Contractor's Report to the Board

Targeted Statewide Waste Characterization Study:

Characterization and Quantification of Residuals from Materials Recovery Facilities

June 2006

Produced under contract by:

R.W. Beck, Inc.

Cascadia Consulting Group

California Environmental Protection Agency
Integrated Waste Management Board

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Table of Contents

Table of Figures

Table of Tables

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This study would not have been possible without the cooperation and assistance of the management and owners of the Materials Recovery Facilities (MRFs) throughout the state of California who generously agreed to participate in completion of the detailed survey. Studies of this kind are an imposition on their time and their cooperation is greatly appreciated. Special thanks are given to the following MRFs which hosted and assisted sampling activities in addition to completing the survey:

- IMS Recycling Services in San Diego
- Downey Area Recycling and Transfer (Sanitation Districts of Los Angeles County)
- West Valley MRF in Fontana
- Blue Line Transfer Company, Inc. in South San Francisco
- Madera Disposal Systems in Chowchilla
- The Recyclery (Allied Waste) in San Carlos
- West County Resource Recovery in Richmond
- Kroeker, Inc. in Fresno
- Cold Canyon Processing Facility in San Luis Obispo
- JWR in Wilmington
- Green Team Zanker in Sunnyvale

Quantity and composition data resulting from the collection and sorting of residual samples at each of the MRFs was obtained under confidentiality agreements and is not presented within this report. Instead, the data from individual facilities was aggregated by MRF type.

Thanks also to the Local Enforcement Agencies (LEAs) throughout the state which assisted in screening lists of potential MRFs in their jurisdictions. Their help streamlined and accelerated the process of identifying facilities to include in the study.

Thanks to the City of Sunnyvale for working in tandem with the California Integrated Waste Management Board (CIWMB) through Cascadia Consulting Group to provide supplemental data for this study. This collaboration benefited both the City and the CIWMB.

Governmental Advisory Associates (GAA) provided supplemental data regarding MRF types and sizes. Their cooperation was greatly appreciated and the information was used for the purposes of this study.

Executive Summary

Overview

State Assembly Bill 939 requires that all municipalities divert 50 percent of their solid waste from landfill disposal through source reduction, recycling, and composting. A large portion of statewide diversion is currently achieved through recycling at various types of materials recovery facilities (MRF). Recyclable materials are sorted into specific commodities which will eventually be reused, while nonrecyclable or otherwise undesirable materials, called MRF residuals, are removed for disposal.

The purpose of this MRF residual characterization study was to estimate the quantity and composition of residuals generated from various types of MRFs throughout the state of California. This is the first time a study of this type has been attempted in California. The information can be used for the evaluation of potential processing improvements, through technology and policy alike, with the goal to further increase diversion.

Project Approach

For the purposes of this study, a MRF was defined as a facility in which commingled recyclables or solid waste materials move over a conveyance system which aggregates or segregates recyclable materials by material type or grade and, as a result of the process, produces residuals that are disposed with the municipal waste stream. Four types of MRFs were examined in this study, as described below:

1. **Multi-stream** MRFs that receive and process multiple types of recyclables separately. Incoming recyclables may be collected in a source separated manner or from a curbside dual stream program that separates fiber and container streams.
2. **Single Stream** MRFs that sort individual recyclable materials from recyclables that have been collected in one stream.
3. **Mixed Waste Processing Facilities (MWPF),** (sometimes called "dirty MRFs”), that remove one or more recyclable materials from municipal solid waste (MSW) streams.
4. **Construction and Demolition (C&D)** processing facilities that separate one or more materials from mixed construction and/or demolition debris with or without a conveyance system.

The study was completed through a planned sequence of facility screening/survey, field sampling, sorting, and data analysis.

Various data sources were used to identify any possible MRF within the state. Screening of these facilities was performed to identify and resolve duplicate facilities, eliminate facilities which did not meet the definition of a MRF, and obtain general information about each MRF. A total of 147 facilities were confirmed to meet specific screening criteria and were termed Potential MRFs.

Detailed surveys were solicited from each of the Potential MRFs to obtain detailed data. The original intent of the study was to collect data from the vast majority, if not all, MRFs in the state; i.e., a census of MRFs rather than a sampling. This information was to be used to determine statewide tonnage of MRF residuals from each type of MRF. At the outset of the project, several large waste management companies as well as several independent MRFs declined to participate in the study, and many other facilities did not respond to the survey. Due to the low response to the survey, additional data was requested and received from the Governmental Advisory Associates (GAA) database later in the project. This additional information expanded the body of data available for analysis needed to estimate statewide tonnage amounts. Facilities that could be characterized by type and for which incoming feedstock and residual quantity data were available, either from the survey or GAA database, were designated as Confirmed MRFs. Ultimately, a total of 77 Confirmed MRFs were identified during the screening process of the 147 Potential MRFs.

Using information from the completed surveys only, sites were recruited to be host facilities for sampling. The Sampling Plan for this study was developed and submitted to CIWMB staff prior to the start of sampling and sorting activities. Samples of MRF residuals were collected over two seasons, winter and summer, from four regions: San Diego Area, Southern California/Los Angeles Basin, Central Valley/Other, and San Francisco Bay Area. Approximately 30 samples were collected from each MRF for each type of processing stream sampled. A total of 390 samples were collected from 13 MRFs, two of which were sampled from two different types of processing lines. The minimum sample weight was 125 pounds. Table 1 presents a summary of the number of samples collected from each MRF type and region.

Table 1 – Sample Distribution by Region and Type, 2005

MRF Type	San Diego Area	So. Cal/ Los Angeles Basin	Central Valley / Other	San Francisco Bay Area	Overall
Single-Stream	28	30	30	30	118
Multi-Stream				62	62
Mixed Waste		60	30	30	120
C&D		30	30	30	90
Overall	28	120	90	152	390

Samples were only collected from multi-stream MRFs in the San Francisco Bay Area because there were no facilities in other regions which met the proper criteria and were willing to host sampling activities. The only responses received from the San Diego Area were from single-stream MRFs.

A majority of MRFs have multiple locations along the processing line which discharge residual. These discharge areas are called ejection points. Common residuals ejection points include presort containers for large, bulky contaminants and end-of-line discharges. The number of samples collected and sorted at each MRF was distributed based on the weight of residual generated at each ejection point. The material within each sample was sorted into 79 material types as defined by the CIWMB (see Appendix B). The weight of material in each category was recorded and entered into a database for analysis.

Average and total statewide residual quantities for each MRF type were developed using data obtained from the screening and survey process. A single and unique residual characterization profile was developed for each MRF type by aggregating the composition data of individual facilities representing that type.

Results and Findings

A total of 77 Confirmed MRFs were identified during the screening process. However, a number of MRFs were identified as processing multiple incoming material streams at the same facility, either at different processing times or on separate processing lines. For example, if a MRF processes both mixed waste and single-stream materials, the facility would have two MRF processing lines. Taking this into account, there are a total of 83 MRF processing lines at the 77 Confirmed MRFs. Table 2 provides a summary of the number of material processing lines listed by MRF type and region. The data for C&D MRFs is based solely on information obtained from the R.W. Beck detailed survey responses. Data for all other MRF types was based on a combination of the R.W. Beck detailed survey responses and the GAA database.

Table 2 – Regional Distribution of Statewide Confirmed MRFs, 2005

MRF Type	San Diego	Los Angeles	Central Valley / Other	San Francisco	Overall
C&D*		1	2	3	6
Single-Stream**	4	12	12	12	40
Multi-Stream**		2	5	9	16
Mixed Waste**		9	9	3	21
Overall	4	24	28	27	83

* – Data obtained from R.W. Beck detailed survey responses
** – Data obtained from GAA database and R.W. Beck detail survey responses

When determining facility distribution by MRF type, data from the two sources used (R.W. Beck survey and GAA) could not be directly combined because the GAA data did not include any information for C&D MRFs. However, 6 of the 44 facilities, or 12 percent, that responded to R.W. Beck's detailed survey were confirmed to be C&D MRFs. Using that data, we estimate that 12 percent of all MRFs are C&D MRFs. Data from both sources was used to apportion the other three types of MRFs to the remaining 88 percent. Table 3 presents the resulting distribution of statewide MRF types.

Table 3 – Estimated Distribution of Statewide MRF Types, 2005

MRF Type	Percentage
C&D	12%
Single-Stream	46%
Multi-Stream	18%
Mixed Waste	24%
Total	100%

Although the majority of MRFs are single-stream, the distribution of incoming material and residual quantities is quite different. Table 4 presents a summary of the average annual incoming material and residual quantities based on information obtained from the Confirmed MRFs. The table also identifies the percentage of incoming material which is not recovered and therefore becomes residual.

Table 4 – Average Quantity of Incoming Material and Residuals, 2005

MRF Type	Quantity of Incoming Material (tons)	Quantity of Residual (tons)	Residual Percentage
Single-Stream	52,900	7,400	14%
Multi-Stream	20,900	1,300	6%
Mixed Waste	234,700	189,800	81%
C&D	40,000	9,170	23%

As expected, there was minimal residual generated by multi-stream processing facilities, generally due to the quality of incoming material. Less contaminants are present because such curbside programs require customers to separate fiber materials (e.g., paper)from commingled containers. Furthermore, processing can be more efficient because each stream is more homogeneous. Fiber processing typically has less moisture or food contamination.

The incoming material at mixed waste processing facilities is essentially municipal solid waste and the residual percentage is predictably much higher than any other type. Many mixed waste MRFs are increasingly accepting more commercial waste and less residential waste, as commercial waste typically has a higher degree of recoverable materials. Based on information from Confirmed mixed waste MRFs, slightly more residential waste is currently processed. These types of MRFs attempt to remove as many recyclables as possible but there is typically more moisture, food contamination, and more unrecoverable material to sort through. Since incoming quantities are much larger, these types of MRFs often load the processing line at a higher rate.

MRFs processing C&D material are increasingly common throughout the state of California due to the growing number of acceptable uses for the materials and local ordinances requiring C&D recycling. The C&D recycling programs in California are largely accepted as some of the most innovative and effective in the nation. Currently, C&D MRFs represent an estimated 12 percent of the total statewide MRFs by number. Many more C&D recovery facilities were identified but did not meet the specific criteria of a residual-generating MRF, usually because the material was homogeneous and did not require processing. C&D MRFs were estimated to achieve only 23 percent residual. A majority of these MRFs recover wood for bio-fuel at conversion plants and fines for landfill alternative daily cover (ADC).

Residual tonnage data for the 77 Confirmed MRFs identified in this study was used to extrapolate the type and size of the remaining MRFs for which data was unavailable. The total annual quantity of statewide residuals, presented as Table 5, was estimated based on this extrapolation.

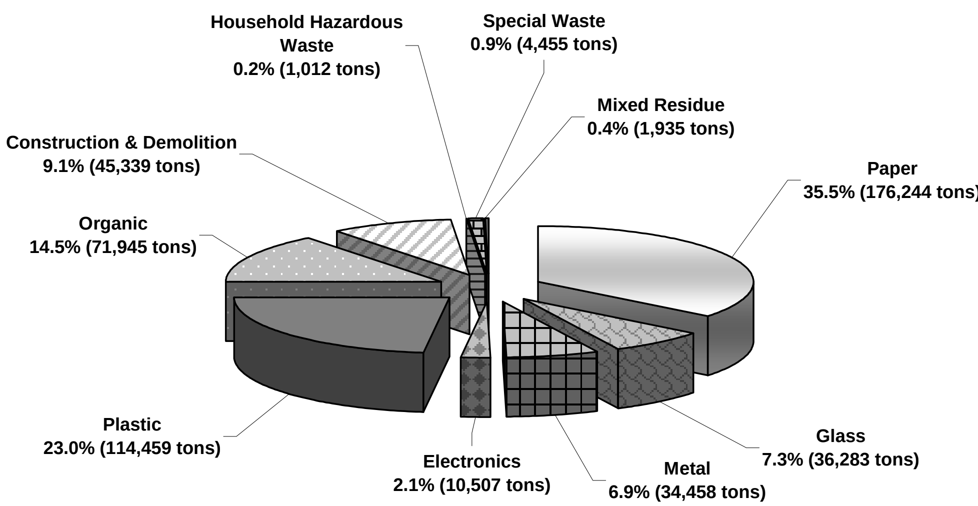
Table 5 – Total Quantity of Statewide Residuals, 2005

MRF Type	Quantity of Residual (tons)	Percentage of Total Residuals
Single-Stream	496,600	6.7%
Multi-Stream	35,900	0.5%
Mixed Waste	6,678,200	90.6%
C&D	161,700	2.2%
Overall	7,372,500	100%

A single and unique residual characterization profile was developed for each MRF type by aggregating the composition data of individual facilities representing that type. Figures A through D present the residual profile charts for each MRF type examined during this study. For summary purposes, only major material categories have been provided. Detailed compositions are provided in the report. The percentage shown represents the average proportion of each material type by weight to the total residual stream. For example, the average percent of paper material within the residual stream from single-stream MRFs was estimated to be 35.5 percent.

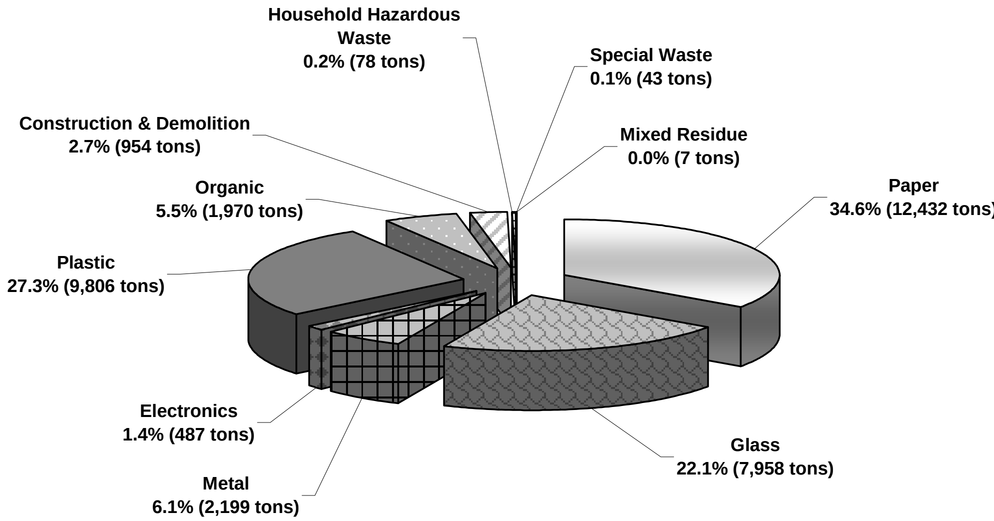
The overall statewide residual characterization, shown as Figure E, was weighted based on the total amount of residual estimated to be produced at each MRF type. Consequently, the overall residual composition largely resembles that of a mixed waste MRF since 90 percent of the statewide residual is generated at this type of facility.

Figure A
Summary of Composition of Residuals - MRFs Receiving Single Stream Recyclables, 2005



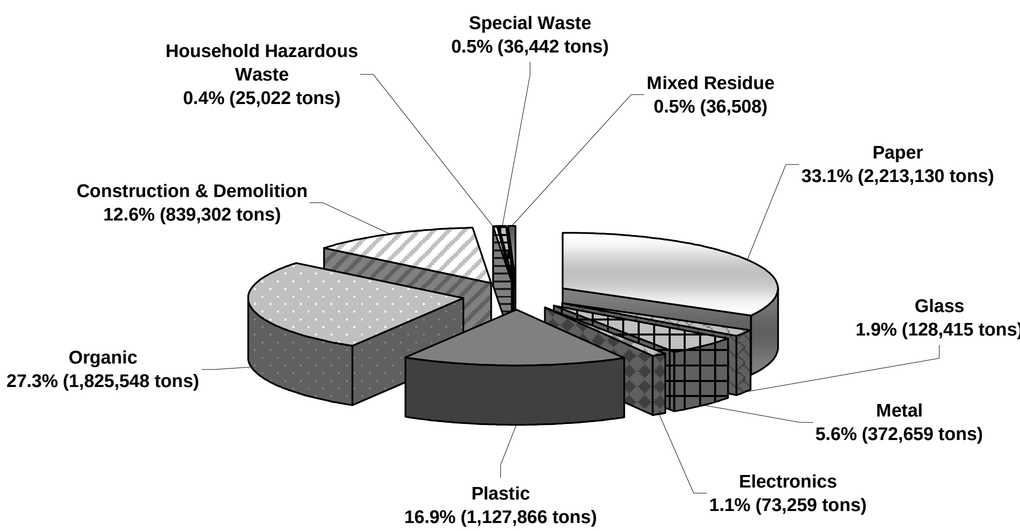
Total Residual Weight is 496,638 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure B
Summary of Composition of Residuals - MRFs Receiving Multi-Stream or Separated Recyclables, 2005



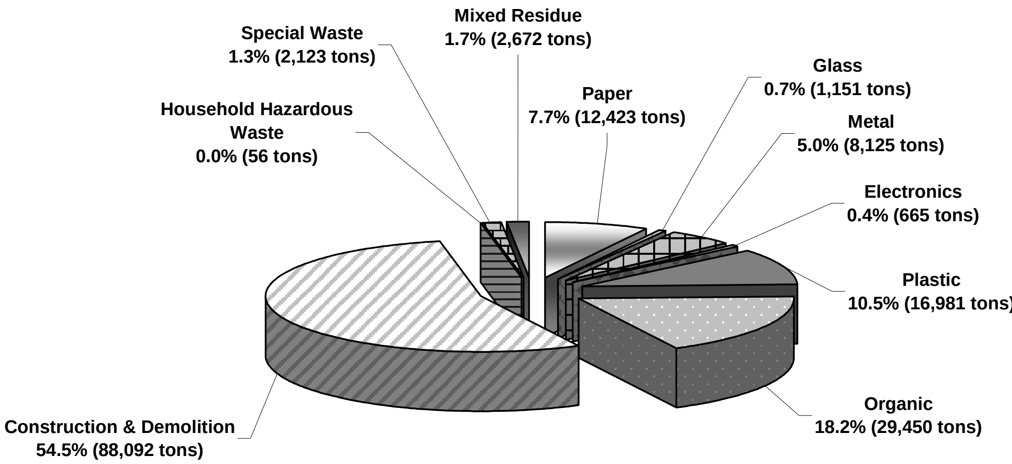
Total Residual Weight is 35,931 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure C
Summary of Composition of Residuals - MRFs Receiving Mixed Waste, 2005



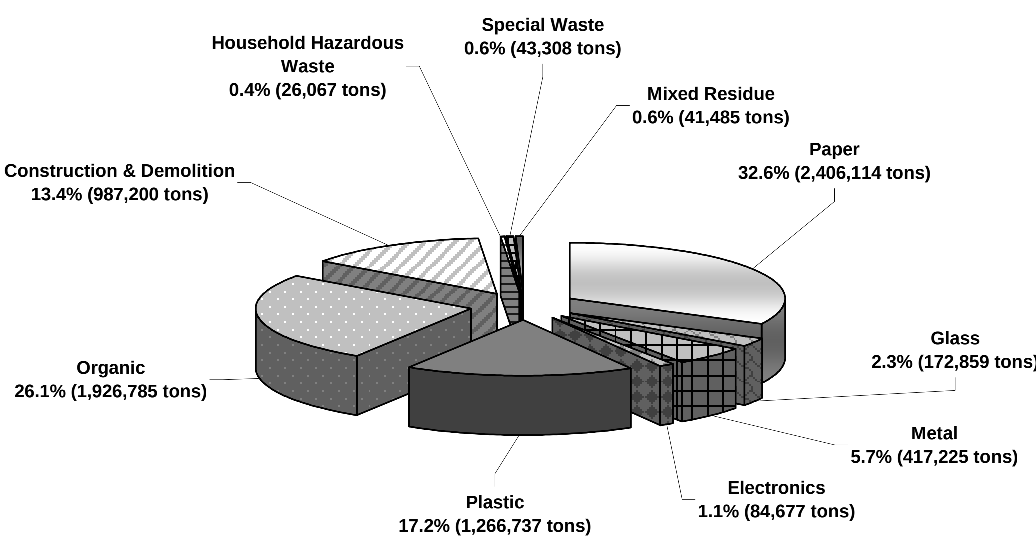
Total Residual Weight is 6,678,151 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure D
Summary of Composition of Residuals - MRFs Receiving Construction and Demolition Materials, 2005



Total Residual Weight is 161,736 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Figure E
Summary of Composition of Residuals - Overall MRFs, 2005



Total Residual Weight is 7,372,456 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Field observations were made at each MRF sampled regarding the various technologies, targeted recyclables, and operational arrangements or sequences. Large variations were identified in each of these categories along with differences in MRF size and region. It is assumed that by aggregating data from multiple MRFs for each material stream, these variations will be averaged and the resultant data will be representative of the residual throughout the state.

Introduction and Overview

Project Background

State Assembly Bill 939 was signed into law in 1989 requiring all municipalities to divert 50 percent of their solid waste from landfill disposal through source reduction, recycling, and composting. Although most municipalities throughout the state are currently complying with or exceeding this regulation, the California Integrated Waste Management Board (CIWMB) has continued to research new ways of further reducing waste disposal and promoting the management of all materials to their highest and best use. To accomplish this, the CIWMB has committed to collecting, developing, maintaining, and publishing accurate, up-to-date waste stream information.

A large portion of statewide diversion is achieved through recycling at various types of materials recovery facilities (MRF). Potentially recyclable materials are collected and transferred to MRFs for processing and removal of contaminants which cannot be recovered or are otherwise undesirable. During processing, the recoverable materials are sorted and consolidated by type of commodity. The unrecoverable material from the MRF, called the residual, is transferred to a landfill for disposal.

The CIWMB commissioned a study of MRF residuals as part of a four-task targeted statewide waste characterization study. This report, identified as the Characterization and Quantification of Residuals from MRFs, presents the results of the second task of the study. The results of the study provide an average profile of residuals from various types of MRFs throughout the state of California.

Purpose and Objectives

The four-task statewide waste characterization study was designed to better understand the state's waste stream, provide a base of information for statewide policy decisions, and share the information gathered with local governments and businesses to assist in their own programs. The purpose of the MRF residual characterization study was to obtain a complete picture of the disposal and recovery potential for MRF residuals in order to allow evaluation of potentially applicable recovery strategies including processing and conversion technologies. The study was designed to estimate the quantity and composition of residuals generated from four different types of MRFs. This was completed through a planned sequence of facility survey/screening, field sampling, sorting, and data analysis.

This study provides an estimate of current total residual tonnages from MRFs throughout the state of California. A database was developed to identify the number, size, location, and type of processing facilities. Determining the quantities of residuals generated from various types of MRFs is important for evaluation of current processing policy, practice, and performance.

Residual composition data was obtained to provide an average residual profile for each type of MRF. This information will be used to facilitate identification of frequent contaminants and unrecovered or potentially recyclable materials within the residual.

The quantity and composition data was combined to obtain a characterization of the residual material generated from each type of MRF, as well as the overall statewide residual. This study is the first of its kind and can be used for the evaluation of potential industry improvements to increase diversion, and will establish a foundation for possible future studies to gauge overall program progress.

Contributing Consultants

This study was managed by R.W. Beck, Inc., under a subcontract with Cascadia Consulting Group, Inc. (Cascadia). It relied on field sampling/sorting activities conducted by GRG Analysis under the direct field supervision of R.W. Beck. The distribution of responsibilities was as follows:

Cascadia Consulting Group, Inc.	Project quality assurance/quality control (QA/QC)
R.W. Beck, Inc.	Project management; Study design; Coordination of data collection; Recruitment of host MRFs; Collection of residuals samples; Data entry and analysis; Reporting; Estimation of quantities and composition
GRG Analysis	Characterization of samples of MRF residuals

MRF Types Examined In This Study

For the purposes of this study, a MRF was defined as a facility in which commingled recyclables or solid waste materials move over a conveyance system which aggregates or segregates recyclable materials by material type or grade and, as a result of the process, produces residuals that are disposed with the municipal waste stream. Four types of MRFs meeting an agreed upon definition of residual-producing Materials Recovery Facilities (MRFs) were included in this study:

1. **Multi-stream** MRFs that receive and process multiple types of recyclables separately. Incoming recyclables may be collected in a source separated manner or from a curbside dual stream program that separate fiber and container streams.
2. **Single Stream** MRFs that sort individual recyclable materials from recyclables that have been collected in one stream.
3. **Mixed Waste Processing Facilities (MWPF),** (sometimes called "dirty MRFs"), that remove one or more recyclable materials from municipal solid waste (MSW) streams.
4. **Construction and Demolition (C&D)** processing facilities that separate one or more materials from mixed construction and/or demolition debris with or without a conveyance system.

Study Design

The finalized R.W. Beck Field Sampling/Sorting Plan for the MRF residual characterization study was previously submitted for approval to the CIWMB staff. A summary of the plan is presented here. The detailed methodology used for the study is presented in this report as Appendix A.

The study design was grouped into three parts:

- Survey/Screening
- Sampling Plan
- Data Analysis

Survey/Screening

To compile sufficient details about the number and types of MRFs in California and the quantities of residuals disposed, the following four-step process was implemented:

1. Compilation of a list of possible MRFs from all relevant industry databases;
2. Solicitation of input on a draft MRF list from the appropriate Local Enforcement Agency (LEA) for review and editing;

3. Performance of a direct screening survey of MRFs for which LEA feedback is uncertain or unavailable; and
4. Performance of a detailed survey of all facilities identified as Potential MRFs.

Average and total statewide residual quantities for each MRF type were developed using data obtained from the screening and survey process. Various data sources were used to identify any possible MRF within the state. Screening of these facilities was performed to identify and resolve duplicate facilities, eliminate facilities which did not meet the definition of a MRF, and obtain general information about each MRF. A facility that was confirmed to meet the specific screening criteria was termed a Potential MRF.

The facilities identified in the Potential MRF database were stratified according to MRF type and region. Each confirmed MRF was grouped to one of the four designated regions of California: San Diego Area, Southern California/Los Angeles Basin, Central Valley & Other, and San Francisco Bay Area. These regions were identified as target areas for all 4 tasks for the statewide study. MRFs that fell outside one of these urban areas were grouped with the Central Valley Region, since this region had the smallest population of the four.

A total of 147 Potential MRFs were surveyed to obtain information concerning incoming, recovered, and residual tonnages. In the survey document, all facilities were offered the option of having a signed confidentiality agreement to protect any data that could be considered sensitive or proprietary, and were informed that all data would be reported in aggregate form only. Detailed surveys were faxed to Potential MRFs and follow-up telephone calls were made to all that did not respond. Facilities that could be characterized by type and for which incoming feedstock and residual quantity data was available were designated as Confirmed MRFs. A total of 44 surveys were completed, qualifying them as Confirmed MRFs, with the remainder split between 36 declining participation and 67 providing no response.

From the database of 44 Confirmed MRFs, a total of 13 MRFs were selected for sampling of residuals in two seasons. Within the constraints imposed by the limited number of responses, every attempt was made to equally allocate sampling sites based on type of MRF and geographic region.

Due to the unexpectedly low response rate to the detailed survey, the Confirmed MRF list was expanded using MRF data obtained and verified by Governmental Advisory Associates (GAA). The addition of 33 MRFs from the GAA database resulted in a total of 77 Confirmed MRFs in the state of California being included as part of this task. The 77 Confirmed MRFs are listed by type and geographic region in Table 6. For MRFs shown in bold, information was obtained through the R.W. Beck detailed survey. Alternatively, information for MRFs shown in italics was obtained from the GAA database. A number of MRFs were identified to process multiple incoming material streams at the same facility, either at different processing times or on separate processing lines. Taking this into account, there are a total of 83 MRF processing lines at the 77 Confirmed MRFs. For example, if a MRF processes both mixed waste and single-stream materials, the facility would have two MRF processing lines.

Table 6 – Confirmed MRFs by Region and Type

Name of Facility	Location	Type of MRF			
		Multi-Stream	Single Stream	Mixed Waste	C&D
San Francisco Bay Area					
West County RR	**Richmond**		**x***		
Green Team/Zanker	**Sunnyvale**	**x**		**x***	
S.F. SW Transfer & Recycling	**San Francisco**				**x**
California Waste Solutions	**Oakland**		**x**		
Tri-Ced	**Hayward**	**x**			
BFI-The Recyclery	**San Carlos**	**x**			
Green Team-San Jose	**San Jose**		**x**		
Pacific Rim Recycling	**Benicia**		**x**		
Recycle Central at Pier 96	**San Francisco**		**x**		
BFI -The Recyclery @ Newby	**Milpitas**	**x**	**x**		
Vallejo Garbage	**Vallejo**	**x***			
Alameda County Industries	**San Leandro**		**x**		
City of Santa Cruz	**Santa Cruz**	**x**			
Blue Line Transfer	**S. San Francisco**	**x***		**x**	**x**
Berkeley Recycling	**Berkeley**	**x**			
West Sonoma County	**Santa Rosa**		**x**		
Daniel O'Davis	**Santa Rosa**				**x**
Z-Best	**Gilroy**			**x***	
Davis Street Station	*San Leandro*	*x*			
Waste Management-Napa	*Napa*		*x*		
Empire Waste Management	*Santa Rosa*		*x*		
Upper Valley Disposal Service	*St. Helena*		*x*		
Southern California/Los Angeles Basin					
JWR	**Wilmington**			**x**	**x**
CR Transfer	**Stanton**			**x**	
Athens Services	**Industry**			**x**	
Downey Area Recycling	**Downey**		**x**		
Robert Nelson Transfer	**Riverside**		**x**		
CR & R, Inc.	**Stanton**		**x**		
Victor Valley MRF	**Victorville**		**x**		
West Valley MRF	**Fontana**		**x***	**x**	
Potential Industries, inc.	**Wilmington**		**x***		
Sun Valley Paper	**Sun Valley**		**x**		
Puente Hills MRF	**Whittier (office)**			**x**	
Allen Company	*Baldwin Park*		*x*		

Table 6 (cont'd) – Confirmed MRFs by Region and Type

Name of Facility	Location	Type of MRF			
		Multi-Stream	Single Stream	Mixed Waste	C&D
Burbank Recycle Center	*Burbank*		*x*		
Consolidated Disposal Services	*Santa Fe Springs*	*x*			
City Fibers	*Los Angeles*		*x*		
Los Angeles Recycling Center	*Los Angeles*		*x*		
Bestway Recycling	*Los Angeles*		*x*		
WM-Orange County	*Santa Ana*	*x*			
CVT Regional MRF	*Anaheim*			*x*	
Carson Transfer Station	*Carson*			*x*	
Sunset Environmental	*Irvine*			*x*	
CR&R,Inc	*Perris*			*x*	
San Diego Area					
IMS Recycling	**San Diego**		**x**		
Allied Waste Recycling	**El Centro**		**x**		
EDCO	*Lemon Grove*		*x*		
North San Diego MRF	*San Diego*		*x*		
Central Valley & Other					
BFI-Rice Rd.	**Fresno**	**x**			
Turlock Recycling	**Turlock**		**x**		
MRWMD MRF	**Monterey**			**x**	
Monterey City Disposal	**Monterey**		**x**		
Lassen Waste Systems	**Susanville**	**x**			
Madera Disposal	**Chowchilla**			**x**	
Sunset Waste Paper	**Fresno**		**x**		
Kroeker Recycling Facility	**Fresno**				**x**
Grindables Recycling	**Arcata**				**x**
Tehama County LFMA	**Red Bluff**		**x**		
Cold Canyon Processing	**San Luis Obispo**		**x***		
Davis Waste Removal	**Davis**	**x**			
City of Redding	**Redding**		**x**		
King's County MRF**	**Hanford**		**x**	**x**	
Carmel Marina Corp	*Castroville*		*x*		
Ft. Irwin	*Ft. Irwin*	*x*			
Central Valley Waste	*Lodi*		*x*		
Bertolotti Transfer & Recycling	*Modesto*		*x*		
City Fibers	*North Hills*		*x*		
Health Sanitation Services	*Santa Maria*		*x*		
Tracy MRF	*Tracy*	*x*			
Gold Coast Recycling	*Ventura*		*x*		
WMI of Santa Cruz	*Watsonville*		*x*		
Oroville Solid Waste Transfer	*Oroville*			*x*	
Western El Dorado MRF	*Placerville*			*x*	

Table 6 (cont'd) – Confirmed MRFs by Region and Type

		Type of MRF			
Name of Facility	**Location**	**Multi-Stream**	**Single Stream**	**Mixed Waste**	**C&D**
WPWMA MRF	*Roseville*			*x*	
Yuba-Sutter Integrated MRF	*Marysville*			*x*	
Waste Management Modesto	*Modesto*			*x*	
South Tahoe Refuse MRF	*So. Lake Tahoe*			*x*	
Eastern Regional MRF	*Truckee*			*x*	
Beck -Total MRF Lines of Each Type		**11**	**23**	**10**	**6**
- % in each Category		**22**	**46**	**20**	**12**
GAA - Added MRF Lines in each category		*5*	*17*	*11*	*0****
- % in each Category		*15*	*52*	*33*	*0****

* Primary MRF process

** MRF was responsive to survey but data could not be used; not included in total

*** GAA intentionally does not obtain information for C&D MRFs

Data obtained by R.W. Beck, Inc. is in bold, GAA obtained data is in italics

Data from the 83 Confirmed MRF processing lines was later used to extrapolate estimates for the remaining Potential MRFs for which no information was available. A description of the methodology used for the data extrapolation is provided in the Data Analysis and Reporting Section in Appendix A.

Sampling Plan

The sampling process began with the selection and scheduling of 13 host MRFs. Information obtained from the Detailed Survey was used to select possible MRFs to host field-sampling operations. MRFs were considered to be good candidates for hosting a sampling/sorting event if they matched several selection criteria, including responsiveness to the survey, sufficient residual quantities, willingness to participate, sufficient space, and acceptable representation of the type of MRF.

All attempts were made to base the selection of potential host MRFs on equal distribution of MRF type, region, and season. However, because of limited responsiveness to the detailed survey, unequal distribution of MRFs by type and region was unavoidable.

Sampling and sorting activities were completed during two seasons, the dry summer season and wet winter season. Dry season sampling was performed in June 2005 and sampling in the wet season was performed in December 2005.

Prior to each sampling season, site visits to the potential host MRFs and potential substitutes were performed at least three weeks prior to scheduled sampling. The site visits contributed to supportive participation by MRFs and facilitated development of a sampling plan tailored to each individual MRF.

The final field sampling schedule for the summer and winter seasons were submitted to CIWMB staff prior to sampling and are presented in Table 25 of Appendix A.

Field methods employed to perform the sampling and sorting activities are discussed later in the section entitled Field Methods.

Data Analysis

Data collected from Field Sampling was entered into a series of spreadsheet templates and was subjected to physical quality control measures (spot checking) and a series of automated logic checks on the source data. Error logs were created for problematic data points and were addressed by sort supervisors prior to being admitted into the analysis dataset.

Average residual composition results were developed by material weight for each MRF type as well as for overall MRFs in the state. The latter computation involved weighting factors that were computed based on estimated annual tonnages of residuals generated at each MRF type. A detailed listing of assumptions underlying these results can be found in Appendix A.

The composition results were subjected to statistical analysis to derive confidence intervals at the 90 percent level of confidence for all MRF types. An explanation of this process is included in Appendix A.

Concurrent to the development of composition results, annual residual tonnage generation estimates by MRF type were developed using an extrapolation method as approved by CIWMB staff. Survey data was combined with additional GAA database data to arrive at average annual generation estimates by MRF type, which were then applied to the percent of total estimates of MRF distribution in the state to produce statewide annual tonnages. A step-by-step walkthrough of this process is also provided in Appendix A.

Once the composition and tonnages estimates were computed, the aggregate MRF type tonnages were partitioned into residue categories based on the respective average percentages by material weight. This resulted in annual tonnage estimates for all material types as defined in this study and cataloged during sorting. Supplemental graphics were also produced showing high-level composition by material groupings for all MRF types (Figures F though J below).

Quantity and composition data resulting from the collection and sorting of residual samples at each of the MRFs was obtained under confidentiality agreements and are not presented within this report. Instead, the data from individual facilities was aggregated by MRF type.

Host MRFs

The sampling plan proposed collection and sorting a total of 360 residual samples from 12 MRFs throughout the state over two seasons. An additional facility was included for a total of 390 samples from 13 MRFs. This additional work was performed by Cascadia and approved by CIWMB staff because Cascadia was already going to be sorting residual samples at the facility and the additional data was beneficial to this study. Approximately 30 samples were collected from each type of MRF. For MRFs where two or more processes were sampled, 30 samples were taken from each process/line. During each season, one facility was used for collection of two different types of residuals. For example, 30 C&D residual samples and 30 mixed waste residual samples were collected and sorted at JWR during the winter season. Samples were typically collected over the course of 2 or 3 days in order to get a representative distribution for characterization.

Table 7 presents the resulting distribution of samples collected from each MRF classified by type, region, and season.

Table 7 – Sample Distribution from Host MRFs, 2005

	Region				MRF Type			
Summer Season	San Diego	Los Angeles	Central Valley / Other	San Francisco	Single-Stream Recyclables	Multi-Stream Recyclables	Mixed Waste	C & D
IMS Recycling Services San Diego, CA	28				28			
Downey Area Recycling & Transfer Downey, CA		30			30			
West Valley MRF Fontana, CA		30					30	
Blue Line Transfer Co., Inc. South San Francisco, CA				62		32		30
Madera Disposal Systems Chowchilla, CA			30				30	
Winter Season								
Allied Waste - The Recyclery San Carlos, CA				30		30		
West County Resource Recovery Richmond, CA				30	30			
Kroeker, Inc. Fresno, CA			30					30
Cold Canyon Processing Facility San Luis Obispo, CA			30		30			
JWR Wilmington, CA		60					30	30
Green Team - Zanker Sunnyvale, CA				30			30	
Number of Samples:	**28**	**120**	**90**	**152**	**118**	**62**	**120**	**90**

Field Methods

This section provides a summary of field methods used during the sampling portion of the study. The detailed methodology used in the study is presented in this report as Appendix A. The objective of this task was to execute the Sampling Plan and collect the targeted data for statistical analysis and extrapolation of residuals.

The sampling process included the following three tasks:

- Residuals Sample Collection;
- Sorting of Residuals; and
- Data Recording.

Any differences between the final plan and actual sampling performed are explained herein. Significant problems or findings encountered during field activities are also described.

Residuals Sample Collection

The field team consisted of a Field Supervisor, Crew Chief, and Sorting Team. The Field Supervisor was responsible for overseeing the collection of each sample. Slightly different sampling techniques were used at almost every facility and for almost every type of residual ejection point. The Field Supervisor took digital photographs of a majority of the collected samples in order to photographically document the origin of each sample and the method by which the sample was taken. A sampling photo journal, provided under separate cover, was assembled to illustrate the range of sampling procedures by MRF and ejection point.

It was confirmed that a majority of MRFs have multiple points along the processing lines where contaminants are either positively removed and/or residues are screened or dropped off the end of a processing line. An approximate 125-pound sample was collected for each ejection point that produced positively sorted or end-of-line residuals. In order to obtain a representative residual profile, the distribution of the samples (typically 30 per facility) collected from each MRF accounted for both the number of residual ejection points and relative quantity of residuals generated from each ejection point. For example, a MRF that generated 3,000 pounds of residuals from a positive sort of contaminants, 2,000 pounds of process residue from the end of the line, and 5,000 pounds of screened unders, would have been sampled such that 30 percent of the samples were taken from the first ejection point, 20 percent from the second ejection point, and 50 percent from the third ejection point. The proportion of samples between ejection points was either estimated by facility operators prior to sampling or measured by the Field Supervisor during sampling. This sample distribution was determined to be more statistically accurate for recombining data to develop a single residual profile rather than sampling each ejection point equally.

Because each MRF used different recovery technologies, configurations, and capabilities, a variety of operational configurations required a variety of sampling procedures in order to obtain representative samples from each MRF. The residues were produced into any configuration of small containers, large containers, bunkers, or stockpiles. The various sampling methods employed were grab, scoop, and negative sort capture. At a majority of the facilities, the selected sampling method was based on operational constraints. In some cases, a combination of methods was used to collect the actual sorted sample. Although facility equipment operators typically assisted with the collection of a sample, the location and time was always directed and administered by the Field Supervisor. When grab samples were collected from a residual pile, randomness was ensured by selecting a location prior to observation of the pile. The sample location was recorded on the sample log.

Sample methods such as stopping the belt and slicing a bale were not used as originally anticipated. Stopping the belt can be necessary if one type of residual mixes with another type of residual before it is discharged to an ejection point. In these cases, facility personnel did not prefer stopping the belt to collect a sample because of safety concerns and operational impacts. Alternatively, processing of the undesirable material was temporarily stopped so that the end-of-line discharge only consisted of the desired residual. A negative sort capture sample was then collected into a container which was emptied in order to collect grab samples. Residual samples obtained from a bale slice were so compact that sorting of the material would have been extremely difficult and results less accurate. When obtaining samples from baled material was necessary, the facility operator was able to grab a less compacted bale and break open the bale to loosen the material. A grab sample was then collected from the resulting residuals pile.

Sorting of Residuals

Once a representative sample was collected, it was transferred to the designated sorting location. The sorting team placed the residual material for each sample onto a specially designed table in order to perform the sort. From the sort table, particles larger than two inches were manually sorted into pre-labeled bins corresponding to the 79 material categories identified by CIWMB. The remaining fines fraction was collected and weighed in its entirety. When the fines weighed less than 15 percent of the entire 125-pound sample, the fines were visually apportioned into major material categories. When the remaining fines weighed more than 15 percent of the entire 125-pound sample, a sub-sample of fines was collected and physically sorted into major material categories or a specific material type if possible (such as glass cullet). The 15 percent fines weight limit was not previously specified in the final sampling plan but was proposed as a detailed clarification prior to the start of sampling activities. The fines sub-sample was collected using the cone and quarter method and was used as the basis for the composition of all fines in that sample. We recombined the composition result analytically using weighted averages based on the relative amounts of fines and larger particle (non-fines) materials. In the event that the ejection point produced fines residuals only, a smaller fines sample was collected and assumed to represent the entire 125-pound sample. This process was documented via digital photography to illustrate examples of the primary sorting and fines sub-sorting.

Four of the material categories were sub-sorts to identify PETE and Polystyrene food and non-food clamshells within the categories for Other PETE Containers and #3-7 Other Containers. CIWMB staff requested the data be submitted under separate cover and not included for the purposes of this report. Therefore, only 75 material categories are listed in the composition results tables.

Data Recording

After all of the material from a sample was sorted into the appropriate pre-labeled bins, our team recorded the gross weights of containers on a data collection sheet. A copy of this form is presented in Appendix D. The tare weight of the empty bins were periodically recorded and subtracted from the gross weights to obtain the net weights for material from each category. This method increased sorting efficiency and reduced the potential for data recording errors.

Results and Findings

Statewide MRF Distribution by Type

This study identified a total of 147 MRFs currently operating within the state of California. Detailed information regarding facility type and size was obtained for 77 Confirmed MRFs, which represented a total of 83 different processing lines. Table 8 provides a summary of the number of material processing lines listed by MRF type and region. The data for C&D MRFs is based solely on information obtained from the R.W. Beck detailed survey responses. Data for all other MRF types was based on a combination of the R.W. Beck detailed survey responses and the GAA database.

Table 8 – Regional Distribution of Statewide Confirmed MRFs, 2005

MRF Type	San Diego	Los Angeles	Central Valley / Other	San Francisco	Overall
C&D*		1	2	3	6
Single-Stream**	4	12	12	12	40
Multi-Stream**		2	5	9	16
Mixed Waste**		9	9	3	21
Overall	4	24	28	27	83

* – Data obtained from R.W. Beck detailed survey responses
** – Data obtained from GAA database and R.W. Beck detail survey responses

When determining facility distribution by MRF type, data from the two sources used (R.W. Beck survey and GAA) could not be directly combined because the GAA data did not include any information for C&D MRFs. However, 6 of the 44 facilities, or 12 percent, that responded to R.W. Beck's detailed survey were confirmed to be C&D MRFs. Using that data, we estimate that 12 percent of all MRFs are C&D MRFs. Data from both sources was used to apportion the other three types of MRFs to the remaining 88 percent. Table 9 presents the resulting distribution of statewide MRF types.

Table 9 – Estimated Distribution of Statewide MRF Types, 2005

MRF Type	Percentage
C&D	12%
Single-Stream	46%
Multi-Stream	18%
Mixed Waste	24%
Total	100%

The following discussion describes the residual characterization results and findings for each type of MRF as well as the overall statewide residual. Pie charts and tables are included to provide a summary of the residual quantity and characterization data.

Findings for MRFs Receiving Single-Stream Recyclables

The following observations and results are based on survey and sampling data collected during this study from MRFs processing single-stream recyclables.

Field Observations

Sampling and sorting activities were performed at four single-stream MRFs throughout the state of California. More than 90 percent of the material processed at the host single-stream MRFs were residential recyclables. It was previously anticipated that each MRF would have a different residual profile based on region, size, and sampling season. However, further variance was discovered within the residual from these MRFs based on sorting technologies, targeted commodities, and operational arrangements.

The processing technologies at single-stream MRFs ranged from a staff of laborers positively removing large residuals and recoverable material from a system of conveyor belts, to a highly mechanized and automated series of separation technologies. Each MRF used conveyor belts as the primary means of moving material through the processing system. Laborers were used at each MRF to presort large, bulky items which could potentially damage the conveyance or sorting equipment. When laborers were used, each laborer would typically target one type of material for removal. Various types of technologies utilized at single-stream host MRFs included, but were not limited to, disc screens, trommel screens, air classifiers, magnets, eddy currents, and shaker or finger screens.

A list of common targeted recyclables from single-stream processing host MRFs is presented as Table 10. Other recyclables targeted at some facilities but considered residue at others included mixed glass cullet, other ferrous and non-ferrous metal, mixed rigid plastics, and plastic film.

Table 10 – Single-Stream Processing Commonly Targeted Recyclables, 2005

Material Category	Material Category
Old Corrugated Cardboard (OCC)	Aluminum Cans
White Ledger	Steel Cans
Newspaper	PETE Containers
Mixed Paper	Colored HDPE Containers
Clear Glass	Natural HDPE Containers
Green Glass	#3-#7 Plastic Containers
Brown Glass	

Although the sorting sequence was fairly consistent, each MRF had a unique processing arrangement and procedure. In general, the order of processing/removal was large presorted residuals followed by various types of fiber or paper, plastics, metals, and glass, respectively. One facility positively removed their entire residual stream and the end-of-line discharge was recovered as mixed paper. The other facilities positively removed large residuals and recyclables and the end-of-line discharge was residual.

Survey Results – Estimated Residual Quantity

A total of 40 MRFs throughout the state of California were confirmed to process single-stream recyclables. Single-stream processing facilities represent approximately 46 percent of the total number of statewide Confirmed MRFs.

The average annual tonnage of incoming material at single-stream Confirmed MRFs was determined to be approximately 52,900 tons. The average residual from single-stream Confirmed MRFs is 7,400 tons. The resulting proportion of residual to the total quantity of incoming material processed was approximately 14 percent, typically ranging from 2 percent to 50 percent.

The total annual statewide tonnage of residual from single-stream MRFs is estimated to be approximately 496,600 tons. This information is summarized in Table 11.

Table 11 – Average Quantity of Incoming Material and Residuals from MRFs Receiving Single Stream Recyclables, 2005

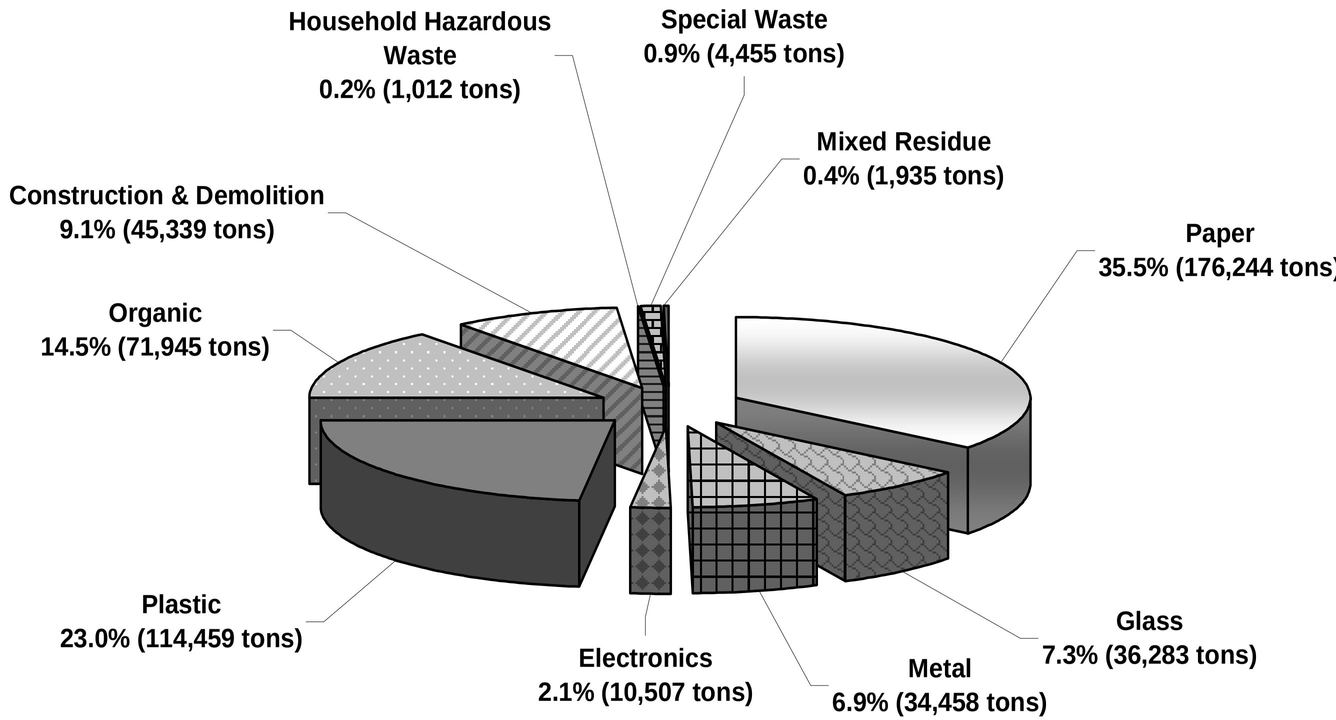
MRF Type	Average Quantity of Incoming Material (tons)	Average Residual Quantity (tons)	Average Residual Percent of Total Incoming	Total Statewide Residual Quantity (tons)
Single-Stream	52,900	7,400	14%	496,600

Sampling Results – Estimated Residual Characterization

Figure F and Table 12 present the results of the single-stream MRF characterization obtained from sampling and sorting. The percentage shown represents the average proportion of each material type by weight to the total residual stream.

More than 58 percent of the residual from this MRF type was determined to be either paper or plastic. A majority of the paper was miscellaneous or remainder/composite (R/C) paper, which is typically unfeasible and/or undesirable to recover. Various types of miscellaneous paper were unopened junk mail, cereal and cracker boxes, milk and juice cartons, and books. R/C paper included paper with food contamination or moisture, aseptic packages, paper towels or tissues, and photographs. Common R/C plastic items were used food/beverage trays or containers and various plastics which were attached to other types of materials or otherwise not representative of another category.

Figure F
Summary of Composition of Residuals - MRFs Receiving Single Stream Recyclables, 2005



Total Residual Weight is 496,638 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Table 12 - Estimated Residual Composition for California MRFs Receiving Single Stream Recyclables, 2005

	Est. Pct.	+/-	Est. Tons
Paper	**35.5%**	**2.9%**	**176,244**
Uncoated Corrugated Cardboard	4.4%	0.8%	21,825
Paper Bags/Kraft	0.8%	0.1%	4,198
Newspaper	6.9%	1.0%	34,189
White Ledger	0.8%	0.2%	4,079
Colored Ledger	0.2%	0.0%	818
Computer Paper	0.1%	0.0%	288
Other Office Paper	2.3%	0.3%	11,400
Magazines/Catalogs	2.4%	0.4%	11,782
Phone Books/Directories	0.4%	0.1%	1,851
Other Misc. Paper	5.1%	0.6%	25,326
Remainder/Composite Paper	12.2%	1.3%	60,487
Glass	**7.3%**	**1.7%**	**36,283**
Clear Glass Bottles & Containers	0.8%	0.2%	4,218
Green Glass Bottles & Containers	0.6%	0.2%	2,809
Brown Glass Bottles & Containers	0.4%	0.1%	1,788
Other Colored Glass Bottles & Containers	0.1%	0.0%	609
Flat Glass	0.1%	0.0%	463
Mixed Cullet	5.1%	1.5%	25,207
Remainder/Composite Glass	0.2%	0.1%	1,189
Metal	**6.9%**	**0.9%**	**34,458**
Tin/Steel Cans	0.9%	0.1%	4,489
Major Appliances	0.2%	0.1%	1,097
Used Oil Filters	0.0%	0.0%	35
Other Ferrous	3.4%	0.7%	16,720
Aluminum Cans	0.3%	0.0%	1,713
Other Non-Ferrous	0.9%	0.2%	4,353
Remainder/Composite Metal	1.2%	0.3%	6,050
Electronics	**2.1%**	**0.5%**	**10,507**
Brown Goods	0.0%	0.0%	234
Computer-related Electronics	0.5%	0.2%	2,516
Other Small Consumer Electronics	1.4%	0.4%	6,921
TV's & Other CRTs	0.2%	0.1%	837
Plastic	**23.0%**	**2.2%**	**114,459**
PETE Bottles	0.9%	0.1%	4,337
Other PETE Containers	0.6%	0.1%	2,778
HDPE Natural Bottles	0.3%	0.1%	1,583
HDPE Colored Bottles	0.3%	0.1%	1,256
HDPE 5-gallon buckets (Food)	0.0%	0.0%	174
HDPE 5-gallon buckets (Non-Food)	0.3%	0.1%	1,262
Other HDPE Containers	0.4%	0.1%	1,888
#3-#7 Bottles	0.1%	0.0%	470
Other #3-#7 Containers	1.3%	0.2%	6,234
Plastic Trash Bags	0.7%	0.1%	3,509
Grocery/Merch. Bags	1.7%	0.3%	8,660
Non-bag Comm./Ind. Packaging Film	0.7%	0.2%	3,255
Film Products	0.4%	0.2%	2,234
Other Film	3.4%	0.4%	16,776
Durable Plastic Items	3.4%	0.7%	16,907
Remainder/Composite Plastic	8.7%	0.7%	43,138

	Est. Pct.	+/-	Est. Tons
Organic	**14.5%**	**1.5%**	**71,945**
Food	3.3%	0.5%	16,611
Leaves and Grass	0.6%	0.3%	3,184
Prunings & Trimmings	0.7%	0.2%	3,607
Branches & Stumps	0.1%	0.0%	561
Agricultural Crop	0.0%	0.0%	65
Manures	0.1%	0.1%	602
Textiles	5.7%	0.8%	28,120
Carpet	0.6%	0.2%	3,166
Remainder/Composite Organics	3.2%	0.5%	16,028
Construction & Demolition	**9.1%**	**1.7%**	**45,339**
Concrete	1.4%	0.7%	7,177
Asphalt Paving	0.1%	0.0%	375
Asphalt Roofing	0.2%	0.1%	834
Lumber	1.6%	0.3%	7,934
Treated Wood Waste	2.2%	0.5%	11,150
Gypsum Board	0.1%	0.0%	614
Rock, Soil, Fines	2.6%	0.6%	13,065
Remainder/Composite C&D	0.8%	0.2%	4,190
Household Hazardous Waste	**0.2%**	**0.1%**	**1,012**
Paint	0.1%	0.0%	353
Vehicle & Equip. Fluids	0.0%	0.0%	37
Used Oil	0.0%	0.0%	0
Batteries	0.1%	0.0%	401
Remainder/Composite HHW	0.0%	0.0%	221
Special Waste	**0.9%**	**0.5%**	**4,455**
Ash	0.0%	0.0%	0
Sewage Solids	0.0%	0.0%	0
Industrial Sludge	0.0%	0.0%	0
Treated Medical Waste	0.0%	0.0%	58
Bulky Items	0.3%	0.1%	1,396
Tires	0.6%	0.2%	2,837
Remainder/Composite Special Waste	0.0%	0.0%	164
Mixed Residue	**0.4%**	**0.2%**	**1,935**
Totals	**100.0%**		**496,638**
Sample count:	**118**		

Notes: Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.
Estimated Percentages calculated by weight as the average proportion of each material type to the total residual weight

Findings for MRFs Receiving Multi-Stream Recyclables

The following observations and results are based on survey and sampling data collected during this study from MRFs processing multi-stream recyclables.

Field Observations

Sampling and sorting activities were performed at two multi-stream MRFs throughout the state of California. The residual from multi-stream MRFs was estimated to represent 6 percent of the total statewide MRF residual. Approximately 63 percent of the material processed at the host multi-stream MRFs were residential recyclables, with the remainder from commercial sources. As with single-stream MRFs, it was anticipated that each MRF would have a different residual profile based on region, size, and sampling season. Common sorting technologies, targeted commodities, and operational arrangements are described below.

The processing technologies were similar at both of the multi-stream MRFs which hosted sampling and sorting activities. Both of these facilities were dual-stream, with a separate line for fiber or paper and for containers. Each MRF used conveyor belts as the primary means of moving material through the processing system. Laborers were used to presort large, bulky items which could potentially damage the conveyance or sorting equipment. One MRF primarily utilized laborers to positively remove the recyclables, whereas the other was significantly more advanced although hand sorters were still largely relied upon. Various types of technologies utilized at the multi-stream host MRFs included, but were not limited to, disc screens, trommel screens, magnets, and shaker or finger screens.

A list of common targeted recyclables from multi-stream processing host MRFs is presented as Table 13. Other recyclables targeted at one facility but considered residue at the other included other ferrous metal and plastic film.

Table 13 – Multi-Stream Processing Commonly Targeted Recyclables, 2005

Material Category	Material Category
Old Corrugated Cardboard (OCC)	Aluminum Cans
Newspaper	Steel Cans
Mixed Paper	PETE Containers
Clear Glass	Colored HDPE Containers
Green Glass	Natural HDPE Containers
Brown Glass	#3-#7 Plastic Containers
Mixed Glass	Mixed Rigid Plastics

Presumably every multi-stream processing facility processes the various incoming recyclable streams separately. However, one of the host MRFs had two separate lines running simultaneously, and the other processed the materials on the same line at different times. For the fiber or paper line, the order of processing/removal was large presorted residuals followed by OCC, newspaper, and mixed paper, respectively. The order of container processing was not consistent between the two host MRFs. Recyclable containers from the fiber line were collected and transferred to the container line for recovery, and vice versa.

Survey Results – Estimated Residual Quantity

A total of 16 MRFs were confirmed to process multi-stream recyclables throughout the state of California. Multi-stream processing facilities represent approximately 18 percent of the total number of statewide Confirmed MRFs.

The average annual tonnage of incoming material at multi-stream Confirmed MRFs was determined to be approximately 20,900 tons. The average residual from multi-stream Confirmed MRFs is 1,300 tons. The resulting proportion of residual to the total quantity of incoming material processed was approximately 6 percent, ranging from 1 percent to 19 percent.

As expected, there was minimal residual generated by multi-stream processing facilities, generally due to the quality of incoming material. Less contaminants are present because such curbside programs require customers to separate fiber materials from commingled containers. Furthermore, processing can be more efficient because each stream is more homogeneous. Fiber processing typically has less moisture or food contamination.

The total annual statewide tonnage of residuals from multi-stream MRFs is estimated to be approximately 35,900 tons. This information is summarized in Table 14.

Table 14 – Average Quantity of Incoming Material and Residuals from MRFs Receiving Multi-Stream or Separated Recyclables, 2005

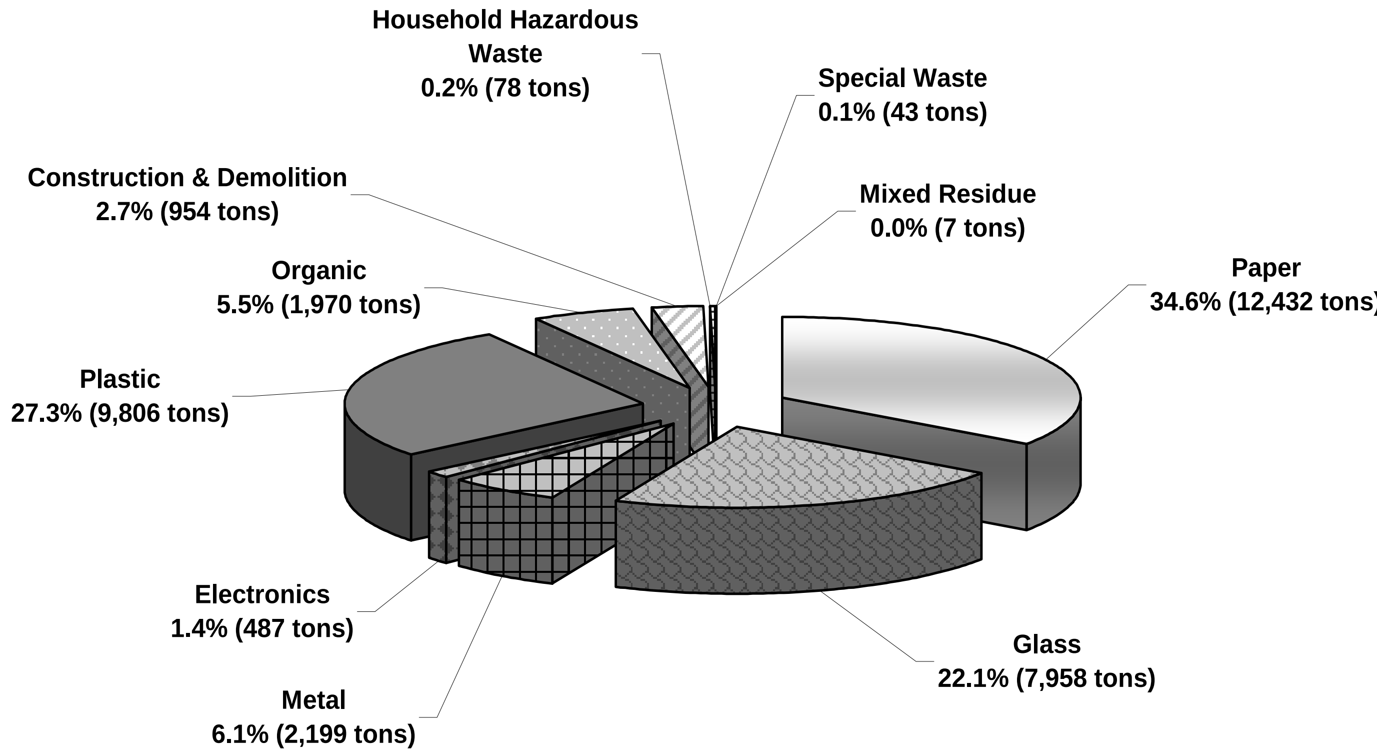
MRF Type	Average Quantity of Incoming Material (tons)	Average Residual Quantity (tons)	Average Residual Percent of Total Incoming	Total Statewide Residual Quantity (tons)
Multi-Stream	20,900	1,300	6%	35,900

Sampling Results – Estimated Residual Characterization

Figure G and Table 15 present the results of the multi-stream MRF characterization obtained from sampling and sorting. The percentage shown represents the average proportion of each material type by weight to the total residual stream.

Similar to single-stream residuals, more than half of the residual stream was paper or plastic. The large percentage of glass (22 percent) in the residual was most likely attributed to the significantly smaller residual quantity of multi-stream MRFs and the fact that there were less contaminants present in the incoming material.

Figure G
Summary of Composition of Residuals - MRFs Receiving Multi-Stream or Separated Recyclables, 2005



Total Residual Weight is 35,931 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Table 15 - Estimated Residual Composition for California MRFs Receiving Multi-Stream or Separated Recyclables, 2005

	Est. Pct.	+/-	Est. Tons
Paper	**34.6%**	**3.2%**	**12,432**
Uncoated Corrugated Cardboard	2.5%	0.6%	887
Paper Bags/Kraft	1.0%	0.2%	343
Newspaper	9.4%	1.6%	3,364
White Ledger	2.8%	1.0%	995
Colored Ledger	0.1%	0.0%	20
Computer Paper	0.2%	0.1%	78
Other Office Paper	1.8%	0.4%	656
Magazines/Catalogs	5.0%	1.0%	1,779
Phone Books/Directories	0.5%	0.2%	172
Other Misc. Paper	5.5%	0.6%	1,966
Remainder/Composite Paper	6.0%	1.1%	2,172
Glass	**22.1%**	**3.5%**	**7,958**
Clear Glass Bottles & Containers	5.6%	1.2%	2,011
Green Glass Bottles & Containers	3.5%	0.6%	1,274
Brown Glass Bottles & Containers	2.1%	0.5%	755
Other Colored Glass Bottles & Containers	0.2%	0.1%	62
Flat Glass	0.1%	0.1%	53
Mixed Cullet	9.8%	2.7%	3,523
Remainder/Composite Glass	0.8%	0.3%	281
Metal	**6.1%**	**0.9%**	**2,199**
Tin/Steel Cans	2.5%	0.6%	898
Major Appliances	0.0%	0.0%	0
Used Oil Filters	0.0%	0.0%	0
Other Ferrous	0.7%	0.3%	258
Aluminum Cans	1.1%	0.2%	398
Other Non-Ferrous	1.1%	0.3%	407
Remainder/Composite Metal	0.7%	0.3%	238
Electronics	**1.4%**	**0.6%**	**487**
Brown Goods	0.1%	0.0%	25
Computer-related Electronics	0.5%	0.3%	192
Other Small Consumer Electronics	0.7%	0.3%	266
TV's & Other CRTs	0.0%	0.0%	3
Plastic	**27.3%**	**2.6%**	**9,806**
PETE Bottles	1.5%	0.3%	556
Other PETE Containers	1.7%	0.4%	607
HDPE Natural Bottles	0.6%	0.2%	233
HDPE Colored Bottles	0.9%	0.1%	312
HDPE 5-gallon buckets (Food)	0.2%	0.1%	66
HDPE 5-gallon buckets (Non-Food)	0.4%	0.2%	129
Other HDPE Containers	0.7%	0.2%	254
#3-#7 Bottles	0.3%	0.1%	102
Other #3-#7 Containers	3.2%	0.5%	1,144
Plastic Trash Bags	0.8%	0.3%	277
Grocery/Merch. Bags	1.6%	0.3%	557
Non-bag Comm./Ind. Packaging Film	0.7%	0.3%	265
Film Products	0.1%	0.0%	22
Other Film	3.0%	0.6%	1,093
Durable Plastic Items	2.3%	0.7%	839
Remainder/Composite Plastic	9.3%	1.1%	3,348

	Est. Pct.	+/-	Est. Tons
Organic	**5.5%**	**1.2%**	**1,970**
Food	3.1%	0.9%	1,118
Leaves and Grass	0.2%	0.1%	66
Prunings & Trimmings	0.2%	0.1%	57
Branches & Stumps	0.0%	0.0%	0
Agricultural Crop	0.0%	0.0%	9
Manures	0.0%	0.0%	0
Textiles	1.0%	0.4%	375
Carpet	0.0%	0.0%	5
Remainder/Composite Organics	0.9%	0.2%	340
Construction & Demolition	**2.7%**	**0.8%**	**954**
Concrete	0.1%	0.1%	50
Asphalt Paving	0.0%	0.0%	0
Asphalt Roofing	0.0%	0.0%	2
Lumber	0.7%	0.3%	244
Treated Wood Waste	0.8%	0.4%	270
Gypsum Board	0.0%	0.0%	5
Rock, Soil, Fines	0.4%	0.2%	134
Remainder/Composite C&D	0.7%	0.3%	249
Household Hazardous Waste	**0.2%**	**0.1%**	**78**
Paint	0.0%	0.0%	2
Vehicle & Equip. Fluids	0.0%	0.0%	0
Used Oil	0.0%	0.0%	0
Batteries	0.1%	0.0%	20
Remainder/Composite HHW	0.2%	0.1%	55
Special Waste	**0.1%**	**0.1%**	**43**
Ash	0.0%	0.0%	0
Sewage Solids	0.0%	0.0%	0
Industrial Sludge	0.0%	0.0%	0
Treated Medical Waste	0.0%	0.0%	1
Bulky Items	0.0%	0.0%	9
Tires	0.1%	0.0%	18
Remainder/Composite Special Waste	0.0%	0.0%	15
Mixed Residue	**0.0%**	**0.0%**	**7**
Totals	**100.0%**		**35,931**
Sample count:	**62**		

Notes: Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.
Estimated Percentages calculated by weight as the average proportion of each material type to the total residual weight

Findings for MRFs Processing Mixed Waste Material

The following observations and results are based on survey and sampling data collected during this study from MRFs processing mixed waste material.

Field Observations

Sampling and sorting activities were performed at four mixed waste MRFs throughout the state of California. A majority of the material processed at the host mixed waste MRFs was residential solid waste. Variances in sorting technologies, targeted commodities, and operational arrangements are described below.

Similar to other MRF types, the processing technologies at mixed waste MRFs ranged from a staff of laborers positively removing large residuals and recoverable material from a system of conveyor belts, to a marginally mechanized and automated series of separation technologies. Each MRF used conveyor belts as the primary means of moving material through the processing system. Laborers were used at each MRF to presort large, bulky items which could potentially damage the conveyance or sorting equipment. When laborers were used, each laborer would typically target one type of material for removal. Various types of technologies utilized at mixed waste host MRFs included, but were not limited to, disc screens, trommel screens, magnets, and shaker or finger screens.

The targeted recyclables from mixed waste processing host MRFs was highly variable. A list of common targeted recyclables is presented as Table 16. Some facilities separated the various colors of glass, while others only targeted mixed color. Similarly, some mixed waste MRFs separated individual types of plastics, while others targeted a combination of HDPE (#2) through #7 plastics. Other recyclables targeted at some facilities but considered residue at others included white ledger, other ferrous and non-ferrous metal, mixed rigid plastics, and plastic film.

Table 16 – Mixed Waste Processing Commonly Targeted Recyclables, 2005

Material Category	Material Category
Old Corrugated Cardboard (OCC)	Aluminum Cans
Newspaper	Steel Cans
Mixed Paper	PETE Containers
Glass	Other Plastic Containers

Although the sorting sequence was fairly consistent, each MRF had a unique processing arrangement and procedure. In general, the order of processing/removal was large presorted residuals followed by various types of fiber or paper, plastics, metals, and glass, respectively. Each mixed waste MRF produced an end-of-line residual since the incoming material was solid waste to begin with.

Survey Results – Estimated Residual Quantity

A total of 21 MRFs were confirmed to process mixed waste throughout the state of California. Mixed waste processing facilities represent approximately 24 percent of the total number of statewide Confirmed MRFs.

The average annual tonnage of incoming material at mixed waste Confirmed MRFs was determined to be approximately 234,700 tons. The average residual from mixed waste Confirmed MRFs is 189,800 tons. The resulting proportion of residual to the total quantity of incoming material processed was approximately 81 percent, ranging from 27 percent to 97 percent.

The incoming material at mixed waste processing facilities is essentially municipal solid waste and the residual percentage is predictably much higher than any other type. Many mixed waste MRFs are increasingly accepting more commercial waste and less residential waste, as commercial waste typically has a higher degree of recoverable materials. Based on information from Confirmed mixed waste MRFs, slightly more residential waste is currently processed. These types of MRFs attempt to remove as many recyclables as possible but there is typically more moisture, food contamination, and more unrecoverable material to sort through. Since incoming quantities are much larger, these types of MRFs often load the processing line at a higher rate.

The total annual statewide tonnage of residuals from mixed waste MRFs is estimated to be approximately 6,678,200 tons. This information is summarized in Table 17.

Table 17 – Average Quantity of Incoming Material and Residuals from MRFs Receiving Mixed Waste, 2005

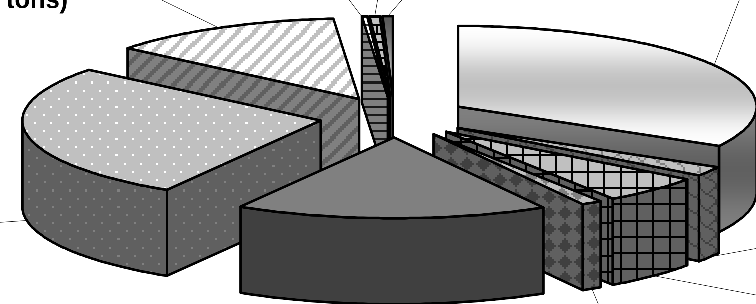
MRF Type	Average Quantity of Incoming Material (tons)	Average Residual Quantity (tons)	Average Residual Percent of Total Incoming	Total Statewide Residual Quantity (tons)
Mixed Waste	234,700	189,800	81%	6,678,200

Sampling Results – Estimated Residual Characterization

Figure H and Table 18 present the results of the mixed waste MRF characterization obtained from sampling and sorting. The percentage shown represents the average proportion of each material type by weight to the total residual stream.

Although approximately the same amount of paper was present within mixed waste residual, a larger portion was R/C paper primarily due to food and/or moisture contamination. The remainder of the residual stream expectedly included larger quantities of C&D and organic material.

Figure H
Summary of Composition of Residuals - MRFs Receiving Mixed Waste, 2005



Total Residual Weight is 6,678,151 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Table 18 - Estimated Residual Composition for California MRFs Receiving Mixed Waste, 2005

	Est. Pct.	+/-	Est. Tons
Paper	**33.1%**	**1.8%**	**2,213,130**
Uncoated Corrugated Cardboard	4.3%	0.4%	284,205
Paper Bags/Kraft	0.7%	0.1%	45,834
Newspaper	4.2%	0.5%	278,891
White Ledger	1.8%	0.3%	120,169
Colored Ledger	0.2%	0.0%	13,761
Computer Paper	0.0%	0.0%	1,676
Other Office Paper	2.5%	0.3%	166,522
Magazines/Catalogs	2.5%	0.4%	163,624
Phone Books/Directories	0.2%	0.1%	12,360
Other Misc. Paper	4.7%	0.4%	310,598
Remainder/Composite Paper	12.2%	1.1%	815,491
Glass	**1.9%**	**0.3%**	**128,415**
Clear Glass Bottles & Containers	0.8%	0.2%	54,896
Green Glass Bottles & Containers	0.2%	0.1%	15,722
Brown Glass Bottles & Containers	0.2%	0.1%	11,930
Other Colored Glass Bottles & Containers	0.0%	0.0%	519
Flat Glass	0.1%	0.0%	3,497
Mixed Cullet	0.4%	0.1%	25,861
Remainder/Composite Glass	0.2%	0.1%	15,991
Metal	**5.6%**	**0.8%**	**372,659**
Tin/Steel Cans	1.1%	0.2%	74,031
Major Appliances	0.2%	0.1%	10,799
Used Oil Filters	0.0%	0.0%	305
Other Ferrous	2.0%	0.5%	136,782
Aluminum Cans	0.3%	0.0%	18,331
Other Non-Ferrous	0.7%	0.2%	49,703
Remainder/Composite Metal	1.2%	0.3%	82,706
Electronics	**1.1%**	**0.3%**	**73,259**
Brown Goods	0.3%	0.1%	20,966
Computer-related Electronics	0.4%	0.1%	23,838
Other Small Consumer Electronics	0.4%	0.1%	28,122
TV's & Other CRTs	0.0%	0.0%	333
Plastic	**16.9%**	**1.1%**	**1,127,866**
PETE Bottles	0.7%	0.1%	43,746
Other PETE Containers	0.1%	0.0%	9,710
HDPE Natural Bottles	0.3%	0.1%	19,636
HDPE Colored Bottles	0.3%	0.1%	17,303
HDPE 5-gallon buckets (Food)	0.1%	0.0%	4,852
HDPE 5-gallon buckets (Non-Food)	0.3%	0.1%	21,262
Other HDPE Containers	0.1%	0.0%	6,097
#3-#7 Bottles	0.1%	0.0%	6,863
Other #3-#7 Containers	0.8%	0.1%	53,697
Plastic Trash Bags	1.3%	0.2%	87,248
Grocery/Merch. Bags	1.1%	0.2%	76,432
Non-bag Comm./Ind. Packaging Film	1.8%	0.4%	117,378
Film Products	0.1%	0.1%	8,592
Other Film	3.7%	0.4%	246,411
Durable Plastic Items	1.2%	0.2%	80,524
Remainder/Composite Plastic	4.9%	0.5%	328,115

	Est. Pct.	+/-	Est. Tons
Organic	**27.3%**	**2.4%**	**1,825,548**
Food	10.4%	1.3%	691,353
Leaves and Grass	7.9%	1.9%	530,628
Prunings & Trimmings	1.0%	0.3%	63,914
Branches & Stumps	0.3%	0.1%	22,940
Agricultural Crop	0.0%	0.0%	2,710
Manures	0.0%	0.0%	1,879
Textiles	2.4%	0.4%	163,550
Carpet	0.3%	0.1%	22,798
Remainder/Composite Organics	4.9%	0.7%	325,776
Construction & Demolition	**12.6%**	**2.0%**	**839,302**
Concrete	0.6%	0.2%	41,868
Asphalt Paving	0.0%	0.0%	215
Asphalt Roofing	0.2%	0.1%	12,605
Lumber	3.1%	0.6%	204,749
Treated Wood Waste	1.9%	0.4%	127,948
Gypsum Board	0.8%	0.3%	52,064
Rock, Soil, Fines	3.2%	0.6%	216,690
Remainder/Composite C&D	2.7%	0.8%	183,161
Household Hazardous Waste	**0.4%**	**0.1%**	**25,022**
Paint	0.0%	0.0%	1,232
Vehicle & Equip. Fluids	0.0%	0.0%	0
Used Oil	0.0%	0.0%	459
Batteries	0.3%	0.1%	19,319
Remainder/Composite HHW	0.1%	0.0%	4,012
Special Waste	**0.5%**	**0.4%**	**36,442**
Ash	0.0%	0.0%	1,111
Sewage Solids	0.0%	0.0%	0
Industrial Sludge	0.0%	0.0%	0
Treated Medical Waste	0.0%	0.0%	90
Bulky Items	0.0%	0.0%	0
Tires	0.0%	0.0%	1,566
Remainder/Composite Special Waste	0.5%	0.2%	33,675
Mixed Residue	**0.5%**	**0.2%**	**36,508**
Totals	**100.0%**		**6,678,151**
Sample count:	**120**		

Notes: Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.
Estimated Percentages calculated by weight as the average proportion of each material type to the total residual weight

Findings for MRFs Processing C&D Material

The following observations and results are based on survey and sampling data collected during this study from MRFs processing C&D material.

Field Observations

Sampling and sorting activities were performed at three C&D MRFs throughout the state of California. Almost all of the material processed at the host C&D MRFs was commercial material. Variances in sorting technologies, targeted commodities, and operational arrangements are described below.

Similar to other types of MRFs, the processing technologies at C&D MRFs ranged from a staff of laborers positively removing large residuals and recoverable material from a system of conveyor belts, to a moderately mechanized and automated series of separation technologies. Each MRF used conveyor belts as the primary means of moving material through the processing system. Laborers were used at each MRF to presort large, bulky items which could potentially damage the conveyance or sorting equipment. When laborers were used, each laborer would typically target one type of material for removal. Various types of technologies utilized at mixed waste host MRFs included, but were not limited to shredders or chippers, disc screens, trommel screens, magnets, and shaker or finger screens.

The targeted recyclables from C&D processing host MRFs were fairly standard. A list of common targeted recyclables is presented as Table 19. A large, unique source of recovery from C&D MRFs was the ability to use fines material for alternative daily cover (ADC). Some facilities recovered mixed rigid plastics and asphalt.

Table 19 – C&D Processing Commonly Targeted Recyclables, 2005

Material Category	Material Category
Untreated Lumber	ADC
Other Wood	Concrete
Ferrous Metal	

MRFs processing C&D material are increasingly common throughout the state of California due to the growing number of acceptable uses for the materials. The C&D recycling programs in California are largely accepted as some of the most innovative and effective in the nation. Currently, C&D MRFs represent an estimated 12 percent of the total statewide MRFs by number. Many more C&D recovery facilities were identified but did not meet the specific criteria of a residual-generating MRF, usually because the material was homogeneous (such as pure loads of concrete) and did not require processing.

Each MRF had a unique processing arrangement and procedure. Some MRFs positively removed their entire residual stream, while others presorted large, bulky residues and recoverable materials and the end-of-the line was disposed as residual. Each host MRF recovered wood for bio-fuel at conversion plants and fines for landfill alternative daily cover (ADC).

Survey Results – Estimated Residual Quantity

A total of 6 MRFs were confirmed to process C&D materials throughout the state of California. C&D processing facilities represent approximately 12 percent of the total number of statewide Confirmed MRFs.

The average annual tonnage of incoming material at Confirmed C&D MRFs was determined to be approximately 40,000 tons. The average residual from Confirmed C&D MRFs is 9,170 tons. The resulting proportion of residual to the total quantity of incoming material processed was approximately 23 percent, ranging from 1 percent to 41 percent.

The total annual statewide tonnage of residuals from C&D MRFs is estimated to be approximately 161,700 tons. This information is summarized in Table 20.

Table 20 – Average Quantity of Incoming Material and Residuals from MRFs Receiving C&D Materials, 2005

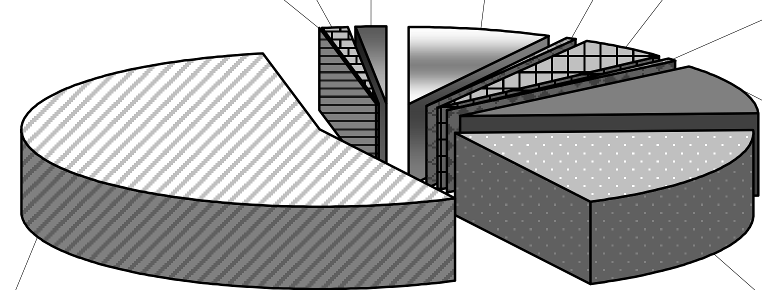
MRF Type	Average Quantity of Incoming Material (tons)	Average Residual Quantity (tons)	Average Residual Percent of Total Incoming	Total Statewide Residual Quantity (tons)
C&D	40,000	9,170	23%	161,700

Sampling Results – Estimated Residual Characterization

Figure I and Table 21 present the results of the C&D MRF characterization obtained from sampling and sorting. The percentage shown represents the average proportion of each material type by weight to the total residual stream.

A significant portion (55 percent) of the C&D residual was determined to be C&D material. However, some of the materials were not recoverable because they were either treated or composite. An example of composite C&D material is wood framing members which still have metal anchors or joints attached and removal would not be cost effective.

Figure I
Summary of Composition of Residuals - MRFs Receiving Construction and Demolition Materials, 2005



Total Residual Weight is 161,736 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Table 21 - Estimated Residual Composition for California MRFs Receiving Construction and Demolition Materials, 2005

	Est. Pct.	+/-	Est. Tons
Paper	**7.7%**	**1.2%**	**12,423**
Uncoated Corrugated Cardboard	2.2%	0.4%	3,596
Paper Bags/Kraft	0.5%	0.1%	844
Newspaper	0.8%	0.2%	1,334
White Ledger	0.2%	0.1%	337
Colored Ledger	0.0%	0.0%	31
Computer Paper	0.0%	0.0%	8
Other Office Paper	0.4%	0.1%	650
Magazines/Catalogs	0.4%	0.2%	679
Phone Books/Directories	0.2%	0.1%	246
Other Misc. Paper	1.1%	0.2%	1,858
Remainder/Composite Paper	1.8%	0.4%	2,840
Glass	**0.7%**	**0.3%**	**1,151**
Clear Glass Bottles & Containers	0.1%	0.0%	94
Green Glass Bottles & Containers	0.0%	0.0%	49
Brown Glass Bottles & Containers	0.3%	0.2%	506
Other Colored Glass Bottles & Containers	0.0%	0.0%	9
Flat Glass	0.0%	0.0%	49
Mixed Cullet	0.0%	0.0%	55
Remainder/Composite Glass	0.2%	0.1%	389
Metal	**5.0%**	**0.9%**	**8,125**
Tin/Steel Cans	0.1%	0.0%	222
Major Appliances	0.0%	0.0%	0
Used Oil Filters	0.0%	0.0%	0
Other Ferrous	2.0%	0.5%	3,276
Aluminum Cans	0.1%	0.0%	84
Other Non-Ferrous	0.6%	0.2%	903
Remainder/Composite Metal	2.3%	0.6%	3,639
Electronics	**0.4%**	**0.2%**	**665**
Brown Goods	0.0%	0.0%	0
Computer-related Electronics	0.1%	0.0%	83
Other Small Consumer Electronics	0.3%	0.1%	507
TV's & Other CRTs	0.0%	0.0%	75
Plastic	**10.5%**	**1.4%**	**16,981**
PETE Bottles	0.1%	0.0%	206
Other PETE Containers	0.0%	0.0%	11
HDPE Natural Bottles	0.1%	0.0%	82
HDPE Colored Bottles	0.1%	0.0%	111
HDPE 5-gallon buckets (Food)	0.0%	0.0%	0
HDPE 5-gallon buckets (Non-Food)	0.2%	0.1%	391
Other HDPE Containers	0.1%	0.1%	231
#3-#7 Bottles	0.0%	0.0%	15
Other #3-#7 Containers	0.3%	0.1%	501
Plastic Trash Bags	0.3%	0.1%	538
Grocery/Merch. Bags	0.3%	0.1%	438
Non-bag Comm./Ind. Packaging Film	0.3%	0.1%	533
Film Products	1.1%	0.4%	1,807
Other Film	0.7%	0.2%	1,194
Durable Plastic Items	2.2%	0.6%	3,593
Remainder/Composite Plastic	4.5%	0.8%	7,330

	Est. Pct.	+/-	Est. Tons
Organic	**18.2%**	**3.2%**	**29,450**
Food	0.3%	0.1%	485
Leaves and Grass	5.7%	1.7%	9,178
Prunings & Trimmings	4.8%	1.3%	7,738
Branches & Stumps	0.9%	0.4%	1,506
Agricultural Crop	0.0%	0.0%	3
Manures	0.0%	0.0%	0
Textiles	2.3%	0.6%	3,706
Carpet	2.6%	1.1%	4,285
Remainder/Composite Organics	1.6%	0.5%	2,550
Construction & Demolition	**54.5%**	**3.8%**	**88,092**
Concrete	5.0%	1.3%	8,096
Asphalt Paving	1.0%	0.4%	1,621
Asphalt Roofing	2.4%	0.7%	3,898
Lumber	13.9%	1.7%	22,473
Treated Wood Waste	10.0%	1.6%	16,251
Gypsum Board	4.8%	1.5%	7,768
Rock, Soil, Fines	7.2%	1.8%	11,694
Remainder/Composite C&D	10.1%	1.9%	16,291
Household Hazardous Waste	**0.0%**	**0.0%**	**56**
Paint	0.0%	0.0%	0
Vehicle & Equip. Fluids	0.0%	0.0%	0
Used Oil	0.0%	0.0%	17
Batteries	0.0%	0.0%	4
Remainder/Composite HHW	0.0%	0.0%	35
Special Waste	**1.3%**	**1.4%**	**2,123**
Ash	0.0%	0.0%	0
Sewage Solids	0.0%	0.0%	0
Industrial Sludge	0.0%	0.0%	0
Treated Medical Waste	0.1%	0.1%	203
Bulky Items	1.0%	0.5%	1,587
Tires	0.2%	0.1%	332
Remainder/Composite Special Waste	0.0%	0.0%	0
Mixed Residue	**1.7%**	**0.9%**	**2,672**
Totals	**100.0%**		**161,736**
Sample count:	**90**		

Notes: Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.
Estimated Percentages calculated by weight as the average proportion of each material type to the total residual weight

Findings for Overall MRFs

Survey Results – Estimated Residual Quantity

Table 22 presents a summary of the residual quantity data for each type of MRF.

Table 22 – Average Quantity of Incoming Material and Residuals from Overall MRFs, 2005

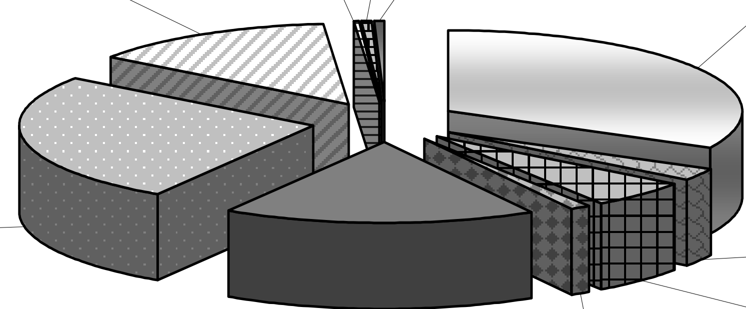
MRF Type	Average Quantity of Incoming Material (tons)	Average Residual Quantity (tons)	Average Residual Percent of Total Incoming	Total Statewide Residual Quantity (tons)	Percent of Overall Residual
Single-Stream	52,900	7,400	14%	496,600	6.7%
Multi-Stream	20,900	1,300	6%	35,900	0.5%
Mixed Waste	234,700	189,800	81%	6,678,200	90.6%
C&D	40,000	9,170	23%	161,700	2.2%

Sampling Results – Estimated Residual Characterization

Figure J and Table 23 present the results of the overall MRF characterization obtained from sampling and sorting. The percentage shown represents the average proportion of each material type by weight to the total residual stream.

The overall statewide residual characterization was weighted based on the total amount of residual produced at each MRF type. Consequently, the overall residual composition largely resembles that of a mixed waste MRF since 90 percent of the statewide residual is generated at this type of facility.

Figure J
Summary of Composition of Residuals - Overall MRFs, 2005



Total Residual Weight is 7,372,456 tons
Note: Percentages calculated by weight as the average proportion of each material type to the total residual weight

Table 23 - Estimated Residual Composition for Overall California MRFs, 2005

	Est. Pct.	+/-	Est. Tons
Paper	**32.6%**	**0.9%**	**2,406,114**
Uncoated Corrugated Cardboard	4.2%	0.2%	309,909
Paper Bags/Kraft	0.7%	0.0%	51,157
Newspaper	4.3%	0.3%	316,549
White Ledger	1.7%	0.2%	125,075
Colored Ledger	0.2%	0.0%	14,575
Computer Paper	0.0%	0.0%	2,039
Other Office Paper	2.4%	0.2%	178,587
Magazines/Catalogs	2.4%	0.2%	177,168
Phone Books/Directories	0.2%	0.1%	14,609
Other Misc. Paper	4.6%	0.2%	338,615
Remainder/Composite Paper	11.9%	0.5%	877,830
Glass	**2.3%**	**0.3%**	**172,859**
Clear Glass Bottles & Containers	0.8%	0.1%	60,871
Green Glass Bottles & Containers	0.3%	0.0%	19,708
Brown Glass Bottles & Containers	0.2%	0.0%	14,974
Other Colored Glass Bottles & Containers	0.0%	0.0%	1,191
Flat Glass	0.1%	0.0%	4,052
Mixed Cullet	0.7%	0.1%	54,227
Remainder/Composite Glass	0.2%	0.1%	17,838
Metal	**5.7%**	**0.5%**	**417,225**
Tin/Steel Cans	1.1%	0.1%	79,307
Major Appliances	0.2%	0.1%	11,848
Used Oil Filters	0.0%	0.0%	339
Other Ferrous	2.1%	0.4%	157,033
Aluminum Cans	0.3%	0.0%	20,437
Other Non-Ferrous	0.8%	0.2%	55,297
Remainder/Composite Metal	1.3%	0.2%	92,966
Electronics	**1.1%**	**0.2%**	**84,677**
Brown Goods	0.3%	0.1%	21,137
Computer-related Electronics	0.4%	0.1%	26,526
Other Small Consumer Electronics	0.5%	0.1%	35,755
TV's & Other CRTs	0.0%	0.0%	1,258
Plastic	**17.2%**	**0.6%**	**1,266,737**
PETE Bottles	0.7%	0.0%	48,654
Other PETE Containers	0.2%	0.0%	13,019
HDPE Natural Bottles	0.3%	0.0%	21,449
HDPE Colored Bottles	0.3%	0.0%	18,907
HDPE 5-gallon buckets (Food)	0.1%	0.0%	5,067
HDPE 5-gallon buckets (Non-Food)	0.3%	0.1%	23,020
Other HDPE Containers	0.1%	0.0%	8,466
#3-#7 Bottles	0.1%	0.0%	7,417
Other #3-#7 Containers	0.8%	0.1%	61,357
Plastic Trash Bags	1.2%	0.1%	91,290
Grocery/Merch. Bags	1.2%	0.2%	85,791
Non-bag Comm./Ind. Packaging Film	1.6%	0.3%	121,026
Film Products	0.2%	0.1%	12,961
Other Film	3.6%	0.2%	264,564
Durable Plastic Items	1.4%	0.2%	102,113
Remainder/Composite Plastic	5.2%	0.3%	381,635

	Est. Pct.	+/-	Est. Tons
Organic	**26.1%**	**1.2%**	**1,926,785**
Food	9.6%	0.6%	706,700
Leaves and Grass	7.4%	0.9%	542,662
Prunings & Trimmings	1.0%	0.3%	76,547
Branches & Stumps	0.3%	0.2%	25,205
Agricultural Crop	0.0%	0.0%	2,776
Manures	0.0%	0.0%	2,472
Textiles	2.7%	0.2%	195,666
Carpet	0.4%	0.1%	30,983
Remainder/Composite Organics	4.7%	0.3%	343,774
Construction & Demolition	**13.4%**	**1.2%**	**987,200**
Concrete	0.8%	0.2%	58,567
Asphalt Paving	0.0%	0.0%	2,526
Asphalt Roofing	0.2%	0.1%	18,044
Lumber	3.2%	0.4%	238,900
Treated Wood Waste	2.1%	0.3%	158,205
Gypsum Board	0.8%	0.3%	61,752
Rock, Soil, Fines	3.3%	0.4%	242,918
Remainder/Composite C&D	2.8%	0.6%	206,289
Household Hazardous Waste	**0.4%**	**0.2%**	**26,067**
Paint	0.0%	0.0%	1,580
Vehicle & Equip. Fluids	0.0%	0.0%	36
Used Oil	0.0%	0.0%	477
Batteries	0.3%	0.2%	19,664
Remainder/Composite HHW	0.1%	0.0%	4,309
Special Waste	**0.6%**	**0.4%**	**43,308**
Ash	0.0%	0.0%	1,107
Sewage Solids	0.0%	0.0%	0
Industrial Sludge	0.0%	0.0%	0
Treated Medical Waste	0.0%	0.0%	391
Bulky Items	0.0%	0.0%	3,296
Tires	0.1%	0.0%	4,800
Remainder/Composite Special Waste	0.5%	0.3%	33,714
Mixed Residue	**0.6%**	**0.2%**	**41,485**
Totals	**100.0%**		**7,372,456**
Sample count:	**390**		

Notes: Confidence intervals calculated at the 90% confidence level. Percentages for material types may not total 100% due to rounding.
Estimated Percentages calculated by weight as the average proportion of each material type to the total residual weight

Abbreviations and Acronyms

ADC — Alternative Daily Cover

APC — American Plastics Council

C&D — Construction and Demolition

CIWMB — California Integrated Waste Management Board

CRV — California Redemption Value

EOL — End-of-Line

GAA — Governmental Advisory Associates

HDPE — High-Density Polyethylene

HHW — Household Hazardous Waste

LEA — Local Enforcement Agency

MRF — Materials Recovery Facility

MWPF — Mixed Waste Processing Facility

MSW — Municipal Solid Waste

OCC — Old Corrugated Cardboard

PETE — Polyethylene Terephthalate

PS — Positively Sorted or Polystyrene

R/C — Remainder/Composite

SWIS — Solid Waste Information System

Glossary of Terms

Confirmed MRF — This designation includes MRFs for which data regarding type, quantity of incoming and residual material, and location was obtained through either the R.W. Beck detailed survey or GAA database.

Ejection Point — refers to the location where residuals are discharged from a MRF processing line. A majority of MRFs have multiple ejection points.

Grab Sample — refers to sample collection from a material pile or bunker at the floor-level either by hand or utilizing a skid steer or loader. Grab samples were collected from various portions of a pile/bunker to obtain data that was representative of the entire residual stream.

Local Enforcement Agency (LEA) — means an enforcement agency with CIWMB certification(s) totally separate from the operating unit(s) of the local governing body. An LEA is a comprehensive solid waste management enforcement agency which performs permitting inspection and enforcement duties for solid waste handling, and for permitted, closed, abandoned, exempt, illegal, and inactive solid waste facilities. An LEA is solely responsible for carrying out solid waste enforcement in its jurisdiction.

MRF — a facility in which commingled recyclables or solid waste materials move over a conveyance system which aggregates or segregates recyclable materials by material type or grade and, as a result of the process, produce residuals that are disposed with the municipal waste stream.

Municipal Solid Waste (MSW) — means all solid wastes generated by residential, commercial, and industrial sources, and all solid waste generated at construction and demolition sites, at food-processing facilities, and at treatment works for water and waste water, which are collected and transported under the authorization of a jurisdiction or are self-hauled

Negatively Sorted — refers to recyclable or residual material which is not positively sorted during processing. Negatively sorted material typically is discharged via conveyor belts at the end of a processing line.

Negative Sort Sample — refers to sample collection of material of the negatively sorted material at the end of a processing line.

Positively Sorted — refers to recyclable or residual material which is physically removed, by laborer or mechanical equipment, from the processing line. Most recyclables are positively sorted into specifically targeted material categories, i.e. PETE bottles/containers, aluminum cans, OCC, etc.

Potential MRF — This designation includes MRFs which have been screened and meet the definition of a MRF for the purposes of this study.

Recyclables — refers to waste materials that can be reprocessed into new usable products.

Residuals — refers to any material emanating from a MRF that is not diverted for recovery through recycling, composting or reuse; or any material emanating from the area of a transfer station or other processing facility devoted to specialized recovery of recyclable materials.

Scoop Sample — refers to sample collection either by hand or by skid steer/loader to reach down into a roll-off container or material bunker to scoop out a representative sample of residuals.

Appendix A:
Detailed Methodology

Overview

Residuals from material recovery facilities (MRFs) represent a significant component of California's disposed waste. The actual magnitude and composition of this type of waste had been largely unknown. This study attempted to answer some of the questions about this previously uncharacterized portion of the waste stream. The study design that was developed and implemented to accomplish the study objectives included the following four tasks:

- Assembling a Database of California MRFs
- Sampling Plan Development
- Field Study Implementation
- Analysis and Reporting

Assembling a Database of California MRFs

The first step in conducting this study was to define the universe of facilities to be included to allow compilation of a database of these facilities. Each facility in the database was then surveyed to obtain the quantity of incoming feedstock as well as outgoing recovered materials and residuals that are generated.

To compile sufficient details about the number of MRFs in California and the quantities of residuals disposed, the study consisted of the following four-step process:

- Assemblage of a list of possible MRFs from industry sources;
- Solicitation of input from the appropriate LEA on a draft MRF list for their respective jurisdiction;
- Performance of a preliminary, direct screening survey of MRFs for which LEA feedback was uncertain or unavailable; and
- Performance of a detailed survey of all facilities confirmed to be MRFs based on steps 1 through 3.

These tasks are described below.

Assembly of Possible MRFs from Industry Sources

The following sources were used to compile a preliminary list of MRFs likely to meet the study definition:

- The CIWMB **Solid Waste Information System (SWIS)** database. A total of 100 facilities were flagged on this list as Potential MRFs as defined for this study. Note: In this database, facilities are classified as "Transfer/Processing" and this classification includes both facilities that meet this study's definition of a MRF as well as facilities that don't, such as transfer stations which don't recover materials. Also, MRFs that produce less than 10 percent residual and meet other conditions are not required to have a Solid Waste Facilities Permit, and therefore are not necessarily contained in the SWIS database.
- The CIWMB **Rigid Plastic Packaging Container (RPPC) survey group facility list**. The RPPC survey group provided a spreadsheet of 224 facilities with the potential to bale plastics, although not all of these are MRFs.

- **Chartwell Information Services Solid Waste Facility Atlas.** Chartwell Publishers provided a listing of all MRFs, transfer stations, and C&D processing facilities in California. There were a total of 375 facilities in this database.
- **Government Advisory Associates (GAA) MRF Handbook**. GAA publishes a handbook of MRFs across the U.S. with the last update released in 2002. GAA only tracks dedicated MRFs and Mixed Waste Processing facilities, and does not track transfer stations or C&D processing facilities where recycling may be taking place. The MRF Handbook contained 63 MRFs and 24 MWPFs;
- The **American Plastics Council (APC) Plastic Markets Database**. APC has compiled a database of facilities and organizations that: (1) sort and bale plastics (i.e., MRFs); (2) wash, flake, and/or palletize sorted plastics (i.e., reclaimers); and (3) broker plastics (i.e., brokers). The list of MRFs in this database was last updated in 2002, and includes both traditional MRFs as well as any facility (such as a transfer station) that may have a sorting line where plastic bottles are recovered. There were a total of 77 facilities in this database.

These sources were cross referenced to identify unique occurrences of all facilities that could be classified as Potential MRFs. Electronic cross-referencing was performed to the extent that it was possible to link databases by the contents of selected fields that contained like character strings (e.g., address or company name).

The final database—termed the Potential MRF Database—contained every facility believed to be a MRF as defined in this study, but also included a range of facilities that were not (i.e., "false positives"). To assure that all data in the Potential MRF Database could be traced back to the original source, these steps were followed when compiling the Potential MRF Database:

- Maintaining each of the source MRF lists in their entirety to preserve useful data about each facility;
- Cross-referencing each data source against the others based on facility name, physical address, contact name and phone number, and other like fields to identify duplicates; and
- Assigning a unique identifying code to each facility that can be traced back to the source databases.

The Potential MRF Database served as a repository for all future findings about any of the targeted facilities. As facilities were identified that did not meet the MRF definition, rationale for eliminating the facility from the MRF study was included in the Potential MRF Database.

LEA Review of Potential MRFs

To test the accuracy of the database, a direct review of summary facility information was performed by LEAs across the state. A sample of the MRF list sent to each LEA is shown as Table 24. Based on input from the LEA, the study team deleted and/or added active MRFs to the list, and added or corrected any information regarding the facility's feedstock.

Screening Survey of Potential MRFs

Although the LEA review confirmed a large number of the MRFs, some facilities were not known in detail to the LEAs. Thus, it was necessary to conduct a screening survey in coordination with the LEA review.

Table 24 - LEA Review of Alameda County MRFs

Potential MRF Database - Alameda County MRFs				Results of LEA Review		
MRF ID	Data ID*	Name	Type	Type	Feedstock	Origin
6	CTW-250	Pleasanton Garbage Service Transfer Station & MRF	Mixed Waste Processing Facility	MWPF MRF	Residential Solid Waste	Pleasanton
7	CTW-90	Davis Street Transfer Station	Transfer Station	Dual Stream MRF	Curbside Recyclables	7 Cities
7	APC-93	Davis Street Transfer Station	Handler	Mixed C&D MRF	Mixed C&D	
7	GAA1-47	Davis Street Transfer Station	Recyclables Processor	Duplicate listing		
7	SWIS-140	Davis Street Transfer Station	Large Volume Trans/Processor	Duplicate listing		
540	GAA1-48	Davis Street Station Mini Mobile MRF	Recyclables Proc	Duplicate listing		
8	CTW-29	Berkeley Solid Waste T S.	Transfer Station	Dual Stream MRF	Curbside Recyclables	Berkeley
35	CTW-336	Tri-Cities Waste Management	Landfill	Landfill		
364	CTW-335	Tri-Cities Recycling Disposal	MRF	Green Waste shredding		
273	CTW-56	California Waste Solutions	MRF	Dual Stream MRF	Curbside Recyclables	Sacramento
273	GAA1-29	California Waste Solutions	Recyclables Processor	Dual Stream MRF	Curbside Recyclables	Oakland
274	CTW-212	National Recycling Corp	MRF	Paper Stock Dealer		
275	CTW-224	Northern Cal Pulp & Paper	MRF	Paper Stock Dealer		
276	CTW-238	Paper Recovery of No. Cal.	MRF	Paper Stock Dealer		
277	CTW-266	Recycled Fibers	MRF	Paper Stock Dealer		
278	CTW-308	Smurfit Recycling Company	MRF	Paper Stock Dealer		
278	APC-2	Smurfit Recycling Company	Handler	Paper Stock Dealer		
279	CTW-334	Tri-Ced Community Recycling	MRF	Dual StreamMRF	Curbside Recyclables	Hayward & Union City
340	CTW-217	Nica Metals	MRF	Scrap Metal		
376	SWIS-87	Capitol Waste Recycling	Large Volume CDI Processor	Clean C&D MRF	Clean C&D	
497	APC-161	Union Recovering	Handler	Recycling Center	Unknown	
506	GAA1-2	Alameda County Industries	Recyclables Processor	Single Stream MRF	Curbside Recyclables	Alameda/San Leandro
512	GAA1-11	Fremont MRF				
526	GAA1-30	Smurfit-Stone Recycling	Recyclables Processor	Paper Stock Dealer	Includes Fiber from Dual	Newark

*APC = American Plastics Council Database
CTW = Chartwell Information Services Solid Waste Facility Atlas
GAA = Governmental Advisory Associates
SWIS = Solid Waste Information System

The screening survey determined if the facility did in fact meet the study's definition of a MRF and should be included in the detailed survey. To accomplish this objective, the questions focused on the characteristics that qualify a facility as a MRF. A minimum of two attempts were made to contact each MRF by telephone. A copy of the screening survey, titled *Waste Characterization MRF Screening Survey,* is included in Appendix D.

The screening survey worked as follows:

- If the LEA confirmed the characteristics of any facility (either it is or is not a MRF), then that facility was considered complete and no further screening was performed;
- However, if the LEA was not sure of the characteristics of a particular facility, then the screening survey was performed on that facility via direct phone call;
- If the LEA was unresponsive or unavailable within two weeks after receiving the Potential MRF list, then we initiated the screening survey to assure timely completion of the project;
- Results of the screening survey were entered into the Potential MRF Database. At this point, the Potential MRF Database also included a subset of Confirmed MRFs.

Detailed Survey of Confirmed MRFs

This task established the basis for development of a representative MRF residuals sampling plan, as well as for the extrapolation of MRF residual composition results to the statewide quantity of MRF residuals. This task was completed by development and transmittal of a detailed survey, followed up by a series of direct (phone, e-mail and fax) contacts with each entity on the Potential MRF list. This task included the following subtasks.

- A survey instrument was developed and sent to each Potential MRF. Given the sensitivity of the information that was requested, it was necessary to include a cover letter from the CIWMB, as well as a Confidentiality Agreement with the detailed survey. A copy of the detailed survey document, titled *Waste Characterization Study MRF Questionnaire*, is attached in Appendix D.
- The detailed surveys were administered to obtain information concerning incoming, recovered, and residuals tonnages from each Potential MRF via a combination of phone calls, e-mails and faxes. The team made a minimum of four phone call attempts to reach each MRF on the Potential MRF list.
- Each survey response was thoroughly reviewed by the survey manager. Additional call-backs were made to rectify any deficiencies or inconsistencies in the data provided on the detailed survey form.
- At the conclusion of the LEA review and both the screening and detailed surveying, the team compiled relevant data on the facilities that were confirmed to be MRFs as defined in this study. The final list, the Confirmed MRF Database, served as the basis for sampling plan development discussed in the next section.

A total of 147 facilities remained on the Potential MRF list at the completion of the detailed survey period. A total of 44 completed surveys were received, qualifying them as Confirmed MRFs, with the remainder of the list split between 36 declining participation and 67 providing no response.

Due to the unexpectedly low response rate to the detailed survey, the Confirmed MRF list was expanded using MRF data obtained and verified by Governmental Advisory Associates (GAA). Addition of 33 MRFs from the GAA database resulted in a total of 77 Confirmed MRFs in the state of

California. The 77 Confirmed MRFs are listed by type and geographic region in Table 6. However, a number of MRFs were identified to process multiple incoming material streams at the same facility, either during separate times or on separate processing lines. For example, if a MRF processes both mixed waste and single-stream materials, the facility would have two MRF processing lines. Taking this into account, there are a total of 83 MRF processing lines at the 77 Confirmed MRFs.

The original intent of the study was to collect data from the vast majority, if not all, MRFs in the state; i.e., a census of MRFs rather than a sampling. At the outset of the project, several large waste management companies as well as several independent MRFs refused to participate in the study, and many other facilities did not respond to the survey. Therefore, data from the 83 Confirmed MRF processing lines was used to extrapolate estimates for the remaining Potential MRFs for which no information was available. A description of the methodology used for the data extrapolation is provided in the Data Analysis and Reporting Section of this Appendix.

Sampling Plan Development

The sampling plan proposed collecting and sorting a total of 360 residual samples from 12 MRFs throughout the state. While attempting to maintain an optimal distribution of residual samples from various types of MRFs within the four study-designated regions of California, it was also necessary to evaluate the availability and willingness of MRFs to host field sampling and sorting such that the targeted samples could be obtained. This section describes the final planning and preparation that was undertaken to ensure effective field sampling and sorting, given the limited number of MRFs that were willing to participate in the study.

This task included:

- Selection of host facilities;
- MRF site visits; and
- Final scheduling.

Selection of Host Facilities

Information obtained from the detailed survey helped assess the feasibility of conducting field-sampling operations at each MRF. This provided a preliminary sense of the potential for a MRF to host sampling/sorting activities.

Responsive MRFs were considered to be a good candidate for hosting a sampling/sorting event if they:

- Responded accurately and completely to the survey;
- Generated residual quantities in sufficient amounts to ensure representative sampling;
- Were willing to accommodate sorting activities for at least two consecutive days;
- Had sufficient on-site space and no significant operational barriers to obtaining samples and conducting the sort; and
- Were judged to be representative of the category.

The inventory of responsive MRFs was stratified by MRF type and region. All attempts were made to base the selection of potential host MRFs on equal distribution of MRF type, region, and season.

DISTRIBUTION BY MRF TYPE

Confirmed MRFs were classified into one of four processing types based on information provided within the survey responses:

- Multiple stream recyclables MRFs;
- Single stream recyclables MRFs;
- Mixed waste processing facilities (MWPF); and
- C&D MRFs.

REGIONAL DISTRIBUTION

Each confirmed MRF was grouped to one of the four designated regions of California. These regions were:

- San Diego Area;
- Southern California/Los Angeles Basin;
- Central Valley and Other; and
- San Francisco Bay Area.

Every attempt was made to distribute the host MRFs so that at least three different types of MRFs were targeted in each designated region. However, actual distribution of MRF types by geographic region, along with willingness to be a host MRF, required adjustments to this strategy. The number of MRFs sampled within each region varied from one for San Diego to five for San Francisco.

SEASONAL DISTRIBUTION

Sampling and sorting activities were completed during two seasons, the dry summer season and wet winter season. Dry season sampling was performed in June 2005 and sampling in the wet season was performed in December 2005. In order to obtain seasonal variation within each geographic region and MRF type, it was proposed to collect samples during each season at each type of MRF and within each region. However, it was not possible to identify a willing host MRF within the San Diego region to conduct sampling during the winter. This was the only deviation from the seasonal distribution strategy.

The actual sample breakdown by MRF type and region is presented as Table 7. Thirty additional samples were collected and sorted at the Green Team/Zanker MRF in Sunnyvale from December 1st through 3rd by Cascadia Consulting Group, Inc. This additional work was approved by CIWMB staff because Cascadia was already going to be sorting residual samples at the facility and the additional data was beneficial to this study.

MRF Site Visits

Since potential host MRFs were selected solely via the surveying process and follow-up telephone screening, it was critical to meet with the targeted MRF managers and to tour the targeted host facilities prior to confirming their participation as host MRFs.

Site visits were made to the potential host MRFs and potential substitutes for each season at least three weeks prior to scheduled sampling. The site visits contributed to supportive participation by MRFs and facilitated development of a sampling plan tailored to each individual MRF. Site visits were also used to obtain an understanding of the daily “standard operating procedures,” and identify potential anomalies in incoming material and processing procedures that directly impact the types of residuals produced. This information allowed us to adjust the sampling plan to ensure that the timing of samples reflected any differences in the types of waste received or processing procedures over the course of the MRF operational day.

Scheduling and Preparation for Field Sampling

The final field sampling schedule for the summer and winter seasons were submitted to CIWMB staff prior to sampling and are presented in Table 25. The schedule was developed to follow a logical geographic travel order and to accommodate any potential differences in incoming material composition between weekend and mid-week material deliveries.

Table 25 - Actual RW Beck Sampling Schedule

Summer Sampling (June 13-30, 2005)

Dates	Facility	Location	MRF Type	Residual Ejection points *	Sample Collection Method
6/13 - 6/15	IMS Recycling Services	San Diego	Single Stream	Mixed Residual Bunker	Grab & Scoop
6/15 - 6/18	Downey Area Recycling & Transfer	Downey	Single Stream	PS Residual Container & EOL	Grab & Negative Sort Capture
6/20 - 6/21	West Valley MRF	Fontana	Mixed Waste	PS Residual Container & EOL	Grab & Negative Sort Capture
6/23 - 6/28	Blue Line Transfer Co. Inc.	South San Francisco	Multi Stream / C&D	MS – PS Residual Container & EOL C&D - 2 PS Residual Containers	MS - Negative Sort Capture C&D - Grab
6/28 - 6/30	Madera Disposal Systems	Chowchilla	Mixed Waste	EOL (into Baler)	Grab

Winter Sampling (November 29 - December 14, 2005)

Dates	Facility	Location	MRF Type	Residual Ejection points *	Sample Collection Method
11/29 - 12/1	Allied Waste The Recyclery	San Carlos	Multi Stream	5 PS Residual & 1 EOL Containers	Grab
12/1 - 12/3	West County Resource Recovery	Richmond	Single Stream	PS Residual Bunker (into Baler) & EOL	Grab
12/5 - 12/6	Kroeker, Inc.	Fresno	C&D	2 PS Residual Containers	Grab
12/7 - 12/9	Cold Canyon Processing Facility	San Luis Obispo	Single Stream	PS Residual Bunker, 2 PS Residual Containers, & Fines EOL	Grab, Scoop, & Negative Sort Capture
12/12 -12/14	JWR	Wilmington	C&D/ Mixed Waste	EOL, Fines EOL, and Presort Stockpile for each MRF Type	Grab & Negative Sort Capture

* PS - Positively Sorted

EOL - End of Line

Field Study Implementation

The objective of this task was to execute the Sampling Plan and collect the targeted data for statistical analysis and extrapolation of residuals.

The sampling process included the following three tasks:

- Taking representative samples of residual material at each location where residuals are generated within each host MRF;
- Physically sorting each sample into the target material types; and
- Recording the weight of sorted materials.

Field Team Structure

Our field data collection project team consisted of the following staff positions:

- **Field Supervisor —** The Field Supervisor was primarily responsible for all phases of the field data collection, including meeting scheduling requirements, coordinating with host facility management leading up to and during the sort, taking all physical samples and recording pertinent data by sample, managing the sorting team, and adhering to proper health and safety requirements during field data collection.
- **Crew Chief —** The Crew Chief was responsible for overseeing and managing the sorting work area, including coordination with the Field Supervisor, management of data collection forms and protocols, proper sorting techniques, and recording of sort data.
- **Sorting Team** — The sorting team was made up of experienced, dedicated sorting staff who traveled with the Field Supervisor and Crew Chief to each host MRF. This configuration assured consistency in the sorting process, eliminated re-training requirements, and maintained high efficiency as the field data collection moved from MRF to MRF.

Given this team structure, the field data collection considered the following elements:

- Sampling sizes;
- Allocation of samples among multiple ejection points;
- Sampling of MRF residuals;
- Sorting of MRF residuals; and
- Data recording.

The manner in which each of these elements was addressed is described in the sections below.

The Field Supervisor was responsible for overseeing the collection of each sample. For each sample, the originating point within the MRF was recorded, as well as the date and time of day the material was sampled. For instances where samples were collected from residuals processed prior to our arrival at the facility, the date of generation was recorded and the composition of the sample was confirmed via visual inspection prior to sorting. Slightly different sampling techniques were used at almost every facility and for almost every type of residual ejection point. The Field Supervisor took digital photographs of a majority of the collected samples in order to photographically document the origin of each sample and the method by which the sample was taken. A sampling photo journal, provided under separate cover, was assembled to illustrate the range of sampling procedures by MRF and ejection point.

Sampling Sizes

To determine the appropriate sample weight, we used existing statistical methods for waste characterization approaches applied to the two types of material streams expected to be encountered in this study: 1) a flow similar to residential or commercial garbage; and 2) fines (screen unders).

For MRF residual material that was similar in particle size to disposed refuse, there is precedent in industry literature for generator samples to target sample sizes in the vicinity of 125 pounds. For each ejection point that produced positively sorted or end-of-line residues, a 125-pound sample was collected. Material particles larger than 2-inches were physically sorted into the material types targeted by CIWMB staff. The remaining fines fraction was collected and weighed in its entirety.

For samples consisting entirely of fines or where a significant portion of the residual sample consisted of fines, it was important to choose a target sample weight that would result in statistically representative composition estimates while allowing for enough samples to be sorted in a given day. Our goal was to choose sample sizes that minimized sampling error for a given level of sorting effort. For fines, we based sample weights on process-stream studies done by Albert Klee.[*] Klee's equation for determining the size of a sample is as follows:

$$Y = Xe^{0.146X}$$

Where: Y = the optimal sample weight (pounds)
X = the characteristic particle size of the sampled material (inches)
e = a constant, 2.71828182845904

Klee's recommendation for 2-inch screen unders results in a sample size of approximately 2.7 pounds. A minimum sample size of one pound was used for the fines primarily consisting of 0.5-inch particles. Field estimates of characteristic particle size or sieve passing size were used when judging the amount of fines to subject to a detailed sort. In the event that the ejection point produced fines residuals only, the sample size was based on characteristic particle size and Klee's formula. For these cases, the smaller fines sample was assumed to represent the entire 125-pound sample.

Allocation of Samples among Multiple Ejection points

Most MRFs have multiple points along various processing lines where contaminants are either positively removed and/or residues are screened or dropped off the end of a processing line. The distribution of the 30 samples collected from each facility accounted for both the number of residual ejection points and relative quantity of residuals generated from each point. This was critical because ejection points can have very different characterizations and the composition of residual from the entire facility is directly proportional to the amount of material generated at each ejection point. For example, a MRF that generates 3,000 pounds of residuals from a positive sort of contaminants, 2,000 pounds of process residue from the end of the line, and 5,000 pounds of residuals that are screened unders, would have been sampled such that 30 percent of the samples were taken from the first ejection point, 20 percent from the second ejection point, and 50 percent from the third ejection point.

Sampling at each residue ejection point was not always logistically possible or statistically beneficial and it was necessary in some cases to take random samples from the aggregated stream of residuals throughout a sort day (e.g., for facilities that use conveyance systems to transport all residuals to a single disposal bunker or roll-off box). However, understanding the process flow at each MRF and a

[*] For more information regarding Klee's sample size equation, please refer to Klee, A.J., "New Approaches to Estimation of Solid Waste Quantity and Composition", *ASCE Journal of Environmental Engineering*, March 1993, pp. 248–261.

qualitative understanding of the proportion of residual generation from each ejection point allowed the Field Supervisor to obtain representative samples under any operational circumstance.

If a particular MRF had multiple residue ejection points that produced separate flows or that were substantially different in terms of particle size, then our first choice was to sample these flows separately. The proportion of samples between ejection points was either estimated by facility operators prior to sampling or measured by the Field Supervisor during sampling.

Sampling of MRF Residuals

Unlike a traditional composition study where material arrives in individual truckloads, MRF residuals are typically generated at various fixed ejection points and are stored in different forms throughout each host facility. At a dual stream MRF processing fiber on one side of the facility and commingled containers on the other, there are likely to be completely independent residual streams. Alternately, single stream and C&D MRFs typically have residuals removed at both the front and back ends as well as at various points along the processing lines. They may also have one or more screens that yield residue. Mixed waste processing facilities typically eject residuals directly into existing tipping areas with MSW destined for disposal.

For a majority of the MRFs visited, residuals were generated at multiple ejection points. The residuals were sometimes stored separately until transfer for disposal, or they were merged together to be transferred for combined disposal. Because each MRF used different recovery technologies, configurations, and capabilities, a variety of operational configurations required a variety of sampling procedures in order to obtain representative samples from each MRF.

To ensure successful sampling, every day at each host MRF the Field Supervisor prepared a list of the number of samples needed from the host MRF that day. Prior to sampling at each facility, the Field Supervisor verified with facility management and staff the number and arrangement of residual ejection points where samples would be taken. The residues were produced into any configuration of small containers, large containers, bunkers, or stockpiles. One of the following sampling methods was utilized based on the specific arrangement of each ejection point. At a majority of the facilities, the selected sampling method was based on operational constraints. In some cases, a combination of methods was used to collect the actual sorted sample.

"GRAB" SAMPLING

In some cases where residuals were stored in a bunker or stockpile where mobile equipment can access the material from floor level, a traditional waste sort "grab" sample was collected, with a skid steer or Bobcat approaching the material pile and taking a floor-level grab of the material for a sample. For instances where sampling with a skid steer would not have yielded representative results, multiple samples were collected by hand from a single residual pile. Hand grab samples were collected using a wide mouth shovel. For any collection method, it was important to obtain random samples from all sides of the bunker or stockpile.

"SCOOP" SAMPLING

Similar to grab sampling, "scoop" sampling involved using a skid steer or loader to reach down into a roll-off container or material bunker to scoop out a representative sample of residuals. This technique was employed when the residual material was uniformly dense and when access to the sample was limited or the proposed sample location was the top of a residual pile.

NEGATIVE SORT CAPTURE

In cases where residuals at the end of a processing line fall into a storage container or stockpile for subsequent disposal and it was possible to place a container under the end of the conveyor belt, the negative sort capture method was used. This was necessary if the residuals were merging with other waste as part of the process, or where a grab sample did not result in a representative quantity of material.

Sorting of MRF Residuals

All sorting personnel were trained in the specific requirements of this sorting protocol prior to performing the analysis of residuals.

The collected samples were transported to the designated area for sorting and weighing. All sorting was done in a designated area of the host MRF that was located as close as practically possible to where the samples were taken, yet out of the way of MRF operations. Sorting was performed inside MRFs with sufficient floor space, but otherwise performed in an adjacent outside area. An approximate 20' by 20' work area was used for the queuing and sorting of samples.

Because most residual samples contain small particles such as broken glass and bottle caps, samples were placed on an area of pavement that was swept clean prior to beginning the sort.

After one or more samples were staged for sorting, our team manually loaded each sample onto a specially designed sorting table. The sorting table consisted of a half-inch screen elevated above a plywood surface.

From the sort table, particles larger than two inches were manually sorted into labeled bins corresponding to the material categories listed on the *Physical Sampling Form* attached in Appendix D. To the extent there were bagged or boxed materials in the residuals (e.g., contaminants), they were broken open and all material was sorted. The remaining fines fraction was collected and weighed in its entirety. The fines were either added to appropriate material categories on the basis of visual apportionment or physical sub-sorting as described previously in the section above titled "Sampling Sizes". When the fines weighed less than 15 percent of the entire 125-pound sample, the fines were visually apportioned into major material categories. When the remaining fines weighed more than 15 percent of the entire 125-pound sample, a sub-sample of fines was collected to be physically sorted into major material categories. The fines sub-sample was collected using the cone and quarter method and was used as the basis for the composition of all fines in that sample. The composition results were recombined analytically using weighted averages based on the relative amounts of fines and larger particle (non-fines) materials. In the event that the ejection point produced fines residuals only, a smaller fines sample was collected and assumed to represent the entire 125-pound sample. This process was documented via digital photography to illustrate examples of the primary sorting and fines sub-sorting.

Data Recording

On the first day of sorting at each host MRF, our team recorded tare weights for each of the containers used in the sort. Tare weights were later subtracted from gross container weights to obtain accurate net material weight data.

Our team used a digital scale with a 200-pound capacity (registering down to 0.1 pound) to weigh all sorting baskets/containers. For the smaller fines samples, our team used a small capacity scale (registering down to 0.01 pound). The team utilized tables, signs/labels, hand tools, tarps and other ground cover, protective clothing and other safety-related equipment not already on site.

After all of the material from a sample was sorted into the appropriate bins, our team recorded the gross weights of containers on a data collection sheet. Bulky items too large to fit into a labeled container were weighed out separately and recorded as net weights. Especially large or unusual items were specifically noted on the data collection sheet.

Weighed material was deposited in an adjacent area or in a container provided by the host facility for staging until the residuals could be commingled with the other facility residuals to be transferred for disposal.

Data Analysis and Reporting

This section provides a description of the analysis and reporting methodology which was used to evaluate the residuals data obtained from sampling and sorting activities. Details are provided for the steps that were necessary for determining MRF residual composition and accompanying uncertainty bounds. It also outlines the assumptions and procedure used to extrapolate available tonnage data from a sampling of MRFs to arrive at statewide annual tonnage generation estimates by MRF type. The following methodology was performed to complete the data analysis and reporting:

- Data Management and Quality Control
- Composition Analysis
- Confidence Interval Construction
- Tonnage Extrapolation Methodology

Additionally, there are several important analytical caveats that are paramount to a proper understanding and interpretation of the results, which will also be explicitly delineated later in this section.

Data Management and Quality Control

Sort data from all facilities was entered into an Excel template for purposes of quality control (“QC”) and analysis. The template detailed the tare weights recorded in the field for each waste category, and was programmed to result in computed net weights by category for each sample in the study. The supervisor of each individual sort was recorded with each data point, or MRF sample. Separate spreadsheets were developed for each facility.

The following set of protocols was established to ensure correct data transcription and ameliorate any potentially problematic data points.

1. Data entry was physically checked for each sample. Typographical errors were immediately corrected.
2. A Potential Error Log was created for each spreadsheet. This Potential Error Log included atypical observations such as: a) negative net weights, b) potentially problematic data points, and c) unusually inflated category or overall weights.
3. Each Potential Error Log was individually addressed and investigated. Once all of the problematic data points were addressed, formulaic checks on weight totals and percent totals were performed. For example, one check involved ensuring that the sum of the individual material component categories all added to exactly 100 percent. This was accomplished via conditional formatting spreadsheet logic.

Once the entire data set was run through the QC process, the spreadsheets were combined as appropriate for the composition analysis.

Composition Analysis

The data for each facility type was combined into a distinct analytical file to determine the combined waste composition of all of the samples for that type.

The sampling at each facility with multiple ejection points was planned such that incoming sample counts and sample weights were representative of the daily flux of waste received during that season. Furthermore, the study was designed so that the average sample weights at each facility were approximately equal. For these reasons, the mean was calculated for each type of MRF by using a simple average of all the sample composition percents.

With regard to overall MRF composition, results from each MRF type were combined using a weighting factor that was computed using total annual residual tonnage estimates by facility type (an explanation of which can be found later in this section). The annual residual tonnage generated from Mixed Waste Processing facilities was calculated to be approximately 90 percent of aggregate MRF residue as defined for the purposes of this study. As a result of this staggered composition weighting, the overall MRF results closely mirror the mixed waste facility results. It should be noted that variances of the individual MRF type results were weighted in similar fashion to produce the overall MRF statistical results.

Composition results were produced for each MRF type as well as overall MRFs, and each observation was subjected to an additional quality control check at this phase of the analysis, as a redundancy check against the raw data. Data associated with the clamshell subcategories identified as material number 30f, 30nf, 37f, and 37nf was not included in the final analysis tables of this report and will be provided under separate cover.

Confidence Interval Construction

Attempting to estimate waste composition for MRFs in the state of California by sampling at every single facility would be prohibitively expensive. Furthermore, given the challenging nature of the process underlying MRF identification, such sampling would most likely never be feasible. Consequently, the composition estimates obtained from field sampling efforts are best expressed with accompanying uncertainty bounds.

In order to obtain a proper estimate of the bound around the mean composition for all waste categories estimated for this study, a *confidence interval* was constructed for each MRF type. A confidence interval is a bound around a sample parameter (typically the mean of a sample) that attempts to estimate the most probable range of values for a measurement to fall in, were the entire population (all possible facilities in the state of California) surveyed.

For example, if the 90 percent confidence interval for the mean percent composition of newspaper for MRFs receiving single stream recyclables was from 54 percent to 59 percent, the probability that the population mean composition for single stream facilities' newspaper composition is less than 54 percent or greater than 59 percent would be 10 percent.

The width of a confidence interval depends on the margin of error of the sample, which is proportional to the sample size. In general, the larger the sample size, the smaller the margin of error (MOE). A small MOE implies that the upper and lower bounds (error boundaries) for the confidence interval will be closer to the sample mean. Conversely, a small sample size implies a large margin of error and large error boundaries.

The following equations were used to calculate Variance, Transformed Mean, Margin of Error (MOE), Translated Upper and Lower Bounds, and 90 percent Confidence Interval.

- Variance = Σ (Arcsin((p)$^{0.5}$) – Arcsin((p$_{avg}$)$^{0.5}$))^2,

  Where: Σ = sum of variances for all samples
  p = weight of each sample
  p_{avg} = the average weight of the sample set

- Transformed Mean = Arcsin*((p$_{avg}$)$^{0.5}$)

  Where: p_{avg} = the average weight of the sample set

- MOE = t*(s/(n)$^{0.5}$)

  Where: t = the 90 percent critical value and is based on the inverse of the normal distribution curve at (10%/2=5%)
  s = (Variance/(n-1))
  n = the sample size

- Upper Bound = Sin (h)^2

  Where: h = the high confidence level and is equal to Transformed Mean + MOE

- Lower Bound = Sin (l)^2

  Where: l = the low confidence level and is equal to Transformed Mean – MOE

- 90 percent Confidence Interval is contained within the Upper or Lower Bounds

The results presented in this report detail the 90 percent confidence interval for single stream, multi-stream or separated, mixed waste, construction and demolition, and overall MRF groupings.

Tonnage Extrapolation Methodology

Data obtained from the screening/survey process of this study and the GAA database was used for extrapolation of residual tonnages of Confirmed MRFs in order to estimate the total annual tonnage generated at each type of facility in the state. The GAA database was a useful supplement to the survey information because of the limited number of responsive MRFs. Because the vintage of the GAA data was slightly older, the survey data gathered during this study was used in cases of overlapping estimates. For these overlaps, the average single and multi-stream MRF incoming recyclables tonnage data was cross-checked and was determined to have increased by approximately 38 percent from GAA's database to the time of this study. Incoming solid waste at mixed waste processing facilities has decreased by about 10 percent from the GAA database. These estimates seem to be reasonable given the general industry conditions throughout the state.

Unfortunately, the GAA database does not catalogue C&D facilities. As a result, the proportion estimate for C&D facilities was based on data from the R..W. Beck detailed survey only. The tonnage estimates for the remaining MRF types were estimated based on information received from GAA as well as that obtained from the R.W. Beck study.

The following is a step-by-step outline of the process used to arrive at annual tonnage estimates for each type of MRF, and describes in detail the steps taken to address the limitations of the tonnage data.

1. Before any extrapolation was possible, an account of the aggregate MRF universe was developed. Based on the best available information gathered in the study, the estimate of the total universe of MRFs in the state that fit the study definition was determined to be 147 facilities. The GAA database was cross-referenced against the study survey data to retrieve entries unique to both databases. All unique data points were combined in a spreadsheet model for purposes of the analysis.

2. After discussions with CIWMB staff, it was determined that the most appropriate way to estimate the proportions of the different MRF strata would be to rely only on the survey data for C&D facilities, and the combined dataset excluding C&D facilities for the other proportions. In the latter case, the universe of total MRFs was adjusted by the amount equal to the estimate of C&D facilities from the survey data. Specifically, based on the survey data, the estimated proportion of C&D facilities as a percent of total MRFs was used to reduce the total number of MRFs estimated to exist in the state that fall into the other 3 strata (i.e. Single Stream, Mixed Waste and Multi-stream). The best available estimate of the aggregate number of facilities was 147, so a deduction of 12 percent based on the survey data to account for C&D facilities resulted in 129 remaining facilities, which then comprised the new universe of MRFs that fell into the remaining 3 strata.

3. After finalizing the proportion estimate for C&D MRFs, revised proportion estimates based on only the available data for Single Stream, Mixed Waste, and Multi-stream facilities were computed. C&D facility data was excluded from this computation. The two available datasets, namely the GAA database and the survey database, were combined to net a larger number of data points. It should be noted that in a few cases, current knowledge regarding specific facilities resulted in the exclusion of GAA items determined to be out of date. It is important to note that this process resulted in essentially two *distinct* universes – the broader state universe, from which C&D tonnage was extrapolated, and the abbreviated universe for the other 3 strata.

4. An average residual tonnage generated by MRF type was computed for all 4 strata. This average tonnage was based on survey responses from all facility types, along with logged average tonnages from the GAA database when appropriate.

5. Using the appropriate respective universe estimate (147 for all MRFs including C&D and 129 for the remaining 3 strata), the average tonnage calculated for each MRF type was then multiplied by the average proportion estimate for that facility type, the product of which was multiplied by the universe count to arrive at the annual tonnage estimate.

6. Individual tonnage results for each MRF type were then summed to net the total annual state MRF residue tonnage generation estimate.

To illustrate the process, suppose that for the Mixed Waste strata, it is determined that the average tonnage amount is 1,000 tons, and that Mixed Waste facilities comprise 10 percent of the combined GAA and survey dataset. The tonnage would be computed as follows:

Average Tons * **Universe Estimate** * **Strata Proportion Estimate** = (1,000)*(129)*(.10) = **13,000 tons**.

In this example, the product of the proportion estimate and the universe value was rounded to the nearest whole number of facilities. This example is not indicative of actual results, and round numbers have been used to simplify the illustration.

Table 26 summarizes the actual results of the tonnage extrapolation process.

Table 26: Summary of MRF Residual Extrapolated Tonnages, 2005

MRF Type	Avg. Residual Tonnage	Universe Count	% of Respective Universe *	Est. Annual Tonnage
Single Stream	7,411	129	52%	496,638
Multi-stream	1,340	129	21%	35,931
Mixed Waste	189,818	129	27%	6,678,151
C&D	9,169	147	12%	161,736
Overall **				**7,372,456**

* Does not add to 100%, as estimated C&D facility count was removed from the universe of MRFs belonging to the other 3 strata.

** Total tonnage was not subjected to extrapolation, and is simply the sum of the combined tonnage contributions from each MRF type.

Analytical Caveats

The composition, confidence intervals, and tonnage extrapolation results culminating from this study and presented herein must be tempered with the following caveats:

1. As mentioned in the tonnage extrapolation methodology, limitations of the data obtained from GAA required C&D MRFs to be considered separately from other MRF types. Therefore, the estimated number of facilities and residual tonnages are based on two distinctive sets of data.

2. The survey research conducted for the purposes of this study resulted in data that was, in some cases, of significantly more current vintage than data on facilities and tonnage estimates as contained in the GAA database. While the study data superseded the older data whenever a cross-referencing of data points was possible, there were instances in which the older GAA data was relied on for estimation purposes. As such, tonnage estimates derived from such a combination of vintage could differ somewhat from current actual values based on changes in generation of residuals subsequent to the recording of the GAA data.

3. Tonnage extrapolations were based on a sampling of facilities deemed to be MRFs based on the criteria of this study and best available sources of information. The estimated number of MRFs and residual tonnages presented in this study and classified by MRF type must be interpreted only in full light of the procedure employed to develop the result. True tonnage dispersion across MRF types may differ somewhat from what is shown in Table 26.

4. The results presented herein are relevant for the period of time in which the study was performed. This study examined a cross-section, or snapshot in time, of MRF residue composition across a sampling of facilities in the state. The estimates presented herein are indicative of conditions as of the vintage of the data and near future but are not valid for an indefinite period. Several conditions are expected to change throughout time, such as targeted recyclables, collection methods, and recovery methods/technologies.

Appendix B:
Definitions of MRF Residuals and MRF Types

Definitions

Due to the variety of recyclable material feedstocks which MRFs receive, it was necessary to define what constitutes a MRF and then classify them into logical groups based on the number and/or type of material inflow streams. To allow consistent assessment of the quantity of residuals emanating from all types of MRFs included in the study, it was also necessary to define MRF residuals. The working definitions of a MRF and a MRF Residual for the purposes of this study are as follows:

Residuals-Producing Materials Recovery Facility (MRF): a facility where individual recyclable materials collected directly from generators or from intermediate collection facilities such as drop-off recycling centers, redemption centers, or buy back centers, move over a conveyance system and are aggregated or segregated by material type or grade from commingled recyclable materials or from solid wastes, either by hand or by use of machinery, for sale to end users for the purpose of recycling and, as a result of the process, produce residuals that are disposed with the municipal waste stream. Types of MRFs include:

1. **Multi-stream** MRFs that receive and process multiple types of recyclables separately. Incoming recyclables may be collected in a source separated manner or from a curbside dual stream program that separate fiber and container streams.
2. **Single Stream** MRFs that sort individual recyclable materials from recyclables that have been collected in one stream.
3. **Mixed Waste Processing Facilities (MWPF),** (sometimes called "dirty MRFs"), that remove one or more recyclable materials from municipal solid waste (MSW) streams.
4. **Construction and Demolition (C&D**) processing facilities that separate one or more materials from mixed construction and/or demolition debris with or without a conveyance system.

The above MRF definitions include all processing facilities that operate on either source-separated (and usually, curbside-collected) recyclable materials or on solid waste feedstocks and prepare as output recyclable materials for shipment to markets. However, if the recovery operation at a facility was not sufficiently advanced as to be able to produce a discernable residual waste stream—such as floor-sort or dump-and-pick operations that operate on the tipping floor at transfer stations—the facility was not considered a MRF for the purposes of this study.

The following types of facilities that handle recyclable materials diverted from the municipal waste stream were not included as Residual-Producing Material Recovery Facilities:

- End users (e.g. paper mills and plastic reclaimers), because the material has already undergone a previous contaminant separation process adequate for material compliance with purchasing and end use specifications.
- Buy back centers, because their activities do not include the separation of individual recyclable materials from commingled recyclables or from municipal solid waste, and therefore do not generate any residuals.
- Drop-off recycling centers, because their activities do not include the separation of individual recyclable materials from commingled recyclable materials or from municipal solid waste, and therefore do not create any residuals.
- Transfer stations (or landfills) that positively sort certain items (such as white goods or scrap metal) from incoming loads of solid waste intended for disposal, but have no separate processing area or conveyance system where this takes place (i.e., recyclable materials are pulled directly from the incoming waste).

MRF Residual: Any material emanating from a MRF (as defined in items 1 through 4 above) that is not diverted for recovery through recycling, composting or reuse; or any material emanating from the area of a transfer station or other processing facility devoted to specialized recovery of recyclable materials. The quantity of residuals from any type of MRF is equal to the total weight of material entering the MRF minus the combined weight of material diverted for recovery, less moisture loss.

Appendix C:
List and Definitions of Material Types

Classification of Disposed Waste According to 79 Material Types

California's standard list of material types contains 67 types, as defined in the 2004 Statewide Study. This list was modified somewhat to capture data on specific categories for this study only. All the modified types can be re-combined to be consistent with the 67 standard types.

Table 27 – List of Material Types

Material ID #	Material Type Name
PAPER	
1	Uncoated Corrugated Cardboard
2	Paper Bags/Kraft
3	Newspaper
4	White Ledger
5	Colored Ledger
6	Computer Paper
7	Other Office Paper
8	Magazines and Catalogs
9	Phone Books and Directories
10	Other Miscellaneous Paper
11	Remainder/ Composite Paper
GLASS	
12	Clear Glass Bottles and Containers
13	Green Glass Bottles and Containers
14	Brown Glass Bottles and Containers
15	Other Colored Glass Bottles and Containers
16	Flat Glass
17mc	*Mixed Cullet*
17	Remainder/ Composite Glass

Table 27 – List of Material Types (cont'd)

Material ID #	Material Type Name
METAL	
18	Tin/Steel Cans
19	Major Appliances
20	Used Oil Filters
21	Other Ferrous
22	Aluminum Cans
23	Other Non-Ferrous
24	Remainder/ Composite Metal
ELECTRONICS	
25	Brown Goods
26	Computer-related Electronics
27	Other Small Consumer Electronics
28	Televisions and Other Items with CRTs
PLASTIC	
29	PETE Bottles
30 *30f* *30nf*	*Other PETE Containers* *PETE food packaging "clamshells"* *PETE non-food packaging "clamshells"*
31	*HDPE Natural Bottles*
32	*HDPE Colored Bottles*
33	HDPE 5-gallon Buckets (food)
34	HDPE 5-gallon Buckets (non-food)
35	Other HDPE Containers
36	#3–#7 Bottles
37 *37f* *37nf*	#3–#7 Other Containers *PS food packaging "clamshells"* *PS non-food packaging "clamshells"*
38	Plastic Trash Bags
39	Plastic Grocery and Other Merchandise Bags
40	Non-Bag Commercial and Industrial Packaging Film

Table 27 – List of Material Types (cont'd)

Material ID #	Material Type Name
41	Film Products
42	Other Film
43	Durable Plastic Items
44	Remainder/ Composite Plastic
ORGANICS	
45	Food
46	Leaves and Grass
47	Prunings and Trimmings
48	Branches and Stumps
49	Agricultural Crop Residues
50	Manures
51	Textiles
52	Carpet
53	Remainder/ Composite Organics
CONSTRUCTION & DEMOLITION	
54	Concrete
55	Asphalt Paving
56	Asphalt Roofing
57	Lumber
58	Treated Wood Waste
59	Gypsum Board
60	Rock, Soil, and Fines
61	Remainder/ Composite Construction and Demolition
HOUSEHOLD HAZARDOUS	
62	Paint
63	Vehicle and Equipment Fluids
64	Used Oil
65	Batteries

Table 27 – List of Material Types (cont'd)

Material ID #	Material Type Name
66	Remainder/ Composite Household Hazardous
SPECIAL WASTE	
67	Ash
68	Sewage Solids
69	Industrial Sludge
70	Treated Medical Waste
71	Bulky Items
72	Tires
73	Remainder/ Composite Special Waste
MIXED RESIDUE	
74	Mixed Residue

Table 28 – Definitions of Material Types

PAPER		
Material ID & Name		**Material Type Definition**
1	**Uncoated Corrugated Cardboard**	**Uncoated Corrugated Cardboard** usually has three layers. The center wavy layer is sandwiched between the two outer layers. It does not have any wax coating on the inside or outside. Examples include entire cardboard containers, such as shipping and moving boxes, computer packaging cartons, and sheets and pieces of boxes and cartons. This type does not include chipboard.
2	**Paper Bags/Kraft**	**Paper Bags** means bags and sheets made from Kraft paper. Examples include paper grocery bags, fast food bags, department store bags, and heavyweight sheets of Kraft packing paper.
3	**Newspaper**	**Newspaper** means paper used in newspapers. Examples include newspaper and glossy inserts, and all items made from newsprint, such as free advertising guides, election guides, plain news packing paper, stapled college schedules of classes, and tax instruction booklets.
4	**White Ledger**	**White Ledger** means uncolored bond, rag, or stationary grade paper. It may have colored ink on it. When the paper is torn, the fibers are white. Examples include white photocopy, white laser print, and letter paper.
5	**Colored Ledger**	**Colored Ledger** means colored bond, rag, or stationery grade paper. When the paper is torn, the fibers are colored throughout. Examples include colored photocopy and letter paper. This type does not include fluorescent dyed paper or deep-tone dyed paper such as goldenrod colored paper.
6	**Computer Paper**	**Computer Paper** means paper used for computer printouts. This type usually has a strip of form feed holes along two edges. If there are no holes, then the edges show tear marks. This type can be white or striped. Examples include computer paper and printouts from continuous feed printers. This type does not include "white ledger" used in laser or impact printers, nor computer paper containing groundwood.
7	**Other Office Paper**	**Other Office Paper** means other kinds of paper used in offices. Examples include manila folders, manila envelopes, index cards, white envelopes, white window envelopes, white or colored notebook paper, carbonless forms, and junk mail. This type does not include "white ledger", "colored ledger", or "computer paper".
8	**Magazines and Catalogs**	**Magazines and Catalogs** means items made of glossy coated paper. This paper is usually slick, smooth to the touch, and reflects light. Examples include glossy magazines, catalogs, brochures, and pamphlets.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
9	**Phone Books and Directories**	**Phone Books and Directories** means thin paper between coated covers. These items are bound along the spine with glue. Examples include whole or damaged telephone books, "yellow pages", real estate listings, and some non-glossy mail order catalogs.
10	**Other Miscellaneous Paper**	**Other Miscellaneous Paper** means items made mostly of paper that do not fit into any of the above types. Paper may be combined with minor amounts of other materials such as wax or glues. This type includes items made of chipboard, groundwood paper, and deep-toned or fluorescent dyed paper. Examples include cereal and cracker boxes, unused paper plates and cups, goldenrod colored paper, school construction paper/butcher paper, milk cartons, ice cream cartons and other frozen food boxes, unopened junk mail, colored envelopes for greeting cards, pulp paper egg cartons, unused pulp paper plant pots, and hardcover and softcover books.
11	**Remainder/ Composite Paper**	**Remainder/Composite Paper** means items made mostly of paper but combined with large amounts of other materials such as wax, plastic, glues, foil, food, and moisture. Examples include waxed corrugated cardboard, aseptic packages, waxed paper, tissue, paper towels, blueprints, sepia, onion skin, fast food wrappers, carbon paper, self-adhesive notes, and photographs.
GLASS		
12	**Clear Glass Bottles and Containers**	**Clear Glass Bottles and Containers** means clear glass beverage and food containers with or without a California Redemption Value (CRV) label. Examples include whole or broken clear soda and beer bottles, fruit juice bottles, peanut butter jars, and mayonnaise jars.
13	**Green Glass Bottles and Containers**	**Green Glass Bottles and Containers** means green-colored glass containers with or without a CRV label. Examples include whole or broken green soda and beer bottles, and whole or broken green wine bottles.
14	**Brown Glass Bottles and Containers**	**Brown Glass Bottles and Containers** means brown-colored glass containers with or without a CRV label. Examples include whole or broken brown soda and beer bottles, and whole or broken brown wine bottles.
15	**Other Colored Glass Bottles and Containers**	**Other Colored Glass Bottles and Containers** means colored glass containers and bottles other than green or brown with or without a CRV label. Examples include whole or broken blue or other colored bottles and containers.
16	**Flat Glass**	**Flat Glass** means clear or tinted glass that is flat. Examples include glass windowpanes, doors, and tabletops, flat automotive window glass (side windows), safety glass, and architectural glass. This type does not include windshields, laminated glass, or any curved glass.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
17 mc	**Mixed Cullet**	**Mixed Cullet** means small broken pieces and fragments of mixed container, flat, and tableware glass that cannot effectively be sorted by type or color. May include particles as large as 2 inches, but generally intended to capture material in which 50 percent or more of all particles pass through a half-inch screen. Examples include broken bottles, windshield fragments and glass tableware.
17	**Remainder/ Composite Glass**	**Remainder/Composite Glass** means glass that cannot be put in any other type. It includes items made mostly of glass but combined with other materials. Examples include Pyrex, Corningware, crystal and other glass tableware, mirrors, non-fluorescent light bulbs, and auto windshields.
METAL		
18	**Tin/Steel Cans**	**Tin/Steel Cans** means rigid containers made mainly of steel. These items will stick to a magnet and may be tin-coated. This type is used to store food, beverages, paint, and a variety of other household and consumer products. Examples include canned food and beverage containers, empty metal paint cans, empty spray paint and other aerosol containers, and bimetal containers with steel sides and aluminum ends.
19	**Major Appliances**	**Major Appliances** means discarded major appliances of any color. These items are often enamel-coated. Examples include washing machines, clothes dryers, hot water heaters, stoves, and refrigerators. This type does not include electronics, such as televisions and stereos.
20	**Used Oil Filters**	**Used Oil Filters** means metal oil filters used in motor vehicles and other engines, which contain a residue of used oil.
21	**Other Ferrous**	**Other Ferrous** means any iron or steel that is magnetic or any stainless steel item. This type does not include "tin/steel cans". Examples include structural steel beams, metal clothes hangers, metal pipes, stainless steel cookware, security bars, and scrap ferrous items.
22	**Aluminum Cans**	**Aluminum Cans** means any food or beverage container made mainly of aluminum. Examples include aluminum soda or beer cans, and some pet food cans. This type does not include bimetal containers with steel sides and aluminum ends.
23	**Other Non-Ferrous**	**Other Non-Ferrous** means any metal item, other than aluminum cans, that is not stainless steel and that is not magnetic. These items may be made of aluminum, copper, brass, bronze, lead, zinc, or other metals. Examples include aluminum window frames, aluminum siding, copper wire, shell casings, brass pipe, and aluminum foil.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
24	**Remainder/ Composite Metal**	**Remainder/Composite Metal** means metal that cannot be put in any other type. This type includes items made mostly of metal but combined with other materials and items made of both ferrous metals and non-ferrous metal combined. Examples include small non-electronic appliances such as toasters and hair dryers, motors, insulated wire, and finished products that contain a mixture of metals, or metals and other materials, whose weight is derived significantly from the metal portion of its construction.
ELECTRONICS		
25	**Brown Goods**	**Brown Goods** means generally larger, non-portable electronic goods that have some circuitry. Examples include microwaves, stereos, VCRs, DVD players, radios, audio/visual equipment, and non-CRT televisions (such as LCD televisions).
26	**Computer-related Electronics**	**Computer-related Electronics** means electronics with large circuitry that is computer-related**.** Examples include processors, mice, keyboards, laptops, disk drives, printers, modems, and fax machines.
27	**Other Small Consumer Electronics**	**Other Small Consumer Electronics** means portable non-computer-related electronics with large circuitry. Examples include personal digital assistants (PDAs), cell phones, phone systems, phone answering machines, computer games and other electronic toys, portable CD players, camcorders, and digital cameras.
28	**Televisions and Other Items with CRTs**	**Televisions and Other Items with CRTs**. Examples include televisions, computer monitors, and other items containing a cathode ray tube (CRT).
PLASTIC		
29	**PETE Bottles**	**PETE Bottles** means clear or colored PETE (polyethylene terephthalate) bottles. When marked for identification, it bears the number 1 in the center of the triangular recycling symbol and may also bear the letters PETE or PET. The color is usually clear, transparent green or amber. A PETE bottle usually has a small dot left from the manufacturing process, not a seam. It does not turn white when bent. Examples of narrow and wide neck bottles include: soft drink, water, and liquor bottles, cooking oil, pastry jars, food jars, and aspirin bottles.
30	**Other PETE Containers**	**Other PETE Containers** means all PETE (polyethylene terephthalate) containers (other than bottles). When marked for identification, it bears the number 1 in the center of the triangular recycling symbol and may also bear the letters PETE or PET. A PETE container usually has a small dot left from the manufacturing process, not a seam. Examples include black frozen food trays, food and non-food clamshell packaging.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
30 f	**PETE Food Clamshells**	**PETE Food Clamshells** means PETE (polyethylene terephthalate) containers with hinged lids that contained food. When marked for identification, it bears the number 1 in the center of the triangular recycling symbol and may also bear the letters PETE or PET. A PETE container usually has a small dot left from the manufacturing process, not a seam. Examples include bakery packaging with hinged lids.
30 nf	**PETE Non-food Clamshells**	**PETE Non-food Clamshells** means PETE (polyethylene terephthalate) containers with hinged lids that contained materials other than food. When marked for identification, it bears the number 1 in the center of the triangular recycling symbol and may also bear the letters PETE or PET. A PETE container usually has a small dot left from the manufacturing process, not a seam. Examples include hardware and fastener packaging.
31	**HDPE Natural Bottles**	**HDPE Natural Bottles** means natural HDPE (high-density polyethylene) bottles. This plastic is cloudy white, allowing light to pass through it. When marked for identification, it bears the number 2 in the triangular recycling symbol. Examples include milk jugs, water jugs, and some juice bottles.
32	**HDPE Colored Bottles**	**HDPE Colored Bottles** means colored HDPE (high-density polyethylene) containers. This plastic is a solid color, preventing light from passing through it. When marked for identification, it bears the number 2 in the triangular recycling symbol. Examples include detergent bottles, some shampoo and hair-care bottles, empty motor oil, empty antifreeze, and other empty vehicle and equipment fluid bottles, and narrow and wide mouth food containers, such as for coffee and coffee creamer.
33	**HDPE 5-gallon Buckets (food)**	**HDPE 5-gallon Buckets (food)** means all types of HDPE (high-density polyethylene) 5-gallon buckets that contained food. This plastic is usually a solid color, preventing light from passing through it (colored). When marked for identification, it bears the number 2 in the triangular recycling symbol on the bottom of the bucket.
34	**HDPE 5-gallon Buckets (non-food)**	**HDPE 5-gallon Buckets (non-food)** means all types of HDPE (high-density polyethylene) 5-gallon buckets that contained materials other than food. This plastic is usually a solid color, preventing light from passing through it (colored). When marked for identification, it bears the number 2 in the triangular recycling symbol on the bottom of the bucket.
35	**Other HDPE Containers**	**Other HDPE Containers** means all types of HDPE (high-density polyethylene) containers not included above. When marked for identification, it bears the number 2 in the triangular recycling symbol. Examples include some margarine, cottage cheese, yogurt tubs, and buckets smaller than 5-gallons.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
36	**#3–#7 Bottles**	**#3-#7 Bottles** means plastic bottles made of types of plastic other than HDPE (high-density polyethylene) or PETE (polyethylene terephthalate). Items may be made of PVC (polyvinyl chloride), LDPE (low-density polyethylene), PP (polypropylene), PS (polystyrene), or mixed resins. When marked for identification, these bottles bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. Examples include bottles for some salad dressings, vegetable oils, juices, syrup, shampoo, and vitamins. NOTE: Previously called "Miscellaneous Plastic Containers".
37	**#3–#7 Other Containers**	**#3-#7 Other Containers** means plastic containers (other than bottles) made of types of plastic other than HDPE (high-density polyethylene) or PETE (polyethylene terephthalate). Items may be made of PVC (polyvinyl chloride), LDPE (low-density polyethylene), PP (polypropylene), PS (polystyrene), or mixed resins. When marked for identification, these items bear the number 3, 4, 5, 6, or 7 in the triangular recycling symbol. Examples include food containers such as flexible and brittle yogurt cups, some margarine tubs, microwave food trays, clamshell-shaped fast food or muffin containers, and foam egg cartons. NOTE: Previously called "Miscellaneous Plastic Containers".
37 f	**PS Food Clamshells**	**PS Food Clamshells** means PS (polystyrene) containers with hinged lids that contained food. When marked for identification, these items bear the number 6 in the triangular recycling symbol. Examples include food containers such as clamshell-shaped fast food or muffin containers, and foam egg cartons.
37 nf	**PS Non-food Clamshells**	**PS Non-food Clamshells** means PS (polystyrene) containers with hinged lids that contained materials other than food. When marked for identification, these items bear the number 6 in the triangular recycling symbol.
38	**Plastic Trash Bags**	**Plastic Trash Bags** means plastic bags sold for use as trash bags, for both residential and commercial use. Does not include other plastic bags like shopping bags that might have been used to contain trash.
39	**Plastic Grocery and Other Merchandise Bags**	**Plastic Grocery And Other Merchandise Bags** means plastic shopping bags used to contain merchandise to transport from the place of purchase, given out by the store with the purchase. Includes dry-cleaning plastic bags intended for 1-time use.
40	**Non-Bag Commercial and Industrial Packaging Film**	**Non-Bag Commercial And Industrial Packaging Film** means film plastic used for large-scale packaging or transport packaging. Examples include shrink-wrap, mattress bags, furniture wrap, and film bubble wrap.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
41	**Film Products**	**Film Products** means plastic film used for purposes other than packaging. Examples include agricultural film (films used in various farming and growing applications, such as silage greenhouse films, mulch films, and wrap for hay bales), plastic sheeting used as drop cloths, and building wrap.
42	**Other Film**	**Other Film** means all other plastic film that does not fit into any other type. Examples include other types of plastic bags (sandwich bags, zipper-recloseable bags, newspaper bags, produce bags, frozen vegetable bags, bread bags), food wrappers such as candy-bar wrappers, mailing pouches, bank bags, X-ray film, metallized film (wine containers and balloons), and plastic food wrap.
43	**Durable Plastic Items**	**Durable Plastic Items** means all other plastic objects other than containers, or film plastic. Examples include mop buckets, plastic outdoor furniture, plastic toys, large paint/food buckets, CD's, plastic stay straps, sporting goods, and plastic house wares such as dishes, cups, and cutlery. This type also includes building materials such as house siding, window sashes and frames, housings for electronics (such as computers, televisions and stereos), fan blades, impact-resistance cases (e.g. tool boxes, first aid boxes, tackle boxes, sewing kits, etc.), and plastic pipes and fittings.
44	**Remainder/ Composite Plastic**	**Remainder/Composite Plastic** means plastic that cannot be put in any other type. They are usually recognized by their optical opacity. This type includes items made mostly of plastic but combined with other materials. Examples include auto parts made of plastic attached to metal, plastic drinking straws, foam drinking cups, produce trays, foam meat and pastry trays, foam packing blocks, packing peanuts, foam plates and bowls, plastic strapping, plastic lids, some kitchen ware, toys, new plastic laminate (e.g., Formica), vinyl, linoleum, plastic lumber, insulating foams, imitation ceramics, handles and knobs, plastic string (such as is used for hay bales), and plastic rigid bubble/foil packaging (as for medications).
ORGANIC		
45	**Food**	**Food** means food material resulting from the processing, storage, preparation, cooking, handling, or consumption of food. This type includes material from industrial, commercial, or residential sources. Examples include discarded meat scraps, dairy products, egg shells, fruit or vegetable peels, and other food items from homes, stores, and restaurants. This type includes grape pomace and other processed residues or material from canneries, wineries, or other industrial sources.
46	**Leaves and Grass**	**Leaves and Grass** means plant material, except woody material, from any public or private landscapes. Examples include leaves, grass clippings, sea weed, and plants. This type does not include woody material or material from agricultural sources.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
47	**Prunings and Trimmings**	**Prunings and Trimmings** means woody plant material up to 4 inches in diameter from any public or private landscape. Examples include prunings, shrubs, and small branches with branch diameters that do not exceed 4 inches. This type does not include stumps, tree trunks, or branches exceeding 4 inches in diameter. This type does not include material from agricultural sources.
48	**Branches and Stumps**	**Branches and Stumps** means woody plant material, branches, and stumps that exceed four inches in diameter from any public or private landscape.
49	**Agricultural Crop Residues**	**Agricultural Crop Residues** means plant material from agricultural sources. Examples include orchard and vineyard prunings, vegetable by-products from farming, residual fruits, vegetables, and other crop remains after usable crop is harvested. This type does not include processed residues from canneries, wineries, or other industrial sources.
50	**Manures**	**Manures** means manure and soiled bedding materials from domestic, farm, or ranch animals. Examples include manure and soiled bedding from animal production operations, racetracks, riding stables, animal hospitals, and other sources.
51	**Textiles**	**Textiles** means items made of thread, yarn, fabric, or cloth. Examples include clothes, fabric trimmings, draperies, and all natural and synthetic cloth fibers. This type does not include cloth-covered furniture, mattresses, leather shoes, leather bags, or leather belts.
52	**Carpet**	**Carpet** means flooring applications consisting of various natural or synthetic fibers bonded to some type of backing material. Does not include carpet padding.
53	**Remainder/ Composite Organics**	**Remainder/Composite Organics** means organic material that cannot be put in any other type or subtype. This type includes items made mostly of organic materials but combined with other materials. Examples include leather items, cork, hemp rope, garden hoses, rubber items, hair, carpet padding, cigarette butts, diapers, feminine hygiene products, wood products (popsicle sticks and toothpicks), sawdust, and animal feces.
CONSTRUCTION & DEMOLITION		
54	**Concrete**	**Concrete** means a hard material made from sand, gravel, aggregate, cement mix, and water. Examples include pieces of building foundations, concrete paving, and cinder blocks.
55	**Asphalt Paving**	**Asphalt Paving** means a black or brown, tar-like material mixed with aggregate used as a paving material.
56	**Asphalt Roofing**	**Asphalt Roofing** means composite shingles and other roofing material made with asphalt. Examples include asphalt shingles and attached roofing tar and tar paper.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
57	**Lumber (non-treated)**	**Lumber (non-treated)** means non-treated processed wood for building, manufacturing, landscaping, packaging, and non-treated processed wood from demolition. Examples include dimensional lumber, lumber cutoffs, engineered wood such as plywood and particleboard, wood scraps, pallets, wood fencing, wood shake roofing, and wood siding.
58	**Treated Wood Waste**	**Treated Wood Waste** means wood that has been treated with a chemical preservative for purposes of protecting the wood against attacks from insects, microorganisms, fungi, and other environmental conditions that can lead to decay of the wood and the chemical preservative is registered pursuant to the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. Sec. 136 and following). This includes wood that has been pressure treated, chemically treated (with copper etc.) or treated with creosote (e.g. railroad ties, marine timbers and pilings, landscape timbers, and telephone poles).
59	**Gypsum Board**	**Gypsum Board** means interior wall covering made of a sheet of gypsum sandwiched between paper layers. Examples include used or unused, broken or whole sheets of sheetrock, drywall, gypsum board, plasterboard, gypboard, gyproc, and wallboard.
60	**Rock, Soil, and Fines**	**Rock, Soil and Fines** means rock pieces of any size and soil, dirt, and other matter. Examples include rock, stones, and sand, clay, soil, and other fines. This type also includes non-hazardous contaminated soil.
61	**Remainder/ Composite Construction and Demolition**	**Remainder/Composite Construction and Demolition** means construction and demolition material that cannot be put in any other type. This type may include items from different categories combined, which would be very hard to separate. Examples include brick, ceramics, tiles, toilets, sinks, dried paint not attached to other materials, and fiberglass insulation. This type may also include demolition debris that is a mixture of items such as plate glass, wood, tiles, gypsum board, and aluminum scrap.
HOUSEHOLD HAZARDOUS WASTE		
62	**Paint**	**Paint** means containers with paint in them. Examples include latex paint, oil based paint, and tubes of pigment or fine art paint. This type does not include dried paint, empty paint cans, or empty aerosol containers.
63	**Vehicle and Equipment Fluids**	**Vehicle and Equipment Fluids** means containers with fluids used in vehicles or engines, except used oil. Examples include used antifreeze and brake fluid. This type does not include empty vehicle and equipment fluid containers.
64	**Used Oil**	**Used Oil** means the same as defined in Health and Safety Code section 25250.1(a). Examples include spent lubricating oil such as crankcase and transmission oil, gear oil, and hydraulic oil.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
65	**Batteries**	**Batteries** means any type of battery including both dry cell and lead acid. Examples include car, flashlight, small appliance, watch, and hearing aid batteries.
66	**Remainder/ Composite Household Hazardous**	**Remainder/Composite Household Hazardous** means household hazardous material that cannot be put in any other type. This type also includes household hazardous material that is mixed. Examples include household hazardous waste which if improperly put in the solid waste stream may present handling problems or other hazards, such as pesticides, caustic cleaners, and fluorescent light bulbs.
SPECIAL WASTE		
67	**Ash**	**Ash** means a residue from the combustion of any solid or liquid material. Examples include ash from structure fires, fireplaces, incinerators, biomass facilities, waste-to-energy facilities, and barbecues.
68	**Sewage Solids**	**Sewage Solids** means residual solids and semi-solids from the treatment of domestic waste water or sewage. Examples include biosolids, sludge, grit, screenings, and septage. This type does not include sewage or waste water discharged from the sewage treatment process.
69	**Industrial Sludge**	**Industrial Sludge** means sludge from factories, manufacturing facilities, and refineries. Examples include paper pulp sludge, and water treatment filter cake sludge.
70	**Treated Medical Waste**	**Treated Medical Waste** means medical waste that has been processed in order to change its physical, chemical, or biological character or composition, or to remove or reduce its harmful properties or characteristics, as defined in Section 25123.5 of the California Health and Safety Code.
71	**Bulky Items**	**Bulky Items** means large hard to handle items that are not defined separately, including furniture, mattresses, and other large items. Examples include all sizes and types of furniture, mattresses, box springs, and base components.
72	**Tires**	**Tires** means vehicle tires. Examples include tires from trucks, automobiles, motorcycles, heavy equipment, and bicycles.
73	**Remainder/ Composite Special Waste**	**Remainder/Composite Special Waste** means special waste that cannot be put in any other type. Examples include asbestos-containing materials, such as certain types of pipe insulation and floor tiles, auto fluff, auto-bodies, trucks, trailers, truck cabs, untreated medical waste/pills/hypodermic needles, and artificial fireplace logs.

Table 28 – Definitions of Material Types (cont'd)

Material ID & Name		Material Type Definition
MIXED RESIDUE		
74	**Mixed Residue**	**Mixed Residue** means material that cannot be put in any other type in the other categories. This type includes mixed residue that cannot be further sorted. Examples include clumping kitty litter and residual material from a materials recovery facility or other sorting process that cannot be put in any of the previous remainder/composite types.

Appendix D:

Survey Forms and Field Forms Used During the Study

Screening/Survey Forms

The following forms were used to collect data from Potential MRFs regarding the type of processing performed, amount of incoming material, recovered material, and residuals:

- Waste Characterization MRF Screening Survey
- Waste Characterization Study MRF Questionnaire

Data obtained from these forms was used during the development of the Potential MRF database and to screen for possible host MRFs for sample collection/sorting. R.W. Beck guaranteed the confidentiality of information which was provided on these forms by Potential MRFs.

Sampling Forms

Field forms were used to record pertinent data during sampling and sorting activities. Examples of these forms, listed below, are provided in this section.

- Field Sample Log
- Physical Sampling Form

Waste Characterization MRF Screening Survey

Consulting firm R. W. Beck, on behalf the Integrated Waste Management Board, is conducting a survey of the composition of residuals generated at MRFs across California. The questions below are intended to determine if your facility meets the parameters of a MRF as applied only to this study. Please complete and return the survey no later than January 31, 2005. You may fax it to Paul Johnson at (858) 592-9209, or e-mail it to pjohnson@rwbeck.com. You may call Paul Johnson at (858) 485-4668 if you have any questions regarding the survey, or Tom Rudy of the CIWMB at (916) 341-6229 for questions regarding the overall study. Thank you in advance for your help.

Facility Name ________________________ Contact ______________________________

1. Would you consider your facility to be a material recovery facility of any kind (whether for traditional residential and commercial recyclables, or for construction and demolition materials)? ☐ Yes ☐ No

2. If so, why? (check all that apply)
   - ☐ A. Receives drop-off recyclables for sorting and densification
   - ☐ B. Receives residential curbside recyclables for sorting and densification
   - ☐ C. Receives commercial recyclables for sorting and densification
   - ☐ D. Sorts recyclables from mixed waste
   - ☐ E. Receives construction and demolition material for sorting and recovery
   - ☐ F. Other ____

3. If you do not consider your facility to be a MRF then what does your facility do? (check all that apply)
   - ☐ A. Transfers waste
   - ☐ B. Incinerates waste
   - ☐ C. Landfills waste

   } *If you checked one of these boxes, proceed to Question 4, else go to end.*
   - ☐ D. Acts as a recycled material buy-back center only, with no sorting or densification
   - ☐ E. Brokers recycled materials
   - ☐ F. Uses recycled paper as a feedstock to make other products
   - ☐ G. Uses recycled plastics as a feedstock to make other products
   - ☐ H. Other ____

4. If you checked A, B or C in Question 3 above, please indicate which, if any, of the following processes occur at your facility (check all that apply)
   - ☐ Do you floor sort any materials to remove recyclables (i.e. “dump & pick”)? ☐ Yes ☐ No
     If yes, describe ______________________________
   - ☐ Do you pull any items or recyclable materials directly from waste? ☐ Yes ☐ No
     If yes, describe ______________________________
   - ☐ Do you have a separate area of the facility where sorting of materials occurs? ☐ Yes ☐ No
     If yes, describe ______________________________

5. If you “yes” to any items in Question 4 above, please indicate if residue is generated from the area of the facility where picking or sorting takes place? ☐ Yes ☐ No
   If yes, describe ______________________________

End.

Waste Characterization Study MRF Questionnaire

The consulting firm R. W. Beck, on behalf of the Integrated Waste Management Board, is conducting a survey of material recovery facilities, mixed waste processing facilities, C&D processing facilities, and any other facilities that sort out and recover materials for recycling across California. The purpose of this analysis is to determine the feasibility of using MRF residuals as feedstock for other activities, such as conversion technologies.

Your facility has been determined to meet the parameters of facilities targeted in this study. Although this survey is not mandatory, we are requesting that you respond to the questions below to help us better understand the processing of recyclable material and generation of residuals for disposal that occurs at this facility.

At your request, R. W. Beck will provide a signed Confidentiality Statement that guarantees your responses will be held confidential from reporting as stand-alone data (although your responses may be reported in the aggregate with those from other facilities).

Please complete and return the survey as soon as possible. You may fax it to Paul Johnson at (858) 592-9209, or e-mail it to pjohnson@rwbeck.com. Please call Paul Johnson at (858) 485-4668 if you have any questions or require a confidentiality statement to participate. Feel free to call Tom Rudy of the CIWMB at (916) 341-6229 if you have questions regarding the study. Thank you in advance for your help.

Facility Name ____________________

Physical Location, Address ____________________

Physical Location, City/State/Zip ____________________

Owned by (company) ____________________

Operated by (company) ____________________

Contact Name ____________________

Contact Phone ____________________

Contact Fax ____________________

Contact E-mail ____________________

FACILITY TYPE AND INCOMING QUANTITIES

5. There are three broadly defined types of facilities that have been included in this study:

   A. Material Recovery Facilities (MRFs) and Recycling Centers: Includes any facility (or a separate area of the facility if it is a multiple-function facility such a combined transfer station and MRF) that receives recyclable materials for further processing and densification.

   B. Mixed Waste Processing Facilities (MWPFs): Includes any facility that receives mixed waste for processing and recovery.

   C. C&D Recycling/Processing Sites: Includes any facility (or a separate area of the facility if it is a multiple-function facility such a combined transfer station and C&D processing center) that receives construction and demolition debris (C&D) for processing and recovery.

   Please complete one of the following three tables based on your facility type above. If your facility meets more than one of these definitions, please fill out the applicable tables.

A. Material Recovery Facilities (MRFs) and Recycling Centers

Generating Sectors and Feedstocks	Annual Tons Received [1]	Jurisdiction(s) of Origin [2]	Notes
Residential recyclables collected in a source separated manner (including drop-off, buy-back, and curb-sort programs)			
Residential recyclables collected in a curbside dual stream program (i.e., fiber and commingled containers)			
Residential recyclables collected in a curbside single stream program (i.e., fiber and containers mixed together, either with or without glass).			
Commercial/institutional recyclables			
Other ___________________________			
Total			

[1] Include the most recent year for which you have data readily available

[2] Please list the jurisdictions. You do not need to provide the tons associated with each jurisdiction

Note: You may provide existing reports showing this data as a substitute to completing the table above.

B. Mixed Waste Processing Facilities (MWPFs)

Generating Sectors and Feedstocks	Annual Tons Received [1]	Jurisdiction(s) of Origin [2]	Notes
Residential solid waste			
Commercial/institutional/industrial solid waste			
Self-haul or "cash customer" (residential and/or small commercial) waste			
Mixed Residential/Commercial/Self-haul solid waste			
Other ___________________________			
Total			

[1] Include the most recent year for which you have data readily available

[2] Please list the jurisdictions. You do not need to provide the tons associated with each jurisdiction

Note: You may provide existing reports showing this data as a substitute to completing the table above.

C. C&D Recycling/Processing Sites

Generating Sectors and Feedstocks	Annual Tons Received [1]	Jurisdiction(s) of Origin [2]	Notes
Residential construction/remodel debris			
Residential demolition debris			
Commercial/institutional construction/remodel debris			
Commercial demolition debris			
Road, bridge, & non-structural construction/demolition debris			
Re-Roofing			
Other ___________________			
Total			

[1] Include the most recent year for which you have data readily available

[2] Please list the jurisdictions. You do not need to provide the tons associated with each jurisdiction

Note: You may provide existing reports showing this data as a substitute to completing the table above.

PROCESSING CONFIGURATION

2. How is the material processed at your facility (check all that apply):
   - ☐ Manual sorting: Floor sort
   - ☐ Manual sorting: Conveyors
   - ☐ Mechanized sorting: Air classifier(s)
   - ☐ Mechanized sorting: Magnet(s)
   - ☐ Mechanized sorting: Eddy current(s)
   - ☐ Mechanized sorting: Star or Disc screen(s)
   - ☐ Mechanized sorting: Shaker or Finger screen(s)
   - ☐ Mechanized sorting: Trommel screen(s)
   - ☐ Other 1 ________________________________
   - ☐ Other 2 ________________________________

3. Please provide a facility schematic (if available):

RECOVERED MATERIALS

4. Check the materials recovered at your facility and indicate annual recovery amounts for the most recent year data is available

Material	Annual Tons Recovered [1]	Material	Annual Tons Recovered [1]
Newspapers		Clear Glass	
Magazines		Green Glass	
Corrugated Cardboard		Brown Glass	
Paperboard		Other Glass	
Office paper		Aluminum Cans	
Mixed Paper		Other Aluminum	
#1 PET Bottles		Other Nonferrous Metal	
#2 HDPE Natural Bottles		Steel Cans	
#2 HDPE Pigmented Bottles		White Goods	
#3 - #7 Bottles		Other Ferrous Metal	
Other Rigid Plastic Containers		Green Waste	
Plastic Film		Dimensional lumber	
Expanded Polystyrene		Land-clearing Debris	
Other Plastic		Engineered and Other Wood	
Asphalt Shingles		Drywall	
Concrete		Block/Brick/Other Aggregate	
Other 1 ___________		Other 3 ___________________	
Other 2___________		Other 4 ___________________	
Total			

[1] Include the most recent year for which you have data readily available

Note: You may provide existing reports showing this data as a substitute to completing the table above.

GENERATION OF RESIDUALS

5. Indicate the annual quantity of residuals (including unrecovered mixed waste from MWPFs) that are disposed, and describe each ejection point (i.e., an "ejection point" is a location on the processing line where contaminants or process residue is discarded for eventual disposal). If you do not maintain separate quantities for each ejection point, please provide the total quantity of residuals on the bottom line.

Residual Ejection Point (describe)	If this passes over/under a screen, list screen size	Annual Tons Generated
Example 1: Screened unders from commingled container processing line	*1.5 inches*	*1,200*
Example 2: Negatively sorted waste	*n/a*	*100,000*
Example 3: Residual from C&D recovery line	*n/a*	*50,000*
Total		

Note: You may provide existing reports showing this data as a substitute to completing the table above.

6. Please name the facility(ies) where the residuals are sent from your facility, and indicate the type of facility (e.g., landfill, incinerator, land application, etc.):

Facility Name: ______________________ Facility Type: ______________________

Facility Name: ______________________ Facility Type: ______________________

Facility Name: ______________________ Facility Type: ______________________

SUITABILITY TO HOST FIELD SAMPLING AND SORTING EVENTS

The final phase of this project involves physically sampling and sorting residuals from a small group of MRFs, MWPFs, and C&D processing facilities (including transfer stations that perform any of these functions) starting in the early spring of 2005. The following questions will help us to determine if your facility may be a good host for field sorting. Note that there is no obligation to incur additional costs for facilities that are selected to host field sampling and sorting. The cost of sorting labor, sorting supplies, and associated travel costs will be borne by R. W. Beck.

7. Would you consider hosting a four- to six-person project team, sponsored by the Board, to perform material sampling and sorting at your facility? ☐ Yes ☐ No ☐ Maybe

> *Note: You may make the following assumptions when answering this question:*
>
> - *A team of five or six R. W. Beck staff would be used to perform the study at your facility. The team is experienced in conducting such studies and will work with you to minimize any impact on your operations,*
> - *A single sorting event would last no more than 3 days, although there may be two separate sorting events spaced roughly 4 to 6 months apart,*
> - *A preliminary site visit would be scheduled in advance of the sorting event to adequately scope out the job requirements,*
> - *There would be no cost to your facility to participate,*
> - *R. W. Beck would provide the facility with proof of insurance and a signed release from liability before performing the study,*
> - *R. W. Beck will comply with all facility health and safety requirements, including the provision of all personal protective equipment,*
> - *Any sensitive data collected as part of the study would, at your request, be held confidential from release in a stand-alone format (but may be used in generating aggregate results);*
> - *Data collected at your facility will be provided to you at your request.*

8. Would you be able to supply a mobile equipment operator from time to time during the sorting event to assist with moving sample materials and sorted materials within the facility? ☐ Yes ☐ No ☐ Maybe

9. Is there sufficient space at your facility, sheltered from vehicle traffic, to set up a 15' by 15' work area in which to conduct sorting activities?

Inside the facility	☐ Yes ☐ No ☐ Maybe
Outside the facility but covered	☐ Yes ☐ No ☐ Maybe
Outside the facility in an uncovered area	☐ Yes ☐ No ☐ Maybe

10. Would your facility be able to host the field sorting as soon as June 2005? ☐ Yes ☐ No

OPTIONAL QUESTIONS

The following questions will help the Board gain insight on contamination problems

at MRFs and C&D recycling/processing sites (excludes MWPFs)

11. How contaminated is incoming material at your facility?

    ☐ Highly contaminated ☐ Moderately contaminated ☐ Slightly contaminated ☐ Not contaminated

    Enter the percentage of incoming contamination, if known: ______________________

12. MRFs and Recycling Centers: Please indicate the types of incoming contamination most commonly encountered at your facility (check all that apply)?

    ☐ Mixed Plastics ☐ #3 through #7 plastic bottles ☐ Film plastic bags

    ☐Polystyrene Foam ☐ Non-container metals ☐ Ceramics

    ☐ Non-container glass ☐ Electronics ☐ Yard Waste

    ☐ C&D Debris ☐ Non-recyclable paper ☐ Garbage

    ☐ Other 1 (specify) ____

    ☐ Other 2 (specify) ____

    ☐ Other 3 (specify) ____

13. C&D Recycling/Processing Sites: Please indicate the types of contamination most commonly encountered at your facility (check all that apply)?

    ☐ Mixed Plastics ☐ Treated/contaminated wood ☐ Insulation

    ☐ Glass ☐ Plastic films ☐ Vegetative wastes

    ☐ Electronics ☐ Hazardous wastes ☐ Garbage

    ☐ Other 1 (specify) ____

    ☐ Other 2 (specify) ____

    ☐ Other 3 (specify) ____

Thank you for your help. Your efforts will help us better understand the waste stream and the valuable role that MRFs play in the recovery of material.

FIELD SAMPLE LOG

R·W·BECK

Facility: ______________________ Date: ____________

Personnel: ______________________

Allocation of Samples: ______________________

Sample No.	Time	Date Processed	Sample Method	Sample Location	Weight (lbs) Tote 1	Tote 2	Tote 3	Photo No.

Verify Allocation of Samples / Other Notes: ______________________

Physical Sampling Form

R·W·BECK

Date Processed:	
Date Sampled:	
Date Sorted:	
Facility:	
Ejection Point:	
Sample#:	

		Material Categories	Tare	Gross Weight	Net Weight	Tare	Gross Weight	Net Weight
Paper	1	Corrugated Cardboard						
	2	Paper Bags/Kraft						
	3	Newspaper						
	4	White Ledger						
	5	Colored Ledger						
	6	Computer Paper						
	7	Other Office Paper						
	8	Magazines/Catalogs						
	9	Phone Book/Directory						
	10	Other Misc. Paper						
	11	R/C Paper						
Glass	12	Clear						
	13	Green						
	14	Brown						
	15	Other Color						
	16	Flat Glass						
	17	R/C Glass						
Metal	18	Tin/Steel Cans						
	19	Major Appliances						
	20	Used Oil Filters						
	21	Other Ferrous						
	22	Aluminum Cans						
	23	Other Non-Ferrous						
	24	R/C Metal						
E-Waste	25	Brown Goods						
	26	Computer-Related						
	27	Other Small Consumer						
	28	TV's & Other CRTs						
Plastic	29	PETE Bottles						
	30	Other PETE Containers						
	30f	PETE Food Clamshells						
	30nf	PETE Non-food Clamshells						
	31	HDPE Natural Bottles						
	32	HDPE Colored Bottles						
	33	HDPE 5-gallon (Food)						
	34	HDPE 5-gallon (Non-Food)						
	35	Other HDPE Containers						
	36	#3-#7 Bottles						
	37	Other #3-#7 Containers						
	37f	PS Food Clamshells						
	37nf	PS Non-food Clamshells						
	38	Plastic Trash Bags						
	39	Grocery/Merch. Bags						
	40	Non-bag Packaging Film						

Physical Sampling Form

R·W·BECK

Date Processed:		Facility:	
Date Sampled:		Ejection Point:	
Date Sorted:		Sample#:	

	41	Film Products						
	42	Other Film						
	43	Durable Plastic Items						
	44	R/C Plastic						
Organic	45	Food						
	46	Leaves and Grass						
	47	Prunings & Trimmings						
	48	Branches & Stumps						
	49	Agricultural Crop						
	50	Manures						
	51	Textiles						
	52	Carpet						
	53	R/C Organics						
C&D	54	Concrete						
	55	Asphalt Paving						
	56	Asphalt Roofing						
	57	Lumber						
	58	Treated Wood Waste						
	59	Gypsum Board						
	60	Rock, Soil, Fines						
	61	R/C C&D						
HHW	62	Paint						
	63	Vehicle & Equip. Fluids						
	64	Used Oil						
	65	Batteries						
	66	R/C HHW						
Special	67	Ash						
	68	Sewage Solids						
	69	Industrial Sludge						
	70	Treated Medical Waste						
	71	Bulky Items						
	72	Tires						
	73	R/C Special Waste						
	74	Mixed Residue						

		Description	% of Total	Description	% of Total
Bottom Fines	Total Weight of Fines:				

Supervisor: ____________________ Crew Chief: ____________________

Notes: ____________________

Bibliography

Klee, A.J., "New Approaches to Estimation of Solid Waste Quantity and Composition," *ASCE Journal of Environmental Engineering*, March 1993, pp. 248–-261.