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METRO MANILA SOLID WASTE MANAGEMENT PROJECT (TA 3848-PHI)

Final Report

Report. No. 3

Waste Analysis and Characterization Study (WACS)

September 2003 (revised)

AEA Technology *In Association With* GlobalWorks • CalRecovery • ENR Consultants

METRO MANILA SOLID WASTE MANAGEMENT PROJECT (TA 3848)

FINAL REPORT

REPORT No. 3

WASTE ANALYSIS AND CHARACTERIZATION STUDY (WACS)

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Executive Summary

RA 9003 requires each city and municipality to develop a 10-year plan to manage its waste. An accurate assessment of the waste stream is needed to design an ecological solid waste management system that will meet the needs of each community.

This report provides an overview of previous WACS, a description of the activities undertaken by the consultants, a presentation of the waste characterization studies conducted by five LGUs, a comparison of current results with previous WACS, and concludes with recommendations.

It is important to note that the results of the waste characterization studies that are presented in this report are the results of five separate studies conducted by the five LGUs. The purpose of the waste characterization studies was to provide important information on waste that is currently being disposed to enable the LGUs to develop well-founded solid waste management plans and programs. It is envisioned that as other LGUs in Metro Manila complete analyses of their waste streams, and as the LGUs conduct further studies to determine seasonality and to analyze recycling and illegal disposal, that the information from these studies would be compiled to characterize the waste stream for all of Metro Manila. It is critical that reliable information on the current waste stream be used as government agencies are moving forward with the implementation of the Ecological Solid Waste Management Act of 2000.

LGU Capacity Building Activities

A number of capacity building activities were conducted to assist the eight LGUs selected under the project in the aspect of waste characterization. These included:

- *Procedure for conducting WACS* – A comprehensive methodology was prepared that included procedures for field work as well as safety procedures. The procedures were based the experience of the consultants in conducting similar studies elsewhere. The methodology explains the procedure for analyzing four types of data: composition, quantity, bulk density, and moisture content.

- *Training at a technical working group meeting* -- A training session was held at a Technical Working Group meeting on January 30, 2003. The purpose of the session was to provide an overview of the methodology for conducting the various parts of a waste characterization study, to explain the data sheets, and to answer specific questions from the LGUs.

- *Presentation at the LGU seminar/workshop* -- The procedure for conducting WACS was described to participants at the Seminar for LGUs held in Antipolo on March 10, 2003.

- *Meetings at the LGUs to conduct site-specific planning* -- Planning meetings were conducted at each of the LGUs planning to conduct a waste characterization study. The purpose of each meeting was to define a framework specific to the LGU for collecting and analyzing waste characterization data.

- *Orientation and training during the field work* – The field crew was trained in the areas of sorting procedures and safety procedures. Assistance was provided during the initial stages of the fieldwork.

- *Public education activities* -- Public education activities related to waste characterization that have been conducted include: (1) press releases and media events; (2) fact sheet distributed at the National Conference, to industry associations, to NSWMC and DENR, and to LGUs; (3) a training presentation; and (4) training videos.

Methodology for Waste Characterization Studies

The methodology that was used in the studies conducted by each of the LGUs was based on the procedures prepared by the consultants. The studies analyzed the disposed waste stream by type of generator, i.e., residential (low-income, middle-income, and high-income); commercial (malls, offices, restaurants, and hotels/condominiums); markets, industrial, and institutional.

The WACS included the following elements:

- *Planning and mobilization* – In addition to the training activities conducted by the consultants, the LGUs were responsible for identification of a site for the field work, preparation of a schedule for sampling, collection of equipment and supplies, as well as other logistics related to the field study.
- *Waste quantity analysis* -- A vehicle count was conducted in order to estimate the quantity of waste disposed at the disposal site(s) serving the LGU. The results of the vehicle count analysis were used to calculate the volume of waste disposed per week for each generator type.
- *Bulk density analysis* -- Representative samples of waste were collected, weighed, and logged. An average bulk density for each generator type was calculated, and subsequently applied to the results of the vehicle count analysis to calculate the mass of waste disposed for each generator type.
- *Waste composition study* – Collected samples were manually sorted into categories, and the data recorded. Information was analyzed to determine an average composition for each generator type.
- *Moisture content determination* -- Samples of various components of the waste stream were collected and dried. Moisture contents of the components were used to calculate an estimated average air-dry moisture content for the entire waste stream.

Results of Waste Characterization Studies

WACS have been conducted by the following of the LGUs selected for participation in the project: Makati, Muntinlupa, Quezon City, Pasig, and Valenzuela.

Table E-1. Summary Results of Disposed Waste Characterization Studies Conducted by LGUs
(Spring 2003)

Component	Makati	Muntinlupa	Pasig	Quezon City	Valenzuela
Quantity					
Tonnes/year*	87,200	80,400	102,067	532,100	60,200
Population**	421,308	366,674	528,179	2,301,261	519,227
Average kg/cap-day	0.57	0.60	0.53	0.63	0.32
Bulk Density (avg. kg/cu m)	92	172	139	218	159
Composition (% wet wt.)					
Paper	14.7	10.2	12.4	14.1	11.3
Glass	2.4	3.1	5.0	3.4	1.4
Metals	2.7	3.9	11.6	3.6	3.1
Plastic	25.0	28.1	20.9	21.4	28.3
Kitchen/Food Waste	32.6	29.1	23.1	39.9	38.0
Other Organic	18.9	20.4	18.9	14.8	14.2
Other Inorganic	3.5	5.0	6.7	2.4	2.2
Hazardous/Special	0.2	0.2	1.4	0.4	0.6
Total	100.0	100.0	100.0	100.0	100.0
Moisture Content (avg. % air dry)	41	29	33	67	38

*Quantity of waste disposed estimated for Pasig based on results of other cities.
**Population based on data from National Statistics Office for 2003.

Table E-1 presents a summary of the key results. As shown in the table, the reported per capita rate for disposed waste ranges from 0.32 kg/cap-day in Valenzuela to 0.63 kg/cap-day in Quezon City. There is a wide range in the reported average bulk density of the waste, from 92 kg/cu m in Makati to 218 kg/cu m in Quezon City. Similarly, there is a wide range in the reported moisture contents of the waste, from 29% in Muntinlupa to 67% in Quezon City.

The estimated composition of disposed wastes for each of the LGUs that conducted the WACS is presented in Figures E-1 through E-5. As shown by the information presented in the figures, the major components of the waste disposed at the LGUs consist of kitchen/food waste, plastics, other organics, and paper.

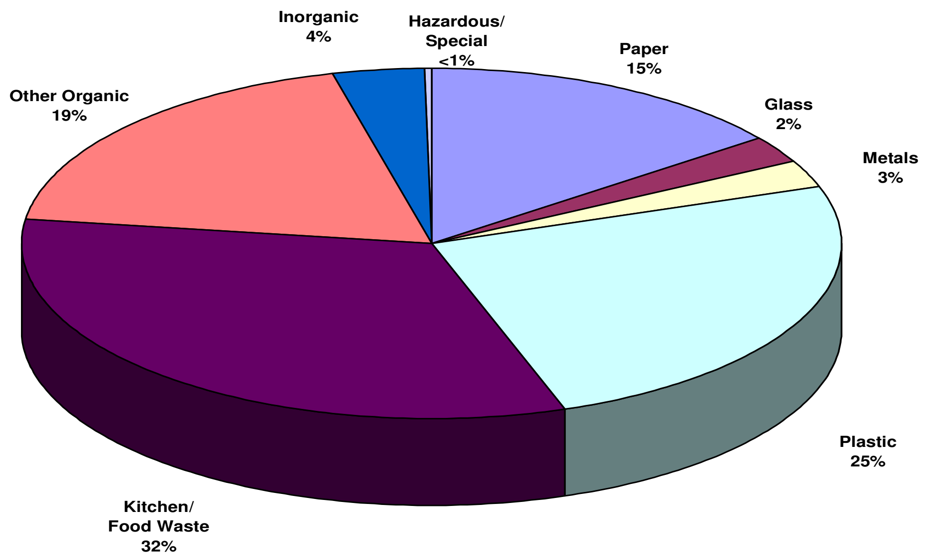

Figure E-1. Estimated Composition of Disposed Waste – Makati (% wet wt.)

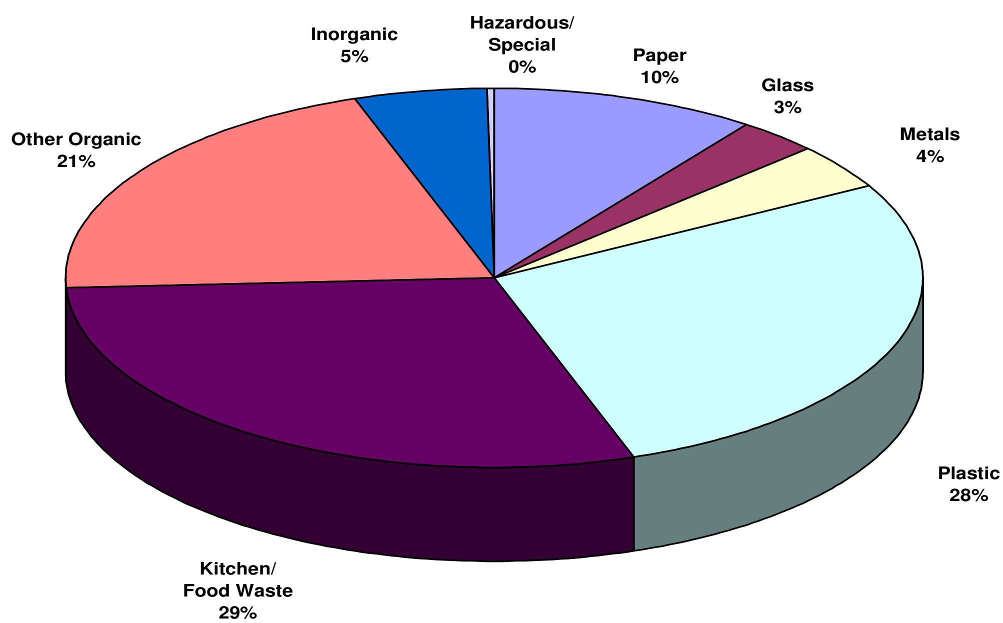

Figure E-2. Composition of Disposed Waste – Muntinlupa (% wet wt.)

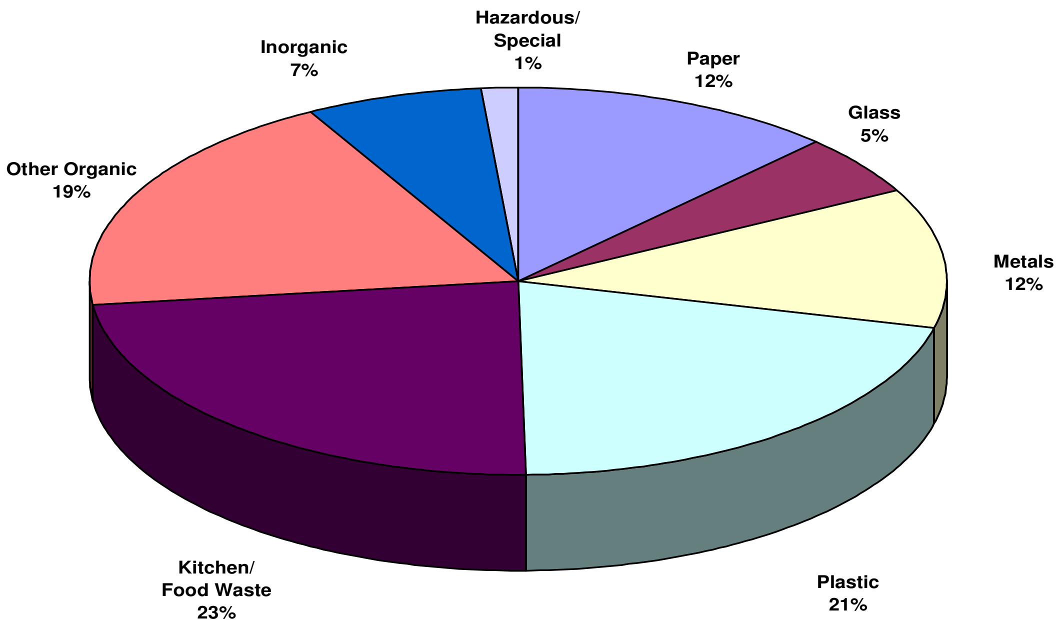

Figure E-3. Estimated Composition of Disposed Waste – Pasig (% wet wt.)

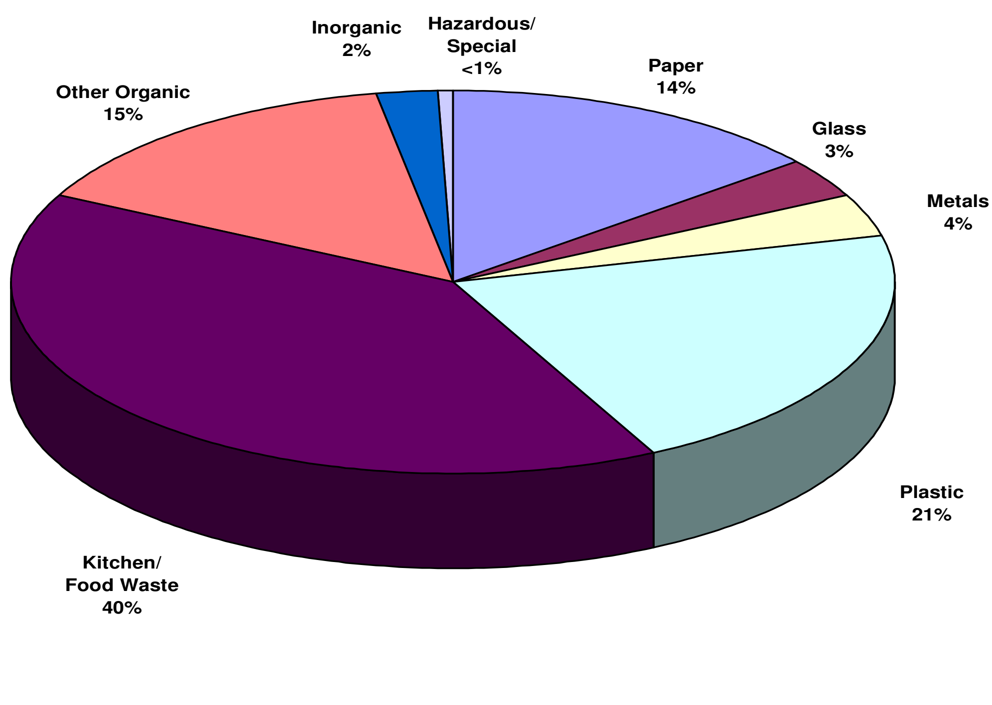

Figure E-4. Estimated Composition of Disposed Waste – Quezon City (% wet wt.)

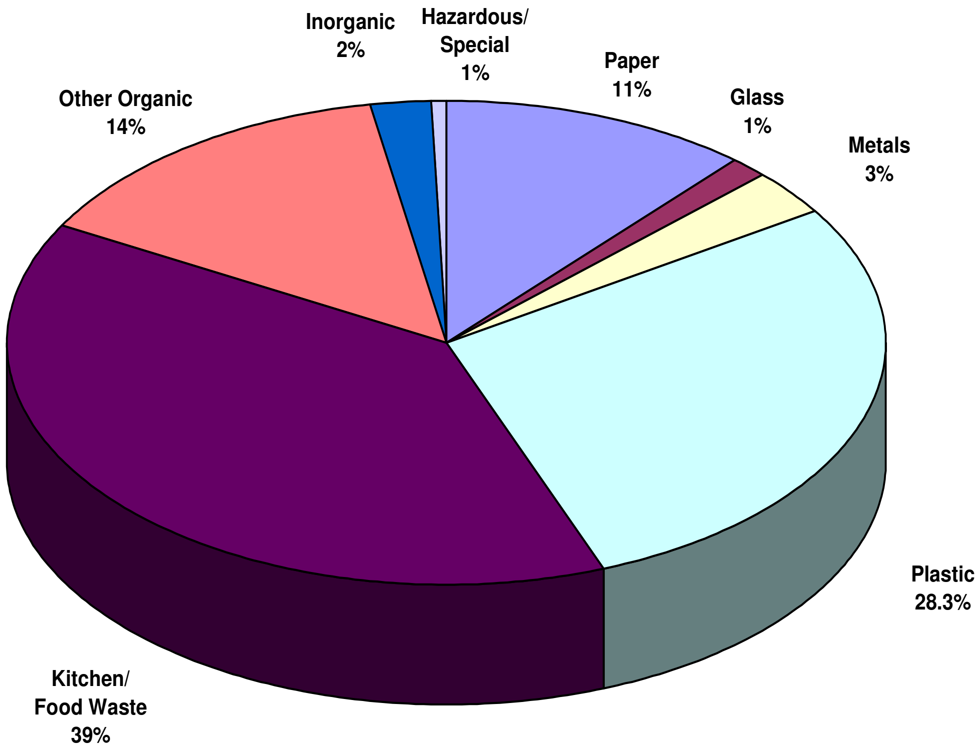

Figure E-5. Estimated Composition of Disposed Waste – Valenzuela (% wet wt.)

Recommendations

Based on the results of the waste characterization work, the following recommendations are made:

- Every LGU in Metro Manila should be encouraged to conduct a WACS as soon as possible. The LGUs that did not participate in this program should make every effort to follow the procedures and methodologies suggested in this report such that all of the data collected can be compared.
- LGUs that participated in this program should conduct another waste characterization study in 6 to 9 months to refine the data and to collect additional information. Thereafter, the study should be repeated every two years.
- A standardized reporting format should be prepared for use by the LGUs.
- Emphasis should be placed on the collection of accurate quantity data by generator type, including bulk density analyses.

- Analyses should be conducted on recycling and illegal disposal by each LGU. Data on disposed waste quantities should be combined with those for recycled materials and illegal disposal to determine the quantity of waste generated.

- Planning should be conducted based on LGU-specific information if possible, rather than generalized per capita generation rates or “national averages” for waste composition.

- Additional training should be provided to LGUs in the utilization of the results of waste characterization studies in the planning process.

1. Introduction

The growing quantity of municipal solid waste generated in the 17 cities and municipalities comprising Metro Manila must be managed effectively to provide sound public health and environmental protection. An accurate characterization of the waste stream is crucial to design an ecological solid waste management system that will meet the needs of the community. An understanding of waste generation rates and characteristics is critical in determining present and future needs and in designing the facilities/equipment that will provide effective waste management.

Accurate information on the quantity of waste that is generated (recycled and disposed) is not currently available. Quantities of disposed waste are typically estimated based on a standard per capita generation rate that is fixed for every community, regardless of demographics. Inasmuch as most disposal sites do not currently have weigh scales, when quantity determinations are made they are based on simple vehicle counts and volumetric estimations, which may not take into consideration how full the vehicle is, i.e., at what percent of capacity. Additional errors may be introduced during the process of converting volumetric estimates to mass, since there is a great variability in the bulk density of waste from different types of generators.

Estimates of levels of recycling have in the past been based primarily on data compiled by one of the NGOs that collects recyclable materials from households and has a cooperative of junk shops (Linis Ganda Foundation). Although this information is valuable, it is apparent that much recycling takes place outside of this entity. The consultants conducted a review of junk shops and a market study, the results of which are presented in a separate report.

RA 9003 requires each city and municipality to develop a 10-year plan to manage its waste. A waste analysis and characterization study (WACS) should be conducted in each city/municipality to collect the data to prepare a well-conceived plan.

Accurate and reliable information on the quantity and characteristics of waste being disposed is important for a number of reasons. Some of the key reasons include:

- Design of storage system – A sound understanding of the quantity and bulk density of the waste produced by different types of generators allows the determination of the number, type and size of the containers required for storage.

- Design of collection system – The number of collection vehicles, frequency of collection, and design of routes should be based on the quantity and volume of the waste that is to be collected. This becomes increasingly important as segregated collection is implemented, as more than one collection service is provided. Proper design allows the efficient use of vehicle capacity, irrespective of the type of vehicle (e.g., compactor, dump truck, tricycle, pushcart), thus minimizing collection costs.

- Development of diversion strategies – Programs to increase diversion (recycling) should be implemented in phases, concentrating first on those activities that will divert the largest quantities of waste at the lowest cost. The results of a WACS allows the LGU to identify large quantities of potentially recoverable materials that are being disposed. For example, the results of the waste characterization study conducted by Muntinlupa identified large concentrations of kitchen/food waste being disposed by markets, and the LGU has decided to implement programs to recover and compost that material.

- Design of processing facilities –MRFs (including composting facilities) need to have adequate capacity to accept and process materials. If the facility has inadequate capacity, materials tend to be stockpiled and create an eyesore and potential negative public health and environmental impacts. On the other hand, if the design capacity of the facility is larger than needed, the facility is underutilized and is not cost efficient.

- Identification and development of markets – Markets for recovered materials should be identified early in the planning process. Types and quantities of materials that could be recycled can be estimated based on the results of the WACS.

Various training activities were undertaken by members of the project team to assist the local government units (LGUs) in conducting a waste characterization study, including: preparation of a procedure for conducting WACS, training sessions at a technical working group meeting and at the LGU seminar/workshop, several meetings at each one of the LGUs to conduct site-specific planning, orientation and training during the field work, and public education activities. The project team provided assistance during the fieldwork and in the analysis of data.

This report provides an overview of previous WACS, a description of the activities undertaken by the consultants, a presentation of the waste characterization studies conducted by five LGUs, a comparison of current results with previous WACS, and concludes with recommendations.

It is important to note that the results of the waste characterization studies that are presented in this report are the results of five separate studies conducted by the five LGUs. The purpose of the waste characterization studies was to provide important information on waste that is currently being disposed to enable the LGUs to develop well-founded solid waste management plans and programs. It is envisioned that as other LGUs in Metro Manila complete analyses of their waste streams, and as the LGUs conduct further studies to determine seasonality and to analyze recycling and illegal disposal, that the information from these studies would be compiled to characterize the waste stream for all of Metro Manila. It is critical that reliable information on the current waste stream be used as government agencies are moving forward with the implementation of the Ecological Solid Waste Management Act of 2000.

2. Historical Information

The results of previous waste characterization studies are reviewed, because of their importance in providing a perspective on the waste management situation today.

2.1 Waste Characteristics – 1982

A waste characterization study was conducted in 1982 as part of a comprehensive study that included the development of a solid waste management plan for Metro Manila.[1] The results of the composition analysis are presented in Tables 1 and 2 for residential and non-residential waste generation, respectively.

Table 1. Composition of Residential Waste (1982)

Component	% Composition (by weight)			
	Low-Income	Middle-Income	High Income	Total Residential
Paper	7.3	13.6	8.7	9.1
Cardboard	2.5	5.7	5.1	3.8
Food and Kitchen Waste	36.2	43.2	26.5	35.8
Textiles	2.0	1.8	1.5	1.8
Rubber and Leather	2.1	1.4	.7	1.6
Plastic, Film	5.7	6.4	2.7	5.2
Plastic, Hard	1.7	1.9	1.3	1.7
Yard Waste	6.2	3.8	26.4	9.9
Other Combustible	4.1	3.9	4.2	4.1
Metals	5.5	7.3	4.7	5.8
Glass	3.9	3.1	2.7	3.5
Other Non-combustible	3.4	2.2	2.7	3.0
Screenings	19.4	5.7	12.8	14.7
Total	100.0	100.0	100.0	100.0

Source: Norconsult, *et al*, 1982.

[1] *Metro Manila Solid Waste Management Study: Waste Stream Characterization*, Prepared by Norconsult A.S., Cal Recovery Systems, Inc., and Engineering-Science, for the Republic of the Philippines, May 1982.

Table 2. Composition of Selected Non-Residential Waste Streams (1982)

Component	% Composition (by weight) Market	Commercial	Industrial	Institutional
Paper	4.3	23	20	20
Cardboard	1.8	23	10	5
Food and Kitchen Waste	70.6	13	2	17
Textiles		1.5	1.5	1
Rubber and Leather		1.5	1.5	
Plastic, Film	3.2	11	15	13
Plastic, Hard	0.3	4	5	1
Yard Waste	14.5			
Other Combustible	0.6	7	25	13
Metals	0.3	9	12	10
Glass	0.4	5		9
Other Non-combustible	0.1			2
Screenings	3.9			
Special and Hazardous Waste		2	8	9
Total	100.0	100.0	100.0	100.0

Source: Norconsult, *et al*, 1982.

2.2 Waste Characteristics – 1997

The latest waste characterization study for MSW in Metro Manila was conducted in 1997 under JICA.[2] The waste characterization surveys were conducted in April and June, 1997, to determine the characteristics of the waste during dry and wet seasons.

According to the report, a total of 3,402 samples (approximately 15 tons total) were collected at the point of generation from nine types of waste generators: residential areas (low, middle, and high income); commercial establishments (restaurants, other shops); institutions; markets; street sweepings; and dredged materials from rivers. The samples were obtained from three areas identified as being representative of the entire Metro Manila area: Quezon City, Makati, and Parañaque. The samples that were collected from each generator type were mixed and subdivided following a procedure similar to cone and quartering until the mixture reached a volume between 30 and 50 liters; the reported average was 25 liters (approximately 5 kg). The 25-liter samples were used for determining the composition and other characteristics of the waste for the various generator types. Unit generation rates were calculated and extrapolated to all generators using population data for 1995 for residential generation and using available information on the number of businesses, number of stalls in markets, etc. for non-residential generation.

In addition to the analysis of waste generation described above, the JICA waste characterization study included a vehicle count and interviews. Vehicles entering disposal sites were counted and volumes estimated. Volume was converted to mass using average weights of representative vehicles obtained at a weighbridge. Interviews were conducted with various groups involved in waste management, e.g., the public, scavengers, collection crews, etc. Based on the results of interviews, the JICA project team developed estimated unit rates for recycling (i.e., grams/person-day at the household level, grams/collector-day during the collection process, etc.), and the unit rates were applied to all LGUs. Quantities of illegally disposed waste were calculated by subtracting disposed quantities (obtained from the vehicle count) and recycled quantities (estimated from the interviews) from generated quantities (determined from the generator analysis).

Summaries of the results of the composition analysis of generated waste are presented in Tables 3 and 4 for residential and selected non-residential waste streams, respectively.

[2] *The Study on Solid Waste Management for Metro Manila in the Republic of the Philippines, Final Report*, Prepared by Pacific Consultants International for the Japan International Cooperation Agency (JICA), March 1999.

Table 3. Composition of Residential Waste Streams (1997)

Component	% Composition (by weight)			
	Low-Income	Middle-Income	High Income	Total Residential
Kitchen Waste	42.00	49.97	41.97	45.82
Paper	13.82	15.90	17.62	15.39
Textile	7.39	2.76	1.81	4.33
Plastic	17.18	15.58	11.79	15.6
Grass and Wood	7.31	5.25	14.84	7.45
Leather and Rubber	1.13	0.39	1.34	0.80
Metal	4.92	6.35	4.03	5.47
Glass	3.24	1.85	4.05	2.69
Ceramic and Stone	1.44	1.13	1.23	1.26
Others (Soil, etc.)	1.66	0.84	1.34	1.19
Total	100.00	100.00	100.00	100.00

Source: JICA, 1999.

Table 4. Composition of Selected Non-Residential Waste Streams (1997)

Component	% Composition (by weight)			
	Market	Restaurant	Other Commercial	Institutional
Kitchen Waste	57.88	54.56	30.85	20.08
Paper	15.45	15.52	27.28	47.12
Textile	1.76	1.06	4.34	1.84
Plastic	13.54	15.45	17.16	15.91
Grass and Wood	7.68	4.23	1.95	2.38
Leather and Rubber	0.52	0.11	0.90	0.69
Metal	1.34	5.94	5.36	4.89
Glass	0.90	2.59	10.60	2.15
Ceramic and Stone	0.56	0.45	0.90	0.85
Others (Soil, etc.)	0.40	0.13	0.69	4.11
Total	100.00	100.00	100.00	100.00

Source: JICA, 1999.

The results of the study conducted by JICA indicated that the per capita waste generation for residential waste in the high-income areas was 0.50 kg/day; in middle-income areas, 0.45 kg/day; and in low-income areas, 0.34 kg/day. The weighted average 'waste' generation for households of Metro Manila based on the distribution level of income of the study area was calculated as 0.42 kg/capita/day. At that time this equated to an aggregated total for Metro Manila of 5,345 tonnes per day.
The study also estimated that the sources of waste that comprised MSW were:

- 48% from residential sources;
- 26% from informal settlers; and
- 26% from commercial and industrial sources.

The results of the apparent specific gravity indicated that the average for MSW was 0.20 kg/liter. Furthermore, the average moisture content for household waste was 45.8%, and that for the entire MSW stream was 45.0%.

3. LGU Capacity Building Activities

Various capacity building activities were conducted by the project team to assist the eight LGUs selected under the project in the aspect of waste characterization. These included:

- preparation of procedures for conducting WACS,
- training at a technical working group meeting,
- presentations at the LGU seminar/workshop,
- meetings at the LGUs to conduct site-specific planning,
- orientation and training during the field work, and
- public education activities.

3.1 Waste Characterization Procedures

The consultants developed comprehensive procedures for conducting waste characterization studies for disposed waste in Metro Manila (Annex 1). The procedures were adapted from those prepared for a similar study conducted in several other countries and most recently in Mongolia,[3] and are appropriate for waste characterization studies conducted in countries where financial resources are scarce. The detailed procedures have taken into consideration the guidelines/procedures included in the IRR for RA 9003 (Annex 2). The procedures were also reviewed and adopted by the NSWMC.

The procedures describe the four types of data to be collected during the waste characterization analysis:

- *Composition* – Samples are taken from collection vehicles for sorting. Samples are selected to ensure that the various sources of waste are addressed, e.g., residential (low-income, medium-income, and high-income), large commercial, industrial, and markets.

- *Quantity* – Data on the waste collected by the city contractor and by private haulers are collected. The quantity is determined by weighing every vehicle or by volume (using accurate bulk density data) when weight measurements are not possible.

- *Bulk density* – The bulk density of the various waste streams is measured in order to determine the quantity (in tons) of waste disposed.

- *Moisture content* -- Measurements are made to provide information that is important to the design of facilities.

In addition, the methodology includes a section entitled *Safety Procedures and Guidelines* provided to protect the health of the personnel participating in the waste characterization process.

3.2 Technical Working Group Meeting

A training session was held at a Technical Working Group meeting on January 30, 2003. The meeting was attended by representatives of the LGUs selected under this project, as well as representatives of NSWMC and DENR. The focus of the meeting was to provide an overview of the methodology for conducting the various phases of a WACS, to explain the content and procedure for completing the data sheets, and to answer specific questions from the LGUs.

The presentation consisted of two main parts:

- *Slide presentation* – A pictorial overview was presented from actual waste characterization studies conducted by the consultants throughout the world. The presentation includes photographs showing the measuring of vehicles (to determine the quantity of waste disposed), selection of samples for sorting, actual sorting, weighing of sorted samples, and moisture content analysis. Participants in the meeting indicated that viewing of actual photographs was very helpful in understanding the procedure. A copy of the presentation is included in Annex 3.

[3] *Waste Characterization Study, Ulaanbaatar, Mongolia, Winter-Summer 2002*, Prepared by CalRecovery, Inc. for the World Health Organization, August 2002.

- *Review of procedures* – The written procedures were then reviewed, with particular emphasis being placed on the procedures for completing the data sheets.

3.3 LGU Seminar

The procedure for conducting waste characterization studies was described to participants at the Seminar for LGUs held in Antipolo on March 10, 2003. The presentation was based on the procedures developed by the consultants.

3.4 Site Specific Planning Sessions

Planning meetings were conducted at each of the LGUs planning to conduct a WACS. The following meetings were held:

- Makati 4th February 2003
- Muntinlupa 7th February 2003
- Quezon City 18th March 2003
- Pasig 19th March 2003
- Valenzuela 8th May 2003

The purpose of each meeting was to define a framework specific to the LGU for collecting and analyzing waste characterization data. Specifically, the following topics were addressed:

- types of generators in the LGUs, including primary types of businesses,
- current collection and disposal practices for each of the generator types,
- procedure for collecting quantity data for each generator type,
- specific areas of the city from which each type of waste could be collected,
- equipment and supplies needed, and
- location and logistics of the fieldwork including safety procedures.

3.5 Orientation and Training during Field Work

The first waste analysis and characterization study was conducted in Makati. All of the personnel involved in the project were first trained in the classroom on the various procedures regarding the program. A training session for inexperienced sorters was carried out at the start of the sorting work. The methodology to be followed for sorting was delineated, stressing the importance of safety and the accuracy of the work. The different components to be sorted were clearly explained and shown to ensure reliable data from the sorting process.

A practical sorting demonstration was performed to allow the sorters to fully understand the tasks to be conducted. Safety precautions (Annex 1) were reviewed with sorting personnel prior to the conduct of the field study.

Representatives from all other LGUs, as well as other interested parties, were invited to observe the WACS in Makati.

3.6 Public Education Activities

A number of public education activities related to waste characterization have been conducted. These activities are briefly described here. A more detailed description of these activities is provided in a separate project report, *Community Awareness Strategies, No. 10*.

- *Press release and media event* – A press release was prepared for the first WACS, conducted in Makati. Media were invited to attend, and coverage showing the DENR Secretary at the event was published (see examples of news clippings *Community Awareness Strategies, No. 10*). The interest on the part of media appeared to be primarily directed at the participation of the DENR Secretary, rather than in the waste characterization work itself.

- *Fact sheet* – The project team prepared informational material to meet the need for factual information, simply written, that could be distributed widely. A one-page fact sheet, containing photos and data, was prepared on the subject of waste characterization. The material was intended to provide accurate information in an easy-to-read format. The fact sheet was: (1) included in the conference kit for the National Solid Waste Management Conference for Barangays held on April 14-15, 2003 (approximately 1500 participants); (2) faxed or e-mailed to industry associations in conjunction with Earth Day; and (3) provided to the NSWMC and the EEIO for duplication and distribution as they saw fit. In addition, copies of the fact sheet were provided to the selected LGUs for distribution to each barangay.

- *Training presentation* – The presentation made at the Technical Working Group meeting was expanded and submitted to DENR for use in conducting training sessions in other areas of the country.

- *Training videos* – (1) The DENR Public Affairs Office prepared a video based on footage taken at the WACS conducted in Makati. Voice over was added in Tagalog. (2) The City of Muntinlupa prepared an instructional video in English based on their experience in planning and conducting a waste characterization study and using footage taken during the fieldwork.

4. Waste Analysis and Characterization Studies conducted by LGUs.

During the project, WACS were conducted by the following of the LGUs selected for participation in the project:

- Makati
- Muntinlupa
- Quezon City
- Pasig
- Valenzuela

The consultants developed the procedures for the WACS and conducted training for the LGUs. The WACs were conducted by the LGUs, and data were entered and analyzed by the LGUs. The project team conducted further analysis and compilation of the data for presentation in this report

4.1 Methodology used in Field Work

An overview of the methodology used in conducting the studies at each of the LGUs is discussed below; the detailed procedures are included in Annex 1. The methodology includes a comprehensive description of the procedures necessary to plan, mobilize, and conduct a WACS. The study consisted of four types of analyses: waste quantity, bulk density, waste composition, and moisture content.

4.1.1 Planning and Mobilization

The overall logistics of the work were carefully analyzed. Planning and mobilization activities included: (1) a training workshop for representatives of the LGUs; (2) a planning meeting to review the logistics; (3) assembling a team of individuals to participate in the study; (4) identification by the LGU of a site for the field work; (5) preparation by the LGU of a schedule for sampling; (6) collection by the LGU of equipment and supplies; and (7) orientation for the sorters, including health and safety training.

4.1.2 Waste Quantity Analysis

A vehicle count was conducted in order to estimate the quantity of waste disposed at the disposal site(s) serving the LGU, inasmuch as truck scales were not available.

The height, width, and length (in meters) of the incoming loads of waste were measured. The date, type of load (by type of generator), and measurements were recorded on a data sheet (Annex 1). The generator types analyzed during the study varied somewhat for each LGU, but generally included:

- Low-income residential
- Middle-income residential
- High-income residential
- Commercial
- Markets
- Industrial
- Institutional

For the commercial sector, the loads were subcategorized by some LGUs (e.g., as malls, offices, restaurants, and hotels/condominiums) in order to allow for additional analysis of these sectors.

The results of the vehicle count analysis were used to calculate the volume (in cubic yards) of waste disposed per week. In Muntinlupa, quantity information was obtained by generator type. In Quezon City and Valenzuela, it was not possible to collect information by generator type, and data was reported for the total waste stream. Makati chose to use an alternate method of quantifying its waste. The unit generation rates that were determined during the fieldwork were extrapolated for the entire generator sector.

4.1.3 Bulk Density Analysis

A representative sample (approximately 100 to 150 kg) was collected from each of the vehicle loads designated for sampling each day. The standard procedure for collection of the representative sample was to discharge the vehicle load into a longitudinal pile, and to collect a portion of the sample from each of the four quadrants of the longitudinal pile.

The date, source of the sample, generator type, and gross and tare weights were recorded for each sample. A container of known volume was loosely filled and weighed.

An average bulk density for each generator type was calculated, and subsequently applied to the results of the vehicle count analysis to calculate the mass (in kg) of waste disposed for each generator type.

The sample collection process is shown in Figure 1. The workers in the process of obtaining the weight of the sample for calculating the bulk density are shown in Figure 2.

4.1.4 Waste Composition Study

The LGUs were instructed to collect approximately 60 representative samples (100 to 150 kg each) during the one-week sampling period, which would result in approximately 30 to 45 tons of waste being sorted for purposes of characterizing the disposed waste stream. The number and mass of the samples actually collected varied with each LGU depending on availability of collection vehicles for each generator type
The representative samples were taken to the designated sorting area. The samples were manually sorted into different categories, the sorted materials were weighed, and the data recorded on a data sheet (see Annex 1). After the materials were weighed, the waste was disposed.

The information on the data sheets was analyzed to determine an average composition (% wet wt.) for each generator type. The average compositions were applied to the quantity data (in kg) to calculate the quantity of each material type that is disposed by each of the generator types and by the LGU as a whole. The sorting process is shown in Figures 3 and 4.

Figure 1. Collection of Representative Sample from Vehicle Load

Figure 2. Weighing of Representative Sample

Figure 3. Sorting of Sample into Components and Subcomponents

Figure 4. Weighing of Sorted Components

4.1.5 Moisture Content Determination

An analysis of the moisture content of key components of the waste stream was conducted as part of the WACS. Due to the lack of laboratory equipment, a procedure was used to obtain the moisture content of the samples on an air-dry basis. Containers were obtained and weighed. Samples of various components of the waste stream were collected, placed in the containers, and weighed again. After weighing, the samples were air dried for a period of 10 days. After the materials were air dried, they were weighed once again, and the weight was recorded.

The moisture contents of the components were used to calculate an estimated average air-dry moisture content for the entire waste stream.

4.2 Summary of Results

A summary of the results of the waste analysis and characterization studies conducted by each of the LGUs is presented in Table 5. Additional details for each LGU is provided in Sections 4.3 through 4.7 of the report.

Table 5. Summary Results of Disposed Waste Characterization Studies Conducted by LGUs
(Spring 2003)

Component	Makati	Muntinlupa	Pasig	Quezon City	Valenzuela
Quantity					
Tonnes/year*	87,200	80,400	102,067	532,100	60,200
Population**	421,308	366,674	528,179	2,301,261	519,227
Average kg/cap-day	0.57	0.60	0.53	0.63	0.32
Bulk Density (avg. kg/cu m)	92	172	139	218	159
Composition (% wet wt.)					
Paper	14.7	10.2	12.4	14.1	11.3
Glass	2.4	3.1	5.0	3.4	1.4
Metals	2.7	3.9	11.6	3.6	3.1
Plastic	25.0	28.1	20.9	21.4	28.3
Kitchen/Food Waste	32.6	29.1	23.1	39.9	38.0
Other Organic	18.9	20.4	18.9	14.8	14.2
Other Inorganic	3.5	5.0	6.7	2.4	2.2
Hazardous/Special***	0.2	0.2	1.4	0.4	0.6
Total	100.0	100.0	100.0	100.0	100.0
Moisture Content (avg. % air dry)	41	29	33	67	38

*Quantity of waste disposed estimated for Pasig based on results of other cities.
**Population based on data from National Statistics Office for 2003.
***Primarily, paint residues and small batteries.

The waste compositions for the low-income residential, middle-income residential, high-income residential, market, industrial, and institutional sectors are compared for the five LGUs in Figures 5 through 11.

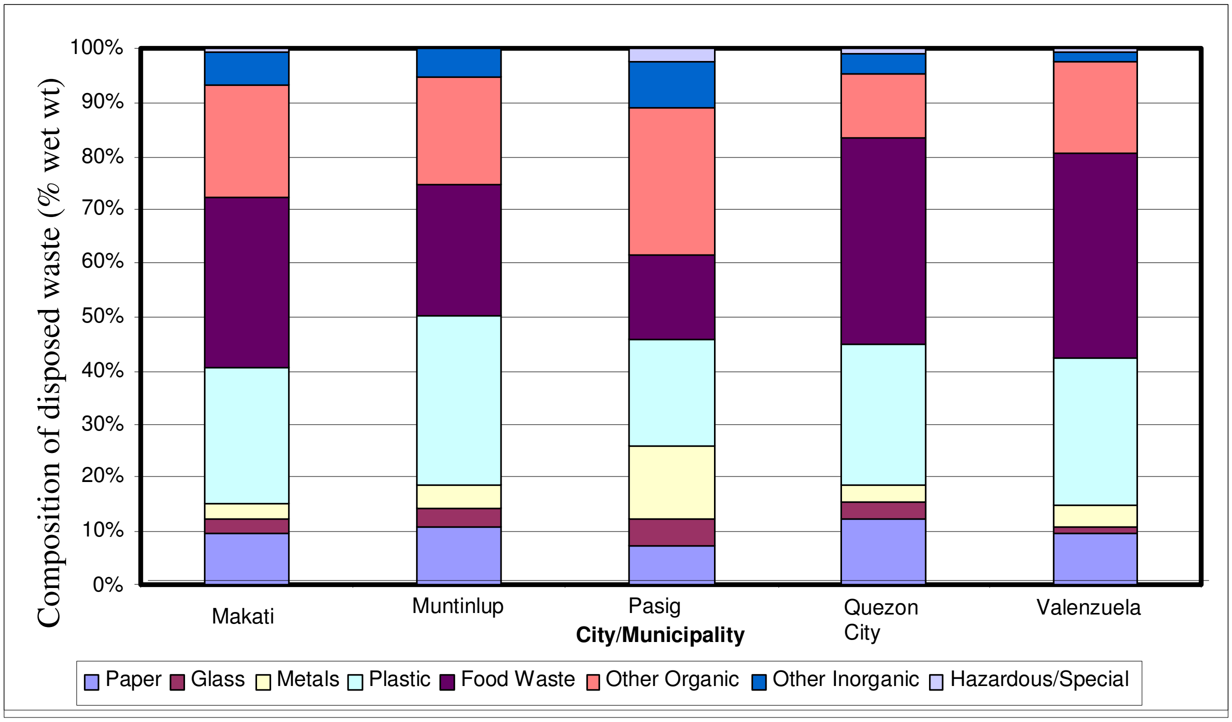

Figure 5. Composition of Disposed Waste from Low-Income Residential Sector – All LGUs (% wet wt.)

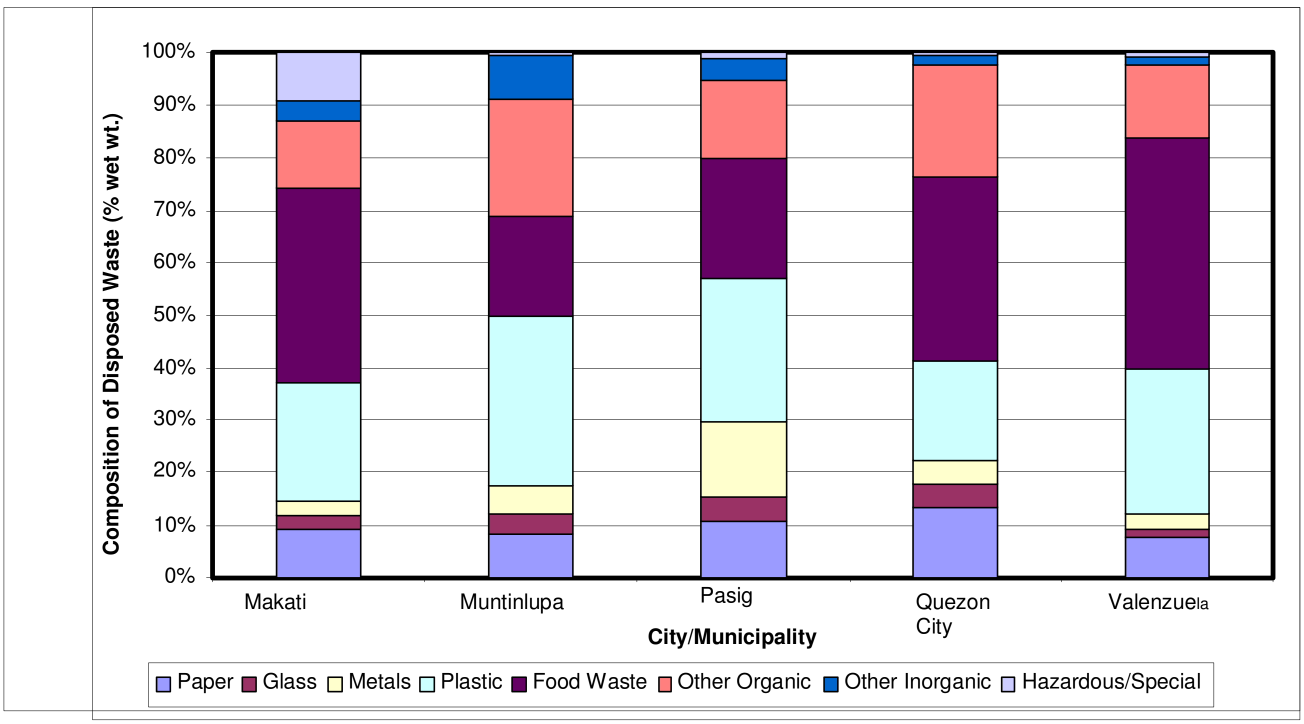

Figure 6. Composition of Disposed Waste from Middle-Income Residential Sector – All LGUs (% wet wt.)

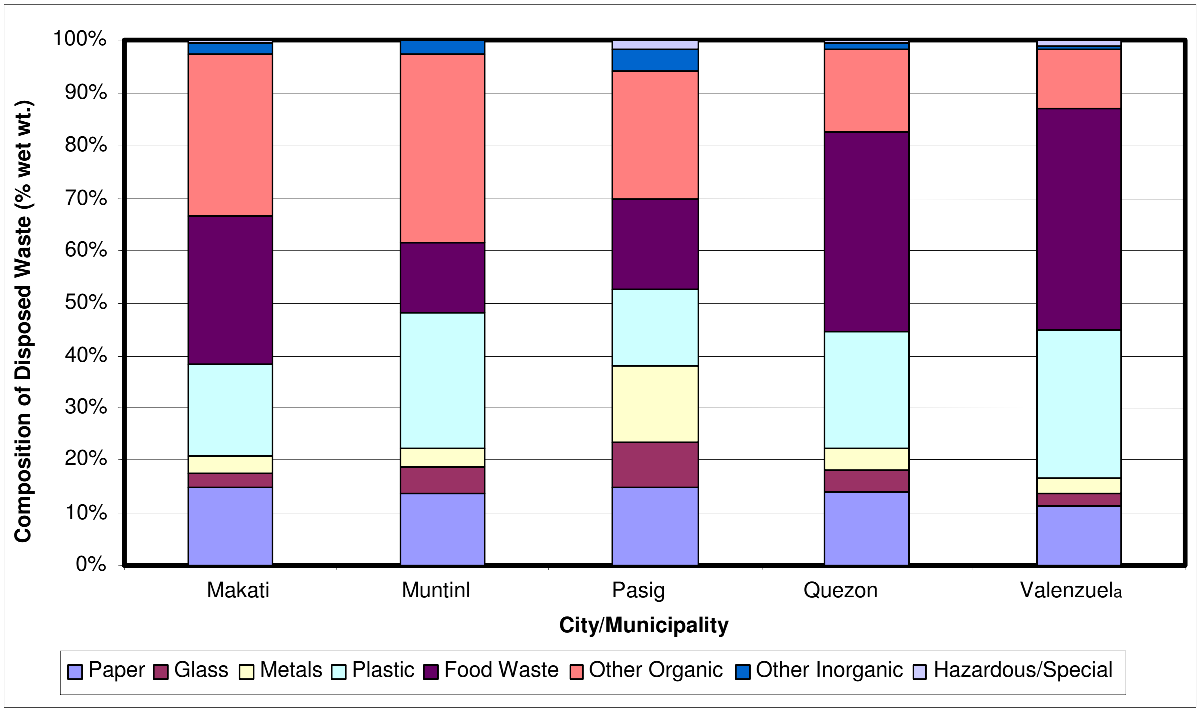

Figure 7. Composition of Disposed Waste from High-Income Residential Sector – All LGUs (% wet wt.)

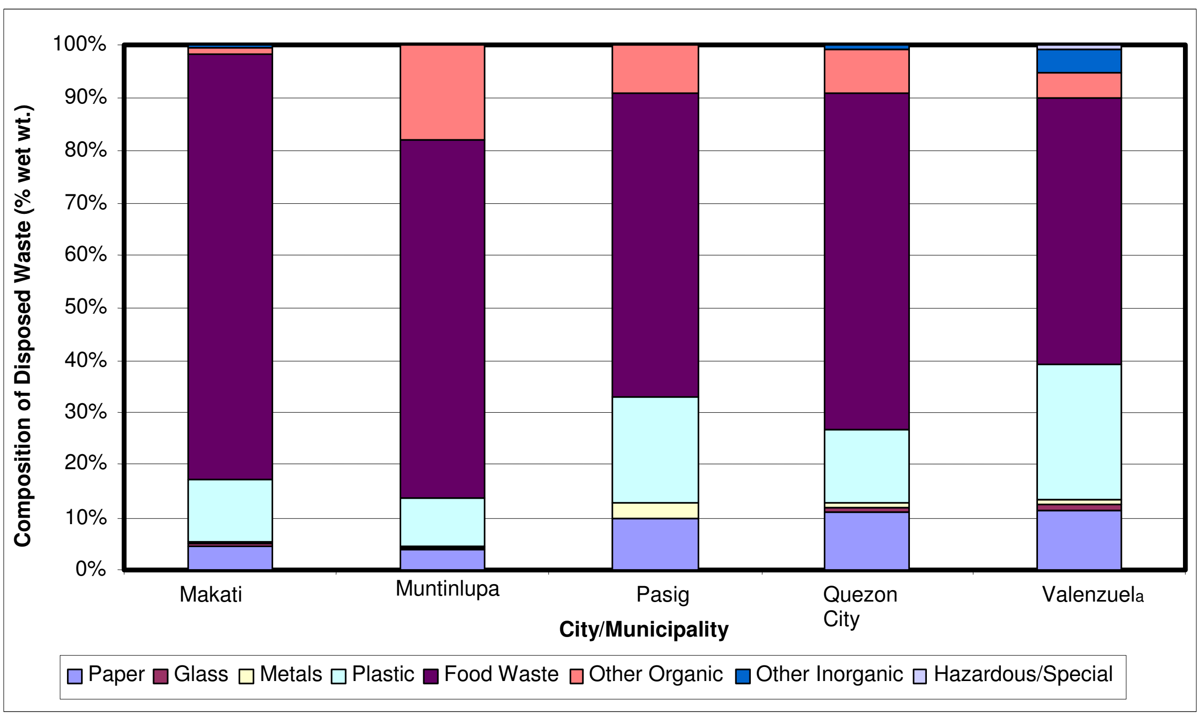

Figure 8. Composition of Disposed Waste from Market Sector – All LGUs (% wet wt.)

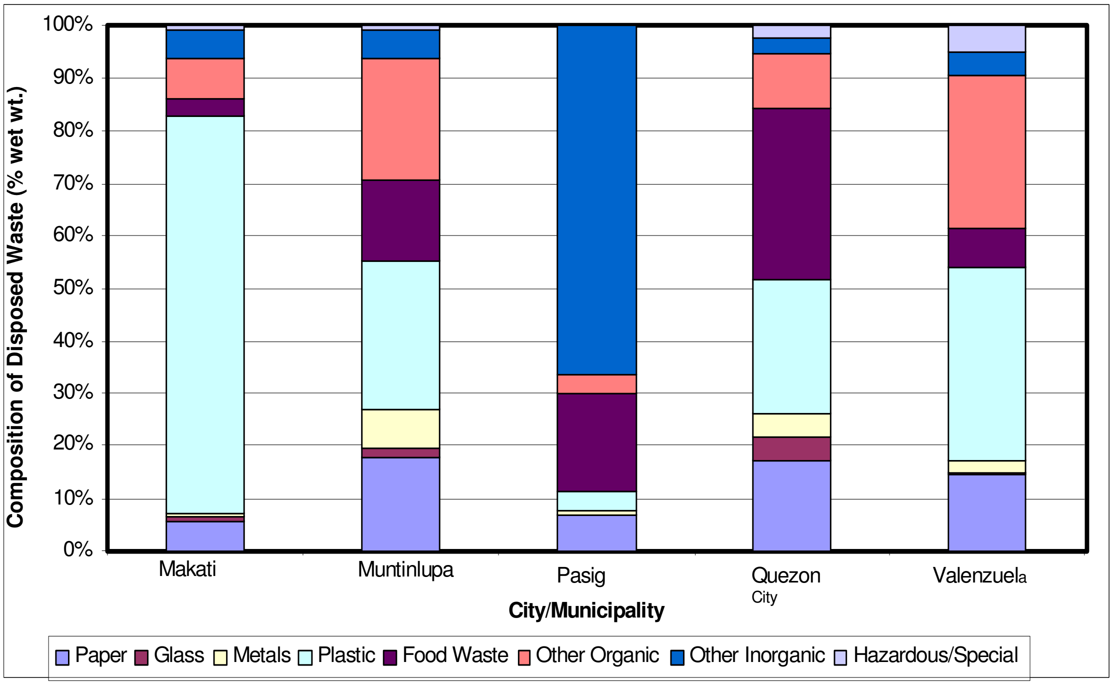

Figure 9. Composition of Disposed Waste from Industrial Sector – All LGUs (% wet wt.)

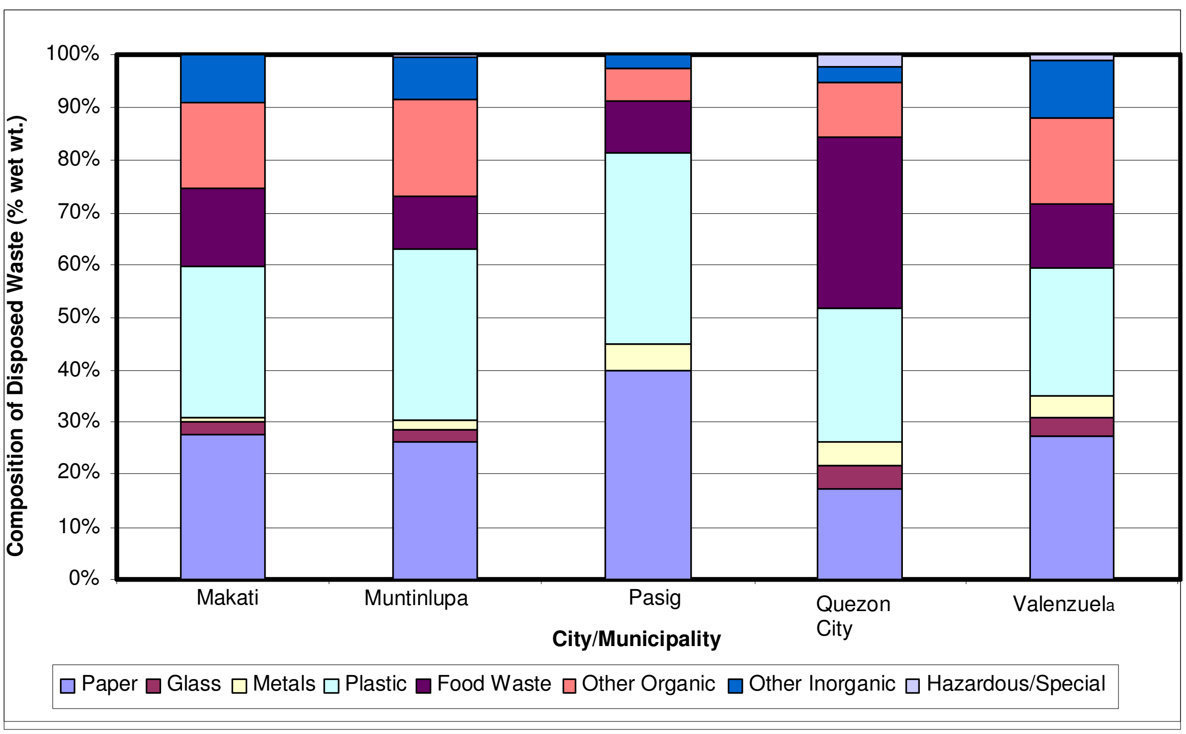

Figure 10. Composition of Disposed Waste from Institutional Sector – All LGUs (% wet wt.)

Figure 11 provides a comparison of the combined waste stream (all generator sectors) for the five LGUs that conducted waste characterization and analysis studies. The data in Figure 11 show that Makati and Quezon City have the highest concentrations of paper (15% and 14%), Muntinlupa and Valenzuela have the highest concentrations of plastic (28% each), Quezon City and Valenzuela found the highest concentrations of food waste (40% and 38%) and that Pasig found the highest concentrations of hazardous/special wastes (1.4%).

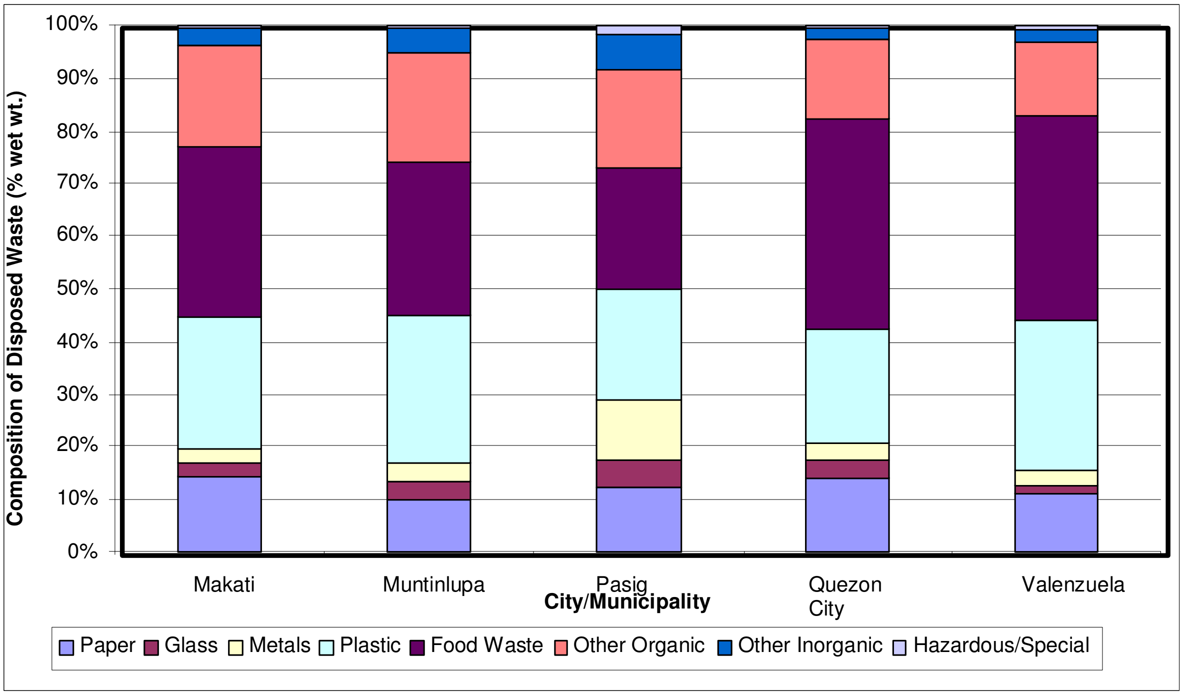

Figure 11. Composition of Disposed Waste from All Sectors – All LGUs (% wet wt.)

4.3 Makati

The results of the waste characterization study conducted by Makati are presented graphically in Figure 12. The figure presents the composition (% wet wt.) broken down by generator sector.

Significant variations in composition exist for the various types of generators. As expected, the concentration of food waste is greatest in the markets sector (81%). It is interesting to note that food waste constitutes a larger percentage of the waste disposed by middle-income residents (40%), as compared to waste disposed by low-income (32%) or high-income residents (28%). Not surprisingly, a relatively high percentage of yard/landscape waste (27%) is disposed by high-income residents (reported as Other Organic). The high percentage of plastic (76%) reported in the industrial waste stream is attributed to the large quantities of HDPE disposed by Colgate.

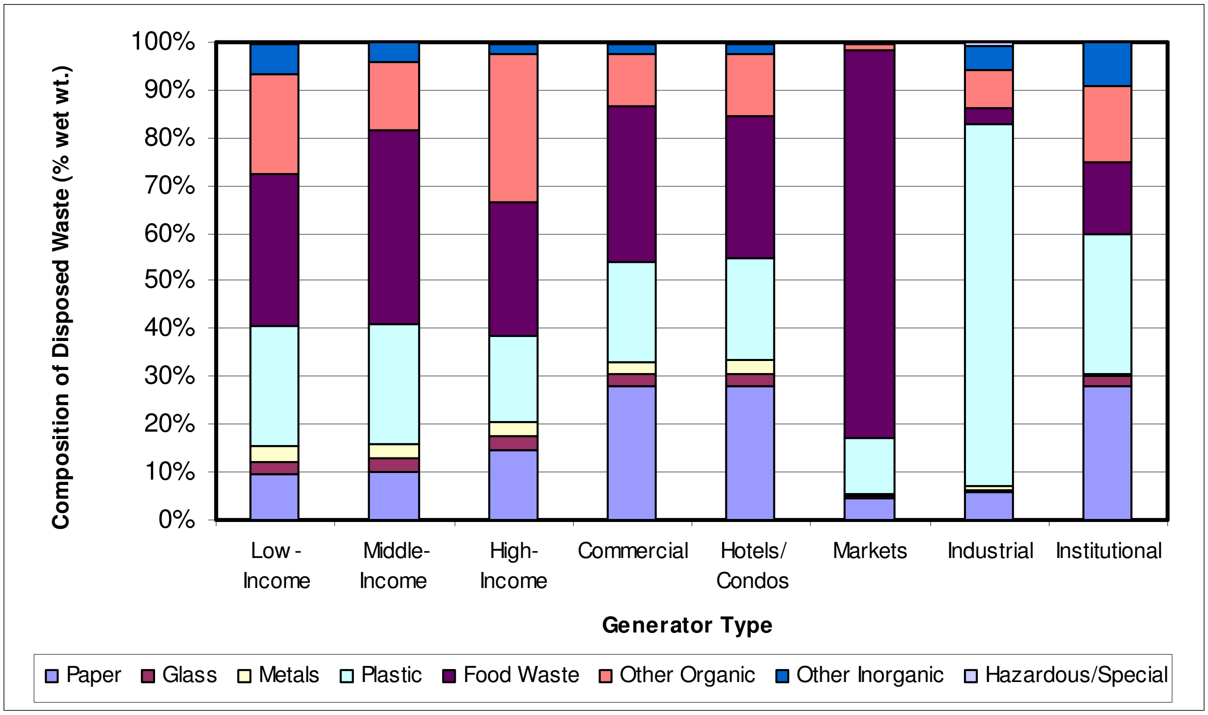

Figure 12. Composition of Disposed Waste by Generator Sector – Makati (% wet wt.)

Results of the analysis of disposed waste in Makati are presented Tables 6 and 7.

Table 6 presents a breakdown of the composition (% wet wt.) by sector and by component/subcomponent. The results of the bulk density and moisture content analyses are reported in Table 7.

Table 6. Makati – Results of Disposed Waste Composition Study (February 2003, % wet wt.)

Component	Low-Income Residential	Middle-Income Residential	High-Income Residential	Commercial
PAPER	**9.8**	**10.2**	**14.9**	**28.2**
Cardboard/Paper Bags	3.6	4.2	4.3	8.8
Newspaper	1.9	1.2	3.4	2.5
Office Paper/High Grade	0.3	0.9	0.2	5.4
Mixed Paper	4.0	3.9	6.9	11.5
GLASS	**2.4**	**2.7**	**2.7**	**2.4**
Bottles and Containers	2.3	2.7	2.7	2.4
Other/Composite	0.1			
METALS	**3.2**	**3.1**	**3.2**	**2.3**
Tin/Steel Cans	2.4	2.7	2.2	0.8
Other Ferrous	0.5	0.2	0.1	0.9
Aluminum Cans		0.1		0.6
Other Non-Ferrous				
Other/Composite	0.2		0.9	
PLASTIC	**25.1**	**25.1**	**17.8**	**21.0**
PET	0.3	0.4	0.1	2.6
HDPE	7.7	5.1	4.5	4.4
Film Plastic/LDPE	7.2	9.8	7.7	8.4
Diapers	8.5	7.9	4.2	2.3
Other/Composite	1.4	1.9	1.3	3.4
OTHER ORGANIC	**52.8**	**54.8**	**59.1**	**43.6**
Kitchen/Food Waste	31.9	40.3	28.1	32.7
Yard/Landscape	9.7	5.8	27.1	3.9
Wood	3.0	2.0	0.3	0.8
Textiles	2.5	2.7	0.8	1.7
Leather	0.3	0.1		
Tires				
Rubber	1.2	0.5		0.4
Animal Remains	0.5	0.3		2.3
Other/Composite	0.8	0.5	0.1	0.7
Fines	3.0	2.5	2.7	1.1
OTHER INORGANIC	**6.4**	**4.0**	**2.2**	**2.2**
Rock/Concrete/Brick	0.5	0.2	0.1	
Ceramic/Stone	0.9	0.9	0.8	0.6
Asphalt				
Soil/Sand	1.5	0.9		
Ash/Charcoal	1.5	1.6	1.4	1.6
Other/Composite	2.0			
Fines		0.5		
HAZARDOUS	**0.1**	**0.0**	**0.0**	**0.1**
Paint				**0.1**
Oil/Oil Filters				
Small Batteries	0.1			
Other/Composite				
SPECIAL	**0.2**	**0.1**	**0.3**	**0.2**
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 6. Makati – Results of Disposed Waste Composition Study (continued) (February 2003, % wet wt.)

Component	Hotels/ Condos	Markets	Industrial	Institutional
PAPER	**27.9**	**4.6**	**5.8**	**27.9**
Cardboard/Paper Bags	8.4	1.0	4.5	9.4
Newspaper	9.9	2.4	0.5	2.7
Office Paper/High Grade	9.7			
Mixed Paper		1.1	0.8	15.9
GLASS	**2.6**	**0.4**	**0.5**	**2.0**
Bottles and Containers	2.4	0.4	0.5	2.0
Other/Composite	0.2			
METALS	**3.1**	**0.3**	**1.1**	**0.8**
Tin/Steel Cans	1.7	0.3	0.3	0.2
Other Ferrous	0.4		0.1	0.2
Aluminum Cans	0.7			0.2
Other Non-Ferrous				0.1
Other/Composite	0.4		0.6	0.1
PLASTIC	**20.9**	**11.7**	**75.6**	**29.0**
PET	2.7	0.2		2.5
HDPE	2.8	3.5	47.4	11.2
Film Plastic/LDPE	7.8	6.6	28.0	9.3
Diapers	3.6	0.7		3.9
Other/Composite	4.1	0.7	0.3	2.1
OTHER ORGANIC	**43.0**	**82.5**	**11.1**	**31.3**
Kitchen/Food Waste	29.7	81.3	3.3	15.0
Yard/Landscape	7.7		3.5	4.6
Wood	0.5	1.0	0.4	3.6
Textiles	3.4	0.3	1.5	5.1
Leather				
Tires				
Rubber	0.1			0.1
Animal Remains				
Other/Composite	0.7			0.7
Fines	0.8		2.3	2.1
OTHER INORGANIC	**2.0**	**0.5**	**5.1**	**8.9**
Rock/Concrete/Brick				0.1
Ceramic/Stone	0.5	0.4		2.4
Asphalt				
Soil/Sand				0.6
Ash/Charcoal	0.1		0.9	2.8
Other/Composite	1.0			
Fines	0.3	0.2	4.2	3.0
HAZARDOUS	**0.3**	**0.0**	**0.0**	**0.1**
Paint				
Oil/Oil Filters				
Small Batteries	0.3			
Other/Composite				
SPECIAL	**0.2**	**0.0**	**0.9**	**0.0**
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 7. Makati – Results of Disposed Waste Bulk Density and Moisture Content Analyses (February 2003)

Generator Sector	Bulk Density (kg/cu m)	Moisture Content (% air-dry)
Low-income Residential	105.9	40.0
Middle-income Residential	94.7	34.1
High-income Residential	72.3	53.3
Commercial	50.6	
Malls		35.0
Offices		11.4
Restaurants		50.0
Hotels/Condominiums	64.3	33.0
Markets	182.1	36.0
Industrial	119.2	44.4
Institutional	77.8	33.0
All Sectors (weighted average)	92.0	41.1

The estimated disposed waste composition, for all generator sectors, is shown in Figure 13. The composition presented reflects a weighted average of the composition for each of the generator sectors, using disposed waste quantity data calculated by the municipality, and using the results of analyses from other LGUs as well as population data broken down by income level.

The figure shows that the components with the highest concentrations are kitchen/food waste (32%) and plastic (25%). The high concentration of kitchen/food waste indicates that methods of diversion should be considered for these materials.

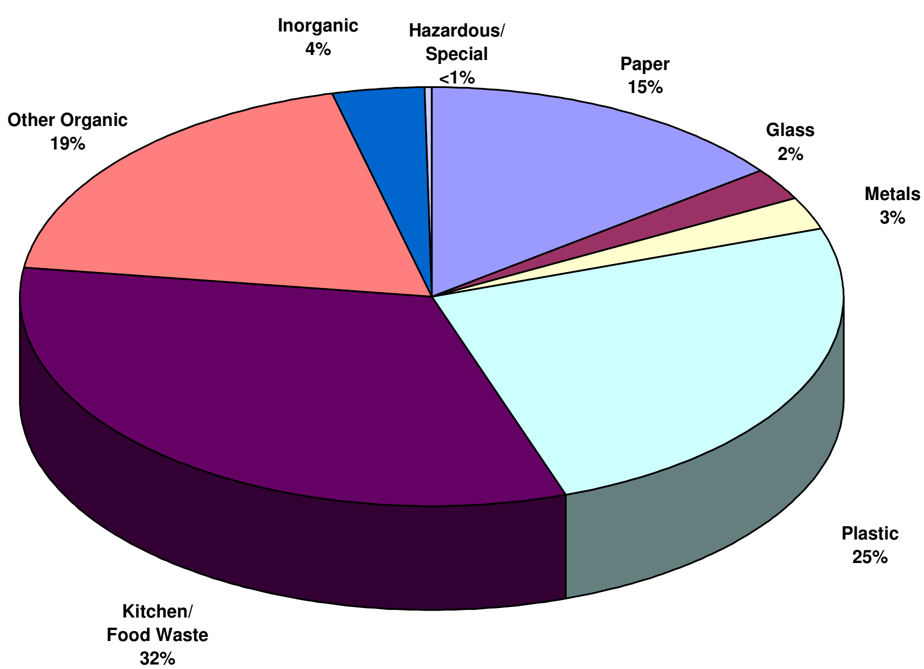

Figure 13. Estimated Composition of Disposed Waste – Makati (% wet wt.)

4.4 Muntinlupa

The results of the waste characterization study conducted by Muntinlupa are presented graphically in Figure 14. The figure presents the composition (% wet wt.) broken down by generator sector.

The composition of the disposed waste stream varies significantly by type of generator. As expected, the concentration of food waste is greatest in the markets sector, and it is also relatively high in the waste from malls, restaurants, and hotels. Interestingly, the highest concentration of paper is in the institutional sector (26%), and that concentration is about 60% greater than that estimated for the office sector. The reason for the substantial difference may be due to the higher rates of recycling in the office sector.

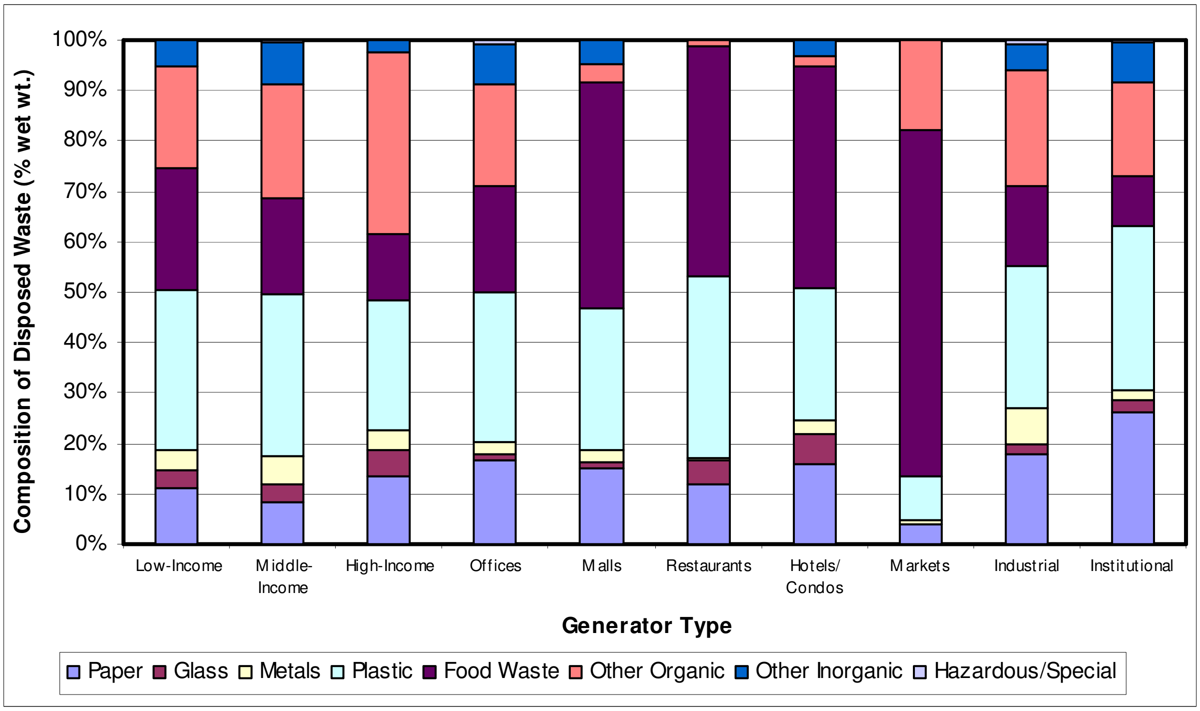

Figure 14. Composition of Disposed Waste by Generator Sector – Muntinlupa (% wet wt.)

Results of the analyses of disposed waste in Muntinlupa are presented Tables 8,9,and 10.

Table 8 presents a breakdown of the composition (% wet wt.) by sector and by component/subcomponent. The quantity of waste disposed, by sector and component, is presented in Table 9; and the results of the bulk density analysis and of the moisture content analysis are reported in Table 10.

Table 8. Muntinlupa – Results of Disposed Waste Composition Study (February 2003, % wet wt.)

Component	All Sectors	Low-Income Residential	Middle-Income Residential	High-Income Residential	Offices	Malls
PAPER	**10.2**	**11.0**	**8.5**	**13.5**	**16.7**	**15.1**
Cardboard/Paper Bags	4.7	5.3	4.2	4.8	3.6	6.5
Newspaper	1.9	2.5	1.2	1.7	2.5	0.3
Office Paper/High Grade	1.6	1.8	1.2	2.3	6.5	1.1
Mixed Paper	2.0	1.3	1.9	4.7	4.1	7.2
GLASS	**3.1**	**3.6**	**3.6**	**5.1**	**1.1**	**1.4**
Bottles and Containers	2.2	2.7	2.2	4.9	0.8	1.2
Other/Composite	0.9	0.9	1.3	0.3	0.3	0.2
METALS	**3.9**	**4.2**	**5.3**	**3.9**	**2.7**	**2.0**
Tin/Steel Cans	2.9	3.2	4.0	3.4	1.3	0.5
Other Ferrous	0.7	0.8	0.9	0.3	0.7	1.1
Aluminum Cans	0.2	0.1	0.2	0.1	0.7	0.4
Other Non-Ferrous	0.1	0.1	0.3	0.1	0.0	0.0
Other/Composite	0.0	0.0	0.0	0.0	0.0	0.0
PLASTIC	**28.1**	**31.6**	**32.4**	**25.7**	**29.8**	**28.1**
PET	1.3	1.2	1.1	1.3	2.0	4.1
HDPE	1.2	1.5	1.3	0.8	0.8	1.3
Film Plastic/LDPE	13.2	13.4	15.2	7.7	17.9	16.7
Diapers	7.3	10.2	10.1	4.1	0.6	0.6
Other/Composite	2.3	3.0	2.1	1.4	3.5	1.1
Styrofoam	0.7	0.7	0.6	0.6	2.3	1.5
PVC	2.0	1.4	1.9	9.9	2.1	2.9
Foam	0.1	0.2	0.1	0.0	0.6	0.0
OTHER ORGANIC	**49.5**	**44.6**	**41.5**	**49.3**	**41.0**	**48.6**
Kitchen/Food Waste	29.1	24.4	18.9	13.2	21.0	44.9
Yard/Landscape	11.4	10.8	13.2	30.9	15.9	0.0
Wood	2.9	3.1	3.6	2.1	1.5	2.0
Textiles	3.2	3.9	3.1	1.3	2.4	0.9
Leather	0.6	0.8	0.7	0.0	0.0	0.0
Tires	0.0	0.0	0.0	0.0	0.0	0.0
Rubber	1.1	1.6	1.4	0.5	0.2	0.4
Animal Remains	1.2	0.0	0.5	1.2	0.0	0.3
Other/Composite	0.0	0.0	0.0	0.0	0.0	0.0
Fines	0.0	0.0	0.0	0.0	0.0	0.0
OTHER INORGANIC	**5.0**	**5.0**	**8.4**	**2.5**	**8.1**	**4.8**
Rock/Concrete/Brick	0.1	0.0	0.2	0.0	0.0	0.0
Ceramic/Stone	1.3	1.4	1.7	0.0	0.9	4.0
Asphalt	0.0	0.0	0.0	0.0	7.2	0.0
Soil/Sand	3.3	3.5	5.4	2.5	0.0	0.8
Ash/Charcoal	0.3	0.1	1.1	0.0	0.0	0.0
Other/Composite	0.0	0.0	0.0	0.0	0.0	0.0
Fines	0.0	0.0	0.0	0.0	0.0	0.0
HAZARDOUS	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**0.0**
Paint	0.0	0.0	0.0	0.0	0.1	0.0
Oil/Oil Filters	0.0	0.0	0.0	0.0	0.0	0.0
Small Batteries	0.0	0.0	0.0	0.0	0.7	0.0
Other/Composite	0.0	0.0	0.0	0.0	0.0	0.0
SPECIAL	**0.1**	**0.0**	**0.4**	**0.0**	**0.0**	**0.1**
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 8. Muntinlupa – Results of Disposed Waste Composition Study (continued) (February 2003, % wet wt.)

Component	Restaurants	Hotels/ Condos	Markets	Industrial	Institutional
PAPER	**11.8**	**15.8**	**3.8**	**17.9**	**26.4**
Cardboard/Paper Bags	2.2	7.0	2.3	7.9	5.7
Newspaper	0.3	2.1	1.3	2.0	6.6
Office Paper/High Grade	2.2	5.4	0.0	3.4	10.3
Mixed Paper	7.1	1.3	0.3	4.6	3.7
GLASS	**4.7**	**6.2**	**0.2**	**1.8**	**2.1**
Bottles and Containers	0.8	5.6	0.1	1.2	0.6
Other/Composite	3.9	0.6	0.1	0.6	1.5
METALS	**0.6**	**2.8**	**0.6**	**7.4**	**2.1**
Tin/Steel Cans	0.5	1.3	0.4	6.1	1.5
Other Ferrous	0.0	0.4	0.2	1.2	0.3
Aluminum Cans	0.1	1.0	0.0	0.1	0.3
Other Non-Ferrous	0.0	0.1	0.0	0.0	0.0
Other/Composite	0.0	0.0	0.0	0.0	0.0
PLASTIC	**35.9**	**26.1**	**9.0**	**27.8**	**32.5**
PET	7.5	2.0	0.1	0.7	5.7
HDPE	0.9	2.0	0.1	1.4	1.4
Film Plastic/LDPE	16.3	15.2	8.1	18.7	12.7
Diapers	0.6	3.0	0.0	0.9	0.5
Other/Composite	2.2	1.5	0.2	3.9	8.2
Styrofoam	4.4	0.7	0.3	0.3	2.1
PVC	4.0	0.7	0.2	1.7	1.9
Foam	0.1	0.9	0.0	0.2	0.0
OTHER ORGANIC	**47.0**	**46.0**	**86.2**	**39.0**	**28.6**
Kitchen/Food Waste	45.7	44.2	68.6	15.9	9.8
Yard/Landscape	0.1	1.4	7.6	4.4	8.8
Wood	0.6	0.2	1.4	4.2	5.2
Textiles	0.6	0.1	1.1	11.4	2.3
Leather	0.0	0.1	0.2	1.6	0.1
Tires	0.0	0.0	0.0	0.0	0.0
Rubber	0.0	0.0	0.0	1.1	2.4
Animal Remains	0.0	0.0	7.4	0.5	0.0
Other/Composite	0.0	0.0	0.0	0.0	0.0
Fines	0.0	0.0	0.0	0.0	0.0
OTHER INORGANIC	**0.0**	**3.2**	**0.1**	**5.3**	**8.0**
Rock/Concrete/Brick	0.0	2.2	0.0	0.0	0.0
Ceramic/Stone	0.0	0.9	0.0	1.1	3.2
Asphalt	0.0	0.0	0.0	0.0	0.0
Soil/Sand	0.0	0.0	0.1	4.1	4.7
Ash/Charcoal	0.0	0.0	0.0	0.0	0.1
Other/Composite	0.0	0.0	0.0	0.0	0.0
Fines	0.0	0.0	0.0	0.0	0.0
HAZARDOUS	**0.0**	**0.0**	**0.0**	**0.4**	**0.3**
Paint	0.0	0.0	0.0	0.1	0.0
Oil/Oil Filters	0.0	0.0	0.0	0.0	0.0
Small Batteries	0.0	0.0	0.0	0.4	0.3
Other/Composite	0.0	0.0	0.0	0.0	0.0
SPECIAL	**0.0**	**0.1**	**0.0**	**0.3**	**0.1**
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 9. Muntinlupa – Quantity and Composition of Disposed Waste (February 2003, tonnes/yr)

Component	All Sectors	Low-Income Residential	Middle-Income Residential	High-Income Residential	Offices	Malls
PAPER	**8,237**	**3,837**	**1,719**	**687**	**87**	**549**
Cardboard/Paper Bags	3,795	1,861	857	245	19	238
Newspaper	1,495	884	236	85	13	11
Office Paper/High Grade	1,314	637	244	116	34	40
Mixed Paper	1,633	455	382	241	21	261
GLASS	**2,466**	**1,250**	**721**	**262**	**5**	**49**
Bottles and Containers	1,770	932	453	248	4	44
Other/Composite	695	318	269	14	1	6
METALS	**3,129**	**1,463**	**1,075**	**199**	**14**	**74**
Tin/Steel Cans	2,347	1,107	804	174	7	17
Other Ferrous	559	272	174	16	4	40
Aluminum Cans	121	49	34	5	3	15
Other Non-Ferrous	103	35	63	3		1
Other/Composite						
PLASTIC	**22,638**	**11,045**	**6,536**	**1,309**	**156**	**1,023**
PET	1,034	406	220	65	10	150
HDPE	959	529	257	41	4	47
Film Plastic/LDPE	10,605	4,690	3,071	390	94	605
Diapers	5,881	3,559	2,043	207	3	21
Other/Composite	1,848	1,058	424	71	18	40
Styrofoam	598	255	127	30	12	54
PVC	1,610	475	382	505	11	104
Foam	102	73	12		3	2
OTHER ORGANIC	**39,829**	**15,579**	**8,375**	**2,507**	**214**	**1,765**
Kitchen/Food Waste	23,426	8,526	3,814	674	110	1,630
Yard/Landscape	9,140	3,782	2,675	1,573	83	
Wood	2,313	1,080	728	106	8	74
Textiles	2,556	1,370	628	66	13	33
Leather	489	279	147			
Tires						
Rubber	917	541	279	26	1	15
Animal Remains	988		103	62		12
Other/Composite						
Fines						
OTHER INORGANIC	**4,014**	**1,729**	**1,699**	**126**	**42**	**173**
Rock/Concrete/Brick	71	14	44			
Ceramic/Stone	1,050	485	350		5	145
Asphalt	37				37	
Soil/Sand	2,619	1,208	1,091	126		28
Ash/Charcoal	237	21	214			
Other/Composite						
Fines						
HAZARDOUS	**32**	**7**	**6**	**0**	**4**	**0**
Paint	2					
Oil/Oil Filters						
Small Batteries	30	7	6		4	
Other/Composite						
SPECIAL	**97**	**13**	**72**	**1**	**0**	**2**
TOTAL	**80,442**	**34,923**	**20,203**	**5,090**	**522**	**3,635**

Values may not total exactly due to rounding.

Table 9. Muntinlupa – Quantity and Composition of Disposed Waste (continued) (February 2003, tonnes/yr)

Component	Restaurants	Hotels/ Condos	Markets	Industrial	Institutional
PAPER	**134**	**86**	**411**	**473**	**254**
Cardboard/Paper Bags	25	39	248	210	55
Newspaper	3	11	135	52	64
Office Paper/High Grade	25	29		89	99
Mixed Paper	81	7	28	121	36
GLASS	**53**	**34**	**22**	**49**	**21**
Bottles and Containers	9	31	12	32	6
Other/Composite	44	3	10	17	15
METALS	**7**	**15**	**67**	**196**	**20**
Tin/Steel Cans	5	7	48	162	15
Other Ferrous		2	16	31	3
Aluminum Cans	1	5	2	2	2
Other Non-Ferrous					
Other/Composite					
PLASTIC	**406**	**143**	**973**	**736**	**312**
PET	85	11	14	19	55
HDPE	11	11	9	37	14
Film Plastic/LDPE	184	83	872	494	122
Diapers	6	17		23	4
Other/Composite	25	8	22	103	79
Styrofoam	50	4	37	9	20
PVC	45	4	20	46	19
Foam	1	5		5	
OTHER ORGANIC	**532**	**252**	**9,300**	**1,031**	**275**
Kitchen/Food Waste	517	242	7,398	421	94
Yard/Landscape	1	8	818	115	85
Wood	7	1	148	111	50
Textiles	7		115	302	22
Leather			19	42	1
Tires					
Rubber			4	28	23
Animal Remains			797	13	
Other/Composite					
Fines					
OTHER INORGANIC	**0**	**17**	**12**	**139**	**77**
Rock/Concrete/Brick		12			
Ceramic/Stone		5		29	31
Asphalt					
Soil/Sand			12	109	45
Ash/Charcoal				1	1
Other/Composite					
Fines					
HAZARDOUS	**0**	**0**	**1**	**12**	**2**
Paint				1	
Oil/Oil Filters					
Small Batteries			1	10	2
Other/Composite					
SPECIAL	**0**	**0**	**2**	**7**	**1**
TOTAL	**1,132**	**548**	**10,786**	**2,641**	**962**

Values may not total exactly due to rounding.

Table 10. Muntinlupa – Results of Disposed Waste Bulk Density and Moisture Content Analyses (February 2003)

Generator Sector	Bulk Density (kg/cu m)	Moisture Content (% air-dry)
Low-income Residential	154.9	24.5
Middle-income Residential	148.0	47.6
High-income Residential	123.8	13.3
Commercial		56.6
Offices	95.4	
Malls	182.3	
Restaurants	122.3	
Hotels/Condominiums	130.3	
Markets	325.2	80.6
Industrial	108.6	27.3
Institutional	90.7	16.0
All Sectors (weighted average)	160.4	39.5

The overall waste composition, for all generator sectors, is shown in Figure 15. The composition presented in the figure reflects a weighted average of the composition for each of the generator sectors, using disposed waste quantity data collected by the municipality. As shown in the figure, the two components with the highest concentrations are kitchen/food waste (29%) and plastic (28%).

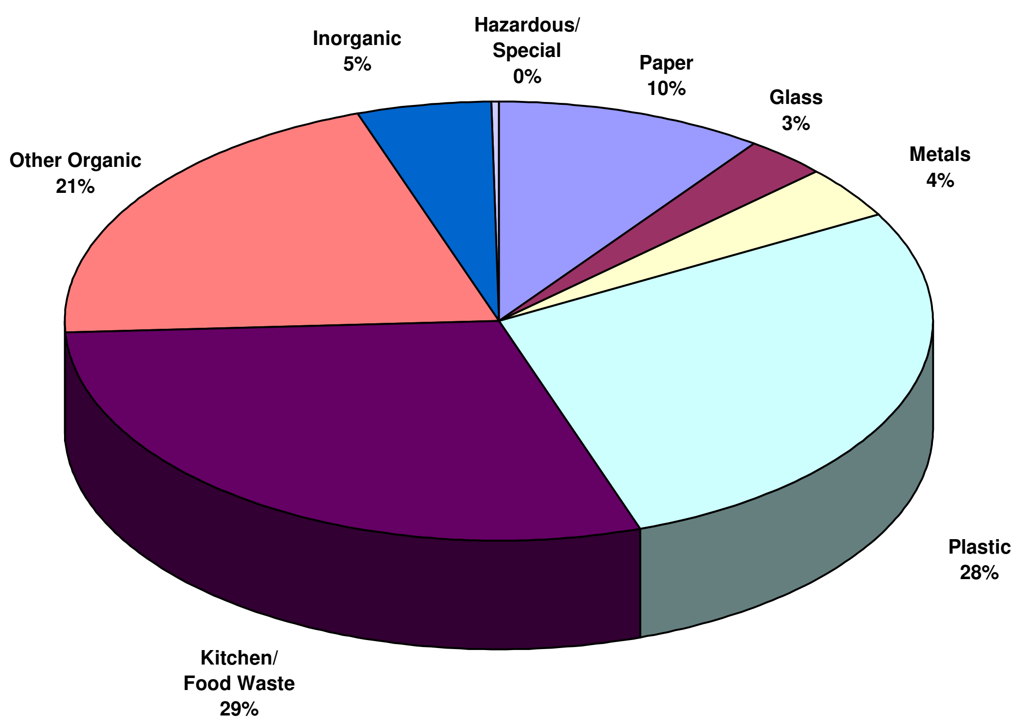

Figure 15. Composition of Disposed Waste – Muntinlupa (% wet wt.)

4.5 Pasig

The results of the waste characterization study conducted by Pasig are presented graphically in Figure 16. The figure presents the composition (% wet wt.) broken down by generator sector.

Of particular significance are the high concentrations of paper in the commercial (38%) and the institutional (40%) waste streams, which potentially represent a good opportunity for additional recycling. Also of interest is the high concentration of inorganic materials in the industrial waste (68%). This material was categorized as "fines" during the WACS. Further review should be conducted by Pasig to collect additional information on the characteristics of this material and thus assess its recyclability.

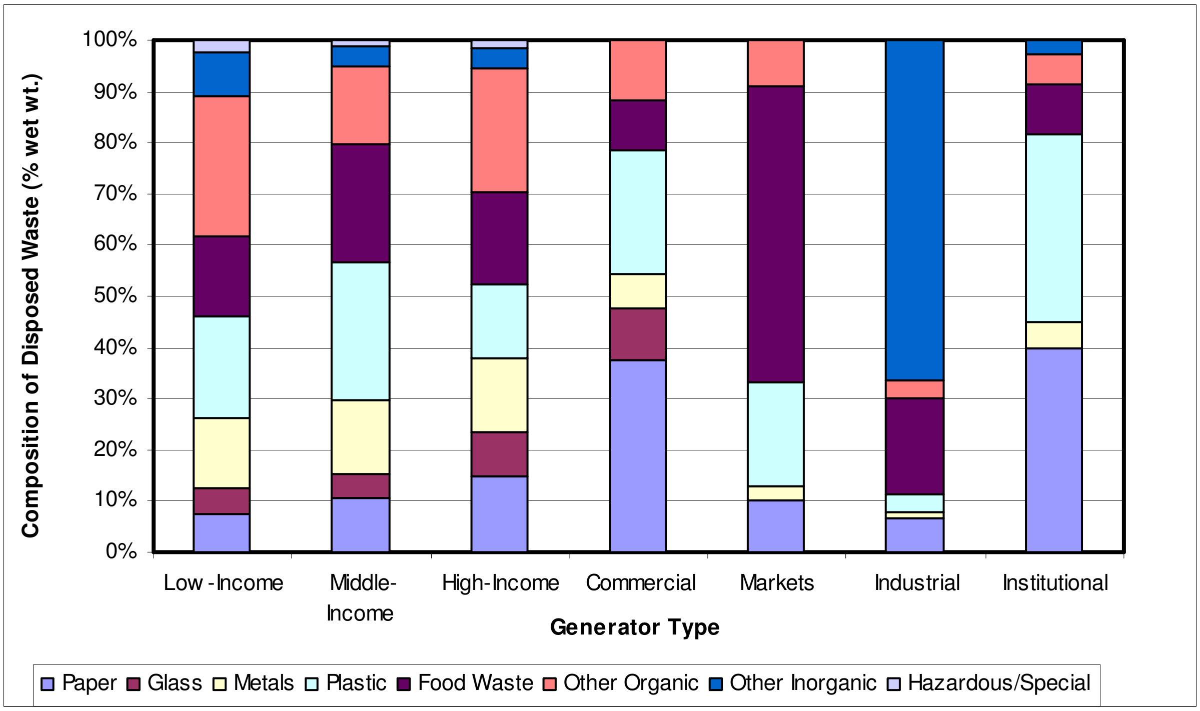

Figure16. Composition of Disposed Waste by Generator Sector – Pasig (% wet wt.)

Results of the analysis of disposed waste in Pasig are presented Tables 11 and 12.

Table 11 presents a breakdown of the composition (% wet wt.) by sector and by component/subcomponent. The results of the bulk density analysis and of the moisture content analysis are reported in Table 12.

Table 11. Pasig – Results of Disposed Waste Composition Study (April 2003, % wet wt.)

Component	Low-Income Residential	Middle-Income Residential	High-Income Residential	Commercial
PAPER	**7.4**	**10.6**	**14.8**	**37.5**
Cardboard/Paper Bags	3.0	4.9	6.8	16.6
Newspaper	2.1	2.3	2.6	6.3
Office Paper/High Grade	0.1	0.4	1.2	7.9
Mixed Paper	2.3	3.1	4.1	6.8
GLASS	**4.9**	**4.8**	**8.6**	**10.1**
Bottles and Containers	3.9	4.0	7.8	9.5
Other/Composite	1.1	0.7	0.9	0.6
METALS	**13.9**	**14.3**	**14.4**	**6.8**
Tin/Steel Cans	9.0	7.1	9.9	2.5
Other Ferrous	1.3			
Aluminum Cans	0.7	1.6	1.8	4.3
Other Non-Ferrous	0.6	0.3		
Other/Composite	2.4	5.3	2.7	
PLASTIC	**19.7**	**27.1**	**14.3**	**24.0**
PET	7.4	7.2	5.8	6.4
HDPE	6.2	10.9	4.1	12.1
Film Plastic/LDPE		0.4	0.2	
Diapers	1.7	4.5	2.7	
Other/Composite	4.4	4.0	1.5	5.4
OTHER ORGANIC	**43.1**	**38.0**	**41.8**	**21.6**
Kitchen/Food Waste	15.7	22.8	17.7	9.9
Yard/Landscape	5.4	1.5	3.9	4.8
Wood	5.2	1.5	7.5	4.4
Textiles	1.2	1.8	1.9	1.7
Leather		1.1	2.7	
Tires	5.3	3.5	1.5	
Rubber	3.2		0.1	
Animal Remains	6.8	4.8	5.7	
Other/Composite	0.2	1.0	0.9	0.8
Fines				
OTHER INORGANIC	**8.5**	**3.9**	**4.1**	**0.0**
Rock/Concrete/Brick	3.3	0.9	1.2	
Ceramic/Stone	1.4	1.4	1.3	
Asphalt				
Soil/Sand	1.5	0.8	1.1	
Ash/Charcoal		0.7		
Other/Composite	0.7	0.1	0.4	
Fines	1.7		0.2	
HAZARDOUS	**1.1**	**1.3**	**1.5**	**0.0**
Paint			**0.3**	
Oil/Oil Filters	0.3			
Small Batteries	0.8	1.3	1.2	
Other/Composite				
SPECIAL	**1.3**	**0.0**	**0.5**	**0.0**
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 11. Pasig – Results of Disposed Waste Composition Study (continued) (April 2003, % wet wt.)

Component	Markets	Industrial	Institutional
PAPER	**10.0**	**6.8**	**39.8**
Cardboard/Paper Bags	2.0	4.0	19.6
Newspaper	5.8		1.7
Office Paper/High Grade		1.2	1.1
Mixed Paper	2.2	1.6	17.4
GLASS	**0.0**	**0.0**	**0.0**
Bottles and Containers			
Other/Composite			
METALS	**3.0**	**0.9**	**5.0**
Tin/Steel Cans	1.3		1.4
Other Ferrous		0.9	
Aluminum Cans	1.7		3.6
Other Non-Ferrous			
Other/Composite			
PLASTIC	**20.3**	**3.7**	**36.7**
PET	9.4	1.6	14.6
HDPE	8.5	1.8	17.7
Film Plastic/LDPE			
Diapers			
Other/Composite	2.3	0.2	4.4
OTHER ORGANIC	**66.8**	**22.1**	**15.7**
Kitchen/Food Waste	57.6	18.8	9.9
Yard/Landscape			2.5
Wood	2.4	3.1	
Textiles			
Leather			
Tires	1.5		
Rubber	0.8		
Animal Remains	1.8		
Other/Composite	2.6	0.2	3.3
Fines			
OTHER INORGANIC	**0.0**	**66.5**	**2.8**
Rock/Concrete/Brick			
Ceramic/Stone			
Asphalt			
Soil/Sand			1.4
Ash/Charcoal			0.8
Other/Composite			
Fines		66.5	0.6
HAZARDOUS	**0.0**	**0.0**	**0.0**
Paint			
Oil/Oil Filters			
Small Batteries			
Other/Composite			
SPECIAL	**0.0**	**0.0**	**0.0**
TOTAL	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 12. Pasig – Results of Disposed Waste Bulk Density and Moisture Content Analyses (April 2003)

Generator Sector	Bulk Density (kg/cu m)	Moisture Content (% air-dry)
Low-income Residential	181.7	24.5
Middle-income Residential	184.8	47.6
High-income Residential	193.9	13.3
Commercial	122.1	56.6
Markets	84.9	80.6
Industrial	127.4	27.3
Institutional	36.2	16.0
All Sectors (weighted average)	138.6	33.3

An estimate of the overall waste composition for Pasig is shown in Figure 17. The estimate is based on the results of the composition analysis for each generator sector conducted by Pasig, with the weighted average calculated using the results of analyses from other LGUs as well as population data broken down by income level. The data in the figure show that the components with the highest concentrations are: kitchen/food waste (23%), plastic (21%), and other organic (19%). Collectively these three components constitute 63% of the waste stream. The figure also shows a high concentration of metals (12%) in the waste stream.

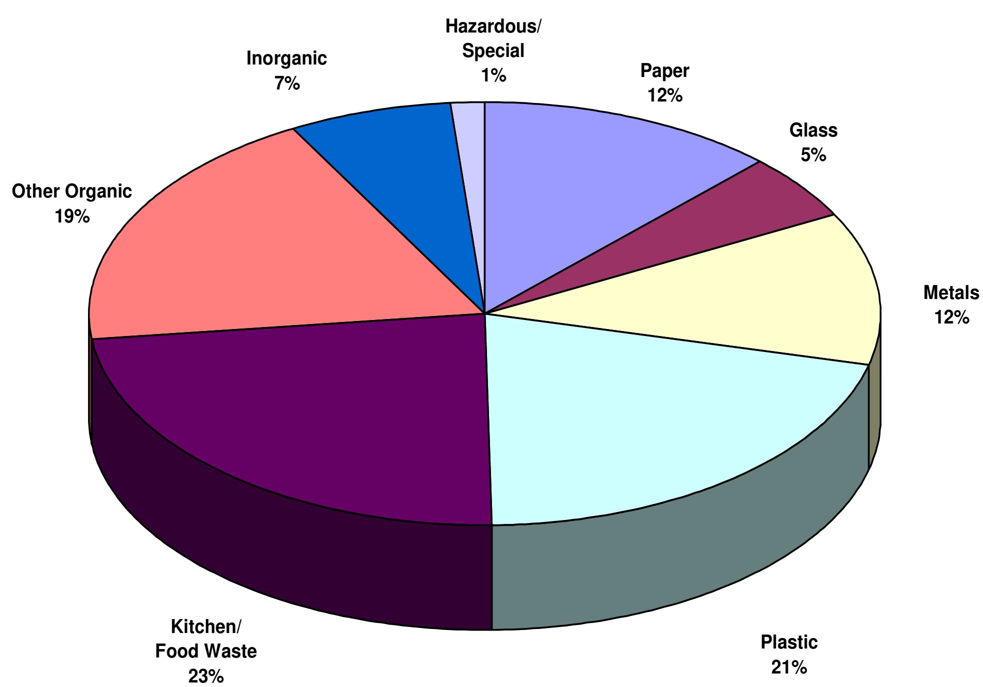

Figure 17. Estimated Composition of Disposed Waste – Pasig (% wet wt.)

4.6 Quezon City

The results of the waste characterization study conducted by Quezon City are presented graphically in Figure 18. The figure presents the composition (% wet wt.) broken down by generator sector.

The results of the analysis show a relatively high concentration of paper disposed by the institutional (31%) and commercial sectors (24%). In addition, kitchen/food waste constitutes a substantial percentage of the waste stream for all of the generator sectors, i.e., from 26% for institutional to 64% for markets.

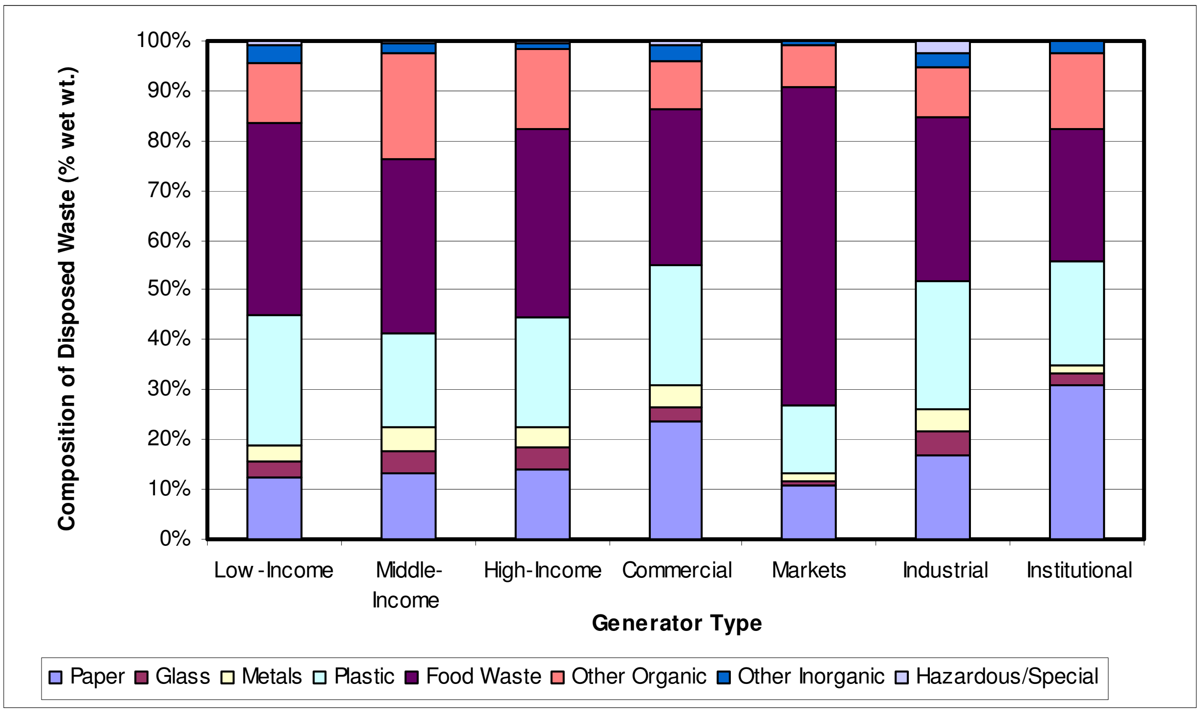

Figure 18. Composition of Disposed Waste by Generator Sector – Quezon City (% wet wt.)

Results of the analysis of disposed waste in Quezon City are presented Tables 13 and 14.

Table 13 presents a breakdown of the composition (% wet wt.) by sector and by component/subcomponent. The results of the bulk density analysis and of the moisture content analysis are reported in Table 14.

Table 13. Quezon City – Results of Disposed Waste Composition Study (April-May 2003, % wet wt.)

Component	Low-Income Residential	Middle-Income Residential	High-Income Residential	Commercial
PAPER	**12.5**	**13.3**	**14.2**	**23.9**
Cardboard/Paper Bags	5.7	5.1	4.7	9.2
Newspaper	0.4	2.0	1.0	0.7
Office Paper/High Grade	0.2	0.1	0.2	0.5
Mixed Paper	6.2	6.0	8.4	13.6
GLASS	**3.1**	**4.4**	**4.2**	**2.8**
Bottles and Containers	2.1	2.9	3.5	1.9
Other/Composite	1.0	1.5	0.7	0.9
METALS	**3.1**	**4.7**	**4.0**	**4.1**
Tin/Steel Cans	2.9	2.8	3.7	3.4
Other Ferrous	0.1	1.6	0.1	0.2
Aluminum Cans	0.1	0.3	0.2	0.5
Other Non-Ferrous				
Other/Composite				
PLASTIC	**26.3**	**19.0**	**22.2**	**24.1**
PET	0.9	1.3	1.0	2.7
HDPE	2.7	1.4	1.9	1.4
Film Plastic/LDPE	16.3	10.5	9.6	14.7
Diapers	6.1	5.2	8.8	3.6
Other/Composite	0.3	0.6	1.0	1.7
OTHER ORGANIC	**50.5**	**56.1**	**53.7**	**41.0**
Kitchen/Food Waste	38.7	34.9	37.9	31.5
Yard/Landscape	1.2	16.5	11.7	0.7
Wood	2.1	0.3	1.1	0.6
Textiles	3.4	3.3	1.4	6.4
Leather	1.2	0.1	0.1	0.5
Tires				
Rubber	1.0	0.1		0.3
Animal Remains			0.2	
Other/Composite	2.3	0.1	0.7	0.2
Fines	0.7	0.8	0.5	0.7
OTHER INORGANIC	**3.8**	**2.2**	**1.4**	**3.4**
Rock/Concrete/Brick	0.5	1.0		0.9
Ceramic/Stone	1.5	0.4	0.9	0.7
Asphalt				
Soil/Sand				
Ash/Charcoal	0.1			0.2
Other/Composite		0.1		
Fines	1.7	0.7	0.5	1.5
HAZARDOUS	**0.5**	**0.2**	**0.3**	**0.7**
Paint	0.2			0.5
Oil/Oil Filters				
Small Batteries	0.1	0.1	0.1	
Other/Composite	0.1	0.2	0.2	0.1
SPECIAL	**0.2**	**0.0**	**0.0**	**0.0**
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 13. Quezon City – Results of Disposed Waste Composition Study (continued) (April-May 2003, % wet wt.)

Component	Markets	Industrial	Institutional
PAPER	**11.0**	**17.0**	**30.7**
Cardboard/Paper Bags	6.0	6.8	5.2
Newspaper		0.6	2.0
Office Paper/High Grade		1.0	8.6
Mixed Paper	5.0	8.6	14.9
GLASS	**0.7**	**4.7**	**2.4**
Bottles and Containers	0.7	2.5	2.4
Other/Composite		2.2	
METALS	**1.4**	**4.3**	**1.6**
Tin/Steel Cans	1.3	3.3	1.3
Other Ferrous		0.7	
Aluminum Cans	0.1	0.3	0.3
Other Non-Ferrous			
Other/Composite			
PLASTIC	**13.6**	**25.6**	**20.6**
PET	0.9	2.9	3.7
HDPE	0.8	2.2	0.9
Film Plastic/LDPE	9.8	15.6	11.1
Diapers	1.5	3.7	3.8
Other/Composite	0.5	1.2	1.1
OTHER ORGANIC	**72.6**	**43.0**	**41.3**
Kitchen/Food Waste	64.1	32.8	26.1
Yard/Landscape	1.4	2.1	10.3
Wood	1.8	2.6	0.9
Textiles	1.3	2.6	2.2
Leather	0.1	0.6	
Tires			
Rubber	0.1	0.7	0.3
Animal Remains	2.3		
Other/Composite	1.1	0.9	0.7
Fines	0.4	0.6	0.8
OTHER INORGANIC	**0.7**	**2.9**	**2.2**
Rock/Concrete/Brick		1.1	0.6
Ceramic/Stone	0.2	0.8	0.1
Asphalt			
Soil/Sand			
Ash/Charcoal	0.1		
Other/Composite		0.2	0.1
Fines	0.3	0.8	1.3
HAZARDOUS	**0.0**	**2.3**	**0.1**
Paint		1.9	
Oil/Oil Filters			
Small Batteries		0.2	0.1
Other/Composite		0.2	
SPECIAL	**0.0**	**0.3**	**1.0**
TOTAL	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 14. Quezon City – Results of Disposed Waste Bulk Density and Moisture Content Analyses (April-May 2003)

Generator Sector	Bulk Density (kg/cu m)	Moisture Content (% air-dry)
Low-income Residential	216.0	68.4
Middle-income Residential	207.3	64.5
High-income Residential	208.5	66.3
Commercial	203.7	61.6
Markets	272.8	76.3
Industrial	220.6	69.5
Institutional	197.0	33.8
All Sectors (weighted average)	218.6	67.0

An estimate of the overall composition is shown in Figure 19. The estimate is based on the results of the composition analysis for each generator sector conducted by Quezon City and data collected by Quezon City on the quantity of waste disposed for all sectors combined, with the weighted average calculated using the results of analyses from other LGUs as well as population data broken down by income level. Similarly to other LGUs, the composition of the waste disposed in Quezon City show the components with the highest concentrations are: kitchen/food waste (40%), plastics (21%) and other organics (16%).

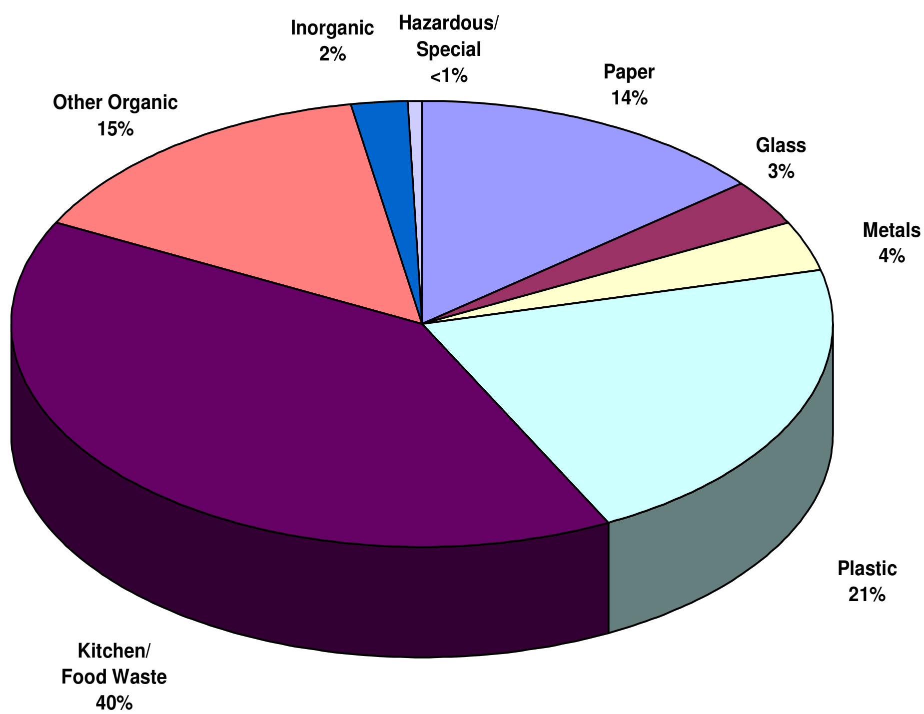

Figure 19. Estimated Composition of Disposed Waste – Quezon City (% wet wt.)

4.7 Valenzuela

The results of the waste characterization study conducted by Valenzuela are presented graphically in Figure 20. The figure presents the composition (% wet wt.) broken down by generator sector.

The results of the analysis show a relatively high concentration of paper disposed by the commercial (31%) and institutional sectors (28%), In addition, there is a relatively high percentage of plastic in the waste stream for all of the generator sectors, i.e., from 24% for institutional to 38% for commercial.

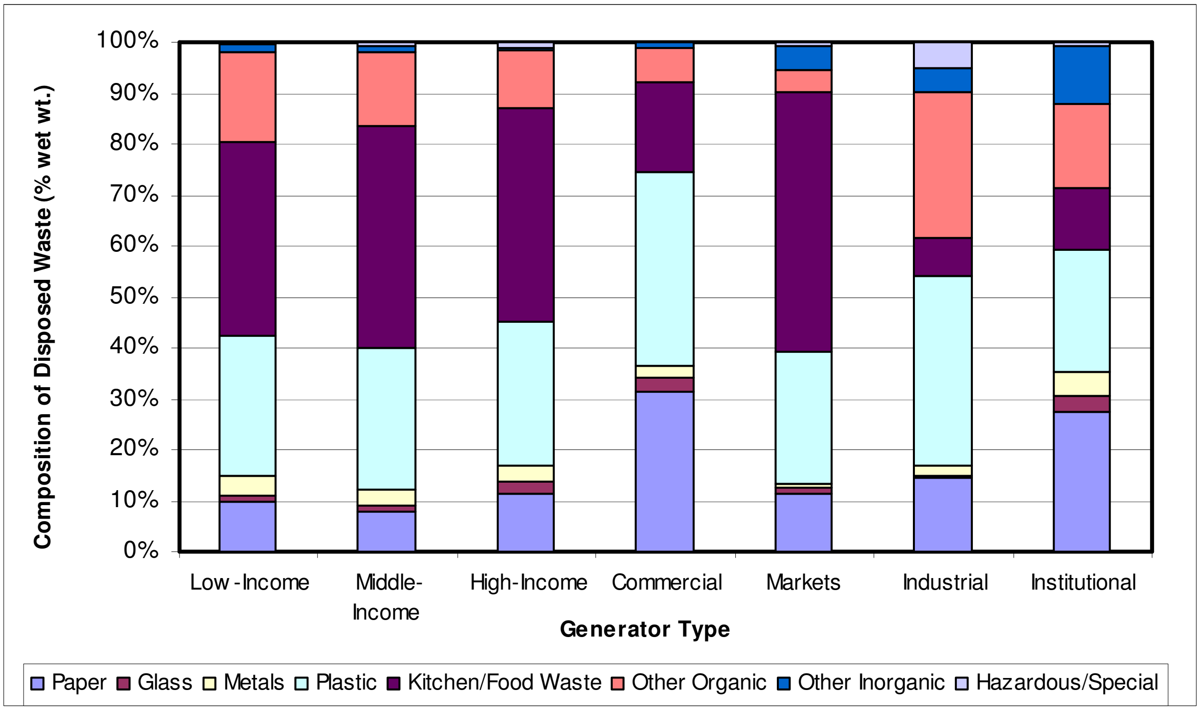

Figure 20. Composition of Disposed Waste by Generator Sector – Valenzuela (% wet wt.)

Results of the analysis of disposed waste in Valenzuela are presented Tables 15 and 16.

Table 15 presents a breakdown of the composition (% wet wt.) by sector and by component/subcomponent. The results of the bulk density analysis and of the moisture content analysis are reported in Table 16.

Table 15. Valenzuela – Results of Disposed Waste Composition Study (May 2003, % wet wt.)

Component	Low-Income Residential	Middle-Income Residential	High-Income Residential	Commercial
PAPER	**9.7**	**7.7**	**11.4**	**31.2**
Cardboard/Paper Bags	2.2	2.9	3.9	9.4
Newspaper	0.8	0.5	2.0	2.6
Office Paper/High Grade	1.4	1.3	1.6	3.0
Mixed Paper	5.3	3.0	3.9	16.3
GLASS	**1.3**	**1.4**	**2.4**	**2.8**
Bottles and Containers	1.1	1.4	1.7	2.8
Other/Composite	0.2		0.6	
METALS	**4.0**	**3.2**	**3.1**	**2.7**
Tin/Steel Cans	3.1	2.4	1.8	1.5
Other Ferrous	0.5	0.3	0.4	0.4
Aluminum Cans	0.3	0.5	0.8	0.8
Other Non-Ferrous			0.1	
Other/Composite	0.1		0.1	
PLASTIC	**27.4**	**27.7**	**28.2**	**37.8**
PET	1.5	2.1	3.0	3.4
HDPE	4.0	0.8	3.8	3.1
Film Plastic/LDPE	9.5	12.6	8.1	22.1
Diapers	9.2	6.0	8.7	0.2
Other/Composite	3.1	6.1	4.7	9.0
OTHER ORGANIC	**55.6**	**58.0**	**53.6**	**24.4**
Kitchen/Food Waste	38.2	43.7	42.1	17.5
Yard/Landscape	6.3	6.6	4.1	1.1
Wood	2.6	2.4	1.6	1.4
Textiles	3.7	2.2	1.9	1.5
Leather	0.4	0.3	0.2	0.1
Tires	0.1			
Rubber	1.2	0.8	0.4	0.1
Animal Remains	1.1			
Other/Composite	0.5	0.7	2.5	1.4
Fines	1.5	1.3	0.8	1.3
OTHER INORGANIC	**1.7**	**1.5**	**0.3**	**1.1**
Rock/Concrete/Brick	0.4	0.3		0.5
Ceramic/Stone	0.8	0.9	0.1	0.5
Asphalt				
Soil/Sand				
Ash/Charcoal				
Other/Composite	0.5	0.3	0.1	
Fines			0.1	0.1
HAZARDOUS	**0.1**	**0.3**	**0.6**	**0.0**
Paint	0.1		0.4	
Oil/Oil Filters		0.1		
Small Batteries		0.1	0.1	
Other/Composite		0.1	0.1	
SPECIAL	**0.3**	**0.3**	**0.5**	**0.0**
TOTAL	**100.0**	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 15. Valenzuela – Results of Disposed Waste Composition Study (continued) (May 2003, % wet wt.)

Component	Markets	Industrial	Institutional
PAPER	**11.4**	**14.5**	**27.5**
Cardboard/Paper Bags	2.3	4.1	7.5
Newspaper	2.8	0.4	2.9
Office Paper/High Grade		1.1	4.5
Mixed Paper	6.3	8.9	12.6
GLASS	**1.1**	**0.5**	**3.3**
Bottles and Containers	0.3	0.5	2.9
Other/Composite	0.8		0.4
METALS	0.7	2.0	4.4
Tin/Steel Cans	0.6	1.0	2.7
Other Ferrous	0.1	0.6	
Aluminum Cans		0.3	0.9
Other Non-Ferrous			0.1
Other/Composite			0.6
PLASTIC	**25.9**	**37.1**	**24.1**
PET	4.1	2.5	6.0
HDPE	6.5	17.6	7.7
Film Plastic/LDPE	7.6	9.1	6.2
Diapers	5.3	0.1	0.1
Other/Composite	2.3	7.7	4.1
OTHER ORGANIC	**55.4**	**36.2**	**28.7**
Kitchen/Food Waste	51.0	7.4	12.2
Yard/Landscape	0.2	1.2	5.8
Wood	0.9	2.9	6.7
Textiles	1.8	12.6	1.0
Leather			
Tires			
Rubber	0.6	2.2	0.7
Animal Remains			
Other/Composite	0.1	5.9	2.0
Fines	0.9	4.0	0.3
OTHER INORGANIC	**4.7**	**4.8**	**11.1**
Rock/Concrete/Brick	0.7	2.4	1.9
Ceramic/Stone		2.4	8.7
Asphalt			
Soil/Sand			0.4
Ash/Charcoal	0.1		
Other/Composite	3.0		
Fines	0.9		0.1
HAZARDOUS	**0.7**	**4.9**	**0.9**
Paint		3.0	0.9
Oil/Oil Filters			
Small Batteries		0.1	
Other/Composite	0.7	1.8	
SPECIAL	**0.1**	**0.1**	**0.1**
TOTAL	**100.0**	**100.0**	**100.0**

Values may not total exactly due to rounding.

Table 16. Valenzuela – Results of Disposed Waste Bulk Density and Moisture Content Analyses (May 2003)

Generator Sector	Bulk Density (kg/cu m)	Moisture Content (% air-dry)
Low-income Residential	177.2	28.2
Middle-income Residential	152.6	34.8
High-income Residential	125.7	14.0
Commercial	48.2	51.6
Markets	185.0	81.5
Industrial	185.0	27.4
Institutional	71.4	14.0
All Sectors (weighted average)	158.8	38.2

An estimate of the overall composition is shown in Figure 21. The estimate is based on the results of the composition analysis for each generator sector conducted by Valenzuela and data collected by Valenzuela on the quantity of waste disposed for all sectors combined, with the weighted average calculated using the results of analyses from other LGUs as well as population data broken down by income level.

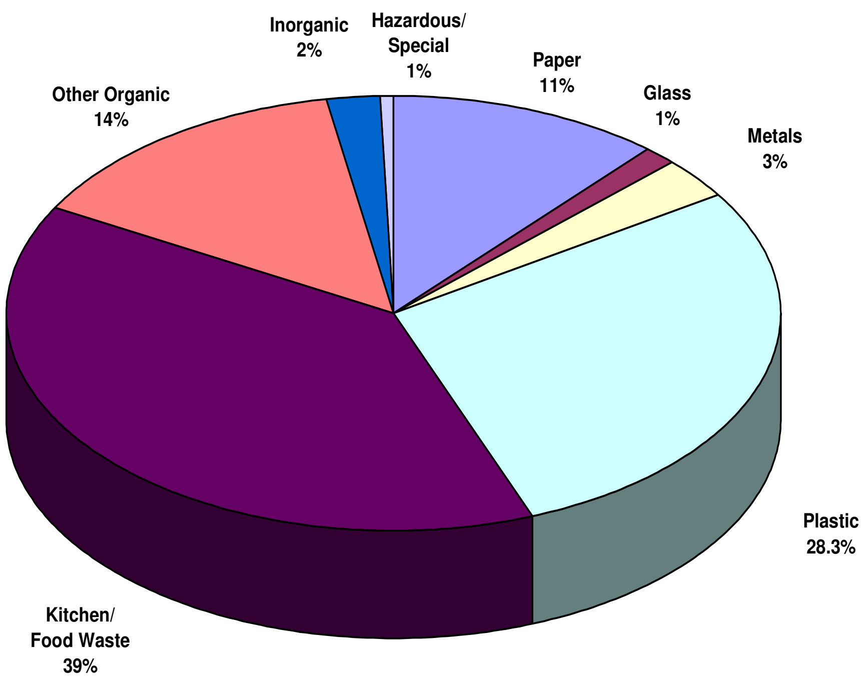

Figure 21. Composition of Disposed Waste – Valenzuela (% wet wt.)

5. Discussion

It is interesting and important to compare the results of the current waste characterization studies conducted by the five LGUs with those of previous waste analyses. Such comparisons provide an understanding of changes in the waste stream that may be due to purchasing habits, consumption practices, collection practices, recycling programs, public education, and any number of other factors. However, any comparison of this nature must take into consideration the differences in methodologies among the studies.

The average of the results of the LGU studies are compared with the results of previous studies (discussed in Section 2) in Table 17 for the residential sector, and in Table 18 for the entire municipal solid waste (MSW stream).

Table 17. Comparison of Results of Composition Analyses, Residential Waste
(Composition, % wet weight)

Component	1982 Generated Waste	1997 Generated Waste	2003* Disposed Waste
Paper	12.9	15.4	11.3
Glass	3.5	2.7	3.7
Metals	5.8	5.5	5.8
Plastic	6.9	15.6	24.6
Kitchen/Food Waste	35.8	45.8	29.9
Other Organic	17.4	12.6	20.3
Other Inorganic	3.0	2.5	3.7
Screenings	14.7		
Hazardous/Special			0.7
Total	100.0	100.0	100.0

Sources: Norconsult, *et al*, 1982; JICA, 1999.
*Average of the results from five LGUs for the low, middle, and high-income residential sectors.

Table 18. Comparison of Results of Composition Analyses, MSW
(Composition, % wet weight)

Component	1982 Generated Waste	1997 Generated Waste	2003* Disposed Waste
Paper	14.5	16.8	12.5
Glass	2.7	3.4	3.1
Metals	4.9	5.2	5.0
Plastic	7.5	15.6	24.7
Kitchen/Food Waste	31.7	45.4	32.7
Other Organic	17.4	11.3	17.4
Other Inorganic	3.0	2.3	4.0
Screenings	14.7		
Hazardous/Special	1.0		0.6
Total	100.0	100.0	100.0

Sources: Norconsult, *et al*, 1982; JICA, 1999.
*Average of the results from five LGUs.

The comparisons show that the concentration of paper products in the MSW increased slightly from 14.5% in 1982 to 16.8% in 1997, but decreased to 12.5% in 2003. The comparison also shows that the concentration of kitchen/food waste increased substantially from 1982 to 1997, then decreased in 2003 to levels that were more similar to those in 1982. The decreases in concentrations of paper products and kitchen/food waste from 1997 to 2003 may be attributable to the differences of the sampling points. The concentrations of glass and metals in the waste stream have remained relatively constant, despite the fact that the 2003 studies were conducted at the point of disposal.

A significant finding of the comparison pertains to plastics. The concentration of plastic has increased dramatically over the last twenty years; in 2003, it is over three times that in 1982. A large concentration of film plastic is reported by the LGUs as currently being disposed. Even taking into consideration the differences in sampling methodologies among the studies, this represents a major change in disposal patterns.

Table 19 presents a comparison of the other results of the studies. The average moisture content in 1982 was reported to vary from 43% to 47% (oven dried), while the moisture content varied from 30% to 55% (oven dried) in 1997. The average moisture contents of MSW measured in 2003 by the five LGUs ranged between 29% and 67% (air dried); the average for all five LGUs was 42%.

The bulk density of the waste ranged from 175 to 275 kg/cu m (as collected) in 1982, and the average bulk density reported for 1997 was 200 kg/cu m. The average bulk densities obtained in 2003 by the five LGUs ranged between 92 and 218 kg/cu m in 2003 (as discharged).

Table 19. Comparison of Other Results of Waste Analyses

	1982 Generated Waste	1997 Generated Waste	2003* Disposed Waste
Moisture Content (%)	43 – 47 oven dried	30 – 55 oven dried	29 – 67 air dried
Bulk Density (kg/cu m)	175 – 275 as collected	200 as discharged	92 – 218 as discharged

Sources: Norconsult, *et al*, 1982; JICA, 1999.
*Average of the results from five LGUs.

6. Recommendations

Based on the results of the waste characterization program, the following recommendations are made:

- Every LGU in Metro Manila should be encouraged to conduct a WACS as soon as possible. The LGUs that did not participate in this program should make every effort to follow the procedures and methodologies suggested in this report such that all of the data collected can be compared.
- LGUs that participated in this program should conduct another waste characterization study in 6 to 9 months to refine the data and to collect additional information. Thereafter, the study should be repeated every two years.
- A standardized reporting format should be prepared for use by the LGUs.
- Emphasis should be placed on the collection of accurate quantity data by generator type, including bulk density analyses.
- Analyses should be conducted on recycling and illegal disposal by each LGU. Data on disposed waste quantities should be combined with those for recycled materials and illegal disposal to determine the quantity of waste generated.
- Planning should be conducted based on LGU-specific information if possible, rather than generalized per capita generation rates or "national averages" for waste composition.
- Additional training should be provided to LGUs in the utilization of the results of waste characterization studies in the planning process.

ANNEX 1

Waste Characterization Procedures

1. Procedures for Field Work to Determine Composition of Waste
2. Procedures for Field Work to Determine Bulk Density of Waste Fractions
3. Procedures for Field Work to Determine Moisture Content of Waste Fractions
4. Safety Procedures and Guidelines
5. Waste Composition Data Sheet
6. Vehicle Count Data Sheet

Waste Characterization Study for Metro Manila:

Procedures for Field Work to Determine Composition of Waste[1]

General Scheduling/Logistics

1. Determine schedule for sampling. The project schedule should consider calendar dates which will not impact on how representative the field data actually are. Care should be taken to avoid, if possible, weekly periods that include holidays or sampling periods that occur immediately after major holidays.
2. Notify all affected parties in writing and via telephone. City representatives, haulers, and disposal site operators should be contacted to confirm any special operations that might be conducted during the period in question.
3. Hire/assign personnel to assist in the conduct of the sort.
4. Secure necessary heavy equipment.
5. Identify and locate emergency services nearest to the site. Acquire the name, address, and phone number of the nearest hospital and ambulance service, as well as a map indicating directions to the hospital, other emergency facilities, or both.
6. Identify the generator types to be surveyed. The generator types may be divided by type of waste (e.g., residential, commercial, market, light industrial, hospital, etc.). The residential sector may be further divided by economic status. Determine the number of samples to be taken from each type of waste stream. Identify sources of each of the types of waste.

Personnel

The following personnel are recommended:

1. 8 personnel for sorting 8 hours per day.
2. 2 personnel for collecting the samples.
3. bulldozer operator (if bulldozer is available).
4. driver for vehicle used to transport samples (as required).
5. 2 supervisors (one at the disposal site and one at the sorting area).

Equipment and Materials

1. Temporary use of warehouse or similar building to perform the sorting process.
2. Front-end loader or bulldozer with a grapple attachment to aid in sample collection. Alternatively, samples can be collected with shovels and containers.
3. Weigh scale capable of reading from 0 to 60 kg, preferably in 0.1-kg increments.
4. Two shovels, preferably wide-mouth shovels.
5. Two rakes.
6. Twenty 120 to 200-liter drums and twenty 60 to 80-liter pails to store segregated materials for weighing.
7. A 1.5 m x 3 m section of 2 cm plywood and two saw horses (or use 55-gallon drums as legs for the table) to be used as sorting table.

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[1] Adapted from *Waste Characterization Study, Ulaanbaatar, Mongolia, Winter-Summer 2002*, Prepared by CalRecovery, Inc. for the World Health Organization, August 2002.

8. A 1 m x 1 m sheet of 2 cm plywood for use as a base on which to set the weigh scale (or a solid, level area in a building).
9. Safety equipment for the sorters including: hard hats (if sorting takes place outdoors)).
10. Drinking water.
11. A minimum of six orange cones (or stakes and tape) to delineate the working area (if sorting takes place outdoors).
12. Vehicle and operator to transport samples from disposal site to sorting area.
13. A supply of 100-liter plastic bags.
14. A 5 m x 5 m tarp to place on the ground under the sorting table.
15. Two dust pans with brushes.
16. Two three-finger claw-type garden tools to assist in opening plastic bags and segregating food residues.
17. A section of 1 m x 1 m metal screen (2.5-cm mesh) to sort the fines.
18. Safety equipment for the sorters including: vests (if sorting takes place outdoors), gloves, fiber masks, and a first aid kit.

The area for collecting the samples should be approximately 20 meters by 10 meters to accommodate the stockpiling of 2 or 3 vehicle loads of waste and continually grab samples. The constant collection of samples is important in order to maintain the sorters busy.

Training

A training session for inexperienced sorters should be carried out at the start of the "official" sorting work. The sorting methodology to be followed should be delineated, stressing the importance of safety and the accuracy of the work. The different components to be sorted should be clearly explained and, preferably, shown to ensure reliable data from the sorting procedure. A practical sorting demonstration performed by the sorters, at least on a small sample portion, should be performed to allow them to fully understand the tasks to be conducted. At all times the supervisors must check that the sorting and related work is properly done, explaining any detected mistakes to all the crew members.

Even if the crew is experienced in sorting or in scavenging, safety precautions and sorting procedures should be reviewed with disposal site and sorting personnel prior to the conduct of the field study.

Sampling Procedures

The following procedure is adopted from the Method for Determining the Composition of Unprocessed Solid Waste promulgated by the American Society for Testing and Materials (ASTM), Method D5231.

Preparation

1. Secure a flat and level area for discharge of the vehicle load. The surface should be swept clean or covered with a clean, durable tarp prior to discharge of the load. It is important to select a location for discharge of designated loads, manual sorting activities, and weighing operations that is flat, level, and away from the normal waste handling and processing areas.
2. Position the scale on a clean, flat, and level surface and adjust the level of the scale if necessary.
3. Check the accuracy and operation of the scale with a known (i.e., reference) weight. All weigh scale equipment should be calibrated according to the manufacturer's instructions. Take appropriate corrective action if the readings are different than the calibration weights.
4. Weigh all empty storage containers and record the tare weights. Storage containers should be weighed each day, or more frequently if necessary, in order to maintain an accurate tare weight.
5. Label the storage containers according to the type of waste that will be placed into them.
6. Arrange for delivery of waste to sorting location. Coordinate selection of the vehicles and routing method to the sorting area with traffic monitors, supervisors, etc., at the facility, as required, in order to assure that selected vehicles will find their way to the location where the sampling will take place. The number of samples for each waste source should correspond to the test plan. The field supervisor should obtain the vehicle information and instruct the driver where to discharge the load. Maintain at least one load in inventory so that the sorting crew will not be idle waiting for material to sort. Weights of 100 to 150 kg for sorting samples of unprocessed solid waste are recommended.

Sorting

1. Vehicles for sampling will be selected at random during each day of the sampling period. Vehicles will be selected which have been assigned to collect waste from specific areas on a given day. The waste will be selected depending upon the economic groups and type of generator.
2. Direct the designated vehicle containing the load of waste to the area secured for discharge of the load and collection of the sorting sample.
3. Direct the vehicle operator to discharge the load onto the relatively flat, clean surface in one continuous pile, i.e., to avoid gaps in the discharged load.
4. Collect any required information from the vehicle operator prior to the vehicle leaving the discharge area and label the discharged load for the purpose of maintaining its identification as other loads are discharged nearby.
5. The bulldozer operator will be asked to collect 100 to 150 kg samples from two different sections of the load and deposit them on the floor/tarp. If a bulldozer is not available, the samples can be collected manually. If samples are collected manually, the laborers can be instructed to collect samples from various sections of the load and deposited on the floor/tarp.
6. Once the samples are on the ground, the sampling crew will divide the mix in half, collect one of the halves. If an oversized item constitutes a large weight percentage of the sorting sample, add a notation on the data sheet and weigh it, if possible.
7. Place the sample to be sorted in a plastic bag or other type of container and label the container (include sample number, origin, truck number). The container will be stored and additional samples

collected. The containers with the samples will be transported to the area where the sorting is to take place.

8. All handling and manipulation of the discharged load, longitudinal sample, and sorting sample should be conducted on previously cleaned surfaces. The sample will be transported to the secured and sheltered manual sorting area. The sample will be placed on a clean surface for sorting. For the convenience of the sorting personnel, the surface should be at table height. The sorting area should be a previously cleaned, flat, and level surface.
9. Position the storage containers around and conveniently close to the sorting sample.
10. Empty all containers such as capped jars, paper bags, and plastic bags of their contents.
11. The sorters will be instructed to remove the various categories of materials (i.e., components and subcomponents) and place them in their respective containers.
    a. In the case of composite items found in the waste, separate the individual materials where practical and place the individual materials into the appropriate storage containers. Where impractical, segregate and classify the composite item according to the following order:
    b. If there are many identical composite items (e.g., plastic-sheathed aluminum electrical conductors), place them into the waste component containers corresponding to the materials present in the item and in the approximate proportions according to the estimated mass fraction of each material in the item.
    c. If there are only a few identical composite items, place them in the storage container corresponding to the material which comprises, on a weight basis, the majority of the items (e.g., place bi-metal beverage cans in the ferrous container).
    d. If composite items represent substantial weight percentages of the sorting sample, a separate category should be established, (e.g., tar and gravel roofing material).
    e. If none of the previous procedures is appropriate, place the item(s) in the "Other/Composite" storage container for the type of component.
12. Once all of the large particles are removed, the sorters will use a shovel, brush, dust pan, and screen to remove the fine material from the residue. The material that passes through the 2.5 cm screen will be considered "fines" and the material that remains on the surface of the screen (the overs) will be further segregated into the various categories. Continue sorting until the maximum particle size of the remaining waste particles is approximately 1 cm.
13. Apportion the remaining particles into the storage containers corresponding to the waste components represented in the remaining mixture. The apportionment should be accomplished by making a visual estimate of the mass fraction of waste components represented in the remaining mixture.
14. Record the gross weights of the storage containers and of any waste items sorted but not stored in containers.
15. Empty the storage containers in a designated area and weigh them again, if appropriate.
16. Re-weighing is important and necessary if the containers become moisture-laden, (e.g., from wet waste).
17. Clean the sorting site and the load discharge area of all waste materials. Maintaining a clean work site at all times will allow easier operations and contribute to the accuracy of the analysis.

Time Period

The recommended sampling period is seven days.

Waste Characterization Study for Metro Manila:

Procedures for Field Work to Determine Bulk Density of Waste Fractions

Raw Mixed Solid Waste

Materials

1. Type of container and required volume: wood, metal, or plastic; 0.5 to 1 cubic meter (500 to 1000 liters)
2. Mechanical or electronic scale capable of measuring up to 500 kg with 0.5 or 1 kg precision.
3. Shovels and/or small front end loader to load waste into container.

Procedures

1. Weigh the empty container to determine its tare weight.
2. Select a representative sample of 2 to 4 cubic meters from the load of waste. Cone and quarter the sample, using shovels and/or front end loader, down to a sub-sample of 0.5 to 1 cubic meter (500 to 1000 liter) of waste that will subsequently be loaded into the tared container. Retain the residual sample material pending successful completion of the procedures on the initial sub-sample.
3. Fill the container with the sub-sample of material to a level that is slightly above the rim of the container (to allow for settlement of the material). Do not compact (pack) the waste but try to minimize void space caused by oversized objects (or note on the data sheet and remove oversized objects from the sub-sample if encountered). Shake the container or drop one edge of the container (a drop of about 3 to 5 cm) three times to slightly settle the material in the container; if necessary place more waste material in the container to bring the contents level with the rim.
4. Weigh the filled container to determine its gross weight.
5. Calculate the net weight of the sub-sample by subtracting the tare weight from the gross weight.
6. Calculate the bulk density of the sub-sample by dividing the gross weight of the sub-sample by the volume of the container.
7. Empty the sub-sample from the container and re-weigh the empty container to determine the container tare weight for the next sub-sample. If an error is encountered during the procedure, select another sub-sample from the residual sample material and repeat the process.

Segregated Components of Solid Waste

Materials

1. Types of container and required volume: wood, metal, or plastic; 0.1 to 0.5 cubic meter (100 to 500 liters). Containers with a smaller capacity (volume) can be used to determine the bulk density of small-sized components such as glass, metal, and plastic containers; dirt/ash, or food waste. Larger-volume containers may be required for large objects/materials, such as cardboard or wood waste, etc.)
2. Mechanical or electronic scale capable of measuring up to 500 kg with 0.5 or 1 kg precision.
3. Shovels and/or small front end loader to load waste into container.

Procedures

1. Weigh the empty container to determine its tare weight.
2. From a representative sample volume of 0.25 to 0.5 cubic meters (250 to 500 liters) of the segregated component of interest. Cone and quarter the sample, using shovels and/or front end loader, down to a sub-sample of 0.13 to 0.25 cubic meter (130 to 250 liters) of materials that will subsequently be loaded into the tared container. Retain the residual materials pending successful completion of the procedures on the initial sub-sample.
3. Fill the container with the sub-sample of material to a level that is slightly above the rim of the container (to allow for settlement of the material). Do not pack the waste but try to minimize void space caused by oversized objects (or note on data sheet and remove oversize objects from the sub-sample if encountered). Shake the container or drop one edge of the container (a drop of about 3 to 5 cm) three times to slightly settle the material in the container; if necessary place more waste material in the container to bring the contents level with the rim.
4. Weigh the filled container to determine its gross weight.
5. Calculate the net weight of the sub-sample by subtracting the tare weight from the gross weight.
6. Calculate the bulk density of the sub-sample by dividing the gross weight of the sub-sample by the volume of the container.
7. Empty the sub-sample from the container and re-weigh the empty container to determine the container tare weight for the next sub-sample. If an error is encountered during the procedure, select another sub-sample from the residual sample material and repeat the process.

Waste Characterization Study for Metro Manila:

Procedures for Field Work to Determine Moisture Content of Waste Fractions

Air-dry Moisture Content

Air drying of samples is performed outdoors in an area that is or can be protected from wind and rain. Direct sun light facilitates the drying process.

The sample can be air-dried on a clean, level surface or in drying trays. If drying trays are used, they should be of metal or plastic because these construction materials will not absorb water. Additionally, if drying trays are used their tare weight must be determined.

Materials

1. Weigh scale of capacity of about 100 kg and a precision of 0.1 kg.

Procedures

1. Ideally, the air-dry measurements should be performed on fresh waste as soon as possible. If there will be delays in the performance of the drying procedures, the sample material should be double-bagged in plastic bags. The time elapsed between sampling and commencement of the drying procedures should be noted on the data collection forms.
2. For determinations of air-dry moisture content, use the material from the bulk density determinations; or alternatively, cone and quarter 0.25 to 0.5 cubic meters (250 to 500 liters) of material, using shovels and/or front end loader, down to a sub-sample of 0.13 to 0.25 cubic meters (130 to 250 liters). This material will subsequently be spread on the clean surface or placed in a tared tray for the air-drying process.
3. Weigh the sub-sample to determine its wet weight if the sample is to be placed on a clean surface; or measure the total weight of the sub-sample and drying tray and the tare weight of the drying tray if one is used. Set the sub-sample out to air-dry. If the sub-sample is very wet (e.g., food waste or paper), care should be taken to spread the material out in a thin layer, e.g., no more than about 7 cm, so that it will dry quickly. Stirring wet material gently at intervals during the drying process (carefully making sure not to lose sample material) facilitates the drying process.
4. Allow the material to dry until it reaches a constant weight as evidence by no additional loss of weight through repeated weighings. The material is approximately “air-dry” if one can observe air-borne dust particles when a handful of the material is picked up and dropped a few centimeters. However, constant weight is only accurately determined using a weigh scale. The air-drying process can take several days depending on the moisture content of the waste and meteorological conditions.
5. Record the meteorological conditions (temperature, rainfall, humidity and cloud cover) on the data sheets.
6. Calculate the moisture loss (weight) from the sub-sample by subtracting the tare weight (if any) from the initial (i.e., wet) weight of the sub-sample.
7. Calculate the air-dry moisture content by dividing the moisture loss (weight) by the wet weight of the sample and multiplying by 100.

Oven-dry Moisture Content

The oven-dry determinations should be performed on fresh waste as soon as possible.

The sample should be dried in an oven of sufficient volume to easily accommodate the quantity of material. The oven must be equipped with a system to ventilate the oven air space for purposes of moisture removal and with a system to measure and control the oven temperature.

Materials

1. Weigh scale of capacity of about 100 kg and a precision of 0.1 kg.
2. Drying oven with temperature monitoring and control, and ventilation system.

Procedures

1. If there will be delays in the performance of the drying procedures, the sample material should be double-bagged in plastic bags. The time elapsed between sampling and commencement of the drying procedures should be noted on the data collection forms.
2. For determinations of oven-dry moisture content, use the material from the bulk density determinations; from air-dried samples, or alternatively, cone and quarter 0.25 to 0.5 cubic meters (250 to 500 l) of material, using shovels and/or front end loader, down to a sub-sample of 0.13 to 0.25 cubic meters (100 to 250 liters).
3. Weigh the sub-sample to determine its wet weight (or air-dry weight). Place the sub-sample in the oven. The oven temperature should be within the range of 100 to 105 degrees C. If the sub-sample is very wet (e.g., food waste or paper), care should be taken to spread the material out in a thin layer, e.g., no more than about 2 cm, so that it will dry quickly. Stirring wet material gently at intervals during the drying process (being carefully making sure not to lose sample material) facilitates the drying process.
4. Allow the material to dry until it reaches constant weight as evidence by no additional loss of weight after repeated weighings.
5. Calculate the moisture loss (weight) from the sub-sample by subtracting the tare weight (if any) from the initial (i.e., wet) weight of the sub-sample.
6. Calculate the percent moisture content by dividing the moisture loss by the wet weight of the sample and multiplying by 100. This is the oven-dry moisture content if the initial sub-sample was not air dried prior to oven drying. If an air-dried sub-sample was oven dried, then the percent oven-dry moisture content of the sub-sample is the sum of the moisture losses from air-drying and oven-drying multiplied by 100 and divided by the wet weight of the sample prior to air drying (For example, if the wet weight of the sub-sample prior to air-drying is 50 kg and 5 kg and 10 kg are the moisture losses, respectively, due to air-drying and subsequent oven drying, then the percent oven-dry moisture content is (15 x 100)/50, or 30%).

Waste Characterization Study for Metro Manila:

Safety Procedures and Guidelines

1. All personnel will conduct themselves in a careful and proper manner at all times.
2. Being under the influence of intoxicants, narcotics, or controlled substances is prohibited. Pregnant women should not be allowed to participate in these activities.
3. Smoking, drinking, or eating is only allowed in designated area. Avoid any practice that may increase the probability of hand-to-mouth transfer and ingestion of waste materials. Prescription drugs should not be taken where the potential for contact with toxic substances exists.
4. Proper care must be taken to avoid contact with hazardous or contaminated or potentially contaminated substances. Do not stray from designated work area. Do not walk through puddles. Do not kneel on the ground. Do not lean or sit on equipment, drums, containers, vehicles, or on the ground.
5. Stay within the marked off or the designated work site. Permission must be given by field supervisor before leaving the site.
6. All injuries (no matter how minor) must be reported directly to the field supervisor. Depending on the severity of the injury, first aid will be administered and/or transportation to the nearest medical facility will be provided. A list will be maintained by the field supervisor containing all relevant medical information regarding emergency procedures.
7. Always use sampling, handling, and container-opening techniques demonstrated at the safety and orientation meeting.
8. Always pick waste material from the top of the pile. Never dig into the pile with your hands.
9. No personnel will be admitted into the work facility without the proper safety clearance and understanding of all safety procedures. All personnel must comply with the established procedures. Anyone not in compliance with all stated safety procedures will be dismissed from the area immediately. Report all suspicious or potentially dangerous waste (including sharps and hazardous wastes) to the crew supervisor prior to handling or sorting. The crew supervisor is responsible for the safe handling of potentially dangerous materials and for the handling of household hazardous wastes and their classification.
10. Tetanus immunization must be current.
11. The following work attire is mandatory: long sleeve shirt; full length pants; strong shoes or boots with puncture resistant soles; gloves; long hair must be worn "up" or tied back; and no loose or hanging clothes or garments.
12. The following attire is strongly recommended and may be required depending on site conditions: eye protection (sunglasses, glasses, or goggles); dust masks; hard hats; gloves, and safety vests.
13. The following equipment is available to sorting personnel: gloves; dust masks; and a first aid kit.

Metro Manila, Philippines

Waste Composition Data Sheet

Sample #		**Date:**	**Surveyor** (initials)**:**
City:		**Source:**	
Vehicle Type:		**Vehicle #:**	

	CATEGORY	**Gross Weight**	**Tare Weight**		**CATEGORY**	**Gross Weight**	**Tare Weight**
Paper	Cardboard/Paper Bags			**Other Organic**	Kitchen/Food Waste		
	Newspaper				Yard/Landscape		
	Office Paper/High Grade				Wood		
	Mixed Paper				Textiles		
					Leather		
Glass	Bottles and Containers				Tires		
	Other/Composite				Rubber		
					Animal Remains (dead animals)		
Metal	Tin/Steel Cans				Other/Composite		
	Other Ferrous				Fines		
	Aluminum Cans						
	Other Non-Ferrous						
	Other/Composite			**Other Inorganic**	Rock/Concrete/Brick		
					Ceramic/Stone		
Plastic	PET				Asphalt		
	HDPE				Soil/Sand		
	Film Plastic/LDPE				Ash		
	Diapers				Other/Composite		
	Other/Composite				Fines		
				Hazardous	Paint		
					Oil/Oil Filters		
					Small Batteries		
					Other		
				Special	Medical Waste (Syringes, sharps, gauze, etc.)		
					Electronic appliances		

Comments:

(continue on reverse side if needed)

Vehicle Count Data Sheet[a]

Metro Manila Solid Waste Management Project

Date ____________________ LGU ____________________
Site ____________________ Surveyor ____________________

Vehicle No.	Type of Load[b]	Vehicle Capacity (cu m)	Size of Load[c]		
			Length (m)	Width (m)	Depth (m)

a) Vehicle Count Data Sheet can be used to determine the quantity of waste disposed when weigh scales are not available. All vehicle loads from the LGU should be recorded.
b) The type of load is based on the source of the material, e.g., low-income residential (res-low), medium-income residential (res-med), high-income residential (res-high), industrial (ind), commercial (com), or market (mrkt).
c) If the vehicle capacity (cu m) is not known, the size of the load should be measured. The load size is the height, length, and depth of the material inside the vehicle.

ANNEX 2

Appendix A of IRR to RA 9003

General Guidelines/Procedures in Conducting Waste Characterization Survey/Study

When conducting waste characterization survey/study, the following guidelines shall apply unless modified by the Commission.

1) Waste composition – when analyzing solid waste composition, it is necessary to obtain the following information: total quantities of waste, bulk (density), moisture content, and composition (physical and chemical)

   Waste may be described as:
   Readily biodegradable – garbage, paper, wood, leaves, trees
   Readily combustible – textile, plastics, rubber, leather
   Mostly inert -- metals, glass, dirt, ceramics, ash and stones

2) Sampling of solid waste – in order to obtain representative sample the following steps should be undertaken:
   a. Subdivide the area into sub-areas each representing a certain economic status;
   b. Further subdivide the areas into residential, commercial, market, light industrial, hospital, etc. in case of municipal waste; and
   c. Collect a representative sample for each sub-area.

   To adequately determine the composition, the generalized field procedure should include the following processes:
   a. As soon as the study area is selected and subdivided, a marked vehicle collects refuse from each unit area. Each vehicle must be fully loaded and brought into the sample processing site.
   b. The load is placed on a clean, flat surface, mixed thoroughly, then formed into a square about 30 cm high.
   c. This is subdivided into quarters, two opposite quarters are discarded and the two remaining quarters are thoroughly mixed again, formed into a square, and again quartered. This continues until the desired refuse quantity is obtained (usually about one cubic meter).

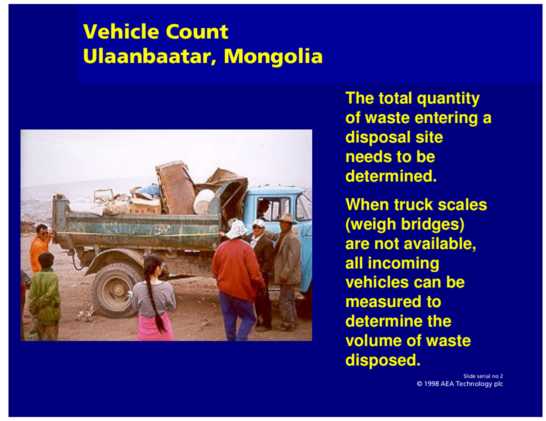
3) Moisture content determination – when determining moisture content of waste, the following steps shall be undertaken:
   a. Weigh the sample
   b. Separate the components
   c. Weigh each component as is
   d. Oven dry the component at about 75 degrees Celsius for 24 hours to minimize the possibility of components sticking to each other; and
   e. Weigh each component again.

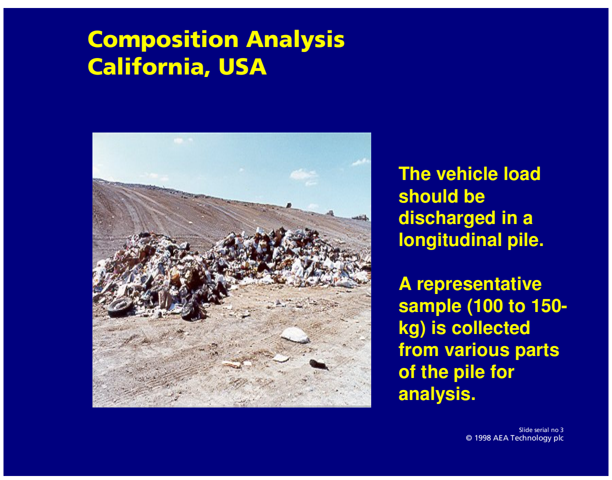
4) Sorting – when sorting the sample, the following guidelines shall apply:
   a. Sort the sample into major components
   b. Weigh each component again

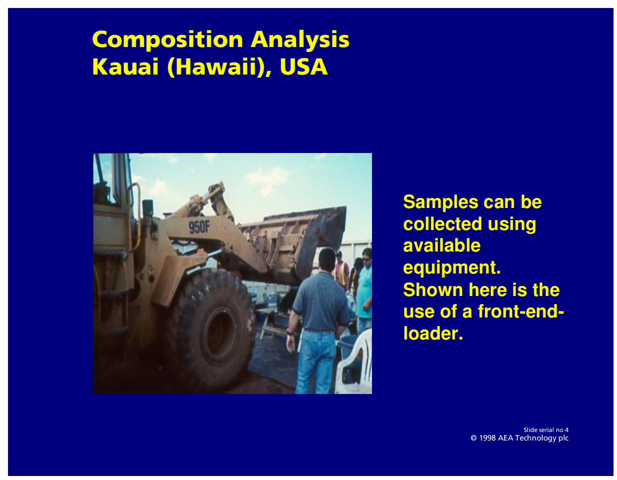
5) Statistical treatment of data – Data obtained is processed to determine the following:
   a. Seasonal means
   b. Differences of generation between economic groups
   c. Differences in quantity and quality between seasons
   d. Others depending on objective of study such as NPK values.

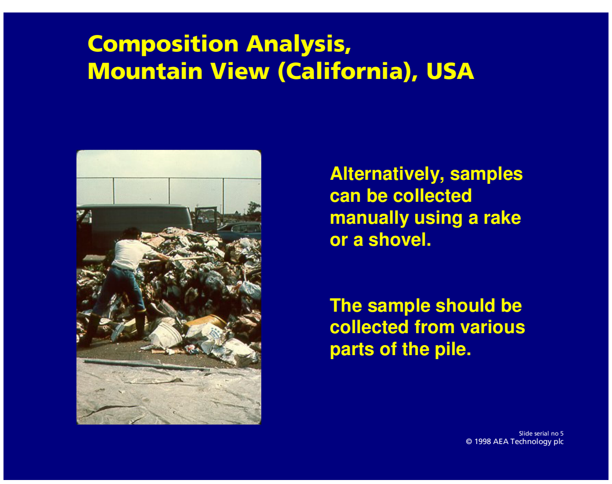
ANNEX 3

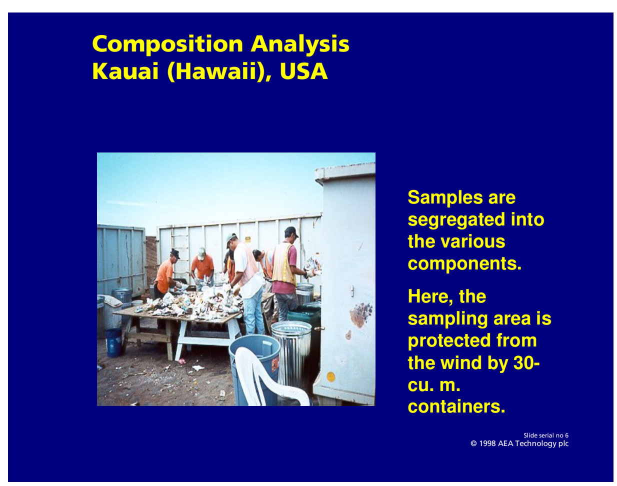
PRESENTATION







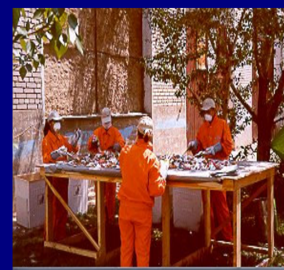




Composition Analysis
Buenos Aires, Argentina

Sorting should take place on an elevated surface such as a table. The height should be determined for the comfort of the workers.

Composition Analysis
Ulaanbaatar, Mongolia



Sorters are provided with safety equipment, including gloves, masks, and uniforms (if available).

Composition Analysis
Ulaanbaatar, Mongolia

Once the large items are segregated, it is recommend that screens be used to separate the fines from the remainder of the sample.

Composition Analysis
Curitiba, Brazil

If rigid plastic or metallic containers are not available, it is possible to use plastic bags for temporarily storing the segregated materials.

Composition Analysis
California, USA

After the entire sample has been segregated into its components, the containers are weighed, and the data recorded.

Note shade and water cooler.

Composition Analysis
American Samoa

Containers with sorted materials should be weighed on a flat surface for the scale to give accurate readings. Shown is a flat electronic scale on the pallet.


Composition Analysis
American Samoa
Any type of storage container can be used as long as it is clean.
Containers with small quantities of materials are weighed using a small scale.
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Additional Sorting
Mountain View (California), USA
Although sorting on the ground is not recommended, additional sorting can be done in this manner for certain components of the waste stream.
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Additional Sorting
Los Angeles (California), USA
In some situations, waste management planners may be interested in determining the composition of specific components such as glass containers.
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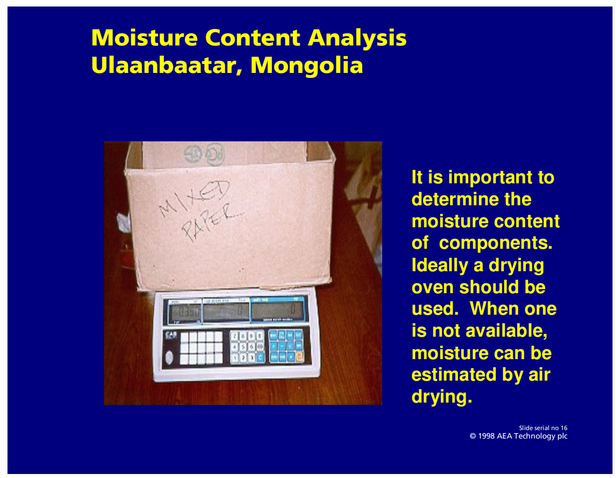
Moisture Content Analysis
Ulaanbaatar, Mongolia
It is important to determine the moisture content of components. Ideally a drying oven should be used. When one is not available, moisture can be estimated by air drying.
Slide serial no 16
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