

# MAXIMIZING FOOD SCRAP COMPOSTING THROUGH FRONT-OF-HOUSE COLLECTIONS AT FOOD ESTABLISHMENTS

## DEVELOPING BEST PRACTICES FOR CUSTOMER-FACING BINS

By Dale Ekart and Kate Bailey, Eco-Cycle



With support from



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Eco-Cycle is one of the nation's oldest and largest nonprofit recyclers. The organization's mission is to identify, explore, and demonstrate the emerging frontiers of sustainable resource management through the concepts and practices of Zero Waste. We believe in personal and community action to transform society's throw-away ethic into environmentally-responsible stewardship.

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## DEVELOPING BEST PRACTICES FOR CUSTOMER-FACING BINS

### TABLE OF CONTENTS

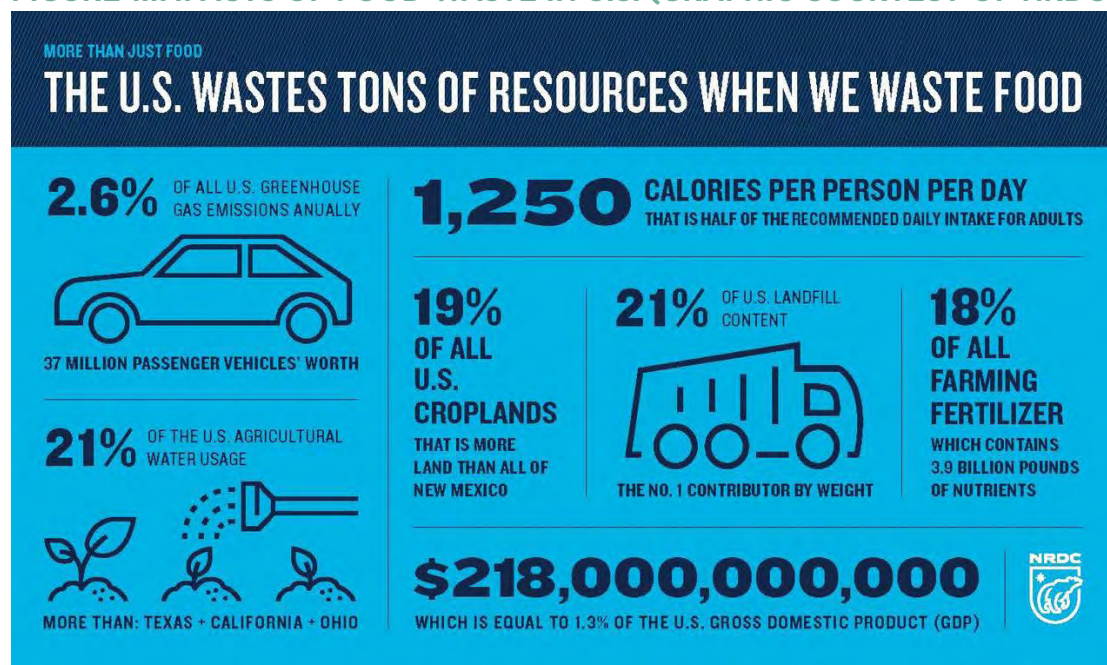
• Executive summary .....	
• Key findings .....	
• Background .....	
• Overall diversion and contamination .....	
• Composting bin findings and food scrap capture rates .....	
• Composting bin contamination .....	
• Recycling findings .....	
• Recycling contamination .....	
• Impacts of changes to bins and signage .....	
• Observations of customer behavior .....	
• Effects of packaging .....	
• Conclusion .....	
• Appendix .....	
• Types of restaurants surveyed .....	
• Timeline .....	
• What is recyclable vs compostable .....	

### EXECUTIVE SUMMARY

Food waste is an epidemic in America—nearly 40% of food goes uneaten. This makes wasted food a strong underlying contributor to many of our environmental crises. Food waste alone is responsible for at least 2.6 percent of all U.S. greenhouse gas emissions. Food and agriculture consume up to 16 percent of U.S. energy, almost half of all U.S. land and account for 67 percent of the nation’s freshwater use.<sup>1</sup>

Restaurants generate over 11.2 billion tons of food waste annually and play a critical role in reducing and recovering food scraps.<sup>2</sup> Less than 15% of restaurant food waste is collected for composting, and these efforts have primarily focused on collecting food scraps from the kitchen.<sup>3</sup> However, on average, diners leave 17 percent of meals uneaten, and 55 percent of these potential leftovers are not taken home.<sup>4</sup> This means there is a large, untapped potential to recover food waste generated by diners through front-of-house composting programs.

**FIGURE 1: IMPACTS OF FOOD WASTE IN U.S. (GRAPHIC COURTESY OF NRDC).**



Front-of-house (FOH) composting collection has always been viewed with skepticism by composters because of the perception that it comes along with high levels of contamination and a large ratio of packaging to food scraps. However, customer-facing composting bins are strongly desirable for cities pursuing aggressive recycling or Zero Waste goals—they represent a highly visible commitment to Zero Waste and can be a valuable tool for educating customers.

Boulder, Colorado is one of those cities pursuing a Zero Waste goal and targeting front-of-house recycling and composting collections at businesses, both as a way to increase diversion and as a tool to educate the community about how and why to participate in the Zero Waste programs.

In 2015, Boulder required all businesses to provide recycling and composting collections for both front- and back-of-house operations. From the onset of the city's program, there was concern about the quality and quantity of organic material collected in front-of-house, customer-facing bins. Eco-Cycle, the local non-profit recycler and a leading Zero Waste advocate, with support from Boulder-based Eco-Products, a leading manufacturer of compostable foodservice items, set out to learn how bin set-up, signage and packaging can influence how much food waste is collected through front-of-house systems, and how to minimize contamination while maximizing diversion.

### CITY OF BOULDER'S UNIVERSAL ZERO WASTE ORDINANCE

In 2014, the city of Boulder hit a record-high 55 percent diversion for single-family homes. However, the city's commercial sector was lagging far behind, diverting only 25 percent of discarded materials. To reach its Zero Waste and climate goals, the City decided it needed to regulate recycling in the commercial sector. In 2015, Boulder approved its Universal Zero Waste Ordinance (UZWO), which requires that every home, business and apartment have recycling and composting services, including FOH composting bins at most food service businesses.

Waste audits were conducted at 18 businesses across five types of foodservice establishments--corporate cafeterias, grocery store delis, quick service restaurants, coffee shops and full service restaurants. Improvements were then made to the collection bins and signage

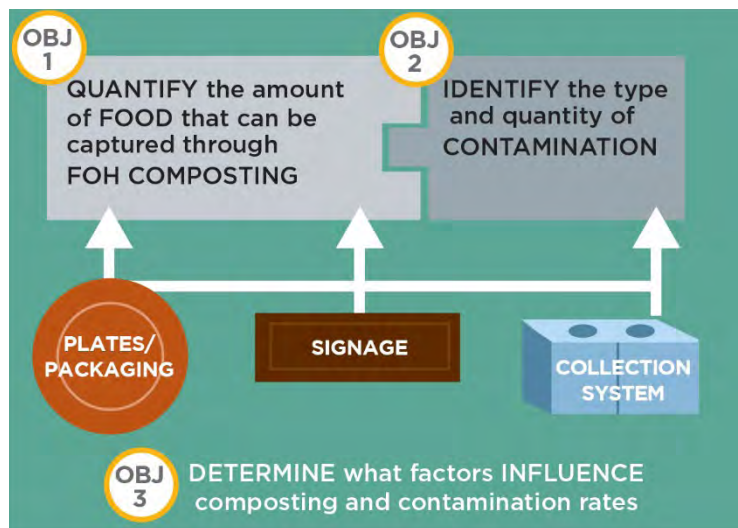
at 10 of the 18 locations and a second round of waste audits was conducted to observe any improvements in diversion and contamination (no changes were made at full service restaurants and some restaurants were unable to make changes during the project timeline).

The study demonstrates that food establishments of all types can achieve very high diversion rates and capture significant amounts of food scraps through front-of-house collections. While diversion rates, food capture rates and contamination rates varied widely between and within sectors, there was at least one high performing business in every sector. The majority of the compostable materials collected was food scraps and napkins, rather than packaging, with quick service and delis having the highest percentage of packaging in the composting bins compared to food scraps. This suggests that FOH composting collection could be a valuable new source of food scraps for commercial composting facilities.

The results suggest that improving the signage and the set-up of collection bins are likely to increase diversion rates and capture rates, and to reduce contamination rates, but improvements were not consistent in all cases. Contamination rates were markedly lower for composting bins than in recycling bins, and four out of five sectors recorded less than 11% contamination rates in composting bins. Lastly, recommendations were made on how to focus outreach efforts to the restaurant community, identifying which sectors offer a greater opportunity to capture more food waste and which sectors offer a greater opportunity to reduce contamination levels.

This research represents a work in progress and the authors hope that it spurs other communities to conduct similar research and improve upon these findings. Our methodology and additional resources are available online at [www.ecocycle.org/specialreports/restaurant-composting](http://www.ecocycle.org/specialreports/restaurant-composting).

## FIGURE 2: REPORT OBJECTIVES



## KEY FINDINGS:

*Note: all calculations and percentage rates are based on weights of materials collected during waste audits; no volume-based measurements were used in this report. See p. 7 for explanations on how rates were calculated for all data tables.*

### High diversion rates are possible across all restaurant sectors:

- Restaurants in every sector achieved high levels of diversion, demonstrating this is

possible across all business types.

- Diversion rates varied widely by individual businesses, ranging from 9% up to 100%.
- Full service restaurants generally had the highest diversion rates.
- By improved sorting and no other changes to packaging or otherwise, every business type could achieve over 80% diversion rate.

**TABLE 1: SUMMARY OF REPORT DATA FINDINGS**

Sector	Overall diversion rate	Overall contamination rate	Food waste capture rate	Composting bin contamination rate
Full service restaurants*	85%	1%	98%	<1%
Deli	77%	20%	76%	8%
Coffee shops	80%	19%	57%	22%
Quick service	75%	37%	57%	11%
Cafeteria	67%	6%	76%	3%

\* Staff bussed tables at full service restaurants while customers bussed tables at most other establishments. See p. 10 for more on why full service restaurants were included in the study and still considered to have FOH composting collections.

### **The amount of food scraps available for composting can be increased through FOH collections.**

- Food scraps and napkins comprised more than half of the compostable material collected in every sector, with the remainder being packaging. Coffee shops and cafeterias had three times more food scraps than packaging while delis and quick service restaurants had a 3:2 ratio of food scraps to packaging.
- Food scraps are not the largest part of the FOH waste stream in most restaurants, aside from full service establishments. Food scraps were only 16-35% of the total FOH waste stream in limited service restaurants, with recyclable materials making up a significant part of the waste stream.

### **At least half the food waste generated by diners was already being collected in every sector.**

- Full service restaurants in the study were already capturing nearly 100% of the food scraps through staff sorting. (It is not clear that this is representative of the entire sector and important to note that the city of Boulder requires all businesses to have composting collection service).
- Capture rates vary widely within cafeterias, coffee shops and quick service, which

## DATA CALCULATIONS

Several different calculation terms and formulas are used throughout this report. They are all based on weight of materials collected during the waste audits:

### Diversion rate:

*amount of material correctly recycled or composted, i.e.*

$$= \frac{\text{recycling} + \text{composting}}{\text{recycling} + \text{composting} + \text{trash}}$$

### Potential diversion:

*total amount of materials that could have been recycled or composted, i.e.*

$$= \frac{\text{recycling} + \text{composting} + \text{all materials that could have been recycled or composted}}{\text{recycling} + \text{composting} + \text{trash}}$$

### Capture rate:

*how well the material was correctly sorted, i.e.*

$$= \frac{\text{recycling in recycling bin}}{\text{recycling in all three bins}} \quad \text{OR} \quad = \frac{\text{food scraps in composting bin}}{\text{all food scraps in three bins}}$$

### Contamination rate:

*amount of material placed in the incorrect bin, i.e.*

$$= \frac{\text{trash in recycling bin} + \text{compostable materials in recycling bin}}{\text{all materials in recycling bin}}$$

Unless otherwise noted, all calculations represent an average of the data collected during the first and second waste audits, i.e. diversion rates by sector are the average of the diversion rates in the first waste audits combined with the diversion rates in the second waste audits.

## DATA QUALITY

This report represents an initial baseline study on FOH composting and recycling collections, and hopes to serve as a guide for future research in other cities. It should not be construed as statistically relevant because of several limitations:

- The sample size was too small to represent the entire business community, with only 18 restaurants participating in the first round of waste audits and only 10 of those businesses receiving second audits.
- While there was a lot of variety between business types, including locally owned businesses, regional chains and national chains, as well as strong sustainability supporters and less enthusiastic participants, these businesses were not reflective of demographics of the entire food service community.
- There were challenges in securing sufficient quantities of trash, recycling and composting from several of the businesses. In some cases, the volumes sorted were quite low. However, the percentage of materials in each stream were relatively consistent among business types and within a reasonable range, which suggests the limited volumes were still accurate.
- More information is provided online as part of the methodology for how to improve collection volumes and data accuracy in future studies.



implies that high rates of success are possible based on best practices in collection systems.

- Food scraps that were not properly sorted overwhelmingly ended up in the trash can and not in the recycling bin.

### **Restaurants were generally using high amounts of recyclable or compostable packaging already.**

- The majority of food establishments were using at least 80% recyclable or compostable packaging. (See appendix for a full breakdown of what was considered recyclable or compostable based on local guidelines.)
- The total amount of recyclable and compostable packaging was a strong indicator of the overall diversion rate--businesses with a very high percentage of recyclable and compostable packaging also had very high diversion rates. As the percentage of recyclable/compostable packaging declined, diversion rate also declined.

### **The use of durable food serviceware or all compostable food serviceware were both strategies for success.**

- Both the quick service restaurant with all compostable food serviceware and the quick service restaurant with mostly durable food serviceware were top performers across all the categories measured, having high overall diversion rates, high rates of food waste capture and low contamination rates. This suggests that both approaches may be used to achieve these goals.
- The prevalent use of durable food serviceware in cafeterias was correlated to lower contamination rates.

### **Contamination rates were lower than 8% in three restaurant sectors**

- Full service restaurants, cafeterias and delis all had less than 8% contamination in the composting bins at all locations. This suggests that FOH collection at these locations can be done with a fairly clean stream of materials for the composting facility.
- The most common contaminants in composting bins were plastic lids, non-compostable boats, glass bottles and plastic utensils. Cardboard and paper were also commonly found in this bin, rather than the recycling bin.
- Contamination rates on average were higher in the recycling bins than the composting bins.

### **Changes to bins and signage were likely to increase capture rates and diversion.**

- Capture rates, overall diversion rates and overall contamination rates improved at most locations following changes to the signs and bins. However, results were mixed for composting bin contamination rates, which only improved 50% of the time after changes were made to bins and signage.
- This suggests that changes to signs and bins cannot be the only approaches used to address contamination, and changes to the type and quantity of packaging used should also be considered. (No packaging changes were made in this study.)

### **Targeted outreach to specific restaurant types might be more effective than working with all food businesses.**

- Full service restaurants are the best candidates for starting FOH composting programs. They are capturing nearly all their food scraps with next to no contamination, and they have the highest percentage of food scraps in their overall waste stream.
- Coffee shops had low amounts of food waste in the waste stream and the highest rates of contamination in the composting bins. This suggests they are a lower priority sector for increasing food waste recovery.



**TABLE 2: SUMMARY OF HOW EACH SECTOR PERFORMED ACROSS STUDY CATEGORIES**

Sector	Reasons to Target FOH	Challenges
Full service restaurants	<p>High food waste capture rates</p> <p>High amount of food waste discarded</p> <p>Low contamination rates</p> <p>Higher ratio of food scraps to packaging</p>	<p>May already be performing well and not need any intervention</p> <p>Requires staff training and participation</p>
Corporate cafeterias	<p>Low contamination rates in both recycling and composting bins</p> <p>Higher ratio of food scraps to packaging</p>	<p>Staff may take meals to other areas of building so collection stations are needed in multiple areas</p>
Grocery store delis	<p>Highest capture rate for compostable packaging</p>	<p>High percentage of packaging in composting stream</p>
Quick service restaurants	<p>High levels of diversion and low contamination rates were possible in some establishments</p>	<p>Highest contamination rates</p> <p>High percentage of packaging in composting stream</p>
Coffee shops	<p>High-traffic locations with strong potential for consumer education</p>	<p>Low amounts of food scraps discarded</p> <p>High levels of contamination overall and in composting bins</p>

## BACKGROUND

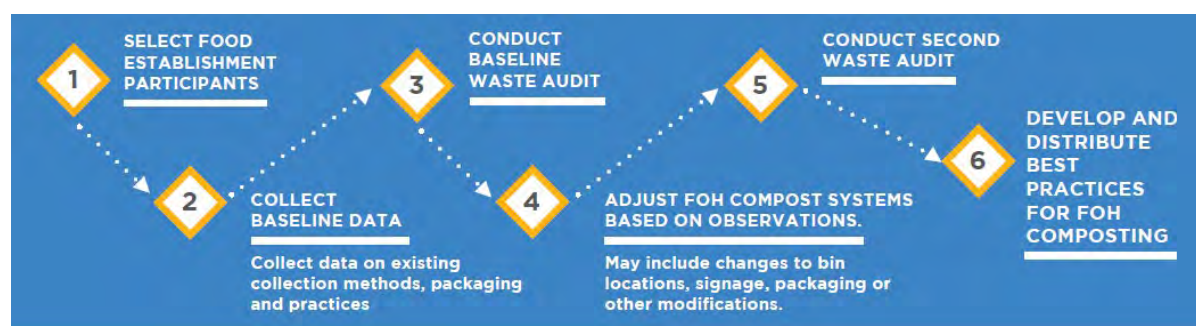
Approximately 40% of food in the U.S. is wasted, and 95% of food waste ends up in landfills. Food now represents the single largest component of municipal solid waste reaching landfills, where it gradually converts to methane, a greenhouse gas at least 84 times more powerful in global warming as carbon dioxide. Composting is an important way to manage this waste; it reduces methane emissions and can store carbon out of the atmosphere, and it recycles nutrients and improves soil quality, which in turn grows healthier food. In fact, **expanded composting has been shown to have the greatest potential to reduce GHG emissions from food waste compared to all other food waste reduction strategies**—but nationwide only 5% of food waste is composted.<sup>1</sup>

Restaurants generate over 11.2 billion tons of food waste annually and play a critical role in reducing and recovering food scraps.<sup>2</sup> Less than 15% of restaurant food waste is collected for composting, and these efforts have primarily focused on collecting food scraps from the kitchen.<sup>3</sup> However, on average, diners leave 17 percent of meals uneaten, and 55 percent of these potential leftovers are not taken home.<sup>4</sup> This means there is a large, untapped potential to recover food waste generated by diners through front-of-house composting programs.

The goal of this study was to conduct needed research to quantify how much additional food can be captured from diners through front-of-house (FOH) collections, to identify the type and quantity of contamination in FOH bins, and to determine how packaging, signage and bin placement influence composting rates and contamination.

The process and methodology are available online; the study results follow below.

**FIGURE 3: OVERVIEW OF PROCESS**



## OVERALL DIVERSION AND CONTAMINATION RATES

Restaurants can achieve high levels of diversion across all sectors and play a critical role in helping their communities reach local waste diversion and climate action goals, as well as serving as an important opportunity to educate residents on the importance of recycling and composting. Over 60% of the restaurants surveyed in the study divert over 75% of their discards, and every sector showed the potential to achieve over 80% diversion by correctly sorting their materials and making no other changes. Full service restaurants generally had the highest diversion rates and the lowest levels of contamination. Both restaurants and cafeterias had overall contamination rates below 6%. Quick service restaurants generally had the dirtiest recycling and composting bins with 37% overall contamination.

### WHY INCLUDE FULL SERVICE RESTAURANTS IN DATA COLLECTION

At full service restaurants, wait staff and bussers typically clear plates from customers and sort leftover food scraps for composting. In the three locations surveyed, restaurant staff collected plates and scraped leftover food into composting bins at a bussing station. Food scraps from customers were not taken back into the kitchen and were not mixed with back-of-house (BOH) food scraps from kitchen prep. Because customer food waste was collected separately from BOH bins, these establishments were still considered to have FOH composting.

However, because food scraps were sorted entirely by restaurant staff, full service restaurants differed substantially from the other food establishments surveyed, which primarily rely upon customers to sort their leftover food and other materials. The report authors chose to include full service restaurants in the study to serve as a baseline, or control group, to determine how well leftover food and recyclables could be sorted by trained staff. In addition, the data from full service restaurants highlights the large amount of food scraps that can be captured from customers' plates, in addition to what is collected from food prep at the back-of-house.

**TABLE 3: OVERALL DIVERSION AND CONTAMINATION RATES FOR ALL SECTORS\***

Sector	FOH diversion rates	Potential diversion rates (if materials were properly sorted)	Contamination rate: FOH composting	Contamination rate: FOH recycling
Full service restaurants	85%	96%	<1%	2%
Deli	77%	86%	8%	40%
Coffee shops	80%	81%	22%	21%
Quick service	75%	89%	11%	40%
Cafeteria	67%	86%	3%	9%

\* See p. 7 for explanations on how rates were calculated for all data tables. Unless otherwise noted, results represent an average of the first and second waste audits.

## OVERALL RESULTS ON FOOD SCRAP RECOVERY

The primary goal of FOH collections is to capture more food scraps for composting. Overall, the study results suggest significantly more food can be recovered for composting through FOH collections, with food scraps and napkins making up at least 57% of the contents of the composting bin in every sector. On average, restaurants are collecting at least 55% of the available food scraps from customers in FOH bins already because of the city's mandatory program, and at least one establishment in every sector was capturing 85-100% of available food scraps. This implies that high rates of success are possible in every sector.

Quick service restaurants and cafeterias have a greater percentage of food scraps in the FOH waste stream than delis and coffee shops, which suggests they may be better sectors to target for FOH recovery efforts. Contamination rates in composting bins were very low for full service restaurants, delis and corporate cafeterias, which suggests clean streams can be collected through FOH collection at these locations. Coffee shops consistently had high rates of contamination in the composting bins, which makes them less desirable targets for starting FOH programs.

Overall, any food scraps that did not end up in the composting bin were most likely to end up in the trash can. Eighty percent of the lost food ended up in the trash bin, with only 20% in the recycling bin. This suggests that signage and other consumer behavior messages should highlight that food is not trash.

**TABLE 4: OVERALL COMPOSTING RESULTS BY RESTAURANT TYPE (BY WEIGHT)\***

Sector	% wasted food captured in FOH composting bin out of total available FOH food scraps	% of FOH composting bin that was food scraps + napkins	% of FOH composting bin that was packaging	% contamination in FOH composting bin	% of total FOH waste stream that was food scraps
Full service restaurants	98%	99%	1%	<1%	70%
Cafeteria	76%	72%	28%	3%	30%
Deli	76%	58%	42%	8%	23%
Coffee shops	57%	74%	26%	22%	16%
Quick service	57%	57%	43%	11%	35%

\* All calculations based on FOH waste only, no back-of-house materials collected or calculated

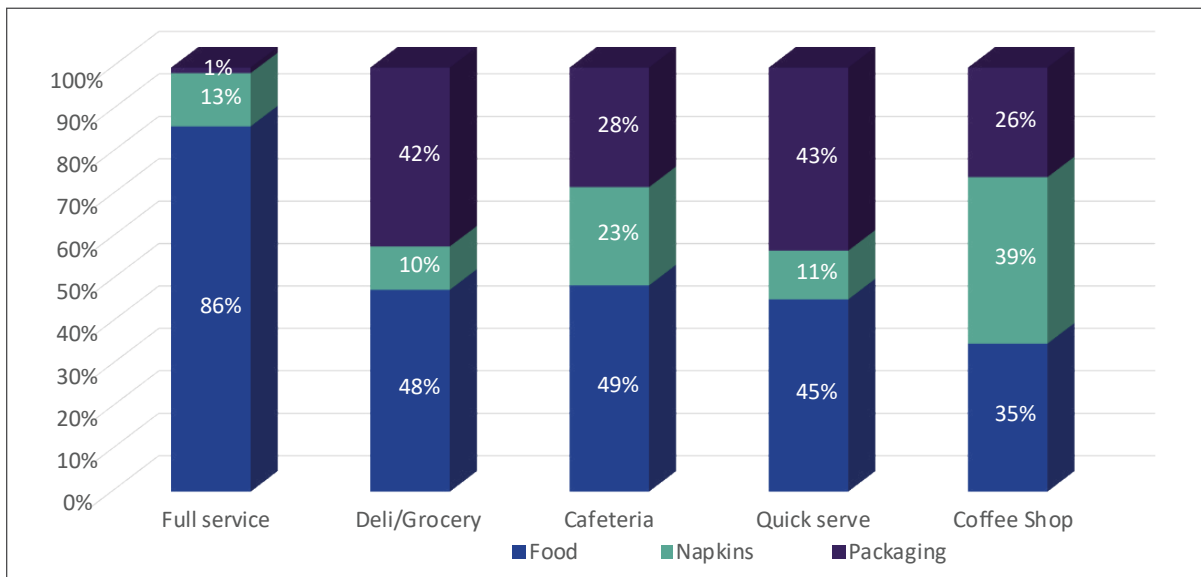
## Composition of the FOH Composting Bin

Napkins and food scraps made up more than 57% of the materials collected in FOH composting bins in every sector. Napkins are a significant portion of the composting stream, ranging from 10-39%, and are generally acceptable with composters. This amount of napkins was surprisingly high given how little napkins weigh compared to food scraps, which underscores just how many napkins are in the bins at FOH. Delis and quick service restaurants had the highest percentage of packaging in the composting stream (see more on packaging on page 23).

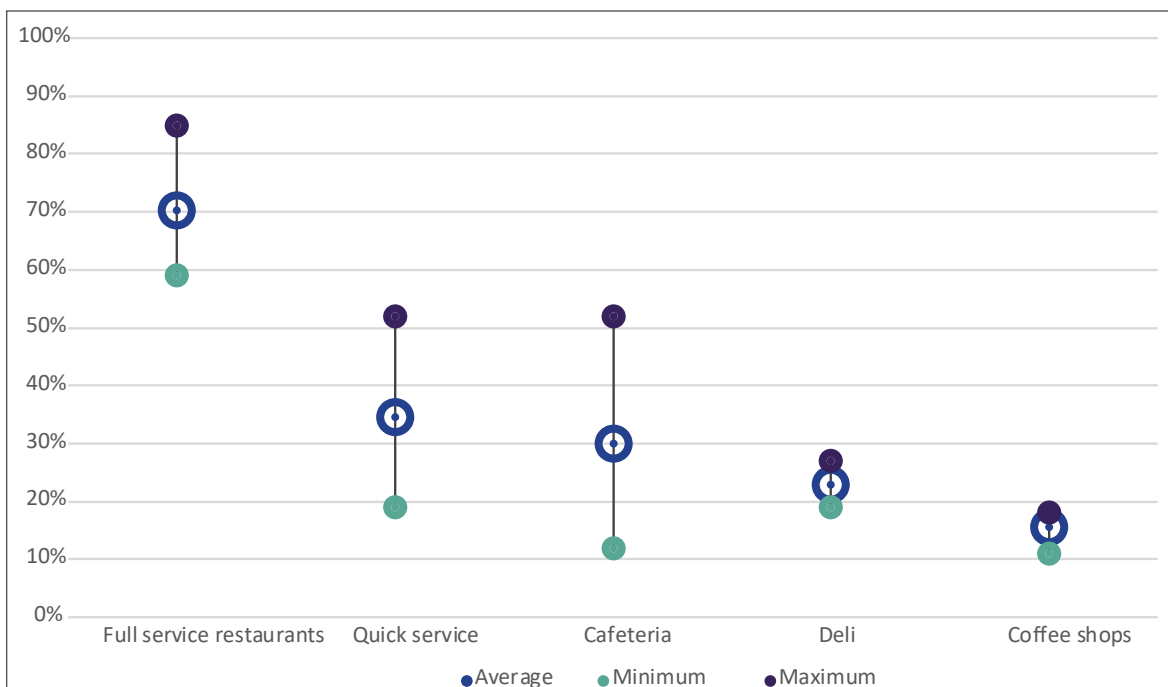
### FOH COLLECTIONS CAN INCREASE FOOD SCRAP RECOVERY

The amount of food scraps collected for composting can be increased through FOH collections. Food scraps and napkins were the majority of the materials in the FOH composting bins. The ratio of food scraps to packaging at coffee shops and cafeterias was nearly 3:1; delis and quick service restaurants had a ratio of 3:2 of food scraps to packaging.

**FIGURE 4: VARIATIONS IN THE PERCENTAGE OF FOOD SCRAPS IN THE WASTE STREAM BY SECTOR**



**FIGURE 5: VARIATIONS IN FOOD SCRAP CAPTURE RATES**



Full service restaurants capture nearly all their food scraps consistently at all establishments. Their success may be attributed to three elements:

- Restaurant staff, not customers, sort the waste and bus the tables
- High percentage of durable, reusable foodservice ware
- Minimal use of packaging and single-use items, except for straws

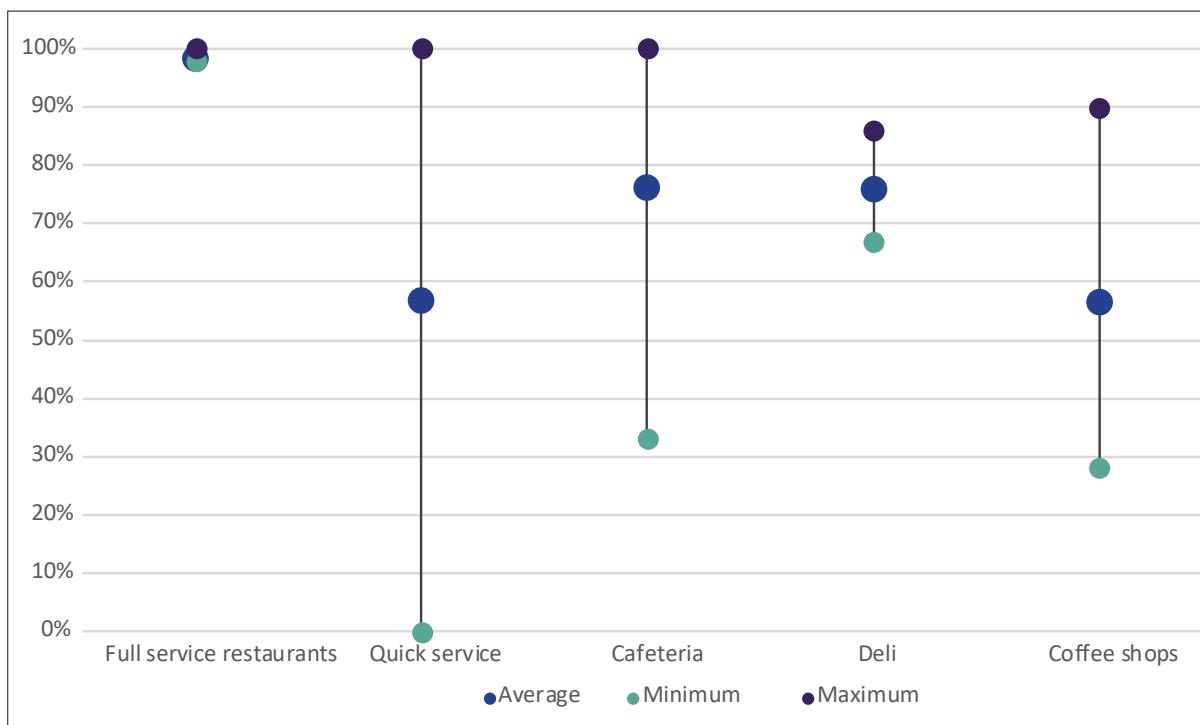
Capture rates vary widely within cafeterias, coffee shops and quick service, which implies that high rates of success are possible based on best practices in collection systems. Factors that influenced capture rates may include:

- **Staff sorting of food scraps:** at the second highest performing corporate cafeteria,

kitchen staff sort the trays after collection, although employees are encouraged to sort before depositing their tray. Additional staff sorting at quick service restaurants to “correct” any customer errors also resulted in high capture rates and low contamination rates.

- **The number of visitors compared to staff:** one of the institutional cafeterias has a large percentage of onsite visitors and had a lower capture rate compared to other cafeterias with mostly on-site staff.
- **How many employees take their meals back to their desk:** many employees were observed to use their deskside trash bins and did not sort out their materials. Materials were also found in other areas of the building.
- **Use of compostable and recyclable packaging:** the coffee shop with lowest food capture rate also had lowest percentage of recyclable or compostable packaging.
- **Use of only compostable packaging:** one quick service restaurant with all compostable foodserviceware had 100% capture rate for leftover food.

**FIGURE 6: VARIATIONS IN FOOD SCRAP CAPTURE RATES BETWEEN SECTORS**



## CONTAMINATION IN COMPOSTING BINS

Contamination in composting bins is a primary concern for composters when looking to accept materials from front-of-house collection systems. This study found very low levels of average contamination rates in full service restaurants (<1%), cafeterias (3%) and delis (8%). In fact, only one deli and one cafeteria had contamination rates above 10% during the audits. This suggests that FOH collections at these locations can be done with a fairly clean stream of materials for the compost facility.

Contamination rates at coffee shops and quick service restaurants were overall much higher than other establishments, but varied widely within their respective groups. While some locations had nearly 40% contamination, others were less than 5%. This suggests that low contamination rates are possible in these sectors. The factors that may have influenced lower contamination rates include:

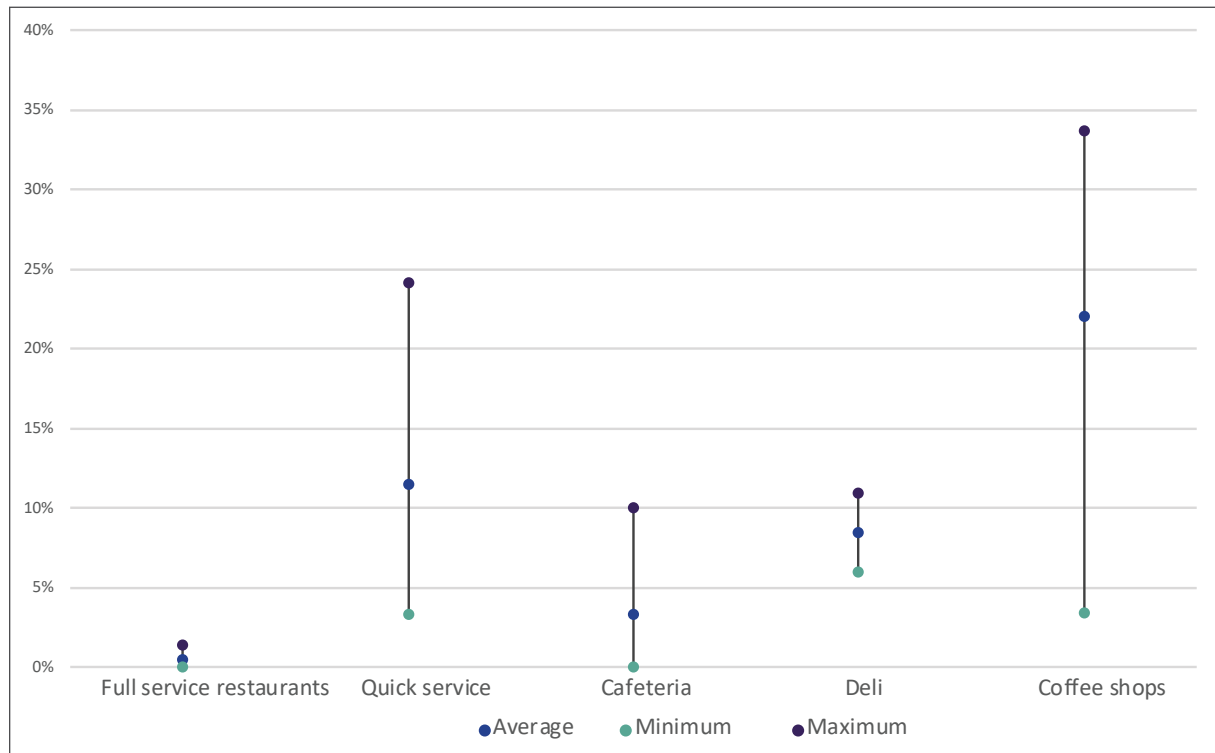
- Preference to serve dine-in customers on durable serviceware.
- Staff bus some tables and/or took an active role in cleaning up composting and recycling

bins.

- Local independent stores far outperformed the two national chains.

All locations had signage in place before the initial audit so we were not able to determine if the presence of signage influenced contamination. Signs were later changed and diversion measured again; see results on p. 18.

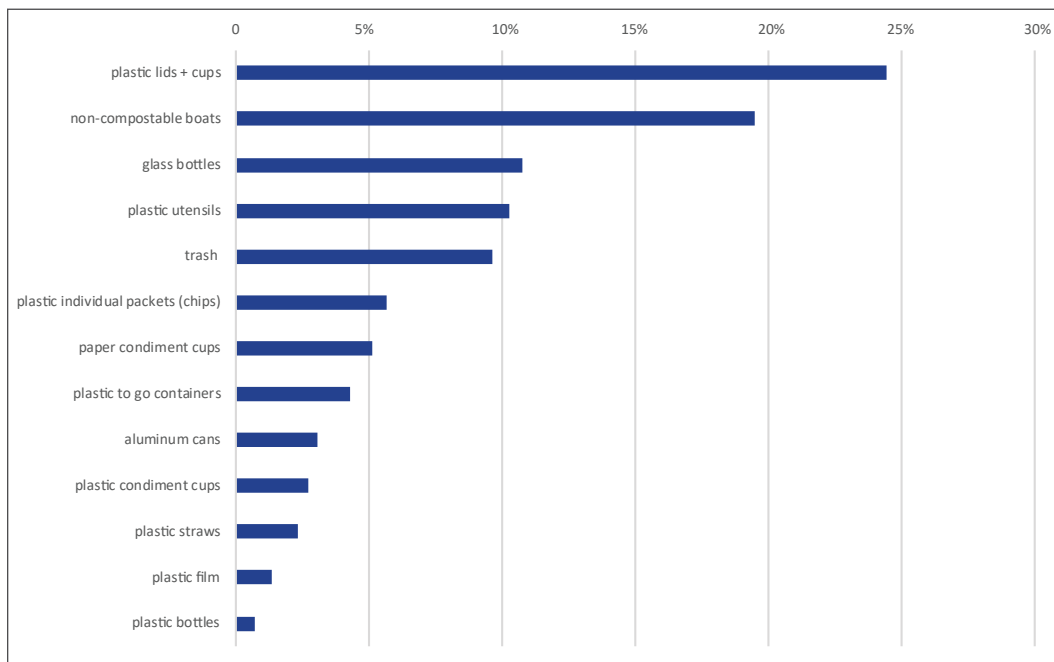
**FIGURE 7: CONTAMINATION RATES IN COMPOSTING BINS VARIED SIGNIFICANTLY IN QUICK SERVICE AND COFFEE SHOPS**



The type of contamination, not just the quantity, is an important factor to consider for a composting facility operator in determining whether or not to accept materials from FOH programs. In particular, glass containers and plastic films are cause for great concern for composters. This study found composting bins were most likely to be contaminated with plastic lids, non-compostable food boats, glass bottles and plastic utensils. It should be noted that glass bottles were only found in the composting bin at quick service restaurants, and because they weigh significantly more than paper and plastic food packaging, the results incorrectly imply that glass is a larger contaminant than was actually observed. Additionally, there were very low levels of plastic film found in composting bins and these materials were only found at coffee shops and quick service restaurants. This suggests that targeted efforts to limit the use of these materials at quick service restaurants and coffee shops could greatly reduce the risk of these materials ending up in the composting bin and secure a cleaner stream of materials for the composting facility. Lastly, many of the non-compostable packaging materials that ended up in the composting bins could be replaced with reusable or compostable alternatives, which as well (Note: Cardboard and paper were not considered contaminants in the composting bins, even though these materials could have been recycled instead.)



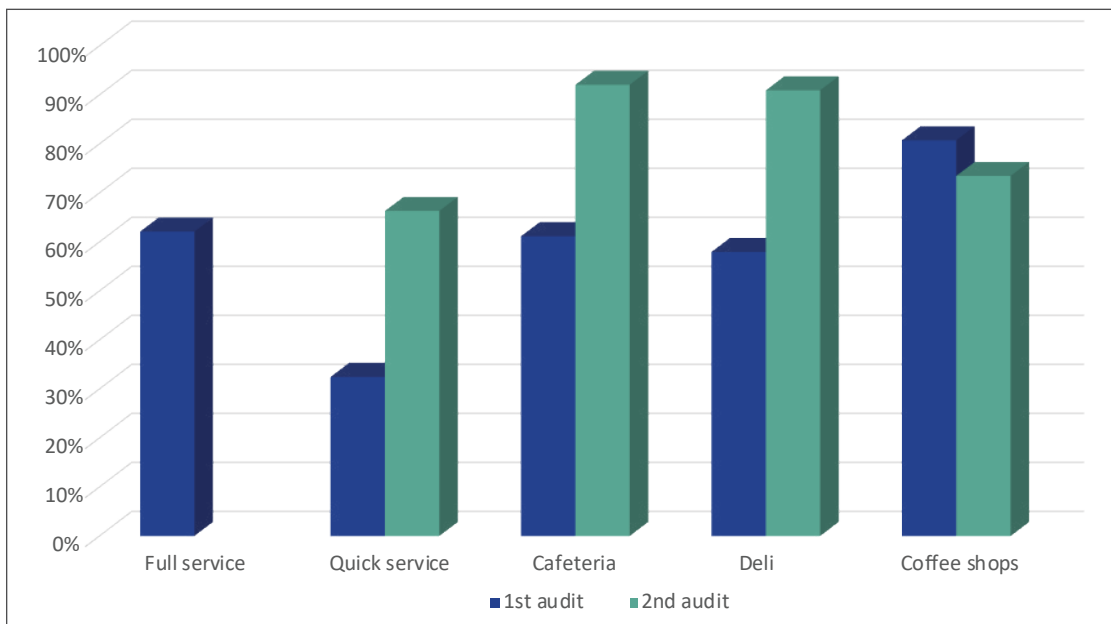
**FIGURE 8: CONTAMINATION IN COMPOSTING BINS BY MATERIAL TYPE  
(%OF GOTAL CONTAMINATION BY WEIGHT)**



## RECYCLING DIVERSION AND CONTAMINATION

Restaurants on average are capturing two-thirds of their recyclable material for recycling. Cafeterias and coffee shops had the highest capture rates for recyclables at 77%, while quick service restaurants performed the worst with only 44% of the recyclables ending up in the recycling bin. Recyclable materials that were placed in the incorrect bin were far more likely to end up in the trash, rather than the composting bin—only 5% of recyclables ended up in the composting bins. The top three recyclable items most commonly found in the trash bins were plastic to-go containers, glass bottles and paper. A significant amount of cardboard and paper was also found in the composting bin, but was considered compostable, not a contaminant.

**FIGURE 9: CAPTURE RATES FOR RECYCLABLES BETWEEN 1<sup>ST</sup> AND 2<sup>ND</sup> AUDITS**



## CONTAMINATION IN RECYCLING BINS

Contamination in recycling bins was significantly higher than contamination in composting bins, with both delis and quick service restaurants recording an average of 40% contamination in their recycling bins. Food scraps were by far the largest source of contamination in recycling bins. Because food scraps are quite heavy and the calculations are based on weight, the large amount of wasted food in the recycling bins skewed the contamination rates much higher for quick service and delis, which had the largest amount of food scraps in the recycling bins. This suggests that improvements to front-of-house collections could have the added benefit of improving the quality of recyclables by reducing the amount of wasted food found in the recycling bin, particularly in these two sectors. While food was a top contaminant in recycling bins, it was found that most of the food that was not correctly sorted for recycling was placed in the trash bin rather than the recycling bin, with only 20% of incorrectly sorted food scraps ending up in the recycling bin.

Other common contaminants in the recycling bins include general trash, compostable plates, and plastic lids. Full-service restaurants (2%) and corporate cafeterias (9%) had the cleanest recycling bins.

**TABLE 5: RECYCLING CONTAMINATION BY SECTOR AND AMOUNT OF FOOD FOUND IN RECYCLING BINS**

Sector	Contamination rates in recycling bins	Range of contamination rates
Deli	40%	35 – 44%
Quick service	40%	0 – 90%

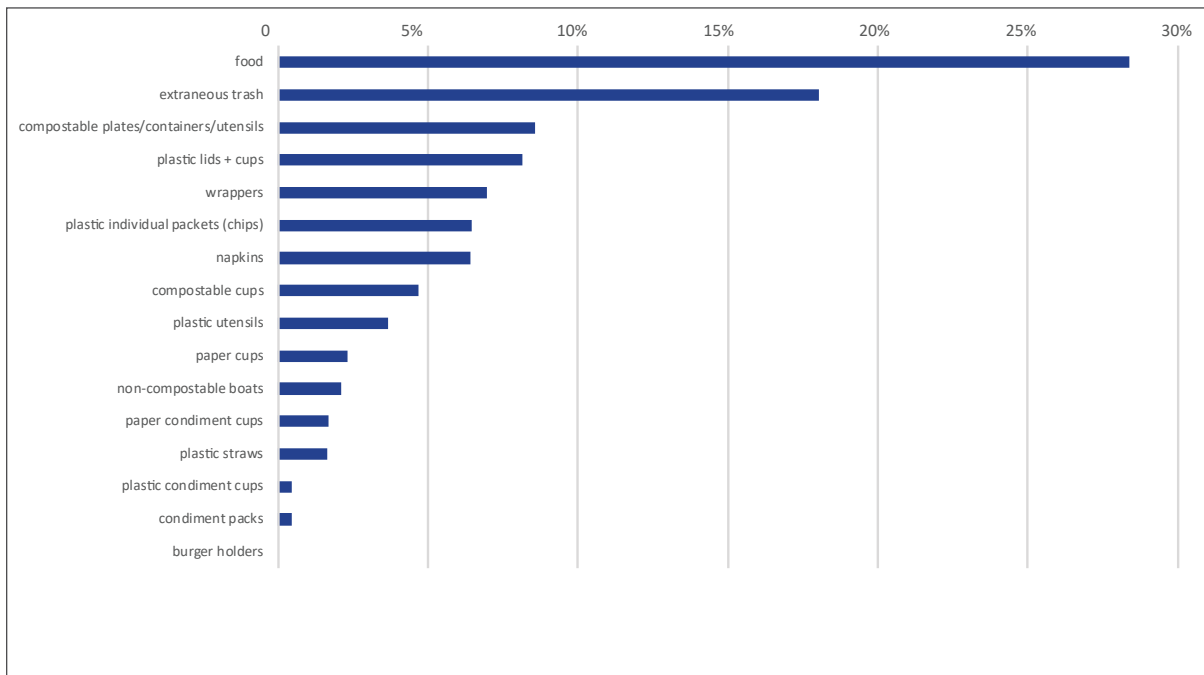
Coffee shops	21%	0 – 50%
Corporate cafeterias	9%	2 – 19%
Full service	2%	0 – 7%

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New signage and improvements to bin locations are likely to improve overall front-of-house collections but not necessarily guaranteed.

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**FIGURE 10: CONTAMINATION IN RECYCLING BINS BY MATERIAL TYPE  
(% OF TOTAL CONTAMINATION BY WEIGHT)**



## IMPACTS OF CHANGES WITH NEW SIGNS AND BIN LOCATIONS

Infrastructure changes were made at 10 locations and a second round of waste audits were conducted at these locations following the changes to see how the changes affected waste diversion and contamination rates. New signs were added at all 10 locations and placed at eye level when possible, and changes to the bins were made at seven locations. This includes bins that were re-organized or moved at half of the locations so all three containers were as close together as possible. Three locations added new bins so there were trash, recycling and composting at all bin locations. No changes were made to the types of packaging used or to any other business practices.

Overall, changes to the collection systems and signage directly improved recycling diversion and reduced recycling contamination, and improved capture rates for recyclables, food scraps and all compostable materials. However, results on composting bin contamination were mixed: only 50% of locations saw a decrease in contamination rates. This suggests that changes to signs and bins cannot be the only approaches used to address contamination, and changes to the type and quantity of packaging used should also be considered. (No packaging changes were made in this study.)

**TABLE 6: SUMMARY OF CHANGES TO FOH COLLECTION SYSTEMS AND EFFECTS ON DIVERSION AND CONTAMINATION**

Sector	Location	Updated Signs	Moved bin(s)	New bin(s)	Increase in overall diversion	Decrease in overall contamination
<b>Corporate Cafeterias</b>						
	CAFÉ 1	X			X	
	CAFÉ 2	X	X	X	X	X
	CAFÉ 3	X	X			
<b>Coffee Shops</b>						
	COFFEE 1	X		X		X
	COFFEE 2	X	X			X
	COFFEE 3	X	X		X	
<b>Quick Service</b>						
	QSR 2	X		X	No change	X
	QSR 3	X			X	X
<b>Delis</b>						
	DELI 1	X			No change	
	DELI 2	X	X		X	X

Overall diversion improved or held steady at 70% of businesses while overall contamination decreased at 60% of the locations. This implies that new signage and improvements to bin locations are likely to improve overall front-of-house collections but improvements are not necessarily guaranteed. Changes specifically to the bins, either moving or adding bins, increased recycling amounts at six out of seven locations and decreased contamination at five of seven locations.

### **Food capture rates improved, composting bin contamination results mixed**

The capture rate for food scraps improved or held steady at 60% of locations following changes to the signs and bins, and the capture rate for all compostable materials improved or did not change at 70% of locations. Four of the seven locations that moved or added new bins saw an increase in food capture rates. This suggests that changes to the collection system are likely to increase the amount of food scraps ending up correctly in the composting bins.

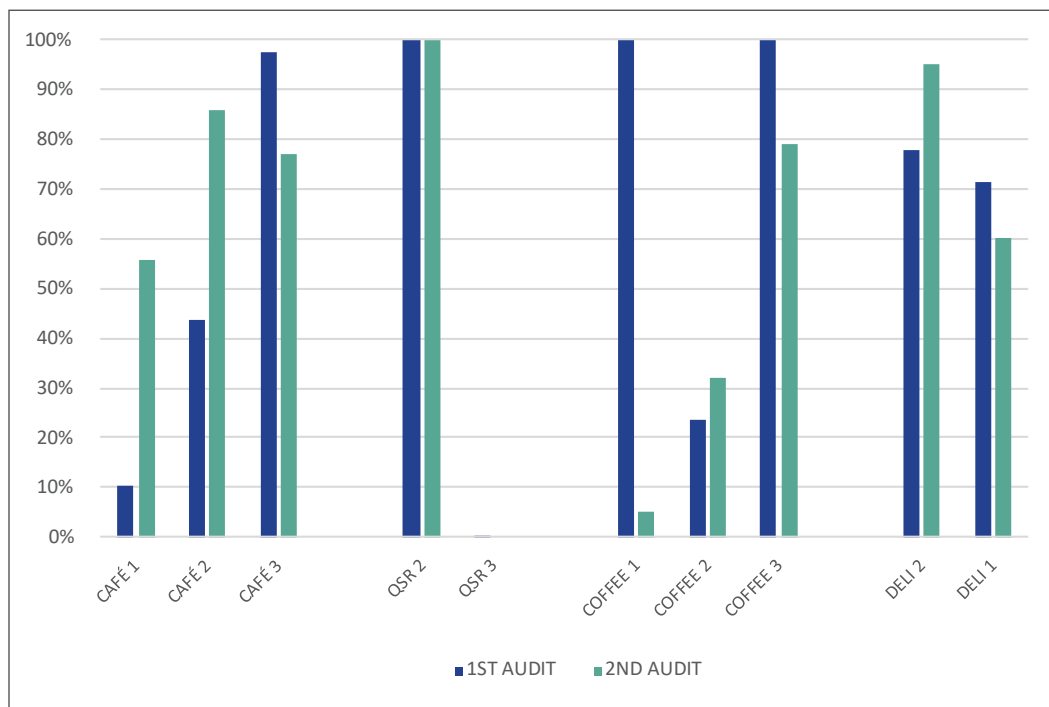
However, the impacts on composting bin contamination was mixed. Contamination in the composting bin decreased or did not change at 50% of locations, but increased at the other 50% of locations. Moving or adding bins did not improve composting contamination at most locations. However, four of the five locations that saw contamination rates increase still had

average composting bin contamination rates of 11% or less. This suggests that these bins were already fairly clean and unlikely to see major changes just from new signs or bins. Overall these results suggest that just changing bins and signage should not be the only strategy used for improving contamination rates, and other operational changes, such as using different types of packaging, should also be considered.

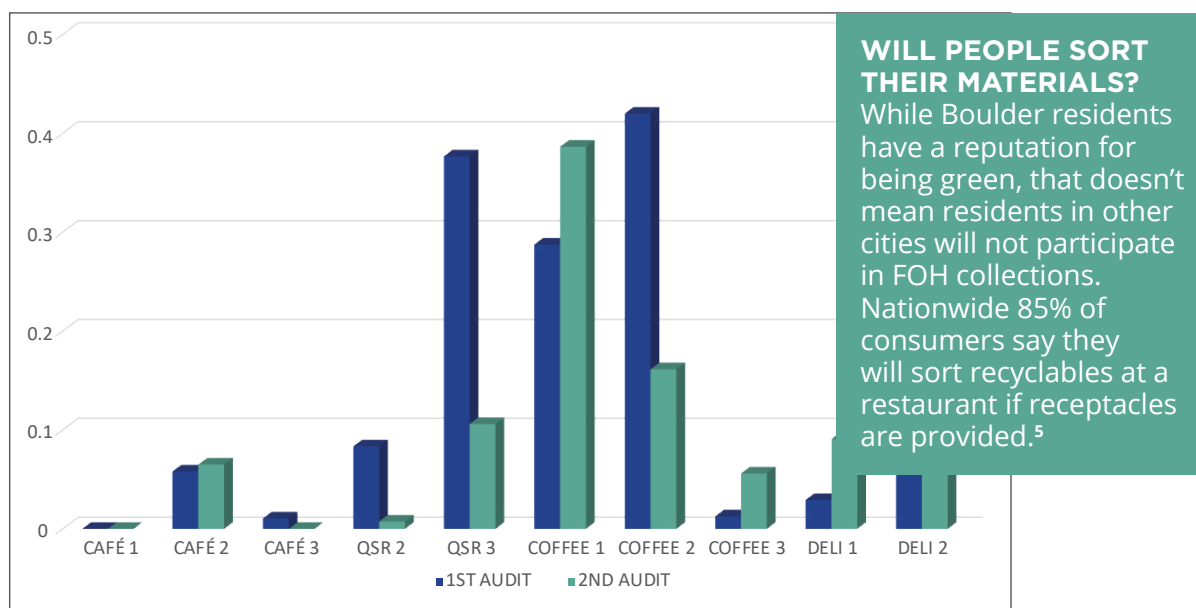
**TABLE 7: CHANGES IN COMPOSTING PERFORMANCE FOLLOWING COLLECTION SYSTEM CHANGES**

Sector	Location	Updated Signs	Moved bin(s)	New bin(s)	Increase in compostable materials captured	Increase in food scraps captured	Decrease in contamination in composting bin
<b>Corporate Cafeterias</b>							
	Café 1	X			X	X	No change
	Café 2	X	X	X	X	X	
	Café 3	X	X				X
<b>Coffee Shops</b>							
	Coffee 1	X		X			
	Coffee 2	X	X		X	X	X
	Coffee 3	X	X				
<b>Quick Service</b>							
	QSR 2	X		X	No change	No change	X
	QSR 3	X			X	No change	X
<b>Delis</b>							
	Deli 1	X			X		
	Deli 2	X	X		X	X	

**FIGURE 11: CHANGES IN THE AMOUNT OF LEFTOVER FOOD CAPTURED IN COMPOSTING BINS FOLLOWING CHANGES TO BIN AND SIGNAGE**



**FIGURE 12: CHANGES IN CONTAMINATION RATES IN COMPOSTING BINS AFTER CHANGES TO BINS AND SIGNS**



### Changes in recycling after collection system changes

Recycling improvements were much more noticeable following the changes to the collection bins. Nine out of ten locations increased their recycling diversion between the first and second audits. Contamination was reduced or remained steady at 70% of locations, and several locations saw significant decreases in recycling contamination rates. This suggests that improved signage and bin locations can greatly improve recycling rates and decrease contamination.

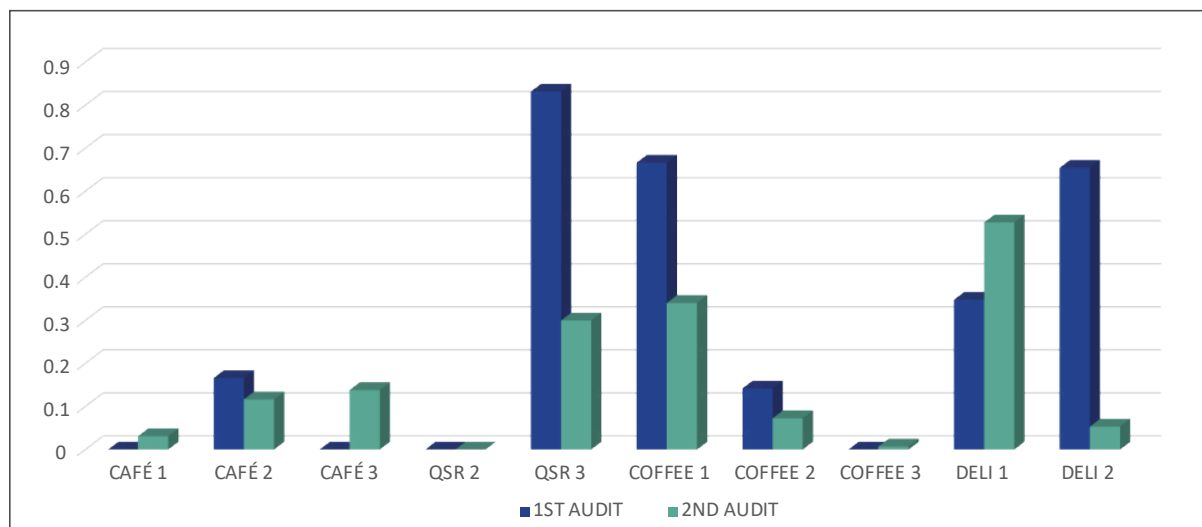


## DEFINING PACKAGING

The following materials were considered as “packaging” in this study. Please see the Appendix for more notes on each category and how materials were sorted.

Recyclable packaging	Compostable packaging	Non-recoverable packaging
Plastic bottles	Burger holders	Non-compostable boats and food wrappers
Glass bottles	Paper cups	Paper cups (plastic-lined)
Aluminum cans/tin foil	Paper wrappers	Plastic lids
Plastic to-go containers	Compostable plates/containers	Plastic individual packets (chips)
Durable food serviceware	Compostable cups	Plastic gloves
		Plastic cups
		Plastic straws
		Condiments packs

FIGURE 13: CHANGES IN CONTAMINATION RATES IN RECYCLING BINS



## OBSERVATIONS OF CUSTOMER BEHAVIOR

In addition to tracking the amount of waste and its composition at each location, staff also sat and observed how customers used the FOH bins. These observations were then used to determine what changes to the bins or signs would be made at each location. While this anecdotal evidence is subjective by nature and no formal methodology was used to record customer behavior, it does offer some interesting insights into how to optimize FOH collections. The three primary findings were:

- **Changes to bin locations were visibly needed at most locations.**
  - When the bins were too far apart or there was a single bin by itself, people dumped everything into that one bin, regardless of whether it was marked for recycling, composting or trash. Many locations had an extra recycling or composting bin, but it did not seem to help customer behavior.
  - It was not always possible to place all the bins directly next to each other or in a particular order at each location. Each establishment had their own space constraints so there was no one-size-fits-all collection system or order of bins identified.
- **Signs do not guarantee success:** People still sorted materials incorrectly even after looking at the signs; sometimes the new signs seemed to help while other times it did not. No optimal sign design was identified, but observations suggest a few key principles:

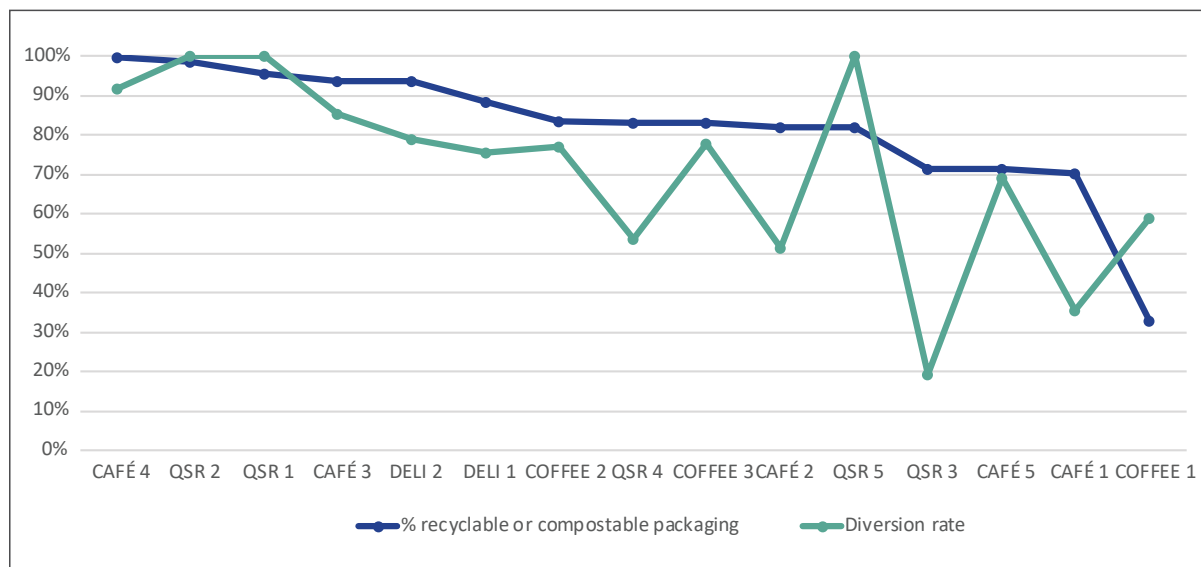
- Simple: People took very little time to look at the signs.
- Photos: People did not read the words.
- Customize: Custom signs for location-specific packaging might be helpful, depicting the exact items a customer will be holding. Cups were a common source of confusion, especially when the restaurant offered several different types of cups. Leftover liquids were also a challenge in coffee shops.
- **Demographics may play a role in diversion rates:** Customers at the national chain quick service restaurant were most likely to be observed just dumping all their materials into one bin and not engaging in any efforts to separate materials.

## IMPACTS OF PACKAGING TYPES ON DIVERSION AND CONTAMINATION

While food scraps and napkins were the majority of the materials in the composting bins, packaging was still a notable portion of the overall waste stream in every sector except for full service restaurants. Delis averaged the highest amount of packaging at nearly 65%, while corporate cafeterias averaged 41% packaging in their waste stream. However, the majority of food establishments had a large percentage of recyclable or compostable packaging--12 out of 15 locations were using at least 80% recyclable or compostable packaging. (Due to a limited project scope, no changes were made to the packaging at any of the locations, only changes to the collection bins and signs.)

The total amount of recyclable and compostable packaging was a strong indicator of the overall diversion rate: the three locations with the lowest percentage of recyclable or compostable packaging also had the lowest overall diversion rates. Locations with nearly 100% recyclable or compostable packaging had the highest diversion rates.

**FIGURE 14: A HIGHER AMOUNT OF RECYCLABLE OR COMPOSTABLE PACKAGING WAS STRONGLY CORRELATED TO HIGHER DIVERSION RATES**



The two national chain shops had the lowest percentage of recyclable or compostable packaging by sector and the lowest diversion rates in their sectors. Delis had the highest percentage of total packaging in the waste stream but also had the highest average capture rate for compostable packaging.

While compostable packaging is widely used, there is still substantial progress to be made in capturing compostable packaging. Every sector was recovering at least 40% of the com-

postable packaging, yet the highest sector-based average was only 71%. Like many other averages, the results varied widely, with capture rates for compostable packaging ranging from as low as 11% up to 100%.

However, the use of compostable packaging was not a clear indicator of how well customers sorted their food scraps on a sector level. It did hold true at quick service restaurants and coffee shops, where those with the highest rates of food composting also had the highest

### IS DURABLE FOOD SERVICEWARE OR COMPOSTABLE SERVICEWARE A BETTER OPTION?

Two quick service restaurants had nearly 100% overall diversion and less than 10% contamination in the recycling and composting bins, yet take two different approaches to packaging and sorting. One restaurant uses mostly durable serviceware for in-house dining and staff play an active role in bussing some tables and cleaning up the collection bins after improper sorting. The second restaurant uses all compostable packaging for all in-house dining customers and no staff sorting at FOH. With similar end results, this suggests both approaches can be used to achieve high diversion rates and clean recycling and composting streams.

rates of composting packaging, while those with the lowest rates of food captured also had the lowest rates of composting their packaging. However, there was no clear correlation in other sectors.

**TABLE 8: RELATIONSHIP BETWEEN COMPOSTABLE PACKAGING AND CAPTURE RATES FOR LEFTOVER FOOD SCRAPS.**

Sector	% total packaging in waste stream	% compostable packaging of all packaging	Capture rate for compostable packaging	Capture rate for wasted food
Deli	65%	34%	71%	76%
Coffee shops	48%	28%	40%	57%
Quick service	52%	47%	61%	57%
Corporate cafeterias	41%	23%	65%	76%
Full service	14%	11%	60%	98%

## **The effects of durable food serviceware on diversion and contamination rates**

Full service restaurants almost entirely serve in-house customers with durable food service-ware, such as reusable plates, glasses and silverware. This is likely to be a strong reason for their high diversion and low contamination rates, along with the practice of staff sorting of the materials.

Corporate cafeterias were found to have the next highest use of durables and the lowest use of overall packaging (27% of the waste stream) compared to other sectors. In terms of diversion rates and capture rates for wasted food, cafeterias came out in the middle of the pack, showing no clear correlation with the use of more durable foodservice-ware. However, cafeterias did perform far better on contamination and consistently had very clean recycling and composting bins. This suggests that the use of durables may help reduce contamination in front-of-house collections by reducing the amount of decisions the customer has to make when sorting their discards because of the lower amount of packaging.

## **CONCLUSION**

The study demonstrates that food establishments of all types can achieve very high diversion rates and capture significant amounts of food scraps through front-of-house collections. While diversion rates, food capture rates and contamination rates varied widely between and within sectors, there was at least one high performing business in every sector. The majority of the compostable material collected was food scraps and napkins, rather than packaging, with quick service and delis having the highest percentage of packaging in the composting bins. This suggests that FOH composting collection could be a valuable new source of food scraps for composting facilities.

This study is one of the first of its kind to focus on front-of-house recycling and composting collection. We encourage cities around the world to conduct their own similar studies so we can start to build a larger database of best practices and establish a stronger correlation between collection bins, signage and packaging choices, and the corresponding effects on diversion and contamination. Our methodology is available online to help guide communities through this process.

# APPENDIX

- Types of restaurants surveyed
- Timeline
- What is recyclable vs compostable

## TYPES OF RESTAURANTS SURVEYED

### **Corporate/institutional cafeterias:**

- CAFE 1: high-tech industry
- CAFE 2: institutional cafeteria
- CAFE 3: institutional cafeterias
- CAFE 4; high-tech industry, with some staff sorting of trays in kitchen
- CAFE 5: institutional cafeterias

### **Grocery store delis:**

- DELI 1: national chain, specializing in natural foods
- DELI 2: locally owned, specializing in natural foods

### **Quick service restaurants:**

- QSR 1: local chain, burgers; using all compostable packaging
- QSR 2: locally owned, Mexican fare
- QSR 3: national chain, burgers
- QSR 4: local chain, sandwiches
- QSR 5: local chain, burritos

### **Coffee shops:**

- COFFEE 1: national chain
- COFFEE 2: locally owned
- COFFEE 3: locally owned, coffee and bagel

### **Full service restaurants:**

- FS 1: locally owned restaurant/brewery
- FS 2 locally owned restaurant/brewery
- FS 3: locally owned breakfast/brunch restaurant

## TIMELINE

- November 2017: Students hired to assist on project; six businesses brought onboard.
- December 2017: On-site audits and observations at six locations.
- January 2018: Data analysis and site recommendations for six initial locations; businesses contacted to make changes; three new locations added and site audits conducted
- February 2018: Waiting for businesses to make changes; original student team left
- March 2018: Two new students hired through May
- April - May 2018: Nine more locations added and initial audits conducted
- June 2018: Delay in creating new signs; several businesses ruled out for second audits because onsite changes could not be made
- July 2018: Final audits completed

## DEFINITIONS OF WHAT IS RECYCLABLE OR COMPOSTABLE

Waste streams were sorted based on the recycling and composting guidelines in Boulder County. Recycling guidelines can be viewed at [www.ecocycle.org/recycle-compost-reuse](http://www.ecocycle.org/recycle-compost-reuse). Any plastic-lined paper products were considered trash and not included as compostable materials. Sorting categories varied slightly based on the type of restaurant and variations in packaging types, i.e. foil-lined paper wrappers at the burger restaurants were included under “Non compostable boats” as were pastry bags from coffee shops. More detail is included below.

ITEMS	DESCRIPTION/NOTES	CONSIDERED PACKAGING
<b>COMPOSTABLE</b>		
Napkins	Included wooden stir sticks	
Burger holders	Box type holders	X
Food		
Paper cups	Wax-coated paper cups	X
Wrappers	Paper wrappers, including hot cup holders	X
Cardboard/paper		
Compostable plates/containers/utensils	BPI certified; includes utensil	X
Compostable cups		X
<b>TRASH</b>		
Non compostable boats	Plastic coating; also included pastry bags and foil-lined paper wrappers	X
Paper cups—drink and condiment	Plastic-lined paper beverage cups; plastic-lined paper condiment cups	X
Plastic lids + cups	Hot and cold drink lids; not accepted locally for recycling	X
Plastic individual packets (chips)	Mostly chip bags	X
Plastic utensils	Mostly forks	X
Plastic condiment cups		X
Plastic straws		X
Condiments packets	Squeeze style packets for ketchup, soy sauce, etc.	X
Trash	Includes gloves,	

RECYCLABLE		
Cardboard	Was also counted as compostable if it ended up in the composting bin	
Paper	Was also counted as compostable if it ended up in the composting bin	
Plastic bottles		X
Glass bottles		X
Aluminum cans/tin foil		X
Plastic containers (togo)	#1 or #5 clamshell containers	X
Plastic film	Only included if clean and could have been collected separately	X
Durable ware		X

## ENDNOTES

<sup>1</sup> U.S. EPA, 2017. Facts and Figures about Materials, Waste and Recycling. Accessed at <https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling> ReFed, 2019. Accessed at <https://www.refed.com/?sort=diversion-potential>.

<sup>2</sup> ReFED, 2018. Restaurant Food Waste Action Guide. Accessed at [https://www.refed.com/downloads/Restaurant\\_Guide\\_Web.pdf](https://www.refed.com/downloads/Restaurant_Guide_Web.pdf).

<sup>3</sup> Food Waste Reduction Alliance, 2014. Analysis of U.S. Food Waste Among Food Manufacturers, Retailers, and Restaurants. Accessed at [http://www.foodwastealliance.org/wp-content/uploads/2014/11/FWRA\\_BSR\\_Tier3\\_FINAL.pdf](http://www.foodwastealliance.org/wp-content/uploads/2014/11/FWRA_BSR_Tier3_FINAL.pdf).

<sup>4</sup> Bloom, Jonathan. 2010. American Wasteland: How America Throws Away Nearly Half of Its Food (and What We Can Do About It).

<sup>5</sup> ReFED, 2018. Restaurant Food Waste Action Guide. Accessed at [https://www.refed.com/downloads/Restaurant\\_Guide\\_Web.pdf](https://www.refed.com/downloads/Restaurant_Guide_Web.pdf).