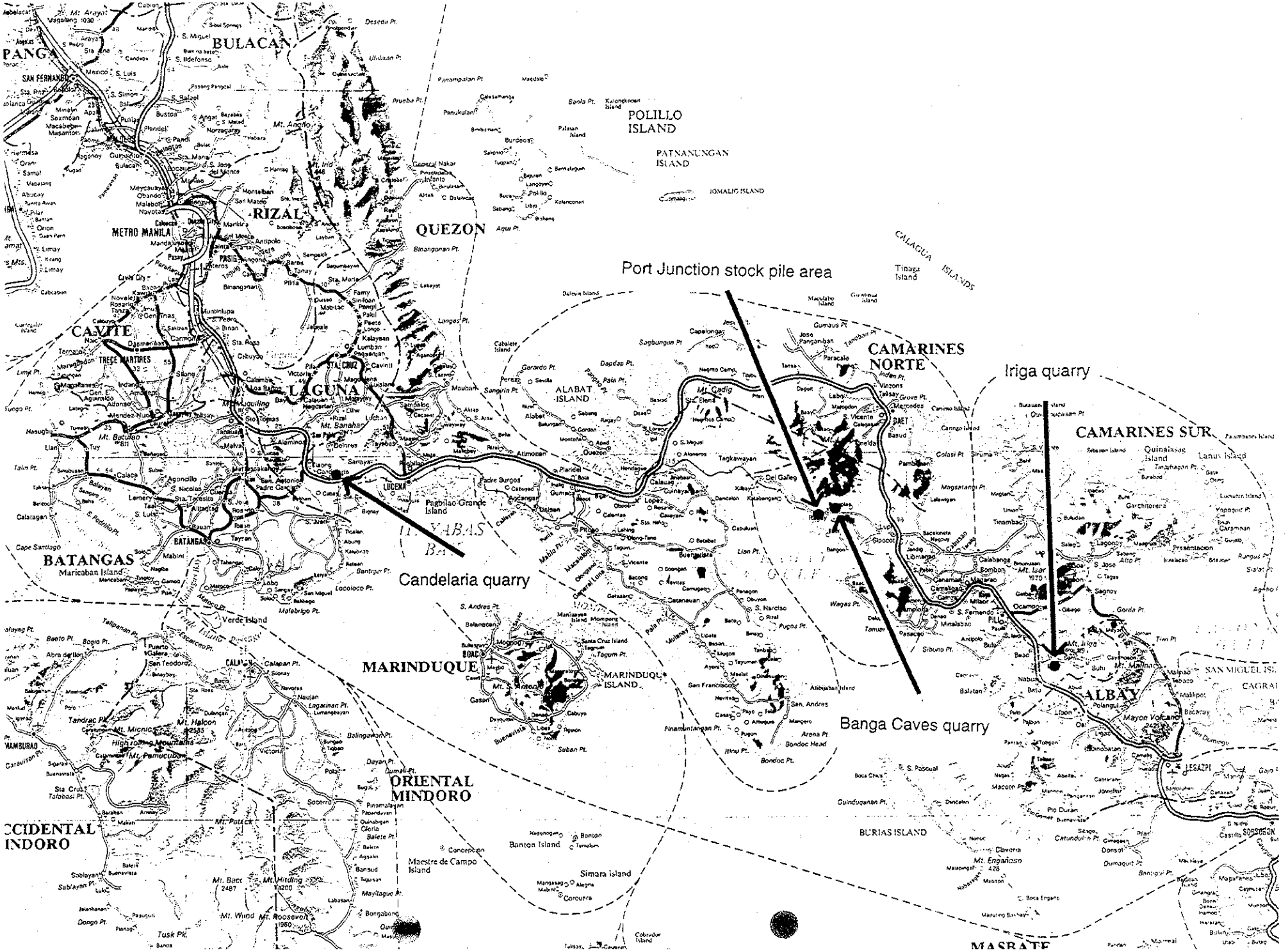


Figure 1 Location of the four PNR sites

DETAILED SITE DESCRIPTION

Candelaria

Quarry Operation. The Candelaria quarry was operated by PNR from the 60's to the early 1980's. Since then, the Provincial Government occasionally has taken material from the quarry after approval from the PNR General Manager. Furthermore, private contractors are illegally taking material from the quarry, even though PNR have tried to stop these activities. During the time of the site visit, crushing and sorting equipment belonging to a private contractor, was present in the quarry.

Location. The quarry is located in Barangay Malansiya in Candelaria City, around 100 km from Manila, and around 1.4 km from the main railway line from Manila to Legaspi. The track, which crosses the provincial road from Manila to Lucena, has been dismantled, and houses and shanties have been built along a large part of the former tracks (Pictures 1 and 3). Some of the houses are located on land leased by PNR, while the rest are illegal settlements. In many places the remaining path is only 2-2.5 m wide. A badly deteriorated, around 20 m long wooden railway bridge, is located along the path (Picture 2).

The site. The PNR lots where quarrying has been carried out totals around 10 ha. In addition, PNR own a 15 wide strip along the former railway track to the quarry from the main railway line. According to Mr. Varquez, PNR is now trying to sell their lots to the highest bidder to cover deficits in PNR pension funds.

The quarry. The quarrying operations have extracted volcanic cinder both above and below ground in the northern part of the site. Around a third of the PNR lots (3 ha) has been excavated down to 10-15 m below surrounding ground level. The remaining southern portion is hilly (Picture 5).

During the site visit, water was found in four different parts of the quarry. According to a nearby resident, the water is visible also during dry periods, which indicates that the water is surfacing groundwater.

The surrounding. The quarry is surrounded by rice fields in the North and West. In the South the quarry is bounded by the remaining hill, and in the East by shanties. 2-3 shanties are present inside the quarry, and an additional 20-30 shanties are built on the border of the quarry.

Landfill development potential. The possibility to develop a landfill in the quarry exists. However, the estimated available total landfill volume of around 500,000 m^3 in the quarry is too small to motivate the investments associated with transport of waste from Metro Manila. The costs will include loading facilities in Manila, special trains and waste containers etc., new tracks to the quarry (by PNR estimated at1,600,000 P/km), construction of a new railway bridge, compensations to residents living on, and along the former tracks to the quarry, compensations to squatters in and around the site and construction of a manned railway crossing at the provincial road from Manila to Lucena.

Iriga

Quarry operation. The Iriga quarry is one of PNR's original quarries which has been operated from the 30's until the early 80's. Last year quarrying operations were resumed by the Australian contractor John Holland which has been contracted by PNR to rehabilitate tracks on the main railway line from Lucena to Legaspi.

Location. The quarry is located In Barangay San Isidro in Iriga City, around 450 km from Manila, and around 200 m from the main railway line. The track, which still remains, are presently utilized by the contractor John Holland.

The Site. The PNR lots, where quarrying has been carried out, are totally around 5-6 ha. However, five lots of totally around 2 ha, have been sold to private persons.

The quarry. The quarrying operations have extracted both volcanic cinder and hard rocks. Around half of the original PNR lot has been excavated. The remaining southern portion is hilly (Picture 6).

The surrounding. A municipal ground water pumping station, incorporating a spring, and retention ponds, which according to PNR is the single water supply for Iriga City, is located 50 m NW of the site.

Landfill development potential. Considering the proximity to the ground water pumping station, and the limited area available, the quarry can not be regarded as an alternative for development into a landfill serving Metro Manila.

Ragay - Banga Caves

Quarry operation. The Banga quarry is a small quarry that was operated only a couple of years from the late 70's to early 80's. The quarry supplied crushed hard rock, a material that was disliked by PNR engineers.

Location. The quarry is located in Banga Caves in Ragay City, around 340 km from Manila, and next to the main railway line.

The Site. The PNR lots where quarrying has been carried out are totally around 4-5 ha.

The quarry. Only approximately 1 ha of the original PNR lots, has been excavated down to surrounding ground level. Today, rice fields cover the excavated parts. The remaining portion of the lots is partly hilly (Picture 7).

The surrounding. The quarried area is surrounded by rice fields and hilly terrain. In the East, the site is bounded by the railway.

Landfill development potential. Considering the very small area available, the former quarry site can not be regarded as an alternative for development into a landfill serving Metro Manila.

Ragay - Port Junction

The Sites. Port Junction consists of two PNR lots. One lot, around 9 ha, is located next to the Ragay Bay, around 3 kilometers from the main railway line from Manila to Legaspi. It was used as an unloading and stockpile area during the earlier part of this century when the railway was built. The tracks to this site has been dismantled.

The second lot is around 6 ha, and is located next to the main railway line. It is a stock pile area that was used from 1983-84 to 1992 by the Australian Contractor John Holland, who used to crush and store material transported from the Pacolago river on the site (Picture 8).

Location. The Port Junction sites are located in Ragay City, around 310 km from Manila.

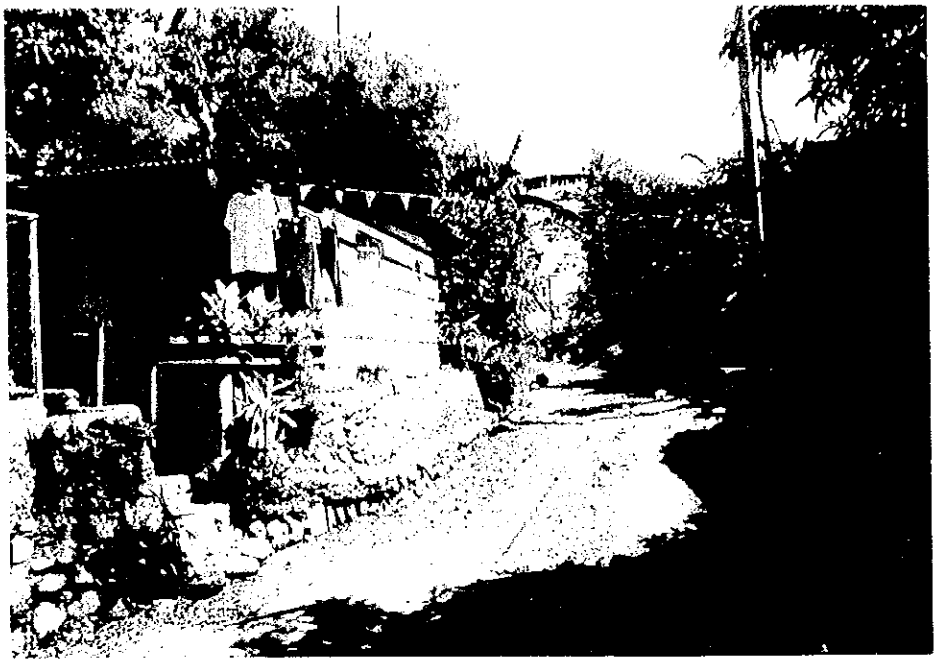
The surrounding. The 9 ha site at Ragay Bay could not be visited due to inferior road conditions. The main part of the 6 ha former stock pile area next to the main railway line has been transformed to rice fields. The site is surrounded by coconut plantations. In the East, the area is bounded by a house and the railway.

Landfill development potential. Considering the small area available, the former stock pile areas in Port Junction can not be regarded as an alternative for development into a landfill serving Metro Manila.

Pili

In Pili, private landowners donated the land where the main railway line is located. On the neighbouring 2.5 ha lot, quarrying for ballast material, and subsequently also for other purposes was carried out. The lot is elongated and stretches along the tracks for around 3 km. The lot is owned by Consuelo L. Vda de Prieto. Behind this lot there are a number of small privately owned lots where quarrying presently is carried out.

Since the Pili quarry is privately owned, and furthermore the layout of the lot is unfavourable for development into a landfill, no site visit was carried out at the Pili quarry.



Picture 1

View along former tracks to Candelaria quarry

Picture 2

Deteriorating wooden railway bridge along former tracks to Candelaria quarry

Picture 3

View along the former tracks to Candelaria quarry. The Quarry can be seen in the background of the picture.

Picture 4

View of the Masosu groundwater pumping station supplying water for Iriga City. The PNR Iriga quarry can be seen in the background of the picture..

Picture 5 Panorama view of Candelaria quarry

Picture 6 Panorama view of Iriga quarry

Picture 7 Panorama view of Ragay - Banga Caves quarry

Picture 8 Panorama view of Ragay - Port Junction stock pile area

CHAPTER 20

FORECAST OF FINAL DISPOSAL AMOUNT

Daily Disposal Amount Waste amount growth rate after 2010 = 2% Economic growth rate after 2010 = 4% Population growth rate 2010 - =

		1997 (ton/day)	1998 (ton/day)	1999 (ton/day)	2000 (ton/day)	2001 (ton/day)	2002 (ton/day)	2003 (ton/day)	2004 (ton/day)	2005 (ton/day)	2006 (ton/day)	2007 (ton/day)	2008 (ton/day)	2009 (ton/day)	2010 (ton/day)	2011 (ton/day)	2012 (ton/day)	2013 (ton/day)	2014 (ton/day)	2015 (ton/day)
1 Manila	Disposal Waste	729.00	742.33	755.67	769.00	799.64	830.29	860.93	891.58	922.22	969.37	1,016.52	1,063.67	1,110.82	1,157.97	1,181.13	1,204.75	1,228.85	1,253.42	1,278.49
	Inland DWA	729.00	742.33	755.67	769.00	799.64	830.29	860.93	891.58	422.22	469.37	516.52	563.67	610.82	39.32	62.48	86.10	110.20	134.77	159.84
	incinerated WA									500.00	500.00	500.00	500.00	500.00	1118.65	1,118.65	1,118.65	1,118.65	1,118.65	1,118.65
	Sea DWA									75.00	75.00	75.00	75.00	75.00	167.80	167.80	167.80	167.80	167.80	167.80
2 Quezon	Disposal Waste	756.00	819.33	882.67	946.00	1,022.64	1,099.29	1,175.93	1,252.58	1,329.22	1,408.55	1,487.89	1,567.22	1,646.56	1,725.89	1,760.41	1,795.62	1,831.53	1,868.16	1,905.52
	Inland DWA	756.00	819.33	882.67	946.00	1,022.64	1,099.29	1,175.93	1,252.58	1,329.22	1,408.55	1,487.89	1,567.22	1,646.56	878.32	912.84	948.05	983.96	1,020.59	1,057.95
	incinerated WA									0.00	0.00	0.00	0.00	0.00	847.57	847.57	847.57	847.57	847.57	847.57
	Sea DWA									0.00	0.00	0.00	0.00	0.00	127.14	127.14	127.14	127.14	127.14	127.14
3 Caloocan	Disposal Waste	159.00	176.33	193.67	211.00	168.80	126.60	84.40	42.20	368.93	418.07	467.21	516.36	565.50	614.64	626.93	639.47	652.26	665.31	678.61
	Inland DWA	159.00	176.33	193.67	211.00	168.80	126.60	84.40	42.20	368.93	418.07	467.21	516.36	565.50	331.39	343.68	356.22	369.01	382.06	395.36
	incinerated WA									0.00	0.00	0.00	0.00	0.00	283.25	283.25	283.25	283.25	283.25	283.25
	Sea DWA									0.00	0.00	0.00	0.00	0.00	42.49	42.49	42.49	42.49	42.49	42.49
4 Navotas	Disposal Waste	39.00	42.00	45.00	48.00	38.40	28.80	19.20	9.60	74.98	83.72	92.47	101.21	109.96	118.70	121.07	123.50	125.97	128.48	131.05
	Inland DWA	39.00	42.00	45.00	48.00	38.40	28.80	19.20	9.60	74.98	83.72	92.47	101.21	109.96	118.70	121.07	123.50	125.97	128.48	131.05
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5 Valenzuela	Disposal Waste	148.00	164.33	180.67	197.00	157.60	118.20	78.80	39.40	275.64	299.25	322.86	346.46	370.07	393.68	401.55	409.58	417.78	426.13	434.65
	Inland DWA	148.00	164.33	180.67	197.00	157.60	118.20	78.80	39.40	275.64	299.25	322.86	346.46	370.07	393.68	401.55	409.58	417.78	426.13	434.65
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6 Malabon	Disposal Waste	95.00	104.00	113.00	122.00	97.60	73.20	48.80	24.40	183.90	199.46	215.01	230.57	246.12	261.68	266.91	272.25	277.70	283.25	288.92
	Inland DWA	95.00	104.00	113.00	122.00	97.60	73.20	48.80	24.40	183.90	199.46	215.01	230.57	246.12	261.68	266.91	272.25	277.70	283.25	288.92
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 Marikina	Disposal Waste	83.00	89.67	96.33	103.00	113.87	124.75	135.62	146.50	157.37	180.28	203.20	226.11	249.03	271.94	277.38	282.93	288.58	294.36	300.24
	Inland DWA	83.00	89.67	96.33	103.00	113.87	124.75	135.62	146.50	157.37	180.28	203.20	226.11	249.03	271.94	277.38	282.93	288.58	294.36	300.24
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8 Pasig	Disposal Waste	271.00	294.67	318.33	342.00	365.96	389.93	413.89	437.86	461.82	484.68	507.54	530.41	553.27	576.13	587.65	599.41	611.39	623.62	636.09
	Inland DWA	271.00	294.67	318.33	342.00	365.96	389.93	413.89	437.86	461.82	484.68	507.54	530.41	553.27	576.13	587.65	599.41	611.39	623.62	636.09
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9 Pateros	Disposal Waste	17.00	18.00	19.00	20.00	21.41	22.81	24.22	25.62	27.03	28.65	30.27	31.89	33.51	35.13	35.83	36.55	37.28	38.03	38.79
	Inland DWA	17.00	18.00	19.00	20.00	21.41	22.81	24.22	25.62	27.03	28.65	30.27	31.89	33.51	35.13	35.83	36.55	37.28	38.03	38.79
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10 San Juan	Disposal Waste	52.00	54.00	56.00	58.00	61.99	65.98	69.98	73.97	77.96	82.51	87.05	91.60	96.14	100.69	102.70	104.76	106.85	108.99	111.17
	Inland DWA	52.00	54.00	56.00	58.00	61.99	65.98	69.98	73.97	77.96	82.51	87.05	91.60	96.14	100.69	102.70	104.76	106.85	108.99	111.17
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11 Taguig	Disposal Waste	84.00	94.67	105.33	116.00	130.76	145.53	160.29	175.06	189.82	217.97	246.13	274.28	302.44	330.59	337.20	343.95	350.82	357.84	365.00
	Inland DWA	84.00	94.67	105.33	116.00	130.76	145.53	160.29	175.06	189.82	217.97	246.13	274.28	302.44	330.59	337.20	343.95	350.82	357.84	365.00
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12 Makati	Disposal Waste	462.00	484.33	506.67	529.00	549.96	570.93	591.89	612.86	633.82	652.96	672.10	691.25	710.39	729.53	744.12	759.00	774.18	789.67	805.46
	Inland DWA	462.00	484.33	506.67	529.00	549.96	570.93	591.89	612.86	633.82	652.96	672.10	691.25	710.39	729.53	744.12	759.00	774.18	789.67	805.46
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13 Pasay	Disposal Waste	279.00	295.67	312.33	329.00	345.21	361.43	377.64	393.86	410.07	425.02	439.97	454.91	469.86	484.81	494.51	504.40	514.48	524.77	535.27
	Inland DWA	279.00	295.67	312.33	329.00	345.21	361.43	377.64	393.86	410.07	425.02	439.97	454.91	469.86	484.81	494.51	504.40	514.48	524.77	535.27
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14 Muntinlupa	Disposal Waste	215.00	250.67	286.33	322.00	359.96	397.92	435.88	473.84	511.80	556.02	600.24	644.45	688.67	732.89	747.55	762.50	777.75	793.30	809.17
	Inland DWA	215.00	250.67	286.33	322.00	359.96	397.92	435.88	473.84	511.80	556.02	600.24	644.45	688.67	732.89	747.55	762.50	777.75	793.30	809.17
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15 Mandaluyong	Disposal Waste	178.00	188.33	198.67	209.00	218.93	228.87	238.80	248.74	258.67	267.46	276.24	285.03	293.81	302.60	308.65	314.83	321.12	327.54	334.09
	Inland DWA	178.00	188.33	198.67	209.00	218.93	228.87	238.80	248.74	258.67	267.46	276.24	285.03	293.81	302.60	308.65	314.83	321.12	327.54	334.09
	incinerated WA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sea DWA									0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16 Paranaque	Disposal Waste	129.00	141.33	153.67	166.00	182.02	198.04	214.05	230.07	246.09	265.41	284.72	304.04	323.35	342.67	349.52	356.51	363.64	370.92	378.34
	Inland DWA	129.00	141.33	153.67	166.00	182.02	198.04	214.05	230.07	246.09	265.41	284.72	304.04	323.35	0.00	6.85	13.84	20.97	28.25	35.67
	incinerated WA									0.00	0.00	0.00	0.00	0.00	342.67	342.67	342.67	342.67	342.67	342.67
	Sea DWA									0.00	0.00	0.00	0.00	0.00	51.40	51.40	51.40	51.40	51.40	51.40
17 Las Pinas	Disposal Waste	204.00	231.67	259.33	287.00	309.70	332.40	355.09	377.79	400.49	427.50	454.52	481.53	508.55	535.56	546.27	557.20	568.34	579.71	591.30
	Inland DWA	204.00	231.67	259.33	287.00	309.70	332.40	355.09	377.79	400.49	427.50	454.52	481.53	508.55	127.70	138.41	149.34	160.48	171.85	183.44
	incinerated WA									0.00	0.00	0.00	0.00	0.00	407.86	407.86	407.86	407.86	407.86	407.86
	Sea DWA									0.00	0.00	0.00	0.00	0.00	61.18	61.18	61.18	61.18	61.18	61.18
Total	Disposal Waste	3,900.00	4,191.33	4,482.67	4,774.00	4,944.48	5,114.95	5,285.43	5,455.90	6,529.83	6,966.88	7,403.94	7,840.99	8,278.05	8,715.10	8,889.40	9,067.19	9,248.53	9,433.50	9,622.17
	Inland DWA	3,900.00	4,191.33	4,482.67	4,774.00	4,944.48	5,114.95	5,285.43	5,455.90	6,029.83	6,466.88	6,903.94	7,340.99	7,778.05	5,715.10	5,889.40	6,067.19	6,248.53	6,433.50	6,622.17
	incinerated WA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	500.00	500.00	500.00	500.00	500.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00	3,000.00
	Sea DWA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	75.00	75.00	75.00	75.00	75.00	450.00	450.00	450.00	450.00	450.00	450.00
Incoming Waste	(ton/day)	3,900	4,191	4,483	4,774	4,944	5,115	5,285	5,456	6,030	6,467	6,904	7,341	7,778	5,715	5,889	6,067	6,249	6,434	6,622
-do-	(m3/day)	14,640	15,733	16,827	17,920	18,560	19,200	19,840	20,480	22,634	24,275	25,916	27,556	29,197	21,453	22,107	22,775	23,455	24,150	24,858
Disposal Waste	(m3/day)	4,875	5,239	5,603	5,968	6,181	6,394	6,607	6,820	7,537	8,084	8,630	9,176	9,723	7,144	7,362	7,584	7,811	8,042	8,278
covering soil	(m3/day)	731	786	841	895	927	959	991	1,023	1,131	1,213	1,294	1,376	1,458	1,072	1,104	1,138	1,172	1,206	1,242

ASG of the waste during haulage = 0.2664ton/m3 (3,900/14,639:incoming survey in 1997 conducted by JICA) ASG of disposed waste = 0.8 ton/m3

Volume of covering soil is assumed 15% of a disposal amount of waste 8,328 m3/day

Annual Disposal Amount

		1997 (ton/year)	1998 (ton/year)	1999 (ton/year)	2000 (ton/year)	2001 (ton/year)	2002 (ton/year)	2003 (ton/year)	2004 (ton/year)	2005 (ton/year)	2006 (ton/year)	2007 (ton/year)	2008 (ton/year)	2009 (ton/year)	2010 (ton/year)	2011 (ton/year)	2012 (ton/year)	2013 (ton/year)	2014 (ton/year)	2015 (ton/year)
1 Manila	Disposal Waste	266,085	270,952	275,818	280,685	291,870	303,055	314,240	325,425	336,610	353,820	371,030	388,240	405,449	422,659	431,112	439,734	448,529	457,500	466,650
	Inland DWA	266,085	270,952	275,818	280,685	291,870	303,055	314,240	325,425	154,110	171,320	188,530	205,740	222,949	14,352	22,805	31,427	40,222	49,192	58,342
	incinerated WA	0	0	0	0	0	0	0	0	182,500	182,500	182,500	182,500	182,500	408,307	408,307	408,307	408,307	408,307	408,307
	Sea DWA	0	0	0	0	0	0	0	0	27,375	27,375	27,375	27,375	27,375	61,246	61,246	61,246	61,246	61,246	61,246
2 Quezon	Disposal Waste	275,940	299,057	322,173	345,290	373,265	401,240	429,215	457,190	485,165	514,122	543,079	572,036	600,993	629,950	642,549	655,400	668,508	681,878	695,516
	Inland DWA	275,940	299,057	322,173	345,290	373,265	401,240	429,215	457,190	485,165	514,122	543,079	572,036	600,993	320,587	333,186	346,037	359,145	372,515	386,152
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	309,363	309,363	309,363	309,363	309,363	309,363
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	46,404	46,404	46,404	46,404	46,404	46,404
3 Caloocan	Disposal Waste	58,035	64,362	70,688	77,015	61,612	46,209	30,806	15,403	134,659	152,596	170,533	188,470	206,407	224,344	228,830	233,407	238,075	242,837	247,693
	Inland DWA	58,035	64,362	70,688	77,015	61,612	46,209	30,806	15,403	134,659	152,596	170,533	188,470	206,407	120,957	125,444	130,021	134,689	139,450	144,307
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	103,386	103,386	103,386	103,386	103,386	103,386
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	15,508	15,508	15,508	15,508	15,508	15,508
4 Navotas	Disposal Waste	14,235	15,330	16,425	17,520	14,016	10,512	7,008	3,504	27,368	30,559	33,751	36,942	40,134	43,326	44,192	45,076	45,977	46,897	47,835
	Inland DWA	14,235	15,330	16,425	17,520	14,016	10,512	7,008	3,504	27,368	30,559	33,751	36,942	40,134	43,326	44,192	45,076	45,977	46,897	47,835
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5 Valenzuela	Disposal Waste	54,020	59,982	65,943	71,905	57,524	43,143	28,762	14,381	100,609	109,226	117,842	126,459	135,076	143,693	146,567	149,498	152,488	155,538	158,649
	Inland DWA	54,020	59,982	65,943	71,905	57,524	43,143	28,762	14,381	100,609	109,226	117,842	126,459	135,076	143,693	146,567	149,498	152,488	155,538	158,649
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 Malabon	Disposal Waste	34,675	37,960	41,245	44,530	35,624	26,718	17,812	8,906	67,124	72,801	78,479	84,157	89,835	95,513	97,423	99,372	101,359	103,387	105,454
	Inland DWA	34,675	37,960	41,245	44,530	35,624	26,718	17,812	8,906	67,124	72,801	78,479	84,157	89,835	95,513	97,423	99,372	101,359	103,387	105,454
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Marikina	Disposal Waste	30,295	32,728	35,162	37,595	41,564	45,533	49,502	53,471	57,440	65,804	74,167	82,531	90,894	99,258	101,243	103,268	105,333	107,440	109,589
	Inland DWA	30,295	32,728	35,162	37,595	41,564	45,533	49,502	53,471	57,440	65,804	74,167	82,531	90,894	99,258	101,243	103,268	105,333	107,440	109,589
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8 Pasig	Disposal Waste	98,915	107,553	116,192	124,830	133,577	142,324	151,071	159,817	168,564	176,909	185,254	193,598	201,943	210,287	214,493	218,783	223,159	227,622	232,174
	Inland DWA	98,915	107,553	116,192	124,830	133,577	142,324	151,071	159,817	168,564	176,909	185,254	193,598	201,943	210,287	214,493	218,783	223,159	227,622	232,174
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9 Pateros	Disposal Waste	6,205	6,570	6,935	7,300	7,813	8,326	8,840	9,353	9,866	10,457	11,049	11,640	12,231	12,822	13,079	13,340	13,607	13,879	14,157
	Inland DWA	6,205	6,570	6,935	7,300	7,813	8,326	8,840	9,353	9,866	10,457	11,049	11,640	12,231	12,822	13,079	13,340	13,607	13,879	14,157
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10 San Juan	Disposal Waste	18,980	19,710	20,440	21,170	22,627	24,084	25,541	26,998	28,455	30,115	31,774	33,433	35,093	36,752	37,487	38,237	39,001	39,781	40,577
	Inland DWA	18,980	19,710	20,440	21,170	22,627	24,084	25,541	26,998	28,455	30,115	31,774	33,433	35,093	36,752	37,487	38,237	39,001	39,781	40,577
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11 Taguig	Disposal Waste	30,660	34,553	38,447	42,340	47,729	53,118	58,507	63,895	69,284	79,561	89,837	100,113	110,389	120,665	123,079	125,540	128,051	130,612	133,224
	Inland DWA	30,660	34,553	38,447	42,340	47,729	53,118	58,507	63,895	69,284	79,561	89,837	100,113	110,389	120,665	123,079	125,540	128,051	130,612	133,224
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12 Makati	Disposal Waste	168,630	176,782	184,933	193,085	200,737	208,389	216,041	223,692	231,344	238,331	245,318	252,305	259,292	266,278	271,604	277,036	282,577	288,228	293,993
	Inland DWA	168,630	176,782	184,933	193,085	200,737	208,389	216,041	223,692	231,344	238,331	245,318	252,305	259,292	266,278	271,604	277,036	282,577	288,228	293,993
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13 Pasay	Disposal Waste	101,835	107,918	114,002	120,085	126,003	131,921	137,839	143,757	149,676	155,132	160,588	166,044	171,500	176,956	180,495	184,105	187,787	191,542	195,373
	Inland DWA	101,835	107,918	114,002	120,085	126,003	131,921	137,839	143,757	149,676	155,132	160,588	166,044	171,500	176,956	180,495	184,105	187,787	191,542	195,373
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14 Muntinlupa	Disposal Waste	78,475	91,493	104,512	117,530	131,385	145,241	159,096	172,952	186,807	202,947	219,086	235,226	251,365	267,505	272,855	278,312	283,878	289,556	295,347
	Inland DWA	78,475	91,493	104,512	117,530	131,385	145,241	159,096	172,952	186,807	202,947	219,086	235,226	251,365	267,505	272,855	278,312	283,878	289,556	295,347
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15 Mandaluyong	Disposal Waste	64,970	68,742	72,513	76,285	79,911	83,537	87,163	90,789	94,415	97,621	100,828	104,035	107,242	110,449	112,658	114,911	117,209	119,554	121,945
	Inland DWA	64,970	68,742	72,513	76,285	79,911	83,537	87,163	90,789	94,415	97,621	100,828	104,035	107,242	110,449	112,658	114,911	117,209	119,554	121,945
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16 Paranaque	Disposal Waste	47,085	51,587	56,088	60,590	66,437	72,283	78,130	83,976	89,823	96,873	103,924	110,974	118,024	125,075	127,576	130,128	132,730	135,385	138,092
	Inland DWA	47,085	51,587	56,088	60,590	66,437	72,283	78,130	83,976	89,823	96,873	103,924	110,974	118,024	0	2,501	5,053	7,656	10,310	13,018
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	125,075	125,075	125,075	125,075	125,075	125,075
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	18,761	18,761	18,761	18,761	18,761	18,761
17 Las Pinas	Disposal Waste	74,460	84,558	94,657	104,755	113,040	121,325	129,609	137,894	146,179	156,039	165,899	175,759	185,619	195,479	199,389	203,377	207,444	211,593	215,825
	Inland DWA	74,460	84,558	94,657	104,755	113,040	121,325	129,609	137,894	146,179	156,039	165,899	175,759	185,619	46,611	50,520	54,508	58,575	62,724	66,956
	incinerated WA	0	0	0	0	0	0	0	0	0	0	0	0	0	148,869	148,869	148,869	148,869	148,869	148,869
	Sea DWA	0	0	0	0	0	0	0	0	0	0	0	0	0	22,330	22,330	22,330	22,330	22,330	22,330
Total	Disposal Waste	1,423,500	1,529,837	1,636,173	1,742,510	1,804,734	1,866,957	1,929,181	1,991,405	2,383,388	2,542,913	2,702,437	2,861,962	3,021,487	3,181,012	3,244,632	3,309,524	3,375,715	3,443,229	3,512,094
	Inland DWA	1,423,500	1,529,837	1,636,173	1,742,510	1,804,734	1,866,957	1,929,181	1,991,405	2,200,888	2,360,413	2,519,937	2,679,462	2,838,987	2,086,012	2,149,632	2,214,524	2,280,715	2,348,229	2,417,094
	incinerated WA	0	0	0	0	0	0	0	0	182,500	182,500	182,500	182,500	182,500	1,095,000	1,095,000	1,095,000	1,095,000	1,095,000	1,095,000
	Sea DWA	0	0	0	0	0	0	0	0	27,375	27,375	27,375	27,375	27,375	164,250	164,250	164,250	164,250	164,250	164,250

Acumulated Disposal Amount of Inland Landfill

ASG = 0.8			1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Soil Covering 15%																					
1 Manila	Annual DA	ton/year		203,214	275,818	280,685	291,870	303,055	314,240	325,425	154,110	171,320	188,530	205,740	222,949	14,352	22,805	31,427	40,222	49,192	58,342
	Ac. DA	ton		203,214	479,032	759,717	1,051,587	1,354,642	1,668,882	1,994,308	2,148,418	2,319,738	2,508,268	2,714,007	2,936,957	2,951,308	2,974,113	3,005,541	3,045,763	3,094,955	3,153,298
	Ac. DV	m3		254,017	598,790	949,646	1,314,484	1,693,303	2,086,103	2,492,885	2,685,522	2,899,673	3,135,335	3,392,509	3,671,196	3,689,136	3,717,642	3,756,926	3,807,205	3,868,694	3,941,622
	SLF Volume	m3		292,120	688,609	1,092,093	1,511,657	1,947,298	2,399,019	2,866,817	3,088,351	3,334,623	3,605,635	3,901,286	4,221,875	4,242,506	4,275,288	4,320,465	4,378,284	4,448,998	4,532,865
2 Quezon	Annual DA	ton/year		224,293	322,173	345,290	373,265	401,240	429,215	457,190	485,165	514,122	543,079	572,036	600,993	320,587	333,186	346,037	359,145	372,515	386,152
	Ac. DA	ton		224,293	546,466	891,756	1,265,021	1,666,261	2,095,476	2,552,666	3,037,832	3,551,954	4,095,033	4,667,069	5,268,062	5,588,649	5,921,835	6,267,871	6,627,016	6,999,531	7,385,684
	Ac. DV	m3		280,366	683,082	1,114,695	1,581,276	2,082,826	2,619,345	3,190,833	3,797,290	4,439,942	5,118,791	5,833,836	6,585,078	6,985,811	7,402,293	7,834,839	8,283,770	8,749,414	9,232,104
	SLF Volume	m3		322,420	785,545	1,281,899	1,818,468	2,395,250	3,012,247	3,669,458	4,366,883	5,105,934	5,886,610	6,708,912	7,572,839	8,033,683	8,512,657	9,010,065	9,526,336	10,061,826	10,616,920
3 Caloocan	Annual DA	ton/year		48,271	70,688	77,015	61,612	46,209	30,806	15,403	134,659	152,596	170,533	188,470	206,407	120,957	125,444	130,021	134,689	139,450	144,307
	Ac. DA	ton		48,271	118,960	195,975	257,587	303,796	334,602	350,005	484,664	637,260	807,793	996,263	1,202,670	1,323,627	1,449,072	1,579,093	1,713,782	1,853,232	1,997,539
	Ac. DV	m3		60,339	148,699	244,968	321,983	379,744	418,252	437,506	605,830	796,575	1,009,742	1,245,329	1,503,338	1,654,534	1,811,340	1,973,866	2,142,227	2,316,540	2,496,924
	SLF Volume	m3		69,390	171,004	281,713	370,281	436,706	480,990	503,132	696,705	916,062	1,161,203	1,432,129	1,728,838	1,902,715	2,083,041	2,269,946	2,463,561	2,664,021	2,871,465
4 Navotas	Annual DA	ton/year		11,498	16,425	17,520	14,016	10,512	7,008	3,504	27,368	30,559	33,751	36,942	40,134	43,326	44,192	45,076	45,977	46,897	47,835
	Ac. DA	ton		11,498	27,923	45,443	59,459	69,971	76,979	80,483	107,850	138,409	172,160	209,103	249,237	292,562	336,754	381,830	427,807	474,704	522,539
	Ac. DV	m3		14,372	34,903	56,803	74,323	87,463	96,223	100,603	134,813	173,012	215,200	261,378	311,546	365,703	420,943	477,287	534,759	593,380	653,174
	SLF Volume	m3		16,528	40,139	65,324	85,472	100,583	110,657	115,694	155,035	198,964	247,480	300,585	358,278	420,558	484,084	548,881	614,973	682,387	751,150
5 Valenzuela	Annual DA	ton/year		44,986	65,943	71,905	57,524	43,143	28,762	14,381	100,609	109,226	117,842	126,459	135,076	143,693	146,567	149,498	152,488	155,538	158,649
	Ac. DA	ton		44,986	110,930	182,835	240,359	283,502	312,264	326,645	427,253	536,479	654,321	780,781	915,857	1,059,550	1,206,117	1,355,615	1,508,104	1,663,642	1,822,291
	Ac. DV	m3		56,233	138,662	228,543	300,448	354,377	390,329	408,306	534,066	670,598	817,901	975,976	1,144,821	1,324,437	1,507,646	1,694,519	1,885,130	2,079,552	2,277,864
	SLF Volume	m3		64,668	159,461	262,825	345,515	407,534	448,879	469,552	614,176	771,188	940,587	1,122,372	1,316,544	1,523,103	1,733,793	1,948,697	2,167,899	2,391,485	2,619,543
6 Malabon	Annual DA	ton/year		28,470	41,245	44,530	35,624	26,718	17,812	8,906	67,124	72,801	78,479	84,157	89,835	95,513	97,423	99,372	101,359	103,387	105,454
	Ac. DA	ton		28,470	69,715	114,245	149,869	176,587	194,399	203,305	270,429	343,230	421,709	505,867	595,702	691,215	788,639	888,010	989,370	1,092,756	1,198,211
	Ac. DV	m3		35,588	87,144	142,806	187,336	220,734	242,999	254,131	338,036	429,037	527,137	632,333	744,627	864,019	985,798	1,110,013	1,236,712	1,365,946	1,497,763
	SLF Volume	m3		40,926	100,215	164,227	215,437	253,844	279,449	292,251	388,741	493,393	606,207	727,183	856,321	993,622	1,133,668	1,276,515	1,422,219	1,570,837	1,722,428
7 Marikina	Annual DA	ton/year		24,546	35,162	37,595	41,564	45,533	49,502	53,471	57,440	65,804	74,167	82,531	90,894	99,258	101,245	103,268	105,333	107,440	109,589
	Ac. DA	ton		24,546	59,708	97,303	138,867	184,400	233,902	287,373	344,813	410,617	484,784	567,315	658,209	757,467	858,711	961,979	1,067,312	1,174,753	1,284,341
	Ac. DV	m3		30,683	74,635	121,629	173,584	230,500	292,377	359,216	431,016	513,271	605,980	709,144	822,762	946,834	1,073,388	1,202,474	1,334,140	1,468,441	1,605,427
	SLF Volume	m3		35,285	85,830	139,873	199,621	265,075	336,234	413,099	495,669	590,262	696,877	815,515	946,176	1,088,859	1,234,397	1,382,845	1,534,261	1,688,707	1,846,241
8 Pasig	Annual DA	ton/year		80,665	116,192	124,830	133,577	142,324	151,071	159,817	168,564	176,909	185,254	193,598	201,943	210,287	214,495	218,783	223,159	227,622	232,174
	Ac. DA	ton		80,665	196,857	321,687	455,264	597,587	748,658	908,475	1,077,040	1,253,948	1,439,202	1,632,800	1,834,743	2,045,031	2,259,524	2,478,307	2,701,466	2,929,087	3,161,262
	Ac. DV	m3		100,831	246,071	402,108	569,079	746,984	935,822	1,135,594	1,346,299	1,567,436	1,799,003	2,041,000	2,293,429	2,556,288	2,824,405	3,097,883	3,376,832	3,661,359	3,951,577
	SLF Volume	m3		115,956	282,981	462,425	654,441	859,032	1,076,196	1,305,933	1,548,244	1,802,551	2,068,853	2,347,150	2,637,443	2,939,731	3,248,065	3,562,566	3,883,357	4,210,563	4,544,314
9 Pateros	Annual DA	ton/year		4,928	6,935	7,300	7,813	8,326	8,840	9,353	9,866	10,457	11,049	11,640	12,231	12,822	13,079	13,340	13,607	13,879	14,157
	Ac. DA	ton		4,928	11,863	19,163	26,976	35,302	44,142	53,494	63,360	75,818	84,866	96,506	108,737	121,560	134,638	147,979	161,586	175,466	189,623
	Ac. DV	m3		6,159	14,828	23,953	33,720	44,128	55,177	66,868	79,200	92,272	106,083	120,633	135,921	151,950	168,298	184,974	201,983	219,332	237,028
	SLF Volume	m3		7,083	17,052	27,546	38,778	50,747	63,454	76,898	91,081	106,113	121,995	138,727	156,310	174,742	193,543	212,720	232,280	252,232	272,583
10 San Juan	Annual DA	ton/year		14,783	20,440	21,170	22,627	24,084	25,541	26,998	28,455	30,115	31,774	33,433	35,093	36,752	37,487	38,237	39,001	39,781	40,577
	Ac. DA	ton		14,783	35,223	56,393	79,020	103,104	128,645	155,643	184,099	214,213	245,987	279,421	314,513	351,265	388,752	426,989	465,990	505,771	546,348
	Ac. DV	m3		18,478	44,028	70,491	98,774	128,880	160,806	194,554	230,123	267,767	307,484	349,276	393,142	439,081	485,940	533,736	582,487	632,214	682,935
	SLF Volume	m3		21,250	50,652	81,064	113,591	148,212	184,927	223,737	264,642	307,932	353,607	401,667	452,113	504,944	558,831	613,796	669,861	727,046	785,376
11 Taguig	Annual DA	ton/year		25,915	38,447	42,340	47,729	53,118	58,507	63,895	69,284	79,581	89,837	100,113	110,389	120,665	123,079	125,540	128,051	130,612	133,224
	Ac. DA	ton		25,915	64,362	106,702	154,431	207,548	266,055	329,950	399,235	478,795	568,632	668,745	779,134	899,799	1,022,878	1,148,418	1,276,469	1,407,081	1,540,305
	Ac. DV	m3		32,394	80,452	133,377	193,038	259,435	332,569	412,438	499,043	598,494	710,790	835,931	973,917	1,124,749	1,278,597	1,435,523	1,595,586	1,758,851	1,925,382
	SLF Volume	m3		37,253	92,520	153,384	221,994	298,351	382,454	474,304	573,900	688,268	817,408	961,321	1,120,005	1,293,461	1,470,387	1,650,851	1,834,924	2,022,679	2,214,189
12 Makati	Annual DA	ton/year		132,586	184,933	193,085	200,737	208,389	216,041	223,692	231,344	238,331	245,318	252,305	259,292	266,278	271,604	277,036	282,577	288,228	293,993
	Ac. DA	ton		132,586	317,520	510,605	711,341	919,730	1,135,771	1,359,463	1,590,807	1,829,139	2,074,457	2,326,761	2,586,053	2,852,331	3,123,935	3,400,972	3,683,548	3,971,777	4,265,770
	Ac. DV	m3		165,733	396,899	638,256	889,177	1,149,663	1,419,713	1,699,329	1,988,509	2,286,423	2,593,071	2,908,452	3,232,566	3,565,414	3,904,919	4,251,214	4,604,435	4,964,721	5,332,212
	SLF Volume	m3		190,593	456,434	733,994	1,022,553	1,322,112	1,632,670	1,954,228	2,286,786	2,629,387	2,982,031	3,344,719	3,717,451	4,100,226	4,490,657	4,888,897	5,295,101	5,709,429	6,132,044
13 Pasay	Annual DA	ton/year		80,939	114,002	120,085	126,003	131,921	137,839	143,757	149,676	155,132	160,588	166,044	171,500	176,956	180,495	184,105	187,787	191,542	195,373
	Ac. DA	ton		80,939	194,940	315,025	441,029	572,950	710,789	854,547	1,004,222	1,159,354	1,319,941	1,485,985	1,657,484	1,834,440	2,014,935	2,199,040	2,386,826	2,578,369	2,773,742
	Ac. DV	m3		101,173	243,676	393,782	551,286	716,187	888,486	1,068,183	1,255,278	1,449,192	1,649,927	1,857,481	2,071,856	2,293,050	2,518,669	2,748,799	2,983,533	3,222,961	3,467,178
	SLF Volume	m3		116,349	280,227	452,849	633,979	823,615	1,021,759	1,228,411	1,443,569	1,666,571	1,897,416	2,136,103	2,382,634	2,637,008	2,896,469	3,161,119	3,431,063	3,706,405	3,987,254
14 Muntinlupa	Annual DA	ton/year		68,620	104,512	117,530	131,385	145,241	159,096	172,952	186,807	202,947	219,086	235,226	251,365	267,505	272,855	278,312	283,878	289,556	295,347
	Ac. DA	ton		68,620	173,132	290,662	422,047	567,288	726,384	899,336	1,086,143	1,289,089	1,508,175	1,743,401	1,994,766	2,262,271	2,535,126	2,813,438	3,097,316	3,386,872	3,682,219
	Ac. DV	m3		85,775	216,415	363,327	527,559	709,110	907,980	1,124,170	1,357,678	1,611,362	1,885,219	2,179,251	2,493,458	2,827,839	3,168,908	3,516,798	3,871,646	4,233,590	4,602,774
	SLF Volume	m3		98,641	248,877	417,826	606,693	815,476	1,044,177	1,292,795	1,561,330	1,853,066	2,168,002	2,506,139	2,867,477	3,252,015	3,644,244	4,044,317	4,452,392	4,868,629	5,293,190
15 Mandaluyong	Annual DA	ton/year		51,556	72,513	76,285	79,911	83,537	87,163	90,789	94,415	97,621	100,828	104,035	107,242	110,449	112,658	114,911	117,209	119,554	121,945
	Ac. DA	ton		51,556	124,070	200,355	280,265	363,802	450,965	541,754	636,168	733,790	834,618	938,653	1,045,895	1,156,344	1,269,002	1,383,913	1,501,123	1,620,676	1,742,621
	Ac. DV	m3		64,445	155,087	250,443	350,332	454,753	563,706	677,192	795,210	917,237	1,043,273	1,173,317	1,307,369	1,445,430	1,586,253	1,729,892	1,876,404	2,025,845	2,178,276
	SLF Volume	m3		74,112	178,350	288,010	402,882	522,966	648,262	778,771	914,492	1,054,823	1,199,763	1,349,314	1,503,475	1,662,245	1,824,191	1,989,376	2,157,864	2,329,722	2,505,018
16 Paranaque	Annual DA	ton/year		38,690	56,088	60,590	66,437	72,283	78,130	83,976	89,823	96,873	103,924	110,974	118,024	0	2,501	5,053	7,656	10,310	13,018
	Ac. DA	ton		38,690	94,778	155,368	221,805	294,088	372,218	456,194	546,017	642,890	746,814	857,787	975,812	975,812	978,313	983,366	991,022	1,001,332	1,014,350
	Ac. DV	m3		48,363	118,473	194,210	277,256	367,610	465,272	570,243	682,521	803,613	933,517	1,072,234	1,219,765	1,219,765	1,222,891	1,229,208	1,238,777	1,251,665	1,267,937
	SLF Volume	m3		55,617	136,244	223,342	318,845	422,752	535,063	655,779	784,899	924,154	1,073,545	1,233,069	1,402,729	1,402,729	1,406,325	1,413,589	1,424,594	1,439,415	1,458,128
17 Las Pinas	Annual DA	ton/year		63,419	94,637	104,755	113,040	121,325	129,609	137,894	146,179	156,039	165,899	175,759	185,619	46,611	50,520	54,508	58,575	62,724	66,956
	Ac. DA	ton		63,419	158,075	262,830	375,870	497,195	626,804	764,698	910,877	1,066,916	1,232,815	1,408,574	1,594,193	1,640,804	1,691,324	1,745,832	1,804,407	1,867,132	1,934,088
	Ac. DV	m3		79,275	197,594	328,538	469,838	621,493	783,505	955,873	1,138,596	1,333,645	1,541,019	1,760,718	1,992,742	2,051,005	2,114,155	2,182,290	2,255,509	2,333,915	2,417,610
	SLF Volume	m3		91,164	227,233	377,819	540,313	714,717	901,031	1,099,254	1,309,386	1,533,692	1,772,172	2,024,825	2,291,653	2,358,656	2,431,278	2,509,633	2,593,836	2,684,902	2,780,951
Total	Annual DA	ton/year		1,147,378	1,636,173	1,742,510	1,804,734	1,866,957	1,929,181	1,991,405	2,200,888	2,360,413	2,519,937	2,679,462	2,838,987	2,086,012	2,149,632	2,214,524	2,280,715	2,348,229	2,417,094
	Ac. DA	ton		1,147,378	2,783,551	4,526,061	6,330,795	8,197,752	10,126,933	12,118,338	14,319,226	16,679,639	19,199,576	21,879,038	24,718,025	26,804,037	28,953,668	31,168,193	33,448,908	35,797,137	38,214,230
	Ac. DV	m3		1,434,222	3,479,439	5,657,576	7,913,493	10,247,190	12,658,667	15,147,925	17,899,033	20,849,549	23,999,470	27,348,798	30,897,531	33,505,046	36,192,085	38,960,241	41,811,134	44,746,421	47,767,788
	SLF Volume	m3		1,649,355	4,001,354	6,506,212	9,100,517	11,784,269	14,557,467	17,420,111	20,583,888	23,976,981	27,599,391	31,451,118	35,532,161	38,530,803	41,620,898	44,804,277	48,082,805	51,458,384	54,932,956

CHAPTER 21
TOPOGRAPHIC MAPPING

TOPOGRAPHIC MAPPING

1. Working Outline

(1) Four Survey Teams worked on the project for twenty (20) calendar days during the period October 2, 1998 to October 22, 1998.

(2) A total of thirteen (13) ground control points for photogrammetric mapping was established by GPS using TRIMBLE 4000 Series GPS Receiver.

(3) The GPS Survey was tied in to the PRS '92 System using MMA0 and M34 asd reference points.

(4) Elevations of eight (8) control points were determined by differential leveling while the elevations of the others points were derived from the GPS observations by applying the corresponding spheroidal heights.

(5) Reference BMs for the leveling are BMR1-72 (PC & GS) 1956 and M34 (HSDC).

2. Coordinates and Elevations of the Control Points

The list of coordinates and elevations of the control points are attached herewith.

(1) STARTING POINT OF HORIZONTAL CONTROL

STATION DESIGNATION	NORTHINGS	EASTINGS	ELEVATION
MMA 0	1618610.526	504490.728	54.832

(2) STARTING POINT OF VERTICAL CONTROL

STATION DESIGNATION	NORTHINGS	EASTINGS	ELEVATION
1) M 34			179.425
2) BMR1 72			17.853

C. CONTROLLED PICTURE POINTS

STATION DESIGNATION	NORTHINGS	EASTINGS	ELEVATION
1) SW 1			30.626
2) SW 2			30.986
3) SW 3			34.710
4) SW 8			357.028
5) SW 9			416.812
6) SW 10			420.678
7) SW 12			372.762
8) SW 13			292.875

3. GPS Survey: MMDA Montalban

(1) PTM GRID COORDINATES (C.M. 121)

Station	Nothing	Fasting
MMA 0	1,618,610.526	504,490.729
SW 1	1,629,558.464	517,062.464
SW 10	1,621,787.494	522,191.045
SW 11	1,622,455.145	522,709.954
SW 12	1,621,075.103	522,649.799
SW 13	1,620,021.351	523,192.625
SW 2	1,629,892.611	518,493.777
SW 3	1,629,204.688	519,646.249
SW 4	1,628,077.020	519,535.144
SW 5	1,627,147.585	519,325.144
SW 6	1,628,156.592	521,166.378
SW 7	1,625,883.256	519,077.884
SW 8	1,623,911.094	521,780.848
SW 9	1,622,936.135	522,344.086
M 34	1,617,559.198	526,251.359

(2) PRS'92 GEOGRAPHIC COORDINATES

Station	Latitude	Longitude	H.A.E.	ELEVATION
MMA 0	14°38'12.089"N	121°02'30.072"E	57.148	54.834
SW 1	14°44'08.151"N	121°09'30.451"E	34.888	30.626
SW 10	14°39'55.152"N	121°12'21.678"E	425.173	420.678
SW 11	14°40'16.662"N	121°12'39.042"E	453.288	(448.801)
SW 12	14°39'31.958"N	121°12'36.988"E	377.232	372.762
SW 13	14°38'57.652"N	121°12'55.097"E	297.370	292.875
SW 2	14°44'18.990"N	121°10'18.313"E	35.382	30.986
SW 3	14°43'56.576"N	121°10'56.825"E	39.027	34.710
SW 4	14°43'19.885"N	121°10'53.081"E	71.294	(66.969)
SW 5	14°42'49.647"N	121°10'46.035"E	186.230	(181.905)
SW 6	14°43'22.429"N	121°11'47.617"E	62.568	(58.243)
SW 7	14°42'08.512"N	121°10'37.736"E	118.452	(114.127)
SW 8	14°41'04.265"N	121°12'08.032"E	361.586	357.028
SW 9	14°40'32.524"N	121°12'26.828"E	421.342	416.812
M 34	14°37'37.434"N	121°14'37.231"E	184.081	179.425

4. Horizontal and Vertical Control

(1) Starting of Horizontal Control

1. MMA 0
2. M34 (HSDC)

(2) Starting of Vertical Control

	Elevation
1. BM R1-72 (PC & GS) 1956	17.853
2. M34 (HSDC)	179.425

5. Output of the Topographic Works

1) Original map sheets at 1:2,000	1 set
2) Duplicated map sheets at 1:2,000	1 set
3) Floppy disk (Auto Cad)	1 set
4) Blue copy	3 sets
5) Final report	1 set

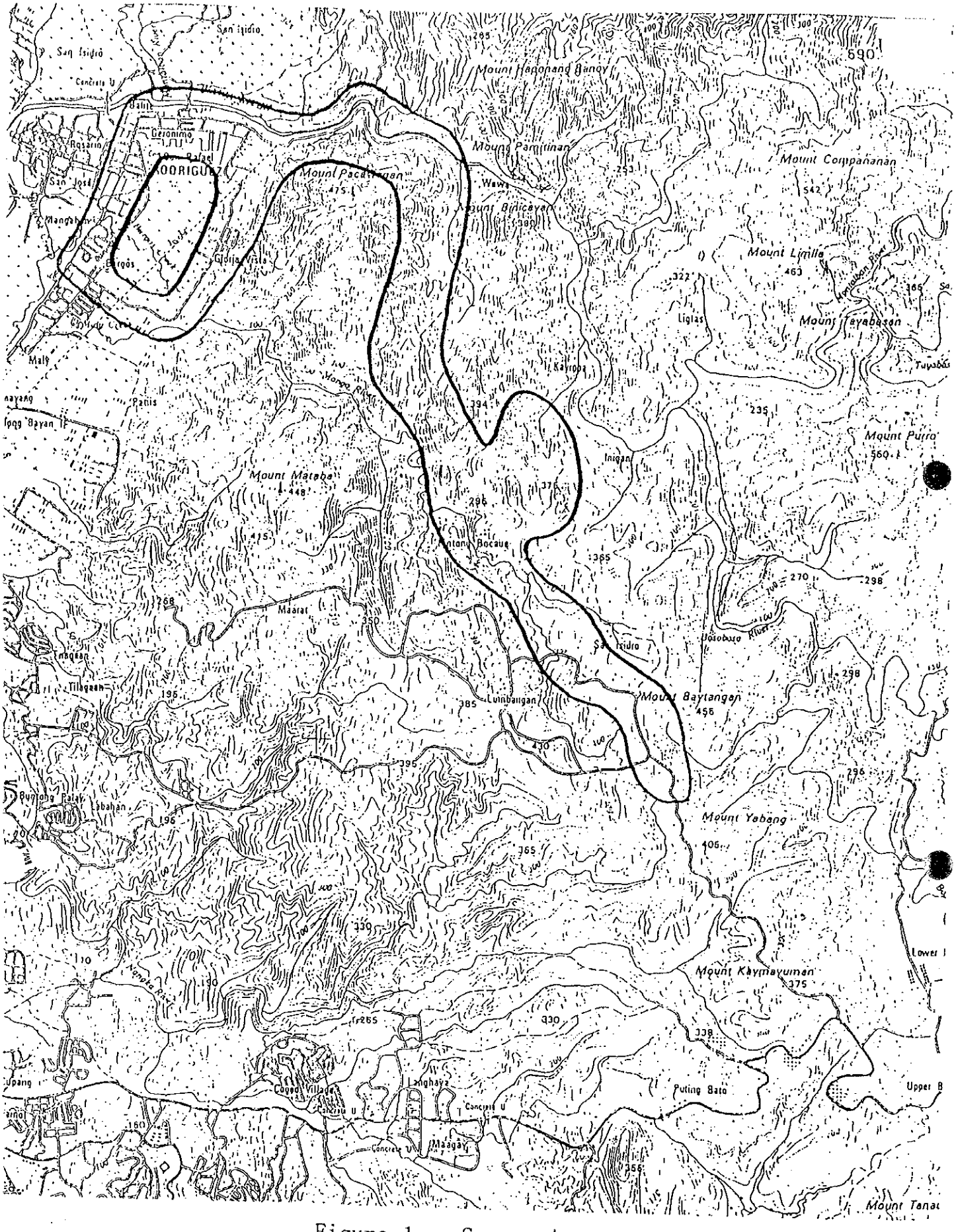


Figure 1 Survey Area

CHAPTER 22
GEOLOGICAL SURVEY

GEOTECHNICAL REPORT

SUBSURFACE INVESTIGATION
THE STUDY ON SOLID WASTE MANAGEMENT
FOR METRO MANILA

1.0 INTRODUCTION

This report embodies our findings and conclusions on the recently concluded Subsurface Soil Investigation Program conducted as part of the **Study On Solid Waste Management For Metro Manila, located at Bo. Wawa, Montalban, Marikina, Rizal.**

Some 6 Shallow Boreholes each 15 meters depth were program at the proposed site to determine the thickness of the overburden soils which is of particular interest. However, initial soil boring showed a much shallower depth of overburden soils. This resulted into 12 Shallow Boreholes group into 6 general locations as shown in **Table 1**. The test results of these Boreholes are summarised and Appended in this Report. Actual drilling works were carried out during the periods from October 29 - November 3, 1998.

Although not included in the **Terms of Reference (TOR)**, some 18 Test Pits were also excavated at the proposed site at an average depth of about 1 meter, to extract samples for Laboratory Compaction Tests (Moisture Density Relations of Soils) and Laboratory Permeability Tests. Also, six (6) Permeameter Tests were performed in the field using a 75mm diameter PVC pipe and set to a 100 mm drilled hole about 0.50 m below existing ground surface. Water percolation rate of the overburden soils at the proposed site can also be observed. Locations of Test Pits are defined by their Coordinates as presented in **Table 1**. Summary of Test pits investigations are also Appended in this report. Actual test pits work and percolation tests were performed during the periods from October 29 - November 3, 1998.

The Field Test results together with the Laboratory tests on samples extracted at site and our observations and findings served as bases for our conclusions and recommendations.

TABLE 1: Scope of Subsurface Investigations

TEST LOCATIONS	BOREHOLES / TEST PITS		COORDINATES		REMARKS
	NO.	Depth (m)	Northing	Easting	
A	BHA1	4.09	14 deg 92' 24.3 "	121 deg 11' 43.2"	Supplementary
	BH-A2	4.30	14 deg 42' 23.8"	121 deg 11' 44"	-do-
	BH-A3	7.10	**14 deg 42' 23"**	**121 deg 11' 45"**	**Reference Borehole for Group A (Samples for Laboratory Tests)**
	TP-A1	1.00	14 deg 42' 25.6"	121 deg 11' 39.5"	For Lab Tests
	TP-A2	1.00	14 deg 42' 27.5"	121 deg 11' 38.8"	-do-
	TP-A3	1.00	14 deg 42' 28"	121 deg 11' 36.1"	-do-
B	**BH-B1**	8.05	**14 deg 42' 21"**	**121 deg 11' 41"**	**Reference Borehole for Group B (Samples for Laboratory Tests)**
	BH-B2	7.11	14 deg 42' 22"	121 deg 11' 39"	Supplementary
	TP-B1	1.00	14 deg 42' 22.5"	121 deg 11' 40.9"	For Lab Tests
	TP-B2	1.00	14 deg 42' 20"	121 deg 11' 38.9"	-do-
	TP-B3	1.00	14 deg 42' 20.7"	121 deg 11' 38.7	-do-
C	**BH-C**	15.00	**14 deg 42' 17"**	**121 deg 11' 35"**	**Reference Borehole for Group C (Samples for Laboratory Tests)**
	TP-C1	1.00	14 deg 42' 17.9"	121 deg 11' 39"	For Lab Tests
	TP-C2	1.00	14 deg 42' 15.5"	121 deg 11' 38.3"	-do-
	TP-C3	1.00	14 deg 42' 18.2"	121 deg 11' 36.9"	-do-
D	**BH-D1**	10.09	**14 deg 42' 14.4"**	**121 deg 11' 36.7"**	**Reference Borehole for Group D**
	BH-D2	7.09	14 deg 42' 15"	121 deg 11' 35.4"	Supplementary
	TP-D1	1.00	14 deg 42' 14.8"	121 deg 11' 35.1"	For Lab Tests
	TP-D2	1.00	14 deg 42' 16.1"	121 deg 11' 36.4"	-do-
	TP-D3	1.00	14 deg 42' 14"	121 deg 11' 35.9"	-do-
E	**BH-E1**	8.65	**14 deg 42'09"**	**121 deg 11' 33"**	**Reference Borehole for Group E (Samples for Laboratory Tests)**
	BH-E2	7.10	14 deg 42' 06"	121 deg 11' 35.6"	Supplementary
	TP-E1	1.00	14 deg 42' 7.2"	121 deg 11' 37.8"	For Lab Tests
	TP-E2	1.00	14 deg 42' 6.7"	121 deg 11' 33.1"	-do-
	TP-E3	1.00	14 deg 42' 5.9"	121 deg 11' 34.1"	-do-
F	BH-F1	7.25	14 deg 42' 08"	121 deg 11' 33"	Supplementary
	BH-F2	7.40	**14 deg 42' 8.4"**	**121 deg 11' 35"**	**Reference Borehole for Group F (Samples for Laboratory Tests)**
	TP-F1	1.00	14 deg 42' 07"	121 deg 11' 34.8"	For Lab Tests
	TP-F2	1.00	14 deg 42' 7.4"	121 deg 11' 33.9"	-do-
	TP-F3	1.00	14 deg 42' 7.9"	121 deg 11' 34.5"	-do-

2.2.5 Plastic Limit and Plasticity of Soils
ASTM D 424-59
The plastic limit of a soil is the water content, expressed as a percentage of the mass of the oven-dried soil, at the boundary between the plastic and semi-solid states.

2.2.6 Density of Soil Particles

In-situ density at depth (Borehole samples) can be measured by the Drive Cylinder Method (Sampling Tube). Immediately after the sample is removed from its container it shall be weighed. Using the field data of the length of sample recovered, the In-Situ Density shall be computed. (DESIGN MANUAL 7.1: NAVFAC DM-7.1-109, May 1982)

2.2.8 Laboratory Permeability Test of Soils
ASTM D 2434 - Falling Head Method

2.2.9 Laboratory Compaction Test of Soils
ASTM D 698- Standard Proctor Test

3.0 GEOLOGY AND TOPOGRAPHY

3.1 Regional Geology

The project area generally lies along the western foothills of the N-S trending Sierra Madre range and east of the Marikina valley. 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.

3.2 Topography

The project site is on a gently rolling to rolling relief generally covered with bushes and trees as the main vegetation. Few small creeks are found traversing the site and draining to the river. Drainage in the area is expected towards the river.

4.0 OBSERVATIONS OF RESULTS AND FINDINGS

4.1 General

Soil investigation results based on six (6) referenced Boreholes as presented on the foregoing tabulation showed a **two(2)-layer overburden soils(Clayey Silt (MH) and Clayey Silt (ML))** to constitute the soil covers in the project site. This is shown on 2-section profiles :- **Soil Profile "1"** and **Soil Profile "3"** appended in this report. The generalized subsurface stratification is described below:

Layer Identification	Description
Layer 1	: Consisting of light to yellowish gray **Clayey SILT (MH)**, medium plasticity, stiff to very stiff in the uppermost **3 to 5 meters** depth (N-values range from 10 to 23, average of 28) and hard consistency (N values greater than 30) down to depth of **about 7 to 8.5 meters** depth.
Layer 2	:Consisting of light gray **Sandy Silt (ML)**, low plasticity to non-plastic with traces of fine gravel, encountered at depth of **3.5 to about 10 meters** in the vicinity of **BH-D1(Soil Profile 1)** and at depth of **6.0 to 15 meters** in the vicinity of **BH-C (Soil Profile 3)**. Consistency of this layer is generally hard to very hard (N values range from 41 to 89).

The test pit investigations also showed that surficial 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 %, average of 27 %. Liquid limits range from 43% to 63%, average of 55 %. Plasticity Index (P.I.) range from 11 to 29 %, average of 19 %. Optimum Moisture Content (OMC) determined from

laboratory compaction tests (Standard Proctor Test) for the Clayey Silt soils range from 21 % to 35 %, average of 29%. Maximum Dry Density (MDD) is average 1.424 g/cc. Laboratory permeability tests of the Clayey Silt have coefficient of permeability, k_{20} to range from 1.326 x 10-5 cm/s to 4.068 x 10-5 cm/s. Such range of the coefficient of permeability values is categorised as impervious, such that a naturally occurring impermeable barrier against seepage prevails at the project site.

For foundation design of structures, a very competent layer is found within the normal founding levels of footings for light to moderately loaded structure. Assuming a footing embedment of 2 meters below existing ground surface, an **Allowable Bearing Capacity of 1.5 tons per square foot** is recommended for design.

CHAPTER 23
ENVIRONMENTAL SURVEY

23.1 Environmental Survey for San Mateo Environmental Improvement Project

23.1.1 Survey for Dry Season

ENVIRONMENTAL SURVEY I (DRY SEASON)
FOR
SAN MATEO ENVIRONMENTAL IMPROVEMENT PROJECT
OF
THE STUDY ON SOLID WASTE MANAGEMENT
FOR METRO MANILA IN THE REPUBLIC OF THE PHILIPPINES

A OBJECTIVE

The objective of the survey is to obtain information on the existing condition of the environment around the San Mateo Sanitary Landfill Site, which will be used as basic data to forecast and evaluate the environmental impacts caused by the project.

B SAMPLING POINTS AND SCHEDULE

TABLE 1 shows the sampling stations at San Mateo Sanitary Landfill Site. The exact sampling points shown in FIGURES 1 to 2 were indicated by the Environmental Engineer of the JICA Study Team, and descriptions of which are shown also in TABLE 1. Method of sampling followed the Philippine standards.

The dry season sampling was conducted on February 19 to 21, February 19, and March 4 to 7, 1998 for Noise and Vibration, Water Quality, and Air Quality and Odor, respectively.

C ITEMS FOR ANALYSIS

TABLE 1 also shows the items for analysis, sampling stations and sampling time.

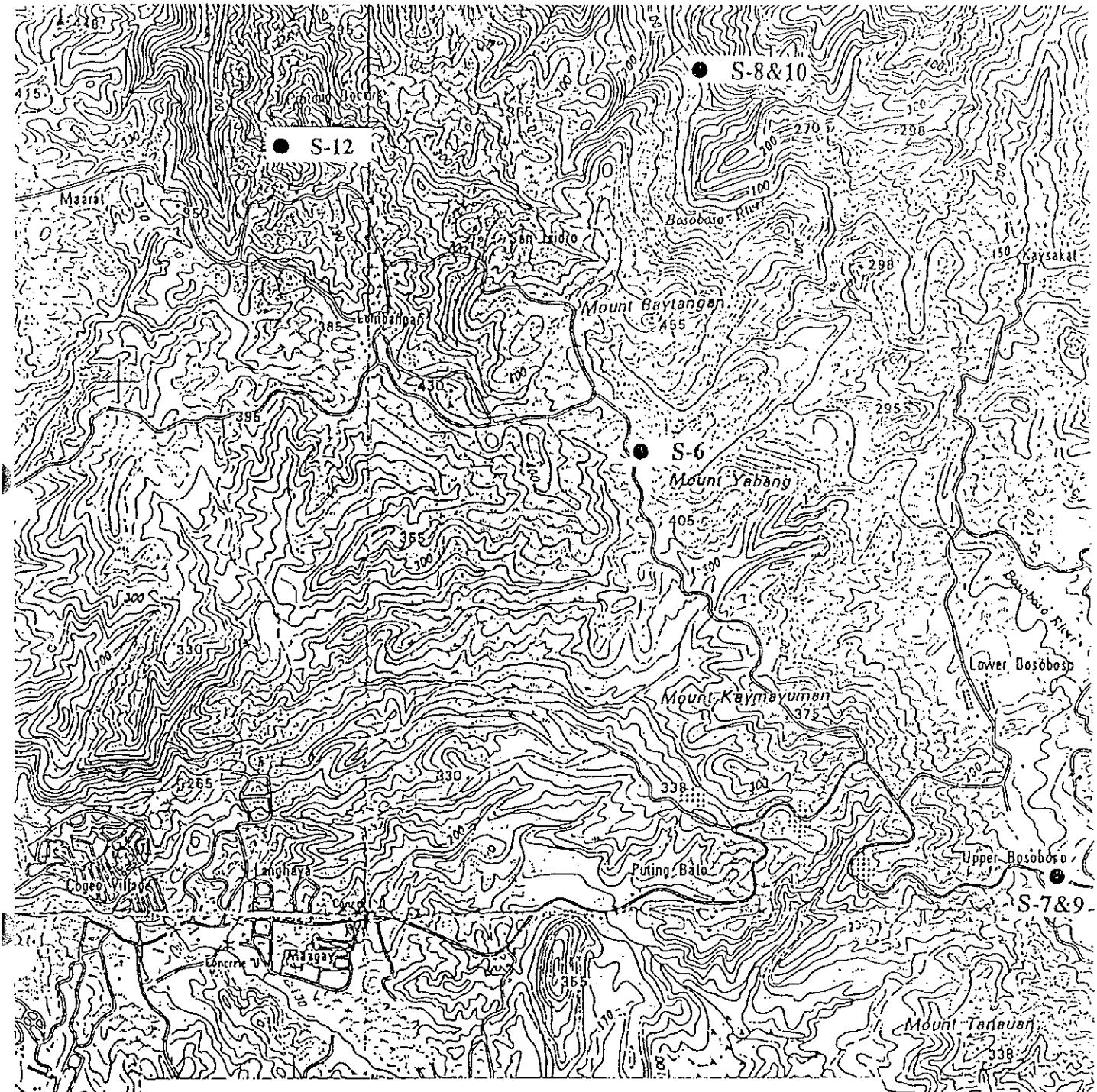
D RESULTS OF ANALYSIS

The methods of analysis and results of the laboratory tests are shown and discussed in following sections.

Table 1 Survey Item, Sampling Point and Sampling Time

Survey Item		Sampling Point		Sampling Time
		No.	Location	
Air Quality	SOx, NOx, CO, AP, Climate (Wind Direction, Wind Velocity, Temperature, Humidity)	S-12	Beside Pintong Bocaue Elementary School	March 4 - 7, 1998
Water Quality	pH, BOD. SS, DO, E-coli	S-5 S-6 S-7	Residential area at the north of the site Sapinit Elementary School at the south of the site Upperstream of Bosoboso River	February 19, 1998
Odor	Odor Concentration	S-1 S-5	Inlet of leachate treatment pond (anaerobic pond) Residential area at the north of the site	March 4 - 7, 1998
Noise/ Vibration	Noise/ Vibration Level by Transportation, Background Noise/ Vibration Level, Traffic Volume by Type	S-1 S-5 S-6 S-11	Inlet of leachate treatment pond (anaerobic pond) Residential area at the north of the site Sapinit Elementary School at the south of the site Entrance/ Exit of the site	February 19 - 21, 1998

Sampling Points of Environmental Survey at San Mateo Sanitary Landfill Site



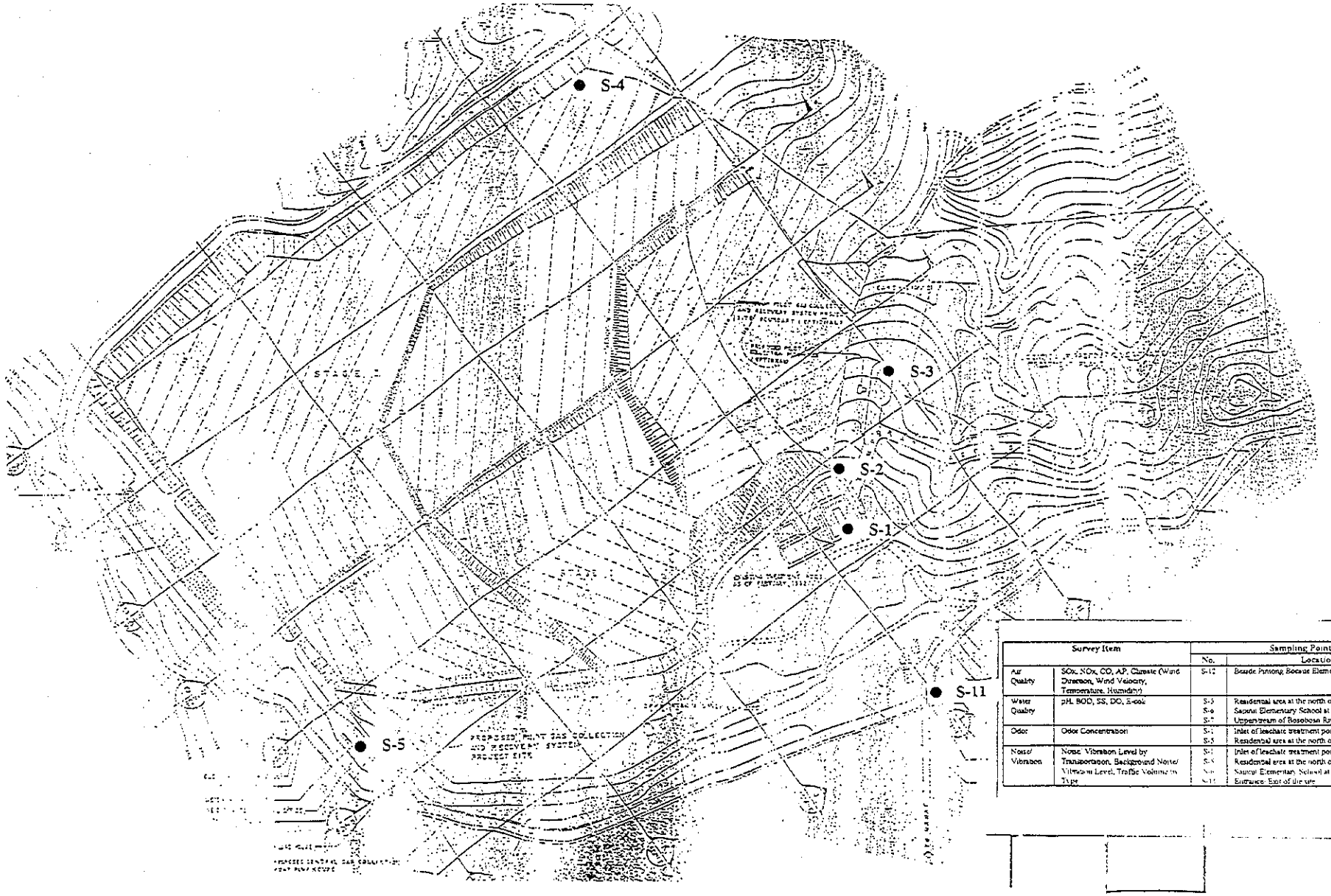
Survey Item		Sampling Point No.	Sampling Point Location	Sampling Time
Air Quality	SOx, NOx, CO, AP, Climate (Wind Direction, Wind Velocity, Temperature, Humidity)	S-12	Beside Puntong Bocaue Elementary School	March 4 - 7, 1998
Water Quality	pH, BOD, SS, DO, E-coli	S-5 S-6 S-7	Residential area at the north of the site Sapinit Elementary School at the south of the site Upperstream of Basobaso River	February 19, 1998
Odor	Odor Concentration	S-1 S-5	Inlet of leachate treatment pond (anaerobic pond) Residential area at the north of the site	March 4 - 7, 1998
Noise/ Vibration	Noise/ Vibration Level by Transportation, Background Noise/ Vibration Level, Traffic Volume by Type	S-1 S-5 S-6 S-11	Inlet of leachate treatment pond (anaerobic pond) Residential area at the north of the site Sapinit Elementary School at the south of the site Entrance/ Exit of the site	February 19 - 21, 1998

Figure 1 Sampling Locations S-6, S-7 and S-12

0 500 1,000 2,000 3,000 m

AIR QUALITY

Sampling Points of Environmental Survey at San Mateo Sanitary Landfill Site



Survey Item		Sampling Point No.	Sampling Point Location	Sampling Time
Air Quality	SOx, NOx, CO, AP, Climate (Wind Direction, Wind Velocity, Temperature, Humidity)	S-11	Beside Pantong Bocaue Elementary School	March 4 - 7, 1988
Water Quality	pH, BOD, SS, DO, E-coli	S-3 S-6 S-7	Residential area at the north of the site Sapang Elementary School at the south of the site Upperstream of Bosoboso River	February 19, 1988
Odor	Odor Concentration	S-1 S-3	Inlet of leachate treatment pond (anaerobic pond) Residential area at the north of the site	March 4 - 7, 1988
Noise/ Vibration	Noise, Vibration Level by Transportation, Background Noise/ Vibration Level, Traffic Volume in Type	S-1 S-3 S-6 S-11	Inlet of leachate treatment pond (anaerobic pond) Residential area at the north of the site Sapang Elementary School at the south of the site Entrance, Exit of the site	February 19 - 22, 1988

Figure 2 Sampling Locations S-1, S-5 and S-11

SAN MATEO LANDFILL
Ambient Air Sampling for TSP, SO2, NO2 and CO
Sampling Location: A vacant lot near elementary school of Sitio Pintong Bocaue (North of Landfill Site)

Date/Time	TSP ug/Ncm	SO2 ug/Ncm	NO2 ug/Ncm	CO ppm
March 04 (5:30 pm) to March 05 (5:30 pm)	231	< 4	< 0.10	< 1
March 05 (6:00 pm) to March 06 (6:00 pm)	509	< 4	< 0.10	< 1
March 06 (7:30 pm) to March 07 (7:30 pm)	356	9.21	< 0.10	< 1
DENR Standard	230	180	150	9

Sampling Procedure:

TSP	Graseby High Volume Sampler	-	Gravimetric Analysis
SO2	Graseby Gas Bubbler Sampler	-	Pararosaniline Method
NO2	Graseby Gas Bubbler Sampler	-	Griess Saltzman Method
CO	Quest Envirotrack IV Gas Monitor (UL registered instrument with accuracy traceable to US-NIST)	-	Direct reading (with disposable sensor)

Note: TSP - total suspended particulates or dust
Ncm - normal cubic meter at 25 deg. C and 760 mmHg (per DENR A.O. 14)
ug - microgram
ppm - parts per million

Description of Sampling Condition:

Ambient air sampling was conducted during dry weather condition. Ambient temperature ranges from 20 to 32 degress celsius with daily average temperature close to 25 deg. C. (hourly values obtained by PAGASA). The sampling site is about 5 meters from uncemented road which is the main source of dust. Variation on dust concentration is attributable to frequency of vehicles coming to the area as well as the wind direction. Traffic density is very light which is composed mainly of passenger jeepneys which arrive and leave the area every 15 to 30 minutes during daytime. The highest dust concentration of 509 ug/Ncm was recorded on March 05 to 06 sampling. This is attributable to the arrival of more than twenty motorbikes which held a sports cycling activity in the nearby area. In general, the traffic volume in the area does not cause significant contribution to the ambient SO2, NO2 and CO level.

OSTREA MINERAL LABORATORIES, INC.
assaying and testing specialists
1150 Pres. Quirino Avenue Extension
Paco Metro Manila 1007
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Pager No. (145) 50747)
Fax No. (632) 563-2536
Cellone: 0918-8186398
E-mail: oml@misa.ilf.ph.net

TEEM, INC.

DATE March 17, 1998
CLIENT REF. NO.
P. A. NO.
CERT. NO.
INVOICE NO.
SHEET NO. 1 OF 1 PAGES

CERTIFICATE OF ANALYSIS

Samples received
March 09, 1998

Samples taken from
SAN MATEO, RIZAL

			SO_2, ug/ncm	NO_2, ug/ncm
SAMPLE	1	24 HRS	<4	<0.10
SAMPLE	2	24 HRS	<4	<0.10
SAMPLE	3	24 HRS	9.21	<0.10

***** NOTHING FOLLOWS *****

ANALYTICAL METHOD/REMARKS:
The test results pertain only to the samples submitted and tested.

TOTAL SAMPLES 3 TOTAL ANALYSIS 6
N.D. = Element is not detected by the method employed.

CERTIFIED BY:

LORNA G. SY
Manager, Analytical Services

ISO/IEC Guide 25 Certified: An independent endorsement of OML's commitment to quality, technical competence, and customer satisfaction.

AMERICAN SOCIETY FOR TESTING MATERIALS