Attachment A

Literature Review Matrix

METRO FOOD GRINDER STUDY LITERATURE SEARCH MATRIX

category	document title, date	rating & comments
methods of dealing with grinders	1. Kitchen Garbage Grinders in New York City, February 1991	
treatment process effects	1. The Effect of Organic Amendments From Garbage Grinding on a Biological Treatment System, June 1972 2. Addition of Garbage to Sewage, November 1950 3. Metcalf & Eddy, Wastewater Engineering - Treatment , Disposal, and Reuse 4. Kitchen Garbage Grinders in New York City, February 1991 5. MEMO: Review of the impact resulting from use of garbage disposals for food waste disposal on the West Point treatment plant, September 1988 6. West Point project data 7. MEMO: Garbage Disposal Use, August 1988 8. Waste Segregation as a Means of Enhancing Onsite Wastewater Management, August 1977 9. Food Waste Disposers - Their Effects on the Sewer System, June 1962 10. An Economic Evaluation of Garbage Grinding vs. surface collection and disposal, November 1971 11. Estimating Food Waste Loading on Sewage Treatment, June 1949 12. Effects of Community Wide Installation of Household Grinders on Environmental Sanitation, 1952 13. Ground Garbage - It's Effect upon the Sewer System and Sewage Treatment Plant, August 1946	7. discusses increased loading of grease operations effects
costs	1. NYC Cost Comparison: Food Waste Vs Food Disposal, December 1991 2. Impact of food waste grinders - response to NYC DOS memo, December 1991 3. Kitchen Garbage Grinders in New York City,	1. looks like a good cost comparison of treatment vs. disposal and/or reuse of curbside collected materials

	February 1991 4. An Economic Evaluation of Garbage Grinding vs. surface collection and disposal, November 1971	
water usage increases	1. Patterns of Household Usage, June 1967 2. Individual Home Wastewater Characterization and Treatment, July 1975 3. Water Requirements For Dishwashers And Food Waste Disposers, September 1962 4. Household Wastewater Characteristics, February 1974 5. Wastewater 2020 Plus (Metro Report), February, 1994 6. Kitchen Garbage Grinders in New York City, February 1991	1. provides data on water usage due to appliances in the home 2. data on water usage
loading rates to wastewater	1. Series of memos between Joel and NYC, March 1992 2. The Contribution From The Individual Home To The Sewer System, December 1967 3. Household Waste Characteristics, February 1974 4. Estimate of Water Pollution Potential Based on Characteristics of Domestic Sewage in Puerto Rico, January 1975 5. Individual Home Wastewater Characteristics and Treatment, July 1975 6. Effects of Garbage Grinders on Waste Loads, July 1988 7. Per Capita Loading of Domestic Wastewater, September 1972 8. MEMO: Garbage Disposal Use, August 1988 9. MEMO: Effects of Food Waste Disposal Systems on Wastewater Strength, June 1988 10. Food Processing Waste, June 1992 11. Metcalf & Eddy, Wastewater Engineering - Treatment , Disposal, and Reuse	10. discusses the contributions from individual food types

METRO FOOD GRINDER STUDY LITERATURE SEARCH MATRIX

	12. Food Waste and Garbage Disposals: The Use of Food Grinders to Dispose of Food Waste in Seattle's Retail Food Stores and Restaurants 13. Characteristics of Rural Household Wastewater, June 1976	13. many parameters examined
industrial discharge	1. Food Processing Waste, June 1992 2. Establishing the fees , rules, and regulations for the disposal of industrial waste into the Metropolitan Sewerage System, May 1993	
wastestream percents	1. MEMO: Solid Waste Disposed of in 1987 by Material, 1988 2. King County Waste Characterization Study, October, 1991 3. Classifying the Food Waste Stream, October 1991 4. Final 1992 Comprehensive Solid Waste Management Plan, King County 5. City of Seattle Waste Stream Composition Study for 1992 6. City of Seattle Waste Stream Composition Study for 1990 7. Seattle Solid Waste Utility Recycling Potential Assessment, 1994 8. Seattle City Integrated Waste Management Plan, 1989	1. discusses commercial and residential waste streams
rules & laws	1. MEMO: Stan Hummel re. King County Ordinances, March 1994 2. MEMO: Stan Hummel re. King County Ordinances, October 1988	
sludge production	1. MEMO: Sludge Production w/ Increased Garbage Disposal Use, handwritten calcs, no date 2. Composting, Sludge, and Demolition Debris, June 1988 3. Groundwater Issues Related to Marketing Land	

	Application of Biosolids, January 1994 4. Biosolids Long Strategy for King County Metro, January 1994	
collection of food wastes	1. MEMO: Dispos-Alls for Food Waste Recycling, August 1990 2. Food Waste Collection and Composting Demonstration Project, 1993	2. Matrix report

Attachment B

Volunteer Collection Program

Attachment B

METRO FOOD GRINDER / DISPOSAL STUDY
VOLUNTEER SEPARATION OF RESIDENTIAL FOOD WASTE

Family	Total Wt	Days	Adults	Children	Breakfast	Lunch	Dinner
1	1523g	2	3	0	2	2	2
2	749g	2	2	3	2	2	3
3	460g		2	2			
4	1016g	1	2	0	0	0	1
5	602g	2	2	0	2	0	1
86	1743g	2	3	0	2	0	2
79	1072g	2	4	0	0	2	1
10	742g	2	2	0	0	2	3
11	636g	2	2	1	2	2	3
12	1302g	2	1	0	1	0	2
13	984g	2	2	0	2	2	1
15	91g	2	2	0	0	0	1
16	251g	2	2	4	2	1	2
17	3294g	2	4	2	2	2	2
18	133g	2	2	0	2	1	2
19	241g	2	2	2	2	0	1
20	232g	2	5	0	6	0	7
			42	14			
Number	17		56				
Mean	886.6		Avg. =	269 g/cap			
Std Dev	790		=	135 g/cap/ day			
	15,071		=	0.30 lb/cap/day			

Attachment B

VOLUNTEER SURVEY RESULTS
FOOD WASTE DISPOSAL METHODS

Have a garbage disposal	6
Disposal Methods	
Garbage	13
Compost	8
Worm Bin	3
Green Cone	1
Dog	1

Metro Food Waste Disposal Evaluation
Volunteer Residential Collection Program

Please Read This Carefully!!

Objective

The objective is to collect samples of food waste generated in the household that would normally be processed through a food grinder and discharged to the sewer system.

Separation Procedure

It is vital to the success of the evaluation that all volunteers are conscientious in separating those food wastes that are suitable for grinding and discharge to the sewer. This collection should not reflect your normal practices of food disposal. Rather, the objective is for you to separate all of the food waste generated in your home that could be disposed of with an in sink grinder and discharged down the drain. You have been provided with a 1 gallon sealed plastic container in which to collect the material. These containers should be kept in the refrigerator once they contain food.

Include in the container: ***All*** of the food waste that ***could*** be processed through an in-sink disposal unit should be put in the container, including:

- vegetable and fruit trimmings
- cheese trimming
- plate scrapings
- refrigerated but unused left overs
- hot liquid grease

Exclude from the container: Any material that would normally be put in the garbage or that can be discharged down the drain without grinding should ***not*** be separated and placed in the container. Examples of ***excluded*** materials are:

- milk, yogurt and cottage cheese
- bones and trimmed fat from raw meat
- large seeds
- stringy materials such as artichokes

Collection Period
Please follow the following collection schedule:

1. Containers are distributed to all participants by 3 PM on Monday, October 10.
2. The separation should begin with breakfast on Tuesday, Oct. 11
3. Continue to collect for two days; through the evening meal and any late snacking on Wednesday, October 12.
4. Keep the container refrigerated throughout the period.

5. Bring the container to work on Thursday, October 13 and give to the designated recipient by 9 am. Attach the questionnaire to the container with a rubber band.
6. Grinding and analysis will begin on Thursday, October 13.

Thank You for your help!!! Your cooperation is Appreciated!

Metro Food Waste Disposal Evaluation
Volunteer Residential Collection Program

Volunteer Information

The data provided by the collection event will be one of the methods used to project the quantities of food waste generated by residences in the Metro service area. To do this, information about the people who contribute food waste is required.

Please complete the following brief questionnaire and return it when you bring in the collected food waste.

1. Do you normally use a food grinder for food waste disposal? ____ yes ____ no
2. What other methods of food waste disposal do you use?
   ____ garbage
   ____ compost
   ____ worm bin
   ____ green cone
   ____ other ____________
3. How many people are currently living in your home? ____ adults (>13 years)
   ____ children
4. How many people are were present during the collection? ____ adults (>13 years)
   ____ children
5. How many meals were prepared at home during the collection period ____ breakfast
   ____ lunch
   ____ dinner
6. Were any guests served during the collection period? Please describe the numbers served and the number of meals

   ____

Thanks for Your Help!!! Your Cooperation is Appreciated!!!

Attachment C

Synthetic Food Waste Mixes

Attachment C

SYNTHETIC FOOD WASTE MIXES

Vegetables & Fruits			
Potatoes	30%	7.2 oz	1/2 peelings, 1/2 cooked
Tomatoes	13%	3.1 oz	all raw
Corn	6%	1.4 oz	1/2 husk, 1/2 cooked
Lettuce	6%	1.4 oz	all raw
Green beans	5%	1.2 oz	1/2 cooked, 1/2 raw
Peas	5%	1.2 oz	all cooked
Onion	3%	0.7 oz	all raw
Apple	14%	3.4 oz	peel & core
Banana	7%	1.7 oz	peel
Orange	5%	1.2 oz	peel
Pears	6%	1.4 oz	peel & core
Carrot		2 oz	peel & ends
Meat & Cheese Mix			
Beef	48%	.72 lb, 11.5 oz	cooked - grease included
Pork	19%	.23 lb, 4.5 oz	
Chicken	11%	.17 lb, 2.6 oz	Buddig Sliced cooked
Fish	6%	.09 lb, 1.4 oz	Van de Camps breaded fish fillets
Nonfat White Cheese	11%	.17 lb, 2.6 oz	Low moisture part skim mozzarella, Precious brand
Fat milk solids	5%	.075 lb, 1.2 oz	Shredded mild cheddar - Sargento brand
Grains			
Wheat bread	63%	15.2 oz	
Whole wheat bread	5%	1.2 oz	
Cooked macaroni	5%	1.2 oz	
Oatmeal	9%	2.2 oz	
Corn cereal	18%	4.3 oz	

NOTE: Assumes waste from all sources is same fraction of total consumption, except cheese 1/2 of meat.

Attachment D

Laboratory Analysis Data

Attachment D - Results of Sewer Travel Impact Analysis

	Volunteer Group, Sample (1)														
	STIRRED SAMPLE			SETTLED SAMPLE (Supernate)											
Time	TS	VS	TDS	TSS	VSS	BOD	Soluble	Primary Solids			Primary Volatile Solids			Secondary BOD	
(hr)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	BOD		Weighted			Weighted		Weighted	
									WP	EDRP		WP	EDRP	WP	EDRP
Unground	243,736	179,439													
Calculated	6,327	4,523	1472.5	596				3,776			2,700				
Ground	5,196	4,644				4,710									
0	5,568	4,996	1472.5	596	549	2,810		3,018			2,708				
3	5,556	5,042	1568.8	605	565	3,185		2,900			2,632				
									2,798	2,798		2,514	2,514	2,896	2,896
6	5,008	4,436	1552.5	700	652	2,920		2,274			2,014				
9	5,370	4,836	1548.8	340	272	2,670		2,999			2,701				
12	5,035	4,512	1248.8	211	181	2,160		3,093			2,772				
										3,068			2,741		2,420
15	5,079	4,521	1326.3	227	204	2,680		3,044	3,022		2,709	2,696		2,547	
18	5,091	4,531	1441.3	239	207	2,800		2,929			2,607				
21	4,334	3,756	1231	300	278	2,785		2,321			2,011				
									2,500			2,186		2,670	
24	4,920	4,336	1470	289	273	2,555	2,425	2,679			2,361				
														2,729	
Averages	5,107	4,552	1,429	390	353	2,729		2,806	2,819	2,844	2,502	2,526	2,553	2,825	2,814
Last/First	88%	87%	100%	48%	50%	91%		89%			87%				
Avg/Weighted									1.00	0.99		0.99	0.98	0.97	0.97
Flow weighting Factor		West Point	0-9 hrs	77.6%	EDRP	0-9 hrs	82.8%	lb/wet lb	0.118	0.119		0.105	0.106	0.118	0.117
			9-18 hrs	16.9%		9-15 hrs	17.2%	lb/dry lb	0.482	0.487		0.432	0.437	0.483	0.481
			18-25 hrs	5.5%				adj avg	3,528	3,560		2,519	2,545		
								lb/wet lb	0.147	0.148		0.105	0.106		
								lb/dry lb	0.604	0.609		0.431	0.435		

Attachment D - Results of Sewer Travel Impact Analysis

	Volunteer Group, Sample (2)														
	STIRRED SAMPLE			SETTLED SAMPLE (Supernate)											
Time	TS	VS	TDS	TSS	VSS	BOD			Primary Solids			Primary Volatile Solids		Secondary BOD	
(hr)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)			Weighted			Weighted		Weighted	
									WP	EDRP		WP	EDRP	WP	EDRP
Unground	239,560	212,093													
Calculated	6,227	5,306	1375	502				3,868			3,296				
Ground	5,416	4,834				4,620									
0	5,378	4,780	1375	502	466	3,190		3,019			2,683				
3	5,096	4,591	1642.5	804	720	3,450		2,168			1,953				
									2,601	2,601		2,329	2,329	2,893	2,893
6	5,004	4,472	1755	440	404	2,650		2,327			2,080				
9	5,355	4,813	1693.8	288	226	2,280		2,891			2,599				
12	6,411	5,836	1350	270	266	2,340		4,309			3,923				
										4,097			3,721		2,570
15	6,117	5,542	1443.8	306	274	2,800		3,885	3,763		3,520	3,403		2,715	
18	5,513	4,924	1665	270	256	3,005		3,096			2,765				
21	4,920	4,322	1336	421	392	3,060		2,681			2,355				
									2,478			2,160		2,803	
24	4,708	4,070	1609	343	317	2,545	2,440	2,274			1,966				
														2,813	
Averages	5,389	4,817	1,541	405	369	2,813		2,961	2,791	2,858	2,649	2,501	2,568	2,858	2,837
Last/First	88%	85%	117%	68%	68%	80%		75%			73%				
Avg/Weighted									1.06	1.04		1.06	1.03	0.98	0.99
								lb/wet lb	0.116	0.119		0.104	0.107	0.119	0.118
								lb/dry lb	0.486	0.498		0.435	0.447	0.497	0.494
								adj avg	3,575	3,662		3,072	3,154		
								lb/wet lb	0.149	0.153		0.128	0.132		
								lb/dry lb	0.622	0.637		0.535	0.549		

Attachment D - Results of Sewer Travel Impact Analysis

	Fruits & Vegetables														
	STIRRED SAMPLE			SETTLED SAMPLE (Supernate)											
Time	TS	VS	TDS	TSS	VSS	BOD	Soluble BO	Primary Solids			Primary Volatile Solids			Secondary BOD	
(hr)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)			Weighted			Weighted		Weighted	
									WP	EDRP		WP	EDRP	WP	EDRP
Unground	149,030	134,616													
Calculated	4,056	3,448	1012.5	271				2,290			1,947				
Ground	2,756	2,314				1,914									
0	3,412	2,692	1012.5	271	234	1,488		1,647			1,299				
3	3,033	2,597	1153.8	273	250	1,890		1,124			963				
									996	996		822	822	1,602	1,602
6	2,705	2,306	1385	276	251	1,491		562			479				
9	2,550	2,141	1148.8	267	231	1,539		652			548				
12	2,653	2,257	955	401	365	1,599		815			693				
										1,054			888		1,613
15	2,719	2,274	696.3	247	223	1,626		1,294	1,051		1,082	880		1,621	
18	2,665	2,207	970	168	134	1,638		1,045			865				
21	2,716	2,258	800	126	112	1,773		1,308			1,087				
									1,299			1,090		1,518	
24	2,850	2,414	946	132	114	1,263	1,413	1,290			1,093				
														1,590	
Averages	2,811	2,350	1,007	240	213	1,590		1,082	1,022	1,006	901	847	833	1,601	1,604
Last/First	84%	90%	93%	49%	49%	85%		78%			84%				
Avg/Weighted									1.06	1.08		1.06	1.08	0.99	0.99
								lb/wet lb	0.043	0.042		0.035	0.035	0.067	0.067
								lb/dry lb	0.286	0.282		0.237	0.233	0.448	0.449
								adj avg	1,422	1,400		1,269	1,249		
								lb/wet lb	0.059	0.058		0.053	0.052		
								lb/dry lb	0.398	0.392		0.355	0.350		

Attachment D - Results of Sewer Travel Impact Analysis

	Breads & Grains														
	STIRRED SAMPLE			SETTLED SAMPLE (Supernate)				Primary Solids			Primary Volatile Solids			Secondary BOD	
Time	TS	VS	TDS	TSS	VSS	BOD			Weighted			Weighted		Weighted	
(hr)	(mg/l)'	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)			WP	EDRP		WP	EDRP	WP	EDRP
Unground	596,930	538,921													
Calculated	14,797	13,144	4431.3	417				9,467			8,409				
Ground	10,116	8,086				20,970									
0	10,496	9,538	4431.3	417	384	2,590		5,166			4,694				
3	10,198	9,326	4441.3	319	292	2,930		4,956			4,532				
									5,102	5,102		4,672	4,672	3,186	3,186
6	10,522	9,675	4352.5	295	269	3,045		5,393			4,958				
9	10,486	9,645	4762.5	346	308	4,180		4,896			4,503				
12	13,735	12,844	4626.3	296	264	4,015		8,331			7,790				
										7,829			7,302		4,573
15	13,129	12,207	5061.3	258	232	5,130		7,328	7,820		6,813	7,291		4,756	
18	12,743	11,873	4240	218	195	5,123		7,803			7,270				
21	13,434	12,446	4503	220	204	5,400		8,229			7,624				
									8,324			7,757		5,093	
24	14,612	13,696	5474	238	217	4,785		8,418			7,890				
														4,133	
Averages	12,151	11,250	4,655	290	263	4,133		6,724	5,739	5,571	6,231	5,284	5,124	3,556	3,425
Last/First	139%	144%	124%	57%	57%	185%		163%			168%				
									1.17	1.21		1.18	1.22	1.16	1.21
Avg/Weighted															
								lb/wet lb	0.239	0.232		0.220	0.214	0.148	0.143
								lb/dry lb	0.401	0.389		0.369	0.358	0.248	0.239
								adj avg	10,517	10,210		9,466	9,179		
								lb/wet lb	0.439	0.426		0.395	0.383		
								lb/dry lb	0.735	0.713		0.661	0.641		

Attachment D - Results of Sewer Travel Impact Analysis

	Meats & Cheeses														
	STIRRED SAMPLE			SETTLED SAMPLE (Supernate)				Primary Solids			Primary Volatile Solids			Secondary BOD	
Time	TS	VS	TDS	TSS	VSS	BOD			Weighted			Weighted		Weighted	
(hr)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)			WP	EDRP		WP	EDRP	WP	EDRP
Unground	583,368	488,187													
Calculated	14,472	11,927	2070	899				11,021			9,083				
Ground	7,032	5,918				8,360									
0	6,292	5,172	2070	899	844	2,995		2,841			2,335				
3	5,602	4,461	2026.3	1,173	1,122	7,800		1,921			1,529				
									2,543	2,543		2,052	2,052	3,854	3,854
6	5,243	4,110	2055	568	476	2,290		2,138			1,676				
9	6,412	5,230	2075	583	533	2,330		3,272			2,669				
12	6,868	5,714	1878.8	920	873	2,365		3,587			2,984				
										3,314			2,736		2,543
15	6,352	5,196	2173.8	655	609	2,720		3,041	3,366		2,488	2,778		2,740	
18	6,766	5,579	2133	681	639	3,135		3,470			2,861				
21	4,744	3,608	1293	724	648	2,860		2,245			1,707				
									3,005			2,423		2,670	
24	7,092	5,914	2198	648	593	2,480		3,764			3,139				
														3,219	
Averages	6,152	4,998	1,989	761	704	3,219		2,920	2,707	2,676	2,377	2,195	2,170	3,600	3,628
Last/First	113%	114%	106%	72%	70%	83%		132%			134%				
									1.08	1.09		1.08	1.10	0.89	0.89
Avg/Weighted															
								lb/wet lb	0.113	0.112		0.092	0.090	0.150	0.151
								lb/dry lb	0.194	0.191		0.157	0.155	0.257	0.259
								adj avg	10,503	10,379		8,539	8,440		
								lb/wet lb	0.438	0.433		0.356	0.352		
								lb/dry lb	0.751	0.742		0.610	0.603		

c:\ws/metrofw/labdata.xls

Attachment D - Results of Sewer Travel Impact Analysis

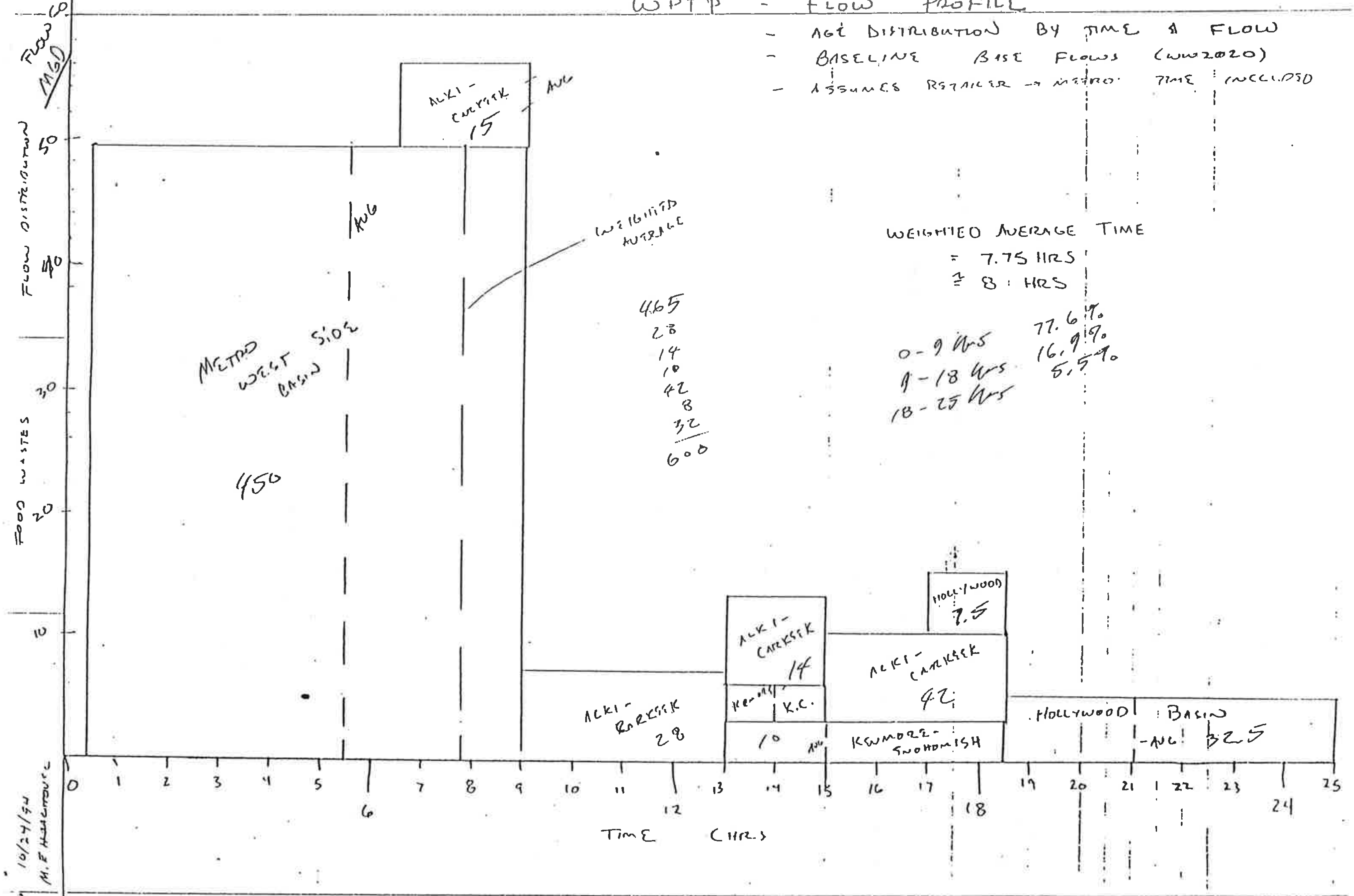
	Renton Primary								
	STIRRED SAMPLE			SETTLED SAMPLE (Supernate)			Week Lates	
Time	TS	VS	TDS	TSS	VSS	BOD	TSS mg/l	VSS mg/l
(hr)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)		
0	486	220						
0	456	212				196		
T 0	482	220	262.5			183	72	54
3	458	190	257.5	75.6	62.4	170	63	48
6	452	188	263.8	92.8	79.2	147	57	39
9	456	190	180	89.2	80.8	112	46	33
12	458	190	280	88.8	75.2	111	41	29
15	452	192	272.5	90.8	76.8	129	35	26
18	472	102	282.5	92.4	78.8	129	40	29
21	452	182	263	86	73	93	49	38
24	470	198	274	88.4	70	73	52	43

Attachment E

Sewer System Travel Time Analysis

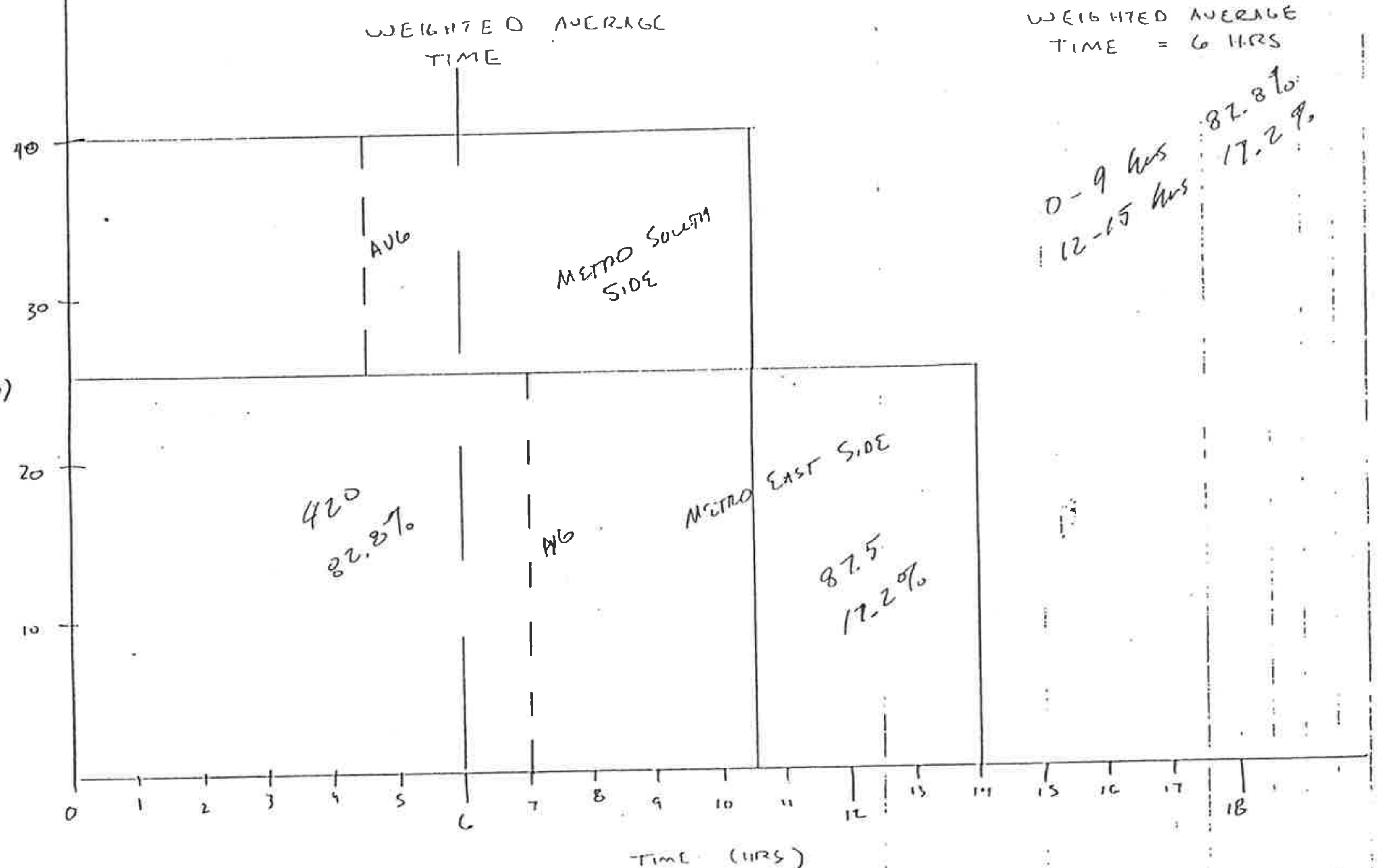
WPTP - FLOW PROFILE

- AGE DISTRIBUTION BY TIME & FLOW
- BASELINE BASE FLOWS (WW2020)
- ASSUMES RETAINER → METRO TIME INCLUDED



EDRP - FLOW PROFILE

- AGE DISTRIBUTION BY TIME & FLOW
- BASELINE BASE FLOWS (WW2020)
- ASSUMES RETAILER → METRO TIME INCLUDED



FLOW DISTRIBUTION FOOD WASTE M.E. HARCHOULC

Attachment F

Typical Diet Analysis

Table		Major Components of Typical Diet							
Fruits and Vegetables	Daily	**Meats & Cheeses**	Daily	**Bread & Grain**	Daily	**Other**	Daily		Adj. Daily
Name	Consumption	Name	Consumption	Name	Consumption	Name	Consumption		Consump.
	(g/kg body wt)		(g/kg body wt)		(g/kg body wt)		(g/kg body wt)		(g/kg)
Apples - fresh	0.457	Beef - boneless - fat	0.372	Barley	0.057	Apple - Juice	0.221		0.000
Apricots - fresh	0.034	Beef - boneless - lean	1.162	Oats	0.083				0.000
Asparagus	0.013	Beef - organ meats - liver	0.021	Rice - milled	0.155	Chocolate	0.036	50%	0.018
Avocados	0.013	Beef - organ meats	0.006	Soybean flour w/ fat	0.003	Coconut oil	0.025	50%	0.013
Bananas - fresh	0.224	Beef - dried	0.003	Soybean flour w/o fat	0.012	Coffee	0.046		0.000
Beets - sugar	0.332	Beef - meat by-products	0.018	Wheat bran	0.012	Corn - grain-oil	0.023	50%	0.011
Beets - roots	0.022	Chicken w/o bones	0.379	Wheat flour	1.257	Corn sugar	0.097		0.000
Beets greens	0.001	Chicken w/o bones & skin	0.060	Wheat - rough	0.141	Cottonseed oil	0.204	50%	0.102
Broccoli	0.049	Fish - freshwater finfish	0.030	Sorgum incl milo	0.024	Cranberry juice	0.017		0.000
Brussel sprouts	0.007	Fish - saltwater finfish	0.189			Distilled alcohol	0.0387		0.000
Cabbage, chinese	0.005	Fish - shellfish	0.034	**Total**	1.744	Eggs - white only	0.009	50%	0.005
Cabbage	0.094	Pork - (organ meats) liver	0.005			Eggs - whole	0.565	50%	0.282
Canteloupes - pulp	0.044	Pork - (organ meats) other	0.004			Eggs - yolks only	0.0066	50%	0.003
Carrots	0.173	Pork - meat byproducts	0.025			Grapefruit juice	0.077		0.000
Cauliflower	0.016	Poultry - w/o bones	0.005			Grape juice	0.090		0.000
Celery	0.061	Sheep - boneless, fat	0.004			Honey	0.015	50%	0.008
Cherries - fresh	0.032	Sheep - boneless	0.012			Artif. sweetener	0.019		0.000
Collards	0.019	Turkey w/o bones	0.048			Maple syrup	0.027	50%	0.013
Corn - sweet	0.237	Turkey w/o bones & skin	0.008			Lactose	0.037	50%	0.019
Cranberries	0.015	Pork - Fat	0.208			Milk - fat solids	0.430	50%	0.215
Cucumbers	0.072	Pork - Lean	0.391			Milk no fat solids	0.903	50%	0.452
Grapefruit - pulp	0.068					Olive oil	0.006	50%	0.003
Grapes - fresh	0.044	**Total**	2.984			Orange juice	1.095		0.000
Grapes - Raisins	0.017					Palm oil	0.016	50%	0.008
Honeydew Melons	0.018					Peanut oil	0.005	50%	0.003
Leeks	0.019					Pineapple juice	0.037		0.000
Lettuce - head	0.212					Prune juice	0.138		0.000
Lettuce - leafy	0.004								0.000
						Soybean oil	0.3221	50%	0.161
Lettuce	0.009					Sugar molasses	0.011	50%	0.005
Mung bean sprouts	0.007					Sunflower oil	0.002	50%	0.001
Mushrooms	0.021					Tomato catsup	0.042	50%	0.021
Mustard greens	0.015	Summary		Fraction of Total	Fraction of	Tomato juice	0.055		0.000
Nectarines	0.013				Three	Wine & sherry	0.084		0.000
Okra	0.015	Fruits and Vegetables	6.717	53%	59%				
Onions - bulb, dry	0.106	Meats and Cheeses	2.984	23%	26%	**Sub-Total**	4.700		1.342
Oranges - pulp	0.150	Breads and Grains	1.744	14%	15%	Water- food based	20.551		
		Incorporated Other	1.342	10%	100%	Water - nonfood	12.970		
Peaches - fresh	0.215	Total	12.787	100%	11.445	**Total**	38.221		

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Pears - fresh	0.122		
Peas - green immature	0.174	Other Other	3.357
		Food Related Water	20.551
Peppers - sweet	0.022		
Peppers - others	0.004	Average Solids Content	44%
Pineapple - fresh	0.031		
Plums - fresh	0.025		
Plums - prunes	0.006	Total Dry Intake Included	16.145
Potatoes - white	1.125	Total Dry Intake	16.134
Spinach	0.044		100%
Squash - summer	0.032		
Squash - winter	0.032		
Strawberries	0.035		
Sweetpotatoes	0.039		
Tomatoes - whole	0.492		
Turnips - roots	0.008		
Turnips - tops	0.015		
Watermelon	0.077		
Cane sugar	0.736		
Tomato paste	0.039		
Tomato puree	0.179		
Beans blackeye peas	0.002		
Beans - garbanzo	0.001		
Beans kidney	0.014		
Beans lima	0.008		
Beans navy	0.037		
Beans other	0.040		
Beans pinto	0.036		
Beans green	0.200		
Beans other	0.026		
Beans yellow	0.005		
Corn - grain	0.165		
Hops	0.022		
Soybean - unspecified	0.001		
Peanuts - whole	0.070		
Sunflower seeds	0.002		
Total	6.717		

Appendix C

Capacity Assumptions

Aeration Basin Design Capacity Calculations

WPTP

Assumptions

6	Aeration Process Trains installed at WPTP
111000	#/d BOD secondary influent @ capacity (Design Annual Average)

$\frac{111000}{6}$ Equals $\boxed{\text{18500 \#BOD/d / Process Train @ WPTP}}$

EDRP

Assumptions

4	Aeration Process Trains installed at EDRP after Renton III
55	#BOD/d/1000 cf (Average annual design loading)
1.1	Million gallon capacity /pass
7.48	Gallons/cf

Total Capacity (Mill Gals)	Total Capacity (1000 cf)	Capacity / Train (1000 cf)	Loading #BOD/d/1000 cf
17600000	2353	588	55

147 X 55 Equals $\boxed{\text{32353 \#BOD/d/Process Train @ EDRP}}$

Digester Design Capacity Calculations

WPTP

Assumptions

6	Digesters installed at WPTP
126000	#/d TSS primary sludge @ capacity (Design Annual Average)
107000	#/d TSS WAS sludge @ capacity (Design Annual Average)
233000	#/d TSS combined primary & WAS sludge

$\frac{233000}{6}$ Equals $\boxed{\text{38833 \#/d TSS/Digester @ WPTP}}$

EDRP

Assumptions

4	Digesters installed at Renton
290000	#/d TSS annual average Design Loading[i]

$\frac{290000}{4}$ Equals $\boxed{\text{72500 \#/d TSS/Digester @ Renton}}$

Appendix D

Food Waste Generation Estimates

Food Waste Generation Estimates

Solid Waste Utility Estimates

Solid Waste Utilities have been estimating the quantity of solid waste that has historically been disposed of to the solid waste system. As part of this effort these utilities have estimated the identifiable components of this disposed stream, including food waste. The estimated quantity of food waste in the solid waste stream is continuously being refined. Composition studies have historically been used to differentiate the components of solid waste. However, this method is known to underestimate food waste quantities because food waste liquids and solids in the collected samples become associated with other components. These estimates do not include all food waste. Food waste that is discharged to the sewer system is not included. Also, it is known that a large portion of the food processing waste stream (industrial sources) has historically been diverted to renderers and other reuse methods. These wastes have not been included in solid waste generation estimates. The latest estimates of solid waste and the food waste fraction of that waste (always presented as weight including water) by the City of Seattle and King County and based on composition studies are:

Table D-1 - Year 1992/3 Solid Waste and Food Waste Generation Estimates

	Total Solid Waste Tons/yr	*Food Waste[1] Tons/yr*	*Percent Food Waste*
Seattle[2]			
Residential	264,300	33,000	12.5%
Commercial	361,800	43,000	11.9%
Sub-Total	626,100	76,000	12.1%
King County[3]			
Residential	509,500[3]	81,500[3,4]	16%[4 (avg)]
Commercial	345,700[3]	44,900[3,4]	13%[4 (avg)]
Sub-Total	854,300	126,400	14.8%
Total	1,480,700	202,400	13.7%

[1]Does not include reused or sewer system discharged food processing waste, only what is landfilled

[2]Recycling Potential Assessment 1994, Vol. 2, May, 1994, Seattle Solid Waste utility

[3]Final 1992 Comprehensive Solid Waste Management Plan Technical Appendices, Aug. 1993, King County Solid Waste Division

[4]Average fractions from Final Report: Comprehensive Waste Stream Characterization, Cascadia Consulting Group, Inc., Nov. 1994

Estimates of Total Generation in the Metro Service Area

For this study the entire food waste quantities generated within the Metro service area has been estimated. These estimates do not directly correlate with the solid waste utility estimates because 1) they include only those portions of king County that are served by the sewer systems that drain to Metro treatment facilities and 2) they include all food waste generated, not just the portion that is part of the solid waste stream.

The estimates developed in this study use the latest adjustments to the composition data estimates. The estimates of food waste generation by source type within the Metro service areas (which does not include all of King County as in the previous table) are:

Table D-2 - Year 2000 Food Waste Generation in the Metro Service Area

	West Point Tons/yr	*East Division Tons/yr*	*Total Tons/yr*
Residential	58,900	37,600	96,500
Food Wholesale/Retail	46,700	21,500	68,200
Food Services	63,400	27,400	90,800
Subtotal	*169,000*	*86,500*	*255,500*
Food Processors	138,000	35,600	173,600
Total	*307,000*	*122,100*	*429,100*

Comparable data estimates total food waste generation in 1990 to be 208,000 tons per year without food processors and 370,000 tons per year with food processors included. Comparing the composition study data with the data developed for this study indicates that actual food waste quantities may be greater than the composition study based estimates indicate.

Appendix E

Education Methods for Altering Food Waste Handling

by
Cunningham Environmental Consultants, Inc.

Commercial Sector Educational Programs

Businesses generating high volumes of food waste would be targeted to change their food disposal practices. The emphasis of an educational program would be to provide information on the benefits of food grinders, or feasible alternatives to the food grinder for the disposal of food wastes. The information could include a resource list of the manufacturers of grease traps, pulper/extractors and interceptors, descriptions of how they work, their technical specifications and costs, and contact names of managers of local businesses that have used these alternatives with success.

Information could be provided through dissemination of literature (e.g. brochures) or through personal contact at the place of business. These two level of effort programs could also be effectively combined. Although a program involving just dissemination of information would require less funds than a program involving on-site technical assistance, the effectiveness could also be less. Before expending any effort on an educational program, several of the large food waste generators should be contacted to get their input on what type of assistance would be most useful to them. A program could then be designed to maximize cost efficiency.

Metro could decide to target the largest firms in their service area or reach a variety of firms. Based on previous studies conducted for King County and Seattle, it has been determined that the large food waste generators fall within the following four-digit SIC codes: food processors, food wholesalers, food retailers; eating establishments; lodging; in-patient care facilities, and educational institutions. The number of firms and average employment for these industry categories in King County in 1993 is presented below.

Table E-1 - Commercial Food Waste Producers

Industry	*SIC Code*	*# of Firms*	*Annual Avg. Employment*
Food processors	2011-2099	304	12,798
Food wholesalers	5141-5149	690	10,400
Food retailers	5411-5499	1,055	22,591
Eating establishments	5812	3,038	55,124
Lodging	7011	255	10,530
In-Patient care facilities	8051-8069	122	38,620
Educational institutions	8211-8222	138	58,115
Total		5,602	208,178

For the purpose of comparing alternatives, the costs of two types of programs are based on serving 200 businesses. The cost of providing 200 businesses with either brochures or on-site technical assistance has been estimated based on similar programs conducted by King County Solid Waste Division. The brochures are assumed to include two or three colors and some art work printed on a relatively heavy stock paper. The technical assistance is envisioned to consist of an initial meeting with the operations manager and tour of the facility, developing a notebook of information and resources tailored to that particular business, and a follow-up phone call.

Estimated Costs for 200 businesses

Brochures - $5,000 - $8,000 (Economies of scale would be realized with an increased number of businesses)

On-Site Technical Assistance - $40,000-$60,000

Another possible approach would be to target trade groups as a vehicle for education.

Residential Sector Educational Programs

School Programs - School educational programs targeting the environment have been used in Washington classrooms for more than ten years. In 1983 the Washington Department of Ecology developed a school curriculum entitled *A-Way with Waste* to educate children about solid waste, waste reduction and recycling. This curriculum has evolved over the years and has been used as a starting point by solid waste agencies interested in developing a curricula for school districts. The Seattle Solid Waste Utility (SWU) has a curriculum called *This Planet Is Mine* which has lessons and activities for grades 1 through 12. In addition, for the first time the Seattle SWU will be awarding grants this year to schools to develop their own curricula on solid waste. The KCSWD has a curriculum on waste reduction, recycling and composting for elementary, middle, and high school students. The curriculum includes teacher's guides, lesson plans, videotapes, and hands-on activities.

The Seattle SWU, KCSWD and Puget Sound Educational Service District continually update these curricula. The opportunity exists for Metro to add to these existing curricula by developing specific materials on food waste.

Estimated Cost - $10,000-$20,000

Telephone Information Line - The phone line could have a recorded message with an opportunity for the caller to talk to a trained technical staff on food waste disposal options. Metro could either provide a Metro employee or hire a contract employee to staff a telephone information line on a half-time basis. The phone number could be published on the sewer bills or other widely read Metro materials.

Estimated Cost - $25,000-$30,000 per year

Public Service Announcements - A public service announcement typically involves a 30 second pre-recorded spot that is aired at specified times during a set period. The frequency and time of day the PSA is played depends on the amount of money spent. King County has promoted recycling and waste reduction through PSAs. The County has paid for some advertising and, in return, has received some free advertising. The effectiveness of PSAs aired on radio has been demonstrated by KCSWD. A random telephone survey indicated that PSAs on waste reduction and recycling aired on 16 local radio stations had a 50% recall rate among radio listeners. The KCSWD has not tried PSAs on television due to the high cost.

Estimated Cost - $10,000-$20,000

Billboards and Busboards - Billboards can be effective in reaching a large audience. Customers can rent a billboard that is rotated to various high traffic locations within King County over a one year period. Busboards are used for promotional campaigns when the message needs to be communicated in a short period of time.

Estimated Cost

Billboards - $30,000 per year for mobile billboards
Busboards - $5,000 for one month (about 60 buses)

Utility Bill Inserts - Flyers promoting the use of food grinders or alternatives to the food grinders can be inserted in the utility bills to ensure the message reaches all Metro customers. In estimating cost, it is assumed the insert would have two or three colors and some artwork. Most of the cost would be the cost of printing.

Estimated Cost - $10,000-$15,000

Appendix F

Alternative Comparison Matrix

Attached is an example of a matrix that would be useful for comparing alternative when comparable cost data is available.

COMPARISON MATRIX
FOOD WASTE MANAGEMENT ALTERNATIVES

Comparison Criteria	Weight	Alternative a Rank	Alternative a Weighted Score	Alternative b Rank	Alternative b Weighted Score	Alternative c Rank	Alternative c Weighted Score	Alternative d Rank	Alternative d Weighted Score	Alternative e Rank	Alternative e Weighted Score	Alternative f Rank	Alternative f Weighted Score	Alternative g Rank	Alternative g Weighted Score	Alternative h Rank	Alternative h Weighted Score
Beneficial Use (10^3 tons/year)			237		271		271		327		327		194		323		335
Beneficial Use	3	3.8	11	2.8	8	2.8	8	1.2	4	1.2	4	5.0	15	1.3	4	1.0	3
Reduced Digester Load (tpy fw)			0		5.1		5.1		9.5		9.5		27.2		-57.3		27.2
WP Digester Load	.15	2.3	34	2.0	31	2.0	31	1.8	28	1.8	28	1.0	15	5.0	75	1.0	15
Reduced Secondary Load (tpy fw)			0		7.3		7.3		15.3		15.3		43.6		-83.2		5.8
Digester Load.	5	2.4	12	2.1	11	2.1	11	1.9	9	1.9	9	1.0	5	5.0	25	2.2	11
Annual Cost ($10^6/yr)			$34.9		$33.6		$33.7		$30.7		$31.4		$36.3		$32.1		$30.7
Annual Cost	25	4.0	100	3.1	77	3.1	79	1.0	25	1.5	38	5.0	125	2.0	50	1.0	25
Operation Simple, flexible	8	1	8	5	40	3	24	4	32	3	24	1	8	1	8	5	40
Energy Conserved	3	2	6	3	9	1	3	3	9	1	3	5	15	1	3	2	6
Changes Required	5	1	5	3	15	2	10	3	15	3	15	4	20	4	20	5	25
Proven Technology	7	1	7	2	14	3	21	2	14	3	21	1	7	1	7	2	14
Odor	4	1	4	3	12	2	8	3	12	2	8	3	12	2	8	3	12
Landfill Capacity	4	4	16	3	12	3	12	1	4	1	4	5	20	3	12	1.5	6
Vectors	5	1	5	2	10	1	5	2	10	1	5	3	15	2	10	4	20
Other Environmental Impacts	4	3	12	2	8	2	8	2	8	2	8	2	8	1	4	1	4
Siting Public Approval	7	1	7	3	21	2	14	3	21	2	14	3	21	2	14	3	21
Recycling Goal Compatability	5	4	20	3	15	3	15	1	5	1	5	5	25	2	10	1	5
Rating	100		248		283		248		196		185		311		250		207

An alternative scoring 100 would be the best in all categories
The lower the score the better the alternative satisfies the criteria

Summary Comparison Matrix	Weight	Alternative a	Alternative b	Alternative c	Alternative d	Alternative e	Alternative f	Alternative g	Alternative h
Cost	25	100	77	79	25	38	125	50	25
Treatment Facility Impacts	20	46	41	41	37	37	20	100	26
Environmental Impacts	19	65	52	46	30	24	83	33	24
Public Health	9	9	22	13	22	13	27	18	32
Public Acceptance	12	12	36	24	36	29	41	34	46
Operations Issues	15	15	54	45	46	45	15	15	54
Alternative Rating	100	248	283	248	196	185	311	250	207

Appendix A

Case Studies

Case Study 1: New York City Department of Environmental Protection

General Information	
Location:	New York City, New York
Agency:	New York City Department of Environmental Protection (DEP)
Contact:	Vincent Sapienza, Industrial Pretreatment
Population Served:	7,500,000
Treatment Plant Size:	14 treatment plants, 1.6 BGD total capacity
Biosolids Disposal:	100 percent utilization
Food Waste Disposal Policy	New York City's sewer use by-laws ban the installation and use of food waste grinders in areas served by a CSO collection system (accounting for 75 to 80 percent of the total wastewater treatment capacity). The ban is comprehensive, including the residential, commercial and industrial sectors. The purpose of the ban is to reduce the release of untreated sewage during high rainfall events. A bill was recently submitted to the mayors office and the New York City Council to allow food waste grinders throughout the system. A source with the National Association of Plumbing, Heating and Cooling Contractors indicated the bill would likely be passed.
Inspection and Monitoring Program	Inspections are primarily limited to industrial users and restaurants. Other commercial entities such as grocery stores and bakeries are only inspected if there is a blockage in the collection system. There is no set frequency for restaurant inspections, but they are probably performed, on average, less frequently than once a year. Large industrial clients (>25,000 gpd) are inspected two times a year. All other industrial clients are inspected annually. Residential sector inspections, even large apartment buildings or new structures, are not conducted. However, the Building Department is aware of the sewer use by-laws and does not allow food waste grinders to be installed in areas where they are banned. No monitoring of the collection system is conducted for the purpose of finding sewer users who are not complying with the food waste grinder ban.
Food Waste Grinder Usage	No formal studies assessing garbage disposal usage have been conducted. Overall, there is compliance with the food waste grinder ban.
Enforcement of By-Laws	If a food waste grinder is found in an area served by a CSO system, the DEP issues a commissioners order for the device to be removed. The violator is given 30 to 60 days to remove the grinder.

Case Study 2: Metro Toronto Works Department

General Information	
Location:	Toronto, Canada
Agency:	Metro Toronto Works Department, Water Pollution Control Division
Contact:	Martin Shaw, Industrial Waste Branch
Population Served:	Approximately 2,000,000
Treatment Plant Size:	4 treatment plants, approximately 390 MGD total capacity
Biosolids Disposal:	Incineration
Food Waste Disposal Policy	Metro Toronto Public Works by-laws prohibit the discharge of food wastes (from food waste grinders) to the wastewater system by industrial and commercial sector clients. The residential usage of food waste grinders to dispose of food wastes is allowed. The contact was unsure as to the reason for the commercial and industrial sector prohibition. One of Metro Toronto's four facilities may be near capacity for suspended solids. The other facilities are all well within capacity. In fact a system wide decrease in BOD has been noted since implementation of the prohibition.
Inspection and Monitoring Program	There is essentially no inspection or monitoring conducted to insure food waste grinders are not in place or being used. Commercial and industrial inspections are conducted but they do not address whether food waste grinders are being used. For example, restaurant inspections focus on whether grease traps and bins are installed and if the restaurant has a contract to dispose of grease residuals. The determination of food grinder usage is not a formal part of the inspection.
Food Waste Grinder Usage	No formal studies assessing garbage disposal usage have been conducted. Overall, there is compliance with the food waste grinder ban. The use of food waste grinders by the commercial and industrial sectors does not appear to be significant.
Enforcement of By-Laws	There is no rigorous enforcement of the food waste disposal by-laws

Case Study 3: Orillia Pollution Control

General Information	
Location:	Orillia, Ontario, Canada
Agency:	Orillia Pollution Control
Contact:	Eric DeHart
Population Served:	24,000
Treatment Plant Size:	4.2 MGD
Biosolids Disposal:	100 percent land application
Food Waste Disposal Policy	The Orillia Pollution Control (OPC) By laws require incoming wastewater to have biological oxygen demand (BOD) and suspended solids (SS) concentrations less than 300 and 350 mg/liter respectively. Exceeding these limits would result in the assessment of a surcharge. The BOD and SS levels are equivalent to the capacity of the wastewater treatment plant. The by-law BOD and SS restrictions are intended to keep incoming wastewaters within the facilities design capacity. The BOD of the incoming wastewater treated by the facility currently ranges between 100 and 180 mg/liter and SS range between 150 to 280 mg/liter. Residential areas have been found to have a higher BOD loading than industrial and commercial areas.
Inspection and Monitoring Program	Commercial and industrial entities, including restaurants, schools, grocery stores and food processors are inspected at least once per year. If garbage grinders are found, monitoring would be conducted to insure BOD and SS are within specified levels. Pre-treatment monitoring entails the collection and analysis of wastewater samples at 12 monitoring points, every two months. No businesses are currently exceeding the BOD or SS limits.
Food Waste Grinder Usage	No formal studies assessing garbage disposal usage have been conducted. However, very few garbage disposals have been noted during inspections of commercial and industrial businesses. The contact also does not think garbage disposals are widely used in the residential sector.
Enforcement of By-Laws	If a business or institution was found to exceed the OPC by law wastewater loading limits, a surcharge would be assessed based on the facilities operation costs. To date, no surcharges have been assessed and the contact is unsure how much the surcharge would be. The Huronia Regional Centre (HRC), an institution, recently considered using the wastewater treatment system for food waste disposal, but decided on-site composting would be less expensive. An on-site composting system at the HRC has been in operation for over a year.

Case Study 4: Denver Metro Wastewater Reclamation District

General Information

Location:	Denver, Colorado
Agency:	Metro Wastewater Reclamation District (Metro) Wastewater Management Division of City and County of Denver (City)
Contact:	Theresa Pfeifer, Industrial Pretreatment (Metro) Dan March, Industrial Pretreatment (City)
Population Served:	7,500,000
Treatment Plant Size:	185 MGD capacity
Biosolids Disposal:	100 percent utilization via composting and land application

Food Waste Disposal Policy

The City of Denver has an ordinance in the plumbing code that mandates the installation of food waste grinders in new residential and commercial buildings. The Health Department enforces the ordinance which was put in place to reduce nuisance pest attraction at outdoor waste collection areas.

Metro's wastewater plant has sufficient capacity and is currently operating at approximately 75 percent of the design flow. Metro has no limit on influent BOD or SS loading but does bill each district according to BOD, SS, and TKN loading. Metro's service area is divided into approximately 60 districts.

Inspection and Monitoring Program

Inspections and monitoring are conducted by Metro and the individual sewer districts. Metro's inspections focus entirely on the residential sector and are most concerned with trace metal and synthetic organic compound inputs. The primary purpose of BOD and SS loading is for invoicing each of the districts the facility serves. If a higher than normal BOD was found, Metro would inform the district, but would not investigate the source.

The Wastewater Management District of the City and County of Denver is the agency that oversees the City's wastewater collection system and administers billing. Commercial and industrial system users are inspected on a regular basis, with restaurants inspected four time per year. Restaurant inspections focus on the use of grease interceptors but also determine if food waste grinders are installed. If a grinder is not installed, the Health Department is informed and they make a determination whether one should be installed.

Food Waste Grinder Usage

No formal studies assessing garbage disposal usage have been conducted. A contact with the City thought food waste grinders were heavily used by the commercial sector. The contact was unsure as to how prevalent their use was in the residential sector.

Surcharge Assessments

The City assess surcharges to large industrial users defined by wastewater strength (>250 mg/l BOD or SS). The City has approximately 70 industrial users in this category that are monitored on a regular basis and invoiced based on BOD and SS loading. Other industrial and commercial users pay a higher use fee than residential users, however restaurants are not placed in this commercial category. The City is considering the development of new surcharge system to make billing more equitable.

Case Study 5: Detroit Water Sewerage Department

General Information	
Location:	Detroit, Michigan
Agency:	Detroit Water Sewerage Department (DWSD)
Contact:	Steve Kuplicki, Industrial Waste Control Division
Treatment Plant Size:	1.2 BGD total capacity
Biosolids Disposal:	100 percent incineration
Food Waste Disposal Policy	Detroit has an ordinance that mandates the installation of food waste grinders. The contact indicated that the mandate is only for the institution, commercial and industrial sector. The mandate is in place to protect human health (i.e. limit vector attraction at the points of collection, transfer and disposal). The facility is currently operating at approximately 70 percent of the design capacity. The DWSD serves 75 communities and sewer districts.
Inspection and Monitoring Program	Approximately 500 commercial and industrial users are inspected on a regular basis. The inspections do not include restaurants, which are only inspected if a flow problem is detected. There is a minimal amount of monitoring conducted and BOD and SS loading is viewed as a low priority
Food Waste Grinder Usage	No formal studies assessing garbage disposal usage have been conducted. The contact was unsure as to how prevalent food waste grinders are used.
Surcharge Assessments	Of the 500 industrial users, approximately 225 are assessed a surcharge. Surcharges are based on BOD, SS, phosphorous and FOG loadings, either through monitoring or historical data.

Case Study 6: Indianapolis Sanitary District

General Information	
Location:	Indianapolis, Indiana
Agency:	Indianapolis Sanitary District (ISD)
Contacts:	Tim Hider, Industrial Pretreatment Coordinator Tom Pendergast, Indianapolis Health Department
Population Served:	700,000
Treatment Plant Size:	2 treatment plants, 250 MGD total capacity
Biosolids Disposal:	100 percent utilization primarily through land application
Food Waste Disposal Policy	Indianapolis has an ordinance that requires the installation of food waste grinders in new buildings. However, neither the ISD nor the Health Department contacts were aware of the ordinance and they do not enforce it. In fact, the Health Department has another ordinance that specifies the proper installation of food waste grinders, *if they are installed.* The treatment plant has capacity to handle food wastes as it is operating at approximately 70 percent of design capacity
Inspection and Monitoring Program	Inspections conducted by the ISD pretreatment group focus on approximately 85 industrial users. Restaurants and other commercial entities are not inspected. Monitoring of BOD and SS is conducted for the purpose of invoicing industrial clients. The Health Department inspects restaurants , but does not suggest or require food waste grinders installation or use.
Food Waste Grinder Usage	No formal studies assessing garbage disposal usage have been conducted. None of the contacts had any idea as to how much food waste is disposed via food waste grinders.
Surcharge Assessments	Only industrial users are assessed surcharges which are based on BOD and SS loading determined by monitoring four to six times per year.

Appendix B

Treatment Plant Loading from Food Waste Disposal

B.1 Literature Review Findings

A literature review was completed to identify and summarize available sources of information about the quantity of food waste and associated water discharged because of the use of residential food grinders. Attachment A includes a matrix that provides an overview of each of the reviewed sources. Table B-1 provides a summary of the usage data on a per capita basis as provided by the literature. In most cases the references are not completely clear as to exactly what the usage number represents. In some cases it appears to be the discharge only from homes with food grinders. In other cases it may be an average discharge for homes with and without grinders. This uncertainty about the data will be considered when developing the average discharge loading factors developed later in this evaluation.

Table B-1 - Summary of Literature Estimates of Food Waste Loadings Disposed to Sewer

Reference	Wet Weight	Dry Weight	BOD	TSS
Siegrist et al., 1976	0.228[a]	0.057	0.024	0.035
Bennett & Linstedt, 1975			0.027	0.044
Ligman et al., 1974			0.067	0.095
Metcalf & Eddy, 1979	0.396[a]	0.099	0.044	0.066
Metcalf & Eddy, 1972	0.264[a]			
Dreckman, 1994	0.097[a]			
Davis & Black, 1962			0.052-0.088	
Erganian et al., 1952			0.060	0.070
Watson & Clark, 1962			0.052	0.064

[a]Assumes material disposed is 25 percent total solids

B.2 Food Waste Collection and Analysis

Food waste samples were gathered during this study for the primary purpose of providing material for laboratory evaluation of the fractionation of food waste into solids that will separate in the primary clarifiers and suspended, colloidal and soluble organics that will be removed in the activated sludge treatment process. The food waste samples were obtained in two ways. First, a volunteer group of 20 families from the consultant team, Metro staff and the City of Seattle Solid Waste staff collected food waste over a two day period. Second, mixes for 1) fruits and vegetables, 2) meats and cheeses and 3) breads and grains were developed using typical American diet information.

B.2.1 Collection for Laboratory Analysis Plan

B.2.1.1. Objectives

Evaluating the impact of food waste disposal on Metro's treatment facilities requires that the loading contribution be fractionated to determine the impact on specific wastewater treatment process units. Figure 3 gives a graphical presentation of the fractions of food waste that are significant for evaluating the impact of this waste on the treatment processes and the way these fractions change character as they pass through a wastewater treatment facility. As an example, it is important to estimate the fractions of influent BOD that are separated as solids in the primary clarifier as opposed to those that are converted to cell mass in the activated sludge process. These two solids act very differently in the anaerobic digestion (gas production) and dewatering process units. For this reason, the fraction of food waste that retains a solid character and settles in the primary clarifier is an important consideration in evaluating the impact of food waste disposal to the sewer system. To develop a basis for analysis, it is suggested that a simple laboratory evaluation be conducted to model the effects of grinder use and sewer transport (including pumping) on the food waste fractionation. By grinding samples of the primary types of food waste (vegetables, meat, bread and grains) in the laboratory and measuring the BOD associated with the solid and liquid fractions, an estimate of the solids generated in the primary and secondary treatment processes from food waste components can be developed.

The objective of this procedure was to develop data on the fractionation of food waste that could be diverted away from the sewers between the solids that will settle in the primary clarifiers and the BOD load on the activated sludge system.

B.2.1.2. Components of Food Waste

The basic components of food waste include five basic categories:

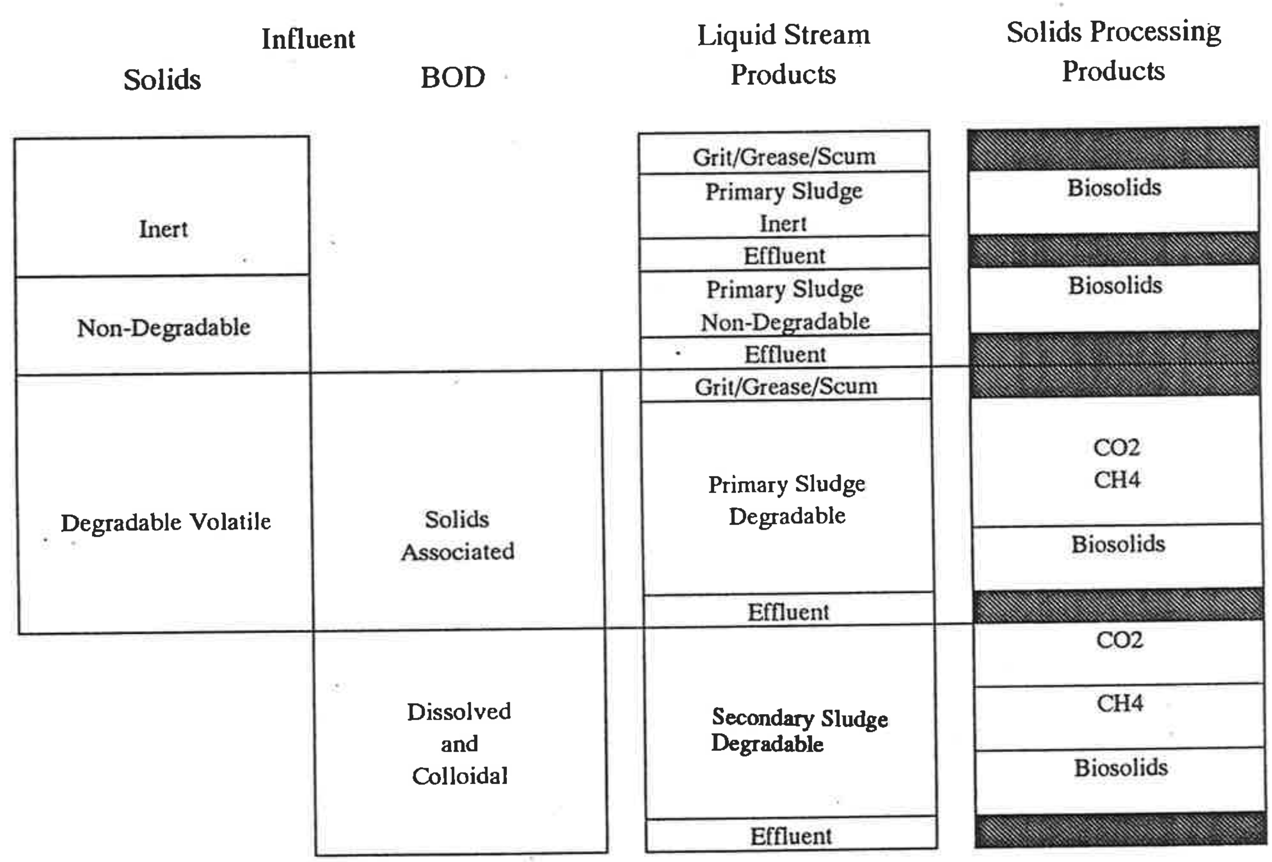
- Vegetables
- Fruit
- Breads and grains
- Meat
- Dairy products

Of these, only those food wastes that would be readily diverted to either the solid waste system or to a backyard composting system are of interest to this evaluation. Generally, waste dairy products (with the exception of cheese) would not be diverted in either of these ways because of their high moisture content and are therefore eliminated from further consideration.

The types of food waste that are discharged to the sewer system would be composed primarily of two components for residential and food service sources:

Figure 3

Fate of Food Waste in the Wastewater Treatment Process



Not to scale or proportional to actual quantities

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1. Meal preparation waste (mostly raw food)

2. Thrown away and excess food (mostly cooked food)

For produce wholesalers, the waste would be almost exclusively raw vegetable and fruit trimmings.

B.2.1.3. Influence of Conveyance System

The character of the food waste as it reaches the treatment facility determines the impact of the solids on the treatment processes. This character is likely influenced by the grinding action of the disposal, the contact with wastewater organisms in the sewers, the amount of turbulence and abrasion encountered enroute to the plant, the temperature and oxygen availability in the sewage and the travel time.

B.2.1.4 Sources of Food Waste Samples

The primary criteria for acquiring food waste samples is that they reflect the total organic contribution from the food waste. Any handling steps that may have allowed the release of organic load before sample collection must be avoided.

Several approaches are available for collecting suitable food waste samples:

1. Collect a significantly large sample of the total food waste stream from generator groups and analyze composite samples from the large sample.

2. Develop a synthetic "typical" mix of food waste for generator groups using the typical diet information used in the development of the 40 CFR 503 regulations.

3. Develop a synthetic mix of each food waste type (veg, fruit, meat) and use analysis together with composition estimates as the basis for developing loading estimates.

The potential sources of food waste samples that have been identified include:

Generator sample collection

1. Grocery store produce waste - would require coordination with store management. The most likely source is QFC or Larry's that already separate. Different separation procedures would need to be exercised to prevent loss of free water.

2. Food waste from a solid waste composition sort - Not feasible because of unrepresentative sample due to loss of liquids and mixing with other fractions.

3. Food waste from a residential collection program - Not on a schedule that allows coordination with our project.

4. Food waste from project team volunteer - Requires 10 to 15 volunteers to get a representative sample.

Synthesized sample of food waste materials

Has greater flexibility for future use if better composition data becomes available.

B.2.2 Processing of Samples

Based on consideration of all the issues discussed above, the recommended protocol is as follows. The rational for the approach is discussed below.

B.2.2.1 Sample Collection and Processing

Table B-2 presents the collection and processing program that is recommended:

Table B-2 - Food Waste Characterization Samples

Source	*Sample*	*Grinding*	*Aging*	*Seeded*
Project Team Collection	Mix 1	Food Grinder	Yes	Yes
	Mix 2	Food Grinder	Yes	Yes
	Control	No food	Yes	Yes
Synthetic Samples	Veg	Food Grinder	Yes	Yes
	Grain	Food Grinder	Yes	Yes
	Meat, cheese	Food Grinder	Yes	Yes

The collection protocol for the volunteer team is attached. The synthetic samples will be assembled based on typical diet information.

B.2.2.2 Laboratory Analyses

At the laboratory the samples were put through the following sequence of processes and analysis:

1. Collect all volunteer samples

2. Identify each volunteer sample with a sample number and add the same identifier to the corresponding volunteer questionnaire

3. Weigh all volunteer food waste samples

4. Mix the volunteer food waste samples and remove a random sample for grinding

5. Weigh 1 pound of each food waste sample before grinding

6. Use the balance of the sample of each mix for TS analysis

7. Grind all samples using primary effluent as the carrier water until a 5 gallon sample is obtained. Measure the volume of primary effluent added to each mix (primary effluent is used to provide seed organisms that would biologically degrade the food waste as in a sewer

8. Collect initial samples for all mixes and analyze

9. Mix the samples at slow speed, uncovered and at room temperature

10. Remove samples from each mix for analysis at 3 hour intervals over 24 hours

The laboratory analyses that were performed are presented in Table B-3.

Table B-3 - Food Waste Fractionation Analysis

Fractionation	*Fraction*	*Lab Analyses*
Primary Effluent	Liquid	TSS,VSS,BOD
Raw sample	Slurry	TS,VS,TDS
Imhoff Cone[1]	Liquid	TSS,VSS,BOD

[1]A glass cone in which solids are allowed to settle

B.2.3 Food Waste Sample Collection

Six samples were collected for analysis in this experiment; 2 volunteer, 3 synthetic and 1 effluent control.

Food waste samples from the volunteer group were composited from food waste collected over a two day period from October 11 through 12, 1994. During this period, twenty volunteers collected all food waste suitable for disposal via grinder and provided the food waste to the study team regardless of normal household practices. Completion of a survey form was also requested to identify the number of people contributing and to identify normal food waste disposal practices. Seventeen of the twenty volunteers participated in the collection. Of the participants, only 6 had garbage grinders in their homes. Disposal practices identified by the participants (some had multiple methods) included: 13 to garbage collection, 8 to composting, 3 to worm bins, 1 to a green cone and 1 to the family dog. Since many of the participants are solid waste and recycling professionals, the disposal practices would not be expected to be representative of the general population.

Even so, most participants still sent at least a portion of the food waste to the solid waste collection system.

The results of the food waste collection and the creation of the synthetic food waste mixes are included as Attachment B. The volunteer collection provided 15 Kg of food waste generated by 56 people over a two day period which is equivalent to 270 g/capita/day (0.30 ppcd). The collected food was about 24 percent solids and 76 percent water, with from 74 to 89 percent volatile solids (mostly organic matter).

Three synthetic mixes were developed using ratios of foods found in the typical American diet based on information generated by EPA for the 40 CFR 503 regulations. Some of the food was cooked to reflect table scrap input. The food samples consisted primarily of the waste portion of the food such as potato peelings and banana skins.

B.2.4 Food Waste Analysis

The collected food waste was analyzed at the East Division Reclamation Plant laboratory to simulate the effects of travel through the sewer system. The fractionation of solids and BOD between primary clarifier and secondary activated sludge process was also determined..

The results of the testing are included as Attachment D. A spreadsheet is provided for each of the five food waste mixes and the primary effluent. The basic data includes, at three hour intervals, the total solids (TS) and volatile solids (VS) of the mixture of primary effluent and food waste, and the BOD of liquid fraction after settling in an Imhoff Cone, to simulate the primary clarifier. The spreadsheet also includes additional data analyses which are discussed below.

The first and last concentrations of each parameter is an estimate of the extent of change over a 24 hour period. In general, the changes were significant. Over the 24 hour period, the TS and VS were reduced about 10 to 15 percent in the volunteer mixes and the vegetable and fruit mix. The meat and cheese mix TS and VS increased about the same percentage and the bread and grain mix increased by about 40 percent. Settling in the Imhoff Cone consistently reduced TSS and VSS by 30 to 50 percent over 24 hours. The Imhoff cone reduced the BOD of all mixes by 10 to 20 percent with the exception of the bread and grain mix that increased by 85 percent. The mechanism of these changes was not identified. The extent of the changes does justify additional evaluation to determine the impact of travel time on the treatment plant loading characteristics.

The next step was to use the laboratory data to estimate the portion of the solids and BOD that would be fractionated by the treatment processes. The data was used in the following ways:

1. The total solids in the lab mixtures less the total dissolved solids (TDS) less the TSS in the settled samples less the TS contributed by the primary effluent is assumed to be equal to the total solids removed in the primary clarifier and transferred to the anaerobic digesters for stabilization.

2. The volatile solids in the lab mixtures less TDS less the VSS in the settles sample less the VS contributed by the primary effluent is assumed to be equal to the associated volatile solids removed in the primary clarifier and transferred to the anaerobic digesters.

3. The BOD in the Imhoff Cone supernatant is assumed to be equal to the BOD loading that is passed from the primary clarifier to the aeration basins.

The calculated estimates of the solid removed in the primary are also given on the Attachment D spreadsheets.

B.2.4.1 Sewer System Travel Effects Analysis

The impact of travel time on the character of the food waste reaching the treatment facility was determined by aging the food waste samples for 24 hours at room temperature in primary effluent. Changes in composition of the mixes was measured at three hour intervals. From this information together with historical and design activated sludge process performance information, the total loading on the digesters can be estimated. The focus was on the primary clarifier separation of solids that are fed to the anaerobic digesters and BOD that continues with the liquid stream to the aeration basins. From this information together with historical and design activated sludge process performance information, the total loading on the digesters can be estimated. The objective of the test was to determine whether travel through the sewer system effects fractionation, and thus individual process loadings..

Travel time characteristics of the two treatment plant service areas was determined using information provided by Metro and is included as Attachment E. The travel time versus daily flow information patterns determine the extent to which the variations in solids and BOD will influence the loading. Analysis of the flow patterns indicates that several relatively uniform periods are indicated. The percentage of flow during these periods is then used to develop a flow weighted mean from the data collected in the 24 hour test. This flow analysis simulates summer average annual value for travel times The flow weighting factors developed from this analysis are:

West Point	0 to 9 hours	77.6% total plant daily influent flows
	9 to 18 hours	16.9% total plant daily influent flows
	18 to 24 hours	5.5% total plant daily influent flows

East Division	0 to 9 hours	82.8% total plant daily influent flows
	9 to 18 hours	17.2% total plant daily influent flows

An average flow weighted concentration was developed for each of the food waste mixes by multiplying the average measured concentration for each period by the weighting percentage and adding the products together. The results of this analysis are included on the Attachment D spreadsheets for each food waste mixes.

Comparison of these weighted averages to the average during the 24 hour period indicates that flow weighting does not give a significantly different result than using the arithmetic mean. In other words, the travel time for the two treatment facilities do not significantly alter the impact of the food waste on the treatment unit loading.

B.2.4.2 Treatment Unit Process Loading

The weighted average concentrations were then used to estimate the treatment process loading that would be expected from food waste. Knowing the amount of dry solids initially added to each mixture and the calculated dry solids removed in the primary clarifiers allows calculation of the pounds of solids removed per pound of food waste dry solids discharged to the sewer system. A similar calculation was made for the BOD loading on the aeration system. The calculation of these values are shown on the Attachment D spreadsheet and are summarized on Table B-4 for each of the mixes tested.

A correction was required based on an observed difference between the initially measured solids in the mixed tanks and the amount of solids that were known to be added to each tank. This comparison indicated that all of the solids were not accounted for in the tank, possibly due to insufficient mixing energy. Since the total mass of solids added was measured and these solids would be removed in the primary clarifier, the estimates of primary loads solids were adjusted upward to adjust the discrepancy.

Volunteer Collection Mix

The two volunteer mixes are composites samples of mixed food waste collected over a period of two days prior to analysis and testing. The loading data for these two samples were very similar with the exception of the volatile solids. This difference is due to the high initial volatile solids content measured for one of the mixes.

Typical Diet Mix

Mixes of the three different food waste types were prepared on the morning of the laboratory testing using a typical diet as the basis for the weight ratios of the constituents. The types and amounts of materials used for each mix are included in Attachment C. The test results summary for these three types of mixes are shown on Table B-4. To develop the loading factors for the typical diet mix, the load factors for the three food type mixes were weighted according to the ratios of these material types in the typical diet. This typical diet data analysis is also included in Attachment C. The result of the typical diet analysis is that 60 percent of the diet is fruits and vegetables, 25 percent is meats and cheeses and 15 percent is breads and grains. The diet weighted loading factors for the typical diet are presented on Table B-5.

Unit Process Fractionation

Siegrist (1976) is the only literature reference source that provides information about the fractionation of food waste such that the impact on wastewater treatment unit process can be estimated. The information indicates the following:

Primary clarifier solids: Assuming that the difference between the total solids and total suspended solids represents the fraction of solids that will separate in the primary clarifier (note that this figure is adjusted to account for primary effluent TS), the data indicates that 0.60 lbs of total solids will be removed per lb of dry food waste solids; and 0.56 lbs of total volatile solids will be removed per lb of dry food waste solids.

Secondary Treatment BOD Loading: Assuming that all of the soluble BOD and 35% of the remaining total BOD passes through the primary clarifier and to the secondary treatment process, the data indicates that 0.21 lbs of BOD will enter the secondary process per lb of dry food waste solids discharged to the sewer system.

This analysis has produced comparable data for a volunteer food waste collection mix and for a mix based on the typical American diet.

The available data is summarized as follows:

	Primary Total Solids lbs TS Raw Sludge	*Primary Volatile Solids lb VS Raw Sludge*	*Secondary BOD lb BOD Primary Effluent*
Siegrist	0.60	0.56	0.21
Volunteer Mix Mean	0.62	0.49	0.49
Typical Diet	0.54	0.46	0.37

Based on this information an average of the volunteer and typical diet loading factors will be used to estimate the treatment process loadings from food waste as shown below.

	Primary Total Solids lb TS Food Waste	Primary Volatile Solids lb TS Food Waste	Secondary BOD lb TS Food Waste
Selected Factors	0.57	0.47	0.43

B.3 Estimated Treatment Unit Process Loading

The estimated loading on the treatment process units is determined using the food waste quantities discharged to the sewer system and the loading fractionation factors. Section 2 provided estimates of the food waste discharged to the sewer system for three separate conditions; 1) a base case that is considered to be a reasonable estimate of current conditions, 2) a reasonable estimate of the maximum discharge and 3) a reasonable estimate of the minimum discharge. For each of these conditions, the food waste discharge loadings were estimated for the West Point and East Division service areas for the years 1990, 2000 and 2010.

B.3.1 Current Practice Continued

The base case represents the estimate for current food disposal to the sewer system and projections for continuation of the same diversion rates through the year 2010. The estimated annual quantities and mass of food waste discharged to the West Point and East Division Treatment Facility collection systems for residential and commercial sources are given on Table B-6. Table B-7 gives the conversion of these annual wet ton estimates to pounds per day units and on a wet and dry weight basis. Table B-8 includes the projection of dry weight daily loadings through the year 2010. Table B-9 shows the conversion of the treatment facility loading to the loading on individual treatment units using the loading factors developed above for 1990, 2000 and 2010.

Table B-10 provides a comparison between the estimated treatment unit from food waste disposal and the total current loading and projected loadings as developed by Metro's wastewater 2022 study.

B.3.2 Loadings for Maximum Diversion to Sewer System

This estimate represents the maximum reasonable expected diversion of food disposal waste to the sewer system and projections for continuation of the same diversion rates through the year 2010. The estimated annual quantities of food waste discharged are given on Table B-11. Table B-12 gives the conversion of these annual estimates to pounds per day units and on a wet and dry weight basis. Table B-13 includes the projection of dry weight daily loadings through the year 2010. Table B-14 shows the conversion of the treatment facility loading to the loading on individual treatment units. Table B-15 provides a comparison between the estimated treatment unit from food waste disposal and the total current loading.

An additional analysis was done to show the potential impact of food processing waste on treatment plant loadings. Table B-16 through B-20 gives the loading information for the maximum contribution from food waste including food processing waste. The results indicate that the food processing is a very large potential source of added loading to the treatment facilities. Because of a lack of information regarding current practices of food processing the Metro service area, the significance of this cannot be adequately addressed without a more complete analysis of the major sources in this category.

B.3.3 Maximum Diversion to Solid Waste Collection

This estimate represents the minimum reasonable expected diversion of food disposal waste to the sewer system and projections for continuation of the same diversion rates through the year 2010. The estimated annual quantities of food waste discharged are given on Table B-21. Table B-22 gives the conversion of these annual estimates to pounds per day units and on a wet and dry weight basis. Table B-23 includes the projection of dry weight daily loadings through the year 2010. Table B-24 shows the conversion of the treatment facility loading to the loading on individual treatment units. Table B-25 provides a comparison between the estimated treatment unit from food waste disposal and the total current loading.

B.3.4 Summary of Loading Estimates

The loading estimates developed above are summarized on Table B-26. In addition, projection are provided for the years 1995 and 2005. These estimates are straight line interpolations between the other estimated results. The flow projections are based on a literature value of 10-20 gallons per dry pound (gpp) of food waste (based on 1-2 gallons per capita per day (gpcd) and 0.5 wet pounds per capita per day (ppcd) @ 25% solids). For this analysis 10 gpp was used for the low estimate, 15 gpp for the base case and 20 gpp for the maximum estimate.

Table B-4 Summary of Loading Data From Laboratory Analysis

(Loading in pounds per dry pound of food waste)

Food Waste Mixture	West Point Service Area			East Division RP Service Area		
	Primary TS	*Primary VS*	*Secondary BOD*	*Primary TS*	*Primary VS*	*Secondary BOD*
Volunteer 1	0.60	0.43	0.48	0.61	0.44	0.48
Volunteer 2	0.62	0.54	0.50	0.64	0.55	0.49
Fruit and Vegetables	0.40	0.36	0.45	0.39	0.35	0.45
Meat and Cheese	0.75	0.61	0.26	0.74	0.60	0.26
Bread and Grains	0.74	0.66	0.25	0.71	0.64	0.24
Typical Diet (1)	0.54	0.46	0.37	0.53	0.46	0.37
Selected Condition	0.57	0.47	0.43	0.58	0.47	0.43

(1) Calculated from above based on a typical diet of

60%	Fruit and Vegetables
25%	Meat and Cheese
15%	Bread and Grains

Table B-5 Major Components of Typical Diet

Fruits and Vegetables	Daily	Meats & Cheeses	Daily	Bread & Grain	Daily	Other	Daily		Adj. Daily
Name	Consumption	Name	Consumption	Name	Consumption	Name	Consumption		Consump.
	(g/kg body wt)		(g/kg body wt)		(g/kg body wt)		(g/kg body wt)		(g/kg)
Apples - fresh	0.457	Beef - boneless - fat	0.372	Barley	0.057	Apple - Juice	0.221		0.000
Apricots - fresh	0.034	Beef - boneless - lean	1.162	Oats	0.083				0.000
Asparagus	0.013	Beef - organ meats - liver	0.021	Rice - milled	0.155	Chocolate	0.036	50%	0.018
Avocados	0.013	Beef - organ meats	0.006	Soybean flour w/ fat	0.003	Coconut oil	0.025	50%	0.013
Bananas - fresh	0.224	Beef - dried	0.003	Soybean flour w/o fat	0.012	Coffee	0.046		0.000
Beets - sugar	0.332	Beef - meat by-products	0.018	Wheat bran	0.012	Corn - grain-oil	0.023	50%	0.011
Beets - roots	0.022	Chicken w/o bones	0.379	Wheat flour	1.257	Corn sugar	0.097		0.000
Beets greens	0.001	Chicken w/o bones & skin	0.060	Wheat - rough	0.141	Cottonseed oil	0.204	50%	0.102
Broccoli	0.049	Fish - freshwater finfish	0.030	Sorgum incl milo	0.024	Cranberry juice	0.017		0.000
Brussel sprouts	0.007	Fish - saltwater finfish	0.189			Distilled alcohol	0.0387		0.000
Cabbage, chinese	0.005	Fish - shellfish	0.034	Total	1.744	Eggs - white only	0.009	50%	0.005
Cabbage	0.094	Pork - (organ meats) liver	0.005			Eggs - whole	0.565	50%	0.282
Canteloupes - pulp	0.044	Pork - (organ meats) other	0.004			Eggs - yolks only	0.0066	50%	0.003
Carrots	0.173	Pork - meat byproducts	0.025			Grapefruit juice	0.077		0.000
Cauliflower	0.016	Poultry - w/o bones	0.005			Grape juice	0.090		0.000
Celery	0.061	Sheep - boneless, fat	0.004			Honey	0.015	50%	0.008
Cherries - fresh	0.032	Sheep - boneless	0.012			Artif. sweetener	0.019		0.000
Collards	0.019	Turkey w/o bones	0.048			Maple syrup	0.027	50%	0.013
Corn - sweet	0.237	Turkey w/o bones & skin	0.008			Lactose	0.037	50%	0.019
Cranberries	0.015	Pork - Fat	0.208			Milk - fat solids	0.430	50%	0.215
Cucumbers	0.072	Pork - Lean	0.391			Milk no fat solids	0.903	50%	0.452
Grapefruit - pulp	0.068					Olive oil	0.006	50%	0.003
Grapes - fresh	0.044	Total	2.984			Orange juice	1.095		0.000
Grapes - Raisins	0.017					Palm oil	0.016	50%	0.008
Honeydew Melons	0.018					Peanut oil	0.005	50%	0.003
Leeks	0.019					Pineapple juice	0.037		0.000
Lettuce - head	0.212					Prune juice	0.138		0.000
Lettuce - leafy	0.004								0.000
						Soybean oil	0.3221	50%	0.161
Lettuce	0.009					Sugar molasses	0.011	50%	0.005
Mung bean sprouts	0.007					Sunflower oil	0.002	50%	0.001
Mushrooms	0.021					Tomato catsup	0.042	50%	0.021
Mustard greens	0.015	Summary		Fraction of Total	Fraction of	Tomato juice	0.055		0.000
Nectarines	0.013				Three	Wine & sherry	0.084		0.000
Okra	0.015	Fruits and Vegetables	6.717	53%	59%				
Onions - bulb, dry	0.106	Meats and Cheeses	2.984	23%	26%	Sub-Total	4.700		1.342
Oranges - pulp	0.150	Breads and Grains	1.744	14%	15%	Water- food based	20.551		
		Incorporated Other	1.342	10%	100%	Water - nonfood	12.970		
Peaches - fresh	0.215	Total	12.787	100%	11.445	Total	38.221		

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Pears - fresh	0.122								
Peas - green immature	0.174	Other Other	3.357						
		Food Related Water	20.551						
Peppers - sweet	0.022								
Peppers - others	0.004	Average Solids Content	44%						
Pineapple - fresh	0.031								
Plums - fresh	0.025								
Plums - prunes	0.006	Total Dry Intake Included	16.145						
Potatoes - white	1.125	Total Dry Intake	16.134						
Spinach	0.044		100%						
Squash - summer	0.032								
Squash - winter	0.032								
Strawberries	0.035								
Sweetpotatoes	0.039								
Tomatoes - whole	0.492								
Turnips - roots	0.008								
Turnips - tops	0.015								
Watermelon	0.077								
Cane sugar	0.736								
Tomato paste	0.039								
Tomato puree	0.179								
Beans blackeye peas	0.002								
Beans - garbanzo	0.001								
Beans kidney	0.014								
Beans lima	0.008								
Beans navy	0.037								
Beans other	0.040								
Beans pinto	0.036								
Beans green	0.200								
Beans other	0.026								
Beans yellow	0.005								
Corn - grain	0.165								
Hops	0.022								
Soybean - unspecified	0.001								
Peanuts - whole	0.070								
Sunflower seeds	0.002								
Total	6.717								

Table B-6 Base Case - Estimated Food Waste Disposal to Wastewater (Total Tons per year)

Annual Loading Projections (Wet tons per year)

	Residential	Food Process	Whls/Retail	Food Serv.	Total Comm. (excl. Process)
West Point					
1990	12,225	4,516	3,243	13,499	16,742
2000	13,198	4,839	4,108	17,100	21,208
2010	14,581	5,185	5,203	21,662	26,865
East Div.					
1990	9,207	1,161	1,496	5,826	7,322
2000	11,062	1,244	1,895	7,380	9,275
2010	12,515	1,333	2,401	9,349	11,750

Table B-7 Base Case - Estimated Food Waste Disposal to Wastewater (In lbs per day)

	Total Weight (Wet)		Dry Solids Fraction	
	West Point	East Division	West Point	East Division
Commercial	91,737	40,121	22,934	10,030
Residential	66,986	50,449	16,747	12,612
Total	158,723	90,570	39,681	22,642
	Assumes	25%	solids content	

Table B-8 Base Case - Projected Food Waste Disposal to Wastewater (In lbs per day - Dry Solids)

	Commercial	Residential	Total
West Point			
1990	22,934	16,747	39,681
2000	29,052	18,079	47,132
2010	36,801	19,974	56,775
East Div.			
1990	10,030	12,612	22,642
2000	12,705	15,153	27,859
2010	16,096	17,144	33,240

Table B-9 Base Case - Loading from Food Disposal Use (In lbs per day)

	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Commercial	13,073	10,779	9,862	5,817	4,714	4,313
Residential	9,546	7,871	7,201	7,315	5,928	5,423
Total	22,618	18,650	17,063	13,133	10,642	9,736
2000						
Commercial	16,560	13,654	12,492	7,369	5,972	5,463
Residential	10,305	8,497	7,774	8,789	7,122	6,516
Total	26,865	22,152	20,267	16,158	13,094	11,979
2010						
Commercial	20,977	17,297	15,825	9,336	7,565	6,921
Residential	11,385	9,388	8,589	9,943	8,058	7,372
Total	32,362	26,684	24,413	19,279	15,623	14,293
Load Factor	0.57	0.47	0.43	0.58	0.47	0.43

Table B-10 Base Case - Fractional Loading from Food Disposal Use (In lbs per day)

	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Food Waste	22,618	18,650	17,063	13,133	10,642	9,736
Plant Total	133,250	109,873	98,800	72,800	58,993	66,950
Percent FW	17%	17%	17%	18%	18%	15%
2000						
Food Waste	26,865	22,152	20,267	16,158	13,094	11,979
Plant Total	132,600	109,337	96,850	102,050	82,696	93,600
Percent FW	20%	20%	21%	16%	16%	13%
2010						
Food Waste	32,362	26,684	24,413	19,279	15,623	14,293
Plant Total	142,350	117,376	104,650	112,450	91,123	103,350
Percent FW	23%	23%	23%	17%	17%	14%
	Based on 2020 Plan (8/94) Tables 8-13&14					
	Assumes 65% of TS & VS and 35% of BOD removed in primary clarifiers					

Table B-11 Maximum Diversion

Estimated Food Waste Disposal to Wastewater (In Total Tons per year)

Annual Loading Projections (Wet tons per year)

	Residential	Food Process	Whls/Retail	Food Serv.	Total Comm. (excl. Process)
West Point					
1990	22,704	20,969	15,055	18,669	33,724
2000	24,511	22,467	19,071	23,649	42,720
2010	27,079	24,071	24,159	29,958	54,117
East Div.					
1990	17,099	5,392	6,946	8,057	15,003
2000	20,543	5,777	8,800	10,207	19,007
2010	23,243	6,189	11,147	12,930	24,077

Table B-12 Max. Diversion - Estimated Food Waste Disposal to Wastewater (In lbs per day)

	Total Weight (Wet)		Dry Solids Fraction	
	West Point	East Division	West Point	East Division
Commercial	184,789	82,208	46,197	20,552
Residential	124,405	93,693	31,101	23,423
Total	309,195	175,901	77,299	43,975
	Assumes	25%	solids content	

Table B-13 Projected Food Waste Disposal to Wastewater (In lbs per day - Dry Solids)

Maximum Diversion

	Commercial	Residential	Total
West Point			
1990	46,197	31,101	77,299
2000	58,521	33,577	92,097
2010	74,133	37,095	111,227
East Div.			
1990	20,552	23,423	43,975
2000	26,037	28,141	54,178
2010	32,982	31,840	64,822

Table B-14 Loading from Food Disposal Use (in lbs per day)						
Maximum Diversion						
	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Commercial	26,332	21,713	19,865	11,920	9,659	8,837
Residential	17,728	14,618	13,374	13,586	11,009	10,072
Total	44,060	36,330	33,238	25,506	20,668	18,909
2000						
Commercial	33,357	27,505	25,164	15,101	12,237	11,196
Residential	19,139	15,781	14,438	16,322	13,226	12,101
Total	52,495	43,286	39,602	31,423	25,464	23,297
2010						
Commercial	42,256	34,842	31,877	19,130	15,502	14,182
Residential	21,144	17,434	15,951	18,467	14,965	13,691
Total	63,400	52,277	47,828	37,597	30,466	27,873
Load Factor	0.57	0.47	0.43	0.58	0.47	0.43

Table B-15 Fractional Loading from Food Disposal Use (in lbs per day)						
Maximum Diversion						
	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Food Waste	44,060	36,330	33,238	25,506	20,668	18,909
Plant Total	133,250	109,873	98,800	72,800	58,993	66,950
Percent FW	33%	33%	34%	35%	35%	28%
2000						
Food Waste	52,495	43,286	39,602	31,423	25,464	23,297
Plant Total	132,600	109,337	96,850	102,050	82,696	93,600
Percent FW	40%	40%	41%	31%	31%	25%
2010						
Food Waste	63,400	52,277	47,828	37,597	30,466	27,873
Plant Total	142,350	117,376	104,650	112,450	91,123	103,350
Percent FW	45%	45%	46%	33%	33%	27%
	Based on 2020 Plan (8/94) Tables 8-13&14					
	Assumes 65% of TS & VS and 35% of BOD removed in primary clarifiers					

Table B-16 Estimated Food Waste Disposal to Wastewater (In Total Tons per year)						
Maximum Diversion Including Food Processors						
Annual Loading Projections (Wet tons per year)						
					Total	
	Residential	Food Process	Whls/Retail	Food Serv.	Comm. (excl. Process)	
West Point						
1990	22,704	20,969	15,055	18,669	54,693	
2000	24,511	22,467	19,071	23,649	65,187	
2010	27,079	24,071	24,159	29,958	78,188	
East Div.						
1990	17,099	5,392	6,946	8,057	20,395	
2000	20,543	5,777	8,800	10,207	24,784	
2010	23,243	6,189	11,147	12,930	30,266	
Table B-17 Estimated Food Waste Disposal to Wastewater (In lbs per day)						
Maximum Diversion Including Food Processors						
	Total Weight (Wet)		Dry Solids Fraction			
	West Point	East Division	West Point	East Division		
Commercial	299,688	111,753	74,922	27,938		
Residential	124,405	93,693	31,101	23,423		
Total	424,093	205,447	106,023	51,362		
	Assumes	25%	solids content			
Table B-18 Projected Food Waste Disposal to Wastewater (In lbs per day - Dry Solids)						
Maximum Diversion Including Food Processors						
	Commercial	Residential	Total			
West Point						
1990	74,922	31,101	106,023			
2000	89,297	33,577	122,874			
2010	107,107	37,095	144,201			
East Div.						
1990	27,938	23,423	51,362			
2000	33,951	28,141	62,092			
2010	41,460	31,840	73,300			

Table B-19 Loading from Food Disposal Use (in lbs per day)						
Maximum Diversion Including Food Processors						
	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Commercial	42,705	35,213	32,216	16,204	13,131	12,013
Residential	17,728	14,618	13,374	13,586	11,009	10,072
Total	60,433	49,831	45,590	29,790	24,140	22,086
2000						
Commercial	50,899	41,970	38,398	19,691	15,957	14,599
Residential	19,139	15,781	14,438	16,322	13,226	12,101
Total	70,038	57,751	52,836	36,013	29,183	26,699
2010						
Commercial	61,051	50,340	46,056	24,047	19,486	17,828
Residential	21,144	17,434	15,951	18,467	14,965	13,691
Total	82,195	67,775	62,007	42,514	34,451	31,519
Load Factor	0.57	0.47	0.43	0.58	0.47	0.43

Table B-20 Fractional Loading from Food Disposal Use (in lbs per day)						
Maximum Diversion Including Food Processors						
	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Food Waste	60,433	49,831	45,590	29,790	24,140	22,086
Plant Total	133,250	109,873	98,800	72,800	58,993	66,950
Percent FW	45%	45%	46%	41%	41%	33%
2000						
Food Waste	70,038	57,751	52,836	36,013	29,183	26,699
Plant Total	132,600	109,337	96,850	102,050	82,696	93,600
Percent FW	53%	53%	55%	35%	35%	29%
2010						
Food Waste	82,195	67,775	62,007	42,514	34,451	31,519
Plant Total	142,350	117,376	104,650	112,450	91,123	103,350
Percent FW	58%	58%	59%	38%	38%	30%
	Based on 2020 Plan (8/94) Tables 6-13&14					
	Assumes 65% of TS & VS and 35% of BOD removed in primary clarifiers					

Table B-21 Estimated Food Waste Disposal to Wastewater (In lbs per day)

Low Diversion

Annual Loading Projections (Wet tons per year)

	Residential	Food Process	Whls/Retail	Food Serv.	Total Comm. (excl. Process)
West Point					
1990	1,746	1,613	1,158	1,436	2,594
2000	1,885	1,728	1,467	1,819	3,286
2010	2,083	1,852	1,858	2,304	4,162
East Div.					
1990	1,315	415	534	620	1,154
2000	1,560	444	677	785	1,462
2010	1,788	476	857	995	1,852

Table B-22 Estimated Food Waste Disposal to Wastewater (In lbs per day)

Low Diversion

	Total Weight (Wet)		Dry Solids Fraction	
	West Point	East Division	West Point	East Division
Commercial	14,214	6,323	3,553	1,581
Residential	9,567	7,205	2,392	1,801
Total	23,781	13,529	5,945	3,382
	Assumes	25%	solids content	

Table B-23 Projected Food Waste Disposal to Wastewater (In lbs per day - Dry Solids)

Low Diversion

	Commercial	Residential	Total
West Point			
1990	3,553	2,392	5,945
2000	4,501	2,582	7,084
2010	5,701	2,853	8,555
East Div.			
1990	1,581	1,801	3,382
2000	2,003	2,164	4,167
2010	2,537	2,449	4,986

Table B-24 Loading from Food Disposal Use (in lbs per day)
Low Diversion

	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Commercial	2,025	1,670	1,528	917	743	680
Residential	1,363	1,124	1,028	1,045	847	775
Total	3,389	2,794	2,556	1,962	1,590	1,454
2000						
Commercial	2,566	2,116	1,936	1,162	941	861
Residential	1,472	1,214	1,110	1,255	1,017	931
Total	4,038	3,329	3,046	2,417	1,959	1,792
2010						
Commercial	3,250	2,680	2,452	1,471	1,192	1,091
Residential	1,626	1,341	1,227	1,421	1,151	1,053
Total	4,876	4,021	3,679	2,892	2,344	2,144
Load Factor	0.57	0.47	0.43	0.58	0.47	0.43

Table B-25 Fractional Loading from Food Disposal Use (in lbs per day)
Low Diversion

	West Point Treatment Plant			East Division Reclamation Plant		
	Primary Settled Solids		Secondary	Primary Settled Solids		Secondary
	TS	VS	BOD Load	TS	VS	BOD Load
1990						
Food Waste	3,389	2,794	2,556	1,962	1,590	1,454
Plant Total	133,250	109,873	98,800	72,800	58,993	66,950
Percent FW	3%	3%	3%	3%	3%	2%
2000						
Food Waste	4,038	3,329	3,046	2,417	1,959	1,792
Plant Total	132,600	109,337	96,850	102,050	82,696	93,600
Percent FW	3%	3%	3%	2%	2%	2%
2010						
Food Waste	4,876	4,021	3,679	2,892	2,344	2,144
Plant Total	142,350	117,376	104,650	112,450	91,123	103,350
Percent FW	3%	3%	4%	3%	3%	2%
	Based on 2020 Plan (8/94) Tables 8-13&14					
	Assumes 65% of TS & VS and 35% of BOD removed in primary clarifiers.					

Table B-26 - Summary of Food Waste Loading (In lbs per day - Dry Weight or MGD)						
	West Point Treatment Plant			East Division Reclamation Plant		
Sewer Discharge Condition	*Flow (MGD)*	*Primary VS ppd - Dry Wt*	*Secondary BOD Load ppd - Dry Wt*	*Flow ppd - Dry Wt*	*Primary VS ppd - Dry Wt*	*Secondary BOD Load ppd - Dry Wt*
1990						
Current Case	0.4	18,700	17,100	0.2	10,600	9,700
Maximum	0.8	36,200	33,100	0.4	20,400	18,700
Minimum	0.1	6,500	6,000	0.1	3,200	2,900
1995						
Current Case	0.5	20,500	18,700	0.3	11,900	10,900
Maximum	0.9	39,700	36,300	0.5	22,800	20,900
Minimum	0.2	7,300	6,700	0.1	3,600	3,300
2000						
Current Case	0.5	22,200	20,300	0.3	13,100	12,000
Maximum	0.9	43,100	39,400	0.5	25,200	23,000
Minimum	0.2	8,000	7,400	0.1	4,000	3,700
2005						
Current Case	0.6	24,500	22,400	0.3	14,400	13,200
Maximum	1.0	47,600	43,500	0.6	27,700	25,300
Minimum	0.2	9,000	8,300	0.1	4,500	4,100
2010						
Current Case	0.6	26,700	24,400	0.3	15,600	14,300
Maximum	1.1	52,000	47,600	0.6	30,100	27,500
Minimum	0.2	10,000	9,100	0.1	4,900	4,500