Desktop Study of the Feasibility of Developing a Centralized Plastics Recovery Facility in the Greater Toronto Area (GTA)

Final Report

Submitted to:

Stewardship Ontario
26 Wellington Street East, Suite 601
Toronto, ON M5E 1S2

Submitted by:

GENIVAR Ontario Inc.
600 Cochrane Drive, Suite 500
Markham, ON L3R 5K3

Entec Consulting Ltd.
1520 Silver Spruce Drive
Pickering, ON L1V 5H3

June 2007

This Project has been delivered with the assistance of Stewardship Ontario's Effectiveness and Efficiency Fund, a Fund financed by Ontario municipalities and stewards of blue box waste in Ontario. Notwithstanding this support, the views expressed are the views of the author(s), and the Association of Municipalities of Ontario and Stewardship Ontario accept no responsibility for these views.

Table of Contents

Appendices

List of Tables

List of Figures

Executive Summary

The cost for the recycling of plastics in Ontario is extremely high with the average cost per tonne across all plastic materials upwards of $865 per tonne. This cost is not likely to decrease, particularly in light of the increases in single serve packaged items in the marketplace. This is specifically an issue with PET, with more and more people moving to bottled water, flavoured waters, sports drinks, etc.

Until recently, the only method being used to sort these plastics in MRFs was to hand sort them from a containers line. With more and more plastics packaging arriving at the MRFs, it is getting increasingly difficult to manually sort the materials and to capture all of the plastics from the line.

As it is getting more difficult to sort plastics, and the cost to manually sort them continues to increase, Stewardship Ontario, in association with the Environment and Plastics Industry Council (EPIC) and the Regions of Peel and York jointly sponsored a study to examine the feasibility of establishing a centralized Plastics Recovery Facility (PRF), which could potentially eliminate the need for municipalities to separate plastics in their individual facilities.

This study compares the cost for the development and operation of a centralized PRF with the estimated cost to continue plastics separation at existing MRFs under their current configurations and also after each has been upgraded through the installation of optical sorting equipment for PET and HDPE, with the remaining plastics being sent to a PRF for further processing. Optical sorting for PET and HDPE has advanced greatly in recent years and the cost for the optical sorting units decreased to where, under certain circumstances it is now more cost effective to use optical sorting rather than manual sorting of plastics.

Quantities Generated and Recoverable

This study area for the PRF includes the seven largest municipalities in the Golden Horseshoe: the Cities of Toronto and Hamilton and the Regions of Niagara, Halton, Peel, York and Durham. In total, these municipalities generate approximately 110,000 tonnes of plastics packaging each year. Under a maximum diversion scenario, it is estimated that almost 35,000 tonnes of plastics could be recovered for processing in a regional PRF.

Current Costs

Overall, the cost to manage plastics across the municipalities in the study totalled almost $22,000,000 in 2005 or approximately $865 per tonne. This cost, however, includes both polystyrene and plastic film, both of which would not be sorted at a PRF. Removing these materials from the scenario, the total cost of management was approximately $17,800,000 or $785 per tonne. This was used as the baseline for comparison to the costs for optical sorting within the MRFs and the PRF option.

MRF Retrofits – Costs and Savings

Overall, it is estimated that the cost to retrofit the six facilities (Durham Region and Halton Region would not be installing new equipment) would be approximately $4.85 million. This capital expenditure would cover the cost of installing optical sorting technology for both PET and HDPE in each facility. One dual eject machine would be required per facility. As a result of

installing these machines, it is estimated that the annual savings in operating costs would total almost $470,000 over the current practice of manually sorting all PET and HDPE (not including York Region where the total operating costs could not be determined).

The PRF

One PRF would be located within the GTA. Overall, the facility would be 15,240 m^2 in size. The equipment, which would be capable of processing a complete stream of all mixed plastics would cost an estimated $4.5 million. Including all design, installation, electrical, controls, the building, site works, etc., the facility would have a total capital cost of approximately $12,000,000. Operating costs are comprised of debaling/declumping, general operations and maintenance, labour, baling and residues management. Overall, it is estimated that the operating costs at full throughput would be approximately $123 per tonne.

In total, the combined capital and operating costs for the facility would be approximately $166 per tonne.

Comparison of Costs

The net overall cost for a MRF only system that processes the approximately 35,000 tonnes of plastics, with the retrofits to include optical sorting of PET and HDPE is estimated at approximately $21.3 million, or just over $600 per tonne. The net cost for the PRF system, incorporating revenues is approximately $26.3 million or $750 per tonne. Overall, the cost for the MRF + PRF scenario shows an initial cost disparity of almost $5.0 million over the MRF only scenario.

Conclusions

In summary, the PRF approach does not eliminate sufficient labour cost to justify the investment, particularly in this case where there is no proposed upgrading of the material other than sorting, i.e. unsorted bales in, sorted bales out.

This study shows the economics of the proposed PRF not to be favourable. While providing a mechanism to recover other plastic packaging for recycling, the PRF approach would neither positively impact the Blue Box system cost, nor be a viable long-term business opportunity.

1. Introduction

The cost for the recycling of plastics in Ontario is extremely high with the average cost per tonne across all plastic materials upwards of $865 per tonne[1]. This cost is not likely to decrease, particularly in light of the increases in single serve packaged items in the marketplace. This is specifically an issue with PET, with more and more people moving to bottled water, flavoured waters, sports drinks, etc.

Until recently, the only way to process these plastics in MRFs was to hand sort them from a containers line. With more and more plastics packaging arriving at the MRFs, it is getting increasingly difficult to manually sort the materials and to capture all of the plastics from the line.

Although machines that optically sort plastics have been available, it was not until the past few years that the cost could be justified as a replacement for hand sorting the plastics, as there was not enough plastic relative to the capital cost. With plastics tonnages increasing significantly in the past few years, particularly with single serve PET, combined with the decrease in cost for the optical sorters, they are now considered cost effective. In fact, in Europe, where labour rates are twice what they typically are in Canada, these machines are fully monetized in less than two years in larger MRFs.

As it is getting more difficult to sort plastics, and the cost to manually sort them continues to increase, Stewardship Ontario, in association with the Environment and Plastics Industry Council (EPIC) and the Regions of Peel and York jointly sponsored a study to examine the feasibility of establishing a centralized Plastics Recovery Facility (PRF), which could potentially eliminate the need for municipalities to separate plastics in their individual facilities.

This study compares the cost for the development and operation of a centralized PRF with the estimated cost to continue plastics separation at existing MRFs under their current configurations and also after each of these MRFs is upgraded through the installation of optical sorting equipment for PET and HDPE, with the remaining plastics being sent to a PRF for further processing.

The study also examines means of improving the management of plastic film, a continuing issue in recycling programs in the province.

This study incorporates the seven largest municipalities in the Golden Horseshoe: the Cities of Toronto and Hamilton and the Regions of Niagara, Halton, Peel, York and Durham. This is done primarily because these programs generate the majority of the plastics recovered in the province, and more importantly because their close geographic proximity would make the transfer of the materials to a centralized facility cost effective.

This study begins by examining the quantities of plastics that could be generated and recovered (Chapter 2). Chapter 3 examines the current cost for the management of plastics in situ in the programs in the Golden Horseshoe. This is based primarily on the costs used by Stewardship Ontario in their stewards' fee setting methodology. Chapter 4 examines the current processing

[1] Based on work done in support of the Stewardship Ontario methodology to determine stewards' fees.

infrastructure for plastics in the MRFs in the municipalities in the study area and how much it would cost to retrofit them to optically sort PET and HDPE.

The next chapter reviews the results of the investigations with the end markets, including how many tonnes would likely be required to reach the economies of scale for a PRF, the market specifications for plastics being sold from the PRF, and the status of current PRFs in North America. Chapter 5 concludes with a discussion of the management of plastic film.

Chapter 6 examines the capital and operating costs associated with a PRF located within the GTA. A complete listing of the equipment required and a description of the process flow is included. Finally, in Chapter 7, the conclusions and recommendations arising from the study are presented.

2. Quantities Generated, Recovered and Recoverable

A series of spreadsheets outline the quantities of each of the streams of plastics available, currently recovered and potentially recovered from the municipalities included in the study area (Tables 2-1 to 2-3).

In each of the three scenarios, Single family (SF) (Table 2-1) and multi-residential (MR) (Table 2-2) household quantities are combined to produce the total plastics that would be handled in the PRF (Table 2-3). Since Durham Region is presently in the process of implementing a new MRF with optical sorting incorporated into the processing design, a second option shows totals without Durham participating in the PRF (Part D under each table).

A brief explanation of how the numbers were derived is as follows:

Table 2-1: Estimated Quantities of Plastics Generated

- Single family (SF) and multi-residential (MR) household data were provided by Stewardship Ontario
- Data from four seasonal waste audits for single family and multi-residential households in the City of Toronto[2] were averaged to give generation rates for each material.

Table 2-2: Estimated Quantities of Plastics – Full Recovery Scenario

- "Full Recovery" represents all municipalities achieving Toronto current recovery rates assuming each municipality is collecting the full range of plastics (more than currently collected). The assumed SF and MR recovery rates are shown in red in the box at the top of the table.

Table 2-3: Estimated Quantities of Plastics – Maximum Recovery Scenario

- "Projected Max Recovery" assumes the highest recovery for each type of plastic in a fully mature program (the assumed SF and MR recovery rates are shown in red at the top of Tables 2-1 and 2-2. Materials such as PET, HDPE and tubs and lids that already have relatively high recovery show minor projected growth, whereas projected growth in mixed plastic is substantial. It was assumed that the projected maximum recovery rate of materials from MR households would be 2/3 of the maximum recovery in SF households, since recovery of recyclables from MR dwellings is generally about 2/3 of that experienced in SF households.

It should be noted that in Table 2-3 (E), the quantity of polystyrene that would be handled by the PRF is 10% of that recovered in the MRF. The other 90% of the PS would be recovered at the MRF in the pre-processing areas.

[2] Spring, summer, winter and fall audits, 2005

Program	SF Households	MF Households	Seasonal Households	Total Households
City of Toronto	506,800	473,372	-	980,172
York Region	187,964	76,402	-	264,366
Peel Region	255,500	84,500	-	340,000
Durham Region	121,298	26,712	-	148,010
Halton Region	167,070	21,338	-	188,408
City of Hamilton	136,080	60,175	-	196,255
Niagara Region	140,805	29,723	2,600	170,528
Totals	1,515,517	772,222	2,600	2,287,739

GENERATION

A. SINGLE FAMILY 8.81 4.32 13.82 2.47 0.35 4.25 19.39

	Generation (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	4,465	2,189	7,004	1,252	177	2,154	9,827	27,068
York Region	1,656	812	2,598	464	66	799	3,645	10,039
Peel Region	2,251	1,104	3,531	631	89	1,086	4,954	13,646
Durham Region	1,069	524	1,676	300	42	516	2,352	6,479
Halton Region	1,472	722	2,309	413	58	710	3,239	8,923
City of Hamilton	1,199	588	1,881	336	48	578	2,639	7,268
Niagara Region	1,240	608	1,946	348	49	598	2,730	7,520
Totals	13,352	6,547	20,944	3,743	530	6,441	29,386	80,944
% of Total Plastics	16%	8%	26%	5%	1%	8%	36%	

B. MULTI RESIDENTIAL 8.33 2.84 9.62 1.31 0.21 3.65 10.64

	Generation (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	3,943	1,344	4,554	620	99	1,728	5,037	17,325
York Region	636	217	735	100	16	279	813	2,796
Peel Region	704	240	813	111	18	308	899	3,093
Durham Region	223	76	257	35	6	97	284	978
Halton Region	178	61	205	28	4	78	227	781
City of Hamilton	501	171	579	79	13	220	640	2,202
Niagara Region	248	84	286	39	6	108	316	1,088
Totals	6,433	2,193	7,429	1,012	162	2,819	8,216	28,263
% of Total Plastics	23%	8%	26%	4%	1%	10%	29%	

C. TOTAL 8.65 3.82 12.40 2.08 0.30 4.05 16.44

	Generation (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	8,408	3,534	11,558	1,872	277	3,882	14,864	44,394
York Region	2,292	1,029	3,333	564	82	1,078	4,458	12,835
Peel Region	2,955	1,344	4,344	742	107	1,394	5,853	16,739
Durham Region	1,291	600	1,933	335	48	613	2,636	7,456
Halton Region	1,650	782	2,514	441	63	788	3,467	9,704
City of Hamilton	1,700	759	2,460	415	60	798	3,279	9,470
Niagara Region	1,488	693	2,232	387	56	707	3,046	8,608
Totals	19,784	8,740	28,373	4,755	693	9,260	37,602	109,207
% of Total Plastics	18%	8%	26%	4%	1%	8%	34%	

D. TOTAL W/O DURHAM

	Generation (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	8,408	3,534	11,558	1,872	277	3,882	14,864	44,394
York Region	2,292	1,029	3,333	564	82	1,078	4,458	12,835
Peel Region	2,955	1,344	4,344	742	107	1,394	5,853	16,739
Durham Region								
Halton Region	1,650	782	2,514	441	63	788	3,467	9,704
City of Hamilton	1,700	759	2,460	415	60	798	3,279	9,470
Niagara Region	1,488	693	2,232	387	56	707	3,046	8,608
Totals	18,493	8,140	26,440	4,420	645	8,647	34,966	101,751
% of Total Plastics	18%	8%	26%	4%	1%	8%	34%	

Table 2-1: Estimated Quantities of Plastics Generated

Single Family Recovery	Current Recovery	Projected
PET	67.0%	70.0%
HDPE	76.0%	80.0%
Film	6.0%	6.0%
Tubs & Lids	85.0%	85.0%
PVC	85.0%	90.0%
Polystyrene	23.0%	23.0%
Mixed Plastics	20.0%	40.0%

Multi Residential Recovery	Current Recovery	Projected
PET	25.0%	46.9%
HDPE	40.0%	53.6%
Film	3.0%	4.0%
Tubs & Lids	36.0%	57.0%
PVC	50.0%	60.3%
Polystyrene	11.0%	15.4%
Mixed Plastics	16.0%	26.8%

FULL RECOVERY

A. SINGLE FAMILY

	67.0%	76.0%	6.0%	85.0%	85.0%	23.0%	20.0%	
	Full Recovery @ Current Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	2,991	1,664	420	1,064	151	495	1,965	**8,751**
York Region	1,109	617	156	395	56	184	729	**3,246**
Peel Region	1,508	839	212	536	76	250	991	**4,412**
Durham Region	716	398	101	255	36	119	470	**2,095**
Halton Region	986	549	139	351	50	163	648	**2,885**
City of Hamilton	803	447	113	286	40	133	528	**2,350**
Niagara Region	831	462	117	296	42	138	546	**2,431**
Totals	**8,946**	**4,976**	**1,257**	**3,182**	**451**	**1,481**	**5,877**	**26,169**
% of Total Recovered Plastics	**34%**	**19%**	**5%**	**12%**	**2%**	**6%**	**22%**	

B. MULTI RESIDENTIAL

	25.0%	40.0%	3.0%	36.0%	50.0%	11.0%	16.0%	
	Full Recovery @ Current Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	986	538	137	223	50	190	806	**2,929**
York Region	159	87	22	36	8	31	130	**473**
Peel Region	176	96	24	40	9	34	144	**523**
Durham Region	56	30	8	13	3	11	45	**165**
Halton Region	44	24	6	10	2	9	36	**132**
City of Hamilton	125	68	17	28	6	24	102	**372**
Niagara Region	62	34	9	14	3	12	51	**184**
Totals	**1,608**	**877**	**223**	**364**	**81**	**310**	**1,315**	4,778
% of Total Recovered Plastics	**34%**	**18%**	**5%**	**8%**	**2%**	**6%**	**28%**	

C. TOTAL

	Full Recovery @ Current Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	3,977	2,202	557	1,287	200	685	2,771	**11,680**
York Region	1,269	704	178	431	64	214	859	**3,718**
Peel Region	1,684	935	236	576	85	284	1,135	**4,935**
Durham Region	772	429	108	267	39	129	516	**2,260**
Halton Region	1,031	573	145	361	52	172	684	**3,017**
City of Hamilton	929	515	130	314	47	157	630	**2,722**
Niagara Region	893	496	125	310	45	150	597	**2,615**
Totals	**10,554**	**5,853**	**1,480**	**3,546**	**532**	**1,791**	**7,192**	**30,948**
% of Total Recovered Plastics	**37%**	**20%**	**5%**	**12%**	**2%**	**6%**	**25%**	

D. TOTAL W/O DURHAM

	Full Recovery @ Current Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	3,977	2,202	557	1,287	200	685	2,771	**11,680**
York Region	1,269	704	178	431	64	214	859	**3,718**
Peel Region	1,684	935	236	576	85	284	1,135	**4,935**
Durham Region								
Halton Region	1,031	573	145	361	52	172	684	**3,017**
City of Hamilton	929	515	130	314	47	157	630	**2,722**
Niagara Region	893	496	125	310	45	150	597	**2,615**
Totals	**9,782**	**5,424**	**1,371**	**3,279**	**493**	**1,662**	**6,676**	28,688
% of Total Recovered Plastics	**34%**	**19%**	**5%**	**11%**	**2%**	**6%**	**23%**	
% Recovery	53%	67%	5%	74%	76%	19%	19%	28%

Table 2-2: Estimated Quantities of Plastics – Full Recovery Scenario

GENIVAR Entec

Single Family Recovery	Current Recovery	Projected
PET	67.0%	70.0%
HDPE	76.0%	80.0%
Film	6.0%	6.0%
Tubs & Lids	85.0%	85.0%
PVC	85.0%	90.0%
Polystyrene	23.0%	23.0%
Mixed Plastic	20.0%	40.0%

Multi Residential Recovery	Current Recovery	Projected
PET	25.0%	46.9%
HDPE	40.0%	53.6%
Film	3.0%	4.0%
Tubs & Lids	36.0%	57.0%
PVC	50.0%	60.3%
Polystyrene	11.0%	15.4%
Mixed Plastic	16.0%	26.8%

PROJECTED MAX RECOVERY

A. SINGLE FAMILY 70.0% 80.0% 6.0% 85.0% 90.0% 23.0% 40.0%

	Full Recovery @ Maximum Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	3,125	1,752	420	1,064	160	495	3,931	**10,947**
York Region	1,159	650	156	395	59	184	1,458	**4,060**
Peel Region	1,576	883	212	536	80	250	1,982	**5,519**
Durham Region	748	419	101	255	38	119	941	**2,620**
Halton Region	1,030	577	139	351	53	163	1,296	**3,609**
City of Hamilton	839	470	113	286	43	133	1,055	**2,939**
Niagara Region	868	487	117	296	44	138	1,092	**3,041**
Totals	**9,346**	**5,238**	**1,257**	**3,182**	**477**	**1,481**	**11,754**	**32,735**
% of Total Recovered Plastics	12%	6%	2%	4%		2%	15%	

B. MULTI RESIDENTIAL 46.9% 53.6% 4.0% 57.0% 60.3% 15.4% 26.8%

	Full Recovery @ Maximum Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	1,849	721	183	353	60	266	1,350	**4,782**
York Region	298	116	30	57	10	43	218	**772**
Peel Region	330	129	33	63	11	48	241	**854**
Durham Region	104	41	10	20	3	15	76	**270**
Halton Region	83	32	8	16	3	12	61	**216**
City of Hamilton	235	92	23	45	8	34	172	**608**
Niagara Region	116	45	11	22	4	17	85	**300**
Totals	**3,017**	**1,176**	**299**	**576**	**98**	**434**	**2,202**	7,801
% of Total Recovered Plastics	11%	4%	1%	2%	0%	2%	8%	

C. TOTAL

	Full Recovery @ Maximum Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	4,975	2,472	603	1,417	220	762	5,281	**15,729**
York Region	1,458	766	185	452	69	227	1,676	**4,832**
Peel Region	1,906	1,012	245	599	91	297	2,223	**6,373**
Durham Region	852	460	111	275	42	134	1,017	**2,890**
Halton Region	1,114	610	147	367	55	175	1,357	**3,824**
City of Hamilton	1,074	562	136	331	50	167	1,227	**3,547**
Niagara Region	984	532	128	318	48	154	1,177	**3,342**
Totals	**12,363**	**6,413**	**1,555**	**3,758**	**575**	**1,916**	**13,956**	**40,537**
% of Total Recovered Plastics	30%	16%	4%	9%	1%	5%	34%	

D. TOTAL W/O DURHAM

	Full Recovery @ Maximum Rates (tonnes/yr)							
Municipality	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	4,975	2,472	603	1,417	220	762	5,281	**15,729**
York Region	1,458	766	185	452	69	227	1,676	**4,832**
Peel Region	1,906	1,012	245	599	91	297	2,223	**6,373**
Durham Region								
Halton Region	1,114	610	147	367	55	175	1,357	**3,824**
City of Hamilton	1,074	562	136	331	50	167	1,227	**3,547**
Niagara Region	984	532	128	318	48	154	1,177	**3,342**
Totals	**11,511**	**5,953**	**1,444**	**3,483**	**534**	**1,782**	**12,939**	**37,647**
% of Total Recovered Plastics	31%	16%	4%	9%	1%	5%	34%	
% Recovery	62%	73%	5%	79%	83%	21%	37%	37%

Table 2-3: Estimated Quantities of Plastics – Maximum Recovery Scenario

Table 2-3: Continued

E. TOTAL PRF QUANTITIES

Municipality	Full Recovery @ Maximum Rates (tonnes/yr)							
	PET	HDPE	Film	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	Totals
City of Toronto	4,975	2,472		1,417	220	76	5,281	**14,440**
York Region	1,458	766		452	69	23	1,676	**4,442**
Peel Region	1,906	1,012		599	91	30	2,223	**5,860**
Durham Region								
Halton Region	1,114	610		367	55	18	1,357	**3,520**
City of Hamilton	1,074	562		331	50	17	1,227	**3,261**
Niagara Region	984	532		318	48	15	1,177	**3,075**
Totals	**11,511**	**5,953**	**0**	**3,483**	**534**	**178**	**12,939**	**34,598**
% of Total Recovered Plastics	**33%**	**17%**	**0%**	**10%**	**2%**	**1%**	**37%**	

3. Current Tonnage and Cost to Process

This spreadsheet outlines the cost to manage the quantities of plastics reported by each municipality (Tables 3-1 and 3-2). Wherever possible, 2005 information was used.

Table 3-1: Estimated Current Quantity of Plastics Being Managed (2005)

Municipality	Quantities of Plastics (tonnes)						Totals
	PET	HDPE	Film	Tubs & Lids	Polystyrene	Mixed Plastics	
City of Toronto	3,632	1,573	591	1,584	540	1,468	**9,388**
York Region	1,690	893	0	0	0	75	**2,658**
Peel Region	2,060	1,551	923	11	37	425	**5,007**
Durham Region	1,508	629	32	236	56	485	**2,948**
Halton Region	730	387	0	108	0	0	**1,225**
City of Hamilton	1,180	613	0	112	0	0	**1,905**
Niagara Region	646	444	535	255	74	359	**2,313**
Totals	**11,446**	**6,091**	**2,081**	**2,306**	**707**	**2,812**	**25,443**
	45%	**24%**	**8%**	**9%**	**3%**	**11%**	

(From www.wdo.ca)

from 2005 Stewardship ON waste audit

from York 2005 Marketed Tonnes

Municipality	Management Costs						Totals
	PET	HDPE	Film	Tubs & Lids	Polystyrene	Mixed Plastics	
Net Cost Per Tonne (1)	*$ 777*	*$ 679*	*$ 1,447*	*$ 927*	*$ 1,709*	*$ 927*	***$ 865***
City of Toronto	$ 2,823,223	$ 1,068,685	$ 854,470	$ 1,468,187	$ 923,019	$ 1,360,987	**$ 8,498,571**
York Region	$ 1,313,908	$ 606,658	$ -	$ -	$ -	$ 69,086	**$ 1,989,652**
Peel Region	$ 1,601,465	$ 1,053,563	$ 1,335,461	$ 10,195	$ 63,232	$ 393,903	**$ 4,457,819**
Durham Region	$ 1,172,702	$ 427,531	$ 46,404	$ 218,770	$ 96,111	$ 449,870	**$ 2,411,387**
Halton Region	$ 567,509	$ 262,881	$ -	$ 100,098	$ -	$ -	**$ 930,488**
City of Hamilton	$ 917,344	$ 416,399	$ -	$ 103,805	$ -	$ -	**$ 1,437,547**
Niagara Region	$ 502,207	$ 301,600	$ 774,075	$ 236,342	$ 126,464	$ 332,732	**$ 2,273,420**
Totals	**$ 8,898,358**	**$ 4,137,317**	**$ 3,010,411**	**$ 2,137,397**	**$ 1,208,825**	**$ 2,606,578**	**$ 21,998,885**

(Based on cost per tonne data from Stewardship Ontario)

Table 3-2: Estimated Cost to Manage the Plastics (as shown in Table 3-1)

In 2005, more than 25,400 tonnes of plastics were recovered through the recycling programs in the study. Of this, almost 70% was PET and HDPE (Table 3-1).

Overall, the cost to manage plastics across the municipalities in the study totalled almost $22,000,000 in 2005 or approximately $865 per tonne. This cost, however, includes both polystyrene and plastic film, both of which would not be sorted at a PRF. Removing these materials from the scenario, the total cost of management was approximately $17,800,000 or $785 per tonne.

4. MRF Visits and Retrofitting Current MRFs for PET and HDPE

Each of the municipalities' MRFs was visited to collect information on their current plastic management practices and to do some preliminary investigation on the requirements for retrofitting their facilities to install optical sorting equipment for PET and HDPE. Outlined below is a brief overview of each facility.

4.1 Toronto – Scarborough

The City of Toronto collects all recyclables in a single stream. Their Scarborough facility[3] uses a typical set-up for the separation of fibres from containers with all materials first passing over an OCC screen to remove the OCC. Following that, the remaining materials pass over double deck CP screens, which separate the fibres from the containers. The containers are conveyed to the container sorting area where oversized materials (HDPE pails) and fibres are removed manually. The materials pass through a venturi system to remove small bits of paper and to separate the light materials from the glass.

The light containers are separated into large containers and small containers, which are then conveyed down two lines. Sorters manually remove each of the different plastics streams (PET, HDPE, tubs and lids), gabletops and aseptics. A ferrous magnet removes the steel cans and an eddy current separator removes the aluminum cans.

4.2 Toronto – Dufferin

The Dufferin MRF uses a typical set-up for the separation of fibres from containers with all materials first passing over an OCC screen to remove the OCC. Following that, the remaining materials pass over double deck ONP screens, which separates the ONP from the mixed fine paper and containers. The unders (materials that drop through the screen) from the ONP screens then pass over finishing screens, which remove the mixed fine paper from the containers. The containers are then conveyed to the sorting area where sorters manually remove each of the different plastics streams (PET, HDPE, tubs and lids), gabletops and aseptics.

The glass, caps and lids that pass through the finishing screen then proceed through a trommel screen which sucks bits of paper off the stream and helps recover steel lids and crushed aluminum cans that fell through the finishing screen (2½" x ¾"). The fines falling through the trommel screen then pass through a venturi system, which further cleans the mixed broken glass. A ferrous magnet removes the steel cans and an eddy current separator removes the aluminum cans.[4]

4.3 Peel Region

Single stream recyclables from the tip floor are fed on two infeed lines through a presort cabin (film, polystyrene, residue removal) and then over OCC screens. Smaller fibres and containers (unders from the OCC screen) travel on to a "V" screen where paper is further separated from the containers. The containers pass through a Trom-mag where fines and ferrous cans are

[3] Operated under contract to the City by Metro Waste Paper
[4] Toronto is in the process of installing optical sorters for PET and HDPE at their Dufferin Facility.

removed. An air classifier then performs a light/heavy split and glass is removed from the remaining containers.

Manual positive sorting is then done for all plastics (PET, HDPE, Tubs and lids (mixed plastics)), gabletops and aseptics.

The last step is a double eddy current separation of aluminum cans. All container materials (except glass) are fed to silos for storage until baling.

A study sponsored by the E&E Fund (PN 85) evaluated two alternative optical sorting systems to sort plastics at the Region of Peel's new MRF. Both options were compared against the status quo manual sorting system currently operated by Waste Management of Canada Corporation (WMCC operates the Peel MRF under contract with the Region). This report can be found at <http://www.stewardshipontario.ca/pdf/eefund/reports/85/85_optical_sorting_report.pdf>

4.4 Durham Region

Durham Region collects all containers separately from fibres. All containers currently go to a MRF in Pickering where they are sorted manually into each of the plastic materials (PET, HDPE, tubs and lids), gabletops and aseptics. A ferrous magnet removes the steel cans and an eddy current separator removes the aluminum cans.

Durham is in the middle of an RFP process to establish a new MRF. The new MRF will have optical sorting for PET and HDPE at a minimum. The Region is proposing to continue with a two-stream collection system.

4.5 York Region

York collects their recyclables in a single stream. Materials are fed up two infeed lines. The pre-sort stations remove non-recyclables and bagged materials (or debag the materials if there is sufficient time). The materials then pass over OCC screens to remove the OCC. The unders from the OCC screen pass over ONP screens which take a #8ONP off the top two decks. The fine mixed paper and containers pass through the ONP screen and to the finishing screens. The fine mixed paper passes over the top of the screens, the mixed broken glass, caps, lids, etc., pass through the screen (2½" x ¾") and the containers drop off to the side of the screen. All containers are then conveyed to the single containers sorting line (Figure 4-1). Manual positive sorting is then done for all plastics (PET, HDPE, Tubs and lids (mixed plastics)), gabletops and aseptics, clear and coloured glass. A ferrous magnet removes the steel cans and an eddy current separator removes the aluminum cans.

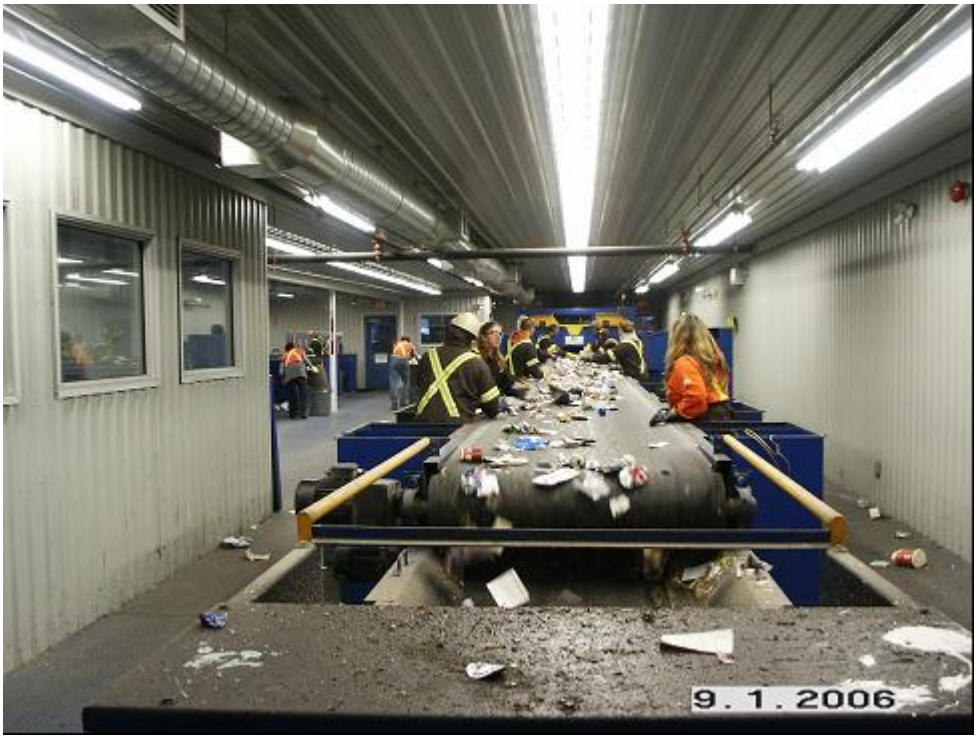
4.6 Halton Region

Halton Region collects their materials in two streams, fibres and containers. The containers travel up a line and through an air classifier where the light materials are separated from the heavy materials. All plastics, including PET, HDPE and tubs and lids, are manually sorted from the line. A ferrous magnet removes the steel cans and an eddy current separator removes the aluminum cans.

The clear glass is manually, positively sorted from the line with mixed broken and coloured glass falling off the end of the line.

Halton's MRF is owned and operated by a private sector operator. As such, it is not included in the analysis of the cost for retrofitting to include optical sorting.

Figure 4-1: York Region MRF Containers Line



4.7 City of Hamilton

The City of Hamilton collects their materials in two streams, fibres and containers. The containers line does not use air classification. All containers travel down the single line. The plastics (PET, HDPE, Tubs and lids) are manually sorted from the line (Figure 4-2). Glass is manually sorted into clear and coloured. A ferrous magnet removes the steel cans and an eddy current separator removes the aluminum cans.

4.8 Region of Niagara

Niagara Region collects all of their materials in two streams. All containers travel up the infeed to the pre-sort area where the plastic film and polystyrene are manually removed. The containers pass first pass under a ferrous magnet, which removes the steel cans. The materials then pass over a glass screen, which removes the mixed broken glass. The remaining materials pass through an air classifier and venturi system, which removes fine bits of paper and separates the glass bottles from the light fraction.

The light containers are separated manually to remove each of the different plastics streams (PET, HDPE, tubs and lids), gabletops and aseptics (Figure 4-3). An eddy current separator removes the aluminum cans.

Figure 4-2: City of Hamilton MRF Containers Line

Figure 4-3: Niagara Region MRF Containers Line

4.9 Retrofitting the MRFs

Overall, it is estimated that the cost to retrofit the six facilities would be approximately $4.85 million. This capital expenditure would cover the cost of installing optical sorting technology for both PET and HDPE in each facility. One dual eject machine would be required per facility. The differences in the capital cost requirements are primarily a result of the varying degrees of retrofitting required to install the machines. For example, in the York Region facility, because of the low roof of the sorting room, additional work would be required to raise the roof of the room to make room for the optical sorting machine. The annualised capital costs are approximately $750,000.

Municipality	Total Capital	Annual Capital	Annual Operating (3)	Total Annual C&O Cost	Est. Savings Over Current
City of Toronto (1)	$ 600,000	$ 122,000	$ 213,000	$ 335,000	$ 28,900
City of Toronto (2)	$ 1,000,000	$ 139,000	$ 219,000	$ 358,000	$ 210,000
York Region	$ 1,000,000	$ 139,000	tbn	$ 139,000	tbn
Peel Region	$ 1,400,000	$ 195,000	$ 423,000	$ 618,000	$ 139,000
Durham Region	n/a	n/a	n/a	n/a	n/a
Halton Region	n/a	n/a	n/a	n/a	n/a
City of Hamilton	$ 450,000	$ 81,000	$ 174,400	$ 255,400	$ 41,900
Niagara Region	$ 400,000	$ 72,000	$ 273,900	$ 345,900	$ 48,500
Totals	**$ 4,850,000**	**$ 748,000**	**$ 1,303,300**	**$ 2,051,300**	**$ 468,300**

(Savings assumes no financial support from Stewardship Ontario for capital)
(1) Scarborough facility
(2) Dufferin Facility
(3) Cost for PET, HDPE, other plastics and residues only
tbn - to be negotiated with contractor

Table 4-1: Estimated Costs for the MRF Retrofits for Optical Sorting for PET and HDPE

The annual operating costs were derived from an estimation of the maintenance costs and the added electricity associated with operating the optical sorting units, the additional conveyors (accelerator conveyors into the units and reclaim conveyors from the optical sorting units) and the required compressors. The annual operating costs also include the quality control sorters (two per MRF) that would be required post the optical sorting units. Overall, the operating costs total approximately $1.3 million.[5] Capital and operating costs combined would be about $1.9 million across the five facilities for which capital and operating costs could be determined (York's facility is not included in this figure). The resulting annual savings from the installation of the optical sorting systems is almost $470,000 (not including potential savings in York Region).

4.9.1 Additional Considerations in the Retrofits

Discussions with equipment suppliers regarding optical sorting systems revealed there are significant limitations in their ability to sort specifically HDPE. The machines in the marketplace currently cannot effectively differentiate between HDPE and LDPE. Therefore, the optical sorting system installed in these facilities would not differentiate between HDPE bottles,

[5] York Region, operating under an operating contract that would require renegotiation to arrive at a cost for the operation of an optical sorting machine, with the requisite staff.

HDPE tubs and all LDPE tubs and lids. This unintended result from the optical sorter may ultimately mean that there is no true benefit in optically sorting HDPE where tubs and lids are part of the program. Typically large facilities require only one to two people to sort tubs and lids and another one to two to sort HDPE. To have a machine optically sorting HDPE, which will by default include LDPE, will likely require not one, but two people to either:

a) sort the HDPE bottles from the stream of HDPE bottles, tubs and LDPE tubs and lids; or

b) sort the tubs and lids from the HDPE bottles.

This operational reality alters the economics of optically sorting HDPE. Most MRFs where optical sorting is currently being used do not have tubs and lids as a part of their product composition. As such, before assuming that the savings shown above will actually be realized, it will be important to evaluate the operations of the optical sorting unit in the context of the stream of materials typically managed in Ontario, including LDPE tubs and lids. It should be noted that the manufacturers are working on this issue, including potentially using shape recognition to differentiate LDPE from HDPE, thereby improving the sorting capabilities of the optical sorting unit for HDPE.

5. Market Discussions

As part of the study, discussions were held with specific end markets concerning the following points:

- Status of current PRFs in North America;
- Market specifications for materials derived from PRFs;
- Minimum tonnage requirements for a multi-stream PRF; and
- Managing plastic film.

The results of the investigations are provided in this section with the detailed notes from the discussions included in Appendix A.

5.1 Status of Current PRFs

There are two PRFs operating in North America, one in Raleigh, North Carolina and the other in Chicago, Illinois. Both are operated by Waste Management Inc. Very little information was forthcoming about the two facilities. Repeated attempts were made by a number of people on the study team to make site visits to the facilities to enable a better understanding of what is involved in a PRF operation and what would be required to establish a PRF in the southern Ontario market. These attempts were unsuccessful, and as a result, no one from the project steering committee was able to visit the facility. Therefore, the information obtained is based on third-party information from people who have seen the facility.

The two facilities each process approximately 45,000 tonnes per year, operating three shifts per day, five days per week. The important distinction with the two WMI PRFs is that they only process mixed bottles; no tubs and lids, polystyrene or plastic film are processed at the facility. Therefore, the operations are much less sophisticated than would be required for a facility in southern Ontario, which, at a minimum, would have to be able to process tubs and lids to be beneficial to the programs it serves.

Typically, optical sorting equipment is used in the facilities, with sorting staff ensuring back up and quality control. It was not possible to acquire information on staffing levels. One important note respecting yield losses - one person suggested that 25-30% yield losses are possible in a PRF. Two other sources suggested that 10-15% is a more reasonable value (this is the range used in the analysis in Chapter 5).

The biggest issue in the plants is getting the material separated from the bales and spread out in a single layer so that the materials can be scanned by the optical system and then accurately sorted. It was outlined that it is preferable if the plastics are baled very loosely rather than tightly, which is typical of shipments to end markets. If the materials are baled too tightly then the debaling/ declumper does not work effectively and the bottles will stay nested, crumpled together, etc., which will lead to increased product loss.

This requirement for loose bales effectively increases transportation costs to the PRF from the MRFs. This has been accounted for in the transfer costs used in Chapter 5.

5.2 Market Specifications for Materials Derived from PRFs

The market specifications for materials from PRFs are identical to that from MRFs. The most important takeaway from the conversations with the end markets is that they do not recommend doing any additional post-sorting processing (i.e., washing, pelletizing or flaking). The end markets indicated that they generally do not "trust" suppliers and, in fact, would end up re-washing and sorting all of the flaked material from a PRF. Therefore, they strongly recommended that no additional post-processing of the materials be done at the PRF as it would provide no added value.

5.3 Minimum Tonnage Requirements for a Multi-stream PRF

There was a broad range of "answers" provided to this question, however the minimum quantity was thought to be in the range of 35,000 tonnes per year. This is the quantity of material that could be reasonably processed on a single line operating three shifts per day, five days per week. Most reprocessors indicated that 50,000 tonnes was now the minimum threshold to achieve the necessary economies for a viable business. As shown in Table 2-1 (Chapter 2), it is suggested that even with maximized recovery rates for all plastics, only approximately 32,500 tonnes of plastics would be recovered annually. Therefore, the end markets initially suggested that only under full recovery would a regional PRF be justified.

5.4 Managing Plastic Film

The consistent message delivered by equipment suppliers with respect to the management of plastic film was to remove it as early as possible in the process. In single stream recycling systems in particular, plastic film must be removed in the pre-sort to avoid it being caught up in the flats-rounds (fibres-containers) separator screens at the front end of these facilities. If the material is not removed early, it will wrap around the discs, quickly limiting the ability of the screens to effectively sort the fibres from the containers. It will also result in increased maintenance costs, as time must be taken to cut the plastic film off from around the screens shafts.

Plastic film that gets through the screens to the sorting lines covers up other materials on the sorting belts making it much more difficult to achieve maximum sorting rates.

As a result of removing plastic film in the pre-sort to maintain the effectiveness and efficiency of the entire MRF, there would ultimately be no plastic film to manage in the PRF.

In speaking with the end markets about having plastic film in the PRF (i.e., as one material in the mixed plastics stream), they indicated that, as with the MRFs, it would have to be removed in the pre-sort area. Because of its low density and large surface area, it does not travel well on accelerator conveyors, i.e., it tends to lift off the belt, leading into the optical sorting machines. Therefore, it cannot be effectively sorted from the lines.

6. PRF Throughput, Costs & Revenues

Table 6-1 outlines the quantities of each plastic resin that could arrive at the PRF using the maximum recovery assumptions outlined in Table 2-3.[6] Note that there is no plastic film and only 10% of the quantity of polystyrene assumed to be recovered will be managed at the new PRF. This is assumed because both plastic film and polystyrene[7] would be removed prior to reaching the containers line

Table 6-1: Estimated Quantities to be Managed in the PRF

Municipality	Quantities of Plastics (tonnes)						Totals
	PET	HDPE	Tubs & Lids	PVC	PS	Mixed Plastics	
City of Toronto	4,975	2,472	603	220	76	5,281	**13,627**
York Region	1,458	766	185	69	23	1,676	**4,176**
Peel Region	1,906	1,012	245	91	30	2,223	**5,505**
Durham Region	852	460	111	42	13	1,017	**2,495**
Halton Region	1,114	610	147	55	18	1,357	**3,300**
City of Hamilton	1,074	562	136	50	17	1,227	**3,066**
Niagara Region	984	532	128	48	15	1,177	**2,885**
Totals	**12,363**	**6,413**	**1,555**	**575**	**192**	**13,956**	**35,055**
	35%	**18%**	**4%**	**2%**	**1%**	**40%**	

Table 6-2 shows the quantities of each material that, assuming 100% participation, could be marketed from the facility. Industry insiders suggest that lost materials could reach as high as 20-30% (see Chapter 5), however, in speaking with the equipment suppliers, they both felt that 10-15% lost plastic material would be more likely. Much of this is contingent on how tightly the materials are baled at the MRF. Generally, the bales should be loosely packed to provide the greatest opportunity for the debaler/declumper to effectively separate the plastics so that they can be optically sorted.

Municipality	Quantities of Plastics (tonnes)						Totals
	PET	HDPE	Tubs & Lids	PVC	PS	Mixed Plastics	
City of Toronto	4,726	2,348	483	176	61	4,224	**12,018**
York Region	1,385	728	148	55	18	1,341	**3,675**
Peel Region	1,811	961	196	73	24	1,778	**4,842**
Durham Region	810	437	89	33	11	814	**2,193**
Halton Region	1,058	579	117	44	14	1,085	**2,898**
City of Hamilton	1,021	534	109	40	13	982	**2,699**
Niagara Region	935	505	103	38	12	941	**2,535**
Totals	**11,745**	**6,092**	**1,244**	**460**	**153**	**11,165**	**30,860**
						Process Loss Tonnage	**4,194**
						Process Loss Percentage	**12.0%**

Process Loss		
	PET	*5.0%*
	HDPE	*5.0%*
	Other	*20%*

Table 6-2: Estimated Quantities Marketed from the PRF

[6] Durham Region is installing optical sorting for PET and HDPE in their new facility. Therefore, these materials would not be available to the new PRF.

[7] 10% of the PS is expected to end up at the PRF. This would be comprised primarily of PS tubs and lids not removed in the pre-sort areas.

Table 6-3 shows the projected revenue value of the individual streams of materials. For the purposes of this exercise, rather than use the current values as shown in the 2006 methodology used to calculate Stewards' fees, the 2004-2006 three year running average for each of the streams of materials was used[8]. This was done to reflect the greatly increased value of plastics during the past two years and the general trend in plastics revenues. It is important to note that there is the potential for over $1.34 million in lost revenue through the operation of the PRF. The losses in the system come from materials that cannot be effectively separated (i.e., too clumped) and captured for market.

Municipality	Revenues from Plastics						Totals
	PET	HDPE	Tubs & Lids	PVC	Polystyrene	Mixed Plastics	
Revenues/Te	*$ 450*	*$ 658*	*$ 90*	*$ 283*	*$ 75*	*$ 283*	
City of Toronto	$ 2,126,723	$ 1,545,301	$ 43,438	$ 49,728	$ 4,570	$ 1,195,852	**$ 4,965,612**
York Region	$ 623,149	$ 478,768	$ 13,349	$ 15,600	$ 1,360	$ 379,486	**$ 1,511,713**
Peel Region	$ 814,725	$ 632,374	$ 17,607	$ 20,649	$ 1,784	$ 503,339	**$ 1,990,478**
Durham Region	$ 364,402	$ 287,463	$ 7,986	$ 9,419	$ 802	$ 230,303	**$ 900,374**
Halton Region	$ 476,100	$ 381,233	$ 10,569	$ 12,530	$ 1,052	$ 307,229	**$ 1,188,712**
City of Hamilton	$ 459,261	$ 351,239	$ 9,800	$ 11,433	$ 1,001	$ 277,876	**$ 1,110,611**
Niagara Region	$ 420,859	$ 332,470	$ 9,234	$ 10,897	$ 926	$ 266,510	**$ 1,040,897**
Totals	**$ 5,285,220**	**$ 4,008,850**	**$ 111,982**	**$ 130,256**	**$ 11,495**	**$ 3,160,595**	**$ 12,708,397**
				Average Revenues Per Tonne Marketed			*$ 412*
Lost Revenues	*$ 278,169*	*$ 210,992*	*$ 27,995*	*$ 32,564*	*$ 2,874*	*$ 790,149*	*$ 1,342,743*

Table 6-3: Estimate of Revenues from the Sale of Plastics from the PRF

6.1 PRF Capital and Operating Costs

Table 6-4 outlines the elements of the PRF and the estimated capital and operating costs for the new facility.

6.1.1 Equipment and Process Flow

The system works as one line only. It would process approximately 9-10 tonnes per hour over two shifts. This throughput is the upper end of the system's capabilities.

Overall, the process flow works as follows:

- The materials arrive and go through a debaler/declumper to separate the plastics bottles, tubs and lids back into a singulated form. The debaler takes in entire bales and can effectively manage the steel ties around the bales. One operator is required for the inbound material management and debaling functions.
- The materials then pass through an air classification/cleanup system to remove plastic film and paper mixed in with the materials.
- They then pass over a size separator/fines screen to remove the small bits of glass, caps, etc. that would not be recovered in the system. The quantity of this material would be a function of the quality of the cleanup done at each of the MRFs feeding the PRF.

[8] Based on Stewardship Ontario data.

- The next step is to pass the material through the PET optical sorting machine. Only PET would be ejected. The feed belt to this machine is about 2.8 metres in width. It is estimated that up to 90% of the PET would be recovered at this point.

Table 6-4: Estimated PRF Capital and Operating Job

		Total Capital	Annual Capital
Major Equipment		$ 4,500,000	$ 630,000
Debaler/Declumper	Air Classifier		
Primary PET Optical Sorter	Fines Screens		
Primary HDPE Optical Sorter	Fibres Optical Sorter		
Secondary PET Optical Sorter	Ferrous Magnet		
Secondary HDPE Optical Sorter	Eddy Current Separator		
PP Optical Sorter	Baler		
LDPE Optical Sorter (?)	Compressors for Optical Sorters		
PS Optical Sorter	Conveyors		
PVC Optical Sorter	Bunkers, Platforms		
TetraPak/Aseptic Optical Sorter			
Building		$5,000,000	$ 450,000
50,000 sq. ft.			
Assumed Tonnage Throughput (All Municipalities)			35,055
Assumed Tonnage Marketed (All Municipalities)			30,860
Other		$2,500,000	$ 350,000
Weighscales	Electrical Controls		
Site Works	Installation		
Design	Contingency		
Total		**$ 12,000,000**	**$ 1,495,915**
Capital Cost Per Tonne			**$ 43**
Operating			
Debaling/Declumping (0.7 cents/pound)			$ 540,000
Operating and Maintenance ($65 per tonne)			$ 2,279,000
Labour (Per shift - 2 shifts per day, 7-8 tph)			
Tip floor/Debaling - 1 @ $30000			$ 60,000
QC - 5 @ $25000			$ 250,000
Baling/Shipping - 1 @ $30000			$ 60,000
Maintenance/Millwright - 2 @ $75000 (days); 1 @$75000 (nights)			$ 225,000
Supervisor - 1 @ $60000			$ 120,000
Other - 1 @ $25000			$ 50,000
Baling ($15 per tonne)			$ 463,000
Residues ($60/te)			$ 252,000
Total			$ 4,299,000
Operating Cost Per Tonne			**$ 123**
Total Capital and Operating			**$ 166**
Revenues Per Tonne Average (pro-rated back to tonnes processed)			**$ 363**
Net			**$ 197**

- After being sorted, the PET bottles pass through a PVC optical sorting system to ensure product quality. Considering the quantity of PET on the belt, the PVC system would require a 1.4m belt width feed
- The remaining materials then pass through the HDPE optical sorting machine where only HDPE would be ejected. At this point, the belt width is reduced to 1.4 metres. It is estimated that up to 90% of the HDPE would be recovered at this point.
- The remaining materials then pass through an optical sorting system for polypropylene. The belt width for this system is 1.0 metre.
- Next, the materials pass through an optical sorting system for polystyrene and aseptics/gable tops. A dual eject machine may be used for this operation as the quantities remaining on the belt are sufficiently small for the machines to accurately see and eject each of the two streams. The belt is 0.7 metres in width.

Optional Components

- LDPE may be optically sorted. One manufacturer indicated that it is difficult for the machines to recognize polyethylene, while another suggested that it could be possible. Both suggested that it may be possible to separate the stream through shape recognition, but this would depend on the quality of the materials coming out of the debaling process.
- At some point the materials could either pass through an optical sorter for aluminum, or would pass over an eddy current separator. They would also pass over a head pulley magnet to capture the steel lids and cans still in the mix.
- If there are still a significant number of PET and HPDE bottles on the belts, the remaining materials would pass through a secondary dual eject PET, HDPE optical separator. This would be a unit with a 0.7 metre belt width feed system.
- There could be one additional optical sorter (or one person) put on at the end of the system, which would eject all remaining plastics. These containers could either be redirected back to the infeed for a second run through the system or could be directed to a bunker for baling as mixed plastics.

6.1.2 Labour

The system will require five QC sorters:

- One for PET;
- Two for HDPE (because the HDPE tubs and all LDPE will be in the mix and have to be removed);
- One for PP; and
- One for PS/Aseptics (or for capturing remaining plastics – this is the assumption for pricing).

Because of the highly mechanical nature of the system, it is recommended that there be two millwrights on staff during the day and one in the evening.

Additional staff would include a baler operator, operations supervisor and a general worker (cleanup, etc.).

System Cost

It is estimated that the equipment would cost approximately $4,500,000, including all structural steel, platforms, conveyors, etc.

To house all of the equipment, a 15,240 m^2 building would be constructed. This would have an estimated cost of $5,000,000.

In addition to the above, $2,500,000 has been allotted for weighscales, site works, electrical controls, installation and design and contingency.

In total the facility would have a capital cost of approximately $12,000,000.

These costs were confirmed with both equipment suppliers contacted.

Annualizing the capital costs with the equipment over ten years and the building over 20 years at 6.5% interest, the annualized cost is approximately $1.4 million. At 35,000 tonnes annually, the projected capital cost of the PRF is about $43 per tonne.

Operating costs are comprised of debaling/declumping, general operations and maintenance, labour, baling and residues management. Overall, it is estimated that the operating costs at full throughput would be approximately $123 per tonne.

In total, the combined capital and operating costs for the facility would be approximately $166 per tonne.

With revenues from the system projected at approximately $363 per tonne, the system operates with a net revenue capability of approximately $197 per tonne.

6.1.3 Future Cost Flow

The final step in the analysis is to compare the costs for a MRF only system (i.e., the current approach) to the costs for MRF + PRF system.

Table 6-5 shows the estimated future costs for the management of the plastics under the maximized recovery scenario. For the purposes of this exercise, it is assumed that the costs for the managing the individual streams of plastics today will not increase or decrease in the future, i.e., the gross costs per tonne under the current scenario are utilized in Table 6-5.

The net overall cost for a MRF only system that processes the approximately 35,000 tonnes of material is estimated at approximately $21.3 million, or just over $600 per tonne.

Table 6-6 carries forward the capital and operating costs for the PRF at $166 per tonne. The average revenues of $401 per marketed tonne are also carried forward. Added to these costs and revenues are the costs for processing the plastics at each of the MRFs and transferring them to the PRF.

Because MRFs typically have residues as the negative sort on the containers line, the containers lines would have to be reconfigured to direct the now negatively sorted plastics to a bunker for baling. Capital costs for the changes have been assumed at $50,000 for each MRF. Across a facility, for example the size of the Peel Region MRF or the City of Toronto MRF, which are processing approximately 5,000 tonnes of plastics per year, this translates into an annual cost of about $1 per tonne (assumes straight-line depreciation over 10 years).

Table 6-5: Cash Flow – Current Costs Against Maximized Tonnes

Cost to Process - Current (Inbound Tonnes)

		Costs	Tonnes		Cost Per Tonne
PET	$	12,610,349	12,363	$	1,020
HDPE	$	6,169,435	6,413	$	962
PVC	$	545,840	575	$	949
PS	$	338,899	192	$	1,769
Mixed Plastics	$	13,244,583	13,956	$	949
Tubs and Lids	$	1,475,983	1,555	$	949
Total	**$**	**34,385,090**	**35,055**	**$**	**981**

Revenues (Marketed Tonnes)

		Revenues	Tonnes		Revenues/Te
PET	$	5,173,952	11,498	$	450
HDPE	$	3,924,453	5,964	$	658
PVC	$	158,334	535	$	296
PS	$	13,362	178	$	75
Mixed Plastics	$	3,674,191	12,979	$	283
Tubs and Lids	$	130,179	1,446	$	90
Total	**$**	**13,074,472**	**32,601**	**$**	**401**

Net Cost (Inbound Tonnes)

		Net Cost	Tonnes		Net Cost/Te
PET	$	7,436,397	12,363	$	602
HDPE	$	2,244,982	6,413	$	350
HDPE	$	387,506	575	$	674
PS	$	325,537	192	$	1,699
Mixed Plastics	$	9,570,392	13,956	$	686
Tubs and Lids	$	1,345,804	1,555	$	865
Total	**$**	**21,310,618**	**35,055**	**$**	**608**

Cost to Process - PRF

		Costs	Tonnes		Cost Per Tonne
Capital	$	1,507,349	35,055	$	43
Operating	$	4,311,720	35,055	$	123
Total	**$**	**5,819,069**	**35,055**	**$**	**166**

Revenues (Marketed Tonnes)

		Revenues	Tonnes		Revenues/Te
PET	$	5,285,220	11,745	$	450
HDPE	$	4,008,850	6,092	$	658
PVC	$	130,256	460	$	283
PS	$	11,495	153	$	75
Mixed Plastics	$	3,160,595	11,165	$	283
Tubs and Lids	$	111,982	1,244	$	90
Total	**$**	**12,708,397**	**30,860**	**$**	**412**

Net PRF Only Cost (Inbound Tonnes)

		Net Costs	Tonnes		Net Cost/Te
Costs	$	5,819,069	35,055	$	166
Revenues	$	12,708,397	35,055	$	363
Total	**$**	**6,889,328**	**35,055**	**$**	**197**

New Processing Costs for Materials at MRFs + Shipped to the PRF

Additional Capital and Operating	$	1
Labour Savings (two-thirds labour savings)	$	70
Original Average Gross Cost	$	981
Transfer to PRF	$	35
Net Processing/Shipping Costs at MRF	**$**	**947**

Net MRF + PRF Cost

		Net Costs	Tonnes		Net Cost/Te
Costs	$	39,012,302	35,055	$	1,113
Revenues	$	12,708,397	35,055	$	363
Total	**$**	**26,303,905**	**35,055**	**$**	**750**

Net Difference

MRF System	$	21,310,618	
MRF + PRF System	$	26,303,905	
Net Difference	**$**	**4,993,287**	***MRF + PRF More Expensive***

Table 6-6: Cost Flow – Current Costs Against Maximized Tonnes

It is estimated that as a result of no longer having to sort the plastics into the individual commodities, approximately two-thirds of the sorters for plastics could be eliminated per shift. In a MRF like Toronto or Peel, typically about 10 sorters are used for plastics sorting per shift. Assuming that seven of these sorters could be eliminated, with the remaining three now responsible for material cleanup – removal of fibres, residues and film, at $25,000 per year per sorter, a total of $350,000 of labour costs per year would be eliminated. Over 5,000 tonnes, the savings would equate to $70 per tonne.

Added to these costs and savings would be the cost for the transfer of plastics to the new PRF. For purposes of this report, the average across all municipalities is assumed to be $35 per tonne.

Combining the savings with the costs results in an estimated cost for the management of plastics of $947 per tonne; approximately $34 per tonne less than if the materials are sorted into their individual resins in the MRFs.

Adding this $947 per tonne to the $166 gross cost per tonne for the PRF operations results in a total gross cost per tonne of $1,113 for the MRF + PRF system. Subtracting the revenues of $12.7 million or $363 per tonne results in net costs of approximately $26.3 million or $750 per tonne.

This does not compare favourably to the current system costs of $21.3 million for the MRF only system. Overall, the cost for the MRF + PRF scenario shows an initial cost disparity of almost $5.0 million.

7. Conclusions and Future Considerations

Technology exists today that will identify and sort plastic automatically by resin type. This equipment has been used successfully at the reclaimer level for removing the contaminants from pre-sorted bales of a particular resin type and most recently at the MRF level by programs collecting PET and HDPE plastic bottles. It has not been used successfully to sort a mix of all plastic packaging for two reasons.[9]

1) With a greater mix of materials being sorted, more sorting errors will occur. These mis-sorts require additional manual sortation.
2) Most resins have subcategories that are not compatible with each other (injection molded and extruded material) and would require further manual sortation to produce products that would carry enough value to attempt to justify the investment.

Simply put, the technology does not eliminate sufficient labour cost to justify the investment, particularly in this case where there is no proposed upgrading of the material other than sorting, i.e. unsorted bales in, sorted bales out.

This study shows the economics of the proposed PRF not to be favourable. Furthermore, taking the following items into account makes the economics less feasible still:

1) Additional capital and operating costs for the PRF that would reflect at least two additional sorts for non-bottle PET and HDPE;
3) Reduction of revenues expected for PVC and mixed plastic categories from $296/tonne to $100 (current market values), and;
4) An increase in the capital improvements necessary to retrofit the MRFs.

Based on all of the above, this particular approach to a centralized PRF, while providing a mechanism to recover other plastic packaging for recycling, would neither positively impact the Blue Box system cost, nor be a viable long-term business opportunity.

7.1 Options for Future Consideration

Two options evolved and were discussed during preparation of this report. They are presented here for future consideration:

1. Optically sort PET and HDPE at individual MRFs and shred all other plastics for further resin sorting either at a central PRF or by interested plastic end markets.
2. Cooperatively market all plastics recovered at MRFs to extract greater value.

[9] These conclusions have been drawn from the peer review completed on behalf of Stewardship Ontario by Mike Schedler, NAPCOR and LOM Enterprises.

7.1.1 Optically Sort PET and HDPE and Shred All Other Plastics at MRFs

One of the concepts discussed during this study was to optically sort PET and HDPE bottles at local MRFs and then prepare all other mixed plastics for further treatment elsewhere. An initial size separation (to separate large/small plastics) combined with a dual eject optical sorter could be used to initially separate PET and HDPE bottles. Manual quality control sorting would be required on the ejected streams to isolate non-targeted materials (other recyclables, HDPE lids, etc.). Remaining items (after passing through an eddy current) would typically consist of mixed plastics and residue.

It is speculated that shredding this material and transferring it to a transfer trailer would:

1. be less costly than baling the plastics
2. avoid problems associated with material loss during the debaling and declumping stage at a PRF, and
3. provide the material in a form that an end market may find attractive.

There are several aspects of this option that require investigation to determine its merit, including the extent of retrofitting and associated costs involved in shredding at a MRF, whether there are end market users interested in the mixed plastics, and if so, the percentage of residue that they would be willing to accept in the mix and the price that they would pay for the material.

Evidence in the United States shows that this material has value to end markets, both for the plastic content and for the high BTU value of the other components of the mixture. If the residue portion of the mixture needs to be reduced at the MRF to meet end market requirements, one additional optical sort could be done at the MRF to isolate mixed plastics from other materials.

Stewardship Ontario should explore the interest of potential end markets to see if this option warrants further investigation.

7.1.2 Cooperatively Market All Plastics to Extract Greater Value

There are economies of scale in recycling apparent at many levels from processing through marketing. Therefore, there may be added revenue value from cooperatively marketing plastics from the eight major MRFs in southern Ontario. For end markets to succeed, they need a firm commitment of plastics resin tonnage. Also, the economics of plastics management suggests that much larger quantities of plastics (minimum of 25,000 tonnes) of a single stream of plastics is required to meet viable economic conditions for reclaim processing. Therefore, having a larger "single" market that could be achieved by cooperatively marketing materials from all of the MRFs may help garner more markets and overall stronger market values. As well, there could be additional savings from shared transportation costs.

As a means of increasing market revenues to municipalities and ultimately reducing the overall cost for plastics packaging to stewards, the logistics and potential positive impacts of cooperatively marketing plastics should be investigated.

Appendix A: End Markets Contacts made

- Merlin Plastics (Calgary, AB/ Delta,BC);
- Plastrec Inc. (Joliett, QC);
- Pure Tech (New York);
- Mohawk Industries (Summerville, GA);
- Wellman Inc. (Johnsonville, SC);
- NAPCOR (Sonoma, CA; Vermont
- Faith Group Plastics (Florence, SC);
- PETCORE (Holland);
- Eco Embes (Spain); and
- PCI Plastics (Darby, UK).