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Food Waste Loss and Donation

U.S. Environmental Protection Agency

Office of Resource Conservation and Recovery

May 2013

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1. FOOD WASTE LOSS

1.1 Introduction

EPA's contractor researched and estimated food loss (during various food lifecycle stages) and national food donations to people. This memorandum summarizes the data sources and methodology the contractor used to arrive at these estimates of food loss that is managed by the solid waste management system.

Food loss estimates developed under this task used a materials flow approach, estimating food loss prior to any waste diversion activities (e.g., food donations, food waste to animal feed). This is in contrast to the methodology used for EPA's municipal solid waste (MSW) annual characterization report series, which use site specific sampling data estimating food waste generation at the point it is ready to be managed as solid waste (after any diversion activities). In our summary table at the end of this memorandum, the 2010 food waste loss developed as part of this task is compared to EPA's MSW 2010 estimated food waste loss developed separately and allows EPA to compare food waste estimates using these two different methodologies.

1.2 Data Sources – Food Loss

To develop the food loss estimates, the contractor obtained loss-adjusted food availability data[1] from the United States Department of Agriculture (USDA) Economic Research Service's (ERS) Food Availability Data System[2, 3] and the spreadsheets and documentation developed in support of that system. The ERS data system quantifies food availability at the following three levels:

- Primary level: farm to retail;
- Retail level: supermarkets, grocery stores and other retail outlets (not including restaurants and other foodservice outlets);
- Consumer level: food consumed at-home and away-from-home (for example, at restaurants and cafeterias) by consumers and food services. This category includes nonedible portions of food, such as banana peels or apple cores, and cooking loss and uneaten food, such as plate waste.

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[1] Loss-adjusted data sets include food available before loss, the factors ERS applied to adjust for loss, and the food available after the loss adjustments.

[2] USDA ERS data products website at http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system.aspx. Loss-adjusted food availability data downloaded March 2013.

[3] USDA ERS uploaded revised data November, 2012. http://ers.usda.gov/media/134272/tb1927_reportsummary.pdf

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The ERS estimates were developed using aggregate food availability data from a number of sources, including data from the National Nutrient Database for Standard Reference, the University of Minnesota's Food Industry Center (TFIC), Pennsylvania State University, the International Life Sciences Institute (ILSI), and studies on food loss at the retail and consumer levels[4].

1.3 Methodology

The contractor estimated food losses from seven food categories at three consumption levels following the steps listed below and described in detail in this section:

1. Downloaded the ERS loss-adjusted food availability data into Microsoft® Excel workbooks;
2. Calculated the food weight loss for each food category at each consumption level (i.e., primary, retail, and consumer);
3. Separated the food loss weight at each consumption level for each food category into solid or liquid food loss;
4. Determined the percentage of solid food loss managed through the sewer system and loss managed through the solid waste system; and
5. Summed the seven food categories into a single food loss quantity.

Step 1. The contractor estimated food losses in pounds per capita per year from the following categories[5] using the ERS data for the years 1970 through 2010:

- Dairy (fluid milk, cream, and other products) – 27 products;
- Added fats and oils – 13 products;
- Fruit – 63 products;
- Grains – 9 products;
- Meats, poultry, fish, eggs, and nuts – 24 products;
- Added sugar and sweeteners – 6 products; and
- Vegetables – 67 products.

For all of these categories, the contractor obtained the following data:

- Primary weight;

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[4] USDA ERS Loss-Adjusted Food Availability Documentation at http://www.ers.usda.gov/data-products/food-availability-(per-capita)-data-system/loss-adjusted-food-availability-documentation.aspx.

[5] The future availability of certain grains and added fats and oils data are uncertain. The current data source (Census Bureau Current Industrial Report (CIR)) was discontinued in 2011. Mark Ash, USDA ERS (Telephone conversation September 25, 2012).

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- Retail weight;
- Consumer weight; and
- Food availability adjusted for loss weight.

The *primary weight* is the weight of the food at a primary distribution level, and in some cases, it is the same as the farm weight. For meat and poultry, the primary weight is the carcass weight. Due to data limitations with some of the food groups, losses on-farm and from farm to retail cannot be estimated and are included in the primary weight. Food products produced for the animal feed market are excluded by ERS in this data system and are therefore not included in the primary weight. However, edible by-products diverted to animal feed from food processing are counted as part of the primary weight.[6] In addition, food by-products diverted to fuel production from food processing are also counted as part of the primary weight.

Retail weight is the weight of a product as it is sold at the retail level prior to removing retail-level losses. However, for meat and poultry, the retail weight may or may not include the weight of bone, fat, or additional water; the USDA data do not have enough information to refine these estimates. Retail losses accounted for in this data system include loss at supermarkets, grocery stores and other retail outlets. Loss from other retail outlets where food is consumed away-from-home such as restaurants and foodservice facilities are included in the consumer weight category. Retail weight includes food that may eventually be diverted through donations to feed people or food to feed animals.

Consumer weight is the weight of the product as it is purchased at the retail level for use by consumers for at-home consumption or as it is purchased for away-from-home consumption at eating establishments (e.g., restaurants, fast food outlets) and other foodservice outlets such as institutions. The consumer weight is the weight after retail-level losses have been subtracted, and before losses at the consumer level have been subtracted. Similar to the other weight levels, consumer weight includes some food products that may eventually be diverted to other uses such as restaurant grease captured for industrial and agricultural uses.

Finally, the *food availability adjusted for loss weight* considers the primary, retail, and consumer food availability minus any food loss from nonedible portions, processing or cooking loss, and uneaten food. Total system food loss equals the primary weight minus the food availability adjusted for loss weight.

Step 2. The ERS data quantifies food availability; the contractor used the ERS data to capture the calculated loss within that data system. For example loss at the primary level, is equal to the difference between the primary weight and the retail weight. Similarly, the loss at the retail level is the difference between the retail weight and the consumer weight. The consumer level loss is the nonedible portion plus the other losses such as cooking loss and uneaten food. The

[6] Buzby, Jean C. and Jeffrey Hyman. "Total and per capita value of food loss in the United States" *Food Policy* 37 (2012) 561–570.

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contractor applied consumer level losses at the percentages estimated by ERS and included in the downloaded data sets.

Step 3. After capturing the food loss estimates from the ERS data system, the contractor separated the data into different management streams (see Figure 1). Both non-MSW food loss and MSW food loss to the sewer system (liquid food loss and food managed through disposal units) were separated from MSW food loss to the solid waste management system at each consumption level for each food category.

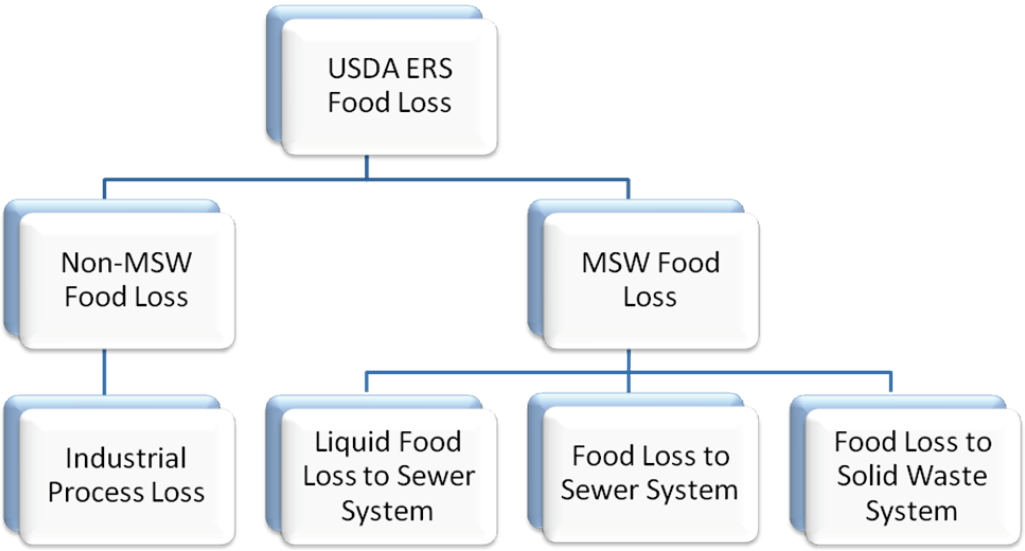

Figure 1. Food Loss Management System Flow

The contractor classified the difference between primary weight and retail weight as non-MSW industrial process loss. Management of the industrial process loss, removed from the MSW food loss system in this task, was studied further in the scoping study titled "Industrial Food Processing Waste Analyses", dated December 2012.

Identifying liquid foods and therefore the management of the resulting losses through the sewer system was, for the most part, straightforward (e.g., milk, eggnog). Identifying the management of other product losses like yogurt and sour cream was less clear. The contractor identified these food products as liquid foods assuming food loss to the sewer system. Conversely, products such as powdered milk (assumed to be solid foods in this analysis) may be disposed of as liquid waste instead of a solid waste. Table 1 lists the ERS food categories and the liquid products identified. The remaining categories (grains, meats, and vegetables) were judged to only contain solid food products. Although vegetable juices would be considered liquid products, the ERS data system did not include vegetable juices.

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Table 1. Liquid Products Identified and Isolated from the Solid Waste Management System

ERS Category	Liquid Product
Dairy	Plain whole milk, 2 percent milk, 1 percent milk, skim milk, whole flavored milk, lowfat flavored milk, buttermilk, yogurt, half and half, eggnog, ice cream, evaporated condensed canned whole milk, evaporated condensed bulk whole milk, and evaporated condensed skim milk.
Added Fats and Oils (includes the fat portion of dairy products)	Half and half, light cream, sour cream, heavy cream, and eggnog.
Fruit	Orange juice, grapefruit juice, lemon juice, apple juice, cranberry juice, grape juice, pineapple juice, and prune juice.
Added Sugar and Sweeteners	Edible syrups, honey, and high fructose corn sweetener.

Step 4. Determining the MSW solid food loss managed through the sewer system involved researching both retail level and consumer level use of food disposal units.

The contractor did not identify a usable data source estimating retail level solid food loss managed through the sewer system. Therefore, in this analysis, it was assumed that all retail solid food loss was managed through the solid waste system. Further research is needed fill this data gap.

Estimating consumer level solid food loss managed through the sewer system required a review of management practices at both the household level and the foodservice establishment level. ERS data separate consumer level loss into two categories; other food loss (e.g., moisture loss, cooking loss, uneaten food) and nonedible portion.

For *other food loss*, the contractor estimated 25 percent of the consumer level loss was managed through the sewer system (75 percent through the solid waste system) as discussed below. The contractor assumed that 100 percent of *nonedible* food loss was managed through the solid waste system.

According to the U.S. Census Bureau, 51 percent of all occupied housing units contain kitchen disposals.[7] A literature review found three studies that estimated the usage rate of households with disposal units. The percentage of food that a household with a disposal unit managed through the sewer system ranged from 41 percent to 75 percent.[8,9,10] These studies

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[7] U.S. Census Bureau. *American Housing Survey for the United States 2009*, March 2011. Table 1-4. http://www.census.gov/housing/ahs/data/national.html

[8] Diggelman, Carol and Robert K. Ham. *Life-Cycle Comparison of Five Engineered Systems for Managing Food Waste*, January 1998.

[9] King County, Washington. Department of Metropolitan Services. *Food Waste Discharge to the Wastewater Collection System*, March 1995. http://your.kingcounty.gov/dnrp/library/wastewater/resourcerecovery/techassess/treatmentopt/FoodWasteStudy/FoodWasteStudy_Report_1995.pdf

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looked at total food loss and did not distinguish between edible and nonedible portions. The contractor assumed that a household with a disposal unit would manage 50 percent of the other food loss through the sewer system and 50 percent through the solid waste system (i.e., composting or disposal). The contractor used a 50 percent usage rate for this analysis for all food categories except added fats and oils, which were assumed at zero percent to the sewer system. The calculation for this step is:

51 percent x 50 percent = 25 percent overall consumer level other food loss to the sewer system.

The consumer level includes food loss from both at-home and away-from-home locations; therefore the assumption that 25 percent of other food loss is managed through the sewer system applies to loss from away-from-home locations. One of the studies that researched household use of disposal units also quantified food loss management from food service locations. That study found 27 percent of the food loss from these types of locations was managed through the sewer system.[11]

Due to the age of the studies reviewed, the household and food service usage rate for disposal units needs further research. Solid waste planners have a renewed interest in researching the best management system for food waste that may provide usable data in the future. For example, Philadelphia, Pennsylvania launched The Clean Kitchen, Green Community pilot program in 2012 to investigate the best way for the city to manage residential food waste.[12]

By difference the remainder of the consumer food loss was assumed to be managed through the solid waste system.

Table 2 illustrates the data output from Steps 1 through 4 for dairy products. Expressed on a per person basis, most dairy product food loss occurs with liquid products. Similar tables were developed for the other six food product categories but are not shown (added fats and oils, fruits, grains, meats, added sugar and sweeteners, and vegetables).

Step 5. The contractor then summed the seven food categories into a single food loss quantity. Table 3 shows the per capita rates for years 1970 through 2010. The highest per capita retail and consumer MSW losses occurred after 1990.The liquid product loss decreased after 2000.

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[10] NYC Department of Environmental Protection. *The Impact of Food Waste Disposers in Combined Sewer Areas of New York City*, 1999. http://www.nyc.gov/html/dep/pdf/grinders.pdf

[11] King County, Washington, *Idem.*

[12] Philadelphia, PA Streets Department. http://www.philadelphiastreets.com/ckgc-overview.aspx

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Table 2. Dairy Products: Output of Methodology Steps 1 through 4

	Dairy Products							
	MSW			Non-MSW				
Year	Retail Loss to MSW System	Consumer Loss to MSW System	Total Loss, Retail & Consumer Levels to MSW System	Retail Loss to Sewer System	Consumer Loss to Sewer System	Total Loss, Retail & Consumer Levels to Sewer System	Liquid Product Loss	Industrial Processing Loss
	pounds per capita per year							
1970	1.65	4.88	6.53	0.00	1.67	1.67	95.03	0.00
1971	1.70	4.97	6.67	0.00	1.70	1.70	95.00	0.00
1972	1.76	4.94	6.69	0.00	1.69	1.69	94.34	0.00
1973	1.77	5.17	6.94	0.00	1.77	1.77	92.76	0.00
1974	1.71	4.81	6.52	0.00	1.65	1.65	89.66	0.00
1975	1.68	4.50	6.18	0.00	1.54	1.54	90.17	0.00
1976	1.74	4.77	6.50	0.00	1.63	1.63	89.77	0.00
1977	1.75	4.76	6.51	0.00	1.63	1.63	89.10	0.00
1978	1.78	4.81	6.60	0.00	1.65	1.65	87.75	0.00
1979	1.77	4.86	6.62	0.00	1.66	1.66	86.38	0.00
1980	1.76	4.81	6.57	0.00	1.65	1.65	84.70	0.00
1981	1.81	4.68	6.50	0.00	1.60	1.60	83.39	0.00
1982	1.90	4.78	6.67	0.00	1.63	1.63	81.33	0.00
1983	1.92	4.87	6.79	0.00	1.67	1.67	81.76	0.00
1984	1.98	5.08	7.05	0.00	1.74	1.74	82.60	0.00
1985	2.11	5.32	7.43	0.00	1.82	1.82	83.62	0.00
1986	2.10	5.41	7.51	0.00	1.85	1.85	83.79	0.00
1987	2.15	5.47	7.62	0.00	1.87	1.87	82.95	0.00
1988	2.12	5.52	7.63	0.00	1.89	1.89	82.60	0.00
1989	2.29	5.75	8.04	0.00	1.97	1.97	82.20	0.00
1990	2.40	6.31	8.71	0.00	2.16	2.16	80.76	0.00
1991	2.46	6.27	8.74	0.00	2.15	2.15	80.41	0.00
1992	2.49	6.46	8.95	0.00	2.21	2.21	79.49	0.00
1993	2.55	6.46	9.01	0.00	2.21	2.21	77.83	0.00
1994	2.56	6.80	9.36	0.00	2.33	2.33	77.60	0.00
1995	2.46	6.68	9.14	0.00	2.29	2.29	76.81	0.00
1996	2.34	6.56	8.90	0.00	2.25	2.25	76.54	0.00
1997	2.28	6.24	8.52	0.00	2.14	2.14	75.75	0.00
1998	2.32	6.29	8.61	0.00	2.15	2.15	74.99	0.00
1999	2.35	6.32	8.67	0.00	2.16	2.16	75.14	0.00
2000	2.39	6.36	8.75	0.00	2.18	2.18	73.97	0.00
2001	2.36	6.47	8.83	0.00	2.21	2.21	73.29	0.00

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Table 2. Dairy Products: Output of Methodology Steps 1 through 4

	Dairy Products							
	MSW			Non-MSW				
Year	Retail Loss to MSW System	Consumer Loss to MSW System	Total Loss, Retail & Consumer Levels to MSW System	Retail Loss to Sewer System	Consumer Loss to Sewer System	Total Loss, Retail & Consumer Levels to Sewer System	Liquid Product Loss	Industrial Processing Loss
	pounds per capita per year							
2002	2.38	6.54	8.91	0.00	2.24	2.24	70.20	0.00
2003	2.38	6.67	9.05	0.00	2.28	2.28	69.89	0.00
2004	2.41	6.90	9.31	0.00	2.36	2.36	68.84	0.00
2005	2.44	6.95	9.39	0.00	2.38	2.38	68.60	0.00
2006	2.48	6.83	9.31	0.00	2.34	2.34	68.84	0.00
2007	2.53	6.95	9.48	0.00	2.38	2.38	68.27	0.00
2008	2.48	6.83	9.31	0.00	2.34	2.34	68.39	0.00
2009	2.44	7.04	9.48	0.00	2.41	2.41	68.25	0.00
2010	2.45	6.89	9.33	0.00	2.36	2.36	67.40	0.00

Source: Analysis of data from: U.S. Department of Agriculture. Economic Research Service Loss-Adjusted Food Availability Data. Downloaded March 2013.
http://ers.usda.gov/data-products/food-availability-(per-capita)-data-system.aspx#26705

Table 3. Total Food Products: Output of Methodology Steps 1 through 5

	Total Food Products							
	MSW			Non-MSW				
Year	Retail Loss to MSW System	Consumer Loss to MSW System	Total Loss, Retail & Consumer Levels to MSW System	Retail Loss to Sewer System	Consumer Loss to Sewer System	Total Loss, Retail & Consumer Levels to Sewer System	Liquid Product Loss	Industrial Processing Loss
	pounds per capita per year							
1970	82.96	186.33	269.29	0.00	47.68	47.68	152.70	200.70
1971	82.63	187.47	270.10	0.00	48.06	48.06	154.62	206.80
1972	81.79	184.28	266.07	0.00	47.32	47.32	153.91	198.82
1973	81.74	183.52	265.26	0.00	46.93	46.93	150.81	194.77
1974	80.82	182.41	263.23	0.00	46.76	46.76	148.36	199.58

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Table 3. Total Food Products: Output of Methodology Steps 1 through 5

	Total Food Products							
	MSW			Non-MSW				
Year	Retail Loss to MSW System	Consumer Loss to MSW System	Total Loss, Retail & Consumer Levels to MSW System	Retail Loss to Sewer System	Consumer Loss to Sewer System	Total Loss, Retail & Consumer Levels to Sewer System	Liquid Product Loss	Industrial Processing Loss
pounds per capita per year								
1975	81.22	180.96	262.19	0.00	46.13	46.13	157.41	198.14
1976	83.49	186.65	270.14	0.00	47.59	47.59	158.87	211.03
1977	82.19	184.24	266.43	0.00	47.12	47.12	174.79	203.46
1978	82.33	184.10	266.43	0.00	47.00	47.00	163.17	198.46
1979	82.44	183.43	265.87	0.00	47.05	47.05	155.83	200.32
1980	82.93	184.94	267.87	0.00	47.30	47.30	158.69	198.34
1981	81.84	181.59	263.42	0.00	46.31	46.31	165.18	196.98
1982	82.12	182.82	264.94	0.00	46.02	46.02	159.90	197.55
1983	82.72	183.42	266.14	0.00	46.29	46.29	166.98	201.06
1984	84.51	186.82	271.33	0.00	47.06	47.06	163.29	210.36
1985	86.58	188.81	275.39	0.00	47.53	47.53	169.59	211.27
1986	87.54	191.72	279.26	0.00	47.95	47.95	170.52	212.17
1987	89.18	196.31	285.48	0.00	49.20	49.20	169.12	216.34
1988	90.27	198.15	288.43	0.00	49.64	49.64	159.31	217.72
1989	89.76	201.03	290.79	0.00	50.15	50.15	160.92	223.62
1990	89.87	200.13	290.00	0.00	50.51	50.51	154.94	227.09
1991	90.25	198.16	288.41	0.00	50.33	50.33	162.81	233.94
1992	93.29	206.57	299.85	0.00	51.83	51.83	154.45	231.34
1993	94.88	208.94	303.83	0.00	52.52	52.52	161.84	236.79
1994	96.01	213.46	309.47	0.00	53.39	53.39	159.62	238.44
1995	94.62	210.13	304.75	0.00	52.81	52.81	160.26	237.71
1996	96.30	214.52	310.82	0.00	53.60	53.60	166.33	239.76
1997	96.82	216.87	313.68	0.00	53.86	53.86	164.72	236.83
1998	96.56	216.24	312.81	0.00	53.79	53.79	165.02	240.09
1999	98.49	219.34	317.83	0.00	54.36	54.36	161.95	239.65
2000	104.01	222.82	326.83	0.00	55.20	55.20	162.47	241.42
2001	102.70	219.86	322.56	0.00	54.38	54.38	159.85	235.89
2002	103.67	220.39	324.07	0.00	54.53	54.53	153.42	240.16
2003	104.40	221.59	325.99	0.00	54.90	54.90	154.09	242.20

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Table 3. Total Food Products: Output of Methodology Steps 1 through 5

	Total Food Products							
	MSW			Non-MSW				
Year	Retail Loss to MSW System	Consumer Loss to MSW System	Total Loss, Retail & Consumer Levels to MSW System	Retail Loss to Sewer System	Consumer Loss to Sewer System	Total Loss, Retail & Consumer Levels to Sewer System	Liquid Product Loss	Industrial Processing Loss
pounds per capita per year								
2004	104.59	222.42	327.01	0.00	55.31	55.31	153.36	241.83
2005	103.99	219.65	323.63	0.00	54.80	54.80	148.70	240.95
2006	104.19	219.38	323.57	0.00	54.40	54.40	146.26	237.07
2007	103.63	218.81	322.44	0.00	54.47	54.47	141.71	238.10
2008	103.05	217.33	320.37	0.00	54.02	54.02	137.29	230.43
2009	99.93	214.64	314.57	0.00	53.40	53.40	136.26	228.14
2010	102.65	217.21	319.86	0.00	53.79	53.79	135.35	226.96

Source: Analysis of data from: U.S. Department of Agriculture. Economic Research Service Loss-Adjusted Food Availability Data. Downloaded March 2013.
http://ers.usda.gov/data-products/food-availability-(per-capita)-data-system.aspx#26705

1.4 Results

The food loss to the solid waste management system includes both edible and nonedible food loss. This will differ from other analyses of the ERS data when the goal is to quantify food loss that could be captured for the nutritional benefit to feed hungry people. In other words, the nonedible portion is excluded. The goal of this analysis is to quantify the food loss that needs to be managed by the solid waste management system (i.e., composting, disposal or donation).

Table 4 shows food loss after U.S. annual populations are applied to the per capita rates shown in Table 3. In 2010, the retail food loss is 32 percent of the loss to the MSW system; consumer loss, including at-home and away-from-home loss, is 68 percent of the total.

Figure 2 depicts total food loss to the solid waste system, the sewer system and the food processing loss, in 2010. As part of this data series, retail and consumer level food loss to the total waste system is 44 percent (14 percent retail level and 30 percent consumer level). The consumer level solid food loss to the sewer system represents 7 percent of the total. Liquid food loss to the sewer is 18 percent and food processing food loss is 31 percent.

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Table 4. Total U.S. MSW and Non-MSW Food Loss from Edible and Non-Edible Products

	TOTAL						
	MSW			Non-MSW			MSW and Non-MSW Total Loss
Year	Retail Loss to MSW System	Consumer Loss to MSW System	Total Loss, Retail & Consumer Levels to MSW System	Consumer Loss to Sewer System	Liquid Produc t Loss	Industrial Processing Loss	
(1,000 tons)							
1970	8,460	19,000	27,460	4,860	15,570	20,470	68,360
1971	8,540	19,390	27,930	4,970	15,990	21,390	70,280
1972	8,560	19,280	27,840	4,950	16,110	20,800	69,700
1973	8,640	19,390	28,030	4,960	15,940	20,580	69,510
1974	8,620	19,460	28,080	4,990	15,830	21,290	70,190
1975	8,750	19,500	28,250	4,970	16,960	21,350	71,530
1976	9,080	20,300	29,390	5,180	17,280	22,960	74,810
1977	9,030	20,240	29,280	5,180	19,210	22,360	76,030
1978	9,140	20,440	29,590	5,220	18,120	22,040	74,970
1979	9,260	20,600	29,850	5,280	17,500	22,490	75,120
1980	9,420	21,010	30,430	5,370	18,030	22,530	76,360
1981	9,390	20,830	30,220	5,310	18,950	22,600	77,080
1982	9,510	21,180	30,690	5,330	18,520	22,880	77,420
1983	9,670	21,440	31,110	5,410	19,520	23,500	79,540
1984	9,960	22,030	31,990	5,550	19,250	24,800	81,590
1985	10,300	22,460	32,760	5,650	20,170	25,130	83,710
1986	10,510	23,020	33,530	5,760	20,470	25,470	85,230
1987	10,800	23,780	34,580	5,960	20,490	26,210	87,240
1988	11,040	24,220	35,260	6,070	19,480	26,620	87,430
1989	11,080	24,810	35,890	6,190	19,860	27,600	89,540
1990	11,220	24,980	36,200	6,300	19,340	28,340	90,180
1991	11,420	25,070	36,480	6,370	20,590	29,590	93,030
1992	11,960	26,490	38,460	6,650	19,810	29,670	94,590
1993	12,330	27,150	39,490	6,820	21,030	30,770	98,110
1994	12,630	28,080	40,710	7,020	21,000	31,370	100,100
1995	12,600	27,980	40,570	7,030	21,340	31,650	100,590

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Table 4. Total U.S. MSW and Non-MSW Food Loss from Edible and Non-Edible Products

	TOTAL						
	MSW			Non-MSW			MSW and Non-MSW Total Loss
Year	Retail Loss to MSW System	Consumer Loss to MSW System	Total Loss, Retail & Consumer Levels to MSW System	Consumer Loss to Sewer System	Liquid Product Loss	Industrial Processing Loss	
(1,000 tons)							
1996	12,970	28,900	41,870	7,220	22,400	32,290	103,780
1997	13,200	29,560	42,760	7,340	22,460	32,290	104,850
1998	13,320	29,830	43,140	7,420	22,760	33,120	106,440
1999	13,740	30,600	44,340	7,580	22,600	33,440	107,960
2000	14,670	31,440	46,110	7,790	22,920	34,060	110,880
2001	14,630	31,330	45,960	7,750	22,780	33,610	110,100
2002	14,910	31,700	46,610	7,840	22,060	34,540	111,050
2003	15,140	32,140	47,290	7,960	22,350	35,130	112,730
2004	15,310	32,560	47,880	8,100	22,450	35,400	113,830
2005	15,360	32,450	47,820	8,100	21,970	35,600	113,490
2006	15,540	32,730	48,270	8,120	21,820	35,370	113,580
2007	15,610	32,960	48,560	8,200	21,340	35,860	113,960
2008	15,670	33,040	48,710	8,210	20,870	35,040	112,830
2009	15,330	32,920	48,250	8,190	20,900	34,990	112,330
2010	15,880	33,590	49,470	8,320	20,930	35,100	113,820

Source: Analysis of data from: U.S. Department of Agriculture. Economic Research Service Loss-Adjusted Food Availability Data. Downloaded March 2013. http://ers.usda.gov/data-products/food-availability-(per-capita)-data-system.aspx#26705

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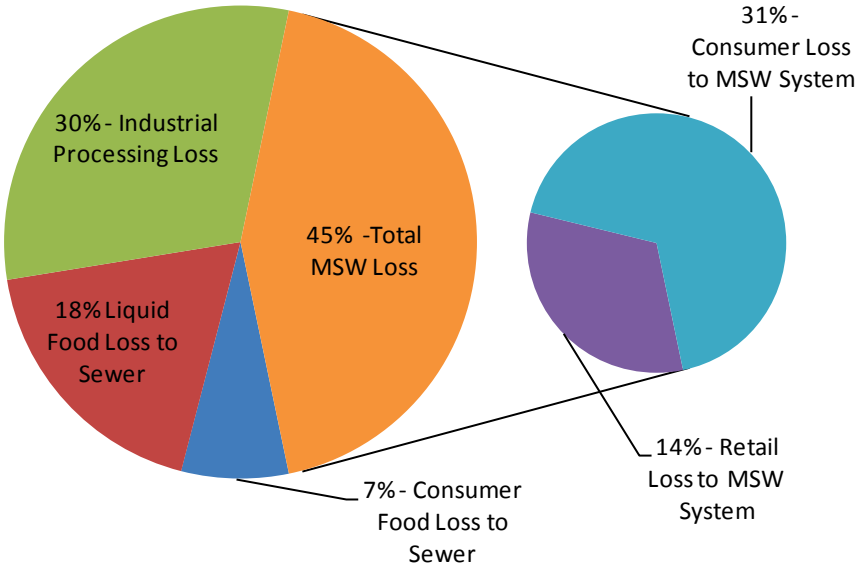

Figure 2. Total MSW and Non-MSW Food Loss by Source, 2010

2. FOOD DONATION

2.1 Introduction

In an effort to increase recovery of surplus food and reduce food waste, EPA and USDA developed a diversion hierarchy of management options from most preferred to least preferred (see Figure 3).[13] The contractor, as part of this task, estimated national food donations to feed hungry people—the second step in the food recovery hierarchy.

Each year, significant amounts of food products are donated by residents and commercial establishments (e.g., grocery stores, restaurants) to local food banks and charities to feed people. A portion of these food donations divert food from the solid waste stream that would otherwise need to be managed through composting or disposal—the last two steps in the hierarchy.

Differentiating data reported in the literature between food donation diversion (i.e., wholesome but not-for-retail food products diverted from the waste stream) and charitable food donations of saleable products is often difficult. The latter does not result in diverted waste. This section provides an overview of available information used to quantify national food waste diversion through donation of wholesome but not-for-retail foods.

[13] U.S. EPA. Food Recovery Initiative. http://www.epa.gov/osw/conserve/materials/organics/food/

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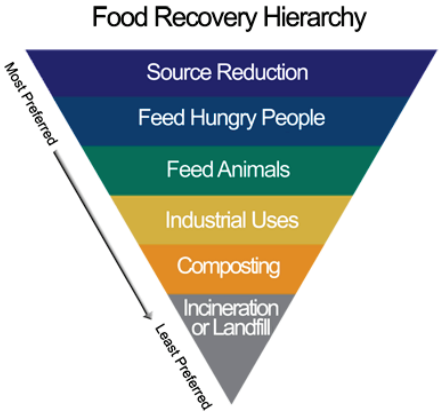

Figure 3. EPA's Food Recovery Hierarchy

2.2 Data Sources – Food Donations

The contractor gathered quantitative food donation data from two major food donation organizations: Feeding America (FA) and Food Donation Connection (FDC). This subsection provides background information on these organizations and describes the structure of the food donation programs that they run.

FA, formerly called America's Second Harvest, is the nation's largest non-profit food donation organization consisting of 200 food banks and food rescue organizations with a total of 61,000 total entities.[14] A portion of the food provided by FA includes food generated specifically for donation and does not represent a diversion of waste. However, FA runs several programs, such as the Retail Store Donation (RSD) program, that coordinate the donation of surplus food from retail stores that would otherwise be handled through the solid waste management system. The RSD program consists of over 10,500 grocery stores. FA also organizes food donations from the manufacturing and agricultural sectors as well but it is unclear whether these programs donate food that would otherwise be handled through the solid waste management system or was generated specifically for donation.

FDC is another non-profit food donation organization consisting of more than 248 food-service entities and 13,880 restaurants.[15] The goal of this organization is to coordinate the donation of surplus food from restaurants that would otherwise be handled through the solid waste management system.

It is important to note the contractor only collected and summarized data representing these two organizations. However, the relative size of these programs likely represents a large portion of national food diversion through donation. For example, the majority of the 10,500 stores that participate in FA's RSD program represent the country's largest firms in the food

[14] General information on the FA is available online at: http://feedingamerica.org/
[15] General information on the FDC is available online at: http://www.foodtodonate.com/

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retail industry in terms of sale volumes including Wal-Mart (2,900 stores), Sam's Club (600 stores), Kroger (2,000 stores), SuperValue (2,000 stores), Delhaize (1,100 stores), and Winn Dixie (500 stores). Similarly, the majority of the 13,880 restaurants that participate in FDC's program represent some of country's largest firms in the restaurant industry including Darden Restaurants, Pizza Hut, KFC, Taco Bell, Long John Silver's, A&W, NPC International, The Cheesecake Factory, Grand Lux Café, Chipotle Mexican Grill, Famous Dave's, Auntie Anne's, Rock Bottom Breweries, Old Chicago, Chop House, Cracker Barrel and Walnut Brewery.

2.3 Methodology

The contractor attempted to contact representatives from the FA and FDC to obtain up-to-date and historical food donation quantities. The contractor successfully contacted a representative from both organizations but was only able to obtain up-to-date data from the FDC. The contractor was, however, able to gather historical food donation quantities for all three of FA's programs from existing literature (i.e., RSD, manufacturing, and agriculture).

2.4 Results

Table 5 summarizes the FA and FDC program results for years 1993 through 2012 with the estimated total loss to the MSW system from retail and consumer levels displayed for comparison. Although the percentage of diverted food is relatively small, the volume has increased over the years. Note that the contractor was unable to identify data for FA programs prior to 2004 and therefore did not calculate total food donation tonnage for those years.

The contractor verified through personal communication with organization representatives that the FA RSD and the FDC programs only donate food that would otherwise be handled through the solid waste management system. The contractor was unable to verify this for the FA manufacturing and produce programs. Therefore, the total food donation quantity in Table 5 should be taken as a high estimate. The contractor estimates that the majority of the food donated from the manufacturing and agriculture sectors represents surplus food that otherwise would have been disposed of through the solid waste management system based on various sources.[16,17]

[16] Zastrow (Food Marketing Institute), Hewett (Publix Super Markets, Inc.). 2012. *Major Initiatives Addressing Food Waste.* (November).

[17] Calvert. 2011. *Declining Food Streams and Increased Need.* Feeding America.

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Table 5. Food Donation Programs Representing Food Waste Diversion through Donation

Year	EPA Estimate of Food Waste Generation (tons)(1)	FA Programs		FDC (tons)(3)	Total (tons)(4)	Percentage of U.S. Food Waste	Non-MSW FA Programs	
		RSD Program (tons)(2)					Manuf. (tons)(2)	Produce (tons)(2)
1993	NR	NR		1,000	Not Calculated		NR	NR
1994	NR	NR		2,000			NR	NR
1995	NR	NR		2,000			NR	NR
1996	NR	NR		2,000			NR	NR
1997	NR	NR		3,000			NR	NR
1998	NR	NR		3,000			NR	NR
1999	NR	NR		2,000			NR	NR
2000	NR	NR		3,000			NR	NR
2001	NR	NR		4,000			NR	NR
2002	NR	NR		4,000			NR	NR
2003	NR	NR		4,000			NR	NR
2004	32,460,000	125,000		5,000	130,000	0.4%	350,000	145,000
2005	32,930,000	132,000		7,000	139,000	0.4%	375,000	151,000
2006	32,270,000	139,000		8,000	147,000	0.5%	438,000	157,000
2007	33,560,000	146,000		9,000	155,000	0.5%	416,000	163,000
2008	34,300,000	160,000		11,000	171,000	0.5%	395,000	180,000
2009	35,270,000	217,000		11,000	228,000	0.6%	404,000	200,000
2010	35,740,000	273,000		15,000	288,000	0.8%	413,000	225,000
2011	36,310,000	330,000		18,000	348,000	1.0%	363,000	225,000
2012	Not Available	450,000		18,000	468,000	Not Available	413,000	275,000

(1) U.S. EPA. *Municipal Solid Waste in the United States: 2011 Facts and Figures*. Draft report.
(2) Zastrow (Food Marketing Institute) and Hewett (Publix Super Markets, Inc.) 2012. *Major Initiatives Addressing Food Waste.* (November).
(3) Communication with Jim Larson, a representative from FDC.
(4) Total food donations includes total tonnage from all FA and FDC programs.
NR—Not Reported.
Manuf.—Manufacturing.
Not Calculated—Total food donation quantities are not calculated for these years because the contractor was unable to identify data.
Not Available—Total U.S. food waste generation data is not yet known for 2012.

3. CONCLUSIONS

Table 6 combines the results from the Sections 1 and 2 analyses for the year 2010. For 2010, the USDA food loss to the MSW management system before any diversion activities is estimated at 49.5 million tons (see Table 4).

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Food loss diversion is presented in the second section of Table 6. The 2010 food diversion through donation (as estimated in Section 2.4) was 288,000 tons, representing the second step in EPA's food recovery hierarchy which is feeding hungry people. The third step in EPA's food recovery hierarchy is food diverted to animals. Although the contractor could not find a usable data source to estimate this diversion, The contractor did identify a data source for the fourth step—food to industrial use. The National Renderers Association[18, 19]estimates the quantity of spoiled and outdated meat and seafood products available to their industry (i.e., generation) and the quantity diverted through rendering.

Food loss to the solid waste system is totaled at the bottom of the second section of Table 6. The USDA food loss estimate is 48.2 million pounds (2.5 percent reduction from the quantified diversion activities). The EPA 2010 food waste estimate from *Municipal Solid Waste in the United States: 2011 Facts and Figures* is 35.7 million tons. [20] EPA's methodology for the characterization report series (referenced in Table 6 footnotes) only addresses food waste going to the solid waste management system and does not include upstream diversion activities, food waste managed through the sewer system, grease and oils, or industrial process waste.

Food loss managed through the sewer system is also presented in Table 6. The contractor's analysis of the USDA loss-adjusted food availability data allowed for the separation of this food loss from food loss managed through the solid waste management system. Consumer level food loss to the sewer system (loss from at-home and away-from-home establishments) is estimated at 8.3 million tons; liquid food loss is greater at 20.9 million tons.

EPA's definition of MSW as used in the MSW characterization report series does not include any grease or oil products (e.g, restaurant grease, transportation, machine, or industrial grease or oils). Therefore consumer waste grease is included in the non-MSW food loss section of Table 6. The generation of consumer waste grease, which is primarily restaurant grease, is assumed to be equivalent to the USDA "Consumer Loss Other" category for added fats and oils. Consumer waste grease may be used for other industrial uses; the diversion of this product through rendering is estimated by the National Renderers Association to be 2.4 billion pounds in 2010[21]. The total 2010 industrial processing loss is estimated at 35.1 million tons (as estimated from USDA data and shown in Table 4).

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[18] National Renderers Association. "Survey Says: A Snapshot of Rendering" Render Magazine. April 2011. http://nationalrenderers.org/assets/4dcab683dabe9d1c690006ed/techtopicsapr11.pdf.

[19] National Renderers Association reports that the quantity of meat products and restaurant grease generated and recovered through rendering has remained fairly constant over the past few years. Tom Cook, President. (Telephone conversation September 26, 2012.)

[20] The contractor believes that the difference in these two estimations is due to the EPA characterization methodology underestimating the amount of food waste generated at the retail level.

[21] National Renderers Association. *Op. Cit.*

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Table 6. USDA National Food Loss and EPA National Food Waste Comparison, 2010

2010	**USDA Food Loss[1]**		**EPA Food Waste[2]**
	lb/person/yr	(1,000 tons)	(1,000 tons)
MSW Food Loss to the Solid Waste System			
Retail Loss	102.7	15,880	
Consumer Loss[3]	217.2	33,590	
Subtotal MSW Food Loss	*319.9*	*49,470*	
Food Loss Diversion			
Food Donations[4]	-1.9	-290	
Food to Animal Feed[5]	NA	NA	
Food to Industrial Uses[6]	-6.2	-960	
Total MSW Food Loss to the Solid Waste System	*311.8*	*48,220*	*35,740*
MSW Food Loss to the Sewer System			
Retail Loss to Sewer System	NA	NA	
Consumer Loss to Sewer System	53.8	8,320	
Liquid Product Loss[7]	135.4	20,930	
Non-MSW Food Loss			
Consumer Waste Grease[3]	14.2	2,200	
Waste Grease Diversion[8]	-7.8	-1,200	
Industrial Processing Loss[9]	227.0	35,100	
Total Food Loss after Diversion	734.3	113,570	

(1) Analysis of data from: U.S. Department of Agriculture. Economic Research Service Loss-Adjusted Food Availability Data. Downloaded March 2013. Includes field losses.

(2) U.S. EPA. *Municipal Solid Waste in the United States: 2011 Facts and Figures*. Does not include upstream diversion activities, food waste managed through the sewer system, or non-MSW food loss.

(3) Consumer Waste Grease is primarily restaurant grease and is equivalent to USDA Other Consumer Loss for added fats and oils.

(4) From Table 6; food donations do not distinguish between solid and liquid product donations.

(5) Retail and consumer level food loss to animal feed is not available. USDA food loss data excludes food grown for animal feed from the primary weight level.

(6) National Renderers Association. Spoiled and outdated meat and seafood products from grocery stores recovered for rendering estimated at 1.92 billion pounds in 2010.

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(7) Liquid Product loss from Retail, Consumer, and Industrial loss levels.

(8) National Renderers Association, Collected yellow grease is estimated to be 2.4 billion pounds in 2010.

(9) USDA industrial process food loss data are available for meat, fruit, and vegetables; other products are not available.

Food wastes that are not being disposed and are instead processed through composting, anaerobic digestion or other management options are not accounted for in this analysis. Comparison with EPA's national food waste estimate from the MSW Facts and Figures report series is only for 2010 due to limited data availability across the time series. Multiple data points are available only for 2010 and extrapolating the 2010 values may not be appropriate in all cases because practices change over time.

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