Five Year Program Review

HF&H Consultants, LLC

in conjunction with

Kelly Runyon
Kies Strategies

December 2017

This page intentionally left blank

HF&H CONSULTANTS, LLC
Managing Tomorrow's Resources Today

201 N. Civic Drive, Suite 230
Walnut Creek, California 94596
Telephone: 925/977-6950
Fax: 925/977-6955
www.hfh-consultants.com

Robert D. Hilton, CMC
John W. Farnkopf, PE
Laith B. Ezzet, CMC
Richard J. Simonson, CMC
Marva M. Sheehan, CPA
Rob C. Hilton, CMC

December 2017

Mr. Tom Padia
Deputy Executive Director
StopWaste
1537 Webster Street
Oakland, CA 94612

Transmitted via email

Subject: 5-Year Program Review for the Alameda County Source Reduction and Recycling Board

Dear Mr. Padia:

It is with pleasure that we transmit the Program Review to the Alameda Source Reduction and Recycling Board. We hope the Review will be helpful to the member agencies and to StopWaste in measuring and assessing progress towards reducing "Good Stuff in the Garbage" (GSIG) and in developing the Agency's next strategic plan.

The Review is a collaborative effort and we wish to thank everyone involved in its development. In particular, we thank member agency staff that provided information, data, and review, and the wide range of Agency staff that assisted with various aspects of the Review. Finally, many thanks to our team members: Kelly Runyon, Independent Consultant, and Delyn Kies of Kies Strategies.

We appreciate the opportunity to work on this project and look forward to discussing its findings and recommendations with the Recycling Board, the Authority Board, and StopWaste staff.

* * * *

If you have any questions regarding this report, please contact Peter Deibler at (925) 977-6968 or pdeibler@hfh-consultants.com, or Rob Hilton at (925) 977-6959 or rchilton@hfh-consultants.com.

Very truly yours,
HF&H CONSULTANTS, LLC

Rob Hilton, CMC
President

Peter M. Deibler
Senior Project Manager

cc: Kim Erwin, HF&H
Kelly Runyon, Independent Consultant
Delyn Kies, Kies Strategies
HF&H Client Files

This page intentionally left blank

TABLE OF CONTENTS

TABLE OF FIGURES

APPENDICES

This page intentionally left blank

EXECUTIVE SUMMARY

Overview

This Five Year Review (Review) has a "forward-looking" and topical focus. The Review seeks to provide information and analysis to support StopWaste's current and future strategic planning efforts, including to measure progress towards StopWaste's "Good Stuff in Garbage" (GSIG) goal and to support strategic planning past 2020. This summary is organized as follows:

- Where are Recycling Markets Headed?
- Pending Organics Management Issues
- The Value of Third-Party Certification
- Developing Metrics for Better Measurement
- "Ultimate Disposition" of Discards: from Collection to New Products

Where are Recycling Markets Headed?

The National Sword

In late July 2017, the Chinese national government announced its "National Sword" policy, introducing a great deal of uncertainty into the recyclables export markets. In general terms, the policy seeks to ban the import of fiber (paper and paper-related materials) and plastics with more than 0.3 percent contamination. The National Sword should not come as a surprise. The policy is a logical extension of the earlier "Green Fence" policy to reduce contamination of incoming materials, coupled with the interests of a rapidly developing economy in encouraging use of its own feedstock materials. There is ongoing speculation about the possible impacts of the National Sword.

In general, note that when there are market restrictions relatively cleaner material will be accepted while more contaminated material will not, and cleaner material will receive more favorable pricing.

Our first suggestion is "don't panic." The details of how the National Sword will be implemented, and its impacts on commodity pricing are not yet known. Our second, related suggestion is to avoid modifying recycling collection programs by dropping collected materials, or by allowing disposal. Fortunately, the Bay Area has close proximity to markets, and in the short-term there is likely to be an available market for nearly any material.

The "Evolving Ton"

The "evolving ton" is a related complication for collectors and processors.

> "The Evolving Ton"
> The composition of recyclables is shifting rapidly and becoming lighter with societal and commodity changes such as the "Amazon effect" (cardboard!), less newsprint, thinner plastic bottles, and use of new plastic resins.

Managing Risk

Many franchise agreements from the 1990s and early 2000s included revenue-sharing mechanisms. These provisions provided for member agencies and franchisees to share the risks and benefits of uncertain market revenues. It is now common for franchisees to enjoy the benefits as well as absorb the risks, but there may be value in returning to arrangements with shared risk. Key objectives for structuring these types of provisions should include simplicity and use of published indices and other objective measures to reduce disputes. There are many approaches for structuring these provisions, consideration of which is beyond the scope of the Review.

Pending Organics Management Issues

CalRecycle is developing regulations for SB 1383, the Short-Lived Climate Pollutants Reduction Act. In many ways, the Mandatory Recycling Ordinance (MRO) anticipates the requirements of SB 1383, including required material separation, outreach, and enforcement. Two provisions of SB 1383 are among those that will directly affect member agencies. First, SB 1383 requires landfill diversion of a broad range of organics by 2022, most of which member agencies are now collecting. Among the added materials are textiles. The Review covers approaches other jurisdictions are taking to textile recovery. Second, SB 1383 will increase demand for organics processing capacity, while more stringent facility siting and operating requirements from the State Water Resources Control Board (Water Board) will make facility siting more difficult. Together, the requirements will increase the cost of processing and possibly make it higher relative to the cost of landfilling.

Urban wood is another organic material for which demand for collection and recovery will increase.

Wood waste recovered from C&D has historically been used as a fuel for biomass plants. However, at the same time as demand for collection and recovery has increased through State action, there are significant growing market barriers for management of discarded urban wood.

The Value of Third Party Certification

Third party certification is a unifying theme of the Review. Perhaps most visibly, StopWaste's promotion of third party certification for mixed C&D facilities currently provides a cost-effective means of ensuring that C&D recovery efforts meet expectations without each member agency needing to conduct its own review of facility performance. The C&D certification process has the added value of addressing change over time, as discarded materials, processing technology and markets all evolve. Among other StopWaste programs, third party certification is an important element of materials optimization and green building (LEED certification). Among areas of interest to the Agency and member agencies for which third party certification could be of value:

- Assessment of recyclables and organics processing facility performance parallel to that for C&D, including verification of facility residue rates.

- Documenting residue levels during intermediate processing, as discussed in regard to ultimate disposition of materials.
- Ensuring responsible handling of e-scrap in regard to data security and environmental and labor impacts of e-scrap recycling practices, especially overseas.

Developing Metrics for Better Measurement

Overview

StopWaste's Strategic Plan contains two goals for 2020. One goal, based upon the questionable State methodology of calculating total waste generation, is to achieve diversion of discards from landfill of "75% and Beyond." The Agency and the member agencies use CalRecycle's per-capita disposal method to track progress towards this goal. The second aspirational goal is to reduce GSIG to no more than ten percent by weight. The Agency's FY 2017-18 budget includes "interim goals" for assessing progress towards meeting the ten percent GSIG goal.

Figure ES-1: Interim Goals for Materials Management

		Organics	Packaging	Built Environment
Upstream ↕ Downstream	**Increase in materials optimization**	Additional upstream goals in development during 2017/18		
	Increase in awareness	10% increase by 2018 of families likely to prevent food waste at home	N/A	N/A
	Reduction in waste generation	10% food recovery by restaurants and groceries by 2018	50% reduction in all single-use bags distributed by newly affected stores	<45% construction and demolition waste in landfill by 2018
	Increase in proper sorting	<20% organics in landfill by 2018	<5% recyclables in landfill by 2018	

The Review analyzes the use of metrics, primarily as a means of measuring progress towards "downstream" interim goals of improving sorting. The Review also provides analysis of issues related to more "upstream" issues, and especially the interim goal for food recovery.

Metrics may provide "direct" measurement when based on data collected through waste sorts or other direct observation of GSIG or related behavior, such as through surveying. "Indirect" measurement involves use of surrogate "indicators" that provide for more simple and less costly assessment of progress using readily-available data to measure factors such as changes in program participation, the volume of subscribed service, the per-capita weight of specific discards, or the weight of material collected in

relation to the available volume. The Agency's current Characterization Study will provide crucial data for creating a new GSIG baseline.[1]

Data Sources

Figure ES-2 and the following text summarize the data sources analyzed for the Review.

Figure ES-2: Sources of Data for Downstream Metrics

Data Category	Data Sub-category	Source	Materials				Indirect	Direct
			Recyclables	Organics	Disposal	Other*		
Disposal Reporting		California State			✔		✔	
Discard Stream Reporting		California State	✔	✔		✔	✔	
Member Agencies	Measure D Forms	Member Agencies	✔	✔	✔		✔	
	Hauler Reporting	Member Agencies	✔	✔	✔		✔	
	Other Data	Member Agencies					✔	
Benchmark Service Audits		StopWaste			✔			✔
Waste Characterizations	Disposal Stream (GSIG)	StopWaste, Various Jurisdictions			✔			✔
	Diverted Streams	Jurisdictions, Facility Operators	✔	✔				✔

* "Other" refers to C&D, food transported for recovery, and other materials.

1. Disposal Reporting Data. CalRecycle uses jurisdiction-specific disposal data to calculate an actual annual per-capita disposal rate for comparison to a CalRecycle target rate.
2. State Discard Stream Reporting Data. Draft regulations for recent state legislation (AB 901) expands the disposal reporting system to create the "Recycling and Disposal Reporting System." Reliable data will likely not be available until later in 2018 or early in 2019, and may prove to be more useful at the state or regional level, than at a more local level.

[1] Given the wide variation of factors affecting the materials discard "system" in multiple ways, equating cause and effect is generally difficult if not impossible. Statisticians refer to the difficulty of separating "signal from noise," which requires having an adequate amount of data and applying statistical analysis to isolate the cause(s) of a given outcome. For example, to what degree was increased organics participation for September for a given member agency a function of recent outreach efforts, the end of the summer vacation season, greater organics participation rates due to higher seasonal volumes of yard trimmings and/or other factors?

3. Member Agency Collection Data. StopWaste staff have used a "Measure D Form" since 2013 to collect annual data from each member agency, with a focus on franchise collection of recyclables, organics, and garbage from residences and businesses.[2]
4. Benchmark Service Audit Data. From 2013 through mid-2017, StopWaste funded "waste sorts" (characterization of the types of material contained primarily in material collected for disposal) to collect and directly analyze GSIG.
5. Waste Characterization Data. The Review focuses on the use of applicable waste characterization data from other jurisdictions to measure GSIG, with the addition of data from the current Characterization Study, once completed.

Progress Towards the "75% and Beyond" Goal

As shown in Figure ES-3, based on a calculated Agency-wide diversion rate for 2015 of 73 percent, the "75% and Beyond" goal is within reach.

Figure ES-3: Member Agency Disposal Tonnages and Diversion Rates, 2012 through 2015

	2012		2013		2014		2015	
Member Agency	Disposal Tonnages	Diversion Rate	Disposal Tonnages	Diversion Rate	Disposal Tonnages	Diversion Rate	Disposal Tonnages	Diversion Rate
Alameda	36,625	76%	35,121	77%	35,880	76%	32,036	79%
Albany	5,428	84%	6,427	81%	5,989	82%	6,096	82%
Berkeley	73,917	73%	60,659	78%	68,874	75%	67,246	76%
Dublin	24,478	76%	27,919	74%	34,787	70%	34,731	71%
Emeryville	18,052	70%	17,973	70%	10,811	83%	8,419	87%
Fremont	144,771	72%	138,179	74%	158,694	71%	160,861	71%
Hayward	106,953	72%	101,757	74%	93,153	76%	106,975	73%
Livermore	57,720	77%	57,317	77%	60,456	76%	64,811	75%
Newark	31,370	73%	35,891	69%	33,081	72%	36,190	69%
Oakland	284,151	66%	281,139	67%	269,850	68%	254,262	71%
Piedmont	4,731	71%	3,304	80%	3,026	82%	3,156	81%
Pleasanton	77,170	70%	80,682	69%	74,666	72%	91,292	67%
San Leandro	103,238	62%	115,220	58%	73,145	74%	76,743	73%
Union City	36,778	77%	36,959	77%	37,208	78%	36,223	78%
Unincorporated County	71,243	72%	71,235	72%	76,340	71%	70,996	73%
Total Tons/Avg Rate (Weighted)	1,076,625	71%	1,069,782	71%	1,035,960	73%	1,050,037	73%

Significant amounts of material collection, processing, and disposal activity occur outside of the franchise agreement, and are thus not "municipally-controlled." This is especially true for C&D and commercial recyclables. Figures ES-4 and ES-5 illustrate the value of the "municipally-controlled" concept in highlighting both the importance of monitoring material collected through the franchise to ensure increased diversion over time, as well as the crucial role that material collected outside of each member

[2] Private sector companies provide collection of dry commercial materials in Berkeley; all other residential and commercial services are municipally-provided.

agency's franchise plays in contributing to overall diversion of discards and to achieving "75% and Beyond."

Figure ES-4: Municipally-Controlled Disposal Tonnages, 2015

Member Agency	Total Disposal Tonnages	Municipally-Controlled Disposal Tonnages	Municipally-Controlled Disposal (Percentage)
Alameda	32,036	26,341	82%
Albany	6,096	4,315	71%
Berkeley	68,221	40,136	59%
Dublin	34,731	28,435	82%
Emeryville	8,419	7,840	93%
Fremont	174,899	121,839	70%
Hayward	108,106	84,555	78%
Livermore	65,094	41,654	64%
Newark	36,190	26,253	73%
Oakland	254,262	156,410	62%
Piedmont	3,521	2,320	66%
Pleasanton	91,292	52,201	57%
San Leandro	82,466	36,402	44%
Union City	38,420	30,513	79%
Unincorporated County *	70,996	n/a	
Castro Valley Sanitary District	n/a	14,213	92%
Oro Loma Sanitrary District	n/a	50,803	
Total	**1,074,746**	**724,230**	**67%**

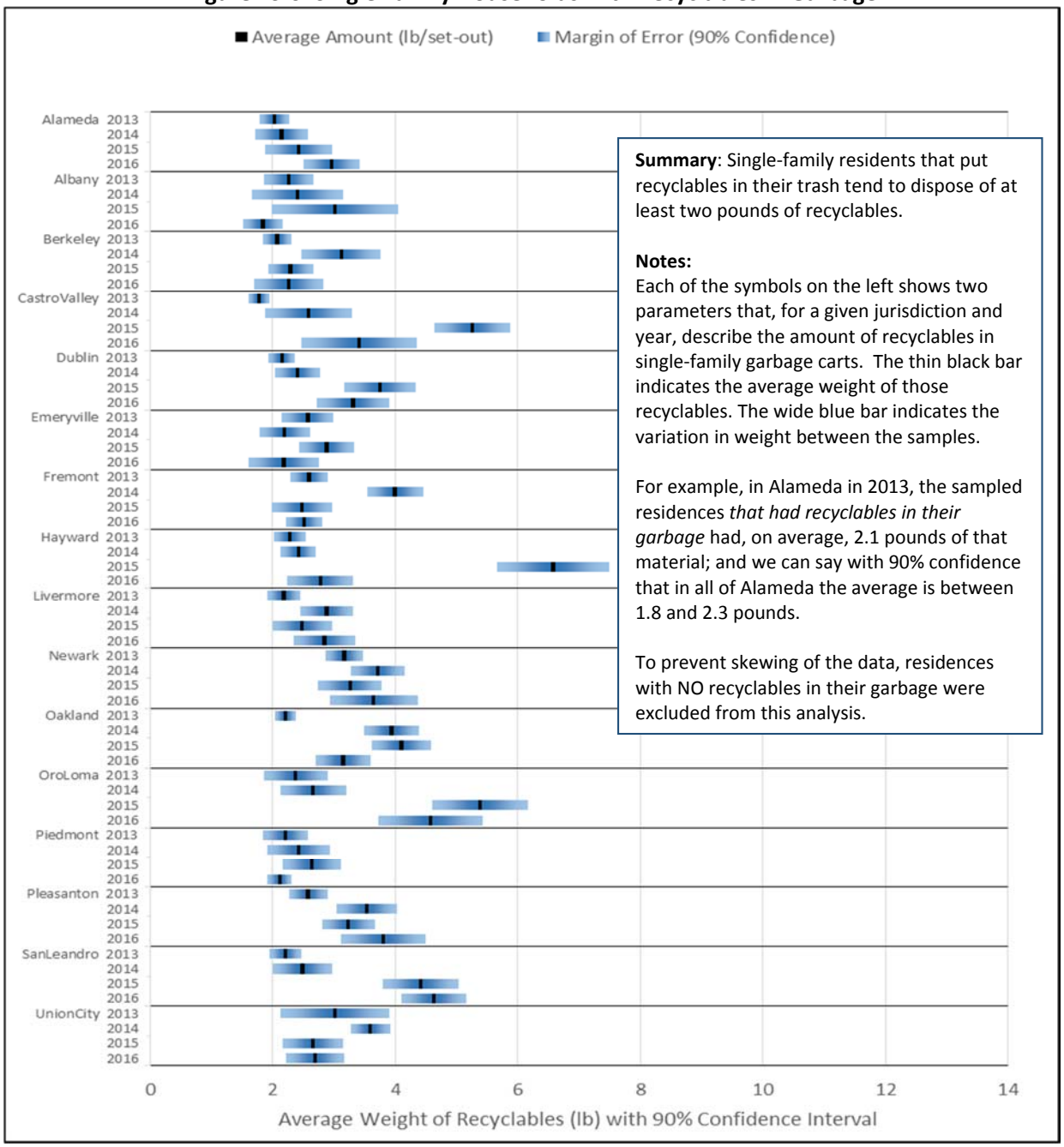
Figure ES-5: Municipally-Controlled Material Tonnages, 2015

Member Agency	Total Recyclables	Total Organics	Total Disposal	Total Generated	Diversion Rate
Alameda	11,458	11,835	26,341	49,634	47%
Albany	2,411	2,669	4,315	9,396	54%
Berkeley	15,877	22,601	40,136	78,614	49%
Dublin	19,185	9,980	28,435	57,600	51%
Emeryville	7,009	2,766	7,840	17,616	55%
Fremont	28,112	32,829	121,839	182,780	33%
Hayward	23,703	22,772	84,555	131,030	35%
Livermore	18,657	20,642	41,654	80,952	49%
Newark	5,398	5,296	26,253	36,947	29%
Oakland	38,500	53,601	156,410	248,511	37%
Piedmont	2,196	2,581	2,320	7,096	67%
Pleasanton	8,440	11,878	52,201	72,519	28%
San Leandro	8,097	9,788	36,402	54,286	33%
Union City	9,724	9,619	30,513	49,857	39%
Castro Valley Sanitary District	9,063	9,850	14,213	33,126	57%
Oro Loma Sanitrary District	15,559	18,805	50,803	85,167	40%
Total	**223,388**	**247,513**	**724,230**	**1,195,131**	**39%**

Benchmark Service GSIG Data

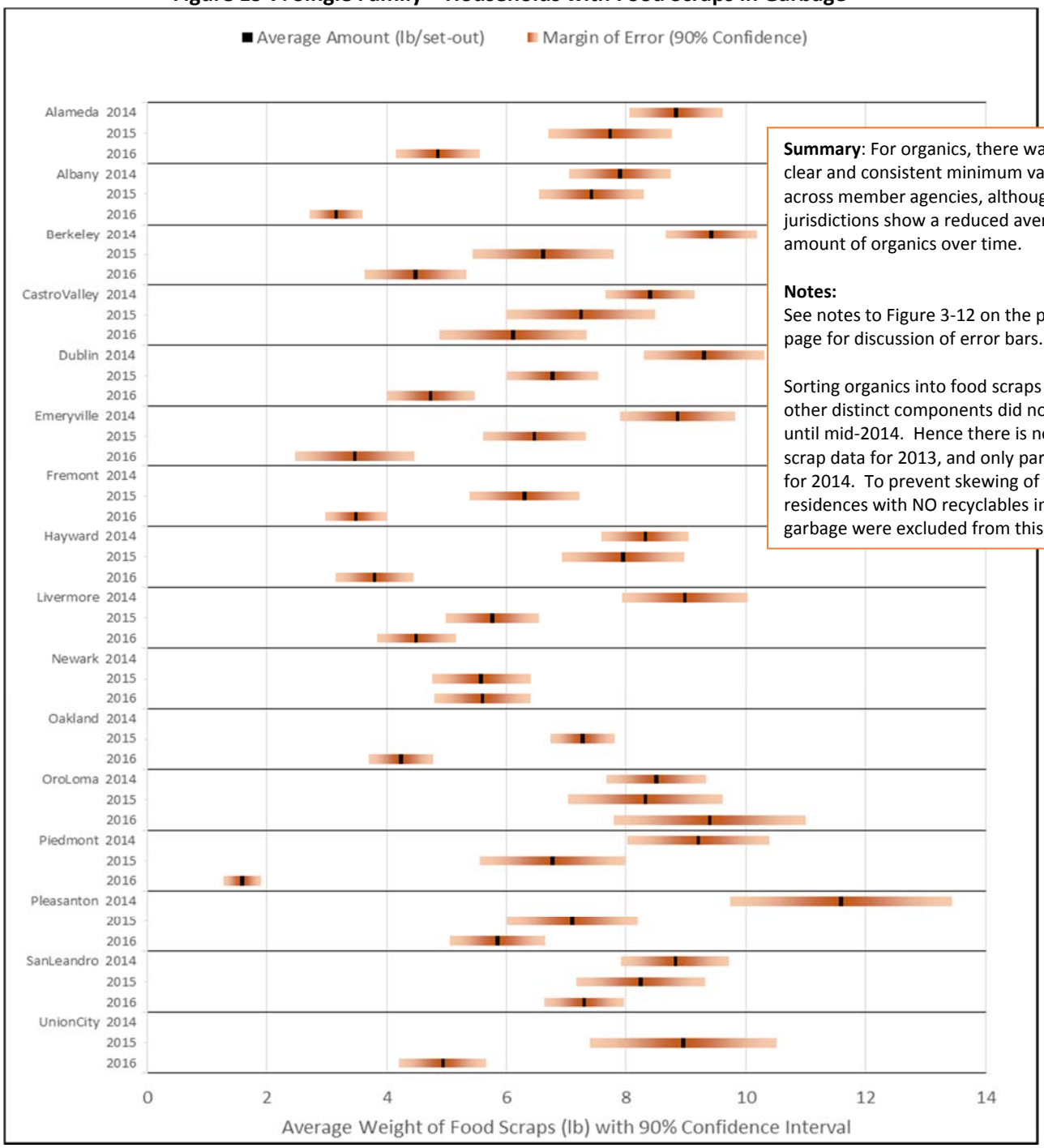
The Review Team computed the average weights, in pounds, of recyclables and food scraps (excluding food-soiled paper) found in garbage set-outs for each member agency. For recyclables, as shown in Figure ES-6, for households with GSIG, a year-by-year trend analysis did not identify distinct trends but did find a clear and consistent lower bound across the member agencies. Single-family residents that put recyclables in their trash tend to dispose of at least two pounds of recyclables. StopWaste might consider setting a goal of, for example, "one pound or less."

Figure ES-6: Single Family Households with Recyclables in Garbage



For food scraps, Figure ES-7 indicates a very clear declining trend from 2014 through 2016 in the weight of food scraps in the garbage for nearly all jurisdictions. However, unlike for recyclables, there was no clear and consistent minimum value across member agencies, which suggests that there is significant opportunity for continued improvement. The Review Team recommends setting a weight-based goal of (for example) two pounds or less, that would allow for a more concrete measurement of progress towards the interim goals of less than 20 percent food in the GSIG, and less than 10 percent GSIG overall.

Figure ES-7: Single Family – Households with Food Scraps in Garbage



Summary: For organics, there was no clear and consistent minimum value across member agencies, although most jurisdictions show a reduced average amount of organics over time.

Notes:
See notes to Figure 3-12 on the previous page for discussion of error bars.

Sorting organics into food scraps and other distinct components did not begin until mid-2014. Hence there is no food scrap data for 2013, and only partial data for 2014. To prevent skewing of the data, residences with NO recyclables in their garbage were excluded from this analysis.

General Recommendations for Downstream Metrics

Two Types of Metrics

The Review Team recommends use of two broad types of metrics:

1. Weight per-capita measures such as pounds per-resident or per-household.
2. Volume measures such as changes in subscribed service, and related density measures such as pounds per-volume of subscribed service.

Weight per-capita and volume-based metrics utilize data from the annual Measure D Forms and overall best meet the criteria for useful metrics in that they are relatively simple, necessary data is available, they require minimal calculation, and are replicable. The Review outlines logical steps for developing member agency and countywide metrics using the two approaches described above, progressing from the general to the specific. Use of multiple metrics provides different information that can lead to more nuanced understanding. Use of multiple metrics can also provide a useful cross-check, helping to identify inconsistencies in the underlying data.

Use of Weight in Measuring Progress towards Reduced GSIG

There is benefit to using weight in addition to, or rather than, percentages to set goals for reducing GSIG. As further discussed in the Review, weight is an absolute measure that does not mask changes in the composition of each of the streams, and in particular due to the "Evolving Ton." This is especially true for recyclables, for which a reduced percentage of GSIG by weight may be the result of changes in recyclables composition that reduce density, rather than reflecting changes in behavior.

Estimates of Edible Food

Based on review of data from a variety of sources, the Review Team concludes that:

1. "Edible food" is probably a little less than half of all food wastes in the single-family, multi-family or commercial streams.

2. As a first approximation, "edible food" in the Alameda County residential disposal stream (single-family and multi-family combined) is likely in the range of 8 to 12 percent of the total disposal stream.

Review of Waste Characterization Data from Other Jurisdictions

The waste characterization analysis is intended to provide a means of comparing the new GSIG data from the Characterization Study, once available, to data from previous StopWaste waste characterizations, from the Benchmark Service audits, and from other jurisdictions in the U.S and Canada with high-performing programs and comparable levels of success in achieving relatively high diversion goals. The Review Team:

- Developed summary profiles identifying key policies, programs and characteristics for six selected jurisdictions, with a focus on the factors that are most likely key to driving diversion and discard practices within each jurisdiction.
- Constructed a "Tool" in Microsoft Excel for StopWaste use containing thousands of data points from 11 studies for the six selected jurisdictions, as well as StopWaste data from the 2013-2017 Benchmark Service audits and waste characterization data from StopWaste studies from 2000 and 2008.
- Prepared a sampling of graphic comparisons, using the data contained in the Tool, to illustrate how the Tool can be used to assess possible associations between waste characterization data and key program features for specific jurisdictions, as well as identify possible larger patterns across data from multiple jurisdictions.

Figure ES-8 summarizes key policy and program features for the six jurisdictions, providing a high-level snapshot of key factors that can play the largest role, all else being equal, in driving discard behavior.[3]

Figure ES-8: Summary Policies and Programs for Selected Jurisdictions

Location	EPR	Diversion Goal	Mandatory Separation	Disposal Ban(s)	"Bottle Bill"	Low Volume Garbage Option(s)
California State	✔	✔		✔	✔	
King County, Washington		✔	✔	✔		✔
Lane County, Oregon	✔	✔		✔	✔	✔
San Francisco, California	✔	✔	✔		✔	✔
Vancouver, British Columbia	✔	✔			✔	
Washington State		✔		✔		

Figures ES-9 and ES-10 illustrate use of the Tool. Figure ES-9 shows the percentage of GSIG in single-family garbage, for waste characterization data from Alameda County, as well as from San Francisco, California state, King County (Seattle), Washington, and Vancouver, British Columbia.

[3] Of course, many other factors also influence discard behavior, such as reduced collection rates for commercial recycling and organics relative to those for garbage. Note that the availability of low generator garbage options can result in added contamination of the recycling or organics streams. Such shifts in material can be detected only if data is simultaneously collected for all three streams.

Figure ES-9: Percent of GSIG for Single-Family

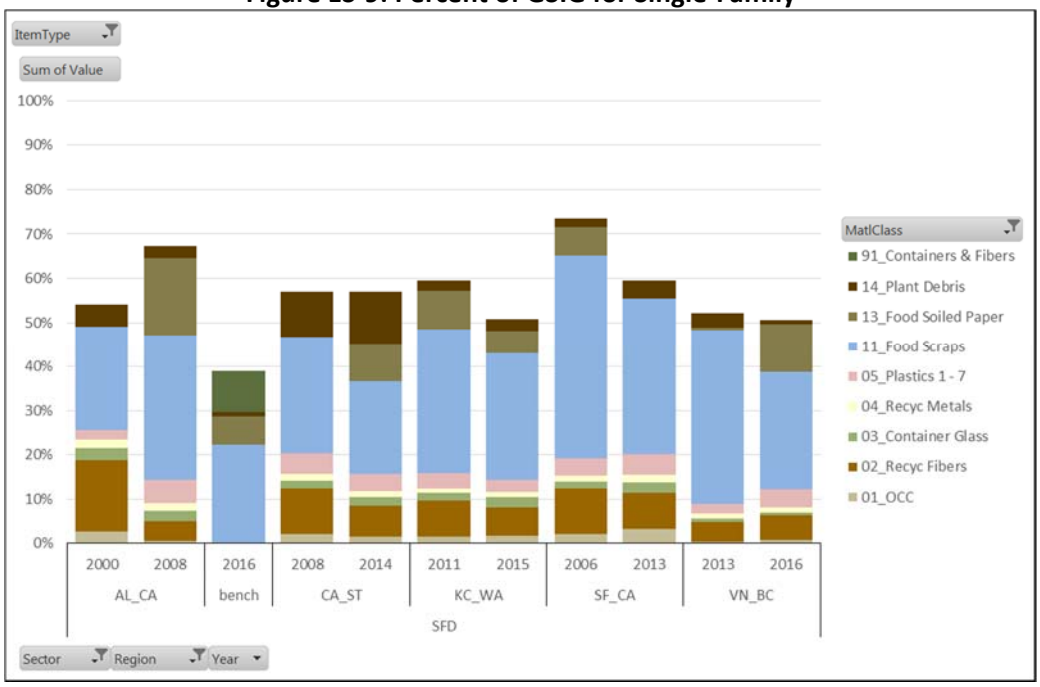
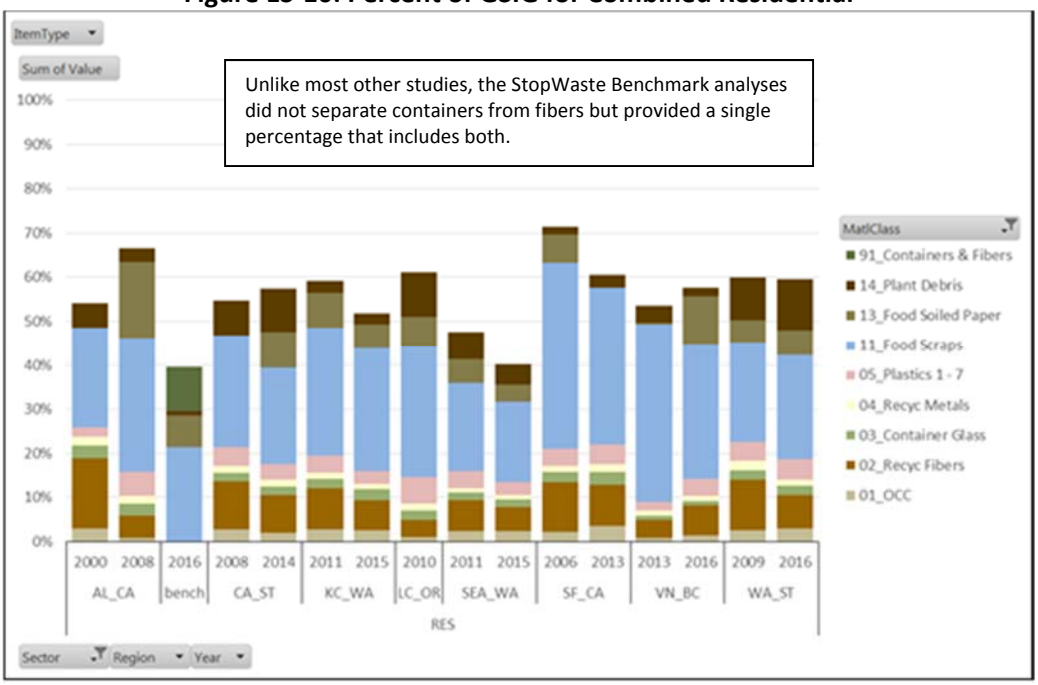


Figure ES-10 shows information for all of the studies, combining single-family and multi-family as a single residential sector, total GSIG is generally in the 40% to 60% range.

With regard to residential GSIG, Alameda County is as successful as other jurisdictions in reducing GSIG. Note also that none of the jurisdictions are close to reaching a goal such as 10 percent for residential GSIG.

Figure ES-10: Percent of GSIG for Combined Residential



"Ultimate Disposition" of Discards: from Collection to New Products

Ultimate disposition can be thought of as: "What happens to collected discards (recyclables, organics or C&D) once they are delivered for initial processing?" The key related question is, "Do diversion rates reported by processors tell the full story, or is there additional unreported residue associated with additional stages of processing?" Discarded recyclables and organics are generally processed in multiple steps, often at different facilities operated by different entities. Agency and member agency value in understanding "secondary" processing is heightened by the recent issues related to the Chinese recyclables markets.

The Review discusses use of franchise agreements to require processing and marketing planning, jurisdiction-specific residue rates that reflect additional steps in processing, and certifications of end-use. The Review Team concludes that franchise agreements are not adequate tools for monitoring, reporting, and providing a useful understanding of the ultimate disposition of most materials. The Review's primary recommendation is to encourage third party certification and market self-policing for both organics and recyclables and, ideally, facility-wide residue reporting. In addition, submittal of annual processing and marketing plans should be required; member agency staff should discuss market issues with haulers on a regular basis.

SECTION 1: INTRODUCTION

Overview

In the late 1990's, StopWaste conducted the first "Five Year Program Review"; this is the fifth such review. Previous reviews have focused primarily on assessing diversion program progress since the previous review, and have involved collection and compilation of detailed information for previous years from member agencies. A portion of each of the previous reviews has described programs from other "diversion high performance" jurisdictions that may be of interest to StopWaste or individual member agencies.

This Five Year Review (Review) has many of the same elements as in past reviews, but with a more "forward-looking" and topical focus. The Review seeks to provide information and analysis to support StopWaste's current and future strategic planning efforts, including to measure progress towards StopWaste's GSIG goal and to support strategic planning past 2020. In addition, the Review is more analytical than previous reviews. To reflect this, the report sections contain more summary discussion, with detail regarding process and analysis in appendices.

Organization of the Review

Section 2 "Context for the Review," identifies key challenges facing StopWaste and the member agencies over the next few years, with potential strategies for addressing them. Foremost among these are the recycling program issues related to possible diminishment or loss of export markets for recovered materials and organics program challenges related to compliance with SB 1383, "The Short-Lived Climate Pollutants Act."

Section 3 "Metrics for Measuring Progress," analyzes data from the member agencies and the Benchmark Service audits to identify options for metrics to measure progress towards GSIG goals.

Section 4 "Understanding the Remaining Disposal Stream" discusses the use of comparative data from waste characterizations from across North America to identify GSIG, provides a "Comparative Program Tool" (Tool) developed for StopWaste use in analyzing GSIG data on a comparative basis (including that from StopWaste's current waste characterization), and provides various examples of how the Tool can be used.

Section 5 "Ultimate Disposition – Where Do Recovered Materials Go?" discusses what happens further "downstream" once collected recyclables have been delivered to a processing facility, addressing the questions: "Is all residue being accounted for?" and "What is the real diversion rate?"

Acknowledgments

The Review Team included HF&H Consultants, LLC, Kelly Runyon, and Kies Strategies.

We wish to thank the staff of the member agencies that assisted us with our review of the "Measure D Form" data and the various Agency staff that managed the Review, provided input, and reviewed drafts. HF&H's project manager wishes to thank our team members for their significant contributions, and HF&H staff that assisted with the Review.

SECTION 2: CHALLENGES AND OPPORTUNITIES

Overview

Section 2 discusses several key challenges for StopWaste and for the member agencies related to recycling and organics collection, processing and recovered material marketing; discusses the value of expanding the role of third party certification; and, provides brief highlights for a set of emerging issues.

Where is Recycling Headed?

China's "National Sword" Policy

In late July 2017, the Chinese national government announced its "National Sword" policy, introducing a great deal of uncertainty into the recyclables export markets. In general terms, the policy seeks to ban the import of fiber (paper and paper-related materials) and plastics with more than 0.3 percent contamination.[4] The ban appears to have been prompted by a longstanding belief that garbage is, in effect being sent to China disguised in bales of recyclables. "National Sword" is an environmental initiative much broader than just recycling, and the recycling aspects are broader than just the paper and plastics applications that are of primary interest here.

China's initial announcement and its follow-up announcements in response to widely expressed concerns, have been vague in many regards. The result is significant, ongoing speculation about the possible impacts of the National Sword. While initially announced to become effective at the end of 2017, that date may be extended. The allowable level of contamination was subsequently increased to 0.5 percent. Recycling industry representatives have expressed concern that either standard may not be feasible. Previous standards also allowed for rejection of individual loads of material deemed to be excessively contaminated with garbage.

The National Sword should not come as a surprise. The policy is a logical and more specific extension of the 2013 "Operation Green Fence" policy to reduce contamination of incoming materials, coupled with meeting the needs of a rapidly developing economy by encouraging use of feedstock material generated within China. The details of which specific materials will be included, the timing of the ban, and allowable contamination levels aside, the key questions for the Review are: What are the potential impacts? How can they be mitigated?

In a broad sense, over the longer-term the National Sword could have a positive overall effect towards maximizing recycling efforts. Export markets, and especially China, have for many years provided US processors an easy way to "move" material, including material with significant amounts of contamination. While this is not to say that poor processing is a common practice, it has certainly occurred. The availability of export markets has reduced pressure to make more difficult changes, such as substantially reducing contamination in collected recyclables. In the long term, raising the bar for acceptable contamination will improve recycling efforts overall, helping to truly "close the loop," and providing other benefits as explored below. However, these benefits may come with higher costs.

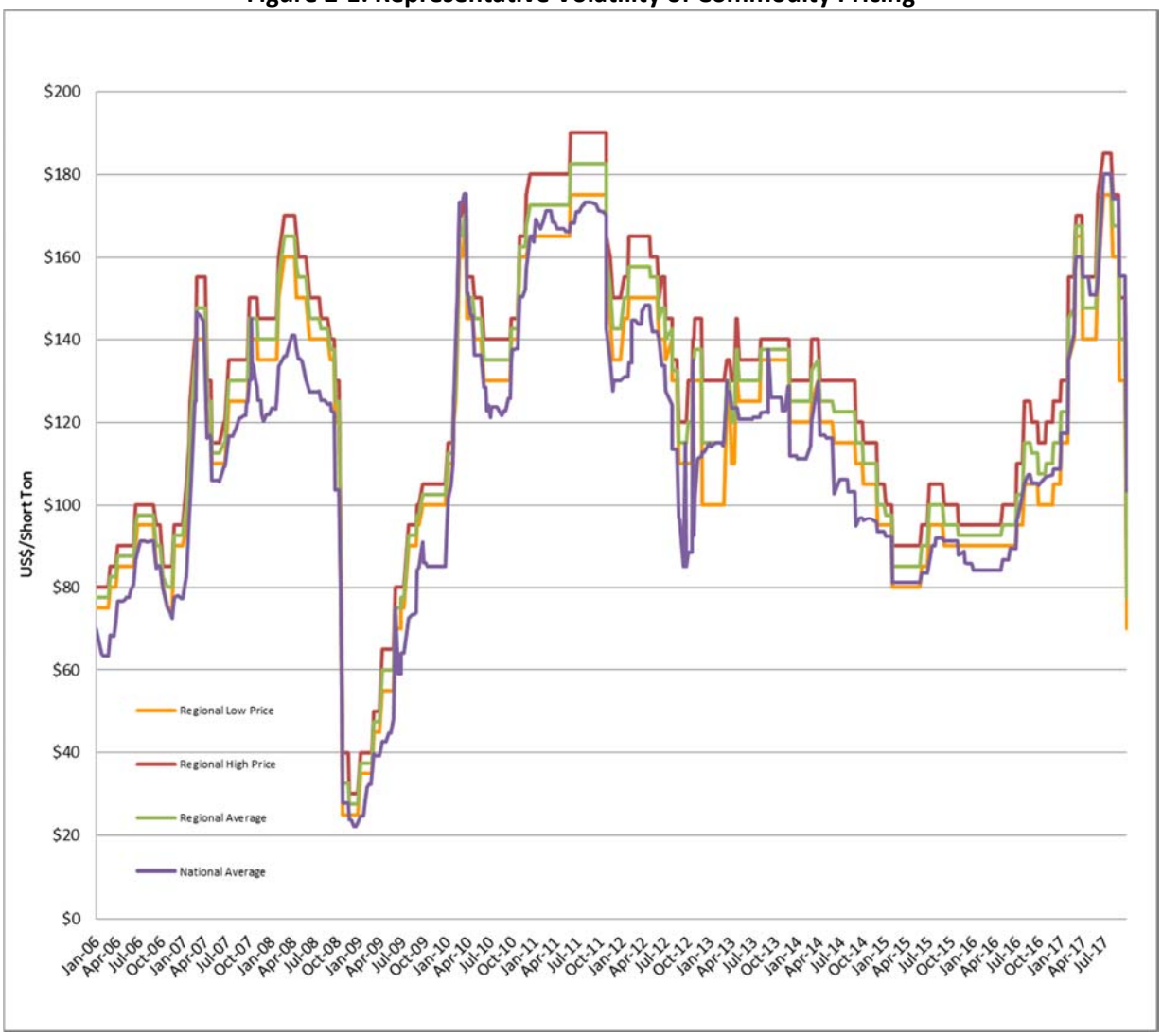
A first suggestion is "don't panic." The details of how the National Sword will be implemented, and its impacts on commodity pricing are not yet known. Figure 2-1 illustrates the historic volatility of commodity

[4] As widely reported in the trade press as well as the mainstream media. See, for instance Resource Recycling (resource-recycling.com) or Waste Dive (www.wastedive.com).

markets, in this case for corrugated containers from 2016 through July of 2017. This type of volatility is characteristic of many materials traditionally recovered from municipal recycling programs. Note from Figure 2-1 that:

- Between January 2006 and July 2017, per-ton prices ranged from about $20 to about $190.
- Prices as of July 2017 were about 3.5 times greater than those of January 2009.

Figure 2-1: Representative Volatility of Commodity Pricing



Since the widespread introduction of curbside recycling in the early 1990s, franchise collectors and processors have become very familiar with commodity market risks and how to effectively price that risk into the services they provide.

A second, and related, suggestion is to avoid modifying recycling collection programs by dropping collected materials, or by allowing disposal. Changing the list of materials collected through a member agency's recycling program creates public perceptions that are very challenging to address effectively. Any such action should be carefully considered prior to implementation and made as part of a well-

communicated and longer-term plan. Knowingly disposing of material collected as recyclables would be far worse, carrying a significant penalty in most franchise agreements. The Oregon Department of Environmental Quality recently indicated that it may provide a short-term exemption from a statewide ban on disposal for recyclables collected in rural locations.[5]

Fortunately, the Bay Area has close proximity to markets, and in the short-term there is likely to be an available market for nearly any material. A processor may be required to pay to have a material marketed, for which it historically received a revenue. Alternatively, depending on the material and availability of space, the processor may choose to stockpile materials while awaiting improved market conditions. Incurring a short-term cost to market a material is preferable to disposal, which of course also carries a cost.

Strategies for Managing Market Uncertainty

Regardless of how the National Sword is implemented, it is useful to look back to two basic lessons from the Green Fence regarding the nature of markets. First, with any form of limits on incoming material, relatively cleaner material will be accepted while more contaminated material will not. Second, cleaner material will receive more favorable pricing. Some material recovery facility operators and processors in the United States are justifiably proud that during the Green Fence, none of their exported material was rejected. This type of success is a function of minimizing contamination in both collection and processing. It is to be hoped that one outcome of the National Sword may be more effective self-policing of material quality within the industry.

Collection

Take steps to “high-grade” materials at the point of collection, such as:

- In the near-term, increase outreach efforts to reduce contamination of recyclables. “Contamination” includes materials that may be placed in recycling carts with the hope that they can be recycled.
- Encouraging use of drop-off locations for glass containers as an alternative to curbside collection, to reduce glass contamination of fibers, and improve the value of the latter material.
- In the longer-term, consider modifications to the collection system. While single-stream collection enhances customer convenience, multi-sort collection has the advantage of keeping glass separate from fibers.
- Agency support for the addition of wine and liquor bottles to the State “bottle bill” program. With a redeemable deposit, fewer of the containers will be placed in recycling carts.

Seek opportunities to offset higher costs and/or improve customer convenience, such as:

- Consider every-other-week collection of garbage.

[5] See www.oregon.gov/deq/mm/Pages/Recycling-Markets.aspx.

- Consider offering less-than-weekly or on-call garbage collection options.

Processing and Marketing

Processors are taking steps to cope with changes in markets such as adding equipment for more precise automated separation and slowing processing lines for improved manual recovery.

Support development of domestic infrastructure for intermediate processing and manufacturing. Re-development of lost domestic capacity may be a long-term "plus" resulting from restricted access to export markets. Examples include:

- Pelletizing plastics to create feedstock for manufacture of new materials domestically or abroad.
- Paper pulping and manufacture.

The "Evolving Ton"

In addition to the discussion of markets above, the "evolving ton" is an additional challenge for collectors and processors. The evolving ton points to the value of using absolute weight rather than percentages to measure changes in GSIG.[6] Changes in relative percentages can mask the actual changes in GSIG. The impacts of the "evolving ton" are seen both in recycling data as well as garbage data, as new light-weighted packaging and materials substitution appear in both streams.

> "The Evolving Ton"
> The composition of recyclables is shifting rapidly and becoming lighter with societal and commodity changes such as the "Amazon effect" (cardboard!), less newsprint, thinner plastic bottles, and use of new plastic resins.

Managing Risk

Many franchise agreements from the 1990s and early 2000s included revenue-sharing mechanisms.[7] These provisions provided for member agencies and franchisees to share the risks and benefits of uncertain market revenues. It is now common for franchisees to enjoy the benefits as well as absorb the risks, but there may be value in returning to arrangements with shared risk. Key objectives for structuring these types of provisions should include simplicity and use of published indices and other objective measures to reduce disputes. There are many approaches for structuring these provisions, consideration of which is beyond the scope of the Review.

Section 5 includes related suggestions regarding ultimate disposition of materials, including member agency use of annual processing and marketing plans.

The Future of Organics

The Agency has many initiatives related to organics and food-related issues. Food waste prevention and food recovery efforts are at the fore-front, with the Agency's commitment to "highest and best use" and

[6] See further discussion in Section 3, page 34.
[7] See further discussion in Section 5, page 66.

application of the EPA Food Recovery Hierarchy, with emphasis on prevention, recovery and finally composting.[8] Efforts to-date include the ongoing success of the Smart Kitchen and Smart Cafeteria initiatives, and current efforts to begin measuring food recovery at restaurants and groceries. "Downstream," the Agency has an interim goal of less than 20 percent organics in the disposal stream. Sections 3 and 4 of the Review include discussion of food-related issues, both with regard to recovery and proper sorting. Food recovery is an emerging component of franchise agreements, expanding the traditional "downstream" focus of collection, processing, and disposal agreements.

CalRecycle is developing regulations for SB 1383, the Short-Lived Climate Pollutants Reduction Act.[9] In many ways, the Mandatory Recycling Ordinance (MRO) anticipates the requirements of SB 1383, including required material separation, outreach, and enforcement. SB 1383 also requires recovery of 20 percent of food. The following discussion highlights several aspects of SB 1383 that will directly affect member agencies. One provision relates to the broadened range of materials requiring collection as "organics." The second provision relates to the availability and pricing of processing for compostable organics such as yard trimmings and food scraps, with new demand driven by SB 1383 as well as other regulatory factors.[10]

Expanded Collection of Organics

SB 1383 requires landfill diversion of a broad range of organics by 2022, many of which member agencies are now collecting through curbside organics and recycling programs or by other means. SB 1383 defines organics from the perspective of materials that emit gasses that affect climate when decaying in a landfill environment. The materials fall in three board categories, with examples as follows:

1. "Paper": Cardboard, paper bags, white paper, newspaper, magazines, and a number of other paper materials commonly collected in the recycling cart.

2. "Other Organics": Food, leaves and grass, prunings and trimmings, branches and stumps, manures, textiles and carpet.

3. "Inerts and Other": Clean lumber, clean engineered wood, clean pallets and crates, and other wood waste. "Clean" materials are unpainted and not chemically treated.

The following discussion focuses on two of the organic materials noted above, textiles and wood waste.

[8] See www.epa.gov/sustainable-management-food/food-recovery-hierarchy.
[9] SB 1383, Lara (Chapter 395, Statutes of 2016).
[10] Except as otherwise noted, the term "organics processing" is used throughout the Review to refer to processing of the compostable organics commonly collected through member agency residential and business organics programs, such as yard trimmings, food scraps, and food-soiled paper.

Textiles

As noted, one of the added materials is textiles such as clothing and other fabrics. The following is summary information regarding textile collection efforts.[11]

- Palo Alto is considering single-family collection of textiles through several means. One option is including textiles with weekly curbside collection, possibly with use of special colored bags co-collected with recycling. An alternative may be to add the material to the annual on-call bulky collection program, which allows unlimited set out of recoverable materials.
- San Francisco recently added textiles to its single-stream recycling collection. Residents may place textiles in a clear plastic bag and then in the recycling cart. The City also encourages residents to bring textiles that are not overly worn to re-use drop-off locations.
- Austin, Texas began a free curbside collection program in late 2016. The program website promotes re-use as the first option, followed by curbside collection. The program also includes curbside collection of "housewares," defined as stuffed animals, toys, linens, tools, kitchenware and books. The city mails bags to residents for this use and materials may be placed next to the recycling cart. A new bag is left each time one is collected.
- King County, Washington (Seattle) promotes re-use options and provides free drop-off at seven transfer stations.

Wood Waste

Urban wood is another organic material for which demand for collection and recovery will increase. In addition to the requirements of SB 1383, beginning in 2017, the State minimum diversion requirements for C&D material through the CalGreen program increased from 50 to 65 percent.[12] Processed (chipped) wood is used as mulch, composting bulking agent, animal bedding, and fuel. Wood waste recovered from C&D has historically been used as a fuel for biomass plants. However, at the same time as demand for collection and recovery has increased through State action, there are significant growing market barriers for management of discarded urban wood.

Wood is an attractive fuel because of its low moisture content, while the non-uniform nature of wood waste makes it less desirable for other types of processing. Unfortunately, the number of biomass electric generating plants in California that use renewable materials such as wood and other agricultural waste to generate electricity and heat are rapidly dwindling in number and in available capacity. Over half of the biomass facilities operating in California in 2000 have closed or idled due to a combination of plant age, low prices for natural gas as a competing fuel, and loss of State incentives for plant operators to use biomass.[13] This disconnect between added demand for recovery of wood waste, and loss of a primary

[11] See following references for material discussed below: phone call, Paula Borges, Contract Administrator, City of Palo Alto, with Ben Collins, HF&H, September 18, 2017; https://sfenvironment.org/textiles; http://www.austintexas.gov/clothing, and; http://kingcounty.gov/depts/dnrp/solid-waste/facilities/textile-recycling.aspx.

[12] See www.documents.dgs.ca.gov/bsc/CALGreen/CALGreen-Guide-2016-FINAL.pdf for link to "Guide To the 2016 California Green Building Standards Code."

[13] See http://ncrarecycles.org/2016/03/recycling-update-2016-speaker-presentation-videos/ for presentation by Michael Gross, "WoodAGeddon.

means for providing recovery must be addressed in the near-term to ensure the material is not landfilled or is of use only as landfill cover.

Organics Processing Capacity

SB 1383 will increase demand for organics processing capacity, while more stringent facility siting and operating requirements from the State Water Resources Control Board (Water Board), among other factors will make it more difficult to expand current facilities, and to site new ones. These requirements as well as other factors will increase the cost of processing, likely making it more expansive relative to the cost of landfilling. Statewide demand for organics processing capacity will increase over the next few years as existing source-separated food collection programs capture more material, and as jurisdictions that do not currently have food scrap programs add them. The Water Board requirements are anticipated to result in development of fewer new facilities. It may be, that in the future, composting facilities will be viewed as a scarce resource, somewhat akin to how landfills were viewed in the past.

Anecdotally, Bay Area per-ton tip fees for "traditional" processing (composting) of yard trimmings and of co-collected food scraps and yard trimmings have increased significantly. One impact of this change may be to eliminate much of the current cost differential between composting and other organics processing options such as anaerobic digestion. It should be noted that anaerobic digestion still requires further processing of the remaining solids, or digestate, and that this usually involves composting. In addition, non-centralized options can also help meet the demand, such as on-site composting at institutional generators such as food banks, emerging small-scale processing on-site at commercial food generators, community composting, use of organics for animal feed, and a re-emphasis on backyard composting.

Third Party Certification

Third party certification is a unifying theme of the Review, tying together issues discussed in Sections 3, 4 and 5. Third party certification plays a direct or indirect role in metrics (Section 3), waste characterization studies (Section 4) and ultimate disposition of materials (Section 5). Perhaps most visibly, StopWaste's promotion of third party certification for mixed C&D facilities currently provides a cost-effective means of ensuring that C&D recovery efforts meet expectations without each member agency needing to conduct its own review of facility performance. The C&D certification process has the added value of addressing change over time, as discarded materials, processing technology and markets all evolve. Among other StopWaste programs and related efforts, third party certification is an important element of materials optimization (e.g., use of eco labeling, and "CE markings"[14]) and green building (LEED certification).

The Recycling Certification Institute (RCI) provides C&D facility certification. RCI describes the certification process on its website home page as follows, "The RCI uses independent third-party evaluators to verify the accuracy and reliability of the recovery/recycling rates reported. Providing a rigorous set of protocols, guidelines, and tools to professionally review and certify the recovery/recycling reports of participating C&D recyclers, the Institute is intended to increase certainty and build confidence in the C&D recycling marketplace on the part of project owners, architects, the environmental community, municipalities and the public."[15]

[14] See Appendix A, page A-11.
[15] Recycling Certification Institute, website, https://www.recyclingcertification.org/.

E-scrap recycling is another example of an area in which third party certification has played a key role. Several organizations have developed third-party standards for in-house data security and for both environmental and labor minimum standards.[16] [17]

Following are several examples of areas for which third party certification could be of value to the Agency and member agencies:

- Assessment of recyclables and organics processing facility performance parallel to that for C&D, including verification of facility residue rates.
- Documenting residue levels during intermediate processing, as discussed in Section 5 in regard to ultimate disposition of materials[18].
- Ensuring responsible handling of e-scrap in regard to data security and environmental and labor impacts of e-scrap recycling practices, especially overseas.

As for C&D facilities, developing new third party certification processes involves difficult issues related to confidentiality, access to proprietary information and technology, assurance of objectivity, and funding. As with C&D certification by RCI, the Agency is well-placed to broaden the role of third party certification.

The Northeast Resource Recovery Association, working with a steering committee comprised of industry and municipal representatives is in the early stages of developing the Solid Waste Environmental Excellence Protocol (SWEEP).[19] As described on the SWEEP website, the intent is to develop standards "governing the environmental performance of municipal solid waste programs or the companies that perform the services supporting these programs." There will be four program areas for industry and municipal programs: Sustainable Materials Management Policies, Waste Generation and Prevention, Solid Waste Collection, and Post-Collection Processing and Disposal. It seems too early to know whether or how this effort will be of interest to the Agency or member agencies, but it is likely worth tracking its progress.

Various Issues

Following is a sampling of issues of current or emerging interest.

Innovative Communication: As with all areas of public concern, effective and targeted social messaging regarding discards and waste prevention and management requires "getting ahead of the messaging." This phrase refers to the need to present a clear, concise and factual message as early as possible, before rumors elicit a negative message that may not be fact-based. We suggest including expert messaging input during initial planning for all pilot programs and for roll-out of new or modified programs. Municipal use of social media platforms can maximize the opportunity to provide accurate and positive messaging.

Cannabis Cultivation: California counties, and some cities are considering how best to manage discards and waste by-products from cannabis cultivation. which These materials include discarded cannabis as well as materials used and discarded in the course of growing cannabis, such as plastic tubing, glass, and film plastic. One consideration is whether these materials are, or should be included in the scope of

[16] See, for instance www.epa.gov/smm-electronics/certified-electronics-recyclers.
[17] Tree harvesting standards are another environmental area in which third party certification plays a valuable role.
[18] See further discussion in Section 5, page 65.
[19] See http://nrra.net/sweep/.

defined materials collected by exclusive franchise collectors. One Bay Area county is considering establishing a non-exclusive franchise system for collection and disposition of these materials.

Commercial Organics Collection: Portland, Oregon's residential food scraps program includes co-collected food scraps, food soiled paper and yard trimmings. However, the commercial organics program allows food but no food soiled paper. The program received more food-soiled paper than originally anticipated, and it was decided to drop the material. This decision reflects a trade-off between a cleaner discard stream that can be more easily processed and marketed for higher uses and a larger volume of lower quality discards.

Technical Innovation: Ensure that franchise agreements provide adequate flexibility to address the readily changing environmental for technical innovation, including provision of real-time collection and customer service data, access to video feeds from collection vehicles, addition of municipal equipment to trucks, use of fill monitors, conducting pilots, and addressing agency-directed changes in scope.

Small-Scale, Distributed Organics Processing: There are a range of established and emerging small-scale technologies for on-site processing of organics from larger generators, including dehydration to reduce volume prior to transport off-site, bio-digestion and composting.

Broaden Revenue Base: In recent years, jurisdictions such as San Francisco have begun to charge rates for recycling and organics service distinct from garbage rates, as the amount of recoverable discards increases and the landfill stream decreases. In a similar manner, agencies funded by per-ton landfill fees should determine how to diversify revenues across the various streams. By imposing relatively-small fees at various junctures (transfer, processing, etc.), revenue can be collected without encouraging illegal dumping of materials or other circumvention of the requirements. Such research and analysis is beyond the scope of the Review and, while not a topic of immediate concern for StopWaste, should be considered in the future.

SECTION 3: METRICS FOR MEASURING PROGRESS

Overview

Introduction

StopWaste's Strategic Plan contains two goals for 2020. One goal, based upon the questionable State methodology of calculating total waste generation, is to achieve diversion of discards from landfill of "75% and Beyond." The Agency and the member agencies use CalRecycle's per-capita disposal method to track progress towards this goal. The second aspirational goal is to reduce GSIG to no more than ten percent by weight. The Agency's FY 2017-18 budget includes "interim goals" for assessing progress towards meeting the ten percent GSIG goal. The interim goals expand the focus to include "upstream" decisions made by manufacturers and generators that affect discards. This reflects StopWaste's budget priorities, which are increasingly focused on preventing, rather than managing, discards.

The primary goal for the Review Team was to identify "metrics" that individual member agencies and the Agency can use on a countywide basis to measure progress over time in meeting the Strategic Plan goals. The scope of this effort was modified to also address specific 2018 interim goals.

In discussion with StopWaste staff, it was agreed that proposed metrics should be:

1. Relatively simple and easy to explain;
2. Feasible, in that the necessary data is readily available (or relatively easy to develop);
3. Easily applied with minimal calculation; and
4. Replicable, so that results can be compared over time.

Metrics may provide "direct" measurement when based on data collected through waste sorts or other direct observation of GSIG or related behavior, such as through surveying. Such data can be collected to allow for statistically significant results, with a 90 or 95 percent probability that a given result is accurate within a specified margin of error.[20] "Indirect" measurement involves use of surrogate "indicators" that provide for more simple and less costly assessment of progress using readily-available data to measure factors such as changes in program participation, the volume of subscribed service, the per-capita weight of specific discards, or the weight of material collected in relation to the available volume. Unfortunately, there is no accurate way to measure GSIG indirectly. The Agency's current Characterization Study will provide crucial data for creating a new GSIG baseline.[21] Recognizing that direct collection of data will remain important, the FY 2017-18 budget also designates funding for a Measurement and Analysis Project to help support the process of developing metrics for evaluation of progress.

[20] See summary discussion of statistical analysis and techniques in Appendix D.

[21] The Review uses "Characterization Study" to refer to StopWaste's current waste characterization study, and "waste characterization(s)" to refer to earlier StopWaste characterization studies and to characterization studies conducted by the other jurisdictions.

Interim Goals

The interim goals are contained in the Agency's FY 2017-18 budget adopted in June 2017. As shown in Figure 3-1, the interim goals are intended to help measure progress over the next several years towards meeting the ten percent GSIG goal.[22]

Figure 3-1: Interim Goals for Materials Management

		Organics	Packaging	Built Environment
Upstream	**Increase in materials optimization**	Additional upstream goals in development during 2017/18		
	Increase in awareness	10% increase by 2018 of families likely to prevent food waste at home	N/A	N/A
	Reduction in waste generation	10% food recovery by restaurants and groceries by 2018	50% reduction in all single-use bags distributed by newly affected stores	<45% construction and demolition waste in landfill by 2018
Downstream	**Increase in proper sorting**	<20% organics in landfill by 2018	<5% recyclables in landfill by 2018	

The interim goals address the full spectrum of materials management decisions, including:

1. "Upstream" - "Materials optimization" decisions made by product designers and manufacturers;
2. "Midstream" - Consumer and manufacturer decisions affecting waste prevention; and,
3. "Downstream" – Increases in proper sorting to place discards in the correct containers (e.g., minimizing or eliminating GSIG).

The material in Section 3 and Appendix A is intended to assist the Agency in developing the means to measure progress prior to 2020, as well as assist in developing goals as part of strategic planning for beyond 2020. The primary focus of Section 3 and Appendix A is identifying and discussing sources of data, and metrics of potential use as indicators of:

1. Reduced GSIG through increases in proper sorting - the "downstream" goals of less than 20 percent organic GSIG and less than five percent recyclable GSIG – shown in the bottom row of Figure 3-1.

[22] Figure 3-1 is replicated from StopWaste Annual Budget, Fiscal Year 2017-18, Figure 2, page I-2, with shading added as described in the text.

2. Success in achieving the "75% and Beyond" goal.

Section 3 also provides information related to developing metrics for:

1. "Increases in materials optimization" (shown in light blue in Figure 3-1).

2. "Reduction in waste generation" (shown in light green in Figure 3-1).

Metrics for "reduction in waste generation" focuses on the food recovery goal (10 percent food recovery by restaurants and groceries), and the goal of less than 45 percent construction and demolition waste (C&D) sent to landfill. Measuring progress towards the materials optimization and food recovery goals is challenging, and Agency work on related metrics is at a relatively preliminary stage. Section 3 and Appendix A provide targeted information from other agencies engaged with these issues and limited analysis in support of developing metrics for them.

Metrics for Measuring Increases in Proper Sorting

Reducing GSIG is a "downstream activity" with a focus on improving proper sorting of the three material streams (garbage, recyclables and organics) so that the correct material is placed in the correct container. Section 3 discusses the strengths and limitations of each of the sources of data that can be used to develop metrics to measure progress in reducing GSIG, with a primary focus on the "Measure D Forms" and the Benchmark Service audit data. Waste characterizations, another key source of data, are the subject of Section 4.

Summary of Data Sources

Figure 3-2 and the following text summarize the data sources, followed by more detailed discussion of each. As noted in Figure 3-2, data sources apply to varied material types, and are collected on a direct or indirect basis.

Figure 3-2: Sources of Data for Downstream Metrics

Data Category	Data Sub-category	Source	Materials				Indirect	Direct
			Recyclables	Organics	Disposal	Other*		
Disposal Reporting		California State			✔		✔	
Discard Stream Reporting		California State	✔	✔		✔	✔	
Member Agencies	Measure D Forms	Member Agencies	✔	✔	✔		✔	
	Hauler Reporting	Member Agencies	✔	✔	✔		✔	
	Other Data	Member Agencies					✔	
Benchmark Service Audits		StopWaste			✔			✔
Waste Characterizations	Disposal Stream (GSIG)	StopWaste, Various Jurisdictions			✔			✔
	Diverted Streams	Jurisdictions, Facility Operators	✔	✔				✔

* "Other" refers to C&D, food transported for recovery, and other materials.

1. Disposal Reporting Data. CalRecycle uses jurisdiction-specific disposal data to calculate an actual annual per-capita disposal rate for comparison to a CalRecycle target rate, as provided in SB 1016. This process replaced the earlier, more detailed process for measuring compliance with the 50 percent diversion requirement of AB 939.[23]
2. State Discard Stream Reporting Data. Draft regulations for recent state legislation (AB 901) expands the disposal reporting system to create the "Recycling and Disposal Reporting System." AB 901 provides CalRecycle the ability to require that a range of types of facilities collect and report data regarding the flow of recyclables and organic materials, as well as C&D material and discarded food. CalRecycle's full implementation of AB 901 has the potential to provide useful jurisdiction-specific data for these materials similar to that now collected for disposed material. As discussed further below, reliable data will likely not be available until later in 2018 or early in 2019, and may prove to be more useful at the state or regional level, than at a more local level.
3. Member Agency Collection Data. StopWaste staff have used a "Measure D Form" since 2013 to collect annual data from each member agency, with a focus on franchise collection of recyclables, organics, and garbage from residences and businesses.[24] In addition, franchised haulers provide regular reporting to the member agencies with whom they contract. This data is the primary, or in some cases the sole source of data used to complete the Measure D Forms. Finally, for most member agencies, significant amounts of material collection, processing, and disposal activity occur outside of the franchise agreement. This is especially true for C&D and commercial recyclables.
4. Benchmark Service Audit Data. From 2013 through mid-2017, StopWaste funded "waste sorts" (characterization of the types of material contained primarily in material collected for disposal) to collect and directly analyze GSIG. The Benchmark Service data has been the primary means for measuring GSIG in recent years. The FY 2017-18 budget provides for limited collection of similar data, as further discussed in Section 3 and in Section 4.
5. Waste Characterization Data. Section 4 focuses on the use of comprehensive waste characterization data to measure GSIG and the role of the data from the current Characterization Study, once completed. The Characterization Study will provide the most comprehensive measurement of progress towards the GSIG interim goals, and will provide a new baseline for assessing policies and programs, and for measuring progress. In addition, limited sorting of samples of material arriving at or leaving facilities can provide data regarding proper sorting following collection, and the amounts of GSIG in residue following processing, respectively.

While identification and analysis of available demographic data was not a focus of the Review, the Review Team conducted some testing using demographic factors.[25] The recommended metrics rely primarily on readily obtained data such as the total number of residents, single-family households, etc. The State Department of Finance, the Association of Bay Area Governments, and member agency planning departments are among the best sources of free or low-cost demographic data. U.S Census tract data can

[23] The per capita disposal goal measurement process is codified in SB 1016, Wiggins (Chapter 343, Statutes of 2008) as a simplified means of measuring compliance with the State's 50 percent diversion goal. See Appendix A, page A-3 for further explanation of per-capita measurement.
[24] Private sector companies provide collection of dry commercial materials in Berkeley; all other residential and commercial services are municipally-provided.
[25] See further discussion in Appendix A, page A-10.

also be of use. There is also a wide range of available data that can be purchased for specific applications. Specialized demographic data could play a role in targeted sorts.

StopWaste is a large joint powers agency, with 17 member agencies served by six private sector franchised garbage collectors plus three other franchised recycling collectors, one municipal collector, multiple transfer, processing and landfill facilities, and varied programs. This diversity inherently complicates collection of data on a comparable basis. However, several of the collection contractors are affiliates, which potentially reduces the number of franchised garbage collectors with distinct reporting to four entities. As with any effort to develop simplified means for understanding complex systems, there are challenges and limitations. A few key issues that directly affect data collection and analysis include:

- Each member agency "controls," and collects data for only a portion of the total disposal, recyclables and organics management activity occurring within its boundaries. As discussed further below, collecting data and developing metrics for the "municipally-controlled" fraction is relatively straightforward; this is less the case for the remaining material.
- Collection routes and service tend to be based on container type, rather than account type or customer sector. Thus, recycling and organics "cart routes" generally collect carts both from residents and from businesses. Similarly, recyclables, organics and disposal "bin routes" generally collect material from both multi-family and commercial accounts and from mixed-use buildings. For policy and programmatic purposes, referring to "single-family," "multi-family" and "commercial" sectors provides clarity in summarizing data and assessing program impacts. Converting from container type to account/sector requires use of allocations, which vary in initial accuracy and which themselves change over time.
- Self-haul disposal customers, at times, misreport the location from which the material originated, and it is easy for self-haulers to make mistakes, especially when the source of the waste is in an unincorporated area near a city.

From a data collection and analysis perspective, there are several challenges including:

- Discards management practices are affected at any given time by disparate direct and indirect factors. Among factors that can be identified, if not necessarily easily measured, are the strength of the economy and its impact on disposal tonnages, the effect of the "evolving ton" on relative volumes and weight of recyclables, or a given recent outreach effort regarding accepted recyclables.[26]
- Given the wide variation of factors affecting the materials discard "system" in multiple ways, equating cause and effect is generally difficult if not impossible. Statisticians refer to the difficulty of separating "signal from noise," which requires having an adequate amount of data and applying statistical analysis to isolate the cause(s) of a given outcome. For example, if lid-flipping indicates an increase in the number of households placing food scraps in their organics cart during a given September in comparison to the previous month, is that a function of a recent outreach effort, the end of the summer vacation season, greater organics participation rates due to higher seasonal volumes of yard trimmings and/or other factors?

[26] See further discussion in Section 2, page 5.

Total Disposal, Per-Capita Disposal and Jurisdictional Diversion Rate

CalRecycle annually develops a per-capita disposal target and an actual per-capita disposal rate based on total reported disposal tonnage for each incorporated jurisdiction (and for unincorporated county areas).

StopWaste posts the annual total disposal tonnages and a calculated diversion rate (derived using CalRecycle's per-capita disposal data) on the Agency website for each member agency, with the two sanitary districts combined as "unincorporated." Figure 3-3 provides this data for 2012 through 2015.[27] The diversion rates are calculated by comparing the two pounds per-capita disposal rates, as described in the adjacent text box. These are "imputed" diversion rates that effectively assume that "total per-capita discards" are, in fact, equal to twice the CalRecycle targets. While diversion rates are calculated in this manner by jurisdictions across the state, their accuracy cannot easily be assessed.

Example: Computing a Diversion Rate

- Assume that for 2014, a city had a CalRecycle goal of five pounds of disposal per-day, per-capita. The five pounds of disposal equates to a disposal rate of 50 percent. Thus, "total discards" equates to ten pounds of material per day.
- Assume the city's actual per-capita disposal rate in 2014 equaled four pounds.
- On a proportional basis, the city's actual 2014 disposal rate was 40 percent. Conversely, its diversion rate was 60 percent.

Figure 3-4 graphically illustrates the total countywide disposal and weighed diversion rates from Figure 3-3. Note the narrow variation in both total tons and countywide diversion rate for 2012 through 2015. Total tonnage is a verified figure, with some marginal improvement in accuracy likely once AB 901 is fully implemented. As noted above, the relative accuracy of the diversion rate is less certain. In any case, based on a calculated Agency-wide diversion rate for 2015 of 73 percent, the "75% and Beyond" goal is within reach.

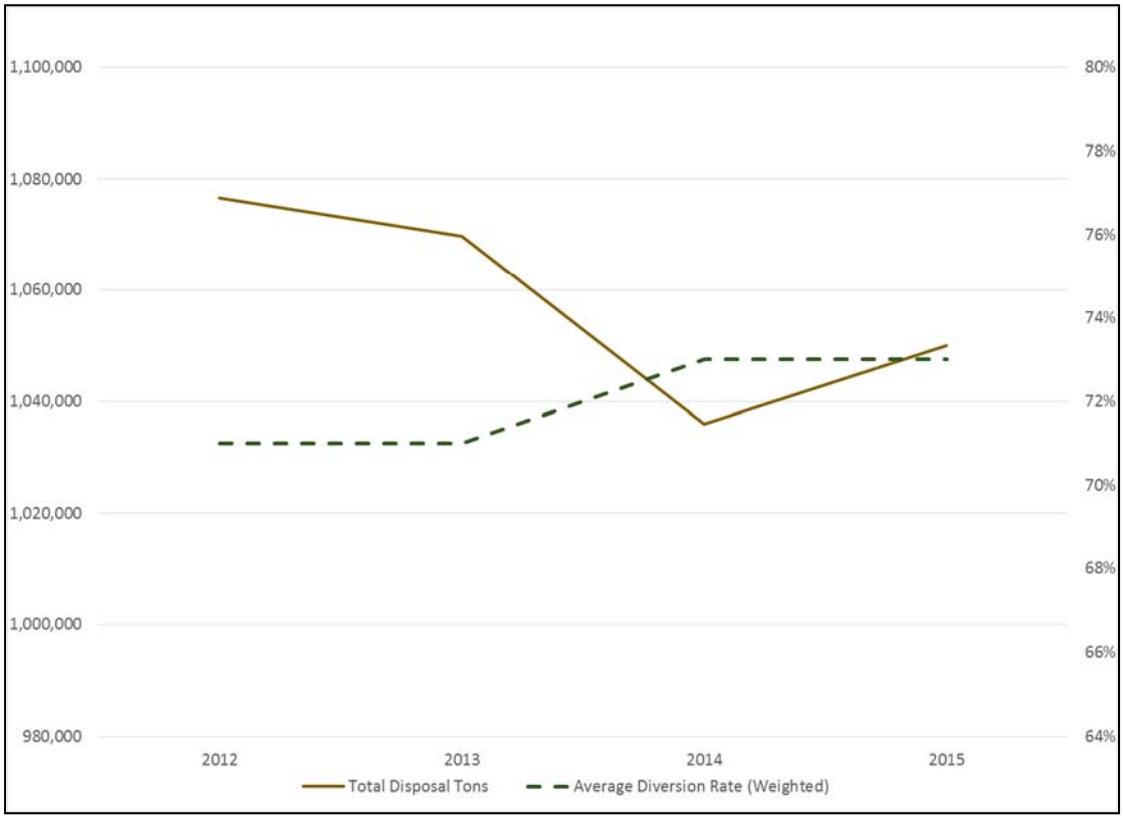
See the "Member Agency Collection Data" subsection below for further comparison of CalRecycle and member agency disposal data, discussion of recyclables and organics streams, and calculated total generation for "municipally-controlled material."

[27] At the time Section 3 was drafted, the CalRecycle website included 2016 data for only nine of the member agencies. Disposal data for 2016 and especially 2017 will show increased disposal reflecting increased economic activity, a recent statewide trend.

Figure 3-3: Member Agency Disposal Tonnages and Diversion Rates, 2012 through 2015

	2012		2013		2014		2015	
Member Agency	Disposal Tonnages	Diversion Rate	Disposal Tonnages	Diversion Rate	Disposal Tonnages	Diversion Rate	Disposal Tonnages	Diversion Rate
Alameda	36,625	76%	35,121	77%	35,880	76%	32,036	79%
Albany	5,428	84%	6,427	81%	5,989	82%	6,096	82%
Berkeley	73,917	73%	60,659	78%	68,874	75%	67,246	76%
Dublin	24,478	76%	27,919	74%	34,787	70%	34,731	71%
Emeryville	18,052	70%	17,973	70%	10,811	83%	8,419	87%
Fremont	144,771	72%	138,179	74%	158,694	71%	160,861	71%
Hayward	106,953	72%	101,757	74%	93,153	76%	106,975	73%
Livermore	57,720	77%	57,317	77%	60,456	76%	64,811	75%
Newark	31,370	73%	35,891	69%	33,081	72%	36,190	69%
Oakland	284,151	66%	281,139	67%	269,850	68%	254,262	71%
Piedmont	4,731	71%	3,304	80%	3,026	82%	3,156	81%
Pleasanton	77,170	70%	80,682	69%	74,666	72%	91,292	67%
San Leandro	103,238	62%	115,220	58%	73,145	74%	76,743	73%
Union City	36,778	77%	36,959	77%	37,208	78%	36,223	78%
Unincorporated County	71,243	72%	71,235	72%	76,340	71%	70,996	73%
Total Tons/Avg Rate (Weighted)	1,076,625	71%	1,069,782	71%	1,035,960	73%	1,050,037	73%

Figure 3-4: Countywide Disposal Tonnages and Diversion Rates, 2012 through 2015



State Discard Stream Data

As noted above, AB 901 provides CalRecycle the ability to collect data from various types of facilities regarding a range of discards, including recyclables, organics, C&D material, and food transported for recovery.[28] The new "Recycling and Disposal Reporting System" will also enhance the quality of disposal data collected by CalRecycle. CalRecycle was in the process of developing regulations for implementation of AB 901 as this Review was being completed. As drafted at the time of this report, AB 901 has the potential to provide very useful jurisdiction-specific data. However, provisions of the draft regulations indicate that the data may be of more use at the state or regional level. For instance, while the organics data will assist CalRecycle in implementing SB 1383 by enhancing its understanding of the balance of regional organics processing needs with availability of processing capacity, AB 901 may be less useful in helping member agencies track locally-generated material. Among the concerns regarding the draft regulations include the ability of reporting entities to use "reasonable methods" to allocate discard stream data to individual jurisdictions and the reporting of disposal and processing residue together as "solid waste."[29]

In any case, the current challenges related to annual verification of jurisdictional disposal reporting will become that much more complex with statewide reporting for new material streams. The Review Team believes the full value of the data provided through the new reporting system will not likely be known until early 2019, after completion of at least several quarterly reporting cycles. It is hoped that the Recycling and Disposal Reporting System will provide data for use in developing metrics on a countywide basis, if not for individual member agencies.

Member Agency Collection Data

Measure D Forms

Since 2013, StopWaste staff have used a "Measure D Form" (Form) with a standardized format to collect annual data from each member agency, with a focus on franchise collection of recyclables, organics, and garbage from the single-family, multi-family, and commercial sectors.[30] The Form provides for collection of material tonnages and collection data based on service subscription, including container type, size, and collection frequency. The goal for the data collected from the Forms is that, with consistent use and interpretation over several years, trends in levels and types of service within a jurisdiction should become apparent and the data can be used to develop meaningful member agency and countywide metrics.

A key task for the Review Team was to conduct the first detailed review of the submitted data, with a focus on evaluation of the 2014 and 2015 data submittals using specific verification procedures.[31] As noted in the Introduction, ensuring consistent provision and interpretation of data that allows for comparisons across all member agencies is challenging. The Review Team concluded that:

[28] AB 901, Gordon (Chapter 746, Statutes of 2015).
[29] Based on review of the fourth version of the regulations, as issued in September 2017.
[30] See 2016 sample form in Appendix A, page A-1. Franchise collection refers to those materials collected through each member agency's franchise agreements with third party service providers, or in the case of Berkeley as municipally collected.
[31] See Appendix A, page A-3 for further description of this process and its conclusions.

1. Total reported tonnages appear to be relatively reliable, assuming that "non-franchised" material tonnages, such as C&D or commercial recyclables, were not included on the Forms, or that if they are included, they have been included by that member agency on a consistent basis over multiple years. However, based on the 2015 data, it is not possible to ensure that data reported as "single-family," "multi-family," and "commercial" provides an accurate picture of activity for those sectors, and in some cases allocations may have been used that were not documented.

2. Total service subscription information (total number of accounts, number of containers, and frequency of collection) is probably relatively reliable although less so than for tonnages, and with the same caveats. Again, based on the 2015 data, it is not possible to ensure that data reported as "single-family," "multi-family," and "commercial" provides an accurate picture of activity for those sectors.

Review Team members provided StopWaste staff with suggested modifications to the Form for on-line member agency reporting of 2016 data during the fall of 2017. Further, StopWaste staff worked with member agency staff to improve the consistency of data submittal for 2016, in particular with provision of added instructions and emphasis on consistent definition of terms. It is to be hoped that analysis of the 2016 submittals will indicate that the data can be used to developed metrics for most or all member agencies, and can begin to be used to develop reliable countywide metrics.

Each year's member agency data submittals will continue to require some level of quality assurance to ensure comparability with that agency's prior submittals as well as allowing for meaningful countywide summaries. The following subsection discusses the use of the Form data to better understand "municipally-controlled" material. Otherwise, the use of the data as reported on the Forms in developing and using metrics is discussed in Section 3 under "Recommendations for Downstream Metrics."

Municipally-Controlled Disposal and Discard Streams

As noted above, total tonnages are likely to be the most reliable portion of the Form data submitted through 2015. Figure 3-5 compares calendar year 2015 data for "Total Disposal Tonnages" as reported by CalRecycle with "Municipally-Controlled Disposal Tonnages" as provided on the 2015 Measure D Forms. "Municipally-Controlled Disposal Tonnages" equate to "franchised disposal tons" - the material directly collected and disposed through each member agency's franchise, or through municipal collection. As shown in Figure 3-6, the "municipally-controlled" concept also applies to recyclables and organics. Figure 3-6 adds municipally-controlled recyclables and organics tonnages from the 2015 Forms to the municipally-controlled disposal tonnages from Figure 3-5. Figure 3-6 provides a summary of total tonnages for recyclables, organics, and disposal with diversion rates by member agency and countywide, and an average, countywide diversion rate for municipally-controlled material. The Forms do not reliably distinguish residue from other disposal, and thus the diversion rates as shown likely somewhat understate the true rates.

Prior Five-Year Reviews documented municipally-controlled tonnages for disposed material, recyclables, and organics in an aggregate manner similar to that in Figures 3-5 and Figure 3-6, as well as by sector and by member agency. For the past Reviews, multi-year data was collected from member agencies through a time consuming process that was replaced in 2013 by annual submittal of the Measure D Forms. Comparing the data in Figures 3-5 and 3-6 to earlier data may provide a broad cross-check for the accuracy, in aggregate at least, of the 2015 Form tonnage data.

As shown in Figure 3-5 for 2015, for Alameda County as a whole, about 67 percent of disposal occurred within the franchised collection system. The remaining 33 percent of disposal tonnage primarily reflects self-haul by residents and businesses, disposal of C&D, and disposal of residue from recycling and organics processing. For 2011, as reported in the previous five year review, the comparable figure for disposal within the franchise was about 73 percent.[32] Figure 3-6 indicates a countywide diversion rate for "municipally-controlled" material of about 39 percent, as compared to about 44 percent for 2011.[33]

Figures 3-5 and 3-6 illustrate the value of the "municipally-controlled" concept in highlighting both the importance of monitoring material collected through the franchise to ensure increased diversion over time, as well as the crucial role that material collected outside of each member agency's franchise plays in contributing to overall diversion of discards and to achieving "75% and Beyond."

The Review Team recommends StopWaste update Figures 3-5 and 3-6 with 2016 Form data, in part as a further cross-check for accuracy of data compiled at the countywide level. In addition, beginning with 2016 data, it will hopefully be feasible to breakout such data by sector, as in past Reviews that involved collection of much more detailed data from member agencies.

Figure 3-5: Municipally-Controlled Disposal Tonnages, 2015

Member Agency	Total Disposal Tonnages	Municipally-Controlled Disposal Tonnages	Municipally-Controlled Disposal (Percentage)
Alameda	32,036	26,341	82%
Albany	6,096	4,315	71%
Berkeley	68,221	40,136	59%
Dublin	34,731	28,435	82%
Emeryville	8,419	7,840	93%
Fremont	174,899	121,839	70%
Hayward	108,106	84,555	78%
Livermore	65,094	41,654	64%
Newark	36,190	26,253	73%
Oakland	254,262	156,410	62%
Piedmont	3,521	2,320	66%
Pleasanton	91,292	52,201	57%
San Leandro	82,466	36,402	44%
Union City	38,420	30,513	79%
Unincorporated County *	70,996	n/a	
Castro Valley Sanitary District	n/a	14,213	92%
Oro Loma Sanitrary District	n/a	50,803	
Total	**1,074,746**	**724,230**	**67%**

[32] SAIC, "2012 5 Year Program Audit - Final Report," prepared for the Alameda County Source Reduction and Recycling Board, July 2013, Table 5, page 2-14.
[33] Ibid, Table 4, page 2-11.

Figure 3-6: Municipally-Controlled Material Tonnages, 2015

Member Agency	Total Recyclables	Total Organics	Total Disposal	Total Generated	Diversion Rate
Alameda	11,458	11,835	26,341	49,634	47%
Albany	2,411	2,669	4,315	9,396	54%
Berkeley	15,877	22,601	40,136	78,614	49%
Dublin	19,185	9,980	28,435	57,600	51%
Emeryville	7,009	2,766	7,840	17,616	55%
Fremont	28,112	32,829	121,839	182,780	33%
Hayward	23,703	22,772	84,555	131,030	35%
Livermore	18,657	20,642	41,654	80,952	49%
Newark	5,398	5,296	26,253	36,947	29%
Oakland	38,500	53,601	156,410	248,511	37%
Piedmont	2,196	2,581	2,320	7,096	67%
Pleasanton	8,440	11,878	52,201	72,519	28%
San Leandro	8,097	9,788	36,402	54,286	33%
Union City	9,724	9,619	30,513	49,857	39%
Castro Valley Sanitary District	9,063	9,850	14,213	33,126	57%
Oro Loma Sanitrary District	15,559	18,805	50,803	85,167	40%
Total	**223,388**	**247,513**	**724,230**	**1,195,131**	**39%**

Franchised Hauler Reports to Member Agencies

Many member agencies receive data similar to that in the Forms as part of regular hauler reporting. These data are often used to support program planning and monitoring, and may be a useful substitute and/or cross-check with data from the Forms. Some member agencies already receive reports that contain most of the information required for completing the Forms. This is especially true for member agencies with newer agreements. For instance, Oakland's franchise agreements were finalized in 2015 and the reports provide data that can potentially be placed directly into the Forms.

Other Member Agency Data

To the degree that commercial recyclables are collected through non-exclusive franchise or permit systems, member agencies likely receive data regarding collection and processing of the materials. This can be an important additional source of data for more fully understanding the complete diversion picture. C&D is also often collected through non-exclusive franchise or permit systems.

Benchmark Service Audit Data

StopWaste's Benchmarking Service audits collected data from 2013 through mid-2017, taking samples of single-family, multi-family and commercial disposal streams to directly measure the amount of GSIG. Pending analysis of the data from the Agency's current Characterization Study, the Benchmark Service data provides the best direct measure of remaining non-residential GSIG.[34]

[34] Sampling techniques piloted during the Benchmark Service audits to determine percent of edible, inedible and produce generated by households provides a possible methodology for future residential sampling in support of food waste reduction.

Figures 3-7 through 3-10 provide a summary presentation of the Benchmark Service single-family data through 2016.[35]

Figure 3-7: Single Family - Percent Good Stuff in Garbage

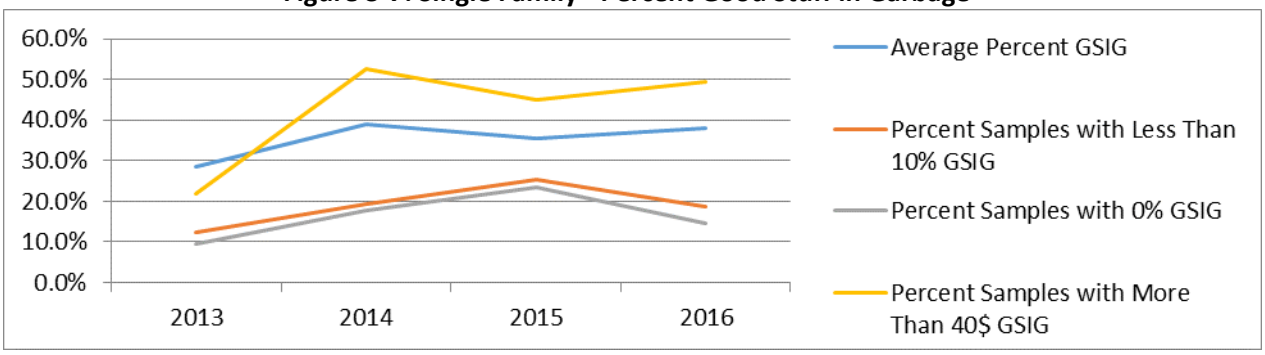


Figure 3-8: Setout Weight (Pounds)

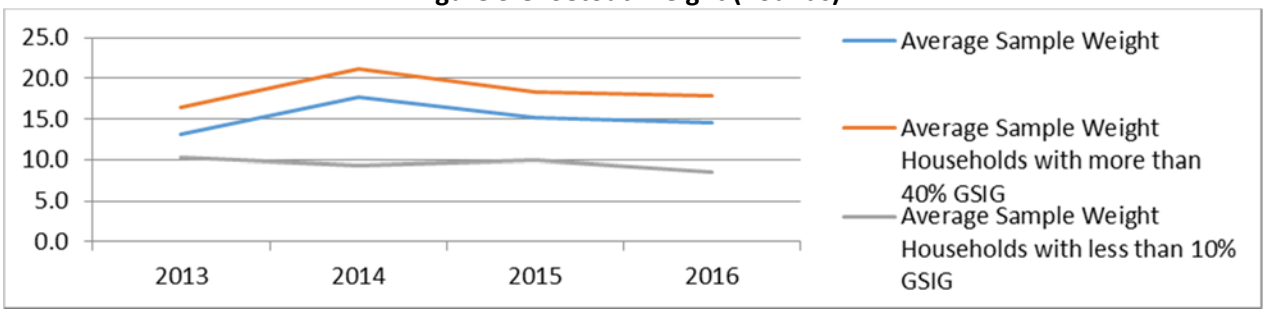


Figure 3-9: Weight Recyclables in Garbage (Pounds per Set-Out)

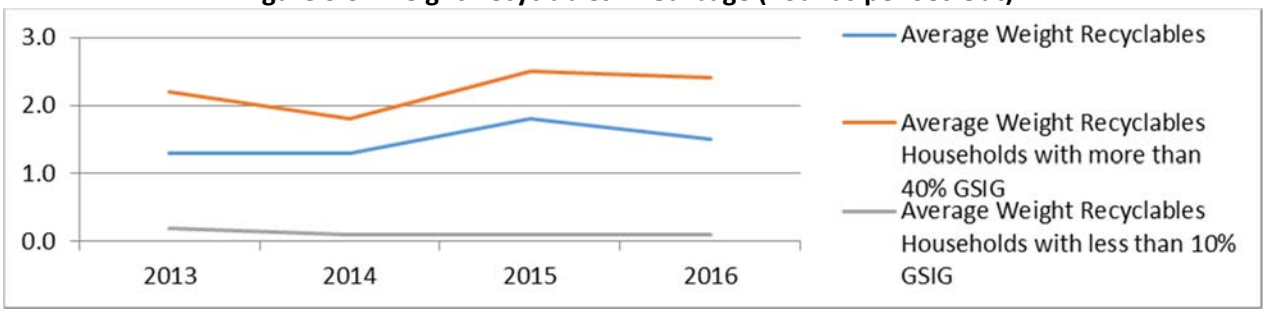
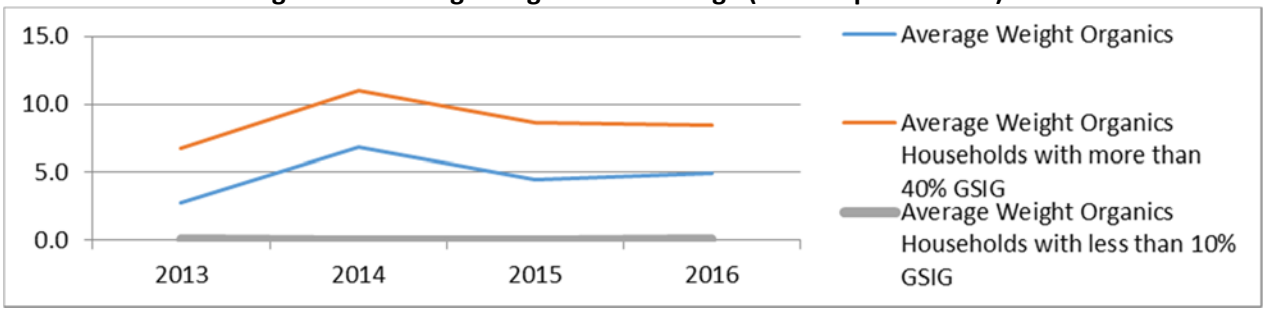


Figure 3-10: Weight Organics in Garbage (Pounds per Set-Out)



[35] Mark Spencer, "Presentation of the 2016 Benchmark Data," the Planning and Organization Committee and the Recycling Board, May 11, 2017.

In general, the high sample-to-sample variability in these data resulted in large margins of error when statistical analyses were performed.[36] Thus, it was not possible to demonstrate statistically significant variation in the data from year to year, separate from factors such as the impact of the drought on yard trimmings generation in general or the rapidly changing composition of recyclables. Taking more samples per jurisdiction is the most straightforward way to address this difficulty given that the calculated margins of error are inversely related to the number of samples.

In comparing single-family food scraps results from 2016 with 2015, Benchmark Service staff found:

- Food scraps were 17 percent of GSIG, compared to 19 percent in 2015;
- Food scraps GSIG averaged 3.0 pounds, versus 3.6 pounds in 2015;
- 39 percent of sampled households had no food scraps in their garbage, compared to 50 percent in 2015; and,
- Samples with food scraps in the garbage averaged 4.8 pounds and made up 28.4 percent of the waste stream, versus 7.2 pounds and 38.4 percent, respectively, in 2015.

As discussed later, differentiating between set-outs with and without GSIG is useful for analyzing the results for the samples with GSIG. The Review Team conducted in-depth analysis of the Benchmark Service data, and its usefulness in developing metrics for downstream measurement of reductions in GSIG, including review of commercial samples with relation to food recovery.[37]

Waste Characterization Data

Introduction

Discussion of waste characterization data and findings requires understanding of several statistical concepts. Typically, several samples of waste are taken from a group of generators (businesses, residences, or institutions) and each sample is sorted into components. Then each component is weighed, and the percentage of the component's weight as a percentage of the total sample weight. For each component, the average, or *mean*, of its percentages gives an estimate of its abundance in that group of generators.

But, how accurately does that sample mean represent the true mean for all of those generators' discards? If ten samples have been taken and the percentage of, say, food scraps ranges between 20 and 30 percent, one can have some confidence in a sample mean of, say 25 percent. If the range is much wider and more scattered, then the 10-element sample is less likely to be a good representation of the entire set of generators. One's confidence level will be lower, or the *margin of error* will be larger.

Statistical techniques can enable an analyst to express the margin of error for a given *confidence level*. For a narrow range of percentages, we might obtain an answer like "We can say with 95 percent

[36] See Appendix D for discussion of statistical techniques.
[37] See further discussion in Section 3, page 36 and Appendix A, page A-11.

confidence that the true mean is within 3.5 percent of the sample mean." If the range is wider, then that statement might be modified as follows:

- We can say with 90 percent confidence that the true mean is within 3.5 percent of the sample mean or,
- We can say with 95 percent confidence that the true mean is within 4.7 percent of the sample mean.

The 90 percent and 95 percent values in these statements are the confidence level. The 3.5 percent and 4.7 percent values are the margin of error.

Appendix D provides a more detailed description of these concepts and an example, with data, to show how they are applied in waste characterization work. The technique is also described in CalRecycle regulations[38].

Jurisdictional Waste Characterizations

Section 4 discusses the role of waste characterization data in some detail. Data from the Agency's current Characterization Study, as well as from the other waste characterizations discussed in Section 4 should prove to be valuable inputs for developing metrics.

Targeted Sorts

In lieu of the Benchmark Service audits, the FY 2017-18 budget for this effort provides for 60 crew-days of sampling and sorting to collect similar data as in 2013 through 2017. It is the Review Team's understanding that the initial focus will be on commercial sector sampling of the types of businesses that were found to be farthest from StopWaste's long-term goal of no more than ten percent GSIG. High organics generators in several jurisdictions, including restaurants and grocery stores, are being targeted for comparative surveys to evaluate the impacts of StopWaste's Mandatory Recycling Ordinance and local outreach efforts. Review Team members assisting StopWaste staff with planning the sorting process, separate from conducting the Review, believe the budget should allow for analysis of a minimum of 500 samples, averaging 125 per targeted jurisdiction, which should be sufficient for statistical comparisons of data sets. In smaller jurisdictions this number of samples may provide more than enough businesses to enable meaningful before-and-after studies of high organics generators - if representative samples can be obtained each time.

While not included in the Review, one time sampling efforts, such as those for the recent Fremont food scraps pilot and the CVSan Less-Than-Weekly Garbage Pilot may provide data of some value in metrics development.

[38] See steps 6 and 7 in these guidelines: http://www.calrecycle.ca.gov/laws/regulations/title14/ch9andx1.htm

Analysis of Benchmark Service GSIG Data

Following are summary observations from the analysis of the Benchmark Service data.[39]

Single-Family Data

The single-family data are useful for providing a broad understanding of residents' practices. For example, in most cities there was a significant cohort of residences that had no GSIG on the day that they were sampled. They also show a very consistent year-to-year downward trend in most cities in the amount of food scraps placed in the refuse bin by those residents that did have GSIG, as described below for Figure 3-11.

Multi-Family Data

For logistical reasons, sampling techniques for multi-family residences required extracting subsamples from dumpsters, rather than taking the contents of the entire container (as was the case for single-family samples). This approach can cause wider variations between samples. In addition, compared to the single-family effort, samples for the multi-family sector were less numerous and the methods of sampling were modified during the four year study period. As a result, the multi-family data provides less robust conclusions. Not surprisingly, the data shows that GSIG is higher for the multi-family than the single-family sector.

Commercial Data

Data for the commercial sector illustrate the significant variability that occurs in this sector, both within and between business types. Despite this variability, the commercial data can be examined to identify the business sectors that are farthest from the GSIG goal and evaluate their progress toward it. This data is discussed further with regard to food recovery.

The Review Team concludes that the Benchmark Service data provides significant value as background information, including in targeting commercial sorts to collect additional data related to food recovery. In general, the Benchmark Service audit data will not be of direct assistance in developing metrics.

Further Observations

However, there are two key insights based on analysis of the single-family data for recyclables and food scraps. The following analysis of the single-family data is derived from the Benchmark Service data for 2014 through 2016, and has two key features. One feature is to focus on weight rather than percentage of GSIG. This has the benefit of being an absolute measure that does not mask changes in the composition of each stream.[40] The second feature is to differentiate single-family garbage set-outs with GSIG from

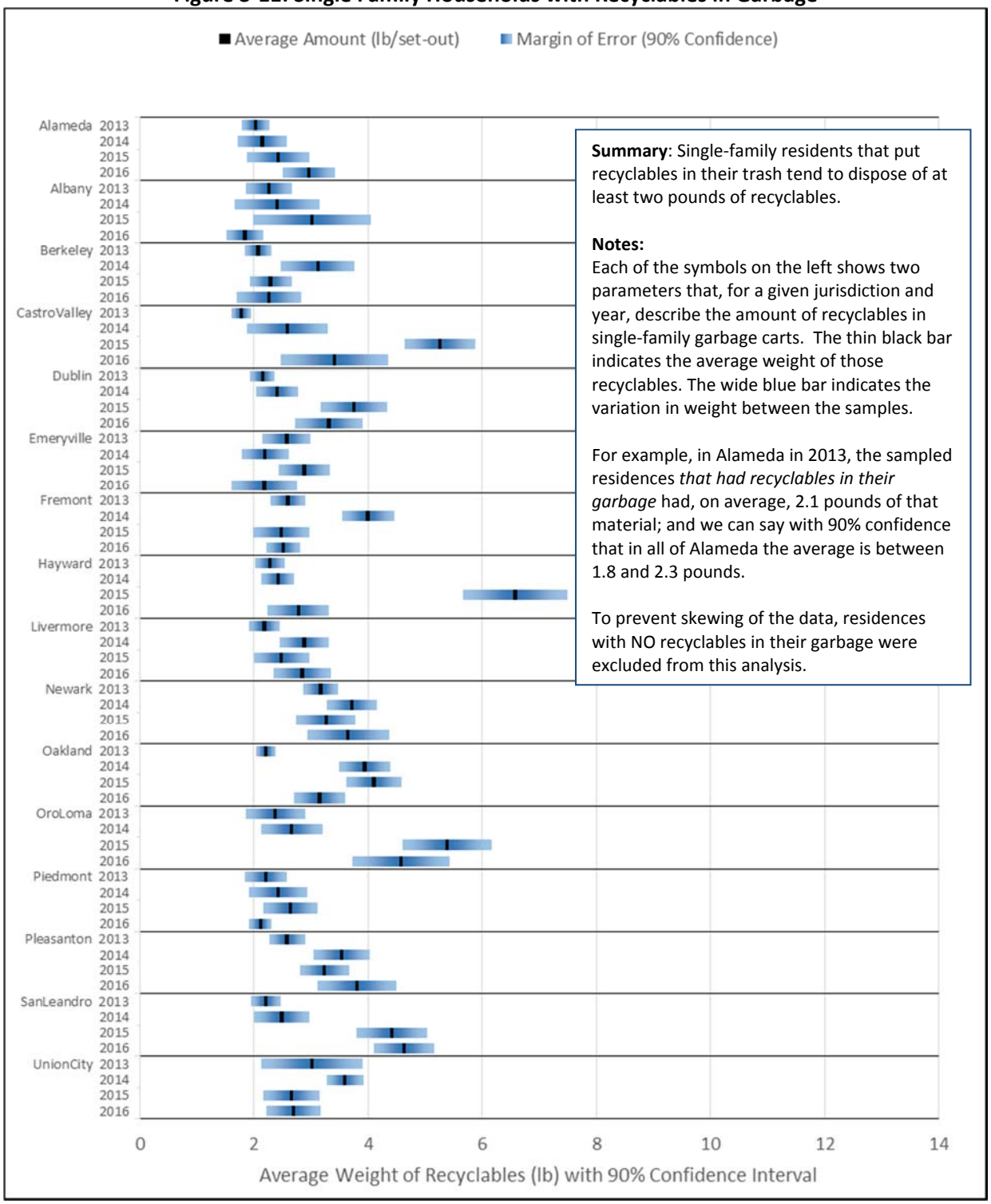
[39] See Appendix A, pages A-9 and A-3 for information regarding additional analysis of the Benchmark Service data, as well as the Measure D Forms, respectively.
[40] See further discussion in Section 4, page 53.

those without GSIG. This has the benefit of facilitating analysis of the set-outs that contain GSIG, and resulting in statistically significant results.

The Review Team computed the average weights, in pounds, of recyclables and food scraps (excluding food-soiled paper) found in garbage set-outs for each member agency. For recyclables, as shown in Figure 3-11, for households with GSIG, a year-by-year trend analysis did not identify distinct trends but did find a clear and consistent lower bound across the member agencies. Single-family residents that put recyclables in their trash tend to dispose of at least two pounds of recyclables. StopWaste might consider setting a goal of, for example, “one pound or less.”

Remainder of page intentionally left blank

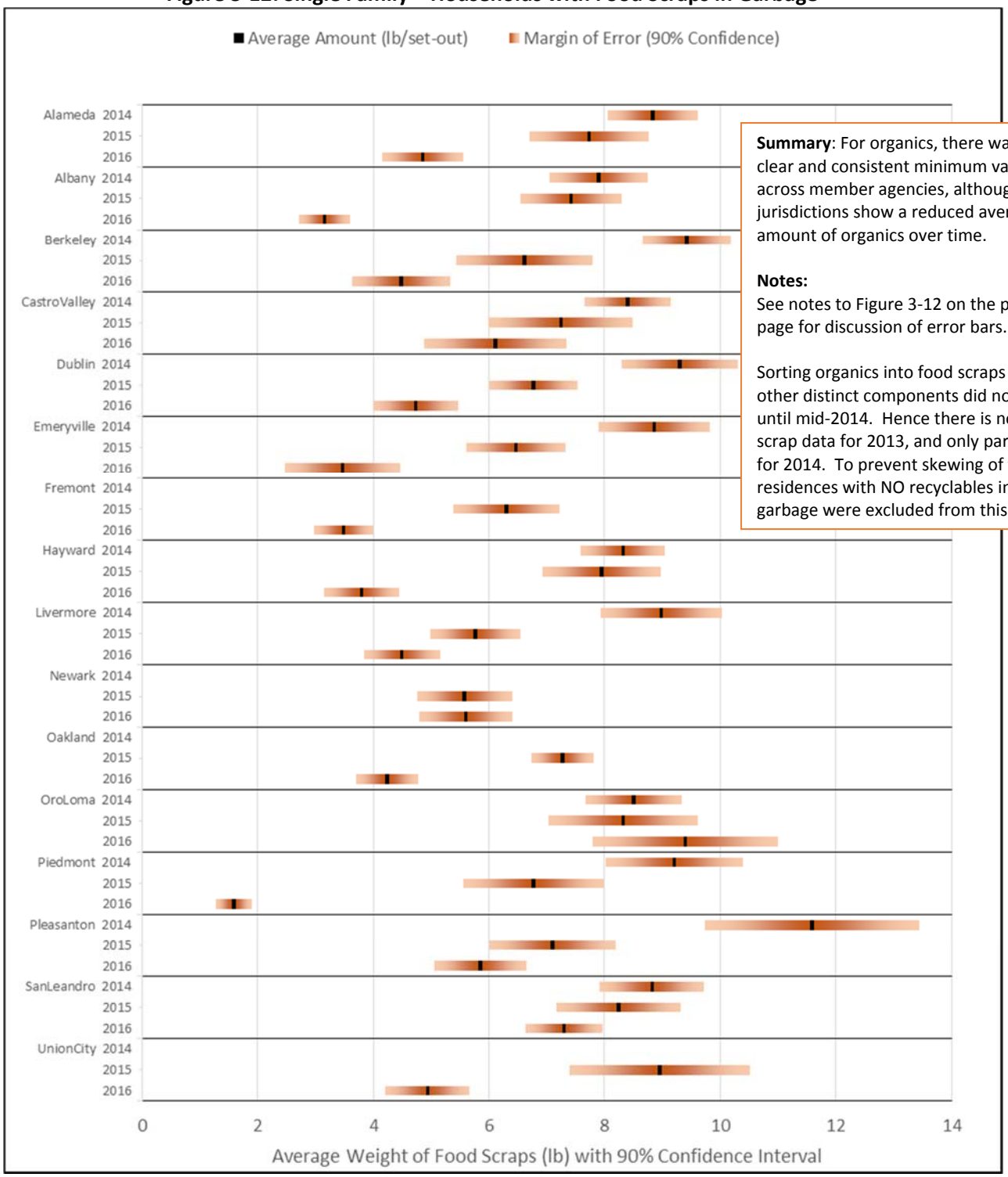
Figure 3-11: Single Family Households with Recyclables in Garbage



For food scraps, Figure 3-12 indicates a very clear declining trend from 2014 through 2016 in the weight of food scraps in the garbage for nearly all jurisdictions. However, unlike for recyclables, there was no clear and consistent minimum value across member agencies, which suggests that there is significant

opportunity for continued improvement. Setting a weight-based goal of (for example) two pounds or less, would allow for a more concrete measurement of progress towards the interim goal of less than 20 percent food in the GSIG, and less than 10 percent GSIG goal.

Figure 3-12: Single Family – Households with Food Scraps in Garbage



Summary: For organics, there was no clear and consistent minimum value across member agencies, although most jurisdictions show a reduced average amount of organics over time.

Notes:
See notes to Figure 3-12 on the previous page for discussion of error bars.

Sorting organics into food scraps and other distinct components did not begin until mid-2014. Hence there is no food scrap data for 2013, and only partial data for 2014. To prevent skewing of the data, residences with NO recyclables in their garbage were excluded from this analysis.

In each case, the results seem consistent with what an informed observer might expect. Recyclables collection is a mature service that has been provided to single-family residents countywide for years. The fairly consistent lower bound of two pounds of recyclables in the GSIG indicates the value of targeting outreach in a way that reaches that subset of the population that continue to place recyclables in the disposal cart. By contrast, food scraps collection is a less mature service, in that average participation rates are much lower than for recyclables. Consistent with this, there is significant variation in the amount of food scraps GSIG between member agencies and no clear lower limit.

Recommendations for Downstream Metrics

The following summarizes two broad types of metrics, describes a process for developing and applying the metrics, provides several alternative approaches, and comments on the value of setting GSIG goals based on weight in addition to, or rather than, percentages.

Key Metrics

The Review Team recommends use of two broad types of metrics:

1. Weight per-capita measures such as pounds per-resident or per-household. This metric is similar to that used by CalRecycle to measure relative disposal, as described earlier in Section 3 (see page 16), and is a useful means for tracking changes in the relative weight of discards over time.
2. Volume measures such as changes in subscribed service, and related density measures such as pounds per-volume of subscribed service. Changes in subscribed service over-time by material type can help assess whether shifts in service (and especially reductions in commercial disposal service subscription relative to that for recyclables and organics) reflect changes in tonnages of material collected for the three streams. Over time, with less disposal, there should be less disposal service capacity, especially for the multi-family and commercial sectors. Changes in density over time can indicate whether available capacity is adequate and being used.

Weight per-capita and volume-based metrics utilize data from the annual Measure D Forms and overall best meet the criteria for useful metrics in that they are relatively simple, necessary data is available, they require minimal calculation, and are replicable. Taken together, weight per-capita and volume-based metrics can provide useful indirect indicators of changes in GSIG over time. In each case, we recommend beginning with the recently-submitted 2016 Measure D data, with addition of vetted data from 2015 and perhaps 2014 as deemed useful for identifying trends.

Suggested Process for Applying Metrics

The following are logical steps for developing member agency and countywide metrics using the two approaches described above, progressing from the general to the specific.

Per-Capita Metrics

1. Establish a single, jurisdiction-wide per-capita measure for each member agency, by material type.

2. Add a cart service, or a single-family per-capita measure, to provide baseline indicators for all three material streams.
3. Identify areas to focus on for improvement reflecting the analysis of the results of the Characterization Study and determine if further sector per-capita measures for multi-family and/or commercial should be developed.

Service Volume Data and Density Metrics

1. Begin tracking jurisdiction-wide data for subscribed service by material type over time.
2. Add jurisdiction-wide data for subscribed service by material type and by sector (or container type), and track over time.
3. Establish a jurisdiction-wide density measure of pounds per cubic yard of subscribed service by material type.
4. Identify areas to focus on for improvement reflecting the analysis of the results of the Characterization Study, and determine if further sector per-capita measures for multi-family and/or commercial should be developed.
5. Add a jurisdiction-wide density measure of pounds per cubic yard of subscribed service.
6. Add sector-specific density measures, beginning with cart service or with the single-family sector.
7. Add multi-family and or commercial sector (or bin service) density measures.
8. Add non-subscribed service, such as for on-call collection of debris boxes or compactors, as feasible and desirable.

As a first step, the Review Team recommends use of total pounds per-capita on an Agency-wide basis (Item 1 of “Per-Capita Metrics” above) as both the initial member agency metric and in the aggregate as the initial countywide metric, and the use of subscribed service by material type (Item 1 of “Density Metrics” above). As a second step, the Review Team recommends use of a density measure on an Agency-wide basis (Item 3 of “Density Metrics” above), for use by member agencies and for “roll-up” countywide.

Beyond these initial steps, we suggest that metrics development reflect specific needs and interests of individual member agencies as well as StopWaste’s objectives for developing useful countywide metrics.

Regardless of which metrics are used, it is important to be aware of their strengths and limitations. For instance, while jurisdiction-wide per capita measures are easiest to calculate, they will also vary widely across member agencies, reflecting the size of the commercial sector relative to the number of residents as well as other factors. Density measures help to provide fuller understanding by “normalizing” these types of variations; density measures should show narrower variations between member agencies.

Use of multiple metrics provides different information that can lead to more nuanced understanding. Use of multiple metrics can also provide a useful cross-check, helping to identify inconsistencies in the underlying data.

Alternative Approaches

Use of Franchise Report Data

As noted earlier, many member agencies receive regular detailed reports from their franchise collectors. StopWaste could review these reports to determine if they provide additional data that can assist in developing single-family, multi-family or commercial sector metrics. Metrics based on such data will likely only be of use to the member agencies that collect that data, and less useful for countywide application. In reviewing such reports, it is important to understand the following:

1. What is the source of the data? How frequently is it updated?
2. Are calculations based on credible assumptions? For example, are containers assumed to be 100 percent full every week, or is average volume or weight closer to actual expectations by material type? Are single-family set-outs (the weekly percentage of customers with carts placed for collection) assumed to be 100 percent, or do they reflect more reasonable assumptions for set-outs by material type, factoring in vacations and other seasonal variations? If compaction factors are used to estimate the weight of compacted wastes, are they reasonable?
3. Are there mixes of customer types on single routes could strongly affect the results, such as a cart route that includes a relatively high percentage of commercial customer accounts? If so, how are estimated weights allocated to each customer type?

Use of a Subset of Member Agencies for Countywide Metrics

As an initial alternative for developing a countywide metric, the Agency could begin with a smaller subset of member agencies. StopWaste could consider aggregating data from the four largest cities (Berkeley, Fremont, Hayward, and Oakland) plus one member agency from the east county, such as Livermore. Together these cities contain approximately two-thirds of the County's population, and cover the geographic range of Alameda County.

The "Other Tonnages"

The initial focus should be on consistent use of the "municipally-controlled" tonnages provided through the Measure D Forms. Longer term, it could be useful to begin adding other tonnages, as available, from member agencies and/or AB 901 reporting. Such data might include materials such as C&D, non-franchise commercial recyclables, or "backhauling" of food and food waste by food retailers. Over time, the additional data could help provide a more complete picture of progress in meeting with goals such as "75% and Beyond."

StopWaste could periodically develop broad Countywide estimates of activities such as non-franchised recycling involving C&D materials, based on tons reported through the Disposal Reporting System, building permit counters and the Green Halo online reporting system, the Measure D Forms and AB 901, compared with influential correlative factors such as building permit issuance, commercial retail and industrial activity, and residential population growth.

For a countywide rollup, StopWaste could prepare a broad estimate each year based on tons reported through the Disposal Reporting System and data for building permit activity, commercial retail or industrial activity. As an example, in the commercial/industrial sector, such an estimate might add 5 percent of disposed tons as a feasible level for assumed diversion through independent salvage of cardboard.

Direct Data Collection

Direct data collection, such as targeted sorts of specific business types, cart set-out counts, and surveying will be crucial to interpreting metrics results and for refining or adding metrics.

Assuring Quality Control of Data

Implicit in our recommendations is the need to work toward consistent reporting of data on the Measure D Forms. Sufficient time and resources should be dedicated to the effort, including ongoing communication with member agency and franchise collector staff preparing the data. Given the number of member agencies and haulers and the range of data collected, a minimum level of data verification and quality control will continue to be necessary.

Examples of Applied Metrics

Following are examples of how metrics can be applied and tracked for individual jurisdictions as well as on an aggregate basis with multiple jurisdictions. The examples are from reporting to the Monterey Regional Waste Management District and its member agencies of Carmel, Del Ray Oaks, Marina, Pacific Grove, Pebble Beach Community Service District, Sand City, and Seaside. Note that collection of this type of data is simplified in these examples; a single hauler serves all of the jurisdictions.

Figure 3-13 provides a density measure for recyclables. In this example, the large spike for a single agency points to a likely data error. Similar to the analysis of Benchmark Service GSIG single-family data discussed earlier, the overall variation between jurisdictions for recyclables (Figure 3-13) is much less pronounced than for organics (Figure 3-14).

Figure 3-13: Weight of Recyclables Collected per Unit of Subscription Volume

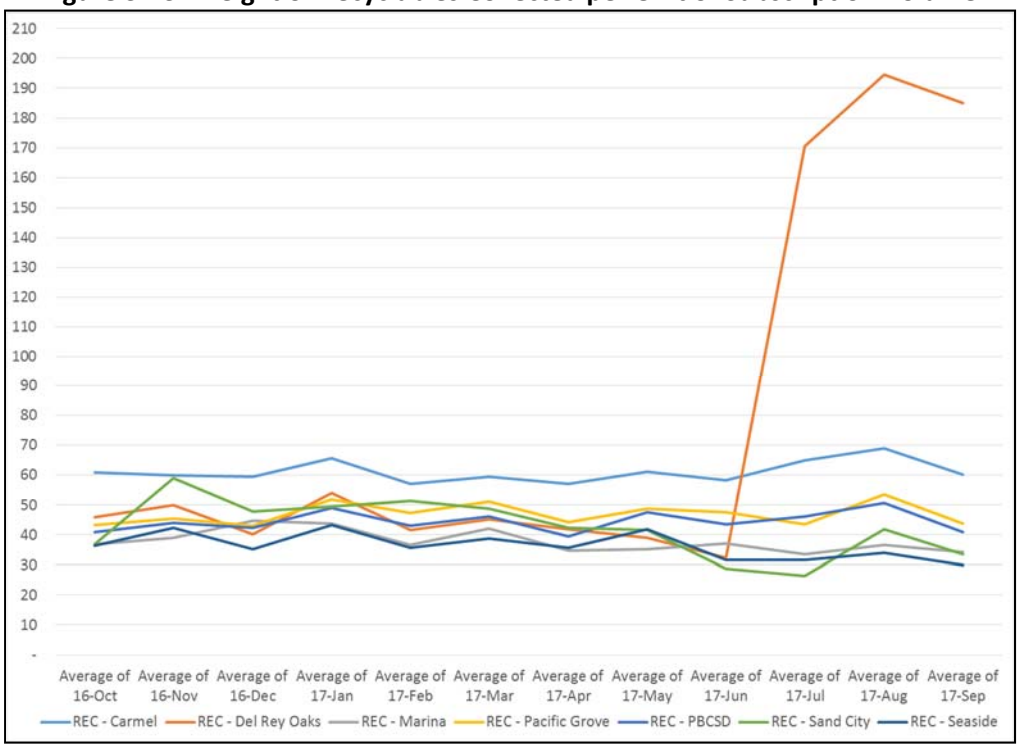


Figure 3-14: Weight of Organics Collected per Unit of Subscription Volume

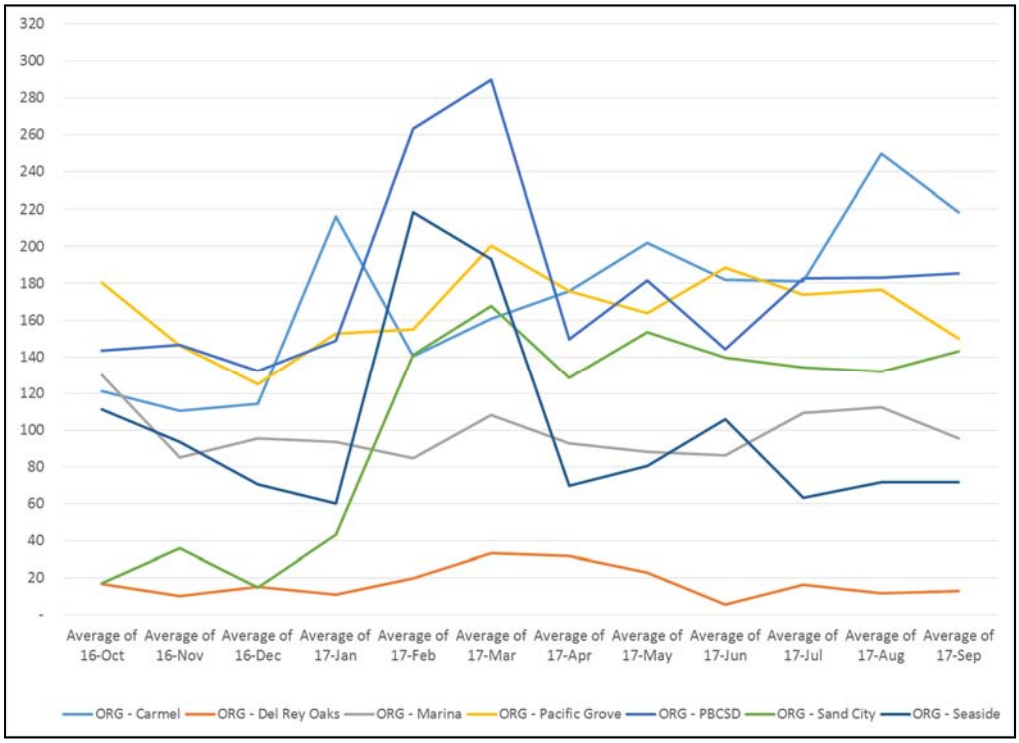
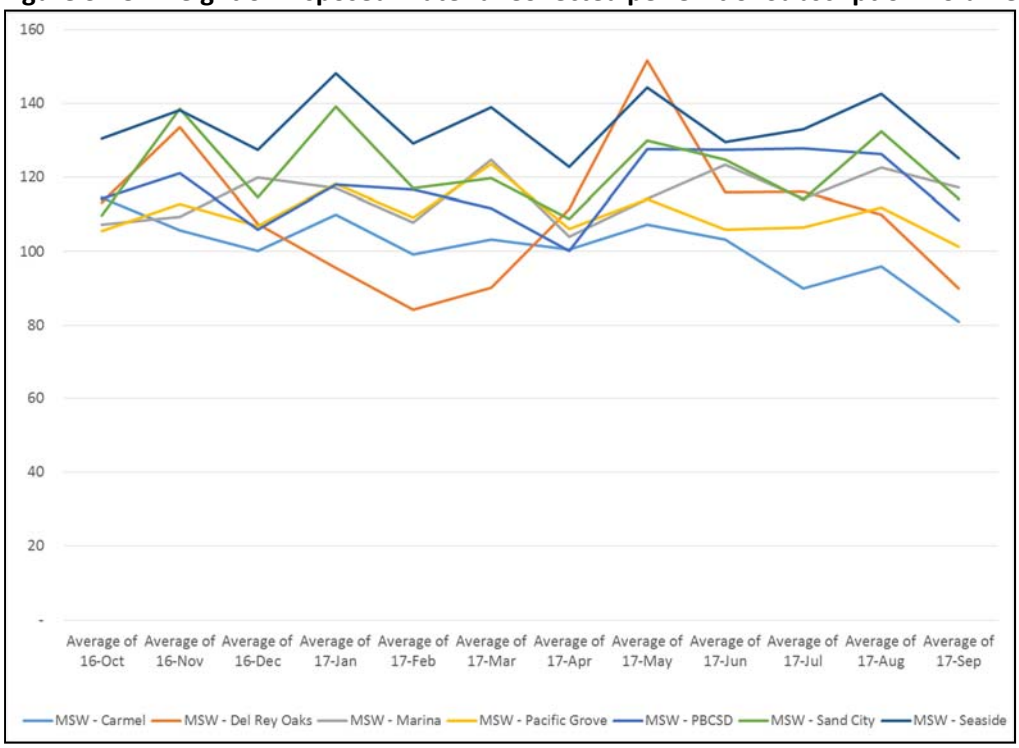


Figure 3-15: Weight of Disposed Material Collected per Unit of Subscription Volume



Use of Weight in Measuring Progress towards Reduced GSIG

As noted above with regard to the analysis of single-family recyclables and food scraps GSIG, there is benefit to using weight in addition to, or rather than, percentages to set goals for reducing GSIG. The single-family data suggest ways to set goals based on reducing the lower bound of GSIG for the Benchmark Service data distribution of single-family recyclables and food scraps. Weight is an absolute measure that does not mask changes in the composition of each of the streams. This is especially true for recyclables, for which a reduced percentage of GSIG by weight may be the result of changes in recyclables composition that reduce density, rather than reflecting changes in behavior.

The multi-family and commercial Benchmark Service data does not support the same type of statistical analysis as conducted for the single-family sector. However, analysis of the Characterization Study data and the addition of data from future sorts, such as for specific types of commercial organics businesses may support development of weight-based measures for reduced GSIG for these sectors.

The concept of using weights in addition to percentages is also discussed in Section 4.[41]

Developing Metrics for Materials Optimization

Agency staff are in the process of developing interim goals and related metrics for measuring progress in materials optimization, as shown in Figure 3-1. The Review Team was asked by Agency staff to undertake a limited review of readily-available work by other organizations that are active in materials optimization issues and that consider metrics for material use intensity, upstream intervention (through use of CE

[41] See Section 4, page 53.

Marking), co-benefits, and availability of data.[42] In consultation with Agency staff, the Review Team identified the work of the Oregon Department of Environmental Quality (ODEQ) as among the most innovative in this area with current projects underway of direct value to StopWaste. Agency staff are generally familiar, and in communication, with ODEQ staff working on these issues. Following are summary highlights of materials that will likely have components of use for StopWaste.

ODEQ's "Materials Management in Oregon: 2050 Vision and Framework for Action" was adopted in December 2012, with an emphasis on sustainable production and consumption. ODEQ has a number of new projects that address these "upstream" portions of the materials life cycle.

ODEQ has been working in partnership with the Oregon Concrete and Aggregate Producer's Association to provide free access to a web-based tool that helps producers measure and disclose the environmental impacts of concrete mixes through environmental product declarations (EPDs).[43] EPDs are third party verified ecolabels that can help to inform both production and purchasing decisions.

ODEQ has contracted with the University of Michigan Center for Sustainable Systems to review and summarize published scientific papers evaluating the life cycle environmental impacts of a variety of foods, as well as two issues that cut across multiple food types: the relative impact of transportation compared to other life cycle stages, and possible environmental trade-offs between packaging and food waste.

In partnership with the Washington State Department of Ecology, ODEQ has published four case studies of businesses that have undertaken product-level "environmental footprinting" or life cycle assessment. The case studies include:

- A furniture company's ability to create new tools to identify opportunities for improvement in evaluating and communicating the environmental impacts of its products;
- A manufacturer's ability to provide credible, third-party life cycle assessment testing results with consumers to substantiate environmental claims;
- A life cycle assessment that lends credibility to the environmental benefits of small batch digital printing; and,
- How a food company used an internally developed and externally reviewed life cycle assessment to understand the impact and resource use along the supply chain of its flagship product.

In December 2016, ODEQ published "Strategic Plan for Reuse, Repair and Extending the Lifespan of Products," the culmination of extensive background research and stakeholder engagement, and outlines specific reuse and repair strategies that will be a focus over the next six years, as well as some key materials.

Current progress includes the awarding of a number of reuse- and repair-related grants, the funding of workforce development training for the Portland-area's deconstruction industry, and new research into collaborative statewide workforce development opportunities to support the reuse and repair industries.

[42] See further description of "CE Markings" in Appendix A, page A-11.
[43] See www.ocapa.net/

Developing Metrics for Food Recovery

Introduction

In consultation with Agency staff, Review Team members conducted limited review and analysis tasks related to development of metrics to address the interim goal of "10 percent food recovery by restaurants and groceries by 2018" identified in Figure 3-1. The Review Team's food recovery work focused on data analysis and literature review. The data analysis focused on the Benchmark Service audit data, as well as analysis of applicable data from waste characterizations conducted for Thurston County, Washington (2013-2014) and Boulder, Colorado (2016).[44] Appendix A (page A-11) provides discussion of the following food-recovery related materials and activities selected in consultation with Agency staff:

1. LeanPath Alameda County Food Waste Study (2014)
2. NCRA Commercial Food Waste Reduction in Alameda County (2017)
3. Oregon DEQ's "Strategy for Preventing Wastage of Food" (2017).

The following addresses the Benchmark Service data, discusses definitions of "edible food" and provides estimates of edible food in the disposal stream.

Analysis of Commercial Benchmark Service Data

Sections 3 and 4 of the Review address various aspects of the Benchmark Service GSIG data collected from 2013 through 2017. With regard to food recovery, the Review Team analyzed commercial data related to restaurants, groceries, and general retail. Restaurants and groceries generally have the largest percentages of food scraps in their refuse containers. The Benchmark Service data is useful for understanding the very different distributions in GSIG between the general retail (Figure 3-16) and restaurant (Figure 3-17) sectors. Variations in these distributions can be of value in determining how best to shape sector-specific food recovery efforts.

[44] See Section 3, page 40.

Figure 3-16: General Retail - GSIG Distribution

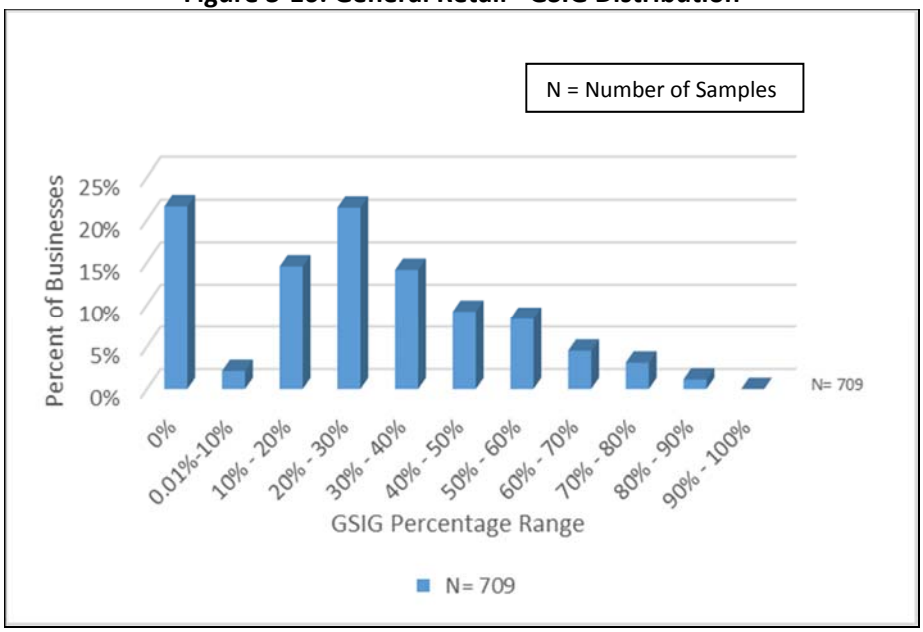
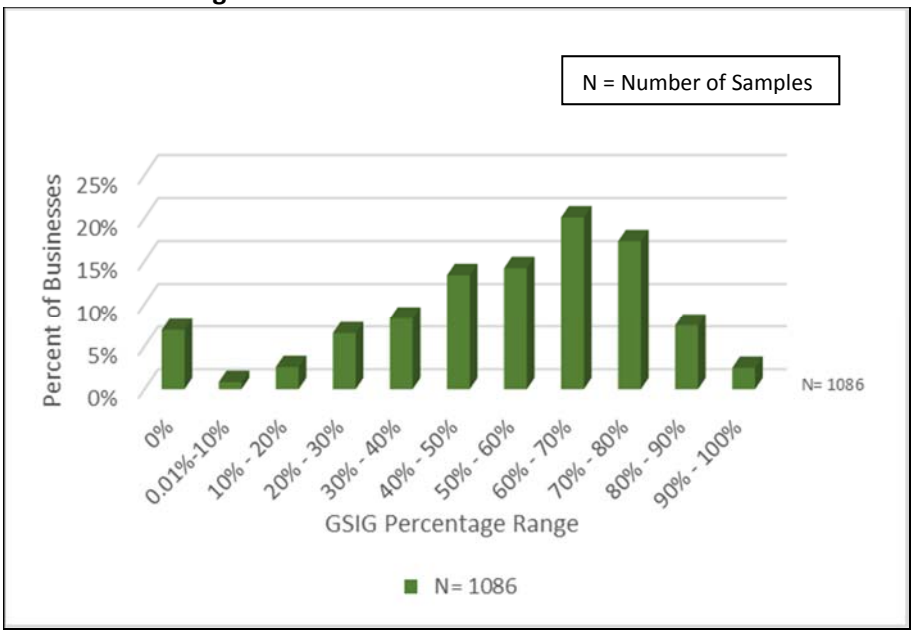


Figure 3-17: Restaurants - GSIG Distribution



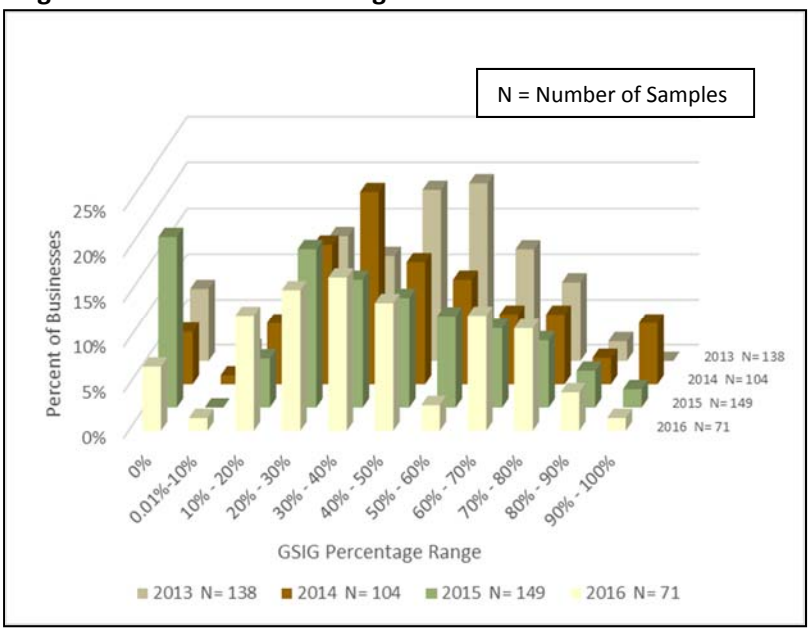
While the findings are not statistically significant, they indicate the following:

- For the sampled general retail businesses, as shown in Figure 3-16, about 20 percent of samples had no GSIG and about 50 percent of the samples had less than 30 percent GSIG.

- For the sampled restaurants, as shown in Figure 3-17, only about 5 percent of samples had no GSIG, while about 50 percent of the samples had more than 40 percent GSIG.

In addition, the Review Team analyzed the four years of Benchmark Service data to understand how GSIG changed over time. Again, although the results are not statistically significant, Figure 3-18 indicates a gradual, although unsteady, shift toward lower GSIG in the grocery sector from 2013 through 2016.

Figure 3-18: Groceries – Changes in GSIG Distribution Over Time



In summary, the Benchmark Service audit data demonstrates that the amount of food scraps varies widely between restaurants and grocers. In addition, in those instances in which the same customers were sampled repeatedly, GSIG for a specific customer varied significantly from one sample to the next. This variability indicates that to provide useful data related to food recovery, future commercial sampling will require taking a larger number of samples from targeted business types in order to provide results that carry a high level of confidence.

Definition of Edible Food

Discarded food is generally the largest single component of the residential and commercial waste streams. Uneaten "edible food" is a major sub-component of discarded food, but a difficult one to define. The term "edible food" broadly refers to food that is intended for human consumption but was discarded due to the unattractive appearance of food items, oversize portions, wasteful preparation methods, damage in handling, spoilage, or other reasons. The Review Team provided specific suggestions and examples for more specific means of identifying and sorting "edible food" separately from "inedible food" during waste sorts.[45]

[45] See further discussion in Appendix B, page B-7.

Food donation is a crucial vehicle for food recovery. The research was also useful in contributing to a methodology to define "edible food" in order to differentiate "wasted food" and "donatable food." Agency staff were particularly interested in definitions for avoidable (edible food) and unavoidable (inedible scraps) specifically intended for use with waste characterization studies or audits. As a further complexity, not all edible food that can be sorted can be donated for human consumption as, for example, plate scrapings. There are a variety of other factors that prevent food from being donated (empty calories, perishables, time and temperature standards, etc.). Agency staff were interested in any insights about ways to determine an estimate of the quantity of "pre-consumer food" that might be captured and the feasibility of assuming a percentage of that "edible food" that could be donated.

Agency staff developed definitions for review and comment.[46] These definitions included three components:

- Avoidable Food Waste (Edible Food)
- Unavoidable Food Waste (Inedible Food)
- Avoidable Produce Waste (Edible Fruit and Veggies)

Based in part on the work of the Review Team, StopWaste staff has decided to use the following definition(s) for "edible food":

Edible Food: Any substance intended for human consumption compatible with the definition of food in the Food Loss and Waste Accounting and Reporting Standard[47].

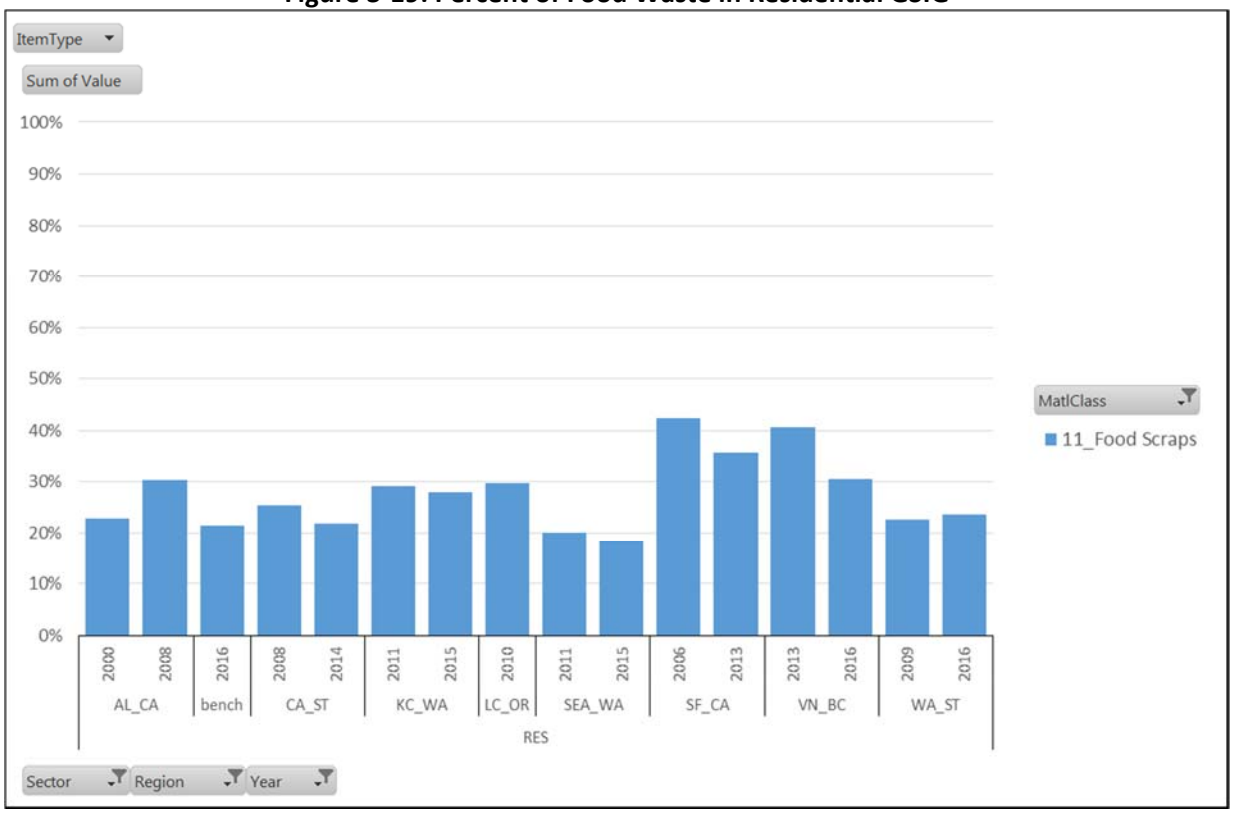
Inedible Parts: Components associated with food which is not typically consumed in the United States and/or for which significant skill or effort would be required to render edible; compatible with the definition of inedible parts in the Food Loss and Waste Accounting and Reporting Standard.[48]

Estimates of Edible Food

Section 4 includes detailed discussion of the organics portion of GSIG with relation to comparing the results of various waste characterizations. Figure 3-19 is a simplified version of Figure 4-10 of Section 4 (see page 56), showing just the food scraps portion of residential GSIG (single-family and multi-family combined). The food scraps percentages in Figure 3-19 range from 18 percent for Seattle in 2015 to 42 percent for San Francisco in 2006. San Francisco's 2006 data predates much of the city's high diversion program development and likely reflects the relatively high multi-family proportion of the city's population. We suggest use of San Francisco's 2013 figure of 36 percent as a reasonable "upper bound" for residential food scraps GSIG.

[46] See CVSan, "Residential Contamination Study Audit," November 3, 2015.
[47] See www.flwprotocol.org/ for FLW Standard; see Section 3.2.4: Definitions Related to Edibility
[48] Ibid.

Figure 3-19: Percent of Food Waste in Residential GSIG



Section 4 and Appendix B (pages 62 and B-8, respectively) provide limited discussion of recent waste characterizations from other parts of the country. The Review Team found that food scraps were generally in the range of 15 to 25 percent of the disposal stream and were always the largest single component of GSIG. The food scrap percentages are similar to those found in the studies shown in Figure 3-19.

Key to Abbreviations

Locations of Waste Characterization Studies

AL_CA	Alameda County, California
bench*	Recent Benchmark Studies in Alameda County
CA_ST	California Statewide Study
KC_WA	King County, Washington (excluding Seattle)
LC_OR	Lane County, Oregon
SEA_WA	Seattle, Washington (from King Co. Studies)
SF_CA	San Francisco, California
VN_BC	Vancouver, British Columbia
WA_ST	Washington Statewide Study

* The benchmark studies were not waste characterizations

The Review Team studied the methodology and results from the 2014 waste characterization study for Thurston County, Washington, which includes the city of Olympia. Thurston County is generally more rural than Alameda County, with a smaller total population of approximately 260,000 in 2014. Thus, the Thurston County findings may not be directly comparable. StopWaste based its definition of "food waste" and "edible food" on the definitions used in the Thurston County study. However, the Review Team found that:

1. Food waste represented 22 to 23 percent of residential garbage, and about 17 percent of total disposed wastes.

2. Edible food was less than 0.5 percent, and inedible food about 2 percent of the mixed organics from the residential "mixed organics" stream.
3. For the commercial sector, the comparable figures ranged from 17 to 26 percent for edible food, and 37 to 48 for inedible food.[49]

In conclusion, the Review Team finds that:

1. "Edible food" is probably a little less than half of all food wastes in the single-family, multi-family or commercial streams.
2. "Edible food" is probably about 10 percent of the refuse for any combination of single-family, multi-family or commercial streams.
3. As a first approximation, "edible food" in the Alameda County residential disposal stream (single-family and multi-family combined) is likely in the range of 8 to 12 percent of the total disposal stream.
4. We did not review published data on commercial samples that are broken down by type of business, although two recent studies do address this issue.[50]

Metrics for Construction and Demolition Material

Waste Generation Estimates

During work on the Review, StopWaste staff requested that the Review Team evaluate and update the Agency's "Waste Generation Estimates for Residential and Commercial Construction Projects."[51] This task was in support of work towards measuring the interim goal of "less than 45 percent C&D in the landfill by 2018," as shown in Figure 3-1 (page 12).

The waste generation estimates were developed in 2006 based on analysis of a year of C&D management plan data submitted to several Alameda County cities with the goal of developing estimates for C&D generation based on type of construction project. Data included total waste generated, including inerts and yard waste, for new residential, multifamily and commercial construction projects and for commercial tenant improvement projects. The waste generation estimates have served the Agency, member agencies and other users well over time.

[49] It is noteworthy that the study team was able to provide these results at all. As StopWaste staff have found during the current Waste Characterization Study for Alameda County, distinguishing edible from inedible food in a sample taken from a collection truck requires considerable care and some judgment; moreover, it is likely that some of the food waste in refuse samples has become inseparable from other materials during storage, collection and transport. Findings from studies of edible and inedible food waste from collection-vehicle samples are, arguably, lower bounds on food concentration rather than averages.

[50] See Oregon DEQ "Strategy for Preventing the Wasting of Food" at and Natural Resource Defense Council, "Estimating Quantities and Types Of Food Waste at the City Level."

[51] StopWaste, "Waste Generation Estimates for Residential and Commercial Construction Projects," 2006. See www.stopwaste.org/recycling/business/waste-management-plans.

With the elapsed time since they were developed, member agency staff have requested that StopWaste revisit the estimates to better assist in evaluating C&D waste management plans submitted by contractors and builders. Addressing this request supports StopWaste's interest in providing member agencies with tools to implement CALGreen requirements and local C&D debris recycling ordinances.

The Review Team first researched other local, regional, state and national sources for more recent waste generation estimates. Finding no definitive data, it was determined that obtaining local data would provide the most relevant basis for this update. C&D project reports were requested from Green Halo Systems, which provides C&D recycling tracking services for a number of member agencies. The requested reports provided project square footage and weight of generated discards (both recycled and disposed) for more than 2,000 construction projects that were completed for the cities of Alameda, Emeryville, Oakland, Pleasanton and San Leandro, the five member agencies with the greatest number of Green Halo reports between July 2014 and June 2017. Together, these cities represent a significant portion of Alameda County population and construction activity. The Review Team calculated ranges for demolition/deconstruction, new construction, remodeling, repair/reconstruction, and tenant improvement projects. The results are shown in Figure 3-20.

StopWaste and member agency staff are now reviewing the data. The goal is to develop updated, credible ranges of generation rates that member agency staff and others can use in evaluating builders' waste management plans for specific construction projects. While the ranges shown in Figure 3-20 are quite large, the median figures likely present useful mid-points when averaged across many projects. The hope it that member agency comments will help in selecting the most useful types of projects, possibly with narrower generation rate ranges for inclusion in the updating of the current waste generation estimates.

Figure 3-20: Construction and Demolition Waste Generation Rates (Lbs/Sq Ft)

Building Type	Project Type	N	Median lb/sqft	Low Lb/Sq Ft	High Lb/Sq Ft
Commercial	Demolition/Deconstruction	57	10.0	1.5	43.5
Commercial	New Construction	65	14.8	2.6	59.3
Commercial	Remodel	88	6.9	1.9	20.1
Commercial	Repair/Reconstruction	57	10.0	1.5	43.5
Commercial	Tenant Improvement	415	3.8	1.2	11.6
Multi-Family	New Construction	96	6.0	3.6	10.8
Office	Tenant Improvement	270	2.3	1.0	6.1
Residential	New Construction	390	7.3	3.9	14.6
Residential	Remodel	162	24.6	9.0	67.4
Retail	Tenant Improvement	65	6.4	1.7	17.6

Notes:
1. "N" is the number of reports per category.
2. The distribution of low to high represents the 20 to 80 percentile results.

C&D Recovery Facilities – Third-Party Certification

The topic of third-party certification, and the expanded role it could play is a focus of Section 2 (see page 8). Third-party certification of mixed C&D facilities is a key component of StopWaste's C&D program and provides insight into how the concept could be more broadly applied.

In recent years, StopWaste has developed programs and resources to support the C&D "industry" (architects, contractors, etc.) and member agencies to promote and increase the recycling and reuse of C&D materials generated from building projects. Member agency C&D recycling ordinances, CALGreen state green building code C&D diversion requirements, and green building rating programs like LEED (US Green Building Council's Leadership in Energy and Environmental Design) and Build It Green's GreenPoint Rated have all contributed to increased tracking, reporting and diversion of C&D materials generated on jobsites.

In response to increasingly stringent diversion requirements, some member agencies have revised their C&D ordinances and are taking new approaches to assess compliance, including requiring contractors to bring C&D materials to facilities that have a third-party-certified recycling rate. Third-party-certified recycling rates are material diversion rates that are reviewed and evaluated by an independent outside party according to a standard, published protocol. Third-party certification also supports maximizing the ability of processors to sort reusables and recyclables to improve diversion rates as end-use market availability and pricing changes.

A limited number of facilities in the Bay Area have such certifications. Recognizing the need for additional certified facilities and the importance of reliable third party verification, StopWaste has developed a financial incentive program to encourage mixed C&D recovery facilities to become certified. StopWaste staff is also monitoring additional efforts to develop third party certification programs and protocols. Progress and opportunities for participation are regularly communicated to the C&D Working Group, comprised of member agency staff working on C&D issues.

SECTION 4: UNDERSTANDING THE REMAINING DISPOSAL STREAM

Introduction

StopWaste is conducting a waste characterization study (Characterization Study) and anticipates presenting the results and related analysis to the Boards in May 2018.[52] StopWaste previously conducted waste characterizations in 1995, 2000 and 2008, and the results have played an important role in evaluating progress and in shaping future policies and programs. The Characterization Study will provide updated information regarding the GSIG remaining in the disposal stream, and will help identify progress towards reaching the 2018 Interim Goals discussed in Section 3, as well as provide important information for shaping the next strategic plan.

The waste characterization analysis for the Five-Year Program Review (Review) is intended to provide a means of comparing the new GSIG data from the Characterization Study, once available, to similar Alameda County data from previous StopWaste waste characterizations and from the Benchmark Service audits, and to waste characterization data from other jurisdictions in the U.S and Canada with high-performing programs and comparable levels of success in achieving relatively high diversion goals. The primary focus of Section 4 and Appendix B is to describe and provide examples of potential uses for an analytical tool (Comparative Program Tool, or Tool) developed by the Review Team for StopWaste use. The Tool can be used to analyze "recoverable materials" – both recyclables and compostables - remaining in the Alameda County disposal stream, and to compare GSIG for Alameda County with that remaining in other jurisdictions' disposal streams. Use of the Tool can help inform future strategic planning and goal setting in general, as well as assist in addressing specific priorities such as food recovery.

The following limitations regarding the analysis contained in this section reflect the inherent variations in waste characterization data collected at different times, for different jurisdictions and for different purposes. While such variations can be minimized, they cannot be eliminated.

1. Sorting methods – how samples are physically collected for characterization – can vary and can affect the results. As discussed below, to address this issue the selected waste characterizations have similar methodologies to those conducted by StopWaste.
2. The customer sectors may vary from one waste characterization to another, and may vary in how they are defined. For instance, as referenced below, some of the waste characterizations discussed in Section 4 collected and analyzed separate data for single-family and multi-family, while others used a combined "residential" sector.
3. Variations in definition of broad material categories, and especially of the specific target types within the categories. In developing and using the Tool, the Review Team sought to address distinctions in material categories and types across waste characterizations to maximize the ability to compare results.
4. Policies and programs, even when seemingly comparable may vary in their impacts on GSIG. For instance, mandatory separation requirements vary in whether and to what degree they are

[52] The Review uses "Characterization Study" to refer to StopWaste's current waste characterization study, and "waste characterization(s)" to refer to earlier StopWaste characterization studies and to characterization studies conducted by the other jurisdictions.

enforced. The maturity of a policy or program, and how long it has been in effect will affect disposal habits and GSIG. The selection of jurisdictions took these types of distinctions into account.

5. The comparisons of data and identification of possible associations across multiple studies and between factors discussed in Section 4 have not been tested for statistical validity, and do not necessarily indicate either correlation or causation.[53]

For this task, the Review Team:

- Conducted an initial review of waste characterizations from 15 other jurisdictions.
- Provided StopWaste staff a shortlist of nine jurisdictions, with six of the jurisdictions recommended for analysis based on specified criteria. Staff concurred with the recommended selection. All of the selected jurisdictions, other than Lane County have conducted multiple waste characterizations, thus allowing for comparisons over time.
- Developed summary profiles identifying key policies, programs and characteristics for the six selected jurisdictions, with a focus on the factors that are most likely key to driving diversion and discard practices within each jurisdiction.
- Constructed the Tool in Microsoft Excel for StopWaste use. Ensuring comparability of data required review of the material types used in the various waste characterizations, with particular focus on food-related definitions. The Tool, as provided to StopWaste staff contains thousands of uploaded data points from 11 studies for the six selected jurisdictions, as well as StopWaste data from the 2013-2017 Benchmark Service audits and waste characterization data from StopWaste studies from 2000 and 2008. The Review Team recommends adding the results of the Characterization Study, once available, to the Tool.
- Prepared a sampling of graphic comparisons, using the data contained in the Tool, to illustrate how the Tool can be used to assess possible associations between waste characterization data and key program features for specific jurisdictions, as well as identify possible larger patterns across data from multiple jurisdictions.
- Provided more summary level observations regarding the waste characterizations conducted for seven other jurisdictions, from other parts of the United States that were not included in the analysis.

Section 4 provides a summary of the Review Team's waste characterization analysis. Appendix B Waste Characterization Analysis – Additional Material provides added detail for many of the issues discussed in Section 4.

Historical Context

A brief history of the role of waste characterizations provides context for the discussion in Section 4. Waste characterizations were first conducted in the 1960's with a focus on identifying the energy available for burning wastes using waste-to-energy. By the late 1970's, systems were being developed to sort solid wastes into marketable materials, and the recoverable amounts of these materials became the focus of data collection. Today, waste characterizations provide baseline data enabling local and state

[53] See discussion of statistical analysis in Section 3 (page 23) and Appendix D.

governments to identify and evaluate which discard prevention and management programs have the greatest potential for achieving policy and program goals.

Over time, the typical number of "material types" (subcategories of recoverable materials) included in a typical waste characterization increased from about 20 to more than 150, in order to better fine-tune waste reduction programs. In the 1960's, all plastics and paper were considered part of the "fuel fraction," the material with energy content. By contrast, recent studies in King County, Washington defined 20 types of plastic alone, based on type of resin and type of product. Vancouver, British Columbia listed 29 types of plastics in its 2016 study, versus 16 in 2013. The evolution of treatment of "organic materials" is similar, with the current focus on identifying the edible and non-edible components of food scraps. For recyclables in general, the results of waste characterizations reflect changes in consumption patterns.[54]

Selection of Jurisdictions

The first step in analysis of waste characterizations was to select the six comparison jurisdictions.

Figure 4-1 summarizes the key criteria used to develop the shortlist of jurisdictions for StopWaste review. Based on the criteria in Figure 4-1 and the available waste characterizations, the following jurisdictions and waste characterizations, shown by year conducted, were selected:

- State of California (2008, 2014)
- King County (and Seattle), Washington (2011, 2015)
- Lane County (and Eugene), Oregon (2010)
- San Francisco, California (2006, 2013)
- Vancouver, British Columbia (2014, 2015, 2016)
- State of Washington (2009, 2016)

[54] See Appendix B, page B-1 for more detail related to defining material categories and types.

Figure 4-1: Key Criteria in Jurisdiction Selection

Criteria	Objectives
Program Maturity	Select jurisdictions with relatively "high performing" and longstanding programs that address all sources of discards and that are generally comparable to those in Alameda County.
Comparable Methodology	Select jurisdictions with data collection methodologies that are relatively comparable to that used for the Characterization Study.
Comparable Material Categories and Types	Select jurisdictions with waste characterization that minimize variation in material categories and types, and that, for more recent studies define an edible food component of the GSIG.
Recent Studies	Select jurisdictions with relatively recent waste characterizations to capture the effects for GSIG of the "evolving ton" for recyclables and the addition of food scraps programs.
Repeated Studies	Select jurisdictions with repeated waste characterizations using comparable methodologies that allow for comparison between that jurisdiction's waste characterizations, and with those of other jurisdictions.

Note that all six jurisdictions are in the western US and western Canada.[55] See "Selection of Jurisdictions" and Figure B-2 of Appendix B for additional detail regarding comparison of each jurisdiction to the key selection criteria. With the addition of Alameda County waste characterizations from 2000 and 2008, and StopWaste's Benchmark Service audit data the complete data set comprises 15 distinct waste characterizations.[56] [57]

Two of the shortlisted jurisdictions that were not selected for the final list of six jurisdictions will be important future sources of data.[58] Oregon State and Portland METRO were not included in the analysis due to timing. As the Review was being drafted, Oregon's Department of Environmental Quality was completing analysis of data from an updated statewide waste characterization, which should be of significant value when issued, along with comparable data for locations within Oregon, such as Portland. The newer data, once available should be added to the Tool and incorporated into the analysis. The most recent available Oregon State waste characterization, completed in 2010 was excluded because its food classifications are limited. The most recent available Portland METRO data was from 2009 and pre-dates

[55] In identifying waste characterizations that best meet the criteria contained in Figure 4-1, the Review Team noted that the most useful studies were generally from western North American jurisdictions due to overall emphasis on and success in achieving higher levels of diversion, greater emphasis on prevention in addition to "downstream" management of discards, greater program maturity (especially for food scraps collection), and a focus on food recovery.

[56] The Benchmark Service data for Alameda County is for the years of 2013 through mid-2017, and has been assigned a nominal date of 2016. See Section 3 of the Review for further analysis of the Benchmark Service audit data.

[57] StopWaste first conducted a waste characterization in 1995. Many of the six selected jurisdictions conducted waste characterizations prior to 2006. These earlier studies are excluded from this analysis because they do not meet the "recent studies" criteria from Figure 4-1.

[58] Austin, Texas, the third shortlisted jurisdiction was not selected for inclusion due to relative lack of comparability of the data and of existing programs.

Portland's significant 2011 shift to every-other-week collection of residential garbage coupled with the addition of food scrap collection.

In addition, see Section 4 page 62 and Appendix B page B-8 for a summary review of recent waste characterization data for seven other jurisdictions in other regions of the United States.

Jurisdictional Profiles

Figure 4-2 summarizes key policy and program features for the six jurisdictions, providing a high-level snapshot of key factors that can play the largest role, all else being equal, in driving discard behavior.[59] [60] For Figure 4-2:

- "EPR" or Extended Produce Responsibility policies and programs that, in various ways, focus on private sector funding of end-of-life management of consumer products.
- "Diversion Goals" refers to jurisdictions with goals of diverting 50 percent or more of the total discard stream from disposal.
- "Mandatory Separation" refers to specific policies requiring separation of garbage, recyclables and organics, with at least some degree of enforcement.
- "Disposal Ban(s)" refers to programs that are in place, such as Seattle's construction and demolition material ban and Metro Vancouver's bans on recyclables and food scraps disposal, or that are pending, such as California's organics disposal ban.
- "Bottle Bill" refers to programs that provide direct economic incentive for consumers to recycle rather than dispose of specified types of beverage containers.
- "Low Volume Garbage Options" refers to small container options (equal to or less than 20 gallons per week) such as those available to residents of San Francisco and Seattle, and every-other-week garbage collection available to residents and businesses in Eugene, Oregon.

Note that policies and programs for the cities of Seattle, Eugene and Vancouver vary from those of the larger governmental entity in which they are located - King County, Lane County and the Province of British Columbia, respectively. In each case, Figure 4-2 references the more stringent requirements. Note also that some programs, such as low generator options are regional or local in nature, and are not a feature of statewide programs. For detail regarding the policies and programs, see Figure B-3 of Appendix B.

[59] Key demographic characteristics, goals and policies for the six jurisdictions are further detailed in Figure B-3 of Appendix B (page B-4).

[60] Of course, many other factors also influence discard behavior, such as reduced collection rates for commercial recycling and organics relative to those for garbage. Note that the availability of low generator garbage options can result in added contamination of the recycling or organics streams. Such shifts in material are detected only if data is simultaneously collected for all three streams.

Figure 4-2: Summary Policies and Programs for Selected Jurisdictions

Location	EPR	Diversion Goal	Mandatory Separation	Disposal Ban(s)	"Bottle Bill"	Low Volume Garbage Option(s)
California State	✔	✔		✔	✔	
King County, Washington		✔	✔	✔		✔
Lane County, Oregon	✔	✔		✔	✔	✔
San Francisco, California	✔	✔	✔		✔	✔
Vancouver, British Columbia	✔	✔			✔	
Washington State		✔		✔		

Comparative Program Tool

The Review Team constructed a "Comparative Program Tool" (Tool) in Microsoft Excel that can be used to select, compile and compare waste characterization data from: 1) the six jurisdictions: 2) the Alameda County waste characterization data from 2000 and 2008; and, 3) the available data from the Benchmark Service audits conducted by StopWaste from 2013 through 2017. It will be relatively easy to add data to the Tool in the future, including that from the current Characterization Study and the current Oregon State and Portland waste characterizations. The Tool has been provided to StopWaste staff, along with instructions for its use. The current version of the Tool has nearly 6,000 data records.

Using the Tool to Compare Data

The various comparisons presented below draw on waste characterization data from the six jurisdictions as well as the information in Figures 4-2 and Figure B-3 of Appendix B to identify possible associations between jurisdictional polices, programs and characteristics, and remaining GSIG.

This subsection illustrates use of the Tool to:

1. Compare GSIG detail by sector.
2. Compare Alameda County GSIG data from 1995, 2000 and 2008.
3. Identify broad trends for GSIG across jurisdictions and over time.
4. Identify specific trends over time.
5. Identify the impact of policy and programs on GSIG.

In each case, the objective is to provide examples of how the Tool can be used, rather than to catalog all possible observations the data may support. In addition, the discussion illustrates particular issues related to comparing the data.

Comparing GSIG Detail by Sector

Figures 4-3 through 4-6 illustrate the proportions of GSIG for all of the waste characterizations contained in the Tool as listed on page 46, for the single-family (SFD), multi-family (MFD), combined residential (RES) and industrial, commercial and institutional (ICI) sectors. The key to the right corresponds to the jurisdictions noted in Figures 4-3 through 4-6.

Figures 4-3 and 4-4 are limited to those waste characterizations that separately address single-family and multi-family.

Key to Abbreviations

Locations of Waste Characterization Studies

AL_CA	Alameda County, California
bench*	Recent Benchmark Studies in Alameda County
CA_ST	California Statewide Study
KC_WA	King County, Washington (excluding Seattle)
LC_OR	Lane County, Oregon
SEA_WA	Seattle, Washington (from King Co. Studies)
SF_CA	San Francisco, California
VN_BC	Vancouver, British Columbia
WA_ST	Washington Statewide Study

* The benchmark studies were not waste characterizations

Figure 4-3: Percent of GSIG for Single-Family

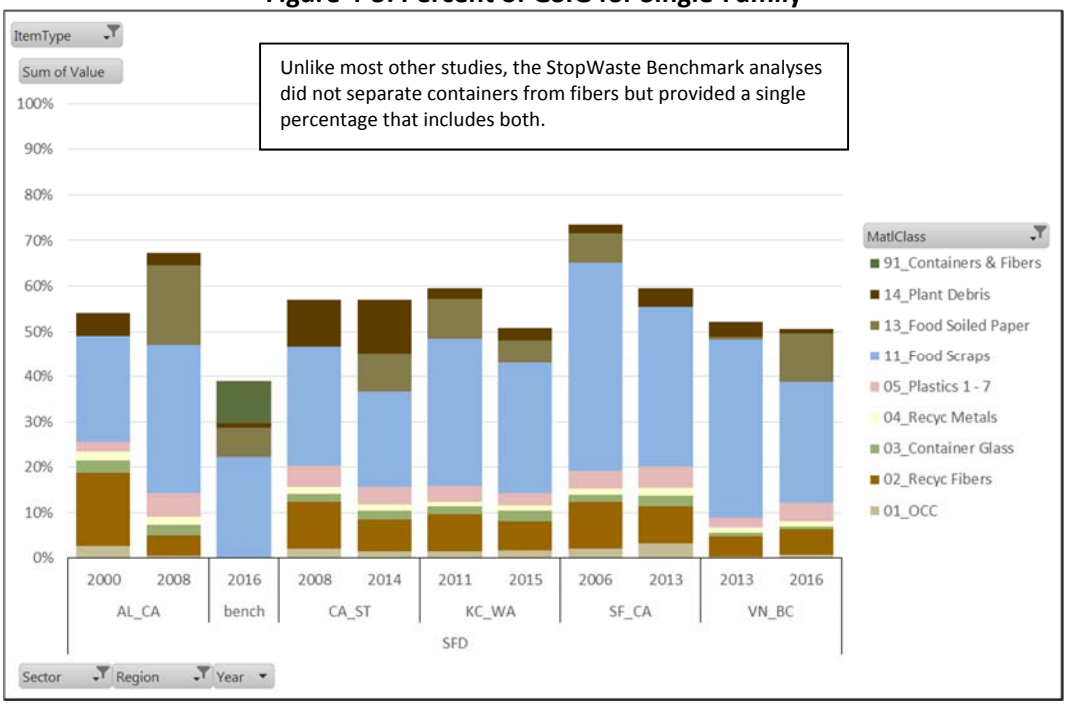


Figure 4-4: Percent of GSIG for Multi-Family

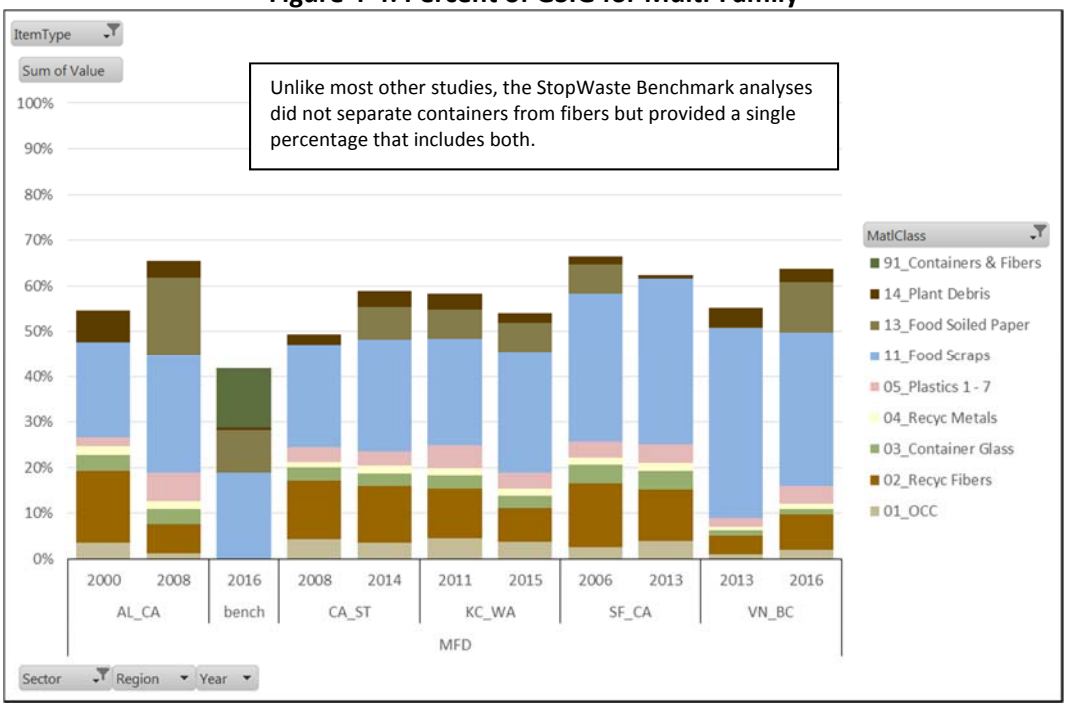


Figure 4-5 shows information for all of the studies, combining single-family and multi-family as a single residential sector, total GSIG is generally in the 40% to 60% range. Three jurisdictions – King County, Seattle, and San Francisco – have a noticeable reduction in GSIG for their most recent waste characterization, compared to the one preceding it. We can speculate that this may be the result of greater outreach and program maturation for organics diversion options, and especially food-related organics. Figure 4-5 also illustrates that Alameda County's recent Benchmark study found substantially less GSIG, 40%, than the 67% found by the waste characterization from 2008. This result may be due to increased food scrap diversion, and/or a difference in the method of sampling.[61] Statistics and conjecture aside, with regards to residential GSIG, Alameda County is as successful as other jurisdictions in reducing GSIG. Note also that none of the jurisdictions are close to reaching a goal such as 10 percent for residential GSIG.

[61] Benchmark samples are taken from individual generators prior to compaction or mixing in a refuse collection truck. The amount of liquid and contaminant that penetrates fiber recyclables in a refuse truck can be substantial. For instance, the Lane County waste characterization measured the contaminants and moisture in sampled materials and found that it added approximately 7% to the weight of recyclable paper products.

Figure 4-5: Percent of GSIG for Combined Residential

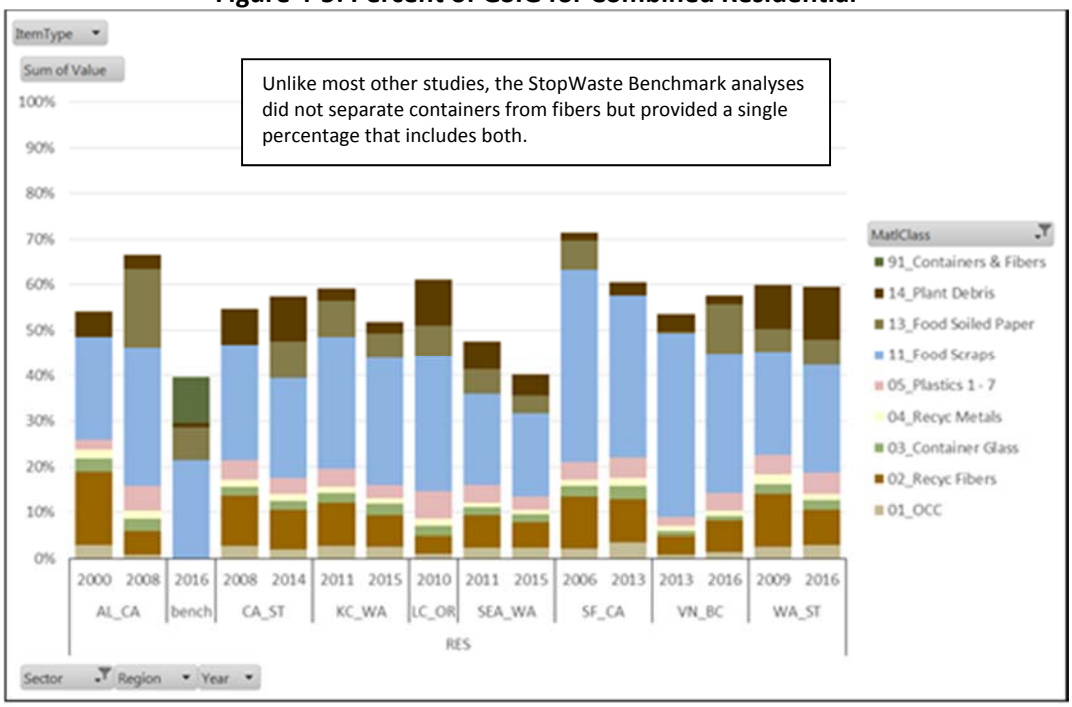
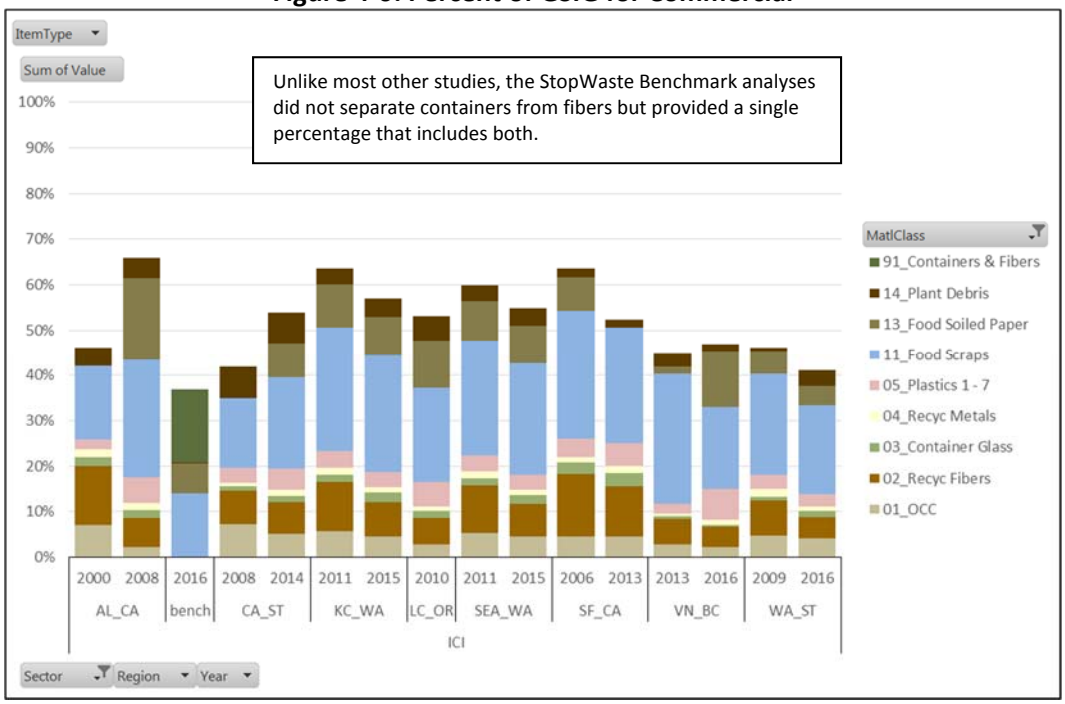


Figure 4-6: Percent of GSIG for Commercial



Note in all four figures the nearly complete disappearance of plant debris from Alameda County wastes, as shown in the Benchmark Service audit data, versus the Alameda County waste characterizations from

2000 and 2008. Although the California drought may have been a contributing factor, it had little or no impact on the California statewide waste characterization result. Thus, one might infer that the Alameda County plant debris ban is the more likely cause of this change.

Comparing Alameda County Data Over Time

Figures 4-7 and 4-8 show data for broad categories of material and for all sectors from Alameda County's waste characterizations of 1995, 2000 and 2008. The two figures illustrate how two different views of the same data, one as *relative weight-based percentages* and one as *absolute weight in tons*, can help identify changes that have occurred over time. Viewing the relative percentages in Figure 4-7, it is apparent that the composition of the average ton has been changing, with less paper, less yard waste, and more other "organics" (principally food scraps).

Figure 4-7: Alameda County Waste Characterization (% of Disposal Stream)

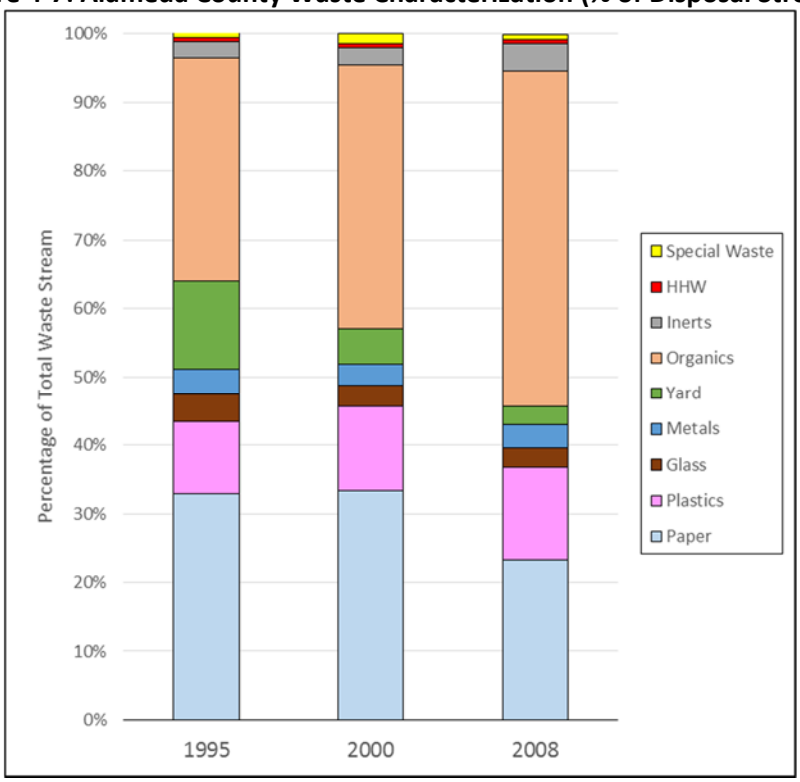
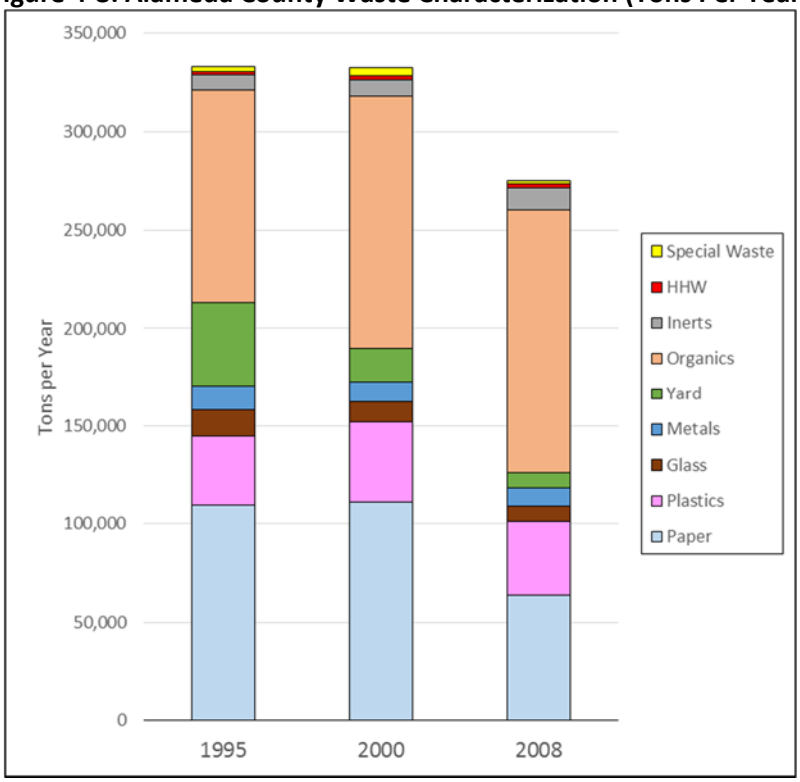


Figure 4-8: Alameda County Waste Characterization (Tons Per Year)



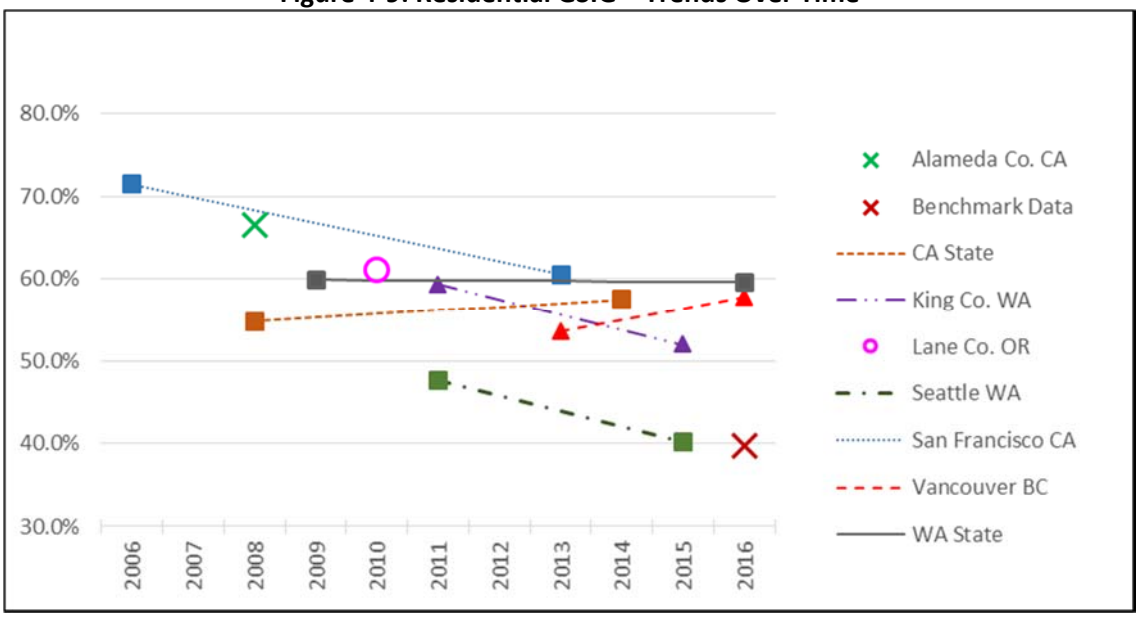
Note in Figure 4-8, that the *absolute quantity* of the "organics" category has not grown so dramatically; rather, the reduction in paper and yard waste has led to the much higher *proportion* of other organics shown in the first figure. In this example, use of both relative and absolute measures provides a fuller picture.

Use of relative weight-based percentages, as in Figure 4-7 is the primary means used for comparing waste characterization data across jurisdictions. While comparing absolute quantities (as in Figure 4-8) provides additional insight, the technique has limitations due to varying methodologies used in various waste characterizations. However, in evaluating program efficacy, combining the use of percentage and weight comparisons can be well worth the added effort. Other than for Figure 4-8, conventional, relative weight-based percentages are used in the remainder of Section 4.

Comparing Broad GSIG Trends Across Jurisdictions and Time

The Tool can be used to graphically track trends in data over time, provided the data are reasonably consistent across waste characterizations. Figure 4-9 shows the values for aggregated GSIG for combined residential (single and multi-family) for all jurisdictions and for the years of data currently included in the Tool. Thus, for example, Figure 4-9 shows a single "X" for Alameda County for the 2008 WCS, while Figure 4-9 indicates that residential GSIG decreased for San Francisco, Seattle and King County, increased for California state and Vancouver, and remained the same for Washington State. The data also indicates a dramatic decrease for Alameda County from the 2008 waste characterization (at over 65%) to the Benchmark Service audit data (about 40%).

Figure 4-9: Residential GSIG – Trends Over Time

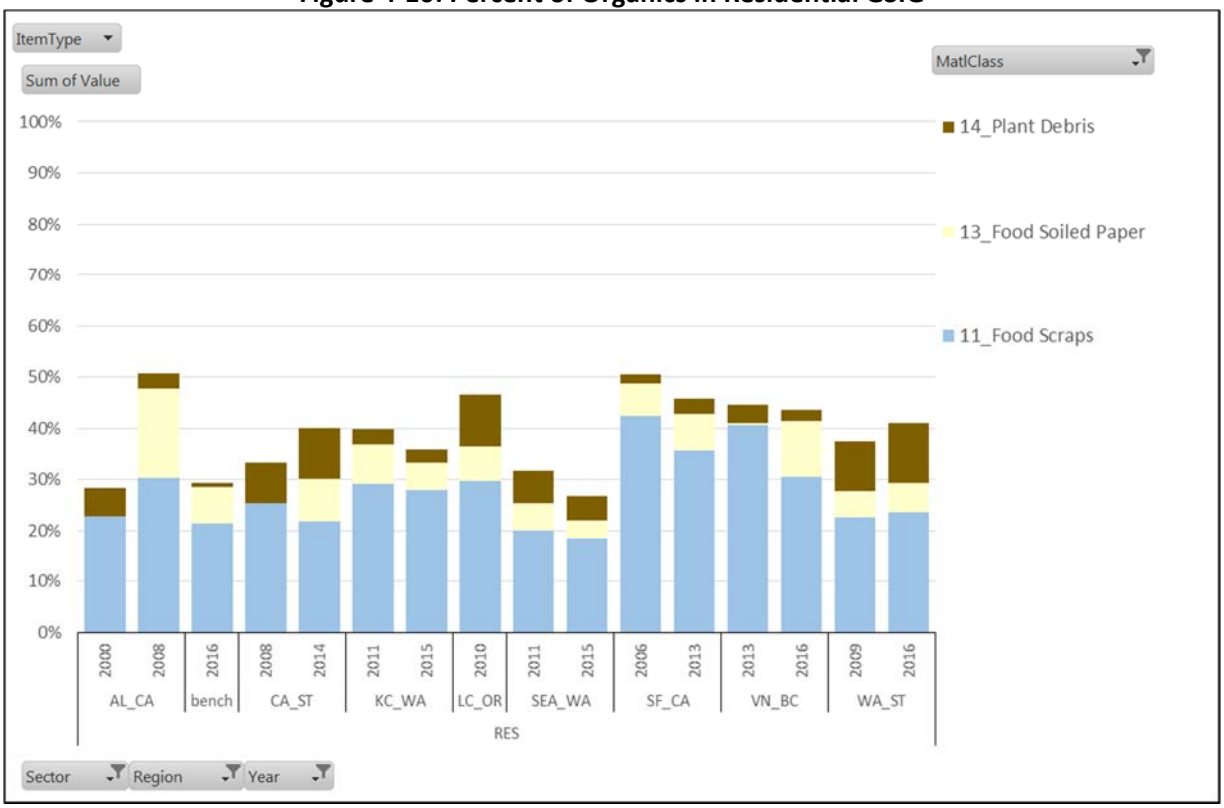


Identifying Specific Trends Over Time

Figures 4-10 through 4-12 illustrate ways in which the individual components of GSIG have changed for the combined residential sector (single-family and multi-family) and separately for the single-family and multi-family sectors. The key below corresponds to Figures 4-10 through 4-12.

Figure 4-10 provides the same data as used in Figure 4-5, but limited to the organics portion of GSIG. The declines in organics accounts for half of the reduction in GSIG for King County and Seattle, and all of the reduction found in San Francisco. Note that food soiled paper was not defined as a separate category for several of the earlier studies.

Figure 4-10: Percent of Organics in Residential GSIG



Figures 4-11 and 4-12 draw on data from the waste characterizations that differentiate single-family and multi-family data, and illustrate relative percent changes in cardboard contained in the two sectors' disposal streams. Figures 4-11 and 4-12 demonstrate that for several jurisdictions the proportions of discarded cardboard have been increasing in recent years. As might be expected, when comparing single-family to multi-family data within regions, it is clear that the single-family sector disposes less cardboard than the multi-family sector.

Key to Abbreviations

Locations of Waste Characterization Studies

AL_CA	Alameda County, California
bench*	Recent Benchmark Studies in Alameda County
CA_ST	California Statewide Study
KC_WA	King County, Washington (excluding Seattle)
LC_OR	Lane County, Oregon
SEA_WA	Seattle, Washington (from King Co. Studies)
SF_CA	San Francisco, California
VN_BC	Vancouver, British Columbia
WA_ST	Washington Statewide Study

* The benchmark studies were not waste characterizations

The two figures also illustrate a potential drawback of comparing data that are relative percentages. With the "Amazon effect," the total amount of cardboard in the recycling stream has been growing; however, does the San Francisco percentage increase in cardboard in single-family and multi-family garbage between 2006 and 2013 reflect the overall growth in cardboard use for small-package home delivery?

Conversely, do the Alameda County and California statewide percentage decreases in cardboard in both single-family and multi-family garbage between 2008 and 2014 reflect improved separation practices reducing cardboard in GSIG? In order to definitively resolve questions like these, a deeper look at both recycling and garbage data, expressed as tonnages, would be helpful. Current data for recycling are not as robust as for garbage, but once AB 901 data becomes available, it may be possible to make such comparisons.

Figure 4-11: Percent of Cardboard in the Single-Family Disposal Stream

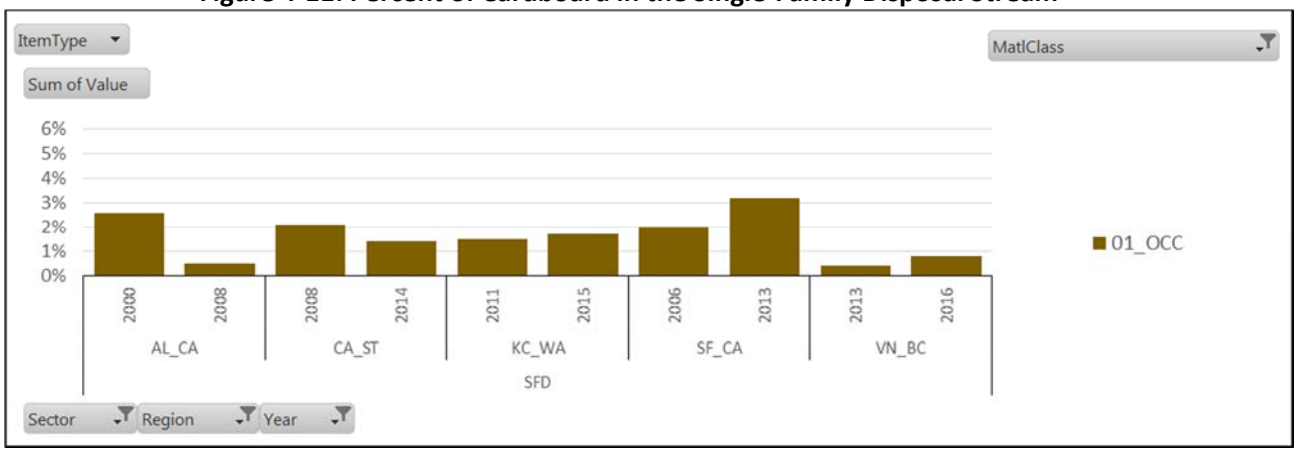
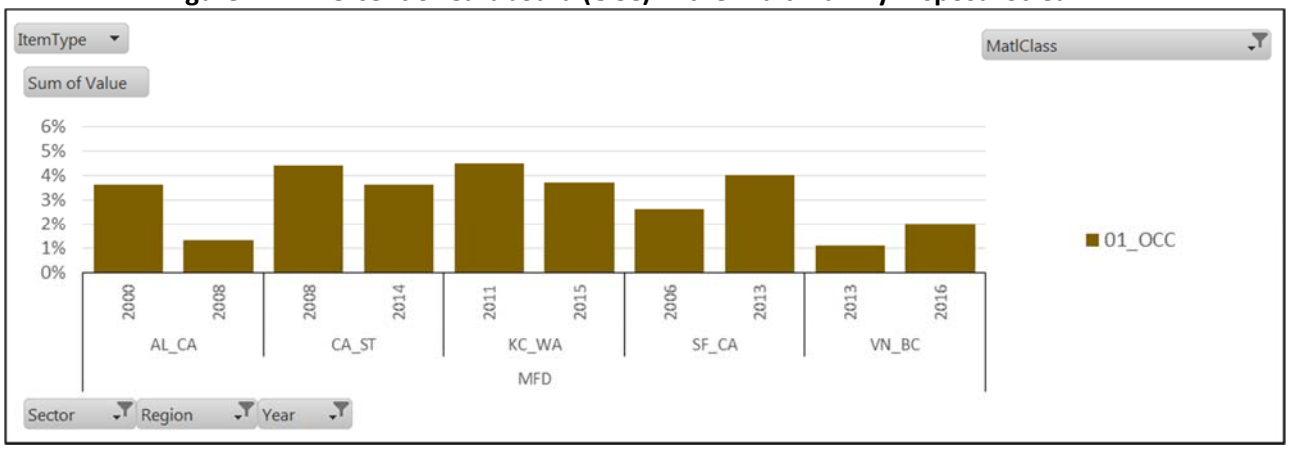


Figure 4-12: Percent of Cardboard (OCC) in the Multi-Family Disposal Stream



Comparing Policy and Program Impacts

The following are several examples of addressing specific policy questions by drawing on the program information in Figure 4-2 and Appendix B Figure B-3, and the GSIG data contained in the Tool. The ability to address these types of questions will be more robust as more, newer data is added to the Tool. In addition, using absolute weights in addition to percentages might provide a more complete picture.

Mandatory Separation

Question

Does GSIG for jurisdictions with mandatory separation contain less recyclables and less organics than for jurisdictions without mandatory separation requirements?

Background

San Francisco and Seattle require mandatory separation by residents and businesses.

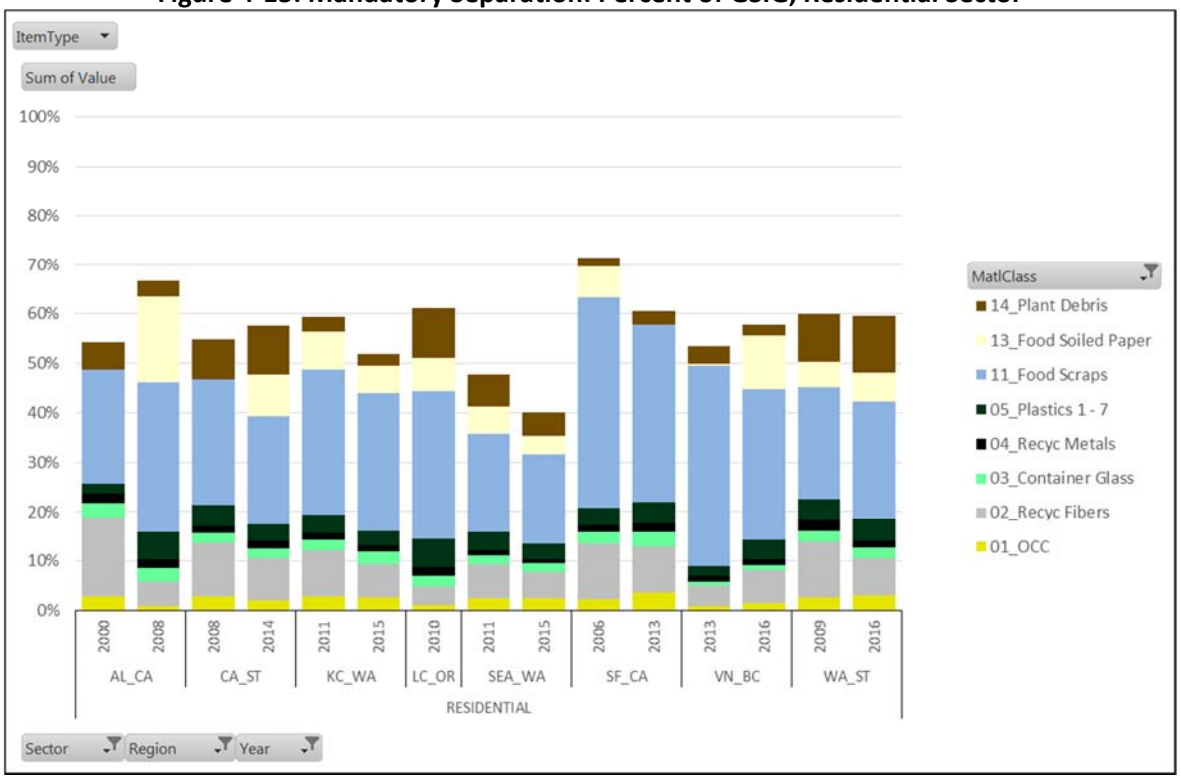
Comparison

Figure 4-13 compares the most recent residential data for Seattle and San Francisco, with the other selected waste characterizations. The available Alameda County data pre-dates mandatory separation requirements. Alameda County GSIG appears to be increasing over time, but this is due to the addition of food-soiled paper to the 2008 waste characterization categories. In 2000, heavily food-soiled paper would have been classified as refuse.

With regard to total GSIG, San Francisco's proportion shows a steep decline between 2006 (prior to the addition of separation requirements) and 2013, largely due to improvement in the single-family sector. Seattle's total residential GSIG also drops significantly between 2011 and 2015. As noted above for Figure 4-10, the decline in organics accounts for half of the GSIG reduction for Seattle and all of the reduction for San Francisco. Similar patterns occur for the commercial sector.

While these are interesting results, without application of statistical analysis it is not possible to determine whether the decreases for jurisdictions with mandatory separation are causal in nature.

Figure 4-13: Mandatory Separation: Percent of GSIG, Residential Sector



"Bottle Bills"

Question

Does GSIG for jurisdictions with bottle bills contain less glass than in those without?

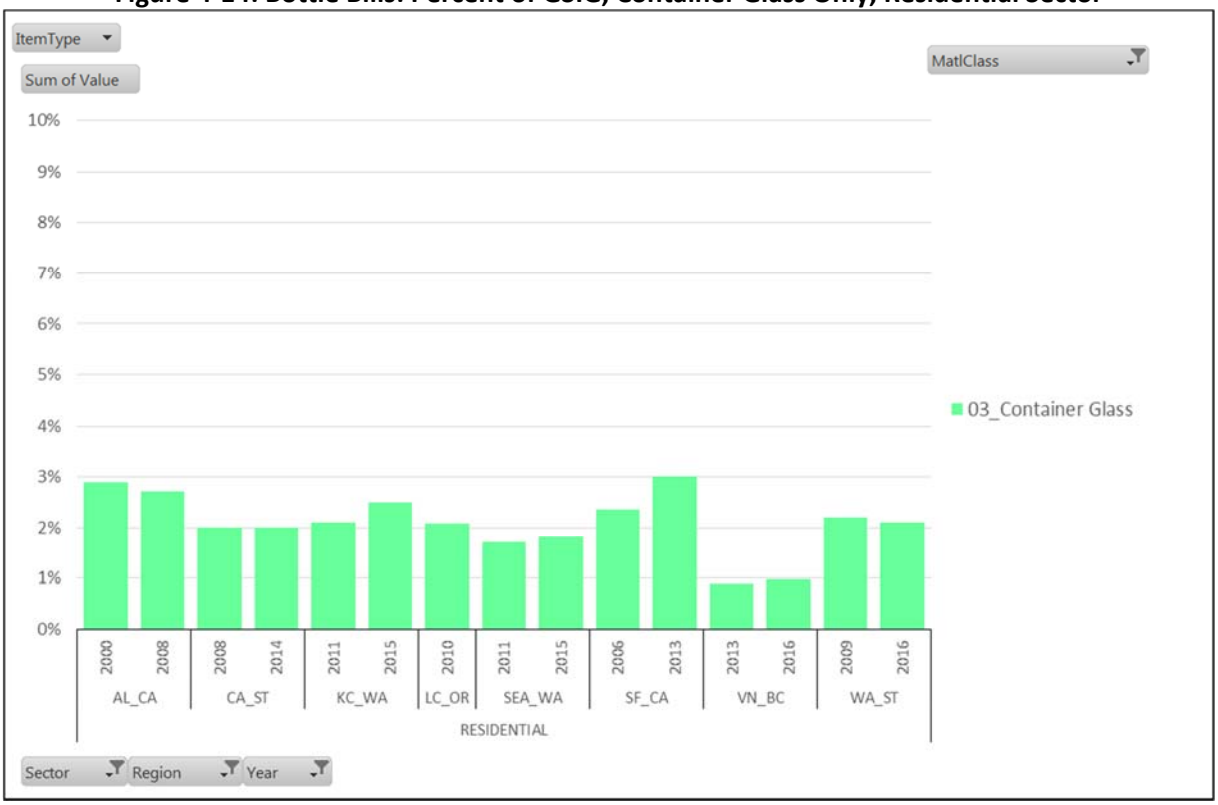
Background

Both California and Oregon have long had statewide bottle bills that place a redemption value on glass containers. British Columbia's extended producer responsibility (EPR) approach varies from that of California and Oregon, is newer, and has similar incentives.

Comparison

Figure 4-14 compares combined residential (single-family and multi-family) data for State of California, Lane County, Oregon, King County and the City of Seattle, with that of other jurisdictions, including Washington State, which do not have bottle bills. Figure 4-14 shows the results for "container glass," for the combined residential sector. With the exception of Vancouver, there is no apparent substantial difference between jurisdictions with and without bottle bills for the amount of container glass remaining in the disposal stream. Proportionally, Vancouver has only about half of the container glass of the other jurisdictions. Other than milk and other dairy glass bottles, British Columbia's EPR/deposit system covers all glass beverage bottles including for wine and liquor. With its deposit system, it is likely that many of these heavier containers are not disposed. While we cannot say for certain, it seems likely that Vancouver's lower amount of glass is a result of its EPR approach.

Figure 4-14: Bottle Bills: Percent of GSIG, Container Glass Only, Residential Sector



Multi-Sort Recycling Programs

Question

Does GSIG for a jurisdiction with multi-sort collection contain less recyclables than those with single-stream?

Background

One means of addressing uncertainty in recyclables markets, as well as to meet other goals, is to reduce contamination of recyclables at the point of collection. Most curbside recycling programs in Alameda County and across California use single-stream collection in which all materials are placed in a single container. Vancouver, British Columbia has a multi-sort program in which glass containers, non-glass containers and fibers are collected separately at the curb. Collecting glass separately from fibers helps maximize the value of the recovered fiber. While impractical to convert to a multi-sort program in the near-term, it may be prove to be a viable longer-term option. This comparison does not address whether glass contamination of fibers is lower for a multi-sort system, but uses the GSIG measure to address overall whether one system or the other appears to reduce GSIG.

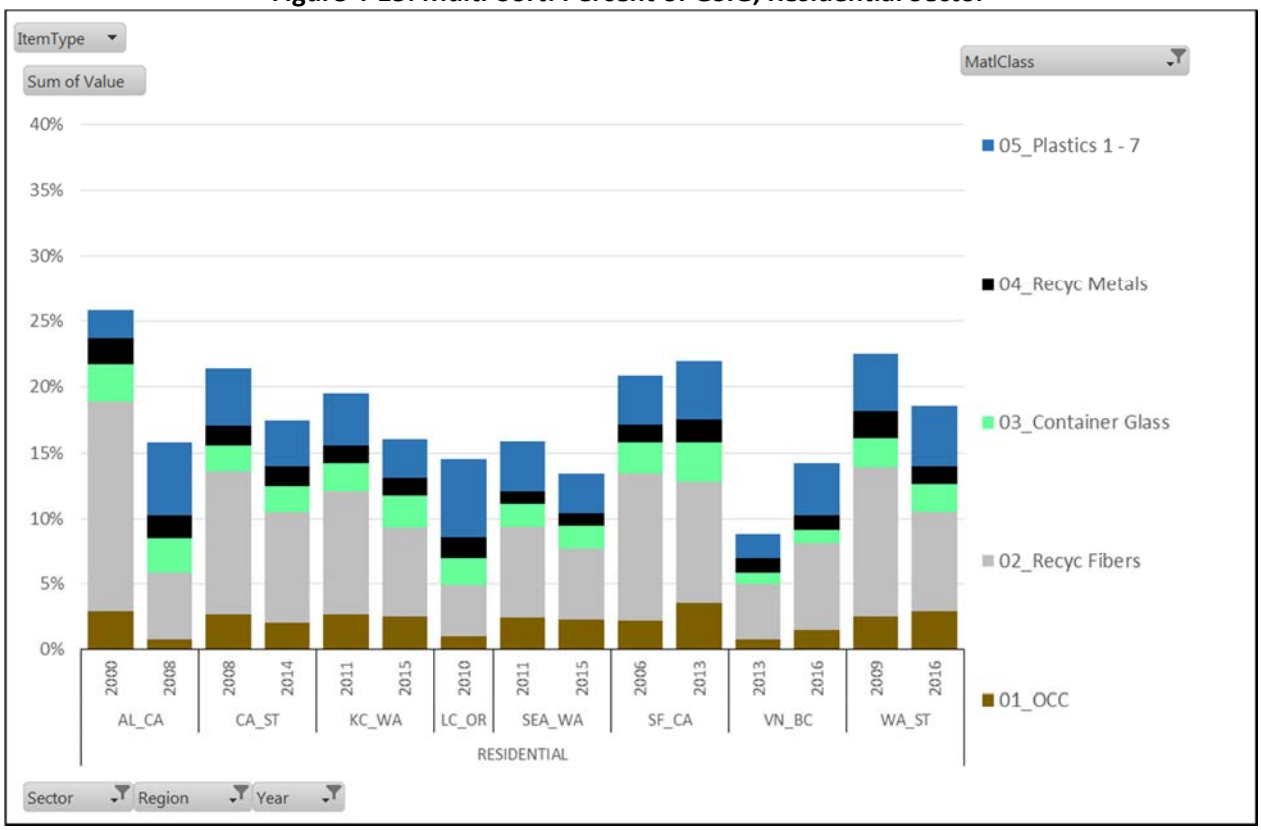
Comparison

Figure 4-15 compares combined residential data for Vancouver with that of the other jurisdictions. It appears that "traditionally recyclable" GSIG is lower in Vancouver than most other locations being summarized. For fibers, particularly, only the 2008 Alameda County waste characterization had similarly

low levels. [Conversely, Vancouver (and Lane County – see below) are two of the jurisdictions with larger portions of organics in the GSIG, with levels between 40% and 50%.]

Note that Eugene also has a multi-sort program in which glass is set out separately from other materials. Eugene's data is not available individually, and Eugene's population constitutes about 45 percent of the population of Lane County. However, similarly to Vancouver, Lane County's proportion of "traditionally recyclable" GSIG is relatively lower.

Figure 4-15: Multi-Sort: Percent of GSIG, Residential Sector



Consistency of Recyclables

Question

Does GSIG for larger jurisdictions with a uniform set of recycling requirements contain less readily recyclable material than in those without?

Background

Vancouver, British Columbia (and the Province of British Columbia) has a defined set of recyclables collected Province-wide by residential curbside programs. San Francisco also has a single set of curbside recyclables. By contrast, curbside programs in Alameda County vary in the types of materials they collect. More generally, it is often commented upon that Bay Area residents experience different separation requirements where they live and where they work, complicating their ability to be successful recyclers.

Comparison

The Review Team compared residential data from all waste characterizations in the Tool for San Francisco and Vancouver, with that of all other data from the selected waste characterizations, omitting only the Benchmark Service audit data due to likely differences in study methodology. The Review Team concluded that if uniform definitions of recyclables make a difference in GSIG, the difference is too small to be apparent based on this pool of data. Inclusion of additional data would be necessary to support a conclusion that there is a significant difference for GSIG in this case.

Reviewing Data from Other Waste Characterization Studies

The following jurisdictions and waste characterizations (denoted by year by year conducted) were reviewed for possible inclusion in the Tool, and in the analysis previously presented in Section 4.

- Larimer County, Colorado (2016)
- Connecticut, Statewide (2015)
- Iowa, Statewide (2011)
- Montgomery County, Maryland (2013)
- Ramsey and Washington Counties, Minnesota (2014)
- Polk County, Minnesota (2014)
- Rhode Island, Statewide (2015)

In general, the above jurisdictions and waste characterizations were excluded from the short-list of six jurisdictions for one or more of the following key reasons:

- Diversion programs in the region were very different from, or much less comprehensive than, those in Alameda County.
- Material categories were too general or non-specific compared to those used in Alameda County and the selected West Coast jurisdictions.
- The number of samples used for the analyses were too few to provide small margins of error, limiting the ability to make meaningful comparisons.

In addition, most of the states (Connecticut, Iowa Maryland, Minnesota and Rhode Island) have yard waste bans with varying degrees of tracking and enforcement.

Figure B-5 in Appendix B provides a high-level summary of GSIG values and related information drawn from these seven “non-West-Coast” waste characterizations. Despite the stated limitations, there are useful points worth noting:

- In states with bottle bill legislation (Connecticut, Iowa) the amount of glass in the waste stream was lower than most others. This is of interest since the similar comparison shown above in Figure 4-14 does not reach a clear conclusion.
- In comparing the Benchmark Service audit results against those from these other waste characterizations, the concentration of recyclables in residential GSIG is lower in Alameda County than in virtually all other locations. This finding may indicate high program effectiveness in Alameda County and/or variation in how samples were collected.

- The concentration of organics in Alameda County residential GSIG is not significantly different from the other locations shown below. The yard waste bans in most states may have put them on an equal footing with Alameda County, with food waste being the “next frontier” for organic waste diversion and prevention.

SECTION 5: ULTIMATE DISPOSITION OF DISCARDS

Background

Section 5 addresses whether and how franchise collection and processing agreements can provide reporting and monitoring requirements to assist member agencies in tracking the "ultimate disposition" of collected materials. Ultimate disposition can be thought of as: "What happens to collected discards (recyclables, organics or C&D) once they are delivered for initial processing?" The key related question is, "Do diversion rates reported by processors tell the full story, or is there additional unreported residue associated with additional stages of processing?"

Why would it be useful to have this type of information, were it available? From a larger perspective, "collection" does not equal "recycling". True recycling involves "closing the loop", with positive impact at each stage of a circular economy: product design to allow for maximum material recovery and reuse; maximal use of recycled content in manufacturing; consumer choices and purchasing decisions that favor high recycled-content products; proper sorting of materials for collection; and processing that provides quality recovered material for manufacturing. Individual jurisdictions can encourage proper sorting practices and provide for quality materials processing services; the Agency's programs work to affect all of the stages. Having better knowledge of what occurs past initial processing helps answer the question of whether full recycling has actually occurred.

Ideally, a true measure of diversion would reflect all of the residue that is generated prior to the recovered portion of the material becoming a new product. In the absence of such data, it can be difficult to fully evaluate program effectiveness in terms of outreach efforts and relative contamination (improper sorting) at the point of collection, as well as overall sector and jurisdiction diversion efforts. Is one customer sector (e.g., single family residential, multi-family residential, commercial) doing relatively well or poorly in this regard? Is messaging about container use and proper set-outs effective?

In addition, the Review Team was requested to address how agreement provisions regarding ultimate disposition can reflect considerations of "highest and best use." Inclusion of this task for the Review was prescient, given the recent regulatory and market pressures with relation to recyclables and organics, as discussed in Section 2.

Section 5 provides context regarding issues related to the ultimate disposition of recyclables, organics, and C&D; discusses experiences with the use of franchise agreements to report residue rates and require end use certification; and recommends use of market self-monitoring and third party certification as the likely most effective means for addressing ultimate disposition.

Context for Considering Issues of Ultimate Disposition

The Nature of Processing

In theory, the use of franchise agreement language to require monitoring and reporting of the ultimate disposition of materials is simpler and more likely to be enforceable in cases of vertical integration - when the collector contractor is also the processor, or the processor is a legal affiliate or named subcontractor. In these instances, the provisions of the franchise agreement can be made to "flow through" to the affiliates and subcontractors. Tracking ultimate disposition is more difficult for recyclable materials that have multiple stages of processing prior to end use, and especially when materials are exported. Recycling "secondary processing" is often done through short-term or spot market contracts; such secondary processors are generally not identified in franchise agreements and are not subject to their provisions. Tracking the ultimate disposition of organics should be comparatively simple in that processing of such materials generally involves fewer steps, and processing is often performed by a single entity subject to the terms of the franchise agreement.

Organics Processing
Mixed yard trimmings and food
- Pre-processing at primary MRF to remove large contaminants
- Composting degradation and curing process
- Post-processing to remove smaller contaminants

Recyclables Processing
Glass bottles and jars
- Separated at a primary material recovery facility
- Color sorting (green, brown, and clear) at a glass recovery facility for re-use in new products

Plastics
- Sorted by resin type at a primary material recovery facility
- "Pelletized" for use in new products

Low value recyclables (some plastics, mixed short fibers)
- Sorted into mixed/"other" category at a primary material recovery facility
- Additional sorting at a facility that aggregates specific materials to market specifications for end-use.

In practice, as discussed in this Section, relying on franchise agreement language to track ultimate disposition is difficult and may be of limited value. Third-party facility certification, such as is in place for C&D facilities through the Recycling Certification Institute (RCI) may be the better option.

Residue Rates

Private sector processors generally provide jurisdictions a "facility-wide" figure for residue reflecting total tonnages of material arriving at, and leaving from the facility, with residue disposal tons pro-rated based on relative tonnages delivered by each user. Some contracts provide for a maximum facility-wide residue rate that, if exceeded, may trigger review of collection and/or processing practices to identify the issue or provide for minimum recovery levels for specific collected streams.

Failure of contractual language to distinguish contamination from residue can result in confusion. "Contamination" can be too general a term. If unspecified, contamination can be interpreted as applying to the composition of incoming material as collected, or to the residue as it leaves the facility. Agreements may include provisions for conducting periodic targeted sorts of processing residue specific to that jurisdiction's incoming material to determine a jurisdiction-specific residue rate. Such sorts are expensive

and contract language regarding sorting needs to be sufficiently detailed to ensure jurisdictional objectives are met.[62]

Sorts are of most value at the primary stage of processing. In general, unless the primary processor is a dedicated facility, once material from many jurisdictions is transported to a secondary processor, sorts are only meaningful on a facility-specific basis. Among the exceptions are the Palo Alto organics sorting provision discussed below, and use of sorts in dispute resolution such as the following glass processing situation. For example, in the case of mixed glass processing, the primary processor's initial reported residue rates may later be increased to include additional residue resulting from secondary processing.

Beginning with widespread curbside programs in the early 1990s, some agreements provided for public agency auditing at post-primary stages, most typically in the context of recyclables revenue sharing to determine if per-unit revenues were competitive. Over time, as curbside recycling and markets matured and all parties became more familiar with the wide fluctuations of commodity pricing, most jurisdictions opted for simplicity, providing contractors the full benefit of recycling revenues to offset processing costs. Without revenue sharing, there was no longer a perceived need for the type of auditing that was used to verify reported revenues and help trace ultimate material disposition.

> Revenue sharing (and related tracking) is not a significant factor for organics due to low per-unit value, local market competition, and pricing confidentiality.

There may be an increased need for improved tracking and reporting of material processing and end-uses reflecting the broad market challenges and opportunities discussed in Section 2 related to tightening export markets for paper and plastics, reduced capacity and increased prices for organics processing, and other factors.

Highest and Best Use

How are materials used and do they meet an agreed standard for "highest and best use"? Must untreated wood waste be converted into landscaping mulch, or is use of biomass energy generation acceptable? Given the costs and environmental impacts of transporting heavy materials, is it acceptable for glass to be used as an aggregate paving material rather than as feedstock for a new bottle? Can compost be marketed for roadside slope stabilization rather than for a "higher use" as a soil amendment?

Making case-by-case determinations of highest and best use, and using agreement language to ensure adherence to a set hierarchy can be difficult at best. In practice, it has proven more fruitful to define non-allowable practices, such as restricting the use of recovered material as alternative cover for landfills as with AB 1594, or prohibiting disposal of organic materials as with SB 1383.

[62] One more nuanced example are paper stock specifications – "prohibitives" vs. "outthrows" in bales of paper destined for recycling. "Outthrows" are generally types of paper unsuitable for making the grade intended, whereas "prohibitives" are materials that could damage equipment, make the paper unusable, etc., and there are separate specified percentages for each.

The Role of AB 901

AB 901, and development of the Recycling and Disposal Reporting System is discussed in Section 3. Based on current draft rulemaking, AB 901 is not likely to be as useful for monitoring ultimate disposition as had been hoped. For instance, AB 901 eliminated the requirement that recycling facilities identify the county of origin for the material they handle, and as now drafted, the regulations do not distinguish residue from material collected for disposal. Draft regulations do provide for some degree of end-use reporting that may prove of value regionally, if not for specific member agencies. StopWaste should certainly monitor the process and determine the value of AB 901 after several reporting cycles.

Case Studies

Palo Alto

As far as we are aware, Palo Alto's experience is the most relevant example of a local jurisdiction using a franchise agreement in a deliberate effort to track ultimate disposition. Palo Alto's 2008 franchise agreement sought to address ultimate disposition of materials in a comprehensive manner, with maximum residue levels, periodic residue sorts, and required submittal of certifications regarding end-uses of materials. The amended 2015 franchise agreement modifies these requirements, reflecting the evolution of Palo Alto's experience with these provisions.

Palo Alto's 2008 agreement with GreenWaste Recovery (GWR) included the following provisions, as tailored to recyclables, organics and C&D:

- Use of GWR facilities (Charles Street Material Recovery Facility and Z-Best Organics) and GWR affiliates (Zanker Materials Processing Facility and Zanker Road Resource Recovery Operations and Landfill).
- Moderately detailed descriptions of processing activities.[63]
- Specified maximum residue rates of 8 percent, 10 percent and 25 percent, respectively for recyclables, organics and C&D. The C&D rate was a composite of 10 percent for source-separated material and 30 percent for mixed loads.
- Periodic sorting to determine residue rates, with City staff present. For recyclables, this provision required annual sorts to determine a facility-wide residue rate and sorts every six months to determine the city-specific residue rate. For organics, the provision required annual sorting of material as collected, and of residue following both pre-processing at the Material Recovery Facility and processing at Z-Best.

[63] For example, "Polishing Screen: This screen is used to separate mixed paper from the containers. Mixed paper will float on top as the containers drop through the bottom on to another conveyor.," or "Direct Baling: Clean source-separated loads, such as cardboard and film plastics from commercial and City facilities, will be fed directly into the accessible baler feed conveyor which provides more than 45 feet of direct load capability." Attachment E, page 2.

- Annual submittal of a marketing plan updating information in the agreement that identified then-current secondary processors and provided much more general information regarding end uses for each recovered material.[64]

- Provision of certificates of end-use. For recyclables, the provision required that, "Contractor shall submit to City on or before July 1 of each year a certification of end use from each purchasers establishing that the materials sold the prior fiscal year have been, in fact, recycled." The comparable requirement for organics stated, "Contractor shall obtain from five of its largest customers a certification of end use, on or before July 1 of each year establishing that the materials sold the prior fiscal year have been, in fact, reused or recycled. The certifications of end use will be retained by Contractor and will be available for review by City."

City staff continue to require submittal of an annual processing marketing plan. [65] The 2017 annual plan (see Appendix C) is relatively detailed with a listing of "primary commodities" recovered, primary vendors by commodity, finished products produced from the commodities, actual tonnage of material recovered by commodity, average unit pricing, and estimated tonnages for the coming year. The plan addresses recyclables, organics, C&D and bulky items. Staff finds the plan to be a useful tool for maintaining a broader understanding of how materials are managed following collection as well as pending market issues. Staff meets with GWR on a monthly basis, in part to identify and discuss market issues.

But Palo Alto staff found it difficult to administer some of the other provisions of the 2008 franchise agreement. With regard to sorting of residue, GWR conducted the required sorts for several years, and residue rates were found to be quite low. Conducting such dedicated sorts posed operational issues for GWR, and the 2015 amended agreement provision requires that GWR determine facility residue rates on a bi-annual basis. The Zanker Road facilities use the Recycling Certification Institute (RCI) to verify tonnages, and City staff recommends use of similar third party process, with auditing, to document facility residue rates for all processing facilities for the benefit of all users. The issue of third party certification is discussed further in Section 2 (see page 8).

The certificates of end use do not provide the level of specificity the City had hoped for. GWR initially tried to implement this provision, but found that since secondary processors were not subject to the terms of the franchise agreement, they could not enforce the requirements. The certificates are brief letters verifying that a specific company purchased material from GWR. While the letters generally state that the material they purchased was recycled and how, they do not provide dates of material receipt or associated tonnages.

See Appendix C for revised 2015 language to Palo Alto's agreement, Palo Alto's 2017 marketing plan, and a sample end-use certification.

[64] For example, "Mixed Paper, OCC - Materials will be recycled into new products such as newspaper and cardboard. Currently, fiber products are primarily sold through Berg Mills to domestic and foreign mills," and "Glass - Glass will be recycled into new glass and fiberglass products. Currently, glass is sold and processed locally to Strategic Materials," Attachment E, page 3.
[65] Phone call, Paula Borges, Contract Administrator, City of Palo Alto, with Ben Collins, HF&H, September 18, 2017.

Other Experiences

Following are several other examples of Bay Area cities that have used some of the tools that can help in tracking ultimate disposition, although not with that purpose in mind. One uses periodic sorts to determine contamination levels for incoming material, while the other conducts sorts to determine residue levels.

Sunnyvale, Mountain View and Palo Alto participate in the SMaRT Station, a material recovery facility and transfer station owned by Sunnyvale. Facility operations are conducted through contract with a private operator. The three cities and the operator share recycling revenue based on a sliding scale that increases operator share as diversion increases. The cities use the most recent waste characterization data and periodic sorts to allocate incoming recyclables tonnages as collected and relative residue percentages to determine the split of the municipal portion of the recycling revenue. This process is not likely to be directly of use to member agencies that are not facility owners or partners.

Unlike the SMaRT Station, which uses periodic sorts as a routine means of allocating revenue, San José's targeted material recovery facility sorts of incoming material and of residue are used to determine compliance with collection and processing contract diversion requirements for both the single-family and commercial sectors. San José contracts with two companies for commercial collection and organics processing. In two of three districts, single-family garbage and recycling collection services are provided by two different companies. In each case, the city has used sorting to address disputes between city contractors or between one or more contractors and the city regarding the adequacy of pre-processing of commercial organics and contamination of collected recyclables. These periodic sorts do not directly relate to ultimate disposition, but can provide city-specific data regarding residue.

Conclusions and Recommendations

Based on the discussion above, and especially Palo Alto's experience, we conclude that franchise agreements are not adequate tools for monitoring, reporting, and providing a useful understanding of the ultimate disposition of most materials. Material sorts can result in useful information for improving programs and targeting outreach efforts, as well as provide data to improve understanding of GSIG as discussed in Sections 3 and 4. However, such material sorts are generally of limited value in determining a complete residue rate incorporating all stages of material processing. Finally, end use certifications are difficult to obtain, are unlikely to extend past a secondary level of processing, and are of limited value.

Our primary recommendation is to encourage third party certification and market self-policing for both organics and recyclables and, ideally, facility-wide residue reporting, as further discussed in Section 2 (see page 8).

Additional recommendations include:

- Require annual marketing plans. Understandably, public sector staff can be reluctant to raise issues related to processing and marketing of materials, not wishing to encourage franchisees with hopes of modifications in compensation. However, the Review Team suggests that in times of market uncertainty, more complete knowledge obtained sooner, rather than later, is better.
- At a minimum, it is useful for member agency staff to understand the management practices at processing facilities in terms of how different types of incoming loads are directed and what sort of recovery occurs for each type of material and at each location in the facility, etc. Observe and ask questions. This understanding can help provide some assurance that primary level processing

achieves anticipated results and can help in formulating questions about secondary or tertiary processing as well as end-uses.

- Contractual provisions for material sorting should:
    - Clearly define the roles of the parties in requesting a sort, in evaluating the results and in disputing the results;
    - Specify the methodology to be used (at least in general terms);
    - Provide a clear distinction between contamination and residue;
    - Specify how the results will be used; and,
    - Address allocation of responsibility for the cost of conducting sorts and analyzing the results.

Finally, the Review Team recommends avoiding separation of collection and processing functions, when feasible. When performed by the same entity, there is reduced opportunity for disputes over contamination. Also, the risk that public agencies are asked or required to mediate disputes is minimized. These types of issues are more likely to arise when collected material has significantly higher contamination than the processing technology is technically able, or the processor is willing, to accept. To the extent the functions are split, ensure inclusion of strong contractual language including performance standards and penalties, and clear allocation of responsibility and cost in dispute resolution.

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

TABLE OF CONTENTS

Sample Measure D Form

The following is a sample member agency Measure D Form (Form) from 2016.

Yearly Tonnages

Member Agency: _____ Year: _____ Calendar or Fiscal _____

Route Type	Collection Method	Annual Tons	Total # of Accounts	# SF Accts	# MF Accts	# Com-mercial
Refuse	Cart					
Refuse	Front Load Bin					
Refuse	Drop Box					
Refuse	Compactor					
Subtotal Refuse						
Recycling	Cart					
Recycling	Front Load Bin					
Recycling	Drop Box					
Recycling	Compactor					
Subtotal Recycling						
Organics	Cart					
Organics	Front Load Bin					
Organics	Drop Box					
Organics	Compactor					
Subtotal Organics						
Grand Total						
Bulky Waste Collection						

Type	Collected Tons	Residual Tons	Net Tons
Residential Refuse			
Residential Recycling			
Residential Organics			

Notes:

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

Subscriptions

Member Agency	
As Of Date	

Single Family Residential

(Defined as 1-4 Units)

Weekly Refuse Volume	# Refuse Accounts	# with recycling	# with organics
<30 Gallons/Mini-Can			
30-32 Gallons			
60-64 Gallons			
90-96 Gallons			
>96 Gallons			

Multifamily Residential Customers

(Defined as 5+ Units)

Weekly Refuse Volume	# Refuse Accounts	# with recycling	# with organics
<1 Cubic Yards			
1-3.9 Cubic Yards			
4+ Cubic Yards			

MF Accounts by Number of Units on Property

Size	# Refuse Accounts	# with recycling	# with organics
5-15 Units			
16-60 Units			
61-100 Units			
100+ Units			

Commercial Customers

(Defined as Non-Residential)

Regular Weekly Refuse Volume	# Refuse Accounts	# with recycling	# with organics
<1 Cubic Yards			
1-3.9 Cubic Yards			
4+ Cubic Yards			

On Call Refuse Volume	# Refuse Accounts	# with recycling	# with organics
1-3.9 Cubic Yards			
4+ Cubic Yards			

Notes:

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

Disposal Reporting

The following summarizes the methods by which CalRecycle measures jurisdictional compliance with the diversion goals of AB 939. The "diversion rate calculation" method was in effect from 1990 through 2006, and was replaced by the current "per-capita diversion rate" method defined in SB 1016. AB 939 required that jurisdictions:

- Develop a Source Reduction and Recycling Element (SRRE). The SRRE included a waste characterization study for each jurisdiction in order to determine their Base Year *Generation.*
  - Generation = Disposal + Recycling + Source Reduction.
- Reach a 25% diversion rate by 1995, and 50% by 2000.
  - The diversion rates were based on generation.
  - The base year generation was adjusted annually to offset changes in a jurisdiction's population and economic conditions between the base year and the measurement year.
  - Adjustment factors included population, employment, consumer price index (CPI), and taxable sales.

SB 1016 changed the diversion rate calculation to one based on four years of averaged waste generation, with a disposal-based indicator (the per capita disposal rate), which uses only two factors: a jurisdiction's population (or in some cases employment) and its disposal as reported by disposal facilities, rather than the adjusted generation used under the old system.

Additional Data Analysis

Measure D Forms

In reviewing the 2014 and 2015 Measure D Forms and comparing data across the member agencies, the Review Team observed the inconsistencies described below. These types of inconsistencies are to be expected when initially collecting data from a wide range of sources, as is the case for the Measure D Forms.

First, as shown in Figure A-1, there is a variation in how single-family service data are presented. Eight of the member agencies provided single-family data that includes just single-family carts. Two member agencies provided data that includes all residential carts (single-family and multi-family). Data for five member agencies included all carts (single-family, multi-family and commercial), and for one member agency we were unable to verify what carts were included as "single-family" service. This is largely a reflection of the fact that collection routes provide service to carts and bins, not to customer sectors. As of the 2015 data, about half of the member agencies were collecting data that allowed for single-family breakout.

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

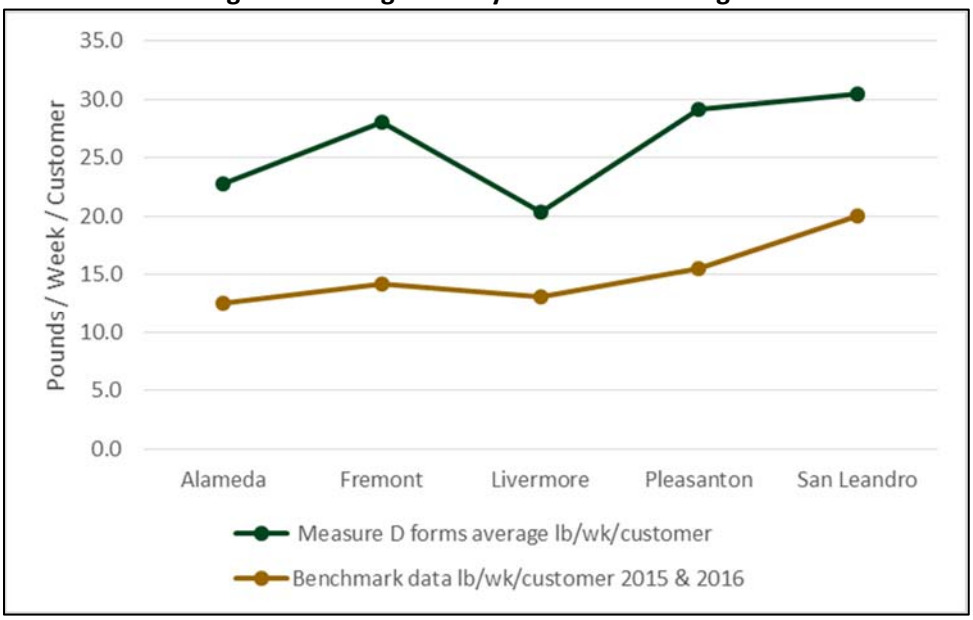
Figure A-1: Measure D Forms – Single-Family Data

Jurisdiction	Single-Family	Single & Multi-Family	All Carts	Other*
Alameda			✔	
Albany				
Berkeley	✔			
Dublin	✔			
Emeryville		✔		
Fremont	✔			
Hayward	✔			
Livermore			✔	
Newark	✔			
Oakland		✔		
Piedmont			✔	
Pleasanton			✔	
San Leandro			✔	
Union City	✔			
Castro Valley Sanitary District	✔			
Oro Loma Sanitrary District				✔

* For "Other", it is unclear how cart service is defined

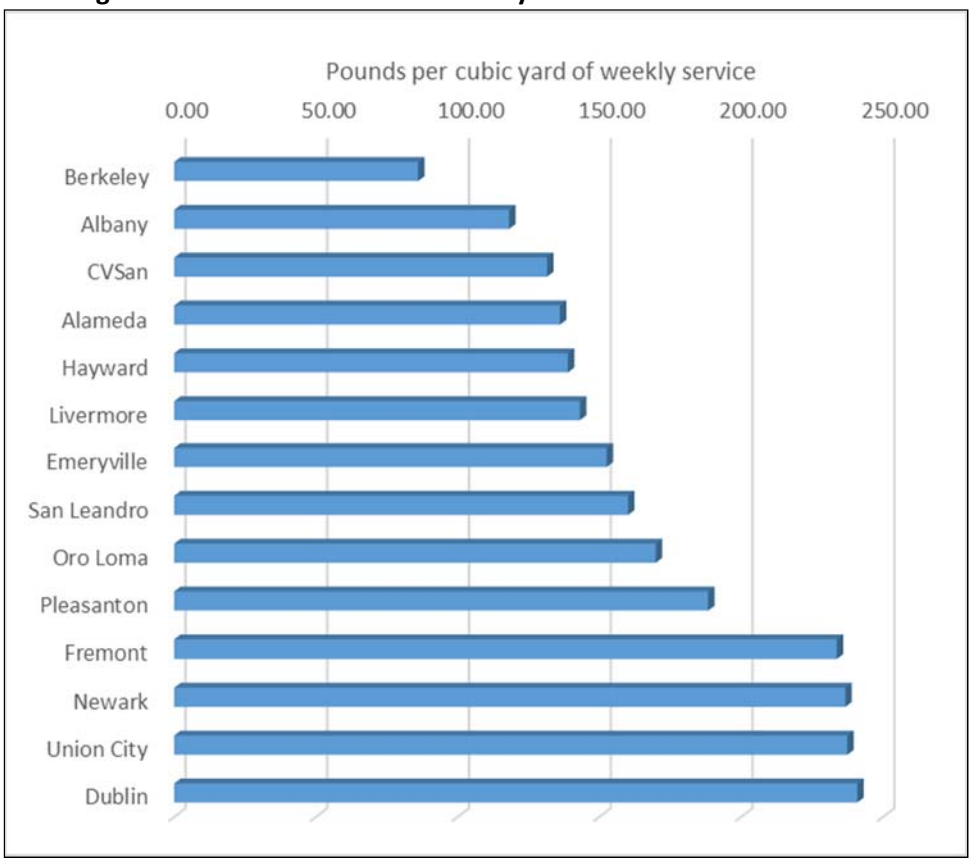
In a further effort to check the validity of the Measure D Form data, we compared single-family collected cart weights from the Measure D Form data to single-family cart net weights from the single-family portion of the 2015 and 2016 Benchmark Service data. As shown in Figure A-2, in all cases, the weights-per-cart computed from the Forms, using reported weights and cart customer counts, were much higher than for the single-family Benchmark Study samples. This could reflect variations in how single-family and cart service was defined on the Measure D Forms, as discussed above with relation to Figure A-1. The Measure D Forms included some data for commercial carts, which are typically heavier. In addition, commercial carts may be collected more than once per week but may have been counted as "one account" with once-weekly collection.

Figure A-2: Single Family Cart Set-Out Weights



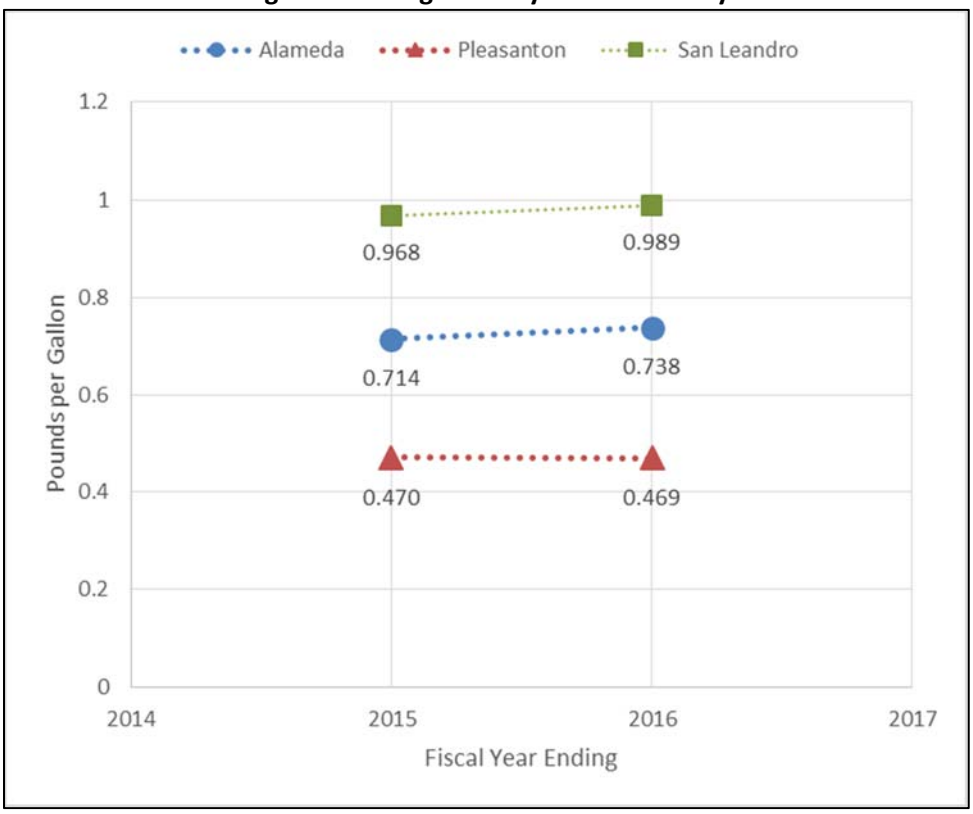
Second, the data on the forms can be used to estimate the density of garbage, expressed as pounds per cubic yard of volume, placed for collection by multi-family and commercial customers. Tonnage data can be applied to each of three broad weekly service ranges of less than 1 cubic yard, 1 to 3.9 cubic yards, and over 4 cubic yards. However, as shown in Figure A-3, the results based on 2015 data vary across a very wide range, from 86 pounds/cubic yard for Berkeley to 241 pounds/cubic yard for Dublin. Although there can be wide variation in the density of commercial refuse from one type of business to another, averages across entire jurisdictions should be much more uniform.

Figure A-3: Variations in Multi-Family and Commercial Bin Densities



Third, a similar type of inconsistency occurs with respect to cart-collected customers, likely stemming at least in part from the variation in how data is reported as discussed for Figure A-1. The average weekly density of cart-collected garbage in 2015 ranged from a low of 80 pounds/cubic yard to a high of 247 pounds/cubic yard. Figure A-4 illustrates this variation for three member agencies.

Figure A-4: Single Family Refuse Density



Other possible factors in the wide density variations shown in Figures A-3 and A-4 include:

Broad size ranges: The weekly-volume size ranges may be too broad, especially in the larger volumes. The 2015 and prior years' data did not provide a means to distinguish between a 4-cubic-yard refuse bin collected from a small apartment building once a week, and a high-rise apartment complex with a 30-cubic-yard trash compactor collected twice a week. The problem can be addressed by enlarging the number of service size categories, especially at the high-volume end of the spectrum.

Misinterpretation of volume data: It would be relatively easy, using a customer database, to mistakenly summarize volumes based on bin sizes rather than total weekly volume. Thus, a customer with a 2-yard bin collected 3 days per week could be tallied in the 1 to 3.9 cubic yard category but are actually in the over 4 cubic yard category.

Inaccurate data: As a customer changes bin size or collection frequency, collection route lists may show the change, but the billing database, if separately maintained, may not. This type of error is most likely to

occur for materials that are collected at no charge, such as may be the case for recycling or organics service in some member agencies.

Demographic differences: The relative mix of multi-family and commercial customers, such as large multi-family complexes and large retail centers vary significantly between member agencies.

There are other potential sources of error on the Measure D Forms that are inherent in the way that collection services are provided:

- Routes that serve multiple jurisdictions.
- Routes that are rapidly changing due to modifications in services, such as added organics or "dry waste" collection.
- "Open routes" that are collected by other nearby trucks due to driver absence or truck breakdown.
- Customers with infrequent on-call service, such as roll-off compactors at office buildings and retail locations.

For cases in which a collection route serves multiple jurisdictions in a single day, the weights for the day should be allocated to each jurisdiction based on that route's service volumes for each jurisdiction that day. This is especially important for collection from small jurisdictions, which are often served by routes that primarily serve neighboring larger jurisdictions. Most, and possibly all Alameda County franchised haulers use customer databases that can provide the allocation factors, if queried correctly. Ideally, these allocation factors would be updated at least quarterly.

The following are some key issues for ensuring consistent countywide collection of data during verification and quality assurance:

Tonnages

- Is any C&D material included?
- Are any nonexclusive recycling tonnages included?
- Are self-haul tonnages included?

Volume Subscription and Frequency

- Single-family is relatively straightforward since there are no frequency issues and a limited amount of unscheduled collection.
- Multi-family is relatively straightforward in that service is generally sized for 1x/week collection of carts and/or bins.
- Commercial cart and bin service is less straightforward given multiple collections per week for putrescibles, especially by restaurants and other businesses generating food scraps on a continuous basis.
- On-call (debris box and compactor pulls) are provided both on a subscription and on-call basis.

We suggest developing cross-checks in Excel to automatically highlight significant variances (such as equal to or greater than ten percent) compared to data from the previous year.

It may be feasible to electronically convert container service data (carts and bins) to sector service data (single-family, multi-family, commercial). Member agency franchisees could be requested to provide conversion parameters such as the volumes of single-family, multi-family and commercial containers on each route each day. This type of information should be readily available through a database query. Service type tonnages can then be converted to customer sector tonnages with minimal effort, once algorithms are constructed and tested. However, the differing configurations of hauler databases, and the differing capabilities among the collection companies, may present substantial limitations for this process. Were StopWaste to pursue this approach, the Review Team recommends that the agency do so by focusing on one or two haulers at a time.

Benchmark Service Audit Data

The following are additional observations regarding the Benchmark Service audit data.

Single-Family Data

The single-family Benchmark Service data shown in Figures 3-11 and 3-12 of Section 3 include only households with GSIG. In excluding those households with no GSIG, the data provides a clearer indication of how households that are sorting discards less successfully are performing. In testing for significance in year-to-year shifts in GSIG percentages for individual member agencies, the Review Team found that when the year-to-year shifts were fairly substantial – 5 percentage points and above – the results were statistically significant. These larger shifts are very unlikely to have occurred by chance. Smaller shifts of one or two percentage points typically did not satisfy criteria for significance.

Multi-Family Data

The multi-family data collection effort included fewer samples, and sampling techniques were modified during the four-year study period. Thus, these data are not robust enough to meet statistical significance requirements for change detection. They do show that the average GISG percentage was higher for multi-family samples (45 percent for those samples with GSIG) than for single-family samples (40 percent for those samples with GSIG). While higher multi-family GSIG is not unexpected, the average percentage gap of only five percent between the multi-family and single-family data is perhaps surprisingly small. However, if samples with no GSIG are added for both multi-family and single-family, the results are 44 percent GSIG for multi-family and 35 percent for single-family.

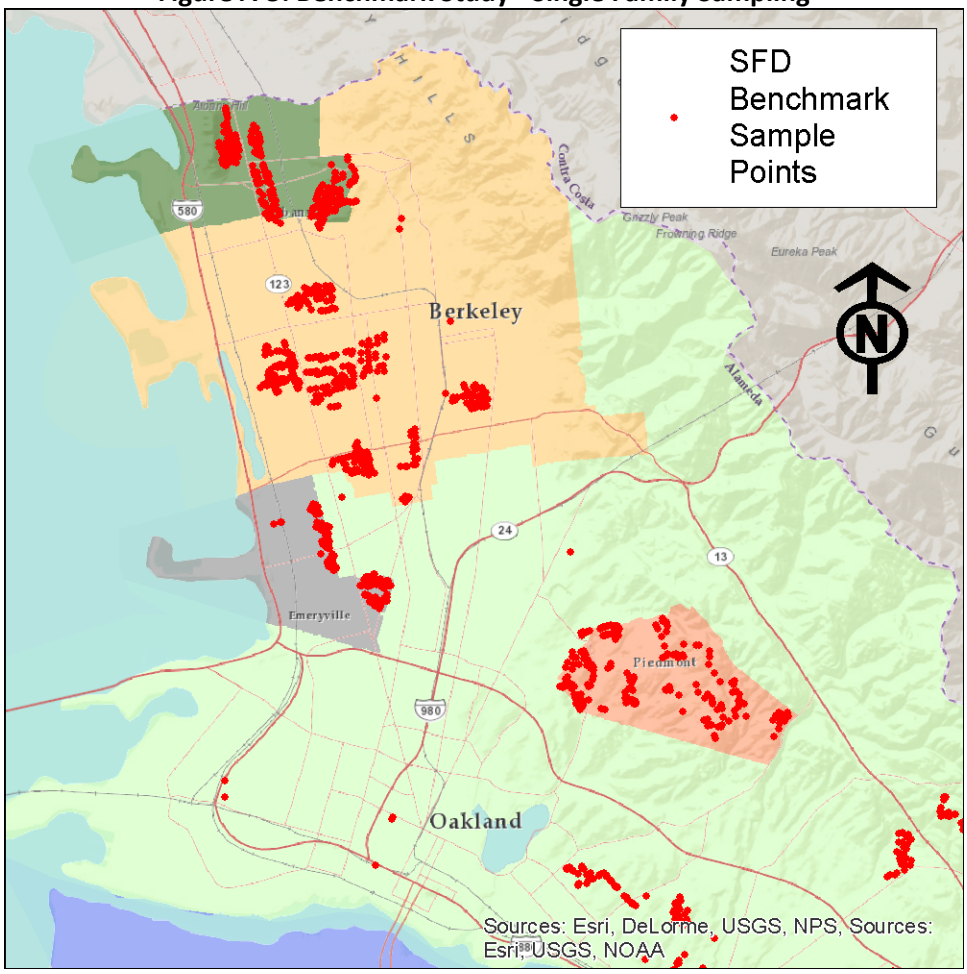
Other Data Testing

Following is a summary of several less successful efforts to find correlations or trends in the Benchmark Service data. Although statistically-significant outcomes were not found, this is a useful finding in itself, in that it suggests that outreach and incentive programs need not be tailored or targeted for distinct subpopulations.

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

As noted above, large year-to-year shifts in single-family GSIG percentage are detectable, but how well does this represent a member agency-wide change? By mapping the sample locations and examining the sampled areas from year to year, it became apparent that in the larger jurisdictions: (a) different parts of those jurisdictions were sampled each year; and, (b) substantial areas within those cities were not sampled at all, as shown in Figure A-5 for Berkeley and Oakland.

Figure A-5: Benchmark Study - Single Family Sampling



In retrospect, for purposes of detecting change, the single-family sampling protocol would have been improved by repeatedly sampling the same set of households over a wider geographic area in each member agency. However, Review Team member experience with the recent CVSan Less-Than-Weekly Garbage Pilot indicates the degree to which these seemingly simple types of improvements can complicate study planning and quality control, requiring additional coordination with the collector and resulting in higher costs for study management and data analysis.

With regard to Figure A-5, the Review Team:

1. Sought to determine if the data could be used to identify a specific type of single-family household, such as those with a single parent and one or more children living at home, that might

need extra support or resources to succeed with proper sorting. Using Census data, the Review Team compared GSIG percentages for the general population to Census Block Groups having a high percentage of households with a single parent and one or more children living at home. No significant difference was seen.

2. The Review Team was also interested in whether a correlation could be detected between single-family GSIG and demographic measures such as per-capita income. We tested this by mapping the single-family sample sites in several larger cities (Fremont, Livermore, and Oakland). We then compared GSIG at those sample sites with US Census Bureau 2015 per-capita income data at the highest resolution, the Census Block Group. No correlations were found.
3. The Review Team tested if a trend showing decreasing overall single-family GSIG from 2013 to 2016 could be detected. Since the sampling methodology did not involve resampling at the same address multiple times, the "noise" from variations among households may have drowned out any "signal" about declining GSIG.

Materials Optimization

"CE Marking" is a symbol which literally means "European Conformity"; the abbreviation of the French phrase "Conformité Européene." CE Marking on a product is a manufacturer's declaration that the product complies with the essential requirements of the relevant European health, safety and environmental protection legislation, "Product Directives" that address "essential requirements" and/or "performance levels" for specific products.

Additional details regarding ODEQ's recent or current projects related to its "Materials Management in Oregon: 2050 Vision and Framework for Action" are available at the project webpage: www.oregon.gov/deq/mm/Pages/Product-Footprint.aspx.

See following link to ODEQ's "Strategic Plan for Reuse, Repair and Extending the Lifespan of Products": www.oregon.gov/deq/mm/Pages/Product-Lifespan-Extension.aspx.

Food Recovery

See the following link for full discussion of the Oregon DEQ's strategy for preventing food wastage: www.oregon.gov/deq/mm/food/Pages/foodwastestrategy.aspx.

Food Recovery Literature Review

Alameda County Food Waste Study, LeanPath

The Review Team reviewed LeanPath's "Alameda County Food Waste Study" (Study).[66] The Study defined and evaluated "preventable pre-consumer edible food waste" as a subset of "total pre-consumer food waste," which in turn was a subset of "food waste."

With regard to metrics, the Study:

[66] LeanPath, "Alameda County Food Waste Study," November 3, 2014.

- Included a total of 5,261 foodservice operations and 26 industries.
- Provided estimates for total pounds of food waste, total pre-consumer food waste, and total preventable food waste.
- Defined broad categories of commercial foodservice operations (restaurants and caterers) and non-commercial foodservice operations (schools and hospitals).
- Excluded supermarkets, food manufacturers and processers, convenience stores, and specialty stores, noting lack of available data.
- Excluded residential food waste.

The report noted that the paucity of data, uses assumptions from LeanPath's experience and general industry data, and notes that further research is needed.

The Study includes data spreadsheets and notes critical assumptions.

Commercial Food Waste Reduction in Alameda County, Northern California Recycling Association

"Commercial Food Waste Reduction in Alameda County" (Report) was prepared for Northern California Recycling Association (NCRA) with support from StopWaste.[67] The Report defined "discarded food" and "edible or preventable discarded food."

With regard to metrics, the report identifies "Estimation Sources and Methods," and uses several sources provided by StopWaste. The report notes that the data are "soft," but estimates that "Of total food discarded annually, approximately 72-115 million pounds (33%) is edible and approximately 20 million pounds (6-9%) is preventable." The breakdown by commercial sector uses the 33% factor across types of businesses. This assumption is an oversimplification that reflects the current state of data in this emerging area.

The Report is primarily focused on policy and program recommendations, noting "Based on our observations and research, we identified over 50 potential policy and program solutions that could be implemented locally summarized in our 'menu of recommendations'. They are categorized into three areas: education and data; policy; and logistics and infrastructure and further sub-divided into short-term (1 to 2 years), medium-term (3 to 4 years) and long-term (5 to 6 years) based on their ease of implementation and the countdown to the SB 1383 deadline of 2025."[68]

[67] NCRA, "Commercial Food Waste Reduction in Alameda County," June 2017.
[68] See page ES-4.

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

Other Food Recovery Review

Boulder, Colorado Food Waste Audit[69]

A February 2016 report regarding food waste generation in Boulder focuses on developing a framework for improving food rescue efforts from commercial and industrial sources. The report focuses on the practices of individual businesses in Boulder, and while the findings may not be directly applicable to Alameda County jurisdictions, it provides a sound, detailed understanding of the motivations and barriers that affect food rescue in individual businesses. We recommend StopWaste staff review this study.

Oregon DEQ, Portland Metro and City of Portland

The following is a summary of food recovery-related material from Oregon. As discussed in Sections 3 and 4, with regard to waste characterization data and C&D recovery, respectively, local data and/or resources from other western states are of the most use for Alameda County. Review Team members experience is that national or data from other parts of the country are not as relevant or useful. The following are a few highlights. Additional detail and contact information can be provided to StopWaste staff.

The Oregon Department of Environmental Quality (ODEQ) is focusing on broad qualitative and quantitative analyses in support of their *Strategy for Preventing the Wasting of Food*. The plan, finalized in March 2017, outlines a framework to direct ODEQ's work over a five-year period to encourage reductions in the wasting of food across the supply chain to support the Agency's Materials Management in Oregon: 2050 Vision and Framework for Action.

Drawing on an eight-month long evaluation of the current landscape around preventing the wasting of food and an assessment of more than 80 potential projects, ODEQ has identified nine projects that it believes will both "change the current conversation" around preventing the wasting of food and make significant, measurable contributions to the state's waste reduction goals.

Two initial residential implementation projects were completed in 2017:

1. Task 1 and Task 2 - The first project is a major research effort into the causes, quantities and types of wasted food in Oregon. ODEQ is partnering with Portland State University to conduct a baseline study of Oregon's edible and inedible wasted food and fill existing research gaps that have inhibited public agencies and food businesses from taking measurable action to prevent wasted food.
2. ODEQ has commissioned research to develop a messaging hierarchy that will form the foundation for wasted food prevention outreach campaigns. This work will inform other projects that include the development of public information materials; engagement with commercial food service businesses; collaboration with the edible food donation and rescue community; supporting efforts to decrease public confusion around sell-by, use-by, and best-by date labels; and pilot projects in school kitchens.

[69] See www.boulderfoodrescue.org/food-waste-audit/.

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

The full Strategy can be found here: www.oregon.gov/deq/mm/food/Pages/foodwastestrategy.aspx.

Here is the link to ODEQ's main page for Food Rescue: www.oregon.gov/deq/mm/food/Pages/Food-Rescue.aspx.

Here is the link to the work to date on Wasted Food Measurement (Task 1 and 2 completed – Qualitative Interviews and phone surveys): http://www.oregon.gov/deq/mm/food/Pages/Wasted-Food-Study.aspx.

Metro, the regional government for the Portland, Oregon metropolitan area, continues to work on metrics and messaging on Food Donation and Prevention in anticipation of outreach to food service businesses in the region in association with a food scraps separation requirement. The bulk of this work will be occurring in the next 6-12 months. There is a great opportunity for collaboration and shared resources.

The Portland Metro region is very similar to Alameda County in terms of population, demographics and geography. Metro serves 3 counties and 24 cities covering urban, suburban and rural areas.

Following is a sampling of the range of Metro's resources and initiatives around food waste:

- "The future of garbage and recycling" – Metro's initiatives: www.oregonmetro.gov/public-projects/future-garbage-and-recycling
- Click on Food Scraps – Background, proposed food scraps policy and administrative rules, and related documents and studies (presentations and capacity reports): www.oregonmetro.gov/public-projects/future-garbage-and-recycling/food-scraps.

Four articles:

1. Part 1: Businesses address challenges to keep food out of the garbage: www.oregonmetro.gov/news/businesses-address-challenges-keep-food-out-garbage.
2. Part 2: Food Waste At Home: www.oregonmetro.gov/news/spoiler-alert-reduce-food-waste-home.
3. Part 3: Food Donation: www.oregonmetro.gov/news/food-rescue-helps-keep-food-out-trash.
4. Part 4: By The Numbers: www.oregonmetro.gov/news/food-garbage-numbers.

"55 percent of the food in the garbage comes from businesses. Take a look at some key numbers related to food that gets tossed – and collected – across greater Portland."

After much national research, Metro has landed on CalRecycle/Cascadia's data for food waste generation estimates. Here is the link to the Business Group Waste Stream Calculator: www2.calrecycle.ca.gov/WasteCharacterization/BusinessGroupCalculator.

City of Portland has required organics collection from businesses for a while. While work progresses on the regional roll-out of mandatory collection, they are focusing on donation and prevention of food waste. They found ReFED didn't offer enough information to develop even a pilot project. They are instead working on case studies (expected Fall 2017) and conducting stakeholder outreach and education.

APPENDIX A:
METRICS – ADDITIONAL MATERIAL

ReFED: www.refed.com/?sort=economic-value-per-ton:

"ReFED was formed in early 2015 to create The Roadmap to Reduce U.S. Food Waste, the first ever national economic study and action plan driven by a multi-stakeholder group committed to tackling food waste at scale."

ReFED developed a core economic model for analysis of economic value, non-financial impacts and metrics for food recovery.

This page intentionally left blank

APPENDIX B: WASTE CHARACTERIZATION ANALYSIS – ADDITIONAL MATERIAL

TABLE OF CONTENTS

Pooling Disparate Data

Material Categories and Waste Generator Types

In order to compare results for waste characterizations that had some variability in their definitions of material types, we defined broader "Material Categories" that typically included several material types within each waste characterization. These Material Categories are shown in Figure B-1.

Figure B-1: Material Categories

Material Class	Description
01_OCC	Corrugated cardboard and Kraft paper bags.
02_Recyc Fibers	All grades of recyclable paper: news, office, etc.
03_Container Glass	Bottles and jars. Does not include plate glass, Pyrex™, etc.
04_Recyc Metals	Metal food and beverage containers and other small metal objects typically accepted in municipal recycling programs.
05_Plastics 1 – 7	Does not include polystyrene foam or plastic film.
11_Food Scraps	Produce and other foods, bones and shells. Does not include whole dead animals.
13_Food Soiled Paper	Wet or food-stained paper, and also compostable plastic bags and waxed corrugated cardboard. In essence, fiber or packaging materials best suited for composting or anaerobic digestion.
14_Plant Debris	Leaves, branches, grass clippings, including stumps.
21_Plain Wood	Unpainted, unvarnished wood, including pallets, crating and dimensional lumber.
22_Wood Product	Painted or varnished wood, plywood, and all-wood furniture. Does not include wood pressure-treated to resist rot.
25_Scrap Metal	Ferrous and non-ferrous scrap, as well as white goods and appliances.
29_Inerts	Rock, soil, bricks, and other mineral materials. Does not include ash.
91_Containers & Fibers	"Traditional" recyclables: cans, bottles (glass or plastic), cardboard, Kraft paper, and various grades of recyclable paper. This Material Class was needed to handle StopWaste's Benchmark Study data, which measured all of these traditional recyclables as a single material type.

Definitions of waste generating sectors, such as single-family (SFD), multi-family (MFD) and commercial, varied among the waste characterizations. Many of the waste characterizations sampled and measured a single residential sector, with no distinction between SFD and MFD. Other jurisdictions carefully kept SFD

and MFD samples and data separate. For those studies, the Review Team created "combined residential" (RES) data for each waste characterization by taking the weighted average of SFD and MFD data, using the proportions of the annual tonnages in each of those streams. The Review Team adopted the term "ICI" (Industrial, Commercial, Institutional) to identify non-residential samples from businesses and other community sources. In summary, eight waste characterizations defined separate SFD and MFD sectors; all 13 waste characterizations defined RES and ICI sectors.

Other Issues Affecting Data Comparability

Following are several issues discussed in Section 2 that are likely to affect the comparability of waste characterizations in the future:

- Increasingly strict limits on the quality of wood scraps acceptable for mulch and for biomass.
- Evolving regulations governing the definition of "organics" for implementation of California Senate Bill 1383.
- The increasing complexity of plastic resins.
- Foreign markets' increasingly stringent contamination limits.

Selection of Jurisdictions

With regard to Figure B-2 below:

1. Each of the years shown represents a distinct waste characterization.
2. The King County studies each in effect contain two distinct waste characterizations - one for Seattle, and one for the remainder of King County.
3. The Lane County, Oregon waste characterization follows the methodology used for the 2010 Oregon statewide waste characterization, as do those for other Oregon jurisdictions that elected to conduct an individual study.

APPENDIX B: WASTE CHARACTERIZATION ANALYSIS – ADDITIONAL MATERIAL

Figure B-2: Selected Jurisdictions and Waste Characterization Studies – Additional Detail

Location	Waste Characterization Study(ies)	Repeated	Recent	Maturity	Notes
CA State	2008, 2014	Yes	Yes	Varies	Will be interesting to compare Alameda County data (prior and forthcoming) to Bay Area region data.
King County, WA	2011, 2015	Yes	Yes	High	Evolving Organics definitions are of interest. See also special studies of organics, 2012 and 2015
Lane County, OR	2010	Yes	7 yr old	Med to High	Useful to see what margins of error occur across a diverse and somewhat comparable county to Alamedas County. Waste characterization includes effort to measure quantities on a "clean, dry" basis as well as "as received."
San Francisco, CA	2006, 2013	Yes	4 yr old	High	Many special streams of less interest, but general data are useful as a benchmark.
Vancouver, BC	2014, 2015, 2016	Yes	Yes	High	Methodology & calculations differ from US work in some ways, but this fresh perspective could be helpful. Organics definitions & data are of special interest.
WA State	2009, 2016	Yes	Yes	Varies	Study geographically broad; Puget Sound data might be most comparable. Organics definitions & data are of special interest.

APPENDIX B: WASTE CHARACTERIZATION ANALYSIS – ADDITIONAL MATERIAL

Jurisdictional Profiles

Figure B-3 provides more detailed profiles for the six selected jurisdictions.

Figure B-3: Key Policies, Programs and Characteristics for Selected Jurisdictions – Additional Detail

Jurisdiction	Key Policies, Programs and Characteristics
CA State	50% jurisdictional diversion requirement. Statewide goal of 75% by 2020. At about 60% for 2016, using pounds/capita measure. Mandatory multi-family and commercial recycling and organics collection (AB 341 and AB 1826) Pending ban on disposal of organics; regulations pending (SB 1383) Beverage Container Recycling and Litter Reduction Act (AB 2020)
King County, WA	King County: • Population approximately 2,150,000 • Goal of 70% diversion in 2030. If single family sector is not at 61% by 2020, County will require mandatory separation and/or incentive based disposal fee. Single family at 56% in 2015. • Mixed C&D high diversion processing required Seattle: • Population approximately 704,000 • 70% diversion goal by 2022. At 59% for 2016. • Disposal of recyclables and compostables prohibited • Required separation for SFD, MFD's and commercial; enforced with notices but few fines • Contracted collection with pay-as-you-throw rate structure • 12-gallon and 19 gallon garbage containers available • No charge multi-family recycling • Choice of third party recycling contractors for businesses • Commercial compostable service provided at reduced rate • Disposal bans for readily recyclable C&D materials phased in 2012-2018

Figure B-3 (Continued)

Jurisdiction	Key Policies, Programs and Characteristics

Lane County, OR	State:
	• Statewide mandatory recovery of 52% by 2020; 55% by 2025.
	• Mandatory material-specific recovery rates:
	  o Food waste – 25 percent by 2020
	  o Plastic waste – 25 percent by 2020
	  o Carpet waste – 25 percent by 2025
	• Beverage Container Act implemented 1972
	Lane County:
	• Population approximately 370,000
	• 63% diversion by 2025; currently at 50-55% countywide
	Eugene:
	• Population approximately 167,000
	• Collection services provided by licensed haulers
	• Residential and commercial cart customers have option of every-other–week garbage collection.
	• Residential 20 gallon garbage option
	• Residential recycling program segregates glass
	• Residential food scrap collection pilot in progress
	• Residential every-other–week yard trimmings collection
	• Food scrap collection for businesses, schools (voluntary); processor charges fee for excess contamination
	• Residential and commercial customers subject to contamination fee
	• Business technical assistance at no charge

City and County of San Francisco, CA	• Population approximately 871,000 (2016)
	• 75% Diversion goal by 2010. 80% in 2010
	• Zero Waste goal by 2020 (90% diversion)
	• Mandatory Recycling & Composting Ordinance (2009)
	  o Requires source separation of material
	  o Covers single family, multi-family, and commercial sectors
	  o Enforcement began in 2013
	• Primary services contracted; single collection, processing and disposal service provider per City charter
	• Small garbage generator option available (16 gallons)
	• Extensive business technical assistance at no charge

Figure B-3 (Continued)

Jurisdiction	Key Policies, Programs and Characteristics

City of Vancouver, BC	Province of British Columbia:
	• Single Province-wide recyclables list for collection programs
	• Extensive product stewardship programs through "Multi-Material BC"; non-profit, industry-funded entity created by the Province
	• "Bottle bill" equivalent through product stewardship program
	Metro Vancouver:
	• City of Vancouver and twenty other small jurisdictions
	• Population approximately 2.5 million (2016)
	• Goal of recovering 80% by 2020. At 61% for 2014
	• Disposal/incineration bans
	  o 2008: recyclables (cardboard, paper, glass, metal and plastic containers)
	  o 2015: food scraps
	• Added difficult-to-recycle materials to curbside with shift in program funding to paper/packaging industry
	Vancouver:
	• Population approximately 631,000 in 2016
	• Disposal facilities include a WTE facility nearby in Burnaby, BC
	• Goal to reduce disposal/incineration by 50% from 2008 levels by 2020
	• Goal of zero waste by 2040. Current stakeholder process to define "zero waste" and how it will be achieved
	• Municipal collection of garbage and organics
	• Multi-Material BC contracted recycling collection
	• Four stream recyclables separation (curbside non-glass containers, glass, and fibers; drop-off for other materials)

WA State	• Statewide diversion goals: 50% by 2007. At 51.4% for 2013 • Solid waste management plans including 20-year plans for facilities and programs required for jurisdictions. • Yard debris disposal ban (2012)

APPENDIX B: WASTE CHARACTERIZATION ANALYSIS – ADDITIONAL MATERIAL

Definition of Edible and Non-Edible Food

Currently, the most actively evolving definitions are those for food. As traditional recyclables have been diverted or prevented through various means, discarded foods and related compostable organics have become the most prevalent remaining class of generally recoverable material in the municipal disposal stream. StopWaste is focused on food recovery, and developing a working definition for "edible food." Food recovery, as well as management of food once discarded through composting, anaerobic digestion or other approaches, each requires a distinct definition. Should it include unopened packages and bottles of water? Unspoiled but unattractive produce? Plate scrapings from restaurants? Containers of kitchen grease? Bones and shells? Considerations of these complexities have led to differing definitions that make subtle distinctions.

StopWaste staff and consultants (including the Review Team) have discussed suitable definitions for Edible Food, with a focus on food recovery. This term refers to food that is intended for human consumption but was discarded, due to the unattractive appearance of food items, oversize portions, wasteful preparation methods, damage in handling, spoilage[70], or other reasons. The final definition will be useful for future waste survey work in Alameda County and for comparison with similar surveys in other locations.

StopWaste staff reported that although the Characterization Study does not require subcategories for the "Food" category, the field crew have experimented with removing foods that could readily be recognized as edible but unused (e.g., raw foods that are generally prepared by cooking). While doing so, they have recognized that some edible foods, especially those that are largely liquid, become impossible to separate and quantify after regular collection. The Review Team's waste characterization experience bears this out and suggests that data on discarded edible food generally represents only part of the edible food that could be diverted through source separation. In any event, as future waste characterizations provide for more subcategorization of edible and non-edible food, it will be very important to clearly document the definitions of those subcategories prior to comparing data. To illustrate, Figure B-4 provides several examples of Food subcategories from three waste characterizations featured in Section 4.

[70] While spoiled food is not edible, identifying it as part of GSIG can help in identifying steps to provide for consumption prior to spoilage, and to minimize or avoid spoilage.

Figure B-4: Sample Food Waste Categories

King County, Washington, 2015	Vancouver, BC, 2016	Lane County, Oregon, 2010
Packaged Vegetative Food	Unavoidable food waste	Non-packaged bakery goods
Unpackaged/Scrap Vegetative Food	Plate scrapings, unfinished meals	Packaged bakery goods
Packaged Non-vegetative Food	Whole fruits and vegetables	Non-packaged other vegetative food
Unpackaged/Scrap Non-vegetative Food	Whole meats, fish	Packaged other vegetative food
	Full/unused ready-made	Non-packaged non-vegetative food
	Baked goods	Packaged non-vegetative food
	Dairy	
	Liquids (drinks, oil in package)	
	Candy and Snacks	
	Condiments and Sauces	

Data from Other Waste Characterization Studies

See Section 4 (page 62) for summary discussion of the jurisdictions and waste characterizations contained in the Figure B-5.

Figure B-5: Summary of GSIG in Recent Non-West-Coast Waste Characterization Studies

	Good Stuff in Garbage			GSIG by type					
Study Area	SFD	MFD	Both	Recy	Org	Glass*	N	Year(s)	Note
StopWaste Benchmark	35.0%			9.5%	25.5%		~8,000	2012-16	samples from household set-outs
		43.9%		14.1%	29.8%		1,550	2014-16	samples from set-outs at complexes
Larimer County, CO			43.8%	12.6%	31.2%	1.8%	30	2016	SFD and MFD materials were combined.
Statewide, CT			54.6%	23.9%	30.7%	2.5%	135	2015	SFD and MFD materials were combined.
Statewide, IA			46.6%	22.8%	23.8%	1.5%	213	2011	SFD and MFD materials were combined.
Montgomery County, MD	43.2%			21.3%	21.9%	2.9%	50	2013	
		48.6%		27.9%	20.7%		19		
Ramsey & Wash'n Co's, MN			50.2%	20.7%	29.5%	2.4%	25	2014	primarily SFD with some MFD
		51.9%		24.5%	27.4%		4		targeted MFD generators
Polk County, MN			41.8%	24.8%	17.0%	4.0%	40	2014	Most samples were mixed residential + commercial. This study focused on fuel characteristics of refuse.
Statewide, RI			50.0%	21.4%	28.6%	3.9%	105	2015	

* Glass data are for all sectors combined: SFD, MFD and Commercial / ICI.

Other Notes for Figure B-5:

1. Material categories varied among studies. The above percentages were compiled from detailed data tables, omitting categories that might contain some non-GSIG such as treated wood, scrap

ferrous metal, bulky plastics, etc. Hence these GSIG percentages are slightly lower than would be found using Alameda County criteria.

2. Waste characterizations conducted in "non-West-Coast" jurisdictions may or may not accurately reflect seasonal variations in yard trimmings.

This page intentionally left blank

APPENDIX C:
ULTIMATE DISPOSITION – ADDITIONAL MATERIAL

TABLE OF CONTENTS

Palo Alto Agreement

Attachment E Materials Processing[71]

A. Recyclable Materials Processing

1. General

a. Facility

All Contractor vehicles collecting Recyclable Materials from the City shall deliver directly to the GreenWaste Material Recovery Facility (Materials Recovery Facility or GreenWaste MRF in this exhibit) located at 625 Charles Street, San Jose, California.

b. Facility Permits

Contractor shall keep in force and be in full regulatory compliance with the terms of all permits and approvals from governmental authorities necessary for the use of the GreenWaste MRF or any other approved alternative processing facility during the term of the Agreement for the processing of City Recyclable Materials.

c. Prohibited Use of Materials

Contractor shall ensure that Recyclable Materials are neither disposed of at a landfill nor utilized as alternative daily cover at a landfill without prior written consent from the Director.

d. Tonnage Tracking and Reporting

Contractor shall submit a report each month to the City on Recyclable Materials received during the immediately preceding month from each collection vehicle. The reports shall include at a minimum: the source, method of delivery, truck number, time of delivery, tonnage delivered, vehicle license number, person receiving the delivery. Contractor shall also update vehicle tare weights twice per year, and provide that data to the City.

e. Facility Contingency

Contractor shall arrange to process Recyclables Materials at no added cost to the City, should processing capacity at the GreenWaste MRF, for whatever reason, be temporarily unavailable or inadequate.

2. Processing

a. Processing Method: GreenWaste Recovery has installed a new material recovery system capable of processing a minimum of 20 tons per hour of single stream recyclable materials. The equipment is

[71] See Section 5 for discussion of the material contained in Appendix C. The documents included in Appendix C are provided in their original form and have not been formatted for consistency with the Review.

manufactured by Bulk Handling Systems (BHS). From time to time equipment will be modified or replaced to update the system but the following components will be the minimum. If processing changes, Contractor shall submit those changes in writing to the City.

Pre-Sort: The system includes ten pre-sorting stations. Sorters will remove contaminants, large items, metals, and injection-molded plastics prior to the material stream entering the mechanical portion of the facility. This will increase plant throughput, machinery efficiency separation and output products quality. Staffing level and location will be according to feedstock being processed on each feed line.

Post-Sort: Quality control post-sort stations are included in the design to ensure optimum marketability of the recovered commodity. The system will operate with 2 to 8 post sorters at a time depending upon the quality of the material and the overall performance of the system.

Trommel Screen: The trommel will separate materials into two distinct fractions being approximately l/i minus, and over's for the purpose of separating glass and fiber.

Cardboard Screen: All captured cardboard from both cardboard disc screens will pass over one quality control sort station where up to two sorters will clean the cardboard before directing it to the cardboard bunker conveyor for later baling.

News Print Screen: This screen will separate newspaper from the rest of the stream. The newspaper will be sent to a post-sort clean up prior to being baled.

Polishing Screen: This screen is used to separate mixed paper from the containers. Mixed paper will float on top as the containers drop through the bottom on to another conveyor.

Optical Sorting: PET beverage containers will be optically sorted prior to final manual quality control (post-sort) before being stored in bunkers, prior to baling. Any cross contamination or trash can be sorted out and redirected to proper streams via conveyors.

Eddy Current Separator: Non-ferrous metals (i.e. aluminum cans) will be separated utilizing an eddy current separator. All non-ferrous metals will be stored prior to baling.

Direct Baling: Clean source-separated loads, such as cardboard and film plastics from commercial and City facilities, will be fed directly into the accessible baler feed conveyor which provides more than 45 feet of direct load capability.

Electro-magnetic Separators: Ferrous metals will be separated using electro-magnetic separators. All ferrous metals will be stored in common storage silo for later baling. If the primary electromagnetic separator is out of service the secondary magnetic separation unit provides redundancy.

Drum Separator: This mechanical separation utilizes a vacuum to separate 3D containers from the waste stream.

b. Acceptable Materials

Recyclable Materials listed in Attachment C, Section 2 shall be processed at the GreenWaste MRF. Additional types of Recyclable Materials which City directs Contractor to collect shall be processed at no additional charge.

c. Residue Rate Requirements.

Contractor guarantees to process mixed loads of Recyclable Materials with a minimum ninety two percent (92%) recovery rate; maximum eight percent (8%) residue annually at the processing facility.

The GreenWaste MRF shall measure and report to the City the annual Recyclables Materials processing line and facility residue rate, and reciprocal recovery rate, prior to August 1 of each year. This report will indicate actual Recyclable Material tonnage received at the Materials Recovery Facility, processed, marketed (by material type) and sent to the landfill. These annual recovery/residue rates shall be utilized to ensure that the Contractor has met tonnage and recovery goals for Recyclable Materials. Contractor shall allow City staff to observe processing, on request.

3. Marketing

a. Marketing Plan

Contractor shall submit to City on or before January 1 of each year, a plan for marketing Recyclable Materials for the coming year. The Marketing Plan shall include the following: 1. Quantities: estimated quantities of each Recyclable Material; 2. Prices: estimated unit market values 3. Marketing: end markets and uses, and 4. Quantities of materials marketed during the preceding year.

b. Marketing Methods

Contractor shall use, and build on its existing network of, vendors to sell commodities. In general, at the time of execution, materials markets are as follows:

Plastic 1-7, Plastic Bags, Plastic Injection, Black Injection - Plastics are cleaned and sorted to produce new flake that will go into the production of many items. Currently plastics are sold through Berg Mills to both foreign and domestic processors.

Mixed Paper, OCC - Materials will be recycled into new products such as newspaper and cardboard. Currently, fiber products are primarily sold through Berg Mills to domestic and foreign mills.

Glass - Glass will be recycled into new glass and. fiberglass products. Currently, glass is sold and processed locally to Strategic Materials

Scrap Metal, Aluminum - Metals will be recycled into new ferrous and non-ferrous products. Currently, metals are sold to Standard Iron to be processed and shipped both domestic and foreign markets.

E-Waste – E-Waste will be disassembled in Hayward at E-Recycling and ·shipped both domestically and internationally to other recyclers.

c. Stockpiling of Materials

Contractor shall provide storage of materials during extreme market fluctuations. Processed materials shall not be stockpiled for more than one year.

d. Certificate of End Use

Contractor shall submit to City on or before July 1 of each year a certification of end use from each purchasers establishing that the materials sold the prior fiscal year have been, in fact, recycled.

B. Compostable Materials Processing

1. General

a. Facility

All Contractor vehicles collecting Compostable Materials from the City shall deliver to the City's designated compost facility, including the following:

ZBEST: Compostable Materials shall be delivered directly to the SMaRT Station or the GreenWaste MRF located at 625 Charles Street, San Jose, California. The City's Compostable Materials may be comingled with materials from other jurisdictions at the GreenWaste MRF. The Compostable Materials shall then be loaded into transfer vehicles for transportation to the Z Best Composting Facility (Z-Best) located in Gilroy for processing and composting.

ZWED: Compostable Materials shall be delivered directly to the ZWED Anaerobic Digestion Facility located at 685 Los Esteros Road, San Jose, California. The City's Compostable Materials may be comingled with materials from other jurisdictions at the ZWED.

b. Facility Permits·

Contractor shall keep in force and be in full regulatory compliance with the terms of all permits and approvals from governmental authorities necessary for the GreenWaste MRF, Z-Best facilities, ZWED facilities, and any other approved alternative processing facility during the term of the Agreement for the processing of City Compostable Materials.

c. Prohibited Use of Materials

Contractor shall ensure that Compostable Materials are neither disposed of at a landfill nor utilized as alternative daily cover at a landfill without prior written consent from the Director.

d. Tonnage Tracking and Reporting

Contractor shall submit a report each month to the City on Compostable Materials received during the immediately preceding month at the GreenWaste MRF or ZWED (or another facility designated and approved by Director) from each collection vehicle. The report shall include at a minimum: the source, method of delivery, truck number, time of delivery, tonnage delivered, vehicle license number, person receiving the delivery. Contractor shall also update vehicle tare weights twice per year, and provide that data to the City.

e. Facility Contingency

As a primary contingency is the Zanker Material Processing Facility (ZMPF) is in the process of designing and permitting the construction of a 200,000 square foot facility that will be capable of processing and transferring Compostable materials.

2. Processing

a. Processing

Method ZBEST:
After weigh-in, transfer vehicles will dump loads in the Processing Building. Z-Best's processing plant consists of several components, including a bag opener, magnet, manual sorting stations, and a shredder. The processing plant removes recyclables such as cardboard, glass, aluminum, metal, as well as large contaminants, before shredding the material to achieve optimum particle size for composting. From time to time methodology and/or equipment may be modified or replaced to update the system and/or increase efficiencies.

Shredded food waste is composted in an enclosed bag with forced aeration called the CTI System. For the majority of the 14 week process, the bagged material reaches 150-160 degrees, which is sufficient to kill all insects, pathogens and weed seeds. After the composting process, the material is sent though a primary ·screening process. The primary screen removes all inorganic contamination of 1-inch size or greater. This residue is shipped to a landfill for disposal. Composted materials smaller than 1-inch are placed in curing piles for several more weeks. After a suitable curing period, final screening takes place and the resulting compost is ready for market. ·

ZWED:

After weigh-in, transfer vehicles will dump loads in the Receiving Hall for pre-processing. Contamination will be removed and the remaining Compostable Materials will be moved to the staging area, where material is held until loaded into the digestion Tunnels. In the digestion tunnels, clean Compostable Materials are deprived of oxygen for approximately 21 days. The resulting digestate is then moved to the decompaction area and structural material is added to increase porosity. This combined material is then moved to In-Vessel compost tunnels to complete the composting process in an aerobic environment. The compost is then moved outside and placed in windrows for final curing, screening and storage.

b. Acceptable Materials
Compostable Materials listed in Attachment C, Section 3 shall be composted at the processing facilities. The City may at no additional charge request Contractor to add additional materials as markets allow.

c. Residue Rate Requirements
Contractor will strive to achieve a minimum rate of ninety percent (90%); maximum ten percent (10%) residue rate for processing City specific materials into compost at the Z-Best or ZWED facility.

Assessment of reaching this goal will be achieved by utilizing facility processing and recovery rates of designated Compost facility. These reports will indicate actual material tonnage received, processed, marketed, and sent to the landfill.

City may observe processing at these Facilities upon notice.

3.Marketing
a. Marketing Plan
Contractor shall submit to City on or before January 1 of each year, a plan for marketing Composted Compostable Materials for the coming year. The marketing plan shall include the

following: 1. Estimated quantities; 2. Prices: estimated unit market values 3. Marketing: end markets and uses and 4. Quantities of materials marketed during the preceding year.

b. Marketing Methods

Compost produced from Compostable Materials is directed into commercial markets that include a diverse collection of potential customers, including landscapers, land developers, contractors, nurseries, greenhouses, golf courses and private recreational facilities.

Z-Best and ZWED markets to the commercial sector through its large database of existing customers, and places advertisements in the yellow pages of telephone directories, as well as in newspapers and trade publications. In an effort to expand its services to the commercial sector, Z-Best and ZWED provide delivery services for materials from its facility. The Compost facilities use a full time sales person to seek new business through referrals and cold calls to potential end-users. Current users of this product include commercial landscape installers, topsoil producers, and nurseries.

c. Stockpiling of Materials

Contractor shall provide storage of materials during extreme market fluctuations. Processed materials shall not be stockpiled for more than two years.

d. Certificate of End Use

Contractor shall obtain from five of its largest customers a certification of end use, on or before July 1 of each year establishing that the materials sold the prior fiscal year have been, in fact, reused or recycled. The certifications of end use will be retained by Contractor and will be available for review by City.

Contractor shall also submit to the City each month, Z-Best or ZWED monthly tonnages for materials being received and each material type being marketed.

C. Construction and Demolition Debris Processing

1.General

Commencing July 1, 2009, Contractor shall collect & transport all roll-off boxes and compactors, to the Zanker Materials Processing Facility (ZMPF) or the Zanker Road Resource Recovery Operations and Landfill (ZRRROL).

a. Facilities

Contractor shall collect & transport the roll-off boxes and compactor materials to the ZMPF located at 675 Los Esteros Road in San Jose or the Zanker Road Resource Recovery Operations and Landfill (ZRRROL) located at 705 Los Esteros Road in San Jose.

b. Facility Permits

Contractor shall keep in force and be in full regulatory compliance with the terms of all permits and approvals from governmental authorities necessary for use of the ZMPF, ZRRROL or any other approved alternative processing facility during the term of the Agreement for the processing of Construction and Demolition Debris.

c. Prohibited Use of Materials

Contractor shall ensure that processed Construction and Demolition Debris is neither disposed of at a landfill nor utilized as alternative daily cover (other than described in subsection 3b) at a landfill without prior written consent from the Director.

d. Tonnage Tracking and Recycling

Contractor shall submit a report each month to the City on Construction and Demolition Debris received from each collection vehicle. The reports shall include at a minimum: the source, method of delivery, truck number, time of delivery, tonnage delivered, vehicle license number, person receiving the delivery. Contractor shall also update vehicle tare weights twice per year, and provide that data to the City.

Tracking for all outbound and disposed tons shall be reported by an average monthly recycling percentage for each site. This information shall be formatted to report the 12-month recycling rate for the ZMPF and ZRRROL. This shall be posted on a web site at: www.z-best.com/recycling_rate.html.

e. Facility Contingency

Contractor shall arrange to process Construction and Demolition Debris at no added cost to the City, should processing capacity at either ZMPF or the ZRRROL, for whatever reason, be temporarily unavailable or inadequate.

2.Processing

a. Processing Method

ZMPF: The following description of the processing method for Construction and Demolition Debris delivered in roll-off boxes and compactors focuses on the processes at the ZMPF, the primary facility for processing City materials and represents minimum standards that will be met. From time to time the processing methodology and/or equipment may be modified or replaced to update the system and/or increase efficiencies.

Roll-off boxes and compactors loads enter the site and are weighed and recorded. The driver is directed to the mixed C&D unloading area for inspection and unloading. As the truck unloads, a load checker will inspect the load for hazardous materials. An active load-checking program shall be utilized to minimize the acceptance of any unacceptable materials.

After the truck has unloaded, ZMPF employees will start to separate large pieces of metals and wood from the load. Wheel loaders will then push the remaining materials to a temporary stockpile before being conveyed to the C&D sorting conveyor system. An excavator removes larger items before loading the feed conveyor. This pre-sort operation removes larger pieces of wood, metal, concrete, and garbage.·

The sorting conveyor system, which includes elevated access platforms and workstations and electrically operated disc-screens, is located above large concrete storage bunkers. The excavator is used to load the walking floor feeder which in tum feeds the incline conveyor of the sort-line.

The C&D Sorting System is designed to evenly distribute the material onto a sorting conveyor that passes a series of work stations where employees presort the larger items such as cardboard, wood, metal and film plastics before the material passes through a two stage disc screen to separate out small materials which is used on-site, or shipped to other landfills, for use as ADC.

After passing through the final stages of the disc screen, the remaining items then pass another series of work stations where employees separate and pick-out smaller recyclable items and drop them directly into the storage bunkers below or place the items in 96-gallon carts adjacent to the work stations. When the bunker is full, the sorted materials are then routed for additional on-site processing, or loaded and hauled to approved recyclers. The unsorted material that falls off the end of the sorting conveyor system is routed to a landfill for disposal.

ZRRROL: materials are routed to the ZRRROL facility, employees will start to separate large pieces of metals, OCC, gypsum wallboard, concrete, rigid plastics and wood from the load. Wheel loaders will then push the remaining materials to a temporary stockpile before being loaded into a truck and weighed prior to disposal.

b. Acceptable Materials

The ZMPF and ZRRROL facilities shall accept mixed loads of Construction and Demolition Debris. Both facilities have exclusions for putrescible, hazardous and liquid wastes. Loads containing putrescible wastes or containing more than twenty-five percent (25%) of materials that are not recovered at these facilities (Such as pressure-treated lumber, construction insulation or Styrofoam) will be diverted to the Sunnyvale SMaRT Station for disposal.

As currently permitted and operated, the facilities are primarily used for the recycling of construction and demolition (C&D) debris. Accordingly, all waste materials received at the facilities typically go through extensive screening and sorting processes to recover recyclable materials (i.e., wood, plastic, paper, cardboard, gypsum, metal, concrete, etc.). The City may at no additional charge request Contractor add additional materials as markets become available and materials are processed at the ZMPF or ZRRROL.

c. Residue Rate Requirements

Contractor guarantees that the two processing facilities (ZMPF and ZRRROL) shall achieve combined facility diversion rates of seventy-five percent (75%) for the following types of Construction and Demolition Debris loads:

1. Source separated C&D loads average a ninety percent (90%) recovery with a reciprocal ten percent (10%) residue. Source separated loads are delivered to both facilities.

   Source separated recyclables in this section is defined as a roll-off box or compactor which is dedicated to only one of the following materials: Wood waste, yard waste, metals (ferrous metals, copper, aluminum, brass) asphalt, sheetrock, cardboard, PETE-HDPE-glass-aluminum containers or cans, mixed paper or concrete. Source separated loads that contain in excess of ten percent (10%) of the non-source separated materials are processed as mixed loads.

2. Mixed C&D loads average a seventy percent (70%) recovery rate with a reciprocal thirty percent (30%) residue rate. Mixed loads are delivered to both facilities.

The monthly recovery rate for each facility will be calculated and posted as described in subsection 1.d above. Compliance with the minimum combined annual facility recovery rate of 75% (and the reciprocal maximum 25% residue rates) will be determined by the arithmetic average of the recovery rates at both facilities for the preceding 12-months period.

3. Marketing

a. Marketing Plan

Contractor shall submit to City on or before January 1 of each year, a plan for marketing Construction and Demolition Debris for the coming year. The marketing plan shall include the following: 1. Quantities: estimated quantities of each Recyclable Material; 2. Prices: estimated unit market values 3. Marketing: end markets and uses and 4. Quantities of materials marketed during the preceding year.

Contractor shall provide to the City prior to each calendar year a proposed marketing plan for each material type for the processing facilities. The City will be allowed to review and suggest recommended changes to that plan. Contractor shall maintain long term relationships with materials brokers, shall continually monitor market condition, shall have the ability to anticipate and react to severe market demand and fluctuations in quantity, composition and pricing. Contractor shall use both domestic and foreign markets to maintain continued material movement and to obtain the highest market value.

b. Marketing Methods

Following are the commodities currently recovered at the ZMPF and ZRRROL from mixed C&D loads, with description of recovery methods and markets for the materials.

Wood Waste: Large pieces of wood are separated at the tipping area utilizing hand labor, loaders or an excavator. Smaller pieces of wood are removed from the sorting line by using hand labor. Zanker has instructed and educated its employees as to the type of wood that is not accepted which includes pressure treated lumber, CCA treated lumber, creosote treated wood and lead painted lumber. These materials are placed in a separate container and properly disposed of. Wood waste is ground and marketed as organic soil amendments, decorative wood chips and co generation fuel.

Yard Waste: Relatively clean loads of yard trimmings are processed at the ZRRROL. Small amounts of yard trimmings found in loads from the City will be processed as wood waste. Z Best Products will be the main vendor for this material

Ferrous Metals: Ferrous metals, such as tin, shall be extracted from loads in the tipping area by laborers or removed from the sort-line. Large iron pieces will be removed and placed in a roll off container or stockpiled until ample materials are available to warrant transportation. These materials will be recovered and transported off site to a metals recycler.

Copper: Copper tubing and wire will be removed using hand labor. Most copper will be removed on the sorting line where sorters will have a better opportunity to capture the materials. Copper will be placed in roll-off containers. Depending on pricing, the copper materials may be baled and shipped to market or sold loose to local recyclers.

APPENDIX C:
ULTIMATE DISPOSITION – ADDITIONAL MATERIAL

Asphalt: In the case where large loads of asphalt enter the site, contaminants will be removed by hand or by using a loader or excavator. Loads will be cleaned in order to meet specifications. The cleaned materials will then be commingled with the clean concrete loads and processed into Class II Base Rock at the ZRRROL.

Sheetrock: Clean gypsum (non-painted or not removed from demolition projects) shall be received at the tipping area. Large pieces of sheetrock will be recycled using hand labor and the loader. Most sheetrock will be removed on the sorting line where sorters will have a better opportunity to capture the materials. Sheetrock will be placed in roll-off containers and shipped to the ZRRROL for further processing and marketing.

Aluminum: Aluminum will be removed at both the tipping area and from the sort-line. Scrap aluminum will be placed into a roll-off container for marketing to local recyclers or baled and marketed.

Brass: Brass fixtures will be recovered from the sort-line by sorters who will have a better opportunity to capture the materials than their ground sorting counterparts. Brass will be placed in roll-off containers. Depending on pricing, the brass materials may be baled and shipped to market or sold loose to local recyclers.

Tires: Passenger and truck tires found in incoming loads will be removed and stockpiled or stored in a separate roll-off container. When ample tires are available to warrant transportation, the tires are hauled to an end-user in Sacramento.

Appliances/White Goods: Appliances will be stored until ample supply is reached to warrant transportation to a recycler.

Hazardous Waste: Hazardous wastes that are dropped off at the tipping area and discovered by load checkers will be stored in an appropriate storage container near the tipping area for a maximum of 90 days or until an ample supply is reached to warrant disposal, whichever comes first. Hazardous wastes will be lab packed and disposed or recycled in accordance with state law. The facilities utilize the services of a certified hazardous waste disposal company for the proper disposal of hazardous wastes.

ADC: ADC is only produced from the screens on the C&D sorting system. Materials pass these screens and the 3-inch minus in size fall into a concrete bunker. Loads of ADC are shipped off site to other landfills or used on site. Currently, most ADC is being shipped to the Vasco Road Landfill in Alameda County, although some materials are used at the ZMPF or the ZRRROL sites.

No fines are used as soil amendments or beneficial reuse because of the amount of organics and other materials like glass, gypsum etc. Soil from the demolition plants at both the ZMPF and ZRRROL are shipped to area landfills and used as cover, not as ADC, beneficial reuse or erosion control. Soil amendments are produced from grinding and screening wood waste and sold to area landscapers.

Asphalt Roofing: Mixed loads of asphalt roofing will enter the tipping area and be directed to a specific area for asphalt roofing. Once deposited in this area, sorters will remove wood, metals and other

residuals. The remaining asphalt roofing may be shipped off-site for use as a buttress fill at the Pacheco Pass Landfill, ADC, or to a local asphalt plant for reuse in asphalt roofing.

Porcelain: Porcelain items such as toilets and sinks will be removed from the tipping area and placed in a stockpile with the asphalt and concrete to be processed at the ZRRROL.

Cardboard: Larger pieces of cardboard (OCC) will be extracted from loads in the tipping area while the remaining OCC will be removed by sorters utilizing the C&D sorting system. The OCC will be baled as necessary and then stockpiled until enough materials have accumulated for a complete load. OCC is sold both domestically and for export.

Mixed Paper: Mixed paper will be removed by personnel using the C&D sorting system and stored in bunkers until enough materials are generated for baling. The mixed paper will be baled, and sold both domestically and for export.

PETE and HDPE Containers, Glass Bottles, Aluminum Cans: PETE containers as well as HDPE containers, glass bottles and aluminum cans will be sorted at stations on the C&D sorting system. Sorters will be instructed to remove these items. Employees have small containers directly behind their individual sorting stations to allow for these commodities.

Once these containers are filled, employees will remove and empty each commodity into a specific container. Over time these containers will be filled, baled with the site's baler and marketed. Glass containers will not be baled; rather, they will be marketed as is to a local glass recycler.

Concrete: Concrete removal will start in the tipping area where large amounts will be found. Materials will be removed by hand into the loader bucket. The loader will bring the concrete to an adjacent area where the material will be stockpiled before being transported to ZRRROL and processed into Class II Base Rock. Smaller pieces of concrete that are removed from the C&D sort-line will also be placed into a container and shipped to ZRRROL for further processing.

E-Waste: When E-Waste is found in the tipping area or on the sort line, employees will -remove the materials to a special container specifically for E-Waste. Materials such as TVs, computer monitors, computers, cell phones and printers will be recycled with a certified state recycler and will not be exported to over-seas markets.

Stones & Bricks: Small amounts of stones and bricks are usually generated during renovation of landscape projects or small demolition projects. These items will be recovered using the sorting conveyor. Stones will be co-mingled with recycled concrete, whereas bricks will be placed into a separate container and co-mingled with roofing tiles. Materials will be processed at the ZRRROL into Class II Base Rock.

Carpet Padding: Carpet padding is very common in renovation and demolition projects. The padding may be sorted using the C&D sorting system. This material will be placed into an enclosed storage box to prevent rain and water spray from being absorbed into the padding, and are marketed to a foam recycler. There is no steady market currently for carpet padding and it may be landfilled if no market exists.

c. Stockpiling of Materials

Contractor shall provide storage of materials during extreme market fluctuations. Processed materials shall not be stockpiled for more than two years.

d. Certificate of End Use

Contractor shall submit to City on or before July 1 of each year a certification of end use from 5 major vendors annually establishing that the materials sold have been, in fact, reused or recycled.

D. Pallet Recycling

Pallets that are collected by Contractor will be delivered to a pallet recycler in the area or brought to ZMPF and stockpiled. Zanker will contact pallet recyclers and allow them to inspect all pallets stockpiled at ZMPF. If pallets can be marketed to these recyclers at this time they will be sold or given away. If the pallet recycler is unwilling to take pallets, then they will be processed at ZMPF. Pallets will be delivered to the wood waste area on the site to be ground and marketed as mulch, fuel and soil amendments. Pallets will be allowed to remain onsite for two weeks prior to being recycled.

E. Bulky Items

1. Bulky items

Bulky items that are collected will be delivered to ZMPF and unloaded in a reuse area. Reuse vendors such as Goodwill, Salvation Army, and other approved vendors will be contacted and allowed to inspect all items. These items will be made available Monday -Friday 8am to 4pm. If these vendors are unwilling to accept any of the items they will be collected and processed at the appropriate ZMPF facility. No item will remain on site for longer than two weeks.

a. Marketing Plan

Contractor shall submit to City on or before January 1 of each year, a plan for partnering with local non-profit organizations to market reusable bulky items for the coming year. The marketing plan shall include the following: 1. Estimated quantities of reusable bulky items; 2. Potential end markets and uses and 4. Quantities of reusable bulky items marketed during the preceding year.

F. Tours of all Facilities

Upon seventy-two (72) hours notice from City, Contractor shall provide tours of the processing facilities. Such tours shall not unreasonably disrupt facilities operations. City shall not be charged for labor, overhead, overtime, or any other costs associated with such tours. As part of such tours, Contractor shall prepare (subject to City's approval of text and form) and shall distribute an educational brochure, printed on recycled paper, on conservation, recycling, and general solid waste management programs.

APPENDIX C:
ULTIMATE DISPOSITION – ADDITIONAL MATERIAL

Palo Alto 2017 Marketing Plan

GreenWaste of Palo Alto Materials Processing Marketing Plan January 1, 2017 - December 31, 2017

This Material Processing Marketing Plan includes the primary commodities recovered, the primary vendors by commodity, the finished products that were produced from the commodities that were collected, the actual tonnage of material recovered by commodity, and the estimated tonnages for the coming year. This Plan covers Recyclable Materials, Compostable Materials, Construction & Demolition Debris and Bulky Items.

The tonnage estimates listed below are for the overall facilities; Palo Alto material makes up a small percentage of the overall materials processed at these facilities. Based on the information from the "markets" and current monthly totals, the managers of these facilities have provided their best estimates. The 2016 numbers do include all of the material from Palo Alto. Given current information, we believe the numbers for 2017 will remain flat to a slight tonnage increase.[72]

GreenWaste Material Recovery Facility – (single stream residue 2.0%)					
Product Specifications:	**Market/Users:**	**2016 Actual Tonnage**	**2017 Tonnage Estimate**	**Average Prices**	**%**
Aluminum Cans	Anheuser Busch is the primary end market; Sims Metal is the alternative. Expected end use is cans, alloys, and tubing.	485.81	500	$4,188.58	7.57%
Aluminum Foil/Scrap	Standard Iron is the primary end market; Sims Metals is the alternative.	356.56	350	447.68	0.59%
Ferrous/Tin	Standard Iron is the primary end market; Sims Metals is the alternative. End use is rebar and structural steel.	2,593.57	2,500	71.57	0.69%
Glass, Commingled	Strategic Materials is the primary end market; Container Recycling Alliance is the alternative. End use is as containers, counter tops, fiber glass and containers for consumption.	28,640.97	28,000	91.65	9.76%
Plastic, HDPE	Berg Mill is the primary end market; Amigo Environmental is the primary end market for HDPE buckets. End use is as plastic bottles and landscape products (border, plastic tools etc.).	4,205.57	4,500	379.20	5.93%
Plastic, PETE	Berg Mill is the primary end market; Weisco Recycling is the secondary end market. End use is as carpet and filler.	3,003.15	3,000	1,691.29	18.89%

[72] The "%" columns in these tables refer to percentage of Palo Alto material relative to total incoming tonnages. Note that Berg Mills, although identified in the table above as an "primary market," is a materials broker rather than an end-user.

Rigid Plastic,	Berg Mills is the primary end market; Smurfit Stone is the alternative. End use is as landscape material (buckets, non-food containers, plastic tools, rakes, hoes etc.)	3,318.47	3,000	101.23	1.25%
Film Plastics	Berg Mills is the primary end market; Smurfit Stone is the alternative. End use is insulation.	1,894.98	1,500	34.58	0.24%
Mixed Paper	Berg Mills is the primary end market; Smurfit Stone is the alternative. End use is as corrugated, boxboard, and wallboard.	63,765.84	65,000	121.42	28.80%
Old Corrugated	Berg Mills is the primary end market; Smurfit Stone is the alternative. End use is as corrugated, boxboard, and wallboard.	41,655.07	40,000	153.69	23.81%
Scrap Metal (all grades)	Sims Metals is the primary end market; Standard Metals is the alternative. End use is rebar and structural.	7,821.87	7,000	83.32	2.42%
E-Waste	ECS Refining is an end-of-life processor and does not ship any whole units out of their facilities; most downstream vendors are located in the US.	98.80	100	117.33	0.04%
Total Diversion for MRF	98% Diversion				
% of Palo Alto Material Processed	15.75% of Total Material				
Total Single Stream Tonnages for MRF		157840.66			

Zanker Road Material Processing Facility (residue 24%)					
Product Specifications:	**Market/Users:**	**2016 Actual Tonnage**	**2017 Tonnage Estimate**	**Average Prices per Ton**	**%**
Aluminum	Sims Metal to process for Anheuser Busch. Expected end use is cans, alloys, and tubing.	685	725	$455	0.15%
Ferrous/Tin	Standard Iron is the primary end market; Sims Metals is the alternative. End use is rebar and structural steel.	20,394	25,000	$75	4.37%
Wood Wastes - Cogeneration Fuel	Wood Waste that is ground and screened. Materials marketed as Co-generation fuel and sold to several plants in the Sierra's and Central Valley.	70,170	60,000	$4.18	15.02%
Wood Wastes - Soil Amendments	Wood Waste that is ground and screened. Sold to landscapers and contractors as a soil amendment.	12,999	18,000	$1.22	2.78%
Wood Wastes - Mulch	Wood Waste that is ground and screened. Colorized and sold to landscapers and contractors in the Bay Area.	15,687	22,000	$144	3.36%
Asphalt Shingles Cleaned	Processed and shipped to Asphalt Shingle Recyclers in Oakland	0	6,000	($33)	0.00%
Carpet/Carpet Pad	Made into new carpet and a mixture of new products. GreenWaste Carpet Recyclers	0	0	$0	0.00%
Compost	Marketed to landscapers and contractors.	4,500	4,500	$54	0.96%

APPENDIX C:
ULTIMATE DISPOSITION – ADDITIONAL MATERIAL

Plastic, HDPE	Shipped to GWR MRF for additional processing. Berg Mill is the primary end market; End use is as plastic bottles and landscape products (border, plastic tools etc.).	12	25	$123	0.00%
Plastic, PETE	Sims is the primary end market; Berg Mill is the alternative. End use is as carpet and filler.	52	60	$1,206	0.01%
Rigid Plastic	Shipped to GWR MRF for additional processing. Berg Mills is the primary end market; Smurfit Stone is the alternative. End use is as landscape material (toys, buckets, non-food containers, plastic tools, rakes, hoes etc.).	697	700	($12)	0.15%
Mixed Paper	Shipped to GWR MRF for additional processing. Berg Mills is the primary end market; Smurfit Stone is the alternative. End use is as corrugated, boxboard, and wallboard.	0	0	$0	0.00%
Old Corrugated #11	Sent to GWR MRF for processing. Smurfit Stone is the alternative. End use is as corrugated, boxboard, and wallboard.	1400	1500	$45	0.30%
Copper	Sims Metals is the primary end market; Standard Metals is the alternative. End use is rebar and structural.	212	220	$1,110	0.05%
Soil	Used on site for cover or sent to Newby Island Landfill. 10% of the better dirt is screened, blended with compost and sold as a top soil.	12732	12000	($28)	2.73%
Fines	Sent to several famers and used as a substitute for gypsum.	28,854	29,000	($27)	6.18%
Appliances/White Goods	Sims Metals; Freon and condensers removed, processed into scrap metals,	73	73	$0	0.02%
Concrete-Base Rock, Sand, Pea Gravel & Drain Rock	Transported to Zanker and crushed. Made into class II recycled base rock, pea gravel, drain rock and sand. Marketed to contractors in the area.	209,201	150,000	$4.76	44.79%
Gypsum	Transported to Marin where it is made into agricultural gypsum.	4,148	4,500	$0.00	0.89%
Tires	West Coast Tire Recycling is primary end of market. Rubber from tires is being ground for crumb for playgrounds and other rubber products.	61	65	($100)	0.01%
E-Waste	E-Recycling of California is an end-of-life processor and does not ship any whole units out of their facilities; most downstream vendors are located in the US.	63	65	$25	0.01%
ADC	Sent to Newby Island Landfill. Cover at area landfills.	85,174	100,000	($28)	18.23%
Percentage of Material Processed at Facility from PA	7.28% of Total Material				
Total Diversion for Zanker	76% Diversion				
Total Tonnage for Zanker		467,114	434,433		

APPENDIX C:
ULTIMATE DISPOSITION – ADDITIONAL MATERIAL

ZWED Composting Facility – (residue 25%)					
Product Specifications:	**Market/Users:**	**2016 Actual Tonnage**	**2017 Tonnage Estimate**	**Average Prices per ton**	**%**
Ferrous/Tin	Standard Iron is the primary end market; Sims Metals is the alternative. End use is rebar and structural steel.	24.8	25	$69	0.20%
Wood Chips	Screen wood chips. Made into soil amendments and mulch.	64	70	$18	0.51%
MSW Compost	Compost is sold to landscapers and horticultural applications. MSW compost contains food waste and yard trimmings.	12,500	12,500	$12	99.15%
Tires	West Coast Tire Recycling, used as ADC, and some crumb rubber products(zero tires from PA)	61 (units)	50	NA	0.00%
E-Waste	ERC is an end-of-life processor and does not ship any whole units out of their facilities; most downstream vendors are located in the US.	5.7	5	NA	0.05%
Glass	Strategic Materials is the primary end market; Container Recycling Alliance is the alternative. End use is as containers.	12.81	12	$90	0.10%
% of Palo Alto Material Processed	27% of Total Material				
Total Diversion for ZWED	75% Diversion				
Total Tonnage for ZWED		12,607			

The difference in tonnage can be attributed to moisture and carbon loss during the composting process. This moisture and carbon loss is counted as diversion.

APPENDIX C:
ULTIMATE DISPOSITION – ADDITIONAL MATERIAL

Bulky Items Reusable Materials			
Place of Donation	**Types of Items**	**2016 Actual Tonnage**	**2017 Tonnage Estimate**
Charity Cars for Kids	Household furnishings, children's toys, etc.	6.5	6.5

Overall Economics 2017

Given the current economic conditions and the consistent amount of materials coming into the three facilities, there are no plans to stockpile materials. The 2017 forecast is for moderate growth in regards to overall tonnage, although we expect increased compost tonnage from Palo Alto. We will also continue to pursue as clean of materials as possible, in order to make products as marketable as possible. We hope for a slight uptick in the average prices per ton in 2017.

Sample End-Use Certification

Mega Fiber, Inc.

Mega Fiber, Inc.
335 N. Puente Street, Suite B
Brea CA 92821
Jun. 1, 2017

City Of Palo Alto
C/O Paula Borges
3201 East Bayshore Rd.,
Palo Alto, CA 94303

Dear City of Palo Alto:

This letter is to certify the end use of the wastepaper we, Mega Fiber, Inc. purchased from the Green Waste Material Recovery Facility.

All of the wastepaper grades we purchased from Green Waste Material Recovery Facility are exported to the mills in China. These mills re-pulp the wastepaper to produce various grades of paper for consumption in China as well as in other countries that China exports.

Should you have any questions, please don't hesitate to make any further inquiries.

Sincerely,

Ling Sun
Vice President
Mega Fiber, Inc.

This page intentionally left blank

APPENDIX D:
STATISTICAL TECHNIQUES

Introduction

The usual goal of a waste characterization study is to learn how much of one or more specified materials (e.g., cardboard) is being discarded into a particular stream (garbage, recycling or organics) from a population of interest. Such populations can be single-family residents, businesses, or cart customers. The choice of population depends on the goals of the study and the practicalities of obtaining the material.

In Sections 3 and 4, several sets of waste characterization study results are summarized and compared. Most of those studies were "disposal based"; that is, the samples were random grab samples taken from the pile deposited at the disposal site by a full truck. In contrast, StopWaste's multi-year Benchmark Study was "generator based" – each sample came from a specific household or business. The Benchmark Study sorted samples into three to six broad material categories to determine how much recyclable and compostable material was in garbage set-outs. In contrast, most of the disposal-based studies sorted their samples into 50 or more categories in order to evaluate which specific types of materials might be the best to target for diversion services and outreach. One aspect of methodology that the two types of studies have in common is that the calculations can be, and usually are, done exactly the same way. However, care must be taken when comparing results from the two because each tends to emphasize certain material categories and de-emphasize others. For example, because materials tend to commingle and become inseparable in a collection truck, disposal-based studies are thought to understate food scraps and overstate food-soiled paper.

Terminology and Example

With rare exceptions, the proportions of materials set out by each member of the population vary from week to week. In addition, that population may produce hundreds of tons of discards each week; therefore, sorting the entire stream is usually impractical. Instead, the practical approach is to take a number of samples to represent the whole population's discards, sort each sample separately, and use statistical techniques to determine three numbers:

- The **average concentration** (e.g., "10.7% cardboard").
- The desired **confidence level** for the remaining statistical analyses (typically, "90% confidence", or "95% confidence").
- The **margin of error** associated with that confidence level and number of samples (e.g., "plus or minus 1.7%").

The results enable the analyst to make statements like the following: "From the population of small businesses, we can say with 90% confidence that the amount of cardboard in their garbage is between 9.0% and 12.4%, and is most likely 10.7%."

The margin of error and the confidence level are closely related. For a given set of samples, if a higher confidence level is desired, the margin of error will be larger. In the above example, if the desired confidence level is changed to 95%, the margin of error would increase from 1.7% to 2.1% and the above statement would read: "From the population of small businesses, we can say with 95% confidence that the amount of cardboard in their garbage is between 8.6% and 12.8% and is most likely 10.7%."

APPENDIX D:
STATISTICAL TECHNIQUES

The methods that produce these results also take into account the number of samples (N) involved. Taking more samples (increasing N) will reduce the margin of error somewhat, if the variance in the additional samples is the same as it was for the initial group.

Calculations

As an example, let us assume that 30 samples of garbage have been taken from small businesses, and each has been sorted into two categories: corrugated cardboard (referred to as "OCC"), and everything else. After weighing each category for each sample, the percentage of OCC can be calculated for each sample, as shown below.

Sample Number	Percent OCC
1	17.35%
2	15.02%
3	13.24%
4	19.51%
5	5.61%
6	18.51%
7	6.97%
8	13.16%
9	10.58%
10	4.61%
11	13.79%
12	19.46%
13	10.18%
14	17.53%
15	10.79%
16	6.34%
17	2.67%
18	6.39%
19	4.36%
20	14.53%
21	8.93%
22	8.69%
23	17.26%
24	1.96%
25	7.52%
26	13.87%
27	17.81%
28	8.24%
29	5.56%
30	1.34%

The number of samples, **N**, is 30.

The **average concentration X** is simply the mean of the percentages: divide their sum by N. For the values in the table above, **X** is 10.7%.

In the waste characterization protocol in CalRecycle regulations, the chosen **confidence level** is 90%.

APPENDIX D:
STATISTICAL TECHNIQUES

The **margin of error δ** is calculated using the number of samples **N**, their standard deviation **S** (here, 5.566%), and a value called the "t-statistic", which is based on the confidence level and N. The t-statistic is found in a lengthy statistical table that gives its values for many combinations of N and %-confidence. The equation below shows how **δ** is calculated.

$$\boldsymbol{\delta = t \times \frac{S}{\sqrt{N}} = 1.699 \times \frac{0.5566}{\sqrt{30}} = 0.017}$$

In this example, with N=30 and a 90% confidence level, t = 1.699. The resulting margin of error is 1.7%, which leads to this finding: There is a 90% probability that the true mean concentration of OCC lies in the range 10.7% ± 1.7%.