

Weight-Based Disposal Research Project

Final Report

December 25, 2001

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EXECUTIVE SUMMARY

In 2000 and 2001, the Alameda County Waste Management Authority (ACWMA) gathered weight data on waste disposed from over 1,500 businesses comprising four commercial waste collection routes in Oakland and Hayward. In addition, the ACWMA commissioned a waste characterization study that included analysis of the composition of waste from 260 of the businesses for which weight information was collected. This report provides a summary of the study, reports on our statistical analysis of the data, and draws conclusions regarding the data's usefulness and applicability for diversion program planning. The primary objective of this report is to apply the findings of the weight-based data as broadly as possible while understanding, and not exceeding, the limitations of the data. The goal of the project is to determine whether subsets of the data for specific industry/business groups can be used to guide the development of targeted diversion programs.

Initial business and weight data verification, correction, and organization resulted in over 12,000 valid weight records for over 1,500 businesses representing 83 Standard Industrial Classification business groupings. Initially, we grouped businesses into the 38 categories used by the California Integrated Waste Management Board in their Statewide Waste Characterization Study. Statistical analysis, however, identified some groups where data were not well distributed. Manipulation of the groupings resulted in the 48 business groups used throughout this study. These are further grouped into four larger categories: Manufacturing; Retail and Wholesale; Service; and, Miscellaneous Businesses.

Mean weekly weight and mean waste density were calculated and are summarized in Figures ES-1 and ES-2. In general, where there is a close similarity of the mean weights or densities between several business groups, there is no statistical difference between these groups. Figure ES-1 indicates that there are several business groups within each of the four major business categories that have distinctly higher or lower mean weights.

Waste and business attribute data are analyzed in the report to indicate the degree to which they may be used for extrapolation or general application (Table ES-1). Waste data include weekly mean waste weight and density; business attributes include number of employees and gross sales. We determined the consistency or efficacy of the data through the calculation of statistical "confidence." Strength of confidence was determined through examination of data variability in proportion to the number of observations and average values. Where variability in the data is relatively low, there is greater confidence that the data is representative of that business group. We have strong confidence in the mean weekly weight calculated for twelve business groups; moderate confidence in the mean weekly weight for 26 groups, and weak confidence in the

mean weekly weight for ten groups (the mean weekly weight derived for these ten groups should be used with little confidence).

Further analysis of the waste weight and business attributes included determination of the strength of relationships between waste data and business attributes (Table ES-1). Correlation coefficients were calculated for each of four possible relationships: weight vs number of employees; weight vs gross sales; density vs number of employees; and, density vs gross sales. 23 of the 48 business groups showed a strong or moderate positive correlation between waste weight and number of employees; in other words, for these groups, waste weight can be predicted with strong to moderate confidence based on the number of employees. Only thirteen of the 48 showed strong or moderate correlations between waste weight and gross sales, and fewer still showed strong or moderate correlations between waste density and business attributes. Very few groups showed inverse relationships between waste and business data (e.g., when the number of employees goes up, waste weight goes down). A few businesses, however, did exhibit moderate negative correlations between waste density and business attributes.

Based on the mean weekly weight for each of the 48 business groups, and the number of businesses within each of these groups in all of Alameda County, we were able to predict the total amount of waste produced in the County each year by each business group (Table ES-2). The yellow shading in Table ES-2 indicates the six business groups that we predict contribute at least five percent of the total disposed commercial waste in the County: Miscellaneous Construction; Retail Restaurants; Business Services; Engineering and Accounting Services; Medical Services; and Real Estate Services. Please note that we calculated strong or moderate confidence in the mean weekly weight for all six of these business groups (Table ES-1). Table ES-2 also indicates by blue shading the nine other business groups that we predict contribute between two and five percent of the County's disposed commercial waste. We calculated strong or moderate confidence in the mean weekly weight for seven of these nine groups (all but Miscellaneous Agriculture/Fisheries and Personal Services).

Based on mean weekly weight and the number of employees in each business group (as reported in a countywide business database), we were able to calculate the average per employee waste generation rate for each of the 48 business groups. These are shown in Table ES-2 and in Figures ES-3 and ES-4. There is considerable variability in the per employee generation rate between business groups, from a low of less than 500 pounds per year to a high of nearly 7,000 pounds. This represents a range of difference of more than an order of magnitude. It should be recalled, however, that these figures are only reliable to the extent of the strength of the mean weekly waste disposal figure calculated for each of the business groups. The major business category with the lowest per employee figure is manufacturing, at just over 1,000 pounds per employee per year, while Retail/Wholesale had the highest figure, at just over 2,500 pounds per year (Figure ES-3).

In addition to the weight data, we analyzed waste composition data for 260 businesses included in the weight-based data collection effort to determine the typical waste composition of each of the 48 business groups. The analysis shows the differences in composition between business groups, and indicates where the best opportunities remain for diversion program development. For

several of the business groups, however, too few samples were collected to produce reliable statistical results. The average waste composition for the six business groups that represent the highest amount of disposed commercial waste in the County (see Table ES-2) are shown in graphic format in Figures ES 5a – 5f. Note the large amounts of mixed paper, other paper, and food waste in most of the composition charts. Film plastics and other plastics are also significant fractions of the waste of these business types. Please note that not all of these waste characterizations are statistically reliable, due to small sample sizes.

We performed statistical analysis of waste weight for each of the weekly collections and for each of the collection routes to determine whether the time of year or route location influenced waste attributes. There is no apparent relationship between the time of year and the amount of waste collected. There are, however, significant differences between waste weight, business attributes, and waste composition for the four collection routes. Two routes tended to be mostly similar (273 & 274), but the other two routes (271 & 295) were significantly distinct from each other and significantly different from the other two as well. It is likely that differences in waste weight and composition are due primarily to differences in business distribution and business attributes between the four routes. This exemplifies the need to use adequate knowledge of business types and attributes when extrapolating waste information from one area to another – random extrapolation of waste data will likely result in erroneous predictions or assumptions of waste characteristics.

We used waste composition data, mean weekly disposed weight data, and information on the kinds of businesses located in each of Alameda County's jurisdictions to develop profiles of commercial waste for each jurisdiction. This information is preliminary and requires crosschecking with other sources, but it can be a useful planning tool for developing commercial diversion programs throughout the County.

TABLE ES-1
SUMMARY OF STRENGTH OF STATISTICS

BUSINESS GROUP	MEAN WEIGHT	MEAN DENSITY	NUMBER OF EMPLOYEES	GROSS SALES	NET WT vs. NUMBER OF EMPLOYEES	NET WT vs. GROSS SALES	DENSITY vs. NUMBER OF EMPLOYEES	DENSITY vs. GROSS SALES
MfrChem	Weak	Moderate	Weak	Moderate	Weak	Weak	Weak	Weak
MfrElect	Weak	Moderate	Moderate	Moderate	Strong	Strong	Weak	Moderate
MfrFood	Moderate	Moderate	Moderate	Weak	Weak	Moderate	Weak	Weak
MfrFurn	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
MfrInstrMisc	Moderate	Weak	Moderate	Weak	Strong	Moderate	Weak	Weak
MfrMach	Moderate	Strong	Strong	Strong	Moderate	Weak	Weak	Weak
MfrMetal	Strong	Strong	Strong	Strong	Moderate	Weak	Weak	Weak
MfrPaper	Moderate	Moderate	Strong	Strong	Moderate	Moderate	Moderate	Moderate
MfrPrint	Strong	Strong	Moderate	Moderate	Weak	Weak	Weak	Weak
MfrRubber	Moderate	Moderate	Moderate	Moderate	Weak	Weak	Weak	Moderate
MfrStone	Moderate	Moderate	Moderate	Moderate	Weak	Weak	Weak	Weak
MfrTextl	Moderate	Moderate	Strong	Moderate	Moderate	Moderate	Weak	Weak
MfrTrans	Weak	Weak	Strong	Moderate	Strong	Weak	Weak	Strong
MfrWood	Weak	Moderate	Moderate	Moderate	Moderate	Weak	Moderate	Moderate
Misc Agfish	Weak	Moderate	Moderate	Strong	Strong	Weak	Moderate	Weak
Misc AmuseRecPks	Moderate	Moderate	Moderate	Strong	Weak	Weak	Weak	Moderate
Misc Commun	Moderate	Moderate	Moderate	Weak	Strong	Moderate	Weak	Weak
Misc Construc	Strong	Strong	Strong	Strong	Weak	Weak	Weak	Weak
Misc Education	Moderate	Strong	Weak	Weak	Weak	Weak	Moderate	Moderate
Misc MovieMuseum	Moderate	Moderate	Weak	Weak	Moderate	Weak	Weak	Weak
Misc PubAdmin	Moderate	Strong	Weak	Moderate	Weak	Weak	Weak	Weak
Misc TransAir	Weak	Moderate	Weak	Weak	Weak	Strong	Weak	Weak
Misc TransOth	Strong	Strong	Moderate	Moderate	Weak	Weak	Weak	Weak
Misc Trucking	Strong	Strong	Strong	Strong	Weak	Weak	Weak	Weak
Misc Utils	Moderate	Moderate	Weak	Weak	Weak	Moderate	Weak	Weak
RetAppar	Weak	Weak	Strong	Moderate	Weak	Weak	Weak	Weak
RetAuto	Strong	Moderate	Strong	Moderate	Moderate	Weak	Weak	Weak
RetBldg	Moderate	Moderate	Moderate	Weak	Weak	Weak	Moderate	Moderate
RetFood	Moderate	Moderate	Moderate	Moderate	Weak	Weak	Weak	Weak
RetFurn	Moderate	Strong	Moderate	Moderate	Strong	Moderate	Weak	Weak
RetMisc	Moderate	Strong	Strong	Weak	Weak	Weak	Weak	Weak
RetRestr	Strong	Strong	Strong	Weak	Strong	Weak	Weak	Weak
RWhslDur	Strong	Strong	Strong	Strong	Weak	Weak	Weak	Weak
RWhslFood	Moderate	Strong	Strong	Strong	Weak	Weak	Weak	Weak
RWhslNondur	Strong	Strong	Strong	Moderate	Weak	Weak	Weak	Weak
RWhslStone	Weak	Weak	Strong	Weak	Strong	Weak	Strong	Weak
SvcAutoRpr	Strong	Strong	Strong	Moderate	Weak	Weak	Weak	Weak
SvcBiz	Strong	Strong	Moderate	Moderate	Weak	Weak	Weak	Weak
SvcEngAcct	Moderate	Moderate	Moderate	Moderate	Weak	Weak	Weak	Weak
SvcFinAvg	Moderate	Moderate	Moderate	Weak	Strong	Strong	Weak	Weak
SvcFinLite	Moderate	Weak	Weak	Weak	Moderate	Moderate	Weak	Weak
SvcHotel	Moderate	Weak	Strong	Weak	Weak	Weak	Weak	Weak
SvcMedic	Moderate	Moderate	Strong	Weak	Strong	Weak	Moderate	Weak
SvcMemberOrgs	Moderate	Strong	Moderate	Moderate	Weak	Weak	Weak	Weak
SvcMisc	Weak	Weak	Strong	Weak	Strong	Weak	Strong	Weak
SvcPers	Weak	Moderate	Weak	Weak	Strong	Weak	Weak	Weak
SvcRealEst	Strong	Strong	Moderate	Weak	Moderate	Weak	Weak	Weak
SvcSocial	Moderate	Strong	Moderate	Moderate	Strong	Moderate	Weak	Weak

TABLE ES-2
COMMERCIAL WASTE DISPOSAL IN ALAMEDA COUNTY
By Business Groups Used in the Study

Business Group	Number of Businesses	Disposed Waste: Tons per Year/1/	Percentage of Total Waste	Number of Employees	Lbs/ Employee/Y ear
Manufacturing	4,178	55,255	7.6%	109,572	1,009
MfrChem	159	1,597	0.2%	6,323	505
MfrElect	442	8,263	1.1%	18,518	892
MfrFood	260	7,755	1.1%	10,203	1,520
MfrFurn	120	2,192	0.3%	1,924	2,278
MfrInstrMisc	558	4,756	0.7%	9,983	953
MfrMach	677	7,026	1.0%	25,522	551
MfrMetal	437	4,864	0.7%	9,388	1,036
MfrPaper	78	1,000	0.1%	2,353	850
MfrPrint	754	7,932	1.1%	7,609	2,085
MfrRubber	117	1,816	0.2%	3,674	989
MfrStone	146	2,163	0.3%	3,403	1,271
MfrTextl	211	1,845	0.3%	2,806	1,315
MfrTrans	94	1,549	0.2%	7,021	441
MfrWood	125	2,497	0.3%	845	5,910
Miscellaneous	9,341	143,963	19.8%	162,404	1,773
Misc Agfish	755	18,634	2.6%	5,708	6,529
Misc AmuseRecPks	855	12,076	1.7%	8,017	3,013
Misc Commun	444	4,224	0.6%	8,278	1,021
Misc Construc	3,640	54,650	7.5%	33,344	3,278
Misc Education	1,040	21,814	3.0%	45,474	959
Misc MovieMuseum	426	3,413	0.5%	3,395	2,011
Misc PubAdmin	387	5,321	0.7%	24,158	441
Misc TransAir	74	1,698	0.2%	7,121	477
Misc TransOth	750	11,360	1.6%	9,652	2,354
Misc Trucking	832	9,311	1.3%	11,618	1,603
Misc Utils	138	1,462	0.2%	5,639	518
Retail/Wholesale	15,059	184,766	25.4%	145,953	2,532
RetAppar	821	7,178	1.0%	6,505	2,207
RetAuto	832	7,851	1.1%	8,787	1,787
RetBldg	347	5,176	0.7%	3,872	2,673
RetFood	1,237	13,020	1.8%	15,171	1,716
RetFurn	1,279	20,324	2.8%	8,226	4,942
RetMisc	3,489	28,345	3.9%	19,417	2,920
RetRestr	2,759	54,848	7.5%	26,751	4,101
RWwhslDur	2,873	27,527	3.8%	34,491	1,596
RWwhslFood	795	12,917	1.8%	15,084	1,713
RWwhslNondur	569	6,125	0.8%	7,229	1,694
RWwhslStone	58	1,456	0.2%	420	6,932
Services	26,696	314,881	43.2%	282,820	2,227
SvcAutoRpr	1,680	20,190	2.8%	8,494	4,754
SvcBiz	5,928	67,984	9.3%	68,765	1,977
SvcEngAcct	4,080	50,496	6.9%	60,594	1,667
SvcFinAvg	951	10,324	1.4%	22,082	935
SvcFinLite	954	5,607	0.8%	7,574	1,481
SvcHotel	270	5,917	0.8%	5,729	2,066
SvcMedic	3,552	53,051	7.3%	53,077	1,999
SvcMemberOrgs	1,973	17,277	2.4%	16,047	2,153
SvcMisc	273	4,611	0.6%	2,067	4,461
SvcPers	3,033	16,544	2.3%	10,384	3,187
SvcRealEst	2,337	43,100	5.9%	12,500	6,896
SvcSocial	1,665	19,778	2.7%	15,507	2,551
Other	2,253	29,570	4.1%	17,193	3,440
All Groups	57,527	728,434	100%	717,942	2,029

Key: Between 2% and 5% of total County waste
 Over 5% of total County waste

Notes: /1/ Calculated by multiplying mean weekly disposed weight by number of businesses in group and number of weeks in one year.

**FIGURE ES-1
MEAN WASTE WEIGHT BY BUSINESS TYPE**

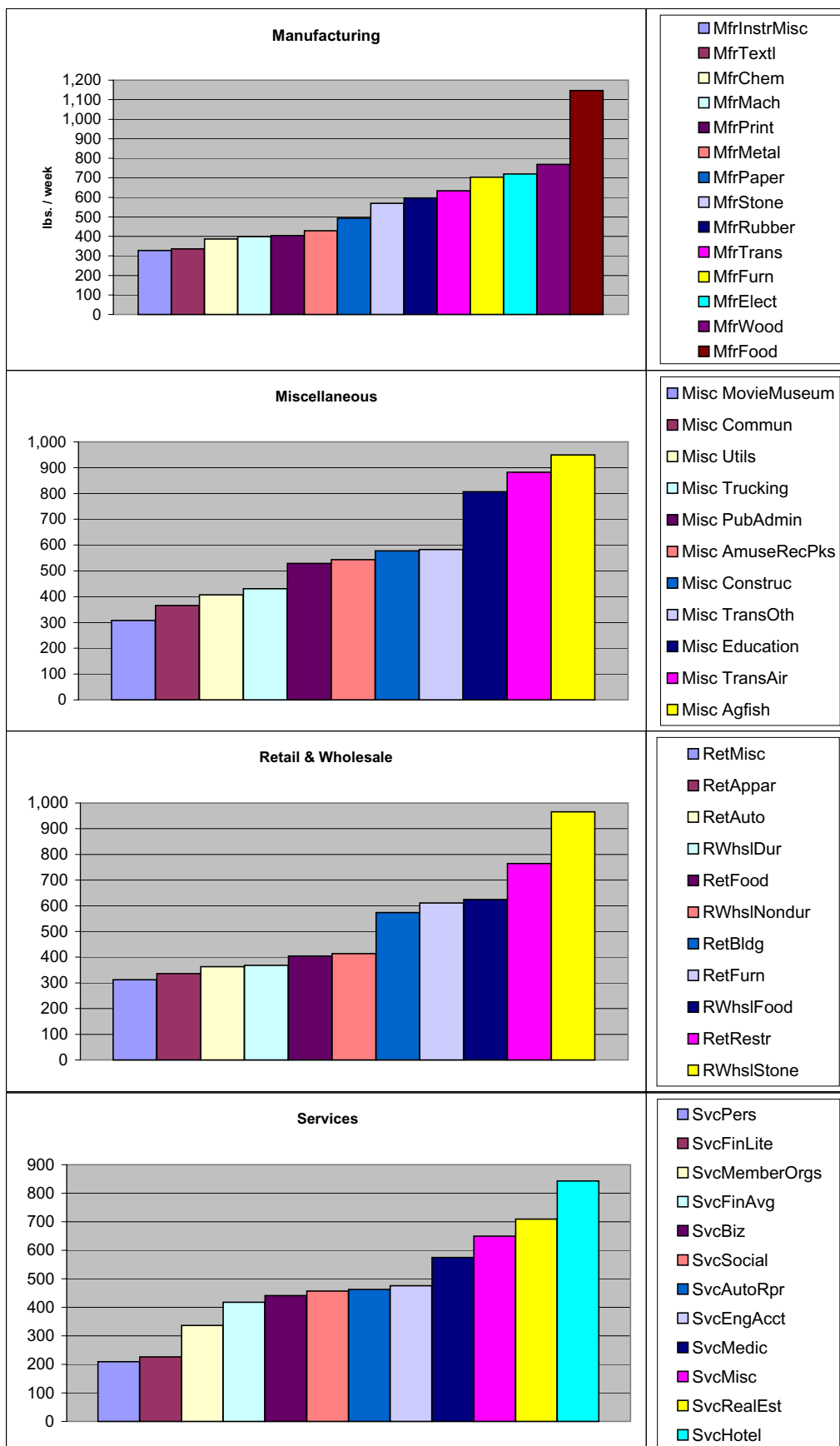


FIGURE ES-2
MEAN WASTE DENSITY BY BUSINESS TYPE

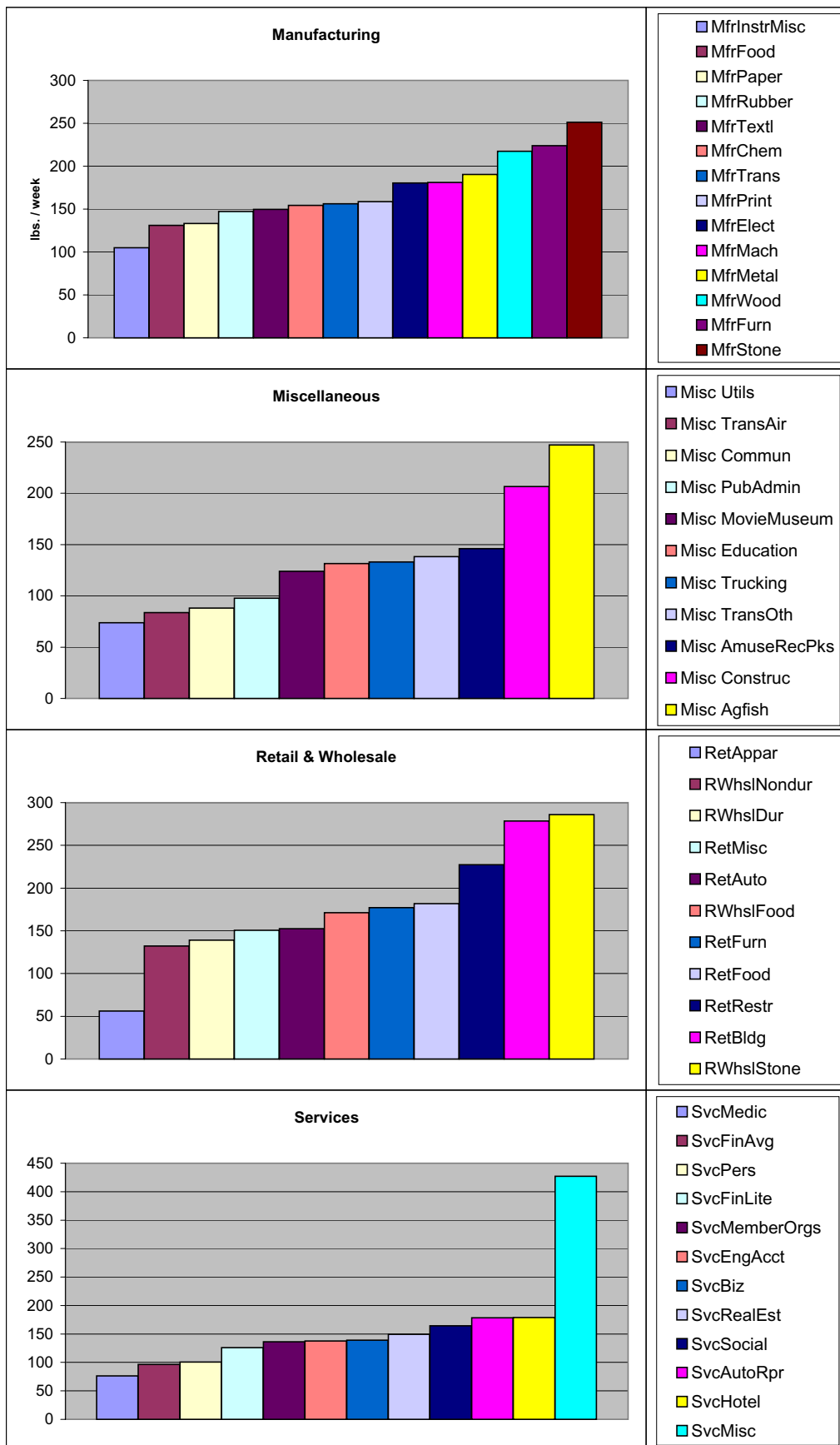


Figure ES-3: Waste Generation per Employee, By Business Group

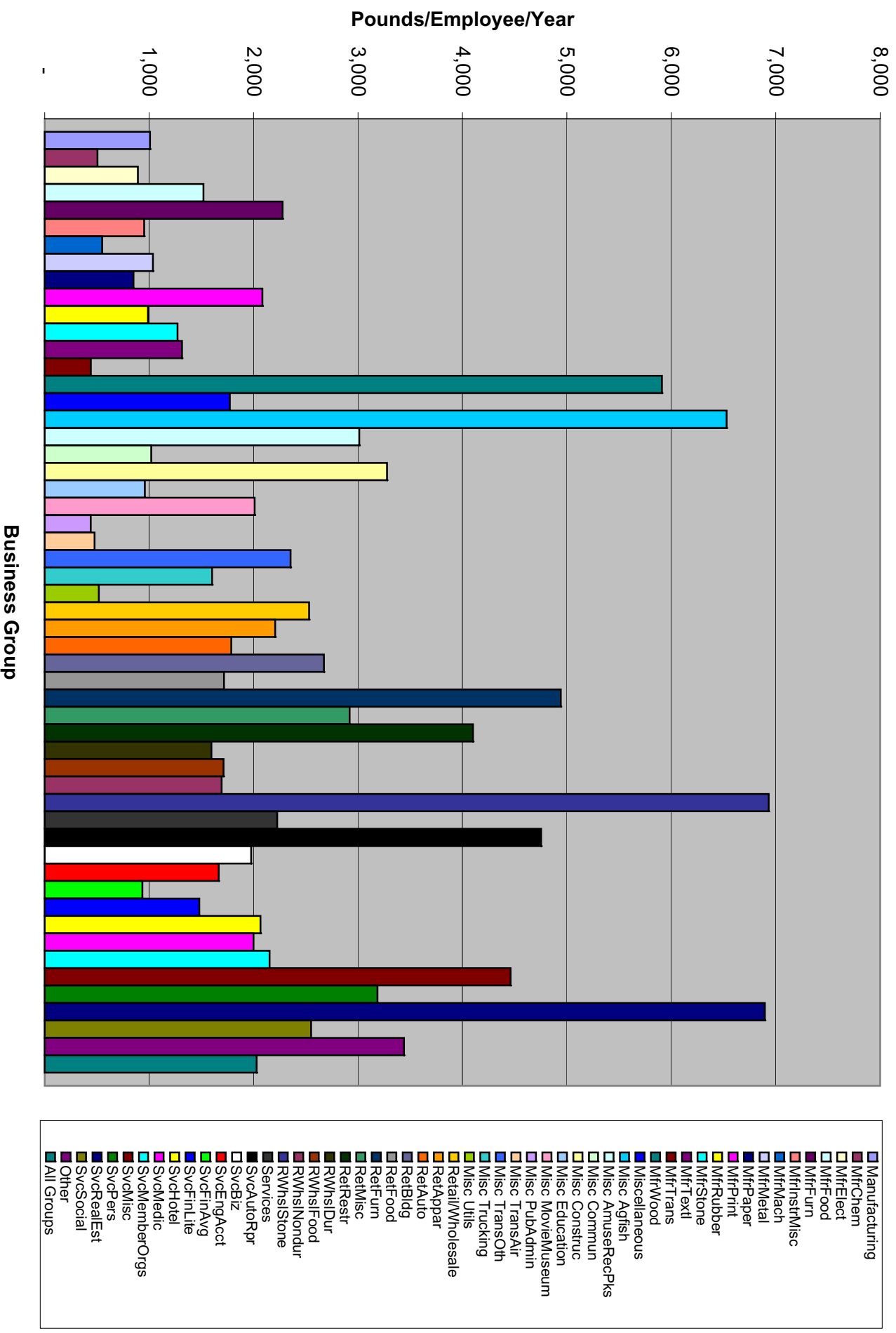


Figure ES-4: Waste Generation per Employee
In Ascending Order

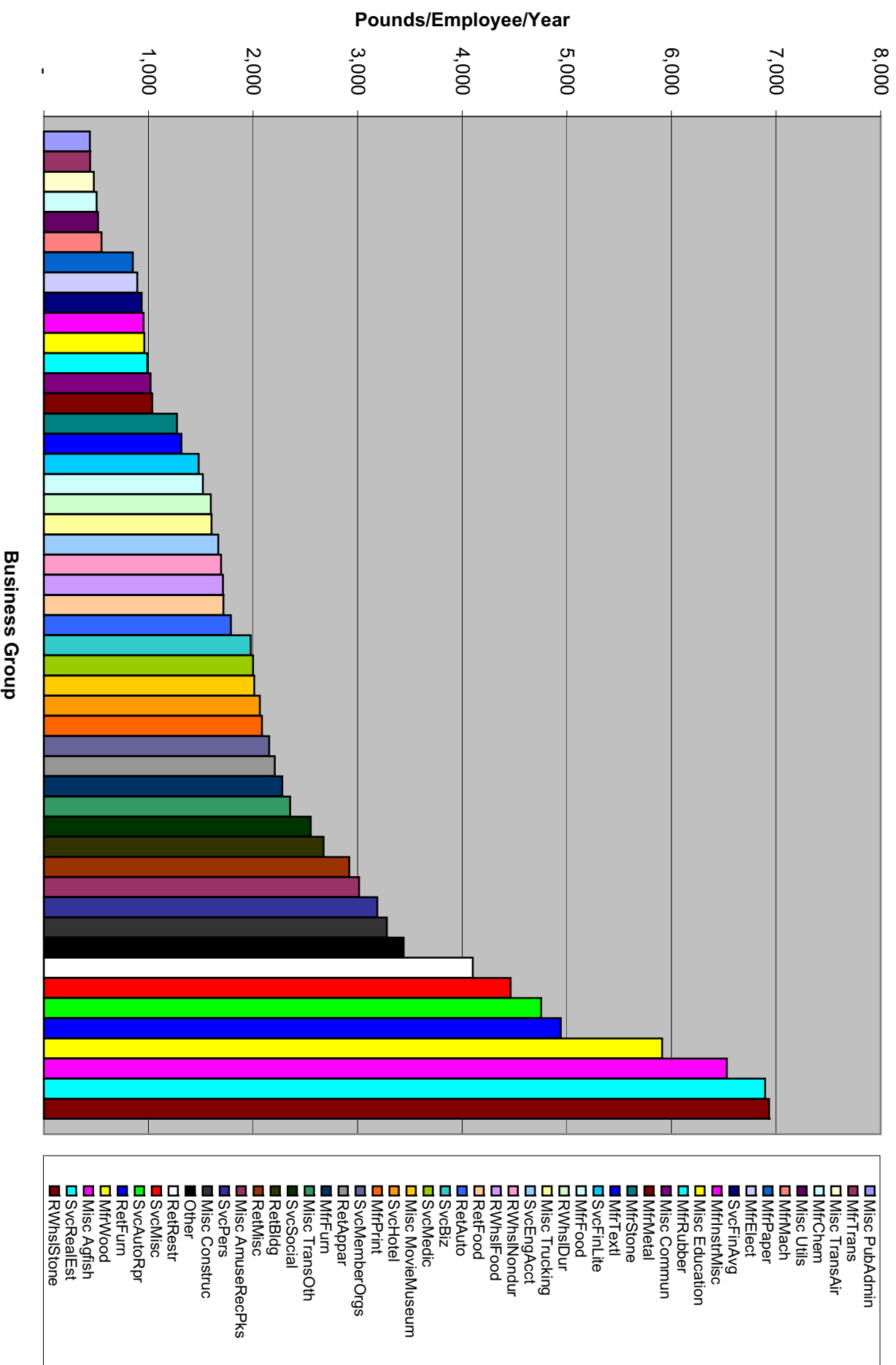


Figure ES-5a
Waste Composition:
Business Services Group

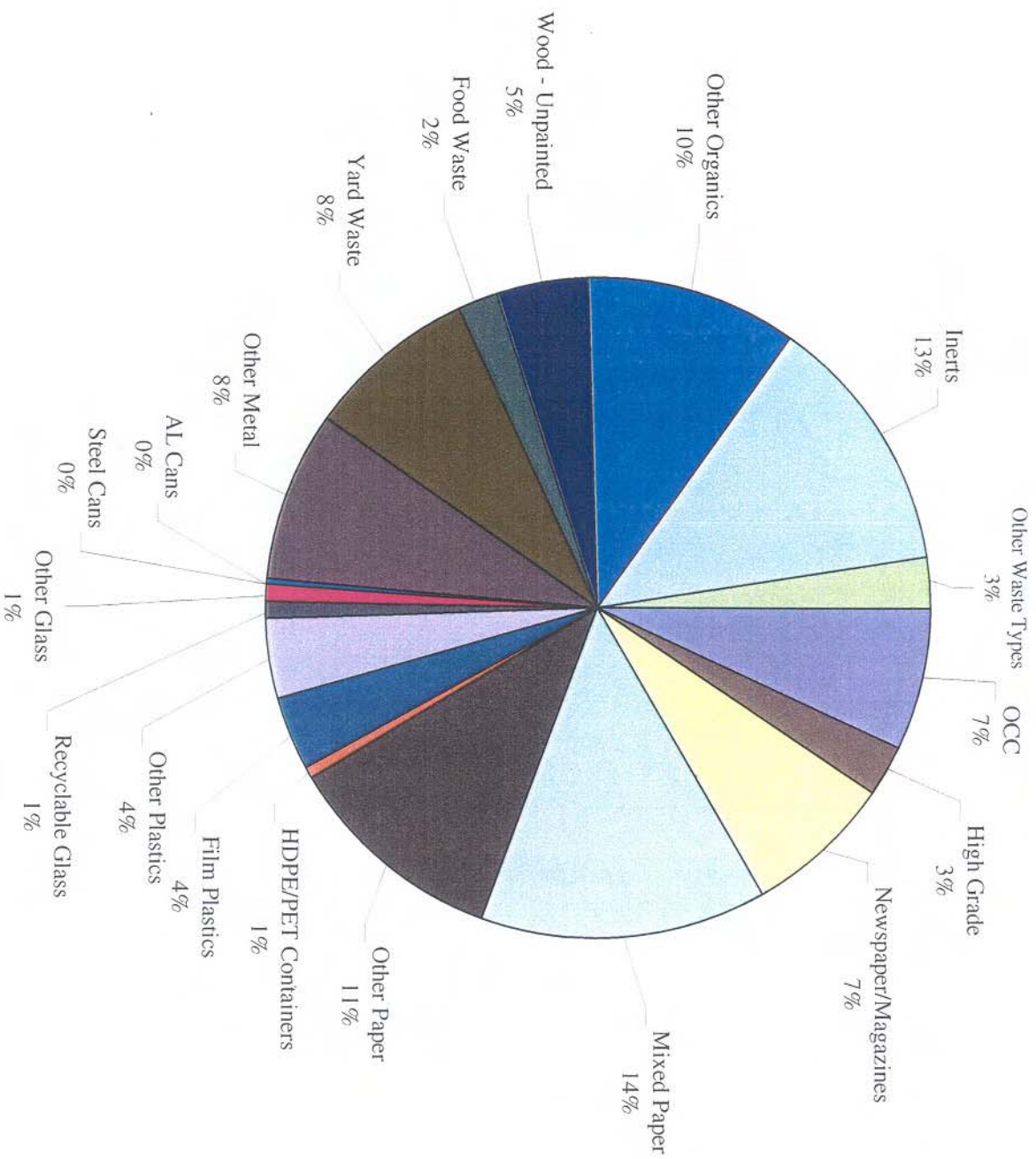


Figure ES-5b
Waste Composition:
Restaurants Business Group

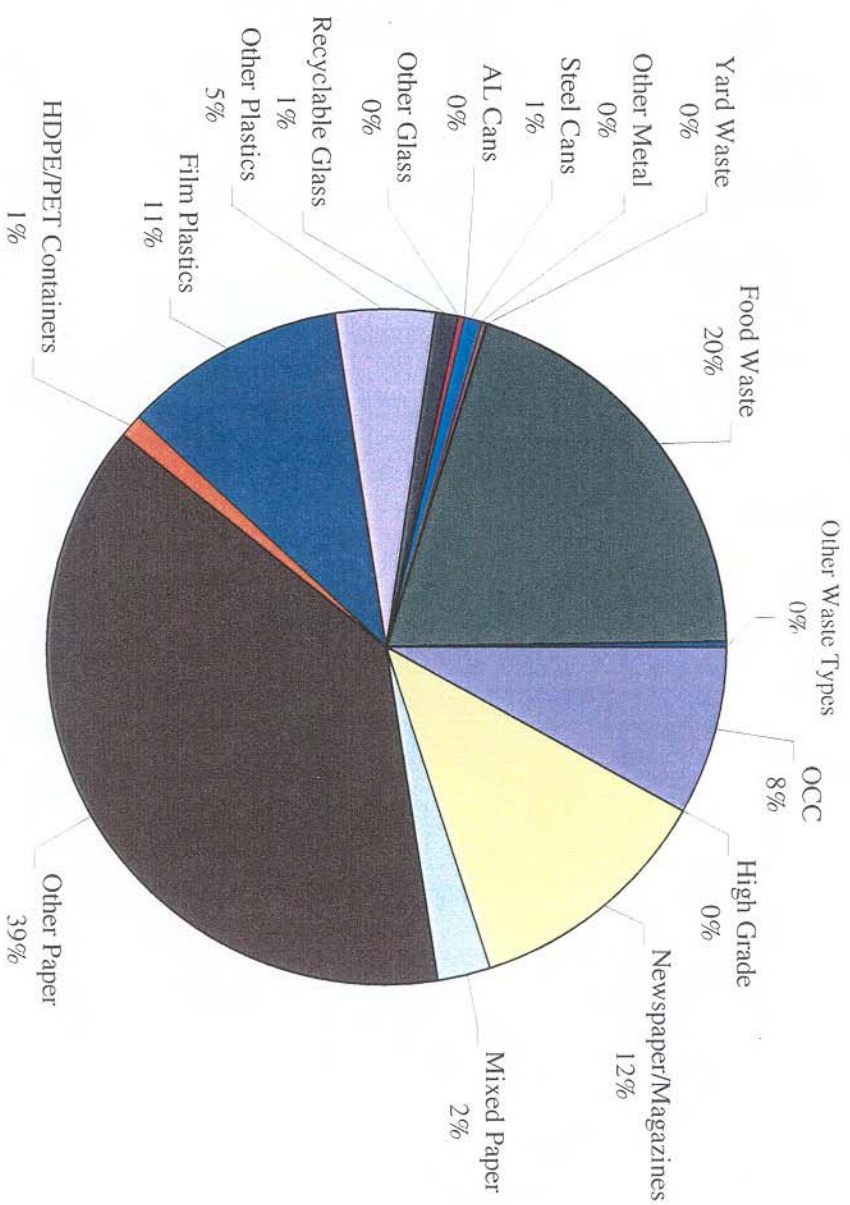


Figure ES-5c
Waste Composition:
Miscellaneous Construction Business Group

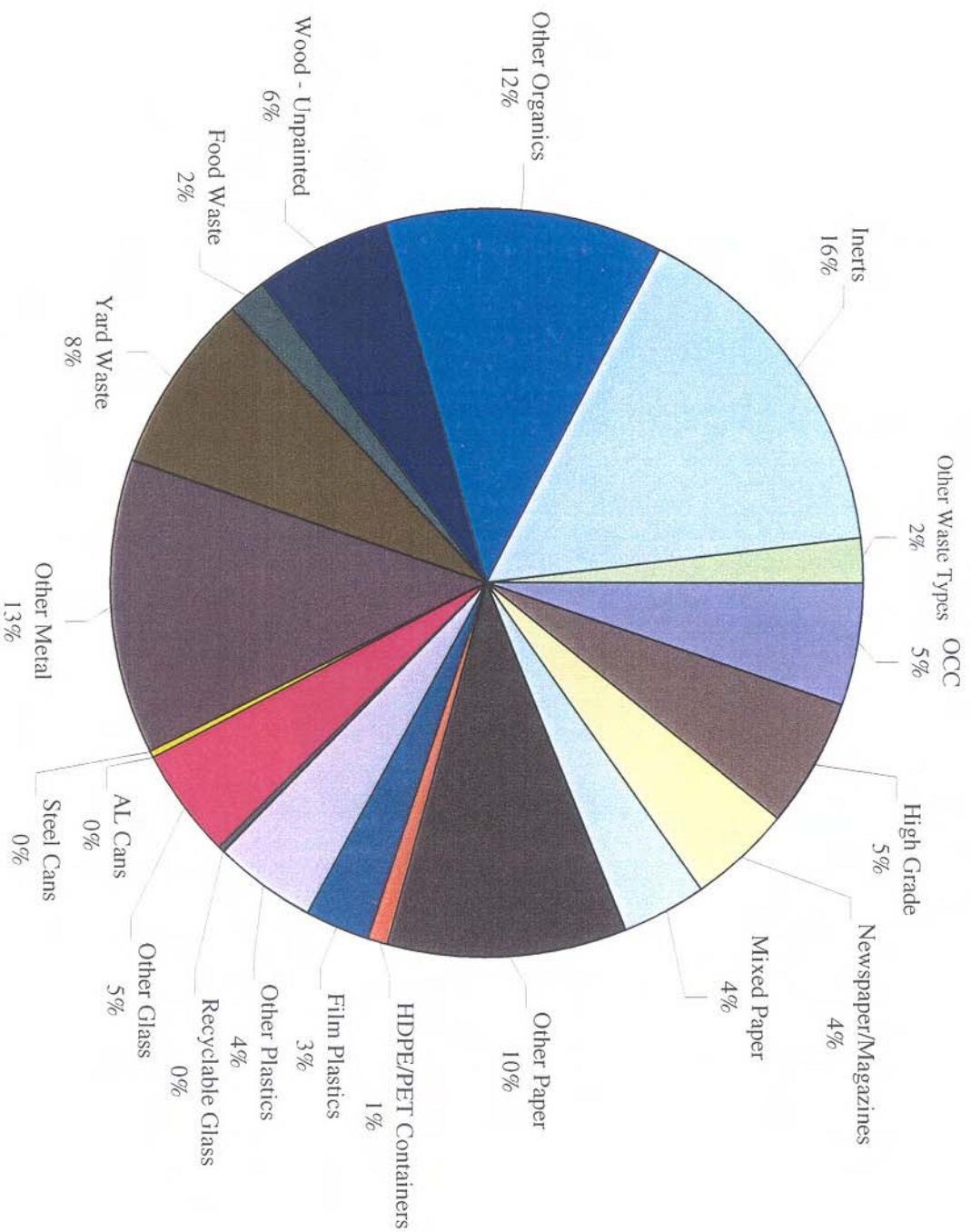


Figure ES - 5d
Waste Composition:
Medical Services Business Group

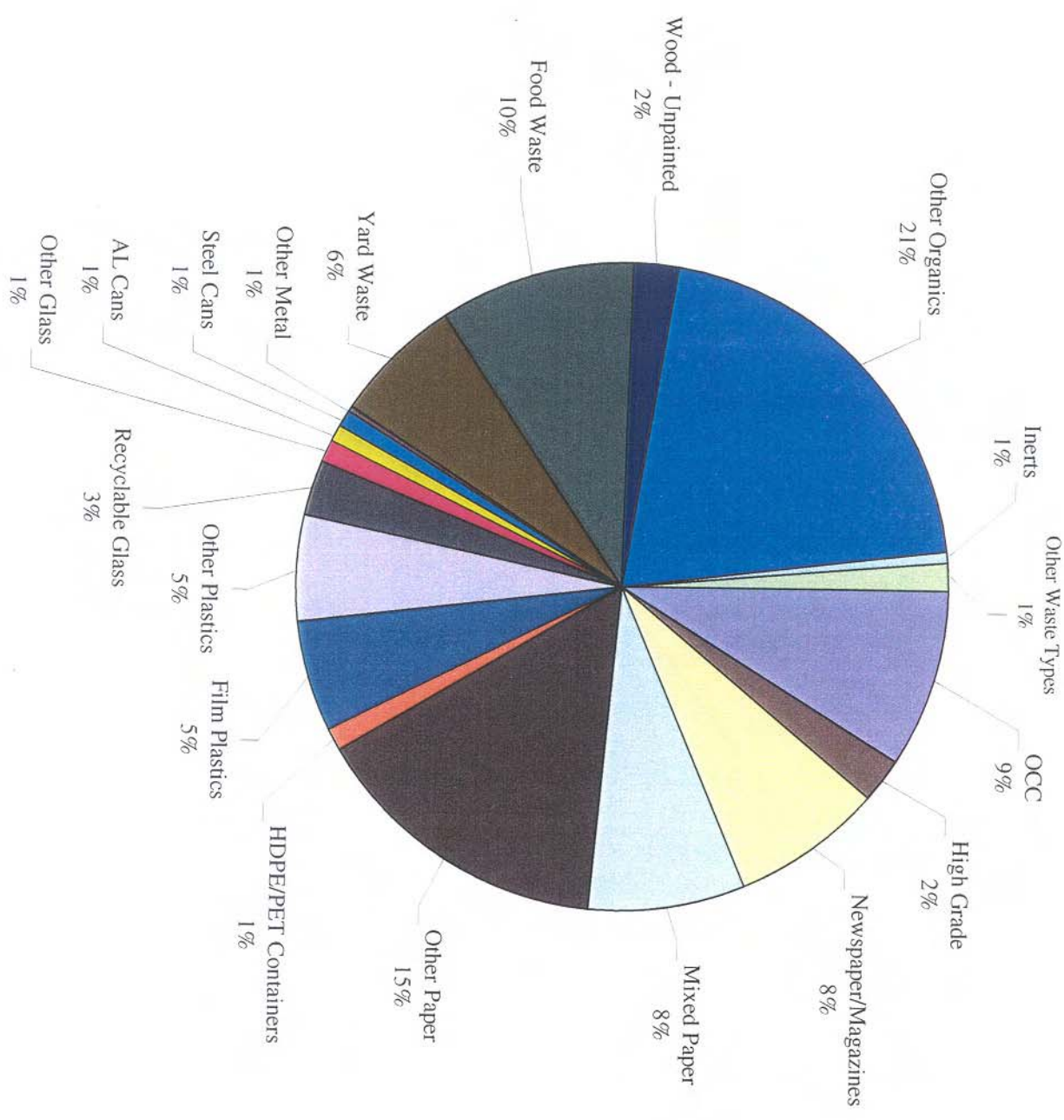


Figure ES-5e
Waste Composition:
Engineering and Accounting Services Business Group

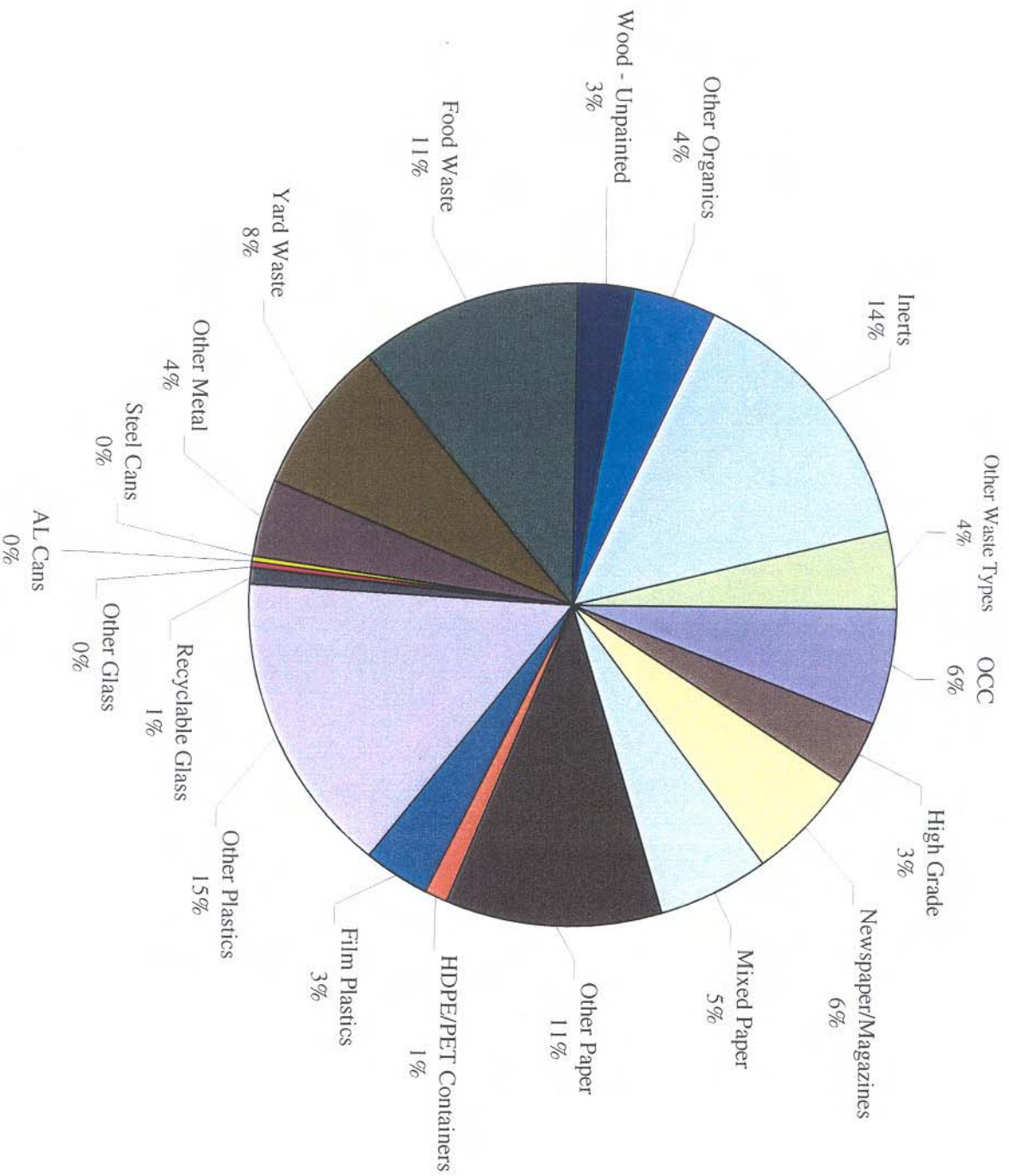
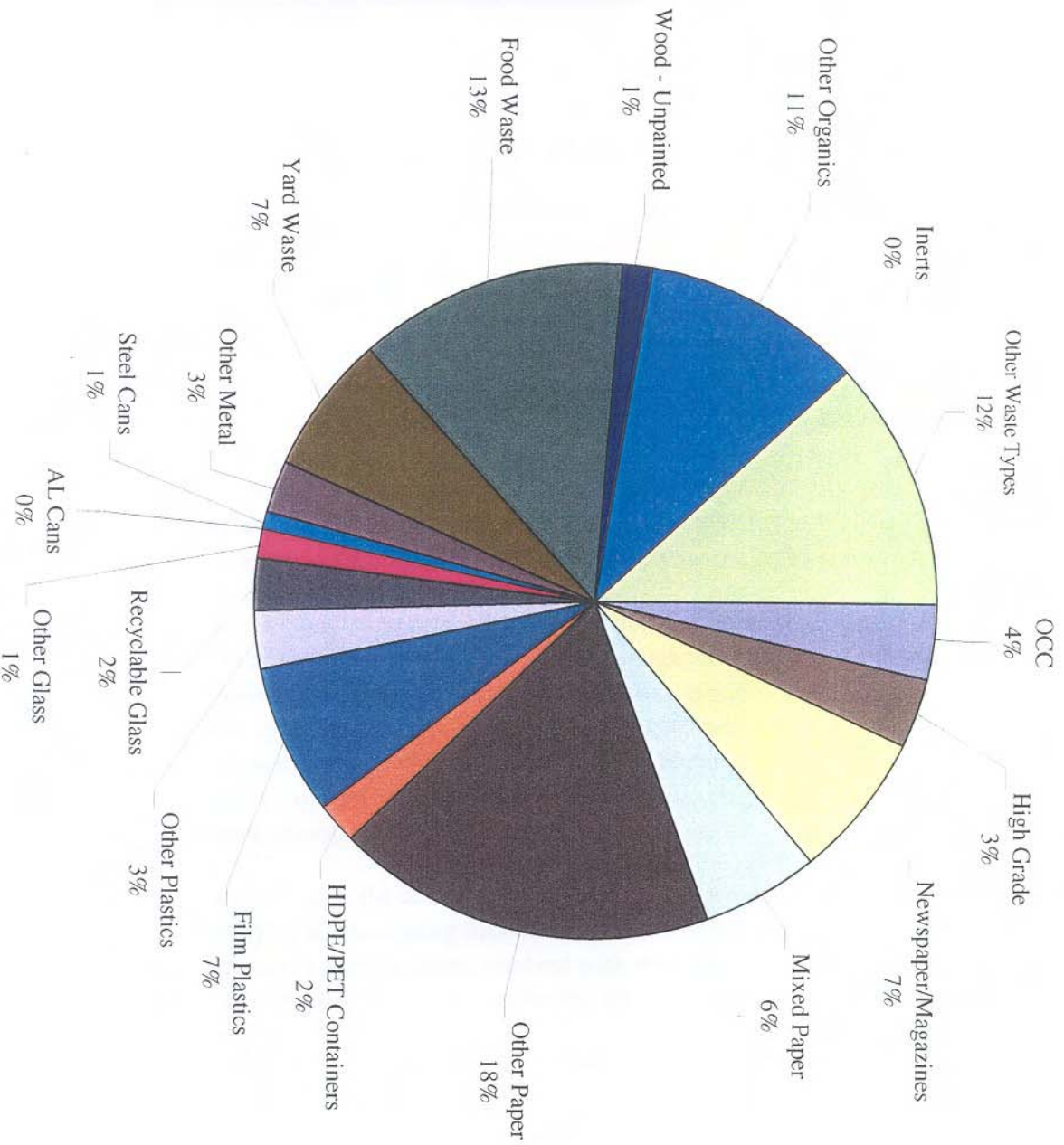


Figure ES-5f
Waste Composition:
Real Estate Services Business Group



SECTION I

INTRODUCTION

BACKGROUND, SCOPE, AND PURPOSE

The Alameda County Waste Management Authority (ACWMA) seeks to develop public education, recycling and source reduction programs to assist Alameda County jurisdictions in reaching the locally mandated 75 percent diversion rate by the year 2010. To achieve this, the ACWMA and Source Reduction and Recycling Board have initiated several related studies, including the *2000 Waste Characterization Study* and the *Waste Production Measurement Study*. The ACWMA has also been conducting a Weight-Based Disposal Research Project, in cooperation with Waste Management of Alameda County and LTS Scales, to measure actual weights of disposed materials at a variety of County businesses. Weight data was collected from individual business loads over a one-year period along four commercial routes in Oakland and Hayward (Figure 1). The current report is intended to complete the Weight-Based Disposal Research Project by evaluating, interpreting, and applying the collected weight data.

This evaluation is intended to determine whether detailed information on the weight of waste can be used as a basis for diversion program design throughout the County, and to use statistical methods to ensure that the use of such data has a firm scientific basis. The primary objective of this report is to apply the findings of the weight-based data as broadly as possible while understanding, and not exceeding, the limitations of the data. The goal of the project is to determine whether subsets of the data for specific industry/business groups can be used to guide the development of targeted diversion programs.

ESA was not involved in the data-gathering phase of this project. ESA's involvement has been limited to rectifying and analyzing data that was collected by other parties. While ACWMA made the ESA team aware of issues involved with the data collection, ESA has of necessity relied on data provided by other parties in conducting the analysis that forms the basis of this report.

During 1999 the California Integrated Waste Management Board (CIWMB) conducted a statewide study¹, the primary objective of which was to obtain information on the types and amounts of materials being disposed in the state. This effort included gathering samples from a total of 1,207 commercial establishments, and recording density and composition data for each sample. The results were then extrapolated to the entire state. To some extent, the statewide study overlaps with the current study, in that both collected and analyzed waste composition data from individual businesses that were then applied statistically to all businesses of the same type.

¹ California Integrated Waste Management Board, *Statewide Waste Characterization Study: Results and Final Report*. Sacramento: CIWMB, December, 1999.

The current study, however, differs from the statewide study in that actual weights were recorded at the time of regular refuse collection over a one-year period. To our knowledge, this study marks the first time that such detailed and extensive records of the weights of refuse from individual businesses have been gathered and analyzed.

SECTION II

METHODOLOGY

The data that forms the basis of this report were collected through a joint effort of ACWMA staff, Waste Management of Alameda County, and LTS Scales. The ACWMA contracted with Waste Management of Alameda County and LTS Scales to have on-board scales placed on four front loader commercial collection vehicles. The vehicles equipped with the scales were assigned to four commercial routes, three in Oakland and one in Hayward (Figure 1). The drivers of the trucks were given a logbook of businesses whose setouts they were to weigh throughout the approximately one-year period, beginning in May, 2000 and ending in June, 2000. One week each month the drivers weighed all of the businesses on their route. For each lift, scales recorded the gross weight of the filled dumpster, and then the tare weight of the empty dumpster. The resulting net weight was derived by subtracting the tare weight from the gross weight.

In conjunction with the weight collection effort, the ACWMA contracted with R.W. Beck, consultants, to characterize the waste from 300 of the businesses whose refuse was being weighed. Waste from the designated businesses was collected and sorted into its constituent material types.

ESA conducted three major steps to rectify and then analyze the weight-based data provided by the ACWMA. These three steps, which are described in detail below, were, first, to verify and where necessary exclude faulty weight records; second, to add data on business attributes, including SIC code, number of employees, and gross sales to the list of businesses from which waste was collected and weighed; and third, to perform statistical analysis of the data.

VERIFYING THE WEIGHT DATA

ACWMA staff had already taken steps to eliminate faulty, irrelevant, and incomplete weight records prior to handing the weight database over to ESA. ACWMA staff eliminated from the study weight records of businesses not targeted in the study, including multi-family residences. ACWMA and ESA both refined the data set by eliminating incomplete or faulty weekly weight records. A weekly weight record is defined as the sum of the weights of all individual collections from a particular business for an entire week. While the majority of businesses included in the study had one bin collected once per week, some businesses had multiple bins, and about 300 had their waste collected two, three, four, or five times per week. If a weekly weight record for a business with more than one pick-up per week was missing a weight or had a faulty weight for one pick-up, the record was still deemed complete; any more than one miss from a weeks' collections resulted in exclusion of the weight record from the database.

Other weight records were excluded because the scale could not obtain a good reading (designation of “x” in the scale record); because of a tare weight greater than the gross weight, resulting in a negative number for the net weight, or because there was an obvious error in the weight record, such as a net weight of ten thousand pounds for a one or two yard bin. Weight records for businesses for which an SIC code could not be obtained were also excluded. The original data set contained approximately 19,000 weekly weight records. The final database contains 12,763 verified weekly weight records.

POPULATING THE BUSINESS DATABASE

ACWMA staff compiled a database, based on account records provided by Waste Management of Alameda County, of the 1,583 businesses from which wastes were collected and weighed. In addition, ACWMA staff populated the database with SIC code information from the iMarket database (primary source is Dunn and Bradstreet) for some of the businesses. The database, as received from the ACWMA, contained no information regarding the businesses’ employee count or gross sales data. ESA gathered the following information from the following sources:

1. SIC code, number of employees, and gross sales information from the iMarket database;
2. For businesses which were either not listed in iMarket or had incomplete iMarket listings, we telephoned the businesses to determine business type (to determine SIC code) and employee count. The search included telephone books and internet research to find telephone numbers for those businesses without contact information in either the ACWMA data or the iMarket data; and,
3. For businesses which remained unclassified after the above steps were performed, we drove-by the business’s address to determine, where possible, the business type from the activities that could be observed occurring at the site.

After the discovery of incorrect SIC information in the original database received from ACWMA, ESA staff compared 1,063 SIC codes in the ACWMA data with the iMarket database. We either phoned, researched on the internet, or drove by businesses not in iMarket to determine their SIC code. In the end, the database contained SIC codes for 1,512 businesses; number of employee data for 1,270 businesses, and gross sales data for 1,080 businesses. Businesses for which SIC codes could not be obtained, and their weight records, were excluded from further analysis.

ACWMA provided ESA with waste characterization data for 300 businesses, obtained by sorting a single load from each of the businesses. ESA was able, however, to match only 260 of the 300 with businesses included in the weight records database. Waste characterization data for the remaining 40 businesses was therefore excluded from the analysis.

STATISTICAL METHODS

EXPERIMENTAL DESIGN AND APPROACH

ESA performed five basic kinds of assessments on the business waste data with statistical methods:

1. Data suitability and consistency to achieve appropriate business grouping;
2. Efficacy of data for general applications or extrapolation to a larger study area;
3. Relationships between variables to predict waste material information from estimated or known values in the study area;
4. Characterization of waste composition; and,
5. Influences of other factors such as time of year and geographic distribution of businesses.

Data suitability analyses determined a grouping scheme for all the businesses that emphasizes confidence in predictability of variables from the samples. The goal was to organize the data into business groups that met two criteria: the groupings would be based on SIC codes that define business groups based on the nature of the business; and, the groupings would provide sufficient, and suitable, data per group to derive summary information on variables (e.g., mean weight per week, waste density, business attributes, or waste composition) with an acceptable level of confidence that the data represent the business group.

Efficacy of Weight and Business Data was performed to provide a measure of the strength of confidence in the data for the business groups delineated above. The goal was to provide some relative measure of how “good” the data were for general information or extrapolation to other areas, or for other analysis – i.e., the “dependability” of the data. The variability of data within each business group was compared to the average variability to provide this relative measure of data strength.

Relationships Between Variables were assessed to determine whether the values of one or more variables could be predicted from the mean values of other variables or influencing factor. For example, whether the total net weight of the waste from a particular business group could be predicted from knowledge of the number of employees or gross sales.

Waste Characterization provided information of the percentages of different materials in the waste. Mean values and variability were used to determine which materials comprised the greatest percentage for business groups, and for other variables.

Influences of Other Factors were assessed to indicate whether variable means were influenced by the time of year, or the geographic location of the waste collections. The time of year was determined by the week in which the observations were collected. The geographic location of

the collection was determined by segregation of data from the route followed by four different waste collectors.

STATISTICAL ANALYSIS

Business Grouping, Data Consistency and Efficacy of Weight and Business Data were estimated from Descriptive Statistics, Distribution Statistics, and Comparative Statistics. Descriptive Statistics summarized information of the variables to assess the strength of confidence in the data; Distribution Statistics show how data variability were distributed to gain insights into the nature of data variability related to business types or other variables; and Comparative Statistics were used to show whether summary information (e.g., variable means) were significantly different from each other – this comparison is used to determine whether business groupings could (or should) be combined or split into smaller groups to improve overall confidence in the information summarized from a business group.

Descriptive Statistics were calculated for all variables for each business group.

Variables for each business group included the following:

- Total Net Weight (the weight of waste from each business per week as measured and reported);
- Waste Density (calculated from the TotalNetWt and a calculation of the volume of service for each business based on the bin size and frequency of pick-ups (information obtained from Waste Management of Alameda County);
- Number of Employees (as reported in the I-Market database or through ESA telephone inquiries);
- Gross Sales (as reported in the I-Market database); and,
- Percent Composition (as derived from sort data for selected businesses throughout the sample area).

For each variable, descriptive statistics include the mean, standard error, and count (# of observations in that group – where an observation is each weekly weight). The mean represents the predicted value of that variable for that business group; the standard error represents the variability expected in the means from the businesses in the group; and the count gives an indication of the amount of data in the sample for the business group. The amount of variability and size of the sample provide an estimate of the confidence in the mean value to represent that business group. A large standard error, usually coupled with a small count relative to the mean and the other business data, would indicate weak confidence in the mean as representative of the business group. A small standard error, usually with a large count, indicated strong confidence in the mean as representative of the group for that variable.

Distribution Statistics included Frequency Histograms and Univariate Scattergrams plotted for each business group. These charts demonstrate how the observations for each variable are distributed from low to high values. It was important to determine whether the data were normally distributed (bell-shaped) – an assumption necessary when used in the kinds of statistical analysis used in this study – or of some other form that might indicate the values are erroneous or being influenced by other factors. A bimodal histogram, for example (which was apparent in some of the original business groups) would indicate that some factor is causing a group of the data not to fit a normal distribution (e.g., a business, or perhaps an unrelated group of observations, within the groups that has distinctively higher values than the rest of the group).

Scattergrams were used when histograms indicated bimodality in the data to find the source of the high value grouping within the business group. Scattergrams were used to show where each observation value is located for each business within a group. Observations, or groups of observations, that seemed to be outliers were investigated. When an outlier was determined to be an erroneous value, it was eliminated from the dataset. When appropriate, an entire business was eliminated from the dataset because the values causing bimodality in the group belonged to a business with attributes indicating unsuitability for that group (e.g., the wrong kind of waste composition, or clearly erroneous business information on number of employees or gross sales).

Comparative Statistics included unpaired t-tests of the differences in means of major variables between each business group; and cell bar charts with confidence intervals of the mean to provide graphic representation and to demonstrate differences between business groups. Differences in variable means were considered significant at 90% confidence level (i.e., when $p < 0.1$). Accordingly, for bar charts demonstrating comparisons of variable means, differences were significant when 90% confidence intervals did not overlap (i.e., overlapping confidence intervals indicated the two means were not significantly different at the 90% confidence level).

The results of Comparative Statistics provided additional information to group businesses and to interpret and extrapolate data from the samples to the study area. If business groups had significantly different means for weight or business variables, there was little support to combine those groups to improve the group integrity. When business groups, however, did not have significantly different means, there was evidence that those groups could be combined (with other justification such as reasonable similarity in the nature of the business) to improve the consistency of values within the group (i.e., lower variability and achieve better data distribution) and thus the confidence that that variable mean is representative of the group for the study area. Examination of cell bar charts with 90% confidence intervals also provides a visual interpretation of the suitability of the data since large confidence intervals, like large standard errors, indicate high variability and weak confidence in the suitability of the data to represent the mean for that business group.

Relationships Between Variables were connoted from correlation coefficients and bivariate scattergrams of variable means. The correlation coefficients were calculated to show the arithmetic relationship of each variable to each other variable for each business group. For example, a correlation coefficient for TotalNetWt and # Employees would, for a particular business group, show whether high values for TotalNetWt corresponded to high values for #

Employees. A high correlation coefficient, indicating a strong relationship between these two variables, would provide evidence that the TotalNetWt could be predicted from the # Employees for that business group. In our analysis, if the correlation coefficient were above .5, we considered the relationship to be strong for that group; a value between .3 and .5 indicated a possible, but weak, relationship; a value below .3 indicated no relationship between those variables. Bivariate scattergrams were used to show how the distribution of observations affect the correlations. For example, when a business group showed little or no correlation between two variables, but such a correlation was expected, the scattergram would identify which business/observations were not in conformance with a relationship between those variables (i.e., potential outliers). When used in conjunction with univariate scattergrams of distribution, observations that did not “fit” well, and seemed to contradict reasonable expectations would be suspected as outliers and investigated further to determine their suitability to represent the business group.

Waste Characterization used descriptive statistics to derive mean percentages of waste materials for each business group. The most common materials were plotted with 90% confidence intervals to ascertain valid (significant) differences in materials for business groups and to demonstrate the efficacy of sort data.

Influences of Other Factors were assessed from further grouping of each business group by each potential influencing factor (i.e., week of collection and route). Descriptive statistics were calculated and displayed to compare mean variable values and relative variability to determine whether there were significant differences in variables between groups. Cell bar charts indicated whether variable means were significantly different between groups of influencing factors at the 90% confidence level (e.g., whether TotalNetWt differed between the four routes).

SECTION III

RESULTS AND DISCUSSION

1. DATA VERIFICATION, BUSINESS GROUPING, AND DATA CONSISTENCY

As described in the methodology section, prior to data analysis several steps were performed to verify the weight-based data, and to add information on business type and business attributes to the database. The size of the final dataset is shown in the final five columns of Table 1. In all, there were 12,763 valid weekly weight records (and the same number of density records) representing the waste of 1,512 businesses with confirmed Standard Industrial Classification (SIC) codes. Of these businesses, the dataset includes information on number of employees for 1,270 businesses and information on annual gross sales for 1,080 businesses. Waste composition data were gathered for 300 businesses, but only 260 of these could be matched with a business for which weight and SIC code data were available.

All of the businesses from the study were initially organized into 38 business groups corresponding to those devised by the California Integrated Waste Management Board (CIWMB, 2001). The 38 CIWMB groups were collated from the 83 major business groups as designated by 2-digit Standard Industrial Classification (SIC) codes. This initiated our business grouping with categories of businesses that were of similar “waste streams,” according to the CIWMB analysis, though many groups were “catch all” groups of less similar business (e.g., Manufacturing: Other, which includes six 2-digit SIC code groups, including Tobacco Products, Stone, Clay, Glass, and Concrete Products, and Petroleum Refining).

We performed two layers of data analysis to reorganize the business groups into groups that provided the best organization to represent the data for further analysis. The first analysis used descriptive statistics to identify business groups that might require lumping with other groups or spitting into one or more groups to maximize data consistency for further analysis and to represent the business waste county-wide. The second run used univariate scattergrams to identify data, or data from entire businesses, from within the groups that may be incorrectly included in the dataset (i.e., outliers). Further examination of outliers would result in elimination of data or businesses that were determined erroneous.

BUSINESS GROUPING

Descriptive statistics, giving information of the mean, variability, and distribution of weight and density of waste from the data, were analyzed for the initial 38 groups. Business groups with high variability (SE), with a high count (high number of observations), and with a histogram

indicating bimodal or uneven distribution were examined in greater detail to determine if the group should be split into two or more groups with less variability and a more “normal” distribution. Five CIWMB groups that were so identified included the following:

- Finance, Insurance, Real Estate, and Legal – which included 8 SIC groups;
- Manufacturing Other – which included 6 SIC groups;
- Retail Other – which included 3 SIC groups;
- Services Other Misc – which included 5 SIC groups; and,
- Services Other Professional – which included 3 SIC groups.

The data from these 25 SIC groups were examined further with t-tests of weight and density to determine which groups were significantly “different” from others. We also wanted to combine reasonably similar business groups (e.g., we didn’t combine Insurance Agents with Museums even though their data were not significantly different). These 25 SIC groups were reorganized into a total of 15 business groups – many of the groups were lumped with others to create larger groups of similar data and waste stream expectation, but several were left as a single 2-digit SIC code group.

Business groups that had a small count, despite having a low standard error, were also examined as candidates for combining with other businesses with similar waste weights and densities – the goal would be to create larger groups with related business natures and similar waste material. For example, the CIWMB group Retail Trade: General Merchandise Stores was only represented by one sample, so this group (which only had one 2-digit SIC group) was combined with Retail Trade: Other (which had 3 SIC code groups, but one had been split – see above).

The process of splitting, combining, and recombining resulted in selection of a total of 48 business groups for further analysis (Table 1).

DATA CONSISTENCY

Univariate scattergrams of weight and density indicated individual weight samples from individual businesses, and groups of weights from an entire business group or subgroup, that seemed to vary considerably from the other samples from within one of the 48 business groups. Several individual weight outliers were identified and examined further to assess whether the data were appropriate – this resulted in elimination of only 3 individual samples from the dataset. The remaining obvious outlier shown on Figure 2, a weight sample nearly twice the weight of any other samples, was retained because it was determined that an unusually high weight might properly represent such a “business” (Oakland Army Base), and that this business was properly designated within the Public Administration group. Further, the scattergram of density (Figure 2) does not indicate that this unusually high weight was also of unusually high density so the waste weight could have been accurate.

When an entire set of waste weights or density from one business seemed disproportionately high, it was also examined for attributes that would account for the values (e.g., high number of employees or high gross sales within a group that showed a correlation of these with weight). The following businesses were identified with these grouped outliers:

- a Real Estate business (SIC 6514.00);
- a Holding & Other Investment Office (SIC 6799.99);
- Asian Neighborhood (*Service, Other*);
- Horizon Service (*Service, Other*);
- City Center Plaza (*Service, Professional*); and,
- Consulting Engineers (*Service, Professional*).

Only one entire “business,” *City Center Plaza*, was eliminated from the dataset. Other businesses, although with higher than usual waste weights, were retained because after checking their data further it was determined they were properly classified and the weights might be reasonable, based on reasonable relationships to number of employees or gross sales. City Center Plaza was grouped as a Professional Service with only 12 employees, but the waste was unusually heavy and contained a high proportion of food waste. Further investigation revealed that City Center Plaza is actually a group of mostly fast food restaurants (about 10) and a few miscellaneous retail businesses – not a professional service group. Since there was no appropriate place for City Center Plaza within any of the business groups without introducing erroneous business data on gross sales, number of employees, as well as mixed business types within one data group, the City Center Plaza data was deleted from the dataset.

2. EFFICACY OF WEIGHT AND BUSINESS DATA

Table 2 provides an overview of the relative strength of the confidence in mean values for waste weight and density, as well as for business data including number of employees and gross sales. Examination of Table 2 reveals that several business groups continue to have weak confidence in the data (i.e., groups with mostly green shading across), while other groups have strong confidence in the data (groups with mostly yellow shading). Confidence in both waste weight data (weight and density) as well as in Business Attributes (number of employees and gross sales) are given. High confidence in both kinds of information is required to use either kind of information to make assumptions about the other (e.g., both gross sales and waste weight must have high confidence in order to assume that high gross sales create high waste weight for a particular business group).

Groups with particularly strong confidence in both waste weight information and business attributes (i.e., strong statistic for three or all four data variables include the following:

Strong Statistic in Four Variables

Manufacturing-Metal
Miscellaneous-Construction
Miscellaneous-Trucking
Retail/wholesale-Durables

Strong Statistic in Three Variables

Retail-Restaurants
Retail/wholesale-Food
Retail/wholesale-Nondurables
Services-Auto Repair

Predictions of waste material and business attributes for these eight business groups will have the strongest confidence of those in the study.

There were no groups with weak statistics in all four variable categories. Groups with particularly weak confidence in both waste weight and business attributes (i.e., weak in three categories) include:

- Misc-Transportation Air
- Retail/wholesale-Stone
- Services-Finance (Lite)
- Services-Miscellaneous
- Services-Personal

Predictions of waste material and business attributes for these five business groups will have the weakest confidence of those in the study. These groups are basically those that remain with small numbers of observations despite attempts to group them to improve data consistency (as described above). Although grouping left these groups with small numbers of observations and high variability, they did not fit well with any other groups – i.e., they would have reduced confidence in other groupings or their business nature was inappropriate.

Examination of Cell Bar Charts showing 90% confidence intervals provides comparative visualization of the strength of confidence in waste weight and density data for the 48 business groups (Figures 3, 4, & 5). Figure 3 shows how business groups within the four sub groups (manufacturing, miscellaneous, retail/wholesale, and services) compare. The 90% confidence intervals are shown as error bars extending above the value bar (i.e., upper confidence interval); the error bar also extends downward into the colored bar but cannot be seen on the chart (lower confidence interval). The 90% confidence interval indicates that the mean value has a 90% probability of being within the interval (i.e., the error bar upper and lower). Therefore, if two bars' confidence intervals overlap, there is a 90% probability that the means are the same (i.e., not different). Figures 3, 4, and 5 indicates whether business groups' waste weights or densities are significantly different from one another.

As Figure 3 shows, many groups are significantly different. For example, within the manufacturing groups, the Food manufacturers group clearly has the highest waste weight, and the confidence interval is small enough that even the lower end is well above the next highest upper limit (Wood manufacturers). Looking back to Table 2, note that MfrFood has moderate confidence in the waste and business data (i.e., mostly blue shading); this “moderate” confidence

is reflected in the size of the confidence interval bar in Figure 3. In this example, although the mean values were considered “moderate” in Table 2 because of the variability of values among the observations, the values were significantly higher than other businesses within that subgroup. Many businesses within the manufacturing subgroup had mean values that were not significantly different even though the mean values seemed different. Electric, Furniture, Transportation, and Wood manufacturers represent four groups that have significantly higher values than the other groups (although all are significantly lower than Food), but they are not significantly different from each other. Chemicals, Instruments and Misc., Machinery, Metal, Print, Textile manufacturers have significantly lower mean weights than the other businesses, but they are not significantly different from each other. Thus it can be seen that many of the business groups fall into bunches of weights that are significantly higher or lower than others, and within those bunches there may be several business groups, or just a single higher or lower group (e.g., Food Manufacturers).

Though several business groups seem to have substantially higher mean waste weights than other businesses within their subgroup (e.g., AgFish, TransAir, WhslStone), the confidence intervals are so large that those values are not significantly different than other high weight businesses. As noted above, TransAir and WhslStone were among those with weak confidence in the waste weight and business attributes (from Table 2); those observations are substantiated by Figure 3 which shows that those seemingly higher values are not really significantly different from other businesses with much lower mean values. As with the manufacturing groups described above, the other subgroups have bunches of groups with values that are significantly different from each other (i.e., higher values and lower values).

An arrangement of the businesses in order of increasing mean waste weight and density (Figures 4 & 5) shows more clearly which businesses fall within lower or higher waste weight or density bunches, but does not show the arrangement within the four subgroups. The Personal and Financial-Light Services clearly have the lowest mean weights, with values significantly lower than any other businesses. Although Food manufacturers was clearly the highest mean weight within the manufacturing category, several other groups with high values are shown as not significantly different from Food (i.e., WhslStone, MiscAgFish, MiscTransAir). These groups are, however, the same groups noted above with high values, large confidence intervals, and weak confidence in the values (which is why they cannot be distinguished from each other). Food has significantly higher waste weight than all of the other business groups.

Examination of waste density values organized in increasing order provides expected results (Figure 5). Businesses with significantly higher waste densities include Rwhsl-Stone, RetBldg, and MiscAgFish -- all of which are likely to contain high density items such as concrete, stone, metals, and wood products. The group with the highest density, Miscellaneous Services, is not as expected, but the error bar is large, indicating high variability, so it is likely that this group contained some very high density wastes observations that might be considered outliers -- the nature of the group is, however, poorly defined and determination of outliers could not be made. As such, this group (SvcMisc) has very weak confidence, is poorly defined, likely contains erroneous data, and is not recommended for use in predictions.

Business groups with significantly lower density wastes include Retail Apparel, Utilities, Medical Services, TransAir, Communication, Finance Avg, and Public Administration – all groups likely to have low density wastes. Most of the business groups fall within a large moderate level density bunch with little or no significant difference within this cluster.

3. RELATIONSHIPS BETWEEN VARIABLES

Examination of the relationships between business waste data (weight and density) and business attributes (employees and gross sales) indicates whether waste weight and density can be predicted from knowledge of business attributes. This would be useful, since data on business attributes are frequently updated, are relatively comprehensive, and are readily available from published sources, such as iMarket. Correlations between waste data and business attributes show whether positive or negative relationships might exist between business attributes and waste data for the 48 business groups in this study (Table 3 and Figure 6). Correlation coefficients (r -sq'd) range from -1 to $+1$, with -1 being a perfect negative correlation (inverse relationship) and $+1$ being a perfect positive correlation. Correlation coefficients therefore that are near -1 or $+1$ show a strong correlation, whereas coefficients near 0 are very weak relationships. For business groups where a strong correlation exists, predictions of waste materials from business attributes are warranted.

As Table 3 shows, strong correlations exist for several business groups. The following groups have particularly high (>0.5) correlation coefficients that indicate a relationship between waste weight and business attributes.

Manufacturers:

Electrical,
Instruments and Miscellaneous,
Transportation.

Miscellaneous Businesses:

Agriculture and fishery,
Communication,
Air Transportation.

Retail & Wholesale Businesses:

Furniture,
Restaurants,
Stone Products.

Services:

Financial (average size),
Medical,
Miscellaneous,
Personal Services,
Social Services.

For all of these groups, the strong correlation is positive (when waste weight goes up, so does the # of employees or gross sales). There were also about an equal number of business groups with moderate (>0.3 , <0.5) correlation coefficients, indicating a likely relationship, but not as strong as with the above groups. For these businesses, it is possible to predict that when the business size (i.e., gross sales and # of employees) is larger, the weight of the waste is higher.

There were few positive correlations between waste density and business attributes. This is expected, for there are few situations where a larger business might generate more dense materials (compactor accounts were not included in the dataset).

There were no strong negative correlations of any kind for any groups. Very few businesses showed an even moderate inverse relationship between waste weight and business attributes. Several groups, however, show inverse relationships between waste density and business attributes. These included the following:

Mfr - Furniture,
Mfr – Paper Products,
Mfr – Wood Products,

Misc – Agriculture & Fishery,
Misc - Education, and

Retail/Wholesale – Building.

For these groups, it is reasonable to predict that when the business size (i.e., gross sales and # of employees) is larger, the density of the waste is less. This may indicate that larger businesses tend to have lighter waste, or that they oversubscribe to refuse service, and tend not to fill up their dumpsters as much as smaller businesses do.

4. WASTE CHARACTERIZATION

Table 4 summarizes the percentage of waste within each of the 46 waste types for the four major business categories (Manufacturing, Miscellaneous, Retail/Wholesale, and Services). Table 4a shows the waste composition for all 48 business groups, but combines waste types into 19 categories of waste. The standard error for the mean percent of waste weight given in these tables provides an indication of the variability of sort data for each business group. Differences in sort data among the four main business subgroups are comparatively represented in Figures 7, a, b, c, d, & e. Figure 7a shows the 19 waste categories in order of decreasing percentage of total weight: for each waste category, each of the four major business categories' percent of that waste category is shown for comparison.

Figure 7a indicates that there are only moderate differences in composition between the major business categories, especially given the relatively large standard errors observed. Other Paper was higher in composition than any other waste category; however, it was not significantly higher (at 90% confidence level) than the second highest, Food Wastes. Uncoated Corrugated, Other Organics, Film Plastics, and Wood-Unpainted basically tied with Food Wastes for second highest composition at 90% confidence level. A group of five categories were significantly lower (at 90% level) than the rest of the categories: Recyclable Glass, HDPE/PET, Other Glass, Steel Food and Beverage Cans, and Aluminum Cans. The remaining eight sort categories occupy a group of middle percentages that are not different from each other.

The waste categories that represent the smallest percentage of wastes, Steel Food and Beverage Cans, and Aluminum Cans, had no significant differences between major business groups.

Examination of Tables 7 (b,c,d,e) provides comparisons of waste categories within each business group. As with the other cell bar charts above, the sort categories tend to fall into higher and lower bunches of significantly different percentages of the waste weight. Wood-Unpainted percentages were significantly higher for Manufacturing and Retail/Wholesale groups than for Miscellaneous and Services business groups. Inerts were significantly higher for Services than for Manufacturing and Retail/Wholesale. And Yard Wastes were significantly higher for Miscellaneous groups than for Manufacturing groups.

For Manufacturing groups (Figure 7b), Unpainted Wood seems to be significantly the highest, but Other Paper, Food Waste, Film Plastics and Other Metals are also high and not significantly different from each other or Unpainted Wood; but, as a group they are significantly higher than the other categories. Recyclable glass, Other Glass, Aluminum Cans and Steel Food and Beverage Cans were significantly lower than the rest.

For Miscellaneous groups (Figure 7c), Other Paper seems to be significantly the highest, with Yard Wastes, Food Wastes, and Other Organics also in a higher percentage bunch. Unpainted Wood is in a middle bunch. Aluminum and Steel Cans again were significantly the lowest.

For Retail/Wholesale groups (Figure 7d), the overall trend from highest to lowest percentages seems to follow the “All Businesses Combined” analysis that established the order of categories (see Figure 7f). . There are basically three bunches that are significantly different from each other: the highest percentage is shared by the top 7 categories; the lowest percentages bunch includes the 5 lowest categories; and the rest are in a middle bunch.

For Service groups (Figure 7e), Other paper is the highest, but sharing that highest percentage bunch with Food Wastes and Inerts, both of which have large error bars that do not separate them from Other Paper. Aluminum and Steel Cans are the lowest, and High Grade paper joins HDPE/PET, Other Glass, and Recyclable Glass in a next to the lowest bunch.

In summary, the 90% confidence intervals show that in general there are few significant differences between percentages of waste weight categories between the major business categories, but as with waste weight data in general (see Figure 3 for example), significant differences appear in clumps of categories within which differences are not significant. Some categories clearly dominate the wastes, with one or a few categories showing significantly higher percentages than the rest within each major business category almost in every major business group.

Waste composition for each of the 48 business groups is shown in Table 4a. Table 4a reveals that the waste composition of most of the business groups is at least ten percent Other Paper; few groups have less than 5 percent Other Paper in their waste. Other material categories that make up a large proportion of the waste of many or most of the business groups include Corrugated Cardboard (OCC), Film Plastics, Food Waste, Wood-Unpainted, and Other Organics. Material

categories that are usually a small proportion of the waste include HDPE/PET containers, Recyclable Glass, Other Glass, and Aluminum and Steel Cans.

Where few waste sorts were performed for a particular business group, the standard error tends to be high relative to the waste composition figure, indicating a large amount of variability in the sample. Where only one sample was sorted, the standard error is 0.0, indicating no variability (and that the sample is statistically meaningless). Business groups with large numbers of sorts tend to have standard errors that are relatively small. Note, for example, the low standard errors for RwhslDur (Retail/Wholesale Durable), which had 27 sorts, and the high standard errors for SvcHotel (Services: Hotels), which had only 3 sorts. In general, the composition data for business groups with 3 or fewer sorts should be considered unreliable. The following business groups had 3 or fewer sorts:

No Sorts

- MfrStone
- MfrTextl
- MfrTrans
- Misc AmuseRecPks
- Misc MovieMuseum

1-3 Sorts

- MfrElect
- MfrFurn
- MfrRubber
- Misc AgFish
- Misc Commun
- Misc Educ
- Misc Utils
- RetAppar
- RetAuto
- RetBldg
- RetRestr
- RwhslStone
- SvcFineLite
- SvcHotel
- SvcMedic
- SvcMisc
- SvcPers

5. INFLUENCES OF OTHER FACTORS --ROUTE AND TIME OF YEAR

Histograms of Total Net Weight and Density of wastes for the combined businesses were examined for evidence of influences of the time of year of the waste samples or the route within which the samples were taken. There was no observed trend or effect of the time of year on weight or density of waste samples – most of the error bars overlapped and minor differences were scattered throughout the year. There were however, significant differences among the routes for waste weights and densities (Figure 8). Further analysis of differences among the

routes revealed there were also significant differences in business gross sales and number of employees (Figure 8) and in waste composition.

Values for mean weight, density, number of employees, and gross sales with standard errors are given in Table 5. Figure 8 more clearly shows the nature of the differences among the collection routes for waste weight and density, and for business gross sales and number of employees.

These descriptions are summarized for each route as follows:

- Route 271. Route 271 consistently had the largest confidence interval, indicating that this route had smaller samples or higher variability in kinds of businesses. This route had significantly higher mean weight than the other routes, and shared the highest density with route 274. Route 271 was not different from other routes in business characteristics.
- Route 273. Route 273 was not significantly different from the other routes, though it did have slightly higher weight and slightly lower density. This route had, however, the highest number of employees per businesses, a significant difference from the other three routes, which were all the same in this regard.
- Route 274. Route 274 was not significantly different from other routes for any comparison category. This route tended to have slightly higher values than others, but never the highest.
- Route 295. Route 295, which included part of Hayward, was almost a mirror image of Route 271 statistically, except for the number of employees, where they both shared the lowest value. Route 295 had the lowest waste weight and density, the highest gross sales, and the lowest number of employees (shared with route 271 as noted).

Examination of waste composition data also revealed significant differences among the four collection routes (Figure 9). In Figure 9, the information is arranged in decreasing order of total percent of waste weights for all businesses. Figure 9 indicates, for the nineteen material categories, which routes have greater or less influence on those percentages. The five largest composition groups vary with routes as summarized here:

- Other Paper. Slight differences, not very significant, decreasing with 271, 273, and 274; but with 295 clearly, and significantly at 90%, the lowest percentage.
- Food Waste. Route 271 seems the highest but large confidence intervals overlap every route, so there are no significant differences within this category.
- Uncoated Corrugated. No differences among routes 271, 273, and 274 – but 295 (previously the lowest percent in the two higher categories) clearly has the significantly highest value for this category.
- Other Organics. No significant difference between any routes.
- Wood-Unpainted. Similar to Uncoated Corrugated, with 295 again the highest, but only significantly higher than 271.

- Inerts. Route 271 is significantly the lowest.
- High Grade paper. Route 271 is significantly the lowest, and 295 the highest.
- Other categories had no significant differences between routes.

Notable observations of waste compositions for the routes derived from Figure 9 include the following for each route:

- Route 271. Clearly dominated by Other Paper and Food wastes, which were also the two overall highest composition categories for all routes combined. In contrast, route 271 had lowest values for Coated Uncorrugated, Wood Unpainted, Inerts, and High Grade Paper.
- Route 273. Was not significantly different from other routes in any composition category. In general, percentages tended to follow the general trend for all businesses combined.
- Route 274. Generally followed the overall trend like route 273, but stood out as having the highest percentage of Inerts of all routes, although because of large confidence interval, this is only significantly different than the lowest route for inerts (271).
- Route 295. Tended to mirror route 271 in most composition categories (i.e., inverse relationship – one is high the other low, etc.). As such, 295 was the lowest for both Other Paper and Food, and the highest for Uncoated corrugated and Wood (i.e., exactly the opposite of 271). Otherwise, this route followed the general trend, except for High Grade paper, where route 295 was clearly and significantly the highest of all routes.

Significant differences among the collection routes indicate several aspects of the waste characterization dataset. First, the differences demonstrate that differing composition of commercial areas in different geographical locations is likely to produce waste with differing composition and character (just as different types of businesses produce different types of waste.) Differences may be in overall weights, density, or in composition. Extrapolation of waste characteristics from one geographic location to another, even within a small area of the County, would have to be done with caution.

Second, the differences in waste weights and densities seem to correspond to, or explain, differences in business characteristics and in waste composition. For example, route 271 had the highest percentages of Other Paper and Food wastes, but low percentages of Uncoated Corrugated and Wood Unpainted – these differences would account for the high waste weight and density for 271 compared to other routes. When extrapolating waste characteristics from one area to another, it is therefore preferable to extrapolate individual business groups' data to reduce errors caused by expected differences in business characteristics.

Third, differences in waste weights, business attributes, and waste composition among the four routes demonstrate that the study encompassed a variety of business attributes and waste characteristics, and therefore, as a whole, may be representative of at least portions of the rest of the County. If, for example, all four routes had shown no differences in waste characteristics or

business attributes, we could assume there was no difference from one area to another throughout the County; but that may have been an erroneous assumption, for it is just as likely that the lack of differences were due to all four routes being within a small geographical area of similar businesses that do not represent the variety within the rest of the County. Further subsampling throughout the County would be required to determine to what extent the sample is representative of the entire County. However, our analysis, showing clearly significant differences between the routes, demonstrates that the four routes encompassed more than one kind of geographical “pocket” of business types. The potential error of the sample not including businesses’ waste characteristics that represent the entire County is therefore less than if there were no differences among the routes.

6. EXTRAPOLATION OF THE RESULTS

Table 6 compares two attributes of businesses within the study sample to data for the County as a whole. The first five columns show the number of employees in businesses within each group in the study sample, and the percent of the whole that this represents; the number of employees in each group in the entire iMarket database for Alameda County, and the percent of the whole that this represents; and the difference, plus or minus, between the two percentage figures. The next five columns provide the same comparison for the number of individual businesses within each business group.

This table demonstrates the similarities and differences of the composition of the study sample with the composition of the whole commercial sector in Alameda County. Green shading indicates business groups for which the sample size significantly under-represents the prevalence of that business group in the County. Green shading is applied if the percent of the whole sample represented by a business group is less than half of the percent of the whole county represented by that business group. For example, Manufacturing – Transportation businesses account for about 1 percent of all employees in Alameda County, but only about .4 percent of the sample. Since .4 is less than one half of 1, we applied green shading to these cells in the table. Overall, the table indicates that the business composition of the sample is fairly reflective of the composition of Alameda County businesses as a whole: only 13 of the 48 categories are seriously underrepresented (in terms of number of employees). Most of the under-represented business groups are services. Manufacturing in the sample is more prominently represented than in the County as a whole. Several important retail groups are not well represented, including food, apparel, furniture, and restaurants. Only 3.9 percent of the businesses in the County, representing only 2.4 percent of employees, fall into the “Other” category, and so have no representation in the study sample.

We used the number of businesses in each business group in Alameda County and the mean weekly weight for each business group to predict the total annual tons disposed by the businesses in each group for the County. The results appear in Table 7 (Note that the tons per year figure for All Groups is slightly different than the sum of the tons per year for all of the individual groups, since the first figure is based on the mean for the entire sample.) The predicted total amount of waste disposed by all Alameda County businesses in one year is about 728,000 tons. The

business groups within the County that are predicted to dispose of the most waste are Miscellaneous Construction, Retail Restaurants, Business Services, Engineering/Accounting Services, Medical Services, and Real Estate Services. Together, these six groups account for about 44 percent of the weight of disposed commercial waste in Alameda County. We calculated strong or moderate confidence in the mean weekly weight for all six of these business groups (Table 2), indicating the reliability of these figures. Nine other business groups (blue shaded in Table 7) account for an additional 26 percent of predicted County commercial waste disposal.

Based on mean weekly weight and the number of employees in each business group in the entire County (as reported in iMarket), we were able to calculate the average per employee waste generation rate for each of the 48 business groups. These are shown in Table 7. There is considerable variability in the per employee generation rate between business groups, from a low of less than 500 pounds per year to a high of nearly 7,000 pounds. This represents a range of difference of more than an order of magnitude. The major business category with the lowest per employee figure is manufacturing, at just over 1,000 pounds per employee per year, while Retail/Wholesale had the highest figure, at just over 2,500 pounds per employee per year.

The weight per employee figures are only reliable to the extent of the strength of the mean weekly waste disposal figure calculated for each of the business groups, and the strength of the correlation between number of employees and weight. There are sixteen business groups which have moderate or strong statistics in both mean weight and the correlation of number of employees to weight. For these sixteen groups, the weight per employee figure may be used with a reasonable degree of confidence. These are:

<u>Manufacturing</u>	<u>Miscellaneous</u>	<u>Retail</u>	<u>Services</u>
Furniture	Communications	Auto	Financial – Average
Instruments- Misc.	Movies/Museums	Furniture	Financial – Light
Machinery		Restaurants	Medical
Metal			Real Estate
Paper			Social
Textiles			

Based on the composition of the commercial sector of each of the 14 cities in Alameda County (and several unincorporated communities) and the mean weekly weight for each business group, we were able to predict the amount of waste disposed by each of the 48 business groups in each city. The results of these calculations are shown in Tables 8a through 8p. Since the mean weights for businesses were derived from the study sample, which only included commercial routes in Hayward and Oakland, the figures should be used as indicators only.

SECTION IV

SUMMARY, CONCLUSIONS AND NEED FOR FURTHER RESEARCH

SUMMARY OF RESULTS

All businesses were organized into 38 groups according to California Integrated Waste Management Board (CIWMB) classification system based on SIC business groupings. Initial statistical analysis of data variability and distribution identified some groups where data were not well distributed and reorganization of several SIC codes into new groups was performed to improve data consistency (i.e., splitting and lumping to reduce variability within business groups). A few observations (waste weights) and one business were eliminated from the data because their variability from a normal distribution could not be accounted for. This process resulted in the businesses in the study being organized into 48 business groups. These 48 groups were further lumped into the following four categories for some analyses: Manufacturing; Retail and Wholesale; Service; and Miscellaneous Businesses.

Variability of the final data were further summarized to display the efficacy of waste and business attribute data for the final business groups. Waste data included weekly mean waste weight and density; business attributes include number of employees and gross sales. Efficacy was determine from the strength of confidence that the data as representative of the business group. Strength of confidence was determined through examination of data variability in proportion to the number of observations and average values. Lower variability in the data will allow greater confidence that the data is representative of that business group. The strength of the four descriptive statistics for each business group is shown in Table 9. Mean waste weights and densities for the 48 groups were also plotted with 90% confidence intervals to visually compare the results of waste data and the significance of differences between data for the business groups.

Further analysis of the waste weight and business attributes included determination of the degree of relationships between waste data and business data. Knowledge of the relationships, together with knowledge of the strength of the data, will provide the confidence in making extrapolations of waste predictions from business attributes – such as predicting a waste weight or density from knowledge of business type and attributes such as number of employees or gross sales. Correlation coefficients were calculated for each of four possible relationships between waste data and business attributes (weight vs # employees; weight vs gross sales; density vs # employees; and, density vs gross sales). Twenty-eight business groups showed a strong or moderate positive correlation between waste and business data (Table 10). For these groups, predictions of waste characteristics from knowledge of business data would be appropriate, although the strength of data should also be taken into consideration regarding confidence in such

extrapolations. Very few groups showed inverse relationships between waste and business data (e.g., when # of employees goes up, waste weight goes down). A few businesses, however, did identify moderate negative correlations between waste density and business attributes.

Waste composition data were analyzed to determine the efficacy of the data and relationships of waste materials to business grouping attributes. Some categories clearly dominate the waste: other paper was significantly higher in composition than any other waste category; food wastes, uncoated corrugated, other organics, and film plastics basically tied for second highest category – although mean values were different, they were not significantly different at the 90% confidence level. This analysis showed that there were often, but not always, significant differences between waste composition for business groups. Other paper, for example, the highest waste category for all groups combined, was not the highest for Retail/Wholesale groups, where it was exceeded by both uncoated corrugated and wood unpainted (which is fifth overall).

Because the data were collected from four geographically distinct routes within Alameda County, and over a period of one year, in weekly collections, it was prudent to ascertain whether the location of time of year influenced the amount or kind of waste discarded. Cell bar charts with 90% confidence intervals of total waste weight for each of the weekly collections and for each of the collection routes revealed the following: there did not seem to be any relationship between the time of year and the amount of waste collected; and, there were significant differences between waste weight for the four collection routes. Further examination of route waste collections revealed several differences between the routes including mean weight, density, and waste composition. Two routes tended to be mostly similar (273 & 274), but the other two routes (271 & 295) were significantly distinct from each other and significantly different from the other two as well. It is likely that differences in waste weight and composition are due primarily to differences in business distribution and business attributes among the four routes. These differences demonstrate the patchiness of business data within the study area and show how this affects waste attributes. This knowledge exemplifies the need to use adequate knowledge of business types and attributes when extrapolating waste information from one area to another – random extrapolation of waste data will likely result in erroneous predictions or assumptions of waste attributes.

CONCLUSIONS

For many of the business groups, mean weight and density are statistically robust enough to be meaningful; that is, they can be used to predict the weight of wastes for other businesses of the same type (Tables 9 and 10). Therefore, within the study area, the analysis of the weight-based data can be used with a reasonable level of confidence for planning diversion programs. Likewise, the waste characterization data for many of the business groups has reasonable consistency, both internally and with other waste characterization studies, and can be considered a useful planning tool. Since, however, the data were not gathered from a random sample, but rather from selected routes, it is difficult to say if the analysis can be applied more broadly, to the rest of Oakland and Hayward, to other cities in the County, and beyond.

One reasonable interpretation of the results is that the data may adequately represent much of Alameda County's commercial sector, even without random sampling. This interpretation is based on the observed variability, within a reasonable range, of weights and other attributes, between the four collection routes included in the study. This impression, however, can only be confirmed through additional research (see below).

The analysis indicates a moderate to strong correlation for most of the business groups between number of employees and mean weekly weight of the waste collected. For sixteen of the business groups – those with moderate or strong correlations between number of employees and weight, and with moderate to strong means for weight, the weight per employee figure (Table 7) is probably an adequate measure for planning purposes.

Correlations between gross sales and waste weight are strong for only a few business groups, and generally gross sales does not appear to be a good predictor of weight waste. The analysis does, however, indicate a weak *negative* correlation between gross sales and density, and also between number of employees and density. This may be due to larger businesses producing lighter waste, or to a tendency among larger businesses not to fill up their dumpsters as much as smaller businesses.

The analysis shows that for some business groups, there was insufficient data to produce reliable, meaningful statistics. Some groups are under-represented relative to their prevalence in the Oakland and Hayward, and in Alameda County as a whole. Some groups simply had too few businesses, or too few weight records, to produce strong statistics.

FURTHER RESEARCH

Three areas are suggested for further research. The first is a targeted random sampling of weights of individual waste collections for businesses throughout Alameda County. A study of this kind would show the extent to which the current study can be applied more broadly, and could also be used to strengthen the statistics for some business groups.

A second area for further research is the fullness of commercial refuse containers when they are collected. Development of “fullness factors” would correct for variations in the derived density of collections, and may reveal trends in over-subscription to refuse collection service.

Finally, the results of this study should be compared to the results of the CIWMB's statewide waste characterization study, particularly the waste composition figures and the weight per employee figures.

SECTION V

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SECTION VI

GLOSSARY

The glossary contains explanations of statistical terms used in the text.

confidence interval (C.I.) A range of values such that there is a known probability that the true value of some quantity lies within that range. For example, the 90% C.I. for a mean represents a range of values within which we expect to find the true value of the mean 90% of the time.

correlation coefficient (R2) A quantitative measure of the relationship between two variables. Correlation coefficients range from -1 to $+1$; a value of $+1$, indicating that large values of one variable are exactly associated with large values of another variable; a value of -1 , indicating that large values of one are exactly associated with small values of the other (an inverse relationship); a 0 value indicates the arithmetic absence of any relationship. The level of correlation that is practically significant varies with the situation, but generally if the correlation coefficient is greater than 0.5, the relationship probably has some basis.

descriptive statistics Computations that summarize data rather than making comparisons between data, its sources, or relative objectives.

error bar The extension of a single point on a graph to reflect the variability of the quantity being estimated.

group A collection of cases in a dataset that share the value of a variable. For example, a variable describing a person's gender divides the data into two group levels: male and female.

histogram A bar chart that plots the distribution of a variable.

mean The sum of the observations divided by the number of observations (i.e., the arithmetic average).

outliers Observations that are distant from the bulk of the data; they can be discarded or corrected if they arise from an obvious error in data collection, or are designated in an incorrect group.

***p* value** A quantitative estimate of the likelihood of an observation, or observed difference in values, occurring by chance. This likelihood is expressed as a decimal such that, for example, a value of 0.01 means it is a one in 100 chance (one percent) that such a difference occurs by chance; a larger *p* value, 0.1 for example, means that it is a ten in 100 (10 percent) chance that the difference occurs by chance.

standard error (S.E.) A statistic that estimates the variability in the sample mean you expect if you take repeated samples of the same size from the population. A large S.E. relative to the mean indicates high variability, and thus weak confidence in how well the mean represents the

population; a low S.E. relative to the mean indicates low variability, and thus strong confidence in the mean.

t-test (unpaired) An analysis that compares the means of two groups and determines the likelihood of the difference occurring by chance. The chance is reported as the p value.

TABLES

TABLE 1: BUSINESS GROUPS AND DATA SETS

Table 1 lists each of the business group designations used in the study and defines the types of businesses included in each group. The first column, Business Group, is the name of the group used throughout this study. The second column, SIC Codes, shows which Standard Industrial Classification codes are included in the group. The third column, Description, describes the types of businesses within these SIC designations. The fourth column, CIWMB SIC Groupings, indicates how the group was determined: it was either taken directly from the groupings of SIC Codes used by the CIWMB, or derived from the CIWMB groups by splitting particular SIC codes out of an existing group, or through a combination of splitting apart one or more CIWMB groups and then lumping those SIC codes into a new group. The final five columns show the size of the samples used in the study for each group: the total number of weekly weight records; the number of individual businesses in each group; the number of businesses in each group for which we have data on the number of employees; the number of businesses in each group for which we have data on gross sales; and the number of businesses in each group for which we have waste characterization data.

TABLE 1
BUSINESS GROUPINGS AND DATA SETS

Group Name	SIC Codes	Description	CW/MB SIC Groupings	Number of Observations	Number of Businesses	Number of Businesses w/Employee Data	Number of Businesses w/Gross Sales Data	Number of Businesses w/Sort Data
Manufacturing								
MfChem	28	Chemicals & Allied Products	Same	2,381	260	243	211	52
MfElect	36	Electronic & Other Electrical Equipment & Components, except Computer Equipment	Same	118	13	13	12	4
MfFood	20	Food & Kindred Products	Same	152	19	16	16	3
MfFurn	25	Furniture & Fixtures	Same	230	25	21	21	2
MfInstrMisc	38,39	Measuring, Analyzing, & Controlling Instruments; Photographic, Medical and Optical Goods; Watches and Clocks/Miscellaneous Manufacturing Industries	Lump and Split	128	14	14	10	4
MfMach	35	Industrial & Commercial Machinery & Computer Equipment	Same	388	43	41	37	8
MfMetal	33,34	Manufacturing: Primary/Fabricated Metal	Same	468	51	49	40	7
MfPaper	26	Paper & Allied Products	Same	96	8	8	7	1
MfPrint	27	Printing, Publishing, & Allied Industries	Same	231	26	26	24	7
MfRubber	30	Rubber & Miscellaneous Plastics Products	Split	92	10	10	8	2
MfStone	32	Stone, Clay, Glass, & Concrete Products	Split	109	12	12	9	0
MfTextil	22,23	Manufacturing: Apparel/Textile	Same	78	11	8	8	0
MfTrans	37	Transportation Equipment	Same	82	9	8	5	0
MfWood	24	Lumber & Wood Products, except Furniture	Same	89	9	8	5	4
Miscellaneous								
Misc AgrFish	1,2,7,9	Agriculture Fisheries	Same	3,088	356	261	213	66
Misc AmuseRecPis	79	Amusement & Recreation Services	Split	54	7	7	6	3
Misc Commu	48	Communications	Split	56	8	5	5	2
Misc Construc	15,16,17	Construction Contractors	Same	86	11	9	8	0
Misc Educat	82	Educational Services	Same	1,045	119	111	96	19
Misc MovieMuseum	84,78	Museums, Art Galleries, & Botanical & Zoological Gardens/Motion Pictures	Same	156	15	8	5	3
Misc PubAdm	43,90's	Public Administration	Lump and Split	54	6	5	5	0
Misc TransAir	45	Transportation by Air	Same	323	46	14	7	9
Misc TransOth	40,41,44,46,47	Transportation: Other	Same	79	15	10	9	4
Misc Trucking	42	Motor Freight Transportation & Warehousing	Same	322	38	24	22	8
Misc Utils	49	Electric, Gas, & Sanitary Services	Same	710	73	64	47	15
				203	18	4	3	3
Retail/Wholesale								
RetaAppar	56	Apparel & Accessory Stores	Split	4,174	496	453	397	78
RetaAuto	55	Automotive Dealers & Gasoline Service Stations	Split	16	1	1	1	1
RetaBldg	52	Building Materials, Hardware, Garden Supply and Mobile Home Dealers	Same	185	23	21	17	1
RetaFood	54	Food Stores	Same	104	13	12	12	3
RetaFurn	57	Home Furniture, Furnishings and Equipment Stores	Split	170	24	22	17	4
RetaMisc	59	Miscellaneous Retail	Split	185	22	17	15	7
RetaRest	58	Eating & Drinking Places	Split	349	40	39	31	6
RWhalDur	50	Wholesale Trade - Durable Goods	Same	443	63	49	39	3
RWhalFood	5100-5159	Wholesale Trade - Groceries and Related Products	Split	1,806	196	188	169	27
RWhalNonDur	5160-5199	Wholesale Trade - Non-Durable Goods	Split	353	44	39	36	10
			Split	490	60	55	50	14
RWhalStone	5032	Stone, Clay, Glass, & Concrete Products	Split	73	10	10	10	2
Services								
SvcAutoRpr	75,76	Automotive Repair, Services, Parking, & Misc. Repair	Split	3,120	400	313	259	64
SvcBdr	73	Business Services	Split	873	101	92	79	17
SvcEngAct	87	Engineering, Accounting, Research, Management, & Related Services	Same	634	84	72	58	10
SvcFinAv	63,60,61	Insurance Carriers/Depository Institutions/Nondpository Credit Institutions	Lump and Split	191	29	26	19	9
SvcFinLife	62,64	Security & Commodity Brokers, Dealers, Exchanges, & Services/Insurance Agents, Brokers, Hotels, Rooming Houses, Camps, & Other Lodging Places	Lump and Split	98	12	6	6	1
SvcHtel	70	Hotels, Rooming Houses, Camps, & Other Lodging Places	Same	33	6	6	5	1
SvcMedic	80	Health Services	Same	92	12	7	7	3
SvcMemberOrgs	86	Membership Organizations	Split	108	10	7	7	3
SvcMisc	89	Miscellaneous Services	Split	302	36	33	28	4
SvcPers	72	Personal Services	Split	48	6	4	3	2
SvcRealEst	65,67	Real Estate/Holding & Other Investment Offices	Lump and Split	50	7	7	4	1
SvcSocial	83	Social Services	Split	477	72	34	28	5
			Split	214	25	19	15	5
TOTAL				12,763	1,512	1,270	1,080	260

TABLE 2: DESCRIPTIVE STATISTICS FOR WASTE WEIGHT AND BUSINESS ATTRIBUTES

Table 2 shows several descriptive statistics for the forty-eight business groups. The table is divided into two sections: Waste Weight Information and Business Information. Throughout the table, yellow shading indicates a strong confidence in representation of the mean; blue shading indicates moderate confidence; and green shading indicates little or no confidence. The strength of the statistical relationship is determined by calculating the ratio of the standard error to the mean and comparing that ratio to the average ratio for all businesses. For weight and density, if the ratio is less than .06, the statistic is considered strong, between .06 and .1 moderate, and greater than .1 weak. For number of employees, the cutoffs are: less than .07 the statistic is considered strong, between .07 and .12 moderate, and greater than .12 weak. For gross sales, the cutoffs are: less than .09 the statistic is considered strong, between .09 and .16 moderate, and greater than .16 weak. This categorization strategy was developed to indicate to the reader where the data are weak, strong, or moderate for each business group.

In the first part of the table, Waste Weight Information, the mean weekly weight and mean density of collections are given, as well as the Standard Error for each mean. A strong statistic in these categories indicates a good clustering (low variability and normal distribution) of weight records within a business group (see Figure 2), and suggests that the mean is a reliable predictor for the weight or density of all businesses represented by the sample. (This information is also graphically shown in Figures 3, 4 and 5.) This part of Table 2 also shows the number of individual weekly weight records for each group (the “Count” column).

The Business Attributes section of Table 2 shows the statistical strength of the data from the I-Market database for the number of employees per business and the gross sales per business for each of the forty-eight business groups. Again, a yellow shading indicates a strong statistic, suggesting that the mean is a good predictor for the number of employees or gross sales per business for all businesses of this type.

The Count columns in Table 2 show the number of individual records used in the analyses. Weight and Density have the same count, since density is derived from the weight records and account information for each business showing the total weekly volume of waste service (the number of containers multiplied by the volume of containers multiplied by the number of collections per week). The counts for number of employees and gross sales in each group is “weighted” because the figure represents the sum of the number of employees or gross sales for each business multiplied by the number of weekly weight records for that business.

TABLE 2
DESCRIPTIVE STATISTICS FOR WASTE WEIGHT AND BUSINESS ATTRIBUTES

Business Group	Waste Weight Information					Business Attributes					
	Weight (lbs/Wk)		Density(lbs/Yd3)		Count	Number of Employees			Gross Sales		
	Mean	S.E.	Mean	S.E.		Mean	S.E.	Count	Mean	S.E.	Count
All Groups	504.8	5.4	158.9	1.4	12,763	21.3	0.5	10,901	2,337,458	72,721	9,410
MfrChem	386.4	42.4	154.4	11.1	118	14.2	2.1	118	1,591,379	227,161	116
MfrElect	719.0	90.2	180.5	15.8	152	31.1	3.2	119	3,830,252	559,911	119
MfrFood	1147.2	80.6	131.1	8.2	230	66.1	5.4	209	9,833,493	2,313,912	209
MfrFurn	702.4	42.5	223.8	15.1	120	20.7	1.9	109	1,988,073	197,111	109
MfrInstrMisc	327.8	28.5	105.0	10.6	128	24.3	2.5	128	1,000,000	186,130	100
MfrMach	399.1	25.0	180.9	7.8	388	16.4	1.0	366	1,775,072	139,141	349
MfrMetal	428.1	17.2	190.5	9.7	468	17.1	0.7	445	1,664,815	119,123	378
MfrPaper	493.3	34.9	133.4	9.0	96	23.1	1.3	96	2,384,091	188,050	88
MfrPrint	404.6	19.8	158.6	9.4	231	18.2	1.4	231	1,442,920	131,650	226
MfrRubber	597.0	49.6	147.2	12.1	92	23.2	2.2	92	2,097,368	264,429	76
MfrStone	569.9	46.1	251.1	20.4	109	10.5	0.9	109	391,358	56,688	81
MfrTextl	336.3	27.3	149.7	14.3	78	24.3	1.7	70	1,637,288	196,980	59
MfrTrans	633.9	70.1	156.2	17.9	82	16.6	0.8	79	1,752,727	212,502	55
MfrWood	768.3	95.6	217.5	18.1	89	6.7	0.5	83	407,692	63,569	52
Misc Agfish	949.3	123.5	247.1	22.8	54	23.6	2.7	54	545,098	26,762	51
Misc AmuseRecPks	543.2	52.2	146.0	12.7	56	4.2	0.4	37	73,469	6,372	49
Misc Commun	365.9	32.8	88.0	6.5	86	52.4	6.2	69	6,662,121	1,102,774	66
Misc Construc	577.5	21.7	206.5	6.3	1,045	25.3	0.9	985	3,959,314	196,316	846
Misc Education	806.7	51.5	131.6	7.7	156	66.5	8.2	85	2,864,000	610,144	50
Misc MovieMuseum	308.1	28.6	124.0	9.0	54	17.7	2.3	47	1,365,957	256,935	47
Misc PubAdmin	528.8	47.1	97.7	5.5	323	201.8	29.6	78	-	-	53
Misc TransAir	882.4	105.8	83.7	6.7	79	181.2	46.8	62	1,464,583	508,444	48
Misc TransOth	582.5	26.3	138.2	7.1	322	28.1	3.0	209	830,890	94,162	191
Misc Trucking	430.4	16.3	133.1	5.1	710	20.9	1.3	623	1,215,000	106,835	460
Misc Utils	407.4	29.2	73.8	5.5	203	32.8	4.9	49	3,500,000	575,396	38
RetAppar	336.3	76.5	56.0	12.8	16	12.0	0.0	16	-	-	16
RetAuto	362.9	17.7	152.4	9.6	185	11.1	0.7	174	639,855	97,268	138
RetBldg	573.7	49.4	278.6	23.1	104	14.3	1.6	93	6,153,763	1,116,820	93
RetFood	404.8	29.3	181.7	14.4	170	5.3	0.5	159	299,167	39,366	120
RetFurn	611.2	52.4	177.2	9.1	185	9.0	1.0	146	267,188	35,444	128
RetMisc	312.5	23.1	150.7	8.3	349	9.8	0.7	338	732,836	138,320	268
RetRestr	764.6	40.2	227.4	7.1	443	13.7	0.8	369	2,243,865	540,145	326
RWhslDur	368.5	10.1	139.1	3.3	1,806	13.6	0.4	1,754	3,236,806	149,765	1,584
RWhslFood	624.9	52.5	171.2	7.1	353	16.6	1.0	307	3,856,207	284,656	290
RWhslNondur	414.0	19.7	132.2	5.3	490	21.8	1.0	462	4,693,857	469,673	407
RWhslStone	965.3	133.2	285.9	34.8	73	9.4	0.6	73	1,682,192	379,324	73
SvcAutoRpr	462.2	18.4	178.5	6.4	873	9.9	0.4	789	400,301	48,297	665
SvcBiz	441.1	17.5	139.0	7.8	634	30.0	3.0	533	686,742	71,508	445
SvcEngAcct	476.0	39.2	137.7	10.3	191	25.0	2.0	175	2,128,571	197,880	133
SvcFinAvg	417.6	35.4	96.6	7.2	98	10.2	1.2	47	1,612,766	604,842	47
SvcFinLite	226.1	22.0	126.0	20.3	33	15.7	5.2	33	1,465,385	530,600	26
SvcHotel	842.9	67.4	179.1	19.2	92	28.4	1.1	53	473,585	80,508	53
SvcMedic	574.4	55.7	76.1	4.7	108	56.2	3.7	79	3,962,025	733,161	79
SvcMemberOrgs	336.8	21.0	136.3	6.5	302	6.4	0.6	273	525,991	76,763	227
SvcMisc	649.6	74.3	426.9	76.9	48	4.7	0.1	26	259,091	47,745	22
SvcPers	209.8	31.5	100.8	9.9	50	11.3	1.4	50	1,006,897	255,527	29
SvcRealEst	709.3	29.8	149.2	6.4	477	11.8	1.2	239	1,369,951	252,002	203
SvcSocial	456.9	30.8	164.5	9.0	214	16.9	1.4	161	1,374,590	195,812	122

Key:

	Indicates strong statistic
	Indicates weak statistic
	Indicates moderate statistic

TABLE 3: CORRELATIONS OF WASTE WEIGHT AND DENSITY WITH BUSINESS ATTRIBUTES

Table 3 is a table of correlations. The data in Table 3 is also represented graphically in Figure 6. A statistical correlation shows the degree to which the value from one data set predicts the value from another related data set. For example, in the first column of Table 3, Net Wt vs Number of Employees, the correlation shows the extent to which the number of employees in a particular business can be used to predict the weekly weight of the business's waste. Correlations are expressed as r-squared (r-squared, or r^2); the range of possible values is from -1 to 1. A higher positive r-squared (a positive decimal closer to 1) indicates a better positive correlation, in other words, a greater likelihood that the value of one type of data will predict another. For example, for MfrElect (Electrical Manufacturers), there is a strong positive correlation between net weight and gross sales, indicating that, within this business group, businesses with higher gross sales tend also to have higher weekly waste weights.

A negative r-squared is referred to as a negative correlation, and indicates an inverse relationship between two data sets. For example, for MfrWood (Wood Manufacturers) there is a moderate negative correlation between the number of employees in businesses within this category, and the density of the waste that the businesses produce. In other words, for businesses of this type, the more employees, the less dense the waste.

In this table, yellow shading indicates a strong positive or negative correlation (r-squared above 0.50 and below -0.50; as it happens, there are no strong negative correlations); blue shading indicates a moderate positive or negative correlation (r-squared between 0.30 and 0.50, and between -0.30 and -0.50) and green shading indicates a weak or non-existent correlation (r-squared between -0.30 and 0.30).

TABLE 3

CORRELATIONS OF WASTE WEIGHT AND DENSITY WITH BUSINESS ATTRIBUTES

BUSINESS GROUPS	Net Wt vs Number of Employees			Net Wt vs Gross Sales			Density vs Number of Employees			Density vs Gross Sales		
	r-sq'd	n		r-sq'd	n		r-sq'd	n		r-sq'd	n	
ALL GROUPS	0.12	10,901		0.15	9,410		-0.06	10,901		-0.05	9,410	
Mfrchem	-0.06	118		-0.07	116		-0.12	118		-0.13	116	
MfrElect	0.63	119		0.83	119		0.18	119		0.39	119	
MrfFood	0.18	209		0.40	209		-0.01	209		-0.17	209	
MfrFurn	0.30	109		0.18	109		-0.38	109		-0.38	109	
MfrInstrMisc	0.66	128		0.48	100		0.10	128		0.23	100	
MfrMach	0.48	366		0.18	349		0.01	366		-0.11	349	
MfrMetal	0.36	445		0.07	378		-0.05	445		-0.07	378	
MfrPaper	0.42	96		0.39	88		-0.44	96		-0.36	88	
MfrPrint	0.26	231		0.12	226		-0.10	231		0.03	226	
MfrRubber	0.05	92		0.02	76		-0.16	92		-0.37	76	
MfrStone	-0.16	109		-0.23	81		-0.21	109		-0.11	81	
MfrTextl	0.33	70		-0.33	59		-0.11	70		-0.17	59	
MfrTrans	0.59	79		0.27	55		0.13	79		0.53	55	
MfrWood	0.48	83		0.06	52		-0.50	83		-0.47	52	
Misc Agfish	0.71	54		-0.11	51		-0.31	54		-0.29	51	
Misc AmuseRecPks	0.01	37		0.03	49		0.06	37		0.34	49	
Misc Commun	0.64	69		0.47	66		0.28	69		0.09	66	
Misc Construc	0.04	985		0.04	846		-0.16	985		-0.14	846	
Misc Education	0.13	85		-0.04	50		-0.31	85		-0.49	50	
Misc MovieMuseum	0.31	47		0.16	47		0.06	47		-0.02	47	
Misc PubAdmin	0.08	78		0.00	53		0.22	78		0.00	53	
Misc TransAir	-0.09	62		0.60	48		0.01	62		-0.02	48	
Misc TransOth	0.04	209		-0.13	191		-0.21	209		0.00	191	
Misc Trucking	0.05	623		0.13	460		0.10	623		0.14	460	
Misc Utils	0.07	49		0.47	38		0.05	49		0.12	38	
RetAppar	0.00	16		0.00	16		0.00	16		0.00	16	
RetAuto	0.35	174		0.15	138		-0.27	174		-0.12	138	
RetBldg	-0.07	93		-0.17	93		-0.33	93		-0.43	93	
RetFood	0.18	159		0.19	120		-0.24	159		-0.21	120	
RetFurn	0.53	146		-0.36	128		0.18	146		-0.01	128	
RetMisc	0.29	338		-0.07	268		-0.07	338		-0.10	268	
RetRestr	0.70	369		-0.09	326		0.22	369		-0.27	326	
RWslDur	0.24	1754		0.23	1584		-0.05	1754		0.03	1584	
RWslFood	0.10	307		0.15	290		-0.03	307		0.06	290	
RWslNondur	0.28	462		0.10	407		-0.12	462		-0.11	407	
RWslStone	0.60	73		0.04	73		0.52	73		0.13	73	
SvcAutoRpr	0.12	789		-0.03	665		-0.14	789		-0.05	665	
SvcBiz	0.17	533		0.12	445		-0.07	533		-0.02	445	
SvcEngAcct	-0.04	175		-0.07	133		-0.24	175		-0.25	133	
SvcFinAvg	0.54	47		0.65	47		-0.03	47		0.10	47	
SvcFinLite	-0.30	33		-0.40	26		-0.18	33		-0.18	26	
SvcHotel	0.29	53		-0.15	53		-0.16	53		-0.18	53	
SvcMedic	0.61	79		-0.01	79		0.45	79		0.19	79	
SvcMemberOrgs	0.09	273		-0.09	227		0.04	273		-0.11	227	
SvcMisc	0.65	26		-0.08	22		0.60	26		-0.21	22	
SvcPers	0.53	50		0.17	29		0.26	50		0.26	29	
SvcRealEst	-0.30	239		-0.26	203		-0.04	239		-0.07	203	
SvcSocial	0.54	161		0.48	122		-0.10	161		0.02	122	

Key:

- Indicates strong statistical correlation (positive or negative)
- Indicates moderate statistical correlation (positive or negative)
- Indicates weak or no statistical correlation

TABLE 4: WASTE COMPOSITION FOR THE FOUR MAJOR BUSINESS GROUPS

Table 4 shows the average composition of waste for each of the four major business categories used in the Study, and for all groups combined. For each business category, for each material type, the percent composition and the standard error are shown.

TABLE 4 WASTE COMPOSITION

All Material Categories, by Major Business Groupings

Material Type	All Groups (n = 260)		Manufacturing Groups (n = 52)		Miscellaneous Groups (n = 66)		Retail/Wholesale Groups (n = 78)		Services Groups (n = 64)	
	Percent Composition	Standard Error	Percent Composition	Standard Error	Percent Composition	Standard Error	Percent Composition	Standard Error	Percent Composition	Standard Error
Paper										
Uncoated Corrugated	7.8	0.6	6.4	0.9	7.2	1.1	10.2	1.2	6.5	0.9
High Grade Paper	3.9	0.5	4.9	1.7	4.0	0.7	4.4	1.1	2.3	0.4
Text Books	0.3	0.1	0.0	0.0	0.4	0.3	0.1	0.0	0.6	0.3
Newspaper	3.3	0.4	1.7	0.4	4.6	1.0	3.3	0.6	3.4	0.6
Magazines	2.2	0.3	2.0	0.6	1.8	0.4	2.2	0.5	2.9	0.7
Phone Books	0.2	0.1	0.2	0.1	0.3	0.2	0.2	0.1	0.3	0.2
Mixed Paper	5.3	0.4	4.9	1.0	4.3	0.5	5.2	0.7	6.8	1.0
Other Paper	11.4	0.6	11.7	1.6	11.2	1.1	10.6	1.1	12.5	1.2
Plastic										
HDPE Bottles-Natural	0.3	0.1	0.4	0.2	0.3	0.1	0.1	0.0	0.3	0.1
HDPE Bottles-Colored	0.5	0.1	0.9	0.3	0.4	0.1	0.3	0.1	0.5	0.2
HDPE-Wide	0.2	0.0	0.3	0.1	0.1	0.0	0.2	0.1	0.1	0.1
PET-Slim	0.6	0.1	0.4	0.1	0.8	0.1	0.4	0.1	0.8	0.2
PET-Wide	0.1	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0
Film Plastics	8.2	0.5	10.7	1.6	7.2	0.8	10.0	1.1	4.9	0.5
Other Plastic Containers	0.5	0.2	0.3	0.1	0.4	0.1	0.2	0.1	1.4	0.7
Mixed Plastics	6.0	0.6	6.7	1.8	4.1	0.5	7.5	1.1	5.6	1.0
Glass										
CRV Glass	1.2	0.1	0.5	0.1	1.3	0.2	1.1	0.3	1.7	0.4
Other Recyclable Glass-Clear	0.4	0.1	0.2	0.1	0.2	0.0	0.4	0.1	0.7	0.2
Other Recyclable Glass-Color	0.3	0.1	0.2	0.1	0.3	0.1	0.3	0.1	0.3	0.1
Other Non-Recyclable Glass	1.1	0.3	0.3	0.1	1.7	1.0	0.6	0.2	1.6	0.7
Metal										
Aluminum Cans	0.3	0.0	0.3	0.1	0.3	0.0	0.3	0.1	0.3	0.1
Other Non-Ferrous Metals	0.7	0.2	0.6	0.2	0.6	0.2	1.1	0.5	0.3	0.1
Steel Food and Beverage Cans	0.4	0.1	0.4	0.1	0.5	0.1	0.2	0.1	0.4	0.1
Other Ferrous Metals	5.1	0.7	8.5	2.3	5.1	1.5	3.6	0.9	4.4	1.1
White Goods	0.1	0.1	0.0	0.0	0.3	0.3	0.2	0.2	0.0	0.0
Organics										
Leaves and Grass	3.2	0.7	1.2	0.5	6.0	2.0	2.2	1.2	3.1	1.0
Branches and Stumps	1.0	0.5	1.1	0.8	1.4	1.1	1.2	1.0	0.2	0.2
Prunings and Trimmings	1.4	0.5	0.1	0.1	1.1	0.6	1.2	0.8	3.2	1.5
Food Waste	9.6	1.0	10.7	2.8	9.3	1.9	8.0	1.5	11.1	2.0
Tires	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2
Other Rubber	1.4	0.5	2.2	1.1	0.6	0.2	2.4	1.4	0.6	0.2
Wood-Unpainted	7.4	1.0	12.5	3.1	5.0	1.5	9.7	1.8	3.0	1.0
Wood-Painted	1.7	0.4	1.5	0.9	2.8	1.4	0.8	0.3	1.7	0.7
Textiles and Leather	2.7	0.4	1.1	0.3	3.3	0.7	2.8	0.6	3.4	1.4
Diapers	0.4	0.1	0.3	0.2	0.3	0.1	0.2	0.1	0.1	0.4
Other Organic Waste	1.8	0.4	1.8	1.1	2.4	0.7	2.1	0.9	0.8	0.2
Other Waste										
Crushable Inerts	3.2	0.7	1.5	0.7	3.0	1.5	2.4	0.9	5.8	2.2
Other Inerts	2.4	0.5	1.1	0.6	3.1	1.0	1.2	0.5	4.3	1.6
Gypsum Wallboard - Painted	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.3
Gypsum Wallboard - Unpainted	0.5	0.2	0.0	0.0	1.0	0.8	0.2	0.2	0.7	0.3
Asphalt Roofing	0.3	0.2	0.0	0.0	0.5	0.5	0.0	0.0	0.5	0.4
Household Hazardous Waste	0.8	0.1	0.4	0.2	0.8	0.2	1.1	0.3	0.8	0.2
Brown Goods	1.0	0.2	0.8	0.4	1.1	0.5	0.9	0.3	0.9	0.4
Composite Bulky Items	0.3	0.1	0.5	0.3	0.5	0.3	0.2	0.1	0.0	0.0
Carpet	0.6	0.2	0.6	0.3	0.7	0.3	0.8	0.7	0.2	0.2
Miscellaneous Fines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	100.0		100.0		100.0		100.0		100.0	

Key:

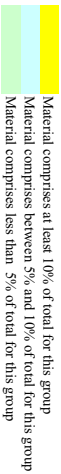


TABLE 4A: WASTE COMPOSITION

Table 4a shows, for each of the 48 business groups, the proportion of disposed waste represented by nineteen material types. The 19 material types are composites of the 46 types for which data was collected. This data is derived from waste sorts of 260 businesses included in the weight study. In the table, any material type that represents 10 percent or more of a business group's waste is shaded yellow, and any material type that represents between 5 and 10 percent is shaded blue. The last column in this table shows the number of businesses included in the waste sort for each group (n=x). For each material type for each business group, the percent composition and the standard error are shown. The standard error provides an indication of the variability of the data in each group. The higher the standard error, the more variable the data. Business groups that only had one sort (n=1) have a standard error of zero, since there is no variability in the data.

The following materials categories are composites:

Composite Category	Consisting Of
Newspaper/Magazines	Newspaper, Magazines
Other Paper	Text Books, Phonebooks, Other Paper
HDPE/PET	HDPE Bottles-Natural, HDPE Bottles-Colored, HDPE – Wide, PET- Slim, PET-Wide
Other Plastic	Other Plastic Containers, Mixed Plastic
Recyclable Glass	CRV Glass ,Other Recyclable Glass- Colored, Other Recyclable Glass- Clear
Other Metals	Other Non-Ferrous Metals, Other Ferrous Metals, White Goods
Yard Waste	Leaves and Grass, Branches and Stumps, Prunings and Trimmings
Other Organics	Tires, Other Rubber, Wood-Painted, Textiles and Leather, Diapers, Other Organic Waste
Inerts	Crushable Inerts, Other Inerts
Other Waste	Gypsum Wallboard – Painted, Gypsum Wallboard – Unpainted, Asphalt Roofing, Household Hazardous Waste, Brown Goods, Composite Bulky Items Carpet, Miscellaneous Fines

TABLE 4a WASTE

NINETEEN MATERIAL CATEGORIES

Material Type	OCC		High Grade		Newspaper/Magazines		Mixed Paper		Other Paper		HDPE/PET Containers		Film Plastics		Other Plastics		Recyclable Glass		Other Glass	
Business Group	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error	Mean Percent	Standard Error
All Groups	8.0	0.6	4.0	0.6	5.7	0.5	5.3	0.4	11.9	0.6	1.5	0.1	7.7	0.5	6.5	0.6	1.8	0.2	1.0	0.1
MfrChem	9.7	3.9	0.8	0.5	0.1	0.1	8.3	4.6	18.6	8.8	7.5	4.3	17.4	5.0	4.0	1.8	0.1	0.1	0.1	0.1
MfrElect	8.3	4.5	4.6	2.5	3.3	1.9	7.8	2.9	24.5	3.0	1.2	0.6	12.9	6.2	6.0	1.9	0.9	0.3	0.2	0.2
MfrFood	5.4	2.7	0.5	0.2	1.6	0.8	2.0	0.7	9.5	3.8	3.9	1.5	16.1	4.3	2.7	0.8	0.3	0.2	0.2	0.2
MfrFurn	5.3	0.0	64.9	0.0	2.5	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MfrInstrMisc	3.5	1.5	1.3	1.3	4.9	4.9	3.5	1.2	45.4	2.6	1.0	0.4	6.9	3.1	16.6	13.4	3.2	2.2	0.0	0.0
MfrMach	7.1	1.8	1.9	1.6	6.9	2.6	3.5	1.2	10.2	3.9	0.4	0.2	2.8	1.3	2.5	1.1	1.2	0.6	0.0	0.0
MfrMetal	10.9	3.3	6.2	5.1	5.1	1.6	7.2	5.8	9.0	1.6	1.4	0.3	10.2	4.1	4.5	1.9	0.9	0.3	0.0	0.0
MfrPaper	2.2	0.0	0.0	0.0	0.8	0.0	2.0	0.0	10.3	0.0	0.0	0.0	22.3	0.0	9.3	0.0	0.0	0.0	0.0	0.0
MfrPrint	4.1	0.8	10.7	6.6	2.1	0.6	9.4	3.4	11.7	2.2	1.4	0.8	16.1	7.2	6.8	1.2	1.6	0.8	0.0	0.0
MfrRubber	4.6	3.2	2.6	0.0	1.2	1.2	1.4	1.4	6.2	6.2	0.4	0.4	8.7	0.9	38.9	36.3	0.4	0.4	0.0	0.0
MfrStone	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MfrTextl	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MfrTrans	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MfrWood	0.6	0.3	0.1	0.1	1.6	0.9	0.2	0.2	0.1	0.1	0.1	0.1	0.3	0.3	12.3	12.3	0.1	0.1	1.0	1.0
Misc AgFish	0.6	0.4	3.0	3.0	1.0	0.9	0.9	0.7	3.2	3.0	0.2	0.2	0.1	0.1	2.1	1.7	0.2	0.2	0.0	0.0
Misc AmuseRecPks	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Misc Commun	4.3	2.1	3.4	2.0	3.4	1.4	5.2	2.7	10.3	3.6	0.9	0.3	2.7	1.2	4.2	2.6	1.9	1.5	2.0	2.0
Misc Construc	5.4	1.2	5.4	2.3	4.5	1.4	3.6	1.3	10.4	3.5	0.7	0.3	2.8	0.8	4.4	1.5	0.4	0.2	4.0	4.0
Misc Educ	9.7	4.5	1.0	0.5	12.5	9.3	6.2	2.7	13.9	5.0	1.3	0.7	5.4	0.8	2.7	0.2	2.3	1.5	0.0	0.0
Misc MovieMuseum	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Misc PubAdmin	5.0	1.9	6.4	3.9	7.5	3.7	5.9	2.1	13.6	4.0	1.6	0.5	6.2	1.4	3.7	0.9	3.7	1.3	2.0	2.0
Misc TransAir	6.8	1.8	3.7	1.7	16.5	7.4	6.3	2.3	16.1	3.4	1.3	0.5	10.4	1.6	7.2	2.8	3.9	1.8	0.0	0.0
Misc TransOth	4.8	1.7	4.0	2.2	11.0	5.9	3.8	1.1	11.7	2.5	1.3	0.4	6.2	1.5	2.4	0.4	2.2	0.6	0.0	0.0
Misc Trucking	15.2	4.2	3.3	0.9	3.4	0.9	3.7	0.8	11.3	2.5	1.9	0.6	12.5	2.6	4.8	0.7	1.7	0.5	1.0	1.0
Misc Utils	4.8	1.7	4.1	2.7	8.9	3.0	6.6	2.4	18.9	2.9	2.0	0.5	7.9	1.4	7.1	1.8	2.0	0.2	0.0	0.0
RetAppar	3.3	0.0	3.5	0.0	1.5	0.0	7.9	0.0	6.7	0.0	1.2	0.0	4.5	0.0	9.7	0.0	0.6	0.0	0.0	0.0
RetAuto	6.2	0.0	0.4	0.0	0.8	0.0	3.0	0.0	0.0	0.0	0.6	0.0	0.9	0.0	32.1	0.0	1.2	0.0	0.0	0.0
RetBldg	10.0	4.0	3.5	3.3	2.5	0.8	4.3	2.3	7.0	5.2	1.2	0.6	2.0	0.6	4.9	2.4	0.1	0.1	0.0	0.0
RetFood	8.8	4.6	10.4	10.1	3.4	1.8	3.7	2.2	6.9	3.1	2.0	1.8	14.1	6.1	0.7	0.2	0.7	0.6	0.0	0.0
RetFurn	9.8	2.8	0.3	0.2	5.1	3.7	5.8	3.6	5.6	1.9	0.4	0.2	9.4	4.5	4.3	2.1	1.0	0.4	0.0	0.0
RetMisc	5.9	2.9	2.5	0.8	13.0	3.7	9.4	4.4	10.8	4.5	1.2	0.2	10.0	4.1	5.5	2.3	1.9	0.8	2.0	2.0
RetRestr	8.1	7.6	0.0	0.0	11.9	0.4	2.4	0.4	38.5	3.6	1.0	0.7	10.5	4.5	4.9	0.9	1.1	0.3	0.0	0.0
RWhslDur	11.1	2.2	6.3	2.7	6.1	1.7	5.1	1.2	9.1	1.6	0.9	0.2	5.7	1.0	10.4	2.7	1.6	0.5	0.0	0.0
RWhslFood	8.4	2.5	1.0	0.4	1.5	0.4	3.0	1.2	13.2	3.9	0.7	0.3	15.1	3.9	4.7	0.9	1.2	0.5	0.0	0.0
RWhslNon	15.7	4.5	7.5	2.7	6.5	2.3	5.3	1.7	12.9	2.2	1.2	0.4	12.0	2.7	8.1	2.3	4.0	1.8	0.0	0.0
RWhslStone	9.5	0.3	0.9	0.5	6.1	4.1	4.7	4.5	11.6	1.4	1.5	1.4	3.2	0.2	5.6	3.7	1.6	1.6	0.0	0.0
SvcAuto&Rpr	7.2	1.2	0.7	0.3	6.3	1.9	5.0	1.1	12.9	2.5	2.3	0.6	4.1	1.2	7.3	2.4	3.5	1.5	3.0	3.0
SvcBiz	6.8	2.8	2.7	0.8	7.2	3.8	13.9	5.3	10.8	3.7	0.7	0.3	3.6	0.9	3.9	0.8	0.6	0.2	0.0	0.0
SvcEngAct	5.8	2.7	3.4	1.1	5.6	1.7	5.5	1.4	11.0	2.5	1.0	0.4	3.4	0.6	15.3	6.5	0.9	0.5	0.0	0.0
SvcFinAvg	10.1	4.8	6.2	4.2	9.6	4.1	8.7	2.9	18.9	5.4	1.2	0.3	8.5	1.8	4.6	1.4	1.7	0.8	0.0	0.0
SvcFineLite	37.8	0.0	12.3	0.0	8.9	0.0	3.3	0.0	13.1	0.0	2.2	0.0	3.1	0.0	5.6	0.0	3.5	0.0	0.0	0.0
SvcHotel	3.9	3.1	0.3	0.3	7.8	4.5	5.4	1.1	9.3	3.8	3.4	0.2	6.7	2.3	4.6	1.9	6.4	2.8	0.0	0.0
SvcMedic	8.9	3.4	2.2	0.8	7.6	2.2	7.6	2.5	15.1	4.3	1.3	0.4	5.3	0.5	5.4	2.3	2.8	1.7	1.0	1.0
SvcMemberOrgs	4.7	1.8	0.5	0.3	4.0	2.1	3.6	0.4	15.0	3.1	1.0	0.4	4.3	0.3	4.6	1.3	3.2	1.2	0.0	0.0
SvcMisc	1.5	0.8	0.3	0.3	2.5	1.8	2.1	1.9	1.4	1.1	0.2	0.2	1.8	1.6	1.0	1.0	0.5	0.3	0.0	0.0
SvcPers	2.4	0.0	0.1	0.0	3.1	0.0	7.8	0.0	6.7	0.0	9.4	0.0	8.2	0.0	4.1	0.0	6.8	0.0	0.0	0.0
SvcRealEst	3.6	1.8	3.3	1.7	7.0	3.0	5.6	2.0	18.0	4.3	1.9	0.9	7.3	1.9	2.8	0.4	2.4	0.8	1.0	1.0
SvcSocial	3.7	1.6	2.5	1.2	5.2	2.6	6.3	1.6	21.7	5.4	1.5	0.6	7.5	2.3	10.7	6.4	4.8	2.9	3.0	3.0

Notes: Blanks indicate no sort data was gathered for this business group.

Key:

- Material comprises at least 10% of total for this group
- Material comprises between 5% and 10% of total for this group
- Material comprises less than 5% of total for this group

TABLE 5: DESCRIPTIVE STATISTICS OF WASTE WEIGHT AND BUSINESS INFORMATION, BY COLLECTION ROUTE

Table 5 compares descriptive statistics for the four collection routes included in the study. This table shows the variability of four factors: weekly weight, density, gross sales, and number of employees, for weighed samples and business attributes for all of the businesses on the four routes included in the study. The table further breaks down each route into the four major business groups: manufacturing, miscellaneous, retail/wholesale, and service. The last set of columns, All Groups Combined, shows the combined data for all four major business groups; this information is also shown graphically in Figure 8.

Throughout Table 5, green shading indicates the lowest value among the four routes (not including All Routes) and yellow shading represents the highest value among the four. For example, for mean weekly weight for manufacturing groups, route 273 had the highest mean weight, route 271 had the highest standard error, and route 295 had the highest number of samples (n).

Table 5 indicates that, overall, the data is fairly consistent. For example, the mean weekly weights for manufacturing and miscellaneous groups from all four routes are quite consistent. However, for retail/wholesale, route 271 had a weight considerably higher than the mean for all groups, and route 295 had a weight considerably smaller than the mean.

This table indicates the problematic nature of Route 271. For all groups, for both weight and density, route 271 had the fewest number of samples, the largest standard error, and the most “highest” values for mean weight and density.

TABLE 5
DESCRIPTIVE STATISTICS OF WASTE WEIGHT AND BUSINESS INFORMATION FOR THE FOUR MAJOR BUSINESS GROUPS
SHOWN BY COLLECTION ROUTES.

Variable/Route	Manufacturing Groups		Miscellaneous Groups		Retail/Wholesale Groups		Service Groups		All Groups Combined							
	Std.		Std.		Std.		Std.		Std.							
	Mean	Error	n	Mean	Error	n	Mean	Error	n	Mean	Error	n				
Mean Weekly Weight																
All Routes	547.9	13.7	2,381	542.6	11.4	3,088	460.3	9.3	4,174	494.1	9.5	3,120	504.8	5.4	12,763	
	271	542.4	71.4	71	576.9	67.9	70	739.2	53.0	242	531.3	45.3	221	621.2	29.5	604
	273	617.2	33.5	542	550.6	22.3	727	497.5	19.6	1,000	553.6	16.7	1,110	546.6	10.8	3,379
	274	567.8	30.4	458	559.2	19.9	1,183	495.2	20.2	805	506.6	17.3	934	530.6	10.6	3,380
295	512.7	17.3	1,310	517.4	17.8	1,108	397.9	12.1	2,127	393.5	14.7	855	449.5	7.7	5,400	
Mean Density																
All Routes	172.1	3.4	2,381	150.4	2.8	3,088	161.1	2.4	4,174	154.4	3.2	3,120	158.9	1.4	12,763	
	271	209.6	29.2	71	160.2	21.4	70	222.0	11.5	242	159.1	13.6	221	190.4	8	604
	273	163.8	5.8	542	134.3	4.8	727	151.3	3.9	1,000	131.0	4.2	1,110	143	2.3	3,379
	274	202.6	10.1	458	152.2	4.9	1,183	221.4	7.0	805	198.8	7.7	934	188.4	3.5	3,380
295	162.8	4.2	1,310	158.3	4.8	1,108	135.9	2.9	2,127	134.9	4.4	855	146.9	2	5,400	
Mean Gross Sales (x 1,000)																
All Routes	2,579	252	2,017	2,606	109	1,899	2,886	113	3,443	930	53	2,051	2,337	73	9,410	
	271	2,800	469	52	2,239	1,445	23	2,379	340	187	1,206	159	135	2,027	200	397
	273	2,217	178	462	2,804	207	415	2,313	207	837	992	83	722	1,987	91	2,436
	274	1,896	128	431	2,520	189	542	3,212	304	550	786	120	540	2,120	105	2,063
295	3,000	464	1,072	2,577	168	919	3,098	159	1,869	924	92	654	2,653	134	4,514	
Mean Number of Employees																
All Routes	22.8	0.7	2,254	36.5	1.9	2,298	13.8	0.3	3,891	17.5	0.8	2,458	21.3	0.5	10,901	
	271	21.6	3.2	67	30.5	9.1	40	15.1	1.0	217	16.6	1.8	159	17.8	1.2	483
	273	33.7	2.2	505	54.9	6.3	534	15.4	0.6	940	24.0	1.8	864	28.7	1.4	2,843
	274	20.0	1.1	433	38.9	3.6	723	12.9	0.5	698	11.5	0.9	652	21.3	1.1	2,506
295	19.5	0.8	1,249	25.2	1.1	1,001	13.2	0.4	2,036	15.5	0.9	783	17.5	0.4	5,069	

Key:

Indicates highest value in set
Indicates lowest value in set

TABLE 6: COMPARISON OF STUDY SAMPLE TO COUNTYWIDE DATA

Table 6 compares two attributes of businesses within the study sample to data for the County as a whole. The first five columns show the number of employees in businesses within each group in the study sample, and the percent of the whole that this represents; the number of employees in each group in the entire iMarket database for Alameda County, and the percent of the whole that this represents; and the difference, plus or minus, between the two percentage figures. The next five columns provide the same comparison for the number of individual businesses within each business group.

Green shading in the table indicates business groups for which the sample size significantly under-represents the prevalence of that business group in the County. Green shading is applied if the percent of the whole sample represented by a business group is less than half of the percent of the whole county represented by that business group. For example, Manufacturing – Transportation businesses account for about 1 percent of all employees in Alameda County, but only about .4 percent of the sample. Since .4 is less than one half of 1, we applied green shading to these cells in the table.

MfrWood	10,203	1.4%	1,253	4.7%	2.7%	200	0.3%	20	1.0%	1.2%
MfrFurn	1,924	0.3%	188	0.7%	0.4%	120	0.2%	10	0.6%	0.4%
MfrInstrMisc	9,983	1.4%	386	1.4%	0.0%	558	1.0%	14	0.9%	-0.1%
MfrMach	25,522	3.6%	607	2.1%	-1.4%	677	1.2%	43	2.7%	1.5%
MfrMetal	9,388	1.3%	769	2.7%	1.4%	437	0.8%	51	3.2%	2.5%
MfrPaper	2,353	0.3%	184	0.6%	0.3%	78	0.1%	8	0.5%	0.4%
MfrPrint	7,609	1.1%	538	1.9%	0.8%	754	1.3%	26	1.6%	0.3%
MfrRubber	3,674	0.5%	210	0.7%	0.2%	117	0.2%	10	0.6%	0.4%
MfrStone	3,403	0.5%	116	0.4%	-0.1%	146	0.3%	12	0.8%	0.5%
MfrTextl	2,806	0.4%	161	0.6%	0.2%	211	0.4%	11	0.7%	0.3%
MfrTrans	7,021	1.0%	117	0.4%	-0.6%	94	0.2%	9	0.6%	0.4%
MfrWood	845	0.1%	52	0.2%	0.1%	125	0.2%	9	0.6%	0.4%
Misc Agfish	5,708	0.8%	160	0.6%	-0.2%	755	1.3%	7	0.4%	-0.9%
Misc AmuseRecPk	8,017	1.1%	23	0.1%	-1.0%	855	1.5%	8	0.5%	-1.0%
Misc Commun	8,278	1.2%	578	2.0%	0.9%	444	0.8%	11	0.7%	-0.1%
Misc Construc	33,344	4.6%	2,550	9.0%	4.4%	3,640	6.3%	119	7.5%	1.2%
Misc Education	45,474	6.3%	596	2.1%	-4.2%	1,040	1.8%	16	1.0%	-0.8%
Misc MovieMuseum	3,395	0.5%	68	0.2%	-0.2%	426	0.7%	6	0.4%	-0.4%
Misc PubAdmin	24,158	3.4%	1,655	5.8%	2.5%	387	0.7%	46	2.9%	2.2%
Misc TransAir	7,121	1.0%	3,057	10.8%	9.8%	74	0.1%	15	0.9%	0.8%
Misc TransOth	9,652	1.3%	850	3.0%	1.7%	750	1.3%	39	2.5%	1.2%
Misc Trucking	11,618	1.6%	1,384	4.9%	3.3%	832	1.4%	73	4.6%	3.2%
Misc Utilis	5,639	0.8%	93	0.3%	-0.5%	138	0.2%	19	1.2%	1.0%
RetApar	6,505	0.9%	12	0.0%	-0.9%	821	1.4%	1	0.1%	-1.4%
RetAuto	8,787	1.2%	237	0.8%	-0.4%	832	1.4%	23	1.5%	0.0%
RetBldg	3,872	0.5%	166	0.6%	0.0%	347	0.6%	13	0.8%	0.2%
RetFood	15,171	2.1%	128	0.5%	-1.7%	1,237	2.2%	26	1.6%	-0.5%
RetFurn	8,226	1.1%	175	0.6%	-0.5%	1,279	2.2%	22	1.4%	-0.8%
RetMisc	19,417	2.7%	465	1.6%	-1.1%	3,489	6.1%	40	2.5%	-3.5%
RetRestr	26,751	3.7%	778	2.7%	-1.0%	2,759	4.8%	65	4.1%	-0.7%
RWInslDur	34,491	4.8%	2,515	8.9%	4.1%	2,873	5.0%	196	12.4%	7.4%
RWInslFood	15,084	2.1%	1,019	3.6%	1.5%	795	1.4%	66	4.2%	2.8%
RWInslNondur	7,229	1.0%	744	2.6%	1.6%	569	1.0%	38	2.4%	1.4%
RWInslStone	420	0.1%	90	0.3%	0.3%	58	0.1%	10	0.6%	0.5%
SvcAutoRpr	8,494	1.2%	563	2.0%	0.8%	1,680	2.9%	71	4.5%	1.6%
SvcBiz	68,765	9.6%	2,117	7.5%	-2.1%	5,928	10.3%	84	5.3%	-5.0%
SvcEngAcct	60,594	8.4%	708	2.5%	-5.9%	4,080	7.1%	29	1.8%	-5.3%
SvcFinAvg	22,082	3.1%	78	0.3%	-2.8%	951	1.7%	12	0.8%	-0.9%
SvcFinLie	7,574	1.1%	80	0.3%	-0.8%	954	1.7%	4	0.3%	-1.4%
SvcHotel	5,729	0.8%	197	0.7%	-0.1%	270	0.5%	12	0.8%	0.3%
SvcMedic	53,077	7.4%	366	1.3%	-6.1%	3,552	6.2%	11	0.7%	-5.5%
SvcMemberOrgs	16,047	2.2%	176	0.6%	-1.6%	1,973	3.4%	36	2.3%	-1.2%
SvcMisc	2,067	0.3%	18	0.1%	-0.2%	273	0.5%	6	0.4%	-0.1%
SvcPers	10,384	1.4%	99	0.3%	-1.1%	3,033	5.3%	7	0.4%	-4.8%
SvcRealEst	12,500	1.7%	426	1.5%	-0.2%	2,337	4.1%	75	4.7%	0.7%
SvcSocial	15,507	2.2%	417	1.5%	-0.7%	1,665	2.9%	26	1.6%	-1.3%
Other	17,193	2.4%	439	1.6%	-0.8%	2,253	3.9%	90	5.7%	1.8%
TOTAL	717,942	100%	28,316	100%	-	57,527	100%	1,583	100%	-

Key:

Indicates that the sample significantly under-represents

Countywide prevalence of the business group.

TABLE 7: COMMERCIAL WASTE DISPOSAL IN ALAMEDA COUNTY

Table 7 shows, for each of the 48 business groups, the predicted amount of waste produced in the County each year by each business group. These figures are achieved by multiplying the number of businesses in each group by the mean weekly waste weight for that group (Table 2), and multiplying this product by 52 (52 weeks in a year). The yellow shading in Table 7 indicates the six business groups that we predict contribute at least five percent of the total disposed commercial waste in the County: Miscellaneous Construction; Retail Restaurants; Business Services; Engineering and Accounting Services; Medical Services; and Real Estate Services. Table 6 also indicates by blue shading the nine other business groups that we predict contribute between two and five percent of the County's disposed commercial waste.

Table 7 also shows the average per employee waste generation rate for each of the 48 business groups. These figures are derived by dividing the predicted annual disposal for a business group by the number of employees in that group. There is considerable variability in the per employee generation rate between business groups, from a low of less than 500 pounds per year to a high of nearly 7,000 pounds. This represents a range of difference of more than an order of magnitude. It should be recalled, however, that these figures are only reliable to the extent of the strength of the mean weekly waste disposal figure calculated for each of the business groups. The major business category with the lowest per employee figure is manufacturing, at just over 1,000 pounds per employee per year, while Retail/Wholesale had the highest figure, at just over 2,500 pounds per year.

TABLE 7
COMMERCIAL WASTE DISPOSAL IN ALAMEDA COUNTY
By Business Groups Used in the Study

Business Group	Number of Businesses	Disposed Waste: Tons per Year/1/	Percentage of Total Waste	Number of Employees	Lbs/ Employee/ Year
Manufacturing	4,178	55,255	7.6%	109,572	1,009
MfrChem	159	1,597	0.2%	6,323	505
MfrElect	442	8,263	1.1%	18,518	892
MfrFood	260	7,755	1.1%	10,203	1,520
MfrFurn	120	2,192	0.3%	1,924	2,278
MfrInstrMisc	558	4,756	0.7%	9,983	953
MfrMach	677	7,026	1.0%	25,522	551
MfrMetal	437	4,864	0.7%	9,388	1,036
MfrPaper	78	1,000	0.1%	2,353	850
MfrPrint	754	7,932	1.1%	7,609	2,085
MfrRubber	117	1,816	0.2%	3,674	989
MfrStone	146	2,163	0.3%	3,403	1,271
MfrTextl	211	1,845	0.3%	2,806	1,315
MfrTrans	94	1,549	0.2%	7,021	441
MfrWood	125	2,497	0.3%	845	5,910
Miscellaneous	9,341	143,963	19.8%	162,404	1,773
Misc Agfish	755	18,634	2.6%	5,708	6,529
Misc AmuseRecPks	855	12,076	1.7%	8,017	3,013
Misc Commun	444	4,224	0.6%	8,278	1,021
Misc Construc	3,640	54,650	7.5%	33,344	3,278
Misc Education	1,040	21,814	3.0%	45,474	959
Misc MovieMuseum	426	3,413	0.5%	3,395	2,011
Misc PubAdmin	387	5,321	0.7%	24,158	441
Misc TransAir	74	1,698	0.2%	7,121	477
Misc TransOth	750	11,360	1.6%	9,652	2,354
Misc Trucking	832	9,311	1.3%	11,618	1,603
Misc Utils	138	1,462	0.2%	5,639	518
Retail/Wholesale	15,059	184,766	25.4%	145,953	2,532
RetAppar	821	7,178	1.0%	6,505	2,207
RetAuto	832	7,851	1.1%	8,787	1,787
RetBldg	347	5,176	0.7%	3,872	2,673
RetFood	1,237	13,020	1.8%	15,171	1,716
RetFurn	1,279	20,324	2.8%	8,226	4,942
RetMisc	3,489	28,345	3.9%	19,417	2,920
RetRestr	2,759	54,848	7.5%	26,751	4,101
RWslDur	2,873	27,527	3.8%	34,491	1,596
RWslFood	795	12,917	1.8%	15,084	1,713
RWslNondur	569	6,125	0.8%	7,229	1,694
RWslStone	58	1,456	0.2%	420	6,932
Services	26,696	314,881	43.2%	282,820	2,227
SvcAutoRpr	1,680	20,190	2.8%	8,494	4,754
SvcBiz	5,928	67,984	9.3%	68,765	1,977
SvcEngAcct	4,080	50,496	6.9%	60,594	1,667
SvcFinAvg	951	10,324	1.4%	22,082	935
SvcFinLite	954	5,607	0.8%	7,574	1,481
SvcHotel	270	5,917	0.8%	5,729	2,066
SvcMedic	3,552	53,051	7.3%	53,077	1,999
SvcMemberOrgs	1,973	17,277	2.4%	16,047	2,153
SvcMisc	273	4,611	0.6%	2,067	4,461
SvcPers	3,033	16,544	2.3%	10,384	3,187
SvcRealEst	2,337	43,100	5.9%	12,500	6,896
SvcSocial	1,665	19,778	2.7%	15,507	2,551
Other	2,253	29,570	4.1%	17,193	3,440
All Groups	57,527	728,434	100%	717,942	2,029

Key: Between 2% and 5% of total County waste
 Over 5% of total County waste

Notes: /1/ Calculated by multiplying mean weekly disposed weight by number of businesses in group and number of weeks in one year.

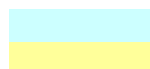
TABLE 8: COMMERCIAL WASTE DISPOSAL IN ALAMEDA COUNTY CITIES

Table 8a-o shows, for each city in the County and for the unincorporated area the number of businesses within each of the 48 business groups and the predicted weight of the waste disposed each year by each business group. Waste weight is derived by multiplying the mean weekly disposed waste weight by the number of businesses in the business group, and multiplying this product by 52 (as there are 52 weeks in one year). In each table, the business groups that represent at least 5 percent of total disposed weight are shaded yellow, and those that represent between 2 and 5 percent are shaded blue.

TABLE 8a
CITY OF ALAMEDA

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	5	50	0.1%
MfrElect	12	224	0.7%
MfrFood	4	119	0.4%
MfrFurn	3	55	0.2%
MfrInstrMisc	18	153	0.5%
MfrMach	15	156	0.5%
MfrMetal	8	89	0.3%
MfrPaper		-	0.0%
MfrPrint	36	379	1.1%
MfrRubber	1	16	0.0%
MfrStone	6	89	0.3%
MfrTextl	12	105	0.3%
MfrTrans	11	181	0.5%
MfrWood	10	200	0.6%
Misc Agfish	16	395	1.2%
Misc AmuseRecPks	51	720	2.1%
Misc Commun	26	247	0.7%
Misc Construc	133	1,997	5.9%
Misc Education	55	1,154	3.4%
Misc MovieMuseum	24	192	0.6%
Misc PubAdmin	28	385	1.1%
Misc TransAir	5	115	0.3%
Misc TransOth	49	742	2.2%
Misc Trucking	26	291	0.9%
Misc Utils	6	64	0.2%
RetAppar	36	315	0.9%
RetAuto	48	453	1.3%
RetBldg	13	194	0.6%
RetFood	61	642	1.9%
RetFurn	58	922	2.7%
RetMisc	177	1,438	4.2%
RetRestr	153	3,042	8.9%
RWhslDur	66	632	1.9%
RWhslFood	15	244	0.7%
RWhslNondur	24	258	0.8%
RWhslStone	1	25	0.1%
SvcAutoRpr	58	697	2.0%
SvcBiz	304	3,486	10.2%
SvcEngAcct	237	2,933	8.6%
SvcFinAvg	44	478	1.4%
SvcFinLite	45	264	0.8%
SvcHotel	9	197	0.6%
SvcMedic	175	2,614	7.7%
SvcMemberOrgs	100	876	2.6%
SvcMisc	16	270	0.8%
SvcPers	197	1,075	3.2%
SvcRealEst	137	2,527	7.4%
SvcSocial	66	784	2.3%
Other	118	1,549	4.6%
All Groups	2718	34,032	100.0%

Key:

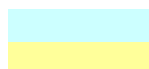


Between 2% and 5% of total
Over 5% of total

TABLE 8b
CITY OF ALBANY

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	1	10	0.1%
MfrElect	2	37	0.4%
MfrFood	1	30	0.3%
MfrFurn		-	0.0%
MfrInstrMisc	6	51	0.6%
MfrMach		-	0.0%
MfrMetal		-	0.0%
MfrPaper		-	0.0%
MfrPrint	9	95	1.0%
MfrRubber		-	0.0%
MfrStone	1	15	0.2%
MfrTextl	1	9	0.1%
MfrTrans	1	16	0.2%
MfrWood		-	0.0%
Misc Agfish	9	222	2.4%
Misc AmuseRecPks	19	268	2.9%
Misc Commun	2	19	0.2%
Misc Construc	31	465	5.1%
Misc Education	14	294	3.2%
Misc MovieMuseum	10	80	0.9%
Misc PubAdmin	5	69	0.8%
Misc TransAir		-	0.0%
Misc TransOth	11	167	1.8%
Misc Trucking	1	11	0.1%
Misc Utils	1	11	0.1%
RetAppar	3	26	0.3%
RetAuto	7	66	0.7%
RetBldg	7	104	1.1%
RetFood	19	200	2.2%
RetFurn	20	318	3.5%
RetMisc	48	390	4.3%
RetRestr	47	934	10.3%
RWhslDur	12	115	1.3%
RWhslFood	7	114	1.2%
RWhslNondur	6	65	0.7%
RWhslStone		-	0.0%
SvcAutoRpr	24	288	3.2%
SvcBiz	61	700	7.7%
SvcEngAcct	57	705	7.7%
SvcFinAvg	10	109	1.2%
SvcFinLite	10	59	0.6%
SvcHotel	1	22	0.2%
SvcMedic	98	1,464	16.1%
SvcMemberOrgs	23	201	2.2%
SvcMisc	3	51	0.6%
SvcPers	52	284	3.1%
SvcRealEst	24	443	4.9%
SvcSocial	31	368	4.0%
Other	16	210	2.3%
All Groups	711	9,104	100.0%

Key:

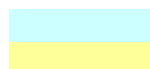


Between 2% and 5% of total
Over 5% of total

TABLE 8c
CITY OF BERKELEY

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	16	161	0.2%
MfrElect	25	467	0.6%
MfrFood	32	954	1.1%
MfrFurn	8	146	0.2%
MfrInstrMisc	55	469	0.6%
MfrMach	30	311	0.4%
MfrMetal	26	289	0.3%
MfrPaper	7	90	0.1%
MfrPrint	155	1,630	1.9%
MfrRubber	3	47	0.1%
MfrStone	19	282	0.3%
MfrTextl	29	254	0.3%
MfrTrans	2	33	0.0%
MfrWood	11	220	0.3%
Misc Agfish	82	2,024	2.4%
Misc AmuseRecPks	103	1,455	1.7%
Misc Commun	51	485	0.6%
Misc Construc	253	3,798	4.5%
Misc Education	254	5,328	6.4%
Misc MovieMuseum	84	673	0.8%
Misc PubAdmin	52	715	0.9%
Misc TransAir	1	23	0.0%
Misc TransOth	68	1,030	1.2%
Misc Trucking	29	325	0.4%
Misc Utils	5	53	0.1%
RetAppar	101	883	1.1%
RetAuto	45	425	0.5%
RetBldg	29	433	0.5%
RetFood	125	1,316	1.6%
RetFurn	166	2,638	3.2%
RetMisc	473	3,843	4.6%
RetRestr	336	6,680	8.0%
RWhslDur	146	1,399	1.7%
RWhslFood	63	1,024	1.2%
RWhslNondur	35	377	0.5%
RWhslStone	3	75	0.1%
SvcAutoRpr	145	1,743	2.1%
SvcBiz	685	7,856	9.4%
SvcEngAcct	650	8,045	9.6%
SvcFinAvg	45	489	0.6%
SvcFinLite	45	264	0.3%
SvcHotel	45	986	1.2%
SvcMedic	615	9,185	11.0%
SvcMemberOrgs	307	2,688	3.2%
SvcMisc	63	1,064	1.3%
SvcPers	256	1,396	1.7%
SvcRealEst	194	3,578	4.3%
SvcSocial	276	3,278	3.9%
Other	206	2,704	3.2%
All Groups	6454	83,628	100.0%

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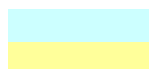


Between 2% and 5% of total
Over 5% of total

TABLE 8d
CITY OF DUBLIN

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem		-	0.0%
MfrElect	10	187	1.1%
MfrFood	6	179	1.0%
MfrFurn	1	18	0.1%
MfrInstrMisc	17	145	0.8%
MfrMach	12	125	0.7%
MfrMetal	6	67	0.4%
MfrPaper	2	26	0.1%
MfrPrint	18	189	1.1%
MfrRubber	1	16	0.1%
MfrStone	1	15	0.1%
MfrTextl	4	35	0.2%
MfrTrans	1	16	0.1%
MfrWood	2	40	0.2%
Misc Agfish	20	494	2.9%
Misc AmuseRecPks	23	325	1.9%
Misc Commun	7	67	0.4%
Misc Construc	89	1,336	7.8%
Misc Education	17	357	2.1%
Misc MovieMuseum	6	48	0.3%
Misc PubAdmin	18	247	1.4%
Misc TransAir		-	0.0%
Misc TransOth	16	242	1.4%
Misc Trucking	16	179	1.0%
Misc Utils	4	42	0.2%
RetAppar	24	210	1.2%
RetAuto	29	274	1.6%
RetBldg	19	283	1.7%
RetFood	22	232	1.3%
RetFurn	57	906	5.3%
RetMisc	96	780	4.5%
RetRestr	61	1,213	7.1%
RWhslDur	85	814	4.7%
RWhslFood	21	341	2.0%
RWhslNondur	11	118	0.7%
RWhslStone	1	25	0.1%
SvcAutoRpr	55	661	3.9%
SvcBiz	136	1,560	9.1%
SvcEngAcct	102	1,262	7.4%
SvcFinAvg	35	380	2.2%
SvcFinLite	40	235	1.4%
SvcHotel	6	131	0.8%
SvcMedic	40	597	3.5%
SvcMemberOrgs	34	298	1.7%
SvcMisc	2	34	0.2%
SvcPers	73	398	2.3%
SvcRealEst	55	1,014	5.9%
SvcSocial	36	428	2.5%
Other	43	564	3.3%
All Groups	1380	17,153	100.0%

Key:



Between 2% and 5% of total
Over 5% of total

TABLE 8e
CITY OF EMERYVILLE

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	9	90	0.5%
MfrElect	11	206	1.0%
MfrFood	14	418	2.1%
MfrFurn	12	219	1.1%
MfrInstrMisc	12	102	0.5%
MfrMach	15	156	0.8%
MfrMetal	15	167	0.8%
MfrPaper	2	26	0.1%
MfrPrint	54	568	2.9%
MfrRubber	2	31	0.2%
MfrStone	7	104	0.5%
MfrTextl	10	87	0.4%
MfrTrans	3	49	0.2%
MfrWood	2	40	0.2%
Misc Agfish	4	99	0.5%
Misc AmuseRecPks	31	438	2.2%
Misc Commun	12	114	0.6%
Misc Construc	100	1,501	7.6%
Misc Education	16	336	1.7%
Misc MovieMuseum	15	120	0.6%
Misc PubAdmin	6	82	0.4%
Misc TransAir	1	23	0.1%
Misc TransOth	39	591	3.0%
Misc Trucking	18	201	1.0%
Misc Utils	5	53	0.3%
RetAppar	15	131	0.7%
RetAuto	12	113	0.6%
RetBldg	14	209	1.1%
RetFood	37	389	2.0%
RetFurn	32	509	2.6%
RetMisc	67	544	2.7%
RetRestr	77	1,531	7.7%
RWhslDur	77	738	3.7%
RWhslFood	35	569	2.9%
RWhslNondur	26	280	1.4%
RWhslStone	4	100	0.5%
SvcAutoRpr	49	589	3.0%
SvcBiz	191	2,190	11.1%
SvcEngAcct	153	1,894	9.6%
SvcFinAvg	19	206	1.0%
SvcFinLite	15	88	0.4%
SvcHotel	9	197	1.0%
SvcMedic	36	538	2.7%
SvcMemberOrgs	63	552	2.8%
SvcMisc	10	169	0.9%
SvcPers	68	371	1.9%
SvcRealEst	63	1,162	5.9%
SvcSocial	25	297	1.5%
Other	48	630	3.2%
All Groups	1560	19,817	100.0%

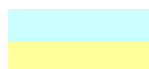
Key:

	Between 2% and 5% of total
	Over 5% of total

**TABLE 8f
CITY OF FREMONT**

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	18	181	0.2%
MfrElect	188	3,515	3.5%
MfrFood	9	268	0.3%
MfrFurn	15	274	0.3%
MfrInstrMisc	121	1,031	1.0%
MfrMach	219	2,273	2.3%
MfrMetal	55	612	0.6%
MfrPaper	4	51	0.1%
MfrPrint	69	726	0.7%
MfrRubber	16	248	0.3%
MfrStone	24	356	0.4%
MfrTextl	18	157	0.2%
MfrTrans	7	115	0.1%
MfrWood	10	200	0.2%
Misc Agfish	109	2,690	2.7%
Misc AmuseRecPks	106	1,497	1.5%
Misc Commun	87	828	0.8%
Misc Construc	482	7,237	7.3%
Misc Education	127	2,664	2.7%
Misc MovieMuseum	44	353	0.4%
Misc PubAdmin	34	467	0.5%
Misc TransAir	5	115	0.1%
Misc TransOth	82	1,242	1.3%
Misc Trucking	105	1,175	1.2%
Misc Utils	24	254	0.3%
RetAppar	68	594	0.6%
RetAuto	102	962	1.0%
RetBldg	43	641	0.6%
RetFood	122	1,284	1.3%
RetFurn	194	3,083	3.1%
RetMisc	454	3,688	3.7%
RetRestr	316	6,282	6.3%
RWhslDur	619	5,931	6.0%
RWhslFood	65	1,056	1.1%
RWhslNondur	67	721	0.7%
RWhslStone	4	100	0.1%
SvcAutoRpr	210	2,524	2.5%
SvcBiz	1049	12,030	12.1%
SvcEngAcct	541	6,696	6.8%
SvcFinAvg	148	1,607	1.6%
SvcFinLite	152	893	0.9%
SvcHotel	22	482	0.5%
SvcMedic	476	7,109	7.2%
SvcMemberOrgs	167	1,462	1.5%
SvcMisc	34	574	0.6%
SvcPers	355	1,936	2.0%
SvcRealEst	334	6,160	6.2%
SvcSocial	163	1,936	2.0%
Other	212	2,782	2.8%
All Groups	7895	99,066	100.0%

Key:

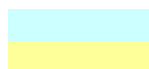


Between 2% and 5% of total
Over 5% of total

TABLE 8g
CITY OF HAYWARD

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	35	352	0.4%
MfrElect	47	879	1.1%
MfrFood	48	1,432	1.8%
MfrFurn	17	310	0.4%
MfrInstrMisc	62	528	0.7%
MfrMach	117	1,214	1.5%
MfrMetal	94	1,046	1.3%
MfrPaper	10	128	0.2%
MfrPrint	80	842	1.1%
MfrRubber	41	636	0.8%
MfrStone	14	207	0.3%
MfrTextl	24	210	0.3%
MfrTrans	14	231	0.3%
MfrWood	22	439	0.6%
Misc Agfish	79	1,950	2.5%
Misc AmuseRecPks	61	862	1.1%
Misc Commun	37	352	0.4%
Misc Construc	484	7,267	9.2%
Misc Education	88	1,846	2.3%
Misc MovieMuseum	32	256	0.3%
Misc PubAdmin	42	577	0.7%
Misc TransAir	22	505	0.6%
Misc TransOth	87	1,318	1.7%
Misc Trucking	174	1,947	2.5%
Misc Utils	20	212	0.3%
RetAppar	76	664	0.8%
RetAuto	150	1,415	1.8%
RetBldg	40	597	0.8%
RetFood	129	1,358	1.7%
RetFurn	112	1,780	2.3%
RetMisc	345	2,803	3.5%
RetRestr	276	5,487	6.9%
RWhslDur	519	4,973	6.3%
RWhslFood	156	2,535	3.2%
RWhslNondur	101	1,087	1.4%
RWhslStone	16	402	0.5%
SvcAutoRpr	275	3,305	4.2%
SvcBiz	555	6,365	8.1%
SvcEngAcct	229	2,834	3.6%
SvcFinAvg	84	912	1.2%
SvcFinLite	78	458	0.6%
SvcHotel	29	636	0.8%
SvcMedic	230	3,435	4.3%
SvcMemberOrgs	170	1,489	1.9%
SvcMisc	8	135	0.2%
SvcPers	245	1,336	1.7%
SvcRealEst	242	4,463	5.7%
SvcSocial	136	1,615	2.0%
Other	255	3,347	4.2%
All Groups	6207	78,977	100.0%

Key:

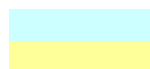


Between 2% and 5% of total
Over 5% of total

TABLE 8h
CITY OF LIVERMORE

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	5	50	0.1%
MfrElect	31	580	1.4%
MfrFood	15	447	1.1%
MfrFurn	5	91	0.2%
MfrInstrMisc	52	443	1.1%
MfrMach	46	477	1.2%
MfrMetal	34	378	0.9%
MfrPaper	7	90	0.2%
MfrPrint	26	274	0.7%
MfrRubber	4	62	0.2%
MfrStone	8	119	0.3%
MfrTextl	8	70	0.2%
MfrTrans	10	165	0.4%
MfrWood	9	180	0.4%
Misc Agfish	111	2,740	6.7%
Misc AmuseRecPks	66	932	2.3%
Misc Commun	14	133	0.3%
Misc Construc	399	5,991	14.6%
Misc Education	62	1,300	3.2%
Misc MovieMuseum	18	144	0.4%
Misc PubAdmin	15	206	0.5%
Misc TransAir	4	92	0.2%
Misc TransOth	25	379	0.9%
Misc Trucking	45	504	1.2%
Misc Utils	12	127	0.3%
RetAppar	21	184	0.4%
RetAuto	53	500	1.2%
RetBldg	28	418	1.0%
RetFood	39	410	1.0%
RetFurn	58	922	2.2%
RetMisc	191	1,552	3.8%
RetRestr	96	1,908	4.6%
RWhslDur	183	1,753	4.3%
RWhslFood	31	504	1.2%
RWhslNondur	27	291	0.7%
RWhslStone	6	151	0.4%
SvcAutoRpr	75	901	2.2%
SvcBiz	317	3,635	8.8%
SvcEngAcct	216	2,673	6.5%
SvcFinAvg	32	347	0.8%
SvcFinLite	44	259	0.6%
SvcHotel	13	285	0.7%
SvcMedic	131	1,957	4.8%
SvcMemberOrgs	73	639	1.6%
SvcMisc	23	388	0.9%
SvcPers	150	818	2.0%
SvcRealEst	133	2,453	6.0%
SvcSocial	85	1,010	2.5%
Other	92	1,207	2.9%
All Groups	3148	41,139	100.0%

Key:

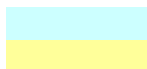


Between 2% and 5% of total
Over 5% of total

TABLE 8i
CITY OF NEWARK

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	9	90	0.5%
MfrElect	9	168	1.0%
MfrFood	4	119	0.7%
MfrFurn	3	55	0.3%
MfrInstrMisc	15	128	0.7%
MfrMach	23	239	1.4%
MfrMetal	10	111	0.6%
MfrPaper	2	26	0.1%
MfrPrint	8	84	0.5%
MfrRubber	8	124	0.7%
MfrStone	7	104	0.6%
MfrTextl	3	26	0.1%
MfrTrans	3	49	0.3%
MfrWood	7	140	0.8%
Misc Agfish	10	247	1.4%
Misc AmuseRecPks	22	311	1.8%
Misc Commun	13	124	0.7%
Misc Construc	90	1,351	7.7%
Misc Education	23	482	2.8%
Misc MovieMuseum	11	88	0.5%
Misc PubAdmin	5	69	0.4%
Misc TransAir		-	0.0%
Misc TransOth	16	242	1.4%
Misc Trucking	29	325	1.9%
Misc Utils	4	42	0.2%
RetAppar	54	472	2.7%
RetAuto	27	255	1.5%
RetBldg	12	179	1.0%
RetFood	44	463	2.6%
RetFurn	50	795	4.5%
RetMisc	132	1,072	6.1%
RetRestr	105	2,087	11.9%
RWhslDur	76	728	4.2%
RWhslFood	14	227	1.3%
RWhslNondur	16	172	1.0%
RWhslStone	1	25	0.1%
SvcAutoRpr	53	637	3.6%
SvcBiz	130	1,491	8.5%
SvcEngAcct	50	619	3.5%
SvcFinAvg	31	337	1.9%
SvcFinLite	27	159	0.9%
SvcHotel	7	153	0.9%
SvcMedic	42	627	3.6%
SvcMemberOrgs	37	324	1.9%
SvcMisc	1	17	0.1%
SvcPers	96	524	3.0%
SvcRealEst	30	553	3.2%
SvcSocial	24	285	1.6%
Other	42	551	3.2%
All Groups	1435	17,498	100.0%

Key:

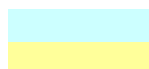


Between 2% and 5% of total
Over 5% of total

TABLE 8j
CITY OF OAKLAND

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	25	251	0.1%
MfrElect	42	785	0.4%
MfrFood	58	1,730	1.0%
MfrFurn	29	530	0.3%
MfrInstrMisc	84	716	0.4%
MfrMach	61	633	0.3%
MfrMetal	84	935	0.5%
MfrPaper	19	244	0.1%
MfrPrint	166	1,746	1.0%
MfrRubber	13	202	0.1%
MfrStone	31	459	0.3%
MfrTextl	66	577	0.3%
MfrTrans	20	330	0.2%
MfrWood	28	559	0.3%
Misc Agfish	124	3,060	1.7%
Misc AmuseRecPks	220	3,107	1.7%
Misc Commun	102	970	0.5%
Misc Construc	690	10,360	5.7%
Misc Education	232	4,866	2.7%
Misc MovieMuseum	112	897	0.5%
Misc PubAdmin	137	1,884	1.0%
Misc TransAir	30	688	0.4%
Misc TransOth	206	3,120	1.7%
Misc Trucking	168	1,880	1.0%
Misc Utils	29	307	0.2%
RetAppar	246	2,151	1.2%
RetAuto	196	1,849	1.0%
RetBldg	64	955	0.5%
RetFood	410	4,315	2.4%
RetFurn	249	3,957	2.2%
RetMisc	816	6,629	3.6%
RetRestr	736	14,631	8.1%
RWhslDur	457	4,379	2.4%
RWhslFood	189	3,071	1.7%
RWhslNondur	115	1,238	0.7%
RWhslStone	7	176	0.1%
SvcAutoRpr	447	5,372	3.0%
SvcBiz	1372	15,734	8.7%
SvcEngAcct	1141	14,122	7.8%
SvcFinAvg	255	2,768	1.5%
SvcFinLite	244	1,434	0.8%
SvcHotel	88	1,929	1.1%
SvcMedic	1003	14,980	8.2%
SvcMemberOrgs	717	6,278	3.5%
SvcMisc	84	1,419	0.8%
SvcPers	903	4,926	2.7%
SvcRealEst	561	10,346	5.7%
SvcSocial	573	6,806	3.7%
Other	863	11,327	6.2%
All Groups	14512	181,630	100.0%

Key:

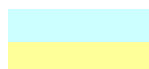


Between 2% and 5% of total
Over 5% of total

TABLE 8k
CITY OF PIEDMONT

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem		-	0.0%
MfrElect	1	19	2.3%
MfrFood	2	60	7.3%
MfrFurn		-	0.0%
MfrInstrMisc	1	9	1.0%
MfrMach		-	0.0%
MfrMetal		-	0.0%
MfrPaper		-	0.0%
MfrPrint	2	21	2.6%
MfrRubber		-	0.0%
MfrStone	1	15	1.8%
MfrTextl		-	0.0%
MfrTrans		-	0.0%
MfrWood		-	0.0%
Misc Agfish		-	0.0%
Misc AmuseRecPks	2	28	3.5%
Misc Commun		-	0.0%
Misc Construc	4	60	7.4%
Misc Education		-	0.0%
Misc MovieMuseum	1	8	1.0%
Misc PubAdmin		-	0.0%
Misc TransAir		-	0.0%
Misc TransOth	1	15	1.9%
Misc Trucking	1	11	1.4%
Misc Utils		-	0.0%
RetAppar	1	9	1.1%
RetAuto		-	0.0%
RetBldg		-	0.0%
RetFood		-	0.0%
RetFurn	2	32	3.9%
RetMisc	4	32	4.0%
RetRestr	2	40	4.9%
RWhslDur	5	48	5.9%
RWhslFood	3	49	6.0%
RWhslNondur		-	0.0%
RWhslStone		-	0.0%
SvcAutoRpr		-	0.0%
SvcBiz	9	103	12.7%
SvcEngAcct	7	87	10.7%
SvcFinAvg		-	0.0%
SvcFinLite	1	6	0.7%
SvcHotel	1	22	2.7%
SvcMedic	2	30	3.7%
SvcMemberOrgs	3	26	3.2%
SvcMisc	1	17	2.1%
SvcPers		-	0.0%
SvcRealEst	3	55	6.8%
SvcSocial	1	12	1.5%
Other	0	-	0.0%
All Groups	61	813	100.0%

Key:

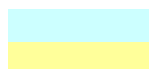


Between 2% and 5% of total
Over 5% of total

**TABLE 81
CITY OF PLEASANTON**

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	10	100	0.2%
MfrElect	27	505	1.0%
MfrFood	16	477	1.0%
MfrFurn	3	55	0.1%
MfrInstrMisc	46	392	0.8%
MfrMach	44	457	0.9%
MfrMetal	19	211	0.4%
MfrPaper	3	38	0.1%
MfrPrint	44	463	0.9%
MfrRubber	5	78	0.2%
MfrStone	10	148	0.3%
MfrTextl	9	79	0.2%
MfrTrans	5	82	0.2%
MfrWood	7	140	0.3%
Misc Agfish	81	1,999	4.0%
Misc AmuseRecPks	53	749	1.5%
Misc Commun	51	485	1.0%
Misc Construc	272	4,084	8.2%
Misc Education	44	923	1.8%
Misc MovieMuseum	22	176	0.4%
Misc PubAdmin	16	220	0.4%
Misc TransAir	1	23	0.0%
Misc TransOth	34	515	1.0%
Misc Trucking	28	313	0.6%
Misc Utils	8	85	0.2%
RetAppar	78	682	1.4%
RetAuto	41	387	0.8%
RetBldg	21	313	0.6%
RetFood	53	558	1.1%
RetFurn	104	1,653	3.3%
RetMisc	218	1,771	3.5%
RetRestr	164	3,260	6.5%
RWhslDur	177	1,696	3.4%
RWhslFood	56	910	1.8%
RWhslNondur	37	398	0.8%
RWhslStone	3	75	0.2%
SvcAutoRpr	68	817	1.6%
SvcBiz	508	5,826	11.7%
SvcEngAcct	372	4,604	9.2%
SvcFinAvg	126	1,368	2.7%
SvcFinLite	116	682	1.4%
SvcHotel	19	416	0.8%
SvcMedic	230	3,435	6.9%
SvcMemberOrgs	71	622	1.2%
SvcMisc	14	236	0.5%
SvcPers	199	1,086	2.2%
SvcRealEst	202	3,725	7.5%
SvcSocial	89	1,057	2.1%
Other	117	1,536	3.1%
All Groups	3941	49,911	100.0%

Key:

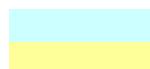


Between 2% and 5% of total
Over 5% of total

TABLE 8m
CITY OF SAN LEANDRO

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	19	191	0.4%
MfrElect	18	336	0.7%
MfrFood	31	925	1.9%
MfrFurn	14	256	0.5%
MfrInstrMisc	41	349	0.7%
MfrMach	52	540	1.1%
MfrMetal	55	612	1.3%
MfrPaper	15	192	0.4%
MfrPrint	50	526	1.1%
MfrRubber	11	171	0.4%
MfrStone	9	133	0.3%
MfrTextl	19	166	0.3%
MfrTrans	12	198	0.4%
MfrWood	9	180	0.4%
Misc Agfish	32	790	1.7%
Misc AmuseRecPks	41	579	1.2%
Misc Commun	17	162	0.3%
Misc Construc	280	4,204	8.8%
Misc Education	35	734	1.5%
Misc MovieMuseum	19	152	0.3%
Misc PubAdmin	16	220	0.5%
Misc TransAir	5	115	0.2%
Misc TransOth	62	939	2.0%
Misc Trucking	97	1,086	2.3%
Misc Utils	9	95	0.2%
RetAppar	64	560	1.2%
RetAuto	67	632	1.3%
RetBldg	32	477	1.0%
RetFood	86	905	1.9%
RetFurn	107	1,700	3.6%
RetMisc	225	1,828	3.8%
RetRestr	197	3,916	8.2%
RWhslDur	287	2,750	5.8%
RWhslFood	86	1,397	2.9%
RWhslNondur	49	527	1.1%
RWhslStone	11	276	0.6%
SvcAutoRpr	145	1,743	3.7%
SvcBiz	265	3,039	6.4%
SvcEngAcct	157	1,943	4.1%
SvcFinAvg	63	684	1.4%
SvcFinLite	65	382	0.8%
SvcHotel	7	153	0.3%
SvcMedic	221	3,301	6.9%
SvcMemberOrgs	92	806	1.7%
SvcMisc	7	118	0.2%
SvcPers	204	1,113	2.3%
SvcRealEst	166	3,061	6.4%
SvcSocial	67	796	1.7%
Other	135	1,772	3.7%
All Groups	3773	47,731	100.0%

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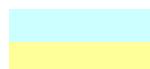


Between 2% and 5% of total
Over 5% of total

TABLE 8n
CITY OF UNION CITY

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	4	40	0.2%
MfrElect	15	280	1.5%
MfrFood	14	418	2.2%
MfrFurn	5	91	0.5%
MfrInstrMisc	13	111	0.6%
MfrMach	25	259	1.4%
MfrMetal	24	267	1.4%
MfrPaper	5	64	0.3%
MfrPrint	23	242	1.3%
MfrRubber	12	186	1.0%
MfrStone	4	59	0.3%
MfrTextl	4	35	0.2%
MfrTrans	4	66	0.4%
MfrWood	4	80	0.4%
Misc Agfish	13	321	1.7%
Misc AmuseRecPks	15	212	1.1%
Misc Commun	16	152	0.8%
Misc Construc	83	1,246	6.7%
Misc Education	24	503	2.7%
Misc MovieMuseum	14	112	0.6%
Misc PubAdmin	4	55	0.3%
Misc TransAir		-	0.0%
Misc TransOth	33	500	2.7%
Misc Trucking	64	716	3.8%
Misc Utils	4	42	0.2%
RetAppar	13	114	0.6%
RetAuto	22	208	1.1%
RetBldg	11	164	0.9%
RetFood	43	453	2.4%
RetFurn	33	524	2.8%
RetMisc	78	634	3.4%
RetRestr	85	1,690	9.0%
RWhslDur	117	1,121	6.0%
RWhslFood	39	634	3.4%
RWhslNondur	32	344	1.8%
RWhslStone	1	25	0.1%
SvcAutoRpr	28	337	1.8%
SvcBiz	153	1,755	9.4%
SvcEngAcct	56	693	3.7%
SvcFinAvg	23	250	1.3%
SvcFinLite	31	182	1.0%
SvcHotel	7	153	0.8%
SvcMedic	55	821	4.4%
SvcMemberOrgs	41	359	1.9%
SvcMisc	2	34	0.2%
SvcPers	70	382	2.0%
SvcRealEst	54	996	5.3%
SvcSocial	28	333	1.8%
Other	33	433	2.3%
All Groups	1481	18,697	100.0%

Key:

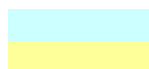


Between 2% and 5% of total
Over 5% of total

TABLE 8o
UNINCORPORATED COMMUNITIES
CASTRO VALLEY, SAN LORENZO, and SUNOL

Business Group	Number of Businesses	Disposed Waste: Tons per Year	Percentage of Total Waste
MfrChem	3	30	0.1%
MfrElect	4	75	0.3%
MfrFood	6	179	0.6%
MfrFurn	5	91	0.3%
MfrInstrMisc	15	128	0.4%
MfrMach	18	187	0.6%
MfrMetal	7	78	0.3%
MfrPaper	2	26	0.1%
MfrPrint	14	147	0.5%
MfrRubber	0	-	0.0%
MfrStone	4	59	0.2%
MfrTextl	4	35	0.1%
MfrTrans	1	16	0.1%
MfrWood	4	80	0.3%
Misc Agfish	65	1,604	5.5%
Misc AmuseRecPks	42	593	2.0%
Misc Commun	9	86	0.3%
Misc Construc	250	3,753	12.8%
Misc Education	49	1,028	3.5%
Misc MovieMuseum	14	112	0.4%
Misc PubAdmin	9	124	0.4%
Misc TransAir	0	-	0.0%
Misc TransOth	21	318	1.1%
Misc Trucking	31	347	1.2%
Misc Utils	7	74	0.3%
RetAppar	21	184	0.6%
RetAuto	33	311	1.1%
RetBldg	14	209	0.7%
RetFood	47	495	1.7%
RetFurn	37	588	2.0%
RetMisc	165	1,340	4.6%
RetRestr	108	2,147	7.3%
RWhslDur	47	450	1.5%
RWhslFood	15	244	0.8%
RWhslNondur	23	248	0.8%
RWhslStone	0	-	0.0%
SvcAutoRpr	48	577	2.0%
SvcBiz	193	2,213	7.6%
SvcEngAcct	112	1,386	4.7%
SvcFinAvg	36	391	1.3%
SvcFinLite	41	241	0.8%
SvcHotel	7	153	0.5%
SvcMedic	198	2,957	10.1%
SvcMemberOrgs	75	657	2.2%
SvcMisc	5	84	0.3%
SvcPers	165	900	3.1%
SvcRealEst	139	2,564	8.8%
SvcSocial	65	772	2.6%
Other	73	958	3.3%
All Groups	2251	29,240	100.0%

Key:



Between 2% and 5% of total
Over 5% of total

TABLE 9: SUMMARY OF STRENGTH OF DESCRIPTIVE STATISTICS

Table 9 summarizes the strength of statistics information provided in Table 2.

TABLE 9
SUMMARY OF STRENGTH OF DESCRIPTIVE STATISTICS

Waste Weight Information

	STRONG	MODERATE	WEAK		STRONG	MODERATE	WEAK
MEAN WEIGHT	MfrMetal	MfrFood	MfrChem	MEAN DENSITY	MfrMach	MfrChem	MfrInstrMisc
	MfrPrint	MfrFurn	MfrElect		MfrMetal	MfrElect	MfrTrans
	Misc Construc	MfrInstrMisc	MfrTrans		MfrPrint	MfrFood	RetAppar
	Misc TransOth	MfrMach	MfrWood		Misc Construc	MfrFurn	RWhslStone
	Misc Trucking	MfrPaper	Misc Agfish		Misc Education	MfrPaper	SvcFinLite
	RetAuto	MfrRubber	Misc TransAir		Misc PubAdmin	MfrRubber	SvcHotel
	RetRestr	MfrStone	RetAppar		Misc TransOth	MfrStone	SvcMisc
	RWhslDur	MfrTextl	RWhslStone		Misc Trucking	MfrTextl	
	RWhslNondur	Misc AmuseRecPks	SvcMisc		RetFurn	MfrWood	
	SvcAutoRpr	Misc Commun	SvcPers		RetMisc	Misc Agfish	
	SvcBiz	Misc Education			RetRestr	Misc AmuseRecPks	
	SvcRealEst	Misc MovieMuseum			RWhslDur	Misc Commun	
		Misc PubAdmin			RWhslFood	Misc MovieMuseum	
		Misc Utils			RWhslNondur	Misc TransAir	
		RetBldg			SvcAutoRpr	Misc Utils	
		RetFood			SvcBiz	RetAuto	
		RetFurn			SvcMemberOrgs	RetBldg	
		RetMisc			SvcRealEst	RetFood	
		RWhslFood			SvcSocial	SvcEngAcct	
		SvcEngAcct				SvcFinAvg	
		SvcFinAvg				SvcMedic	
		SvcFinLite				SvcPers	
		SvcHotel					
		SvcMedic					
		SvcMemberOrgs					
		SvcSocial					

Business Attributes

	STRONG	MODERATE	WEAK		STRONG	MODERATE	WEAK
NUMBER OF EMPLOYEES	MfrMach	MfrElect	MfrChem	GROSS SALES	MfrMach	MfrChem	MfrFood
	MfrMetal	MfrFood	Misc Education		MfrMetal	MfrElect	MfrInstrMisc
	MfrPaper	MfrFurn	Misc MovieMuseum		MfrPaper	MfrFurn	Misc Commun
	MfrTextl	MfrInstrMisc	Misc PubAdmin		Misc Agfish	MfrPrint	Misc Education
	MfrTrans	MfrPrint	Misc TransAir		Misc AmuseRecPks	MfrRubber	Misc MovieMuseum
	Misc Construc	MfrRubber	Misc Utils		Misc Construc	MfrStone	Misc TransAir
	Misc Trucking	MfrStone	SvcFinLite		Misc Trucking	MfrTextl	Misc Utils
	RetAppar	MfrWood	SvcPers		RWhslDur	MfrTrans	RetBldg
	RetAuto	Misc Agfish			RWhslFood	MfrWood	RetMisc
	RetMisc	Misc AmuseRecPks				Misc PubAdmin	RetRestr
	RetRestr	Misc Commun				Misc TransOth	RWhslStone
	RWhslDur	Misc TransOth				RetAppar	SvcFinAvg
	RWhslFood	RetBldg				RetAuto	SvcFinLite
	RWhslNondur	RetFood				RetFood	SvcHotel
	RWhslStone	RetFurn				RetFurn	SvcMedic
	SvcAutoRpr	SvcBiz				RWhslNondur	SvcMisc
	SvcHotel	SvcEngAcct				SvcAutoRpr	SvcPers
	SvcMedic	SvcFinAvg				SvcBiz	SvcRealEst
	SvcMisc	SvcMemberOrgs				SvcEngAcct	
		SvcRealEst				SvcMemberOrgs	
		SvcSocial				SvcSocial	

TABLE 10: STRENGTH OF CORRELATION COEFFICIENTS

Table 10 summarizes the strength of correlation coefficients information provided in Table 3 and Figure 6.

TABLE 10
SUMMARY OF STRENGTH OF CORRELATION COEFFICIENTS

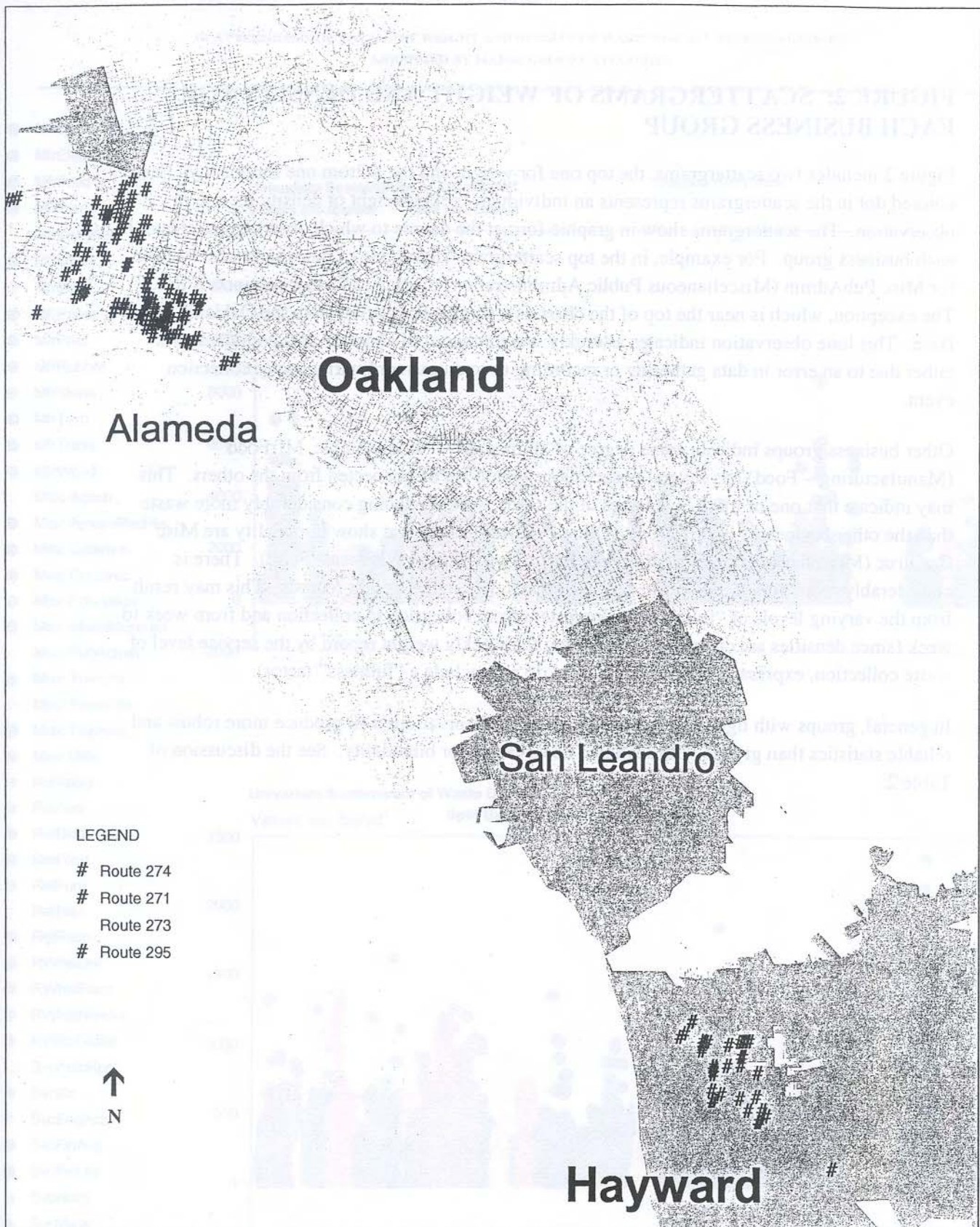
Waste Weight

	STRONG	MODERATE	WEAK		STRONG	MODERATE	WEAK
NET WT vs. NUMBER OF EMPLOYEES	MfrElect	MfrFurn	Mfrchem	NET WT vs. GROSS SALES	MfrElect	MfrFood	Mfrchem
	MfrInstrMisc	MfrMach	MfrFood		Misc TransAir	MfrInstrMisc	MfrFurn
	MfrTrans	MfrMetal	MfrPrint		SvcFinAvg	MfrPaper	MfrMach
	Misc Agfish	MfrPaper	MfrRubber			MfrTextl	MfrMetal
	Misc Commun	MfrTextl	MfrStone			Misc Commun	MfrPrint
	RetFurn	MfrWood	Misc AmuseRecPks			Misc Utils	MfrRubber
	RetRestr	Misc MovieMuseum	Misc Construc			RetFurn	MfrStone
	RWhslStone	RetAuto	Misc Education			SvcFinLite	MfrTrans
	SvcFinAvg	SvcFinLite	Misc PubAdmin			SvcSocial	MfrWood
	SvcMedic	SvcRealEst	Misc TransAir				Misc Agfish
	SvcMisc		Misc TransOth				Misc AmuseRecPks
	SvcPers		Misc Trucking				Misc Construc
	SvcSocial		Misc Utils				Misc Education
			RetAppar				Misc MovieMuseum
			RetBldg				Misc PubAdmin
			RetFood				Misc TransOth
			RetMisc				Misc Trucking
			RWhslDur				RetAppar
			RWhslFood				RetAuto
			RWhslNondur				RetBldg
			SvcAutoRpr				RetFood
			SvcBiz				RetMisc
			SvcEngAcct				RetRestr
			SvcHotel				RWhslDur
			SvcMemberOrgs				RWhslFood
							RWhslNondur
							RWhslStone
							SvcAutoRpr
							SvcBiz
							SvcEngAcct
							SvcHotel
							SvcMedic
							SvcMemberOrgs
							SvcMisc
							SvcPers
							SvcRealEst

Waste Density

	STRONG	MODERATE	WEAK		STRONG	MODERATE	WEAK
DENSITY vs. NUMBER OF EMPLOYEES	RWhslStone	MfrFurn	Mfrchem	DENSITY vs. GROSS SALES	MfrTrans	MfrElect	Mfrchem
	SvcMisc	MfrPaper	MfrElect			MfrFurn	MfrFood
		MfrWood	MfrFood			MfrPaper	MfrInstrMisc
		Misc Agfish	MfrInstrMisc			MfrRubber	MfrMach
		Misc Education	MfrMach			MfrWood	MfrMetal
		RetBldg	MfrMetal			Misc AmuseRecPks	MfrPrint
		SvcMedic	MfrPrint			Misc Education	MfrStone
			MfrRubber			RetBldg	MfrTextl
			MfrStone				Misc Agfish
			MfrTextl				Misc Commun
			MfrTrans				Misc Construc
			Misc AmuseRecPks				Misc MovieMuseum
			Misc Commun				Misc PubAdmin
			Misc Construc				Misc TransAir
			Misc MovieMuseum				Misc TransOth
			Misc PubAdmin				Misc Trucking
			Misc TransAir				Misc Utils
			Misc TransOth				RetAppar
			Misc Trucking				RetAuto
			Misc Utils				RetFood
			RetAppar				RetFurn
			RetAuto				RetMisc
			RetFood				RetRestr
			RetFurn				RWhslDur
			RetMisc				RWhslFood
			RetRestr				RWhslNondur
			RWhslDur				RWhslStone
			RWhslFood				SvcAutoRpr
			RWhslNondur				SvcBiz
			SvcAutoRpr				SvcEngAcct
			SvcBiz				SvcFinAvg
			SvcEngAcct				SvcFinLite
			SvcFinAvg				SvcHotel
			SvcFinLite				SvcMedic
			SvcHotel				SvcMemberOrgs
			SvcMemberOrgs				SvcMisc
			SvcPers				SvcPers
			SvcRealEst				SvcRealEst
			SvcSocial				SvcSocial

FIGURES



SOURCE: Environmental Science Associates

Alameda County Weight Based Study / 201282 ■

Figure 1

Location of Businesses in the Study Sample

FIGURE 2: SCATTERGRAMS OF WEIGHT AND DENSITY FOR EACH BUSINESS GROUP

Figure 2 includes two scattergrams, the top one for weight and the bottom one for density. Each colored dot in the scattergrams represents an individual weekly weight or density record, or observation. The scattergrams show in graphic format the degree to which observations cluster in each business group. For example, in the top scattergram, all but one of the weight observations for Misc PubAdmin (Miscellaneous Public Administration) overlap to form a continuous line. The exception, which is near the top of the chart, is a single observation from the Oakland Army Base. This lone observation indicates a weekly weight record of about 13,000 pounds, and is either due to an error in data gathering or recording or to an extraordinarily heavy collection event.

Other business groups indicate some degree of “bimodality.” For example, MfrFood (Manufacturing – Food) has several observations which are disconnected from the others. This may indicate that one or more businesses in the study were producing considerably more waste than the other businesses in this group. Other business groups that show bimodality are Misc Construc (Miscellaneous Construction) and RwhslFood (Retail-Wholesale Food). There is considerably more bimodality in the density records than in the weight records. This may result from the varying levels of “fullness” in dumpsters from collection to collection and from week to week (since densities are calculated by dividing the weekly weight record by the service level of waste collection, expressed in cubic yards, and do not include a “fullness” factor).

In general, groups with tight, consistent clustering of observations will produce more robust and reliable statistics than groups with scattered observations or bimodality. See the discussion of Table 2.

FIGURE 2

SCATTERGRAMS OF TOTAL NET WEIGHT AND DENSITY OF WASTE FOR ALL BUSINESS GROUPS
ARRANGED BY MAJOR GROUP CATEGORIES

- MfrChem
- MfrElect
- MfrFood
- MfrFurn
- MfrInstrMisc
- MfrMach
- MfrMetal
- MfrPaper
- MfrPrint
- MfrRubber
- MfrStone
- MfrTextl
- MfrTrans
- MfrWood
- Misc Agfish
- Misc AmuseRecPks
- Misc Commun
- Misc Construc
- Misc Education
- Misc MovieMuseum
- Misc PubAdmin
- Misc TransAir
- Misc TransOth
- Misc Trucking
- Misc Utils
- RetAppar
- RetAuto
- RetBldg
- RetFood
- RetFurn
- RetMisc
- RetRestr
- RWHslDur
- RWHslFood
- RWHslNondur
- RWHslStone
- SvcAutoRpr
- SvcBiz
- SvcEngAcct
- SvcFinAvg
- SvcFinLife
- SvcHotel
- SvcMedic
- SvcMemberOrgs
- SvcMisc
- SvcPers
- SvcRealEst
- SvcSocial

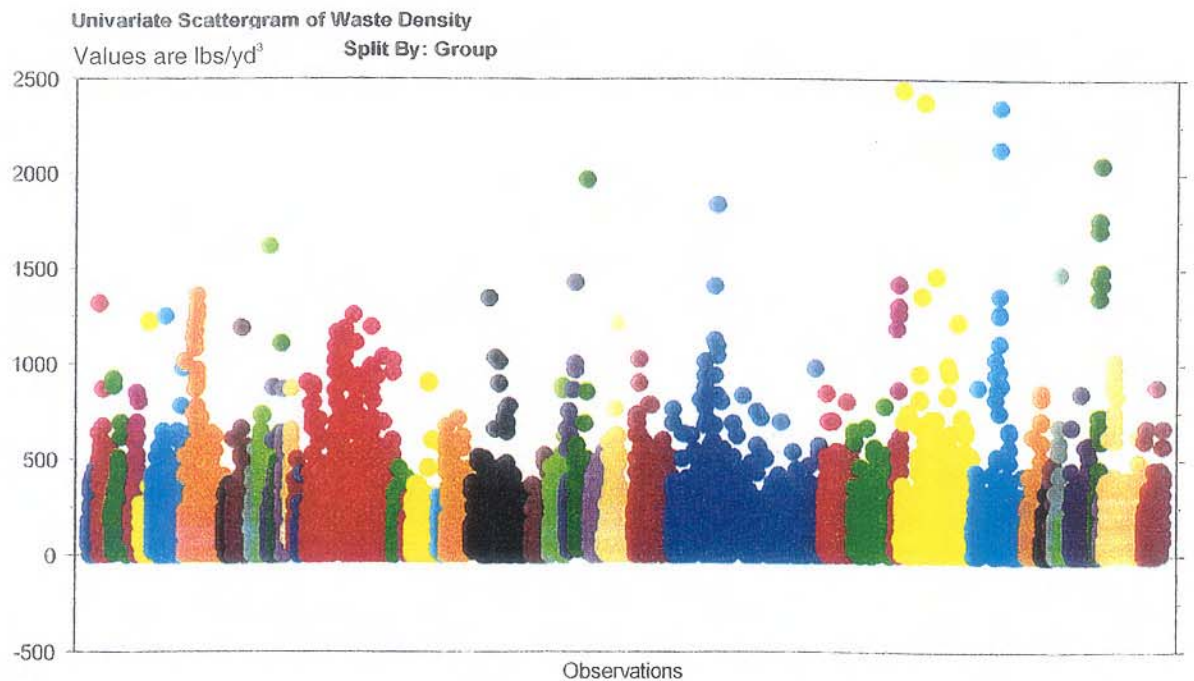
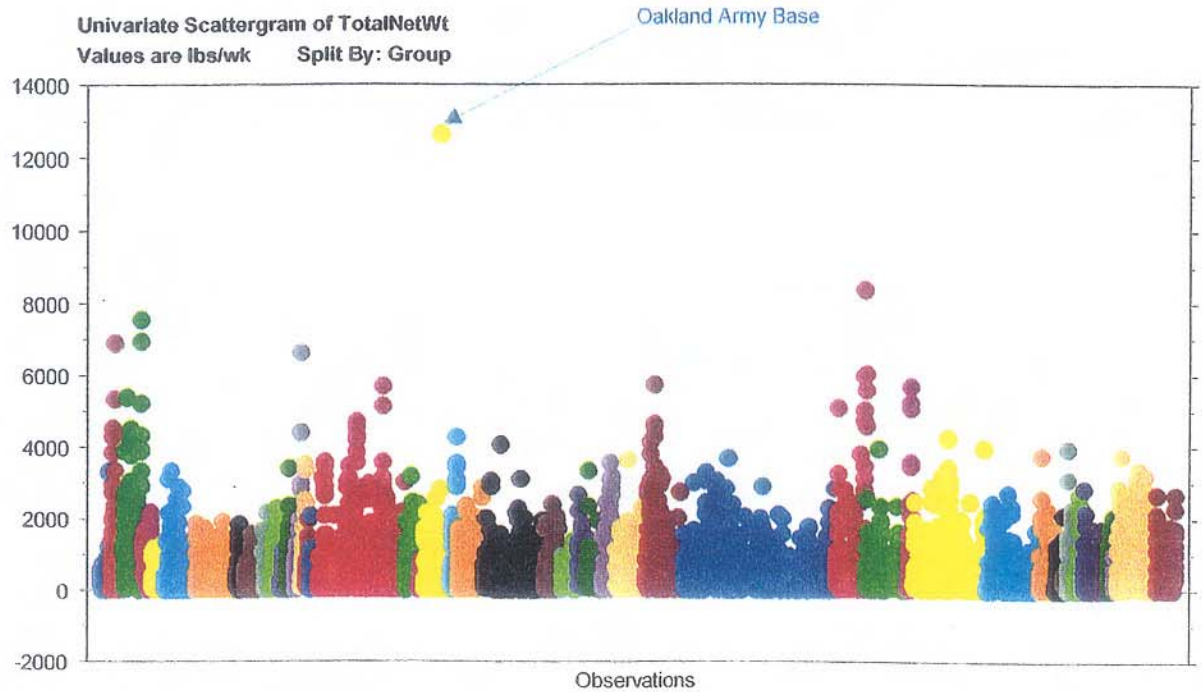


FIGURE 3: MEAN WEEKLY WEIGHT AND DENSITY

Figure 3 presents weight and density data from Table 2 in graphic format. The top bar chart in Figure 3 shows, in alphabetical order within the four major business categories, the mean weekly weight of waste collections for each of the 48 business groups. The error bars (the “T” on top of each solid colored bar) are statistical calculations that indicate the likely range in which the actual value falls at a 90% confidence level. Only the top half of each error bar is shown on the figure, but each error bar also projects below the top of its colored bar an equal distance downward into the colored bar. For example, the error bar for weight for MfrChem (Manufacturing – Chemicals) extends from the top of the solid blue bar, at about 400 pounds per week, almost to 500 pounds per week; the part of the error bar not shown would extend down the same distance, or to about 300 pounds per week. With the 90% confidence interval used in this study, this chart indicates that for all chemical manufacturing businesses represented by those included in this study, there is a 90% chance that the mean weekly weight of their waste is between 300 and 500 pounds. Where error bars overlap between business groups, there is statistically no difference between values.

FIGURE 3

BAR CHARTS OF TOTAL NET WEIGHT AND DENSITY FOR WASTE FROM ALL BUSINESSES IN GROUPS

- MfrChem
- MfrElect
- MfrFood
- MfrFurn
- MfrInstrMisc
- MfrMach
- MfrMetal
- MfrPaper
- MfrPrint
- MfrRubber
- MfrStone
- MfrTextl
- MfrTrans
- MfrWood
- Misc Agfish
- Misc AmuseRecPks
- Misc Commun
- Misc Construc
- Misc Education
- Misc MovieMuseum
- Misc PubAdmin
- Misc TransAir
- Misc TransOth
- Misc Trucking
- Misc Utils
- RetAppar
- RetAuto
- RetBldg
- RetFood
- RetFurn
- RetMisc
- RetRestr
- RWhsiDur
- RWhsiFood
- RWhsiNondur
- RWhsiStone
- SvcAutoRpr
- SvcBiz
- SvcEngAcct
- SvcFinAvg
- SvcFinLite
- SvcHotel
- SvcMedic
- SvcMemberOrgs
- SvcMisc
- SvcPers
- SvcRealEst
- SvcSocial

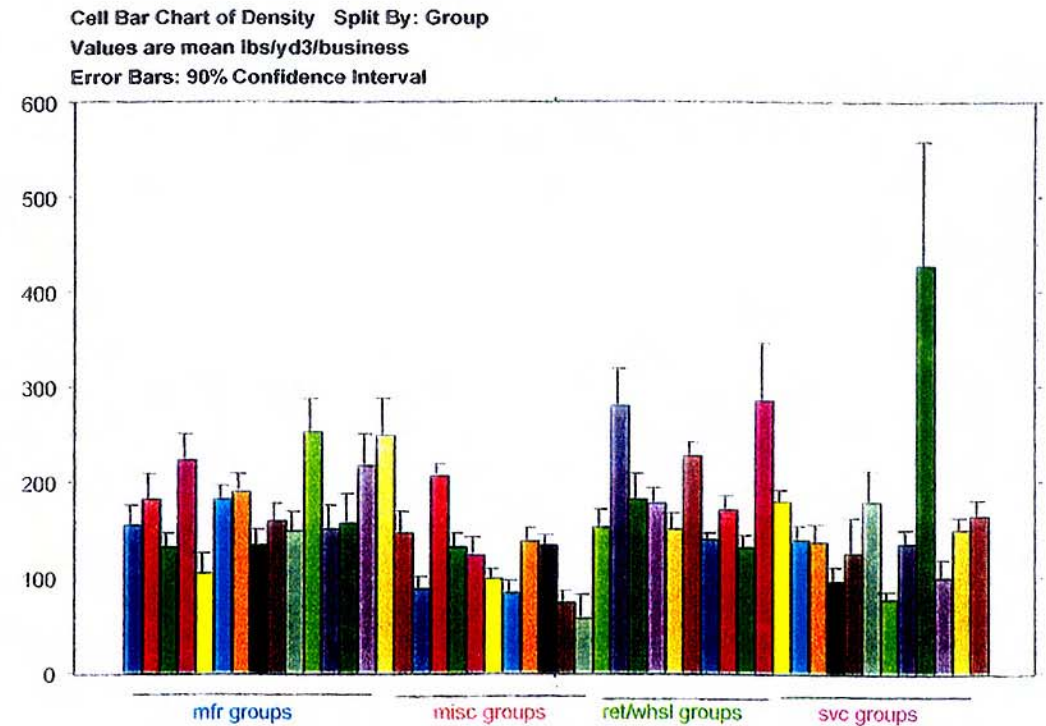
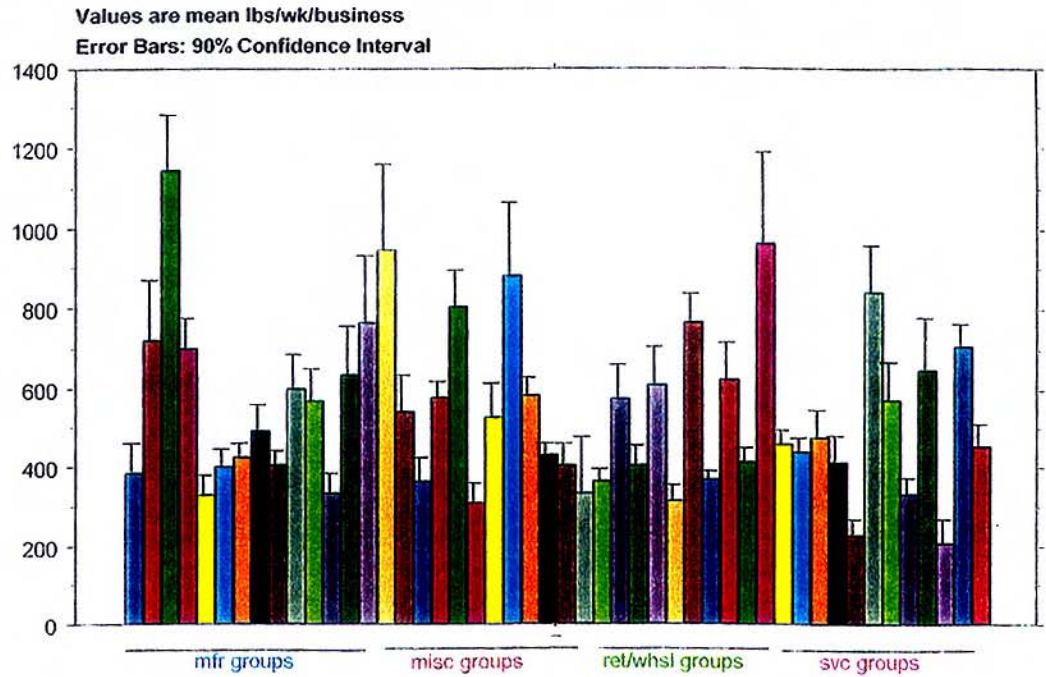


FIGURE 4: MEAN WEEKLY WEIGHT, ARRANGED IN ORDER OF INCREASING VALUES

Figure 4 presents the same information as the top part of Figure 3, but the business groups are arranged in order of increasing value. This figure shows that the business group with the lowest mean of measured weekly weights was SvcPers (Services – Personal) and that the highest was MfrFood (Manufacturing – Food). Error bars show the range in which the actual mean for all businesses represented by the sample would fall, given the 90% confidence interval.

FIGURE 4

BAR CHART OF TOTAL NET WEIGHT FOR WASTE FROM ALL BUSINESS GROUPS ARRANGED IN ORDER OF INCREASING VALUES

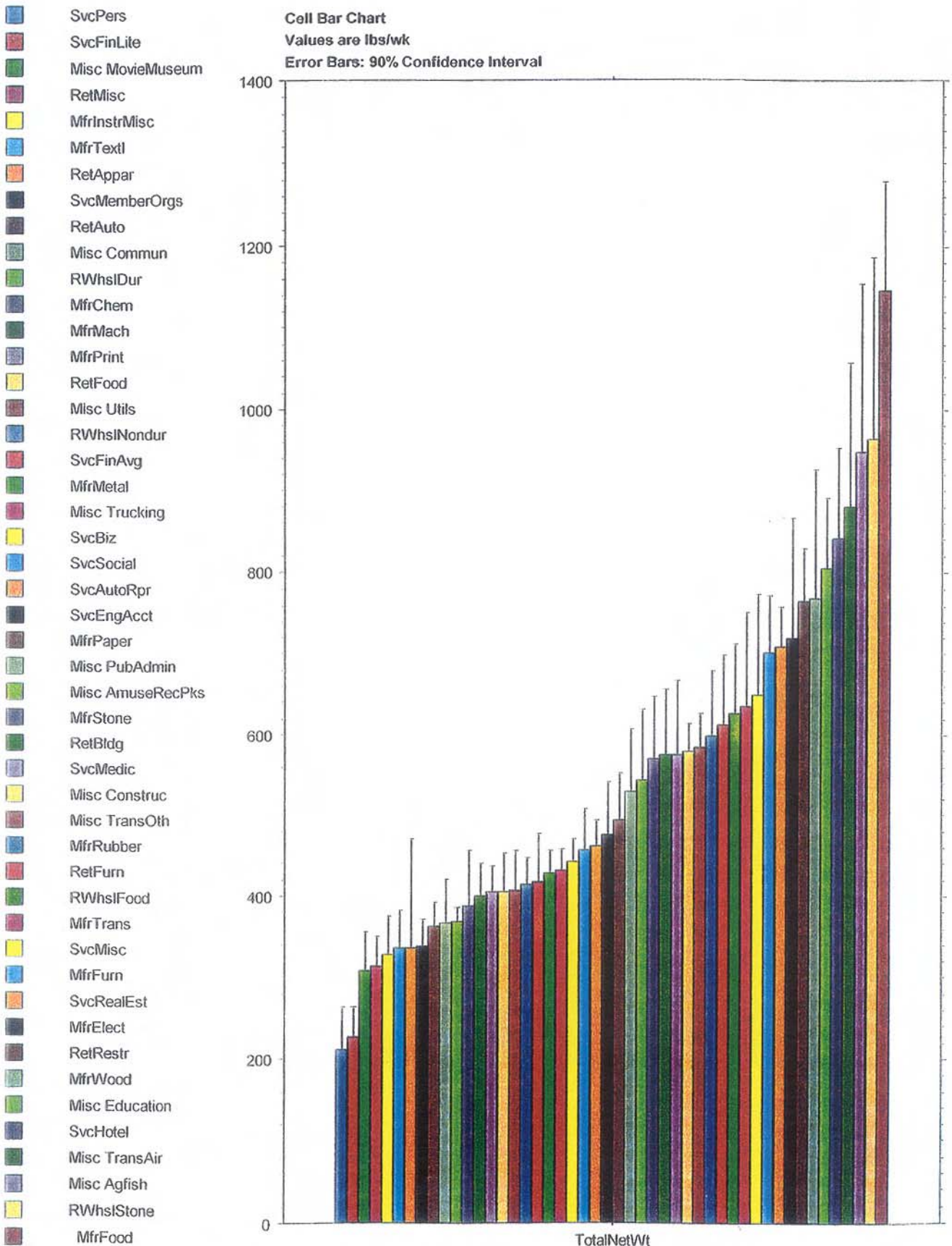


FIGURE 5: MEAN DENSITY, ARRANGED IN ORDER OF INCREASING VALUES

Figure 5 presents the same information as the bottom part of Figure 3, but the business groups are arranged in order of increasing value. This figure shows that the business group with the lowest mean of measured density was Ret Appar (Retail – Apparel) and that the highest was SvcMisc (Services -- Miscellaneous). Note the very large error bar for SvcMisc and the similarity of densities for the majority of business groups in the middle of the chart.

FIGURE 5

MEAN DENSITY OF ALL BUSINESS GROUPS ARRANGED IN ORDER OF INCREASING DENSITY

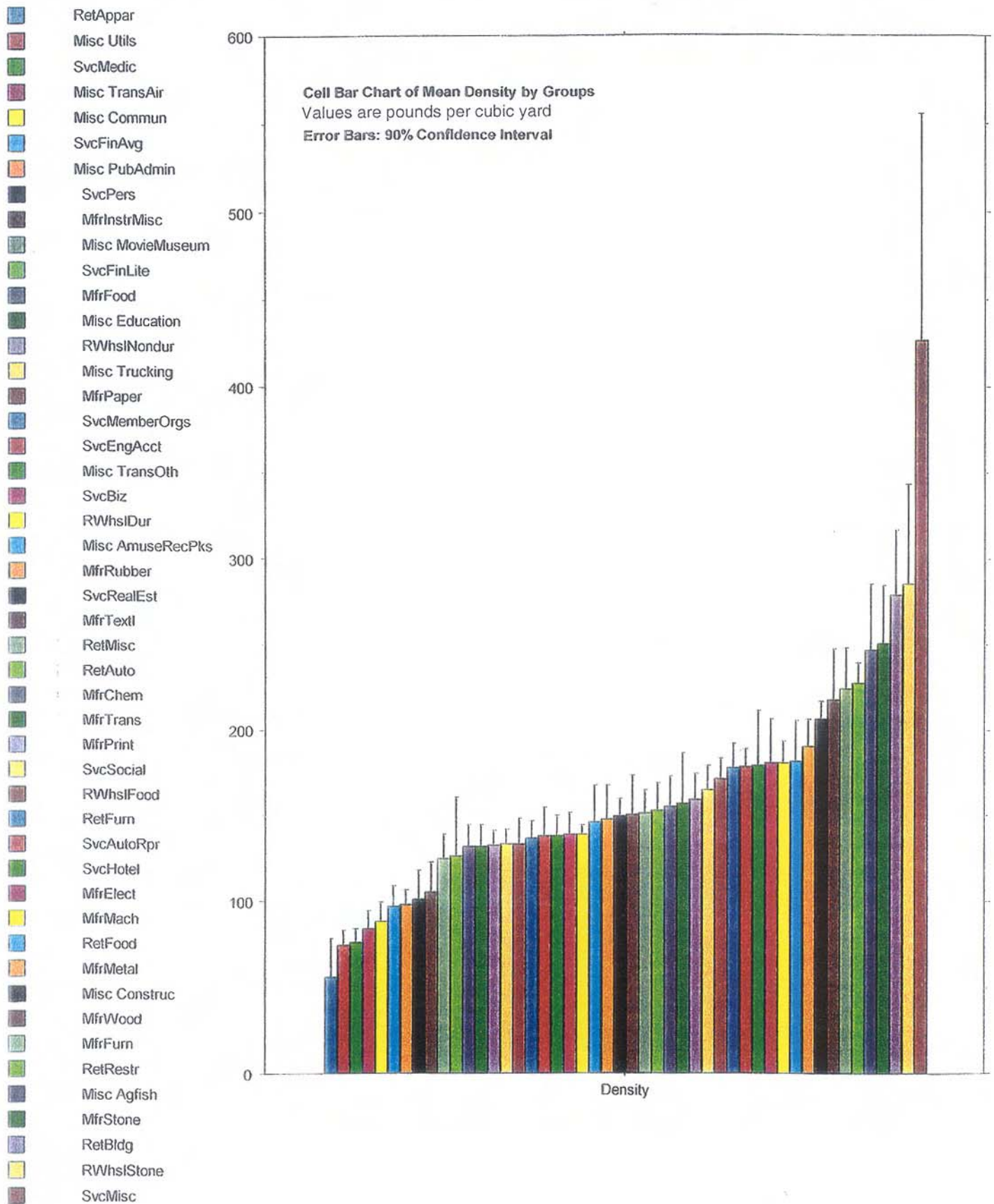


FIGURE 6: CORRELATIONS

Figure 6 presents the same information as Table 3, but in a graphic format. In this figure, positive correlations are indicated by bars that begin at and extend above a horizontal line (the zero (0) line). The higher the bar extends toward 1.00, the stronger the positive correlation. Negative correlations are indicated by bars that begin at and extend below a horizontal line. The lower the bar extends toward -1.00 , the stronger the negative correlation.

**FIGURE 6
CORRELATION CHARTS**

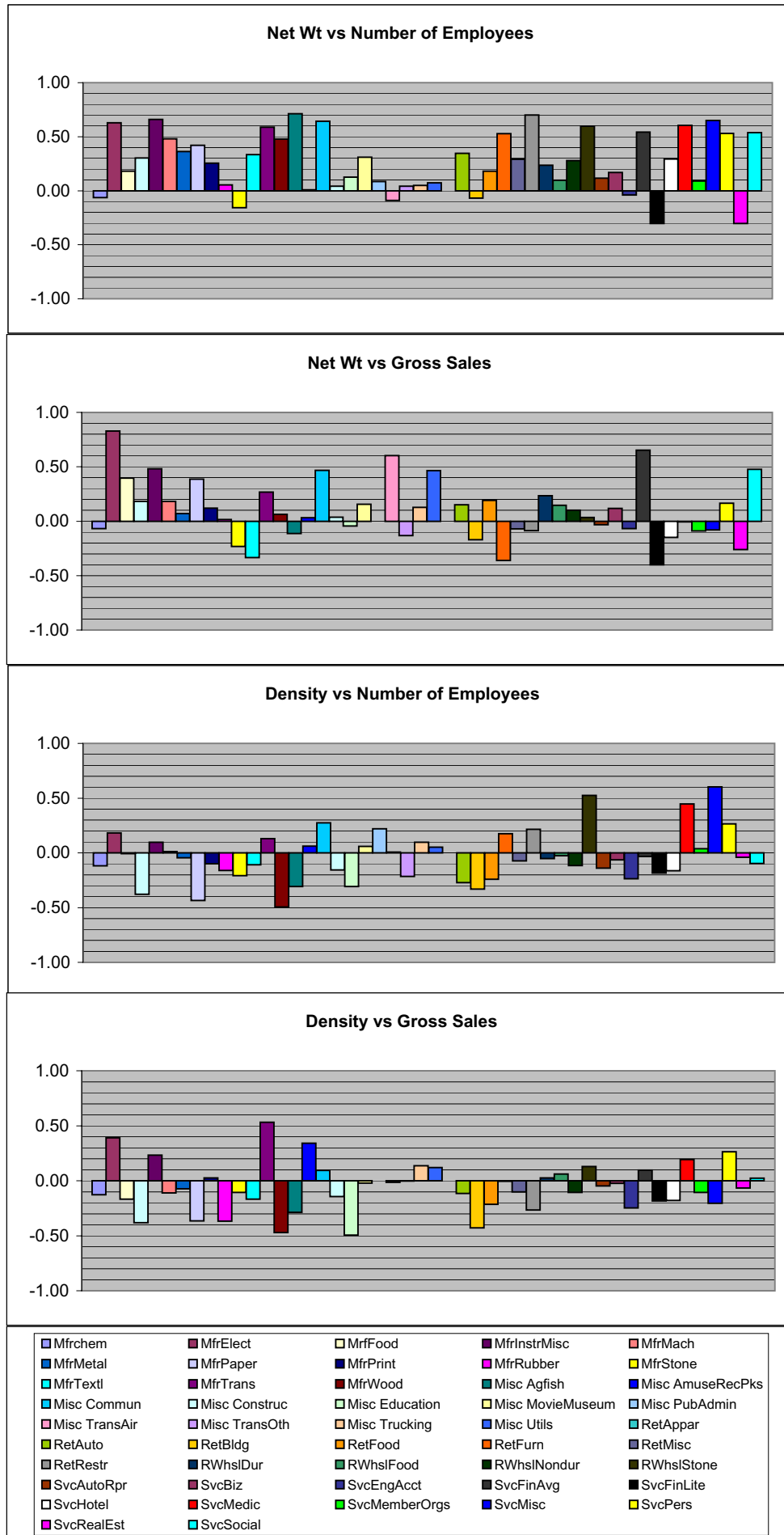


FIGURE 7: WASTE COMPOSITION

Figures 7a, b, c, d, e, and f summarize the same data presented in Table 4.

Figure 7a compares the waste composition of the four major business groups. Error bars show the 90 percent confidence interval.

Figures 7b,c,d, and e show the percentage of each of the 19 agglomerated waste categories for each of the four major business groups. Again, error bars show the 90 percent confidence interval. Figure 7f shows the percentage of each waste category for all groups combined.

FIGURE 7a
COMPARISON OF THE COMPOSITION OF WASTE FOR FOUR BUSINESS CATEGORIES
NINETEEN MATERIAL CATEGORIES
ERROR BARS: 90% CONFIDENCE INTERVAL

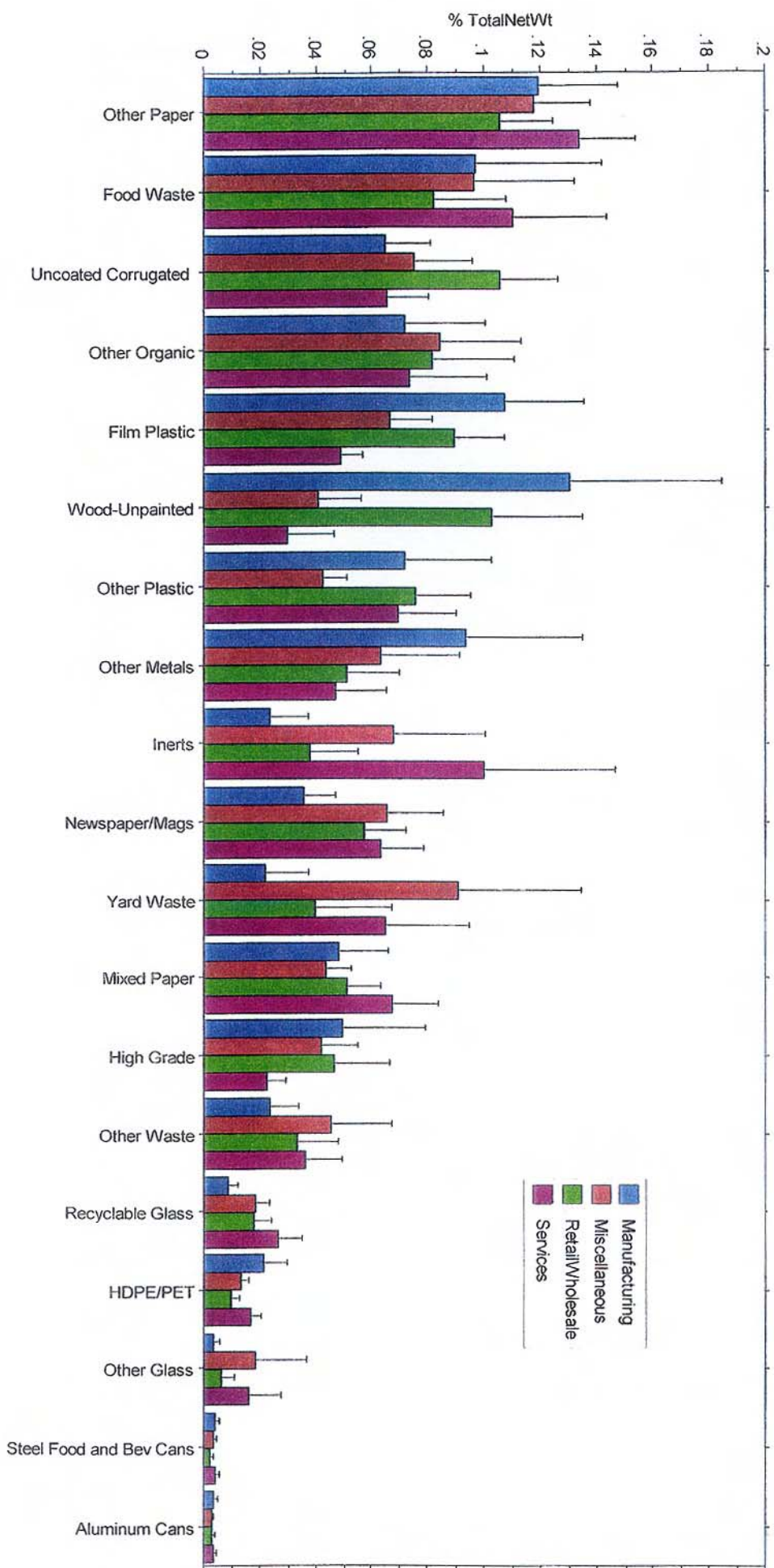


FIGURE 7b
DESCRIPTIVE STATISTICS AND CHART OF WASTE COMPOSITION FOR
MANUFACTURING BUSINESS CATEGORY
NINETEEN MATERIAL CATEGORIES
ERROR BARS: 90% CONFIDENCE INTERVAL

Descriptive Statistics

	Mean	Std. Error
Other Paper	.119	.017
Food Waste	.097	.027
Uncoated Corrugated	.065	.009
Other Organic	.072	.017
Film Plastic	.108	.017
Wood-Unpainted	.130	.032
Other Plastic	.072	.018
Other Metals	.094	.024
Inerts	.023	.008
Newspaper/Mags	.036	.007
Yard Waste	.022	.009
Mixed Paper	.048	.011
High Grade	.050	.018
Other Waste	.024	.006
Recyclable Glass	.009	.002
HDPE/PET	.021	.005
Other Glass	.003	.001
Steel Food and Bev Cans	.004	.001
Aluminum Cans	.003	.001

Cell Bar Chart -- in decreasing order from all businesses combined.
Error Bars: 90% Confidence Interval

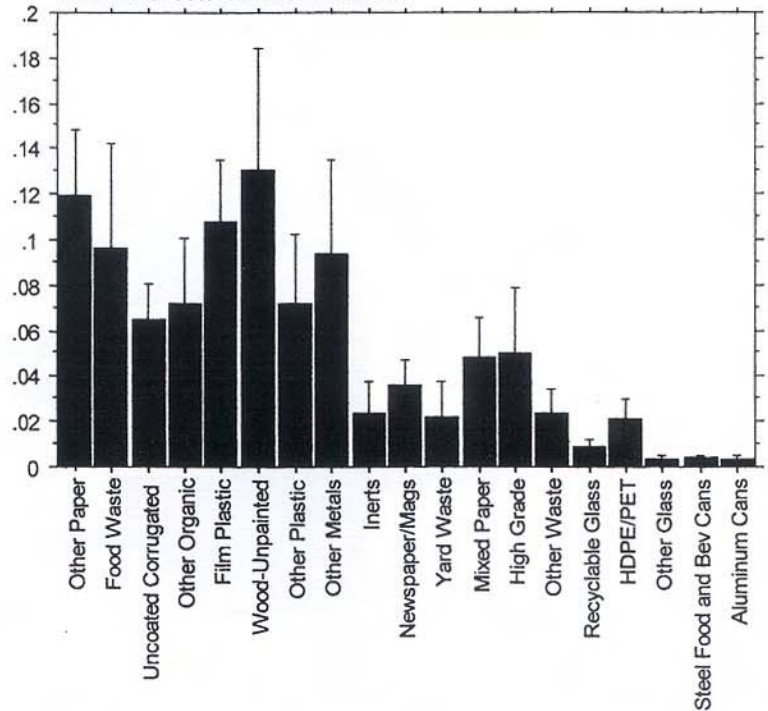


FIGURE 7c
DESCRIPTIVE STATISTICS AND CHART OF WASTE COMPOSITION FOR
MISCELLANEOUS BUSINESS CATEGORY
NINETEEN MATERIAL CATEGORIES
ERROR BARS: 90% CONFIDENCE INTERVAL

Descriptive Statistics

	Mean	Std. Error
Other Paper	.118	.012
Food Waste	.097	.021
Uncoated Corrugated	.076	.012
Other Organic	.084	.017
Film Plastic	.067	.009
Wood-Unpainted	.041	.009
Other Plastic	.043	.005
Other Metals	.063	.017
Inerts	.068	.020
Newspaper/Mags	.066	.012
Yard Waste	.091	.026
Mixed Paper	.044	.005
High Grade	.042	.008
Other Waste	.046	.013
Recyclable Glass	.018	.003
HDPE/PET	.013	.002
Other Glass	.019	.011
Steel Food and Bev Cans	.003	.001
Aluminum Cans	.003	4.371E-4

Cell Bar Chart -- in decreasing order from all businesses combined.
Error Bars: 90% Confidence Interval

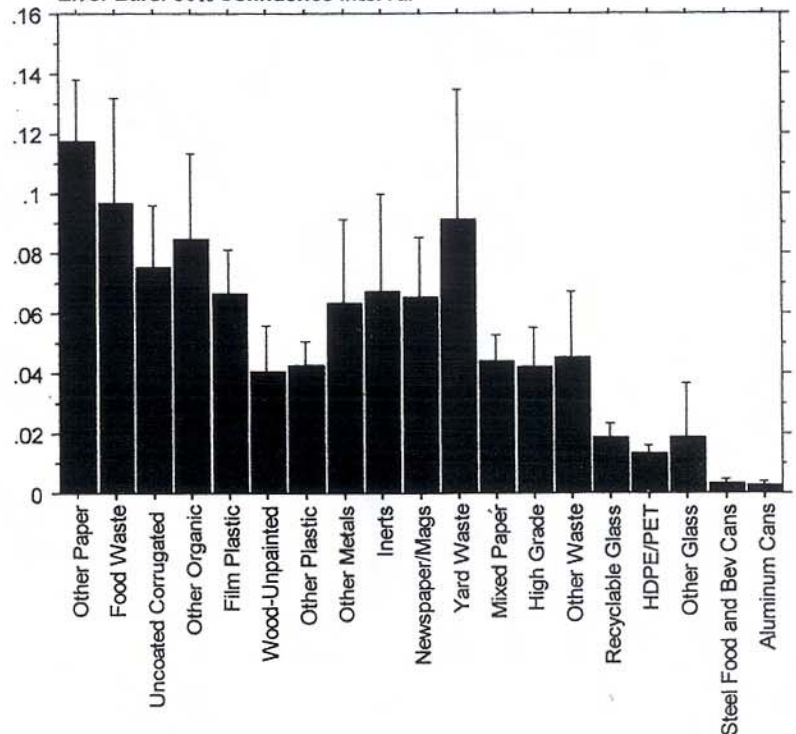


FIGURE 7d
DESCRIPTIVE STATISTICS AND CHART OF WASTE COMPOSITION FOR
RETAIL/WHOLESALE BUSINESS CATEGORY
NINETEEN MATERIAL CATEGORIES
ERROR BARS: 90% CONFIDENCE INTERVAL

Descriptive Statistics

	Mean	Std. Error
Other Paper	.106	.011
Food Waste	.082	.016
Uncoated Corrugated	.105	.012
Other Organic	.082	.018
Film Plastic	.090	.010
Wood-Unpainted	.103	.019
Other Plastic	.076	.012
Other Metals	.051	.011
Inerts	.038	.010
Newspaper/Mags	.058	.009
Yard Waste	.040	.016
Mixed Paper	.051	.007
High Grade	.046	.012
Other Waste	.034	.009
Recyclable Glass	.018	.004
HDPE/PET	.010	.001
Other Glass	.007	.003
Steel Food and Bev Cans	.002	4.768E-4
Aluminum Cans	.003	.001

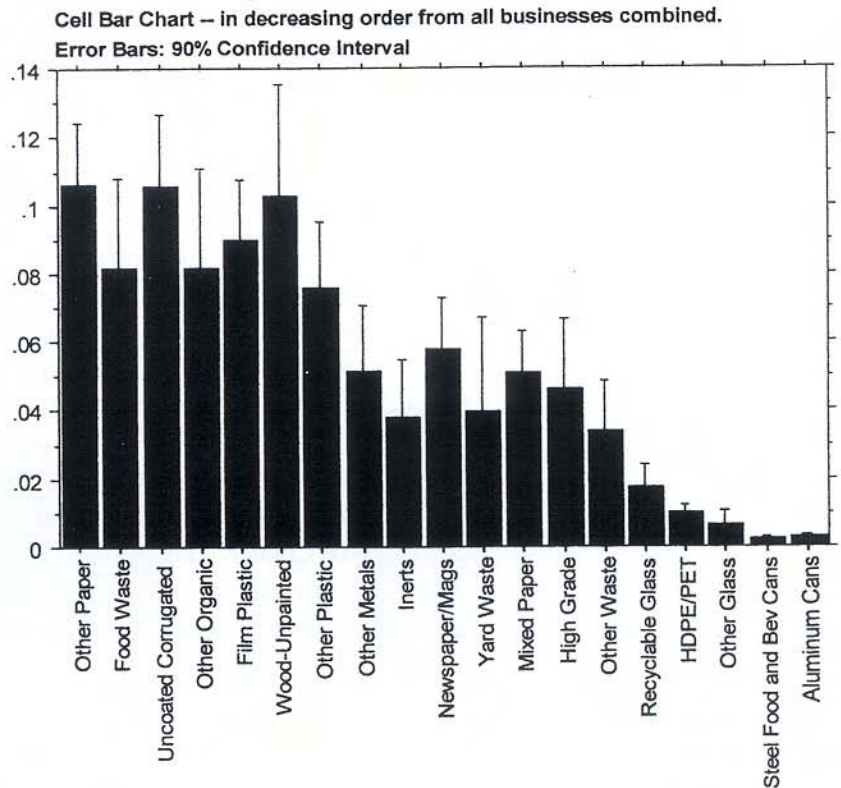


FIGURE 7e
DESCRIPTIVE STATISTICS AND CHART OF WASTE COMPOSITION FOR SERVICE
BUSINESS CATEGORY
NINETEEN MATERIAL CATEGORIES
ERROR BARS: 90% CONFIDENCE INTERVAL

Descriptive Statistics

	Mean	Std. Error
Other Paper	.134	.012
Food Waste	.111	.020
Uncoated Corrugated	.065	.009
Other Organic	.074	.017
Film Plastic	.049	.005
Wood-Unpainted	.030	.010
Other Plastic	.069	.013
Other Metals	.047	.011
Inerts	.100	.028
Newspaper/Mags	.063	.009
Yard Waste	.065	.018
Mixed Paper	.068	.010
High Grade	.022	.004
Other Waste	.036	.008
Recyclable Glass	.026	.005
HDPE/PET	.017	.002
Other Glass	.016	.007
Steel Food and Bev Cans	.004	.001
Aluminum Cans	.003	.001

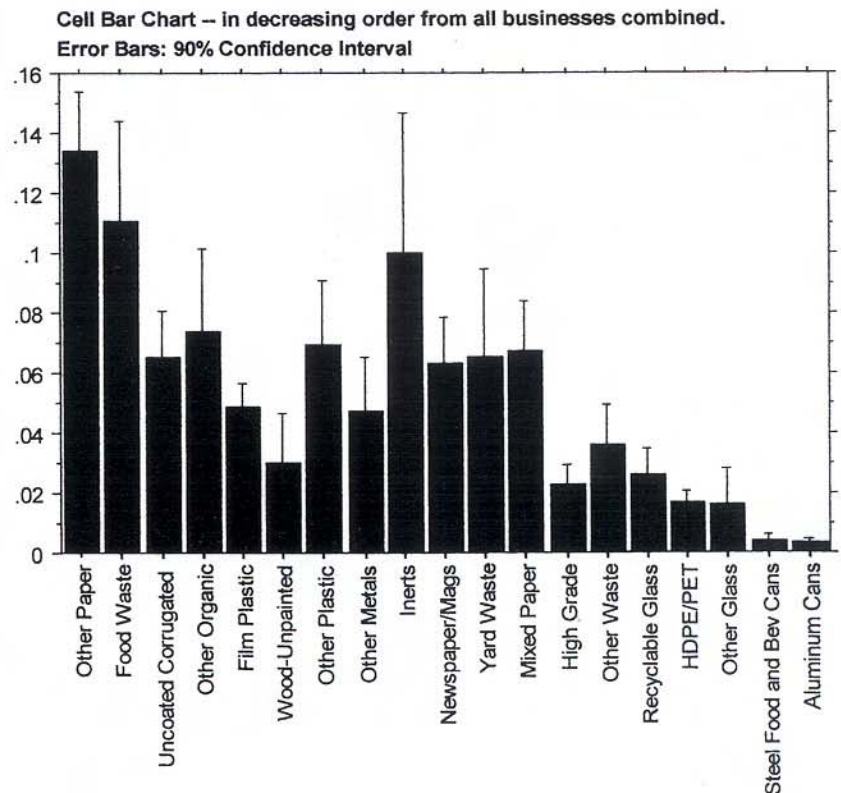


FIGURE 8: VARIABILITY BETWEEN THE FOUR COLLECTION ROUTES

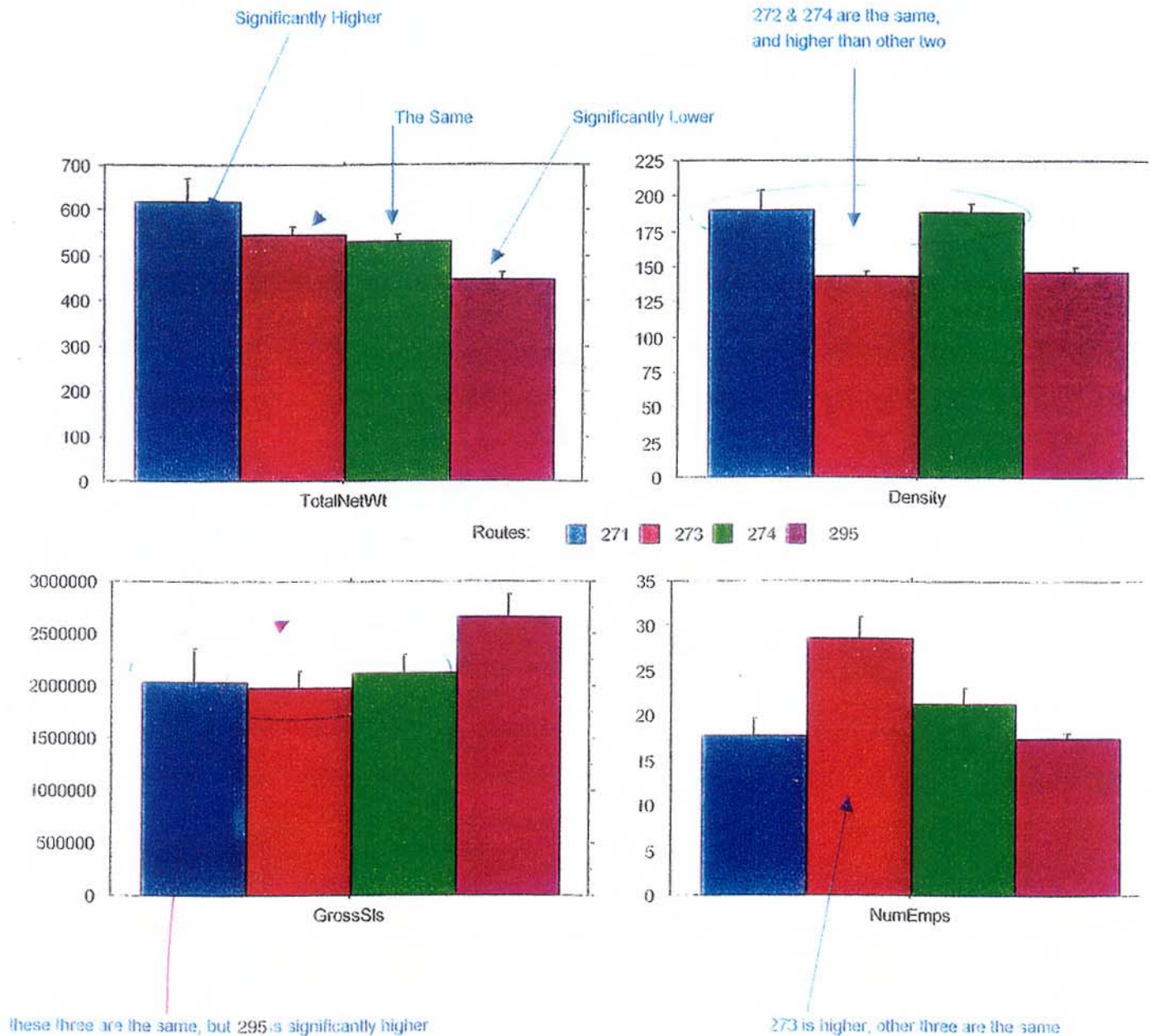
Figure 8 shows the differences between the four collection routes for mean weekly weight, density, gross sales, and number of employees for all business groups. The error bars show the range within which the actual mean falls, given the 90% confidence interval.

Figure 8 demonstrates the range of variability between the routes. The Total Net Weight bar graph shows that among the four routes, one has a significantly higher value, one has a significantly lower value, and the other two are statistically the same. Even with this variation, the range of difference is quite small: the mean weight for the lightest, route 295, is about 72% of the mean weight for the heaviest, route 271 (lowest mean is 449.5; highest is 621.2; see Table 5).

Figure 8 and Table 5 suggest that there may be a sufficient range of variability between the routes to support a conclusion that the four routes are reasonably representative of fairly broad range of commercial collection routes in the County. This would be true if the four routes essentially equate to a statistically representative random sampling of all collection routes within the County. This conclusion can, however, only be confirmed through additional research.

FIGURE 3

BAR CHARTS SHOWING DIFFERENCES BETWEEN FOUR COLLECTION ROUTES FOR TOTAL NET WEIGHT (LBS/WK), DENSITY (YD/3), NUMBER OF EMPLOYEES, AND GROSS SALES FOR ALL BUSINESSES COMBINED - ERROR BARS ARE 90% CONFIDENCE INTERVALS (NOTE - OVERLAPPING CONFIDENCE INTERVALS INDICATE NO SIGNIFICANT DIFFERENCE BETWEEN MEANS)



Notes: As with other bar graphs in this report, the 90% CI (which go into the bar as well as above) can be used to indicate the relative significance of the means - overlapping bars indicate that the means are not different, whereas when error bars do not overlap, the means are significantly different at 90% confidence.

FIGURE 9: WASTE COMPOSITION SHOWING DIFFERENCES BETWEEN COLLECTION ROUTES

Figure 9 compares the proportion of the nineteen composite waste categories (see Table 4a) for businesses from the four collection routes. The error bars show the range in which the actual mean falls, given the 90% confidence interval (recall that the error bars extend down below the top of the bar the same distance that they extend above it). The relatively large error bars indicate the high variability in waste composition within each route.

FIGURE 9
 BAR CHART OF WASTE COMPOSITION FOR THE FOUR WASTE COLLECTION
 ROUTES
 NINETEEN MATERIAL CATEGORIES
 ERROR BARS: 90% CONFIDENCE INTERVAL

