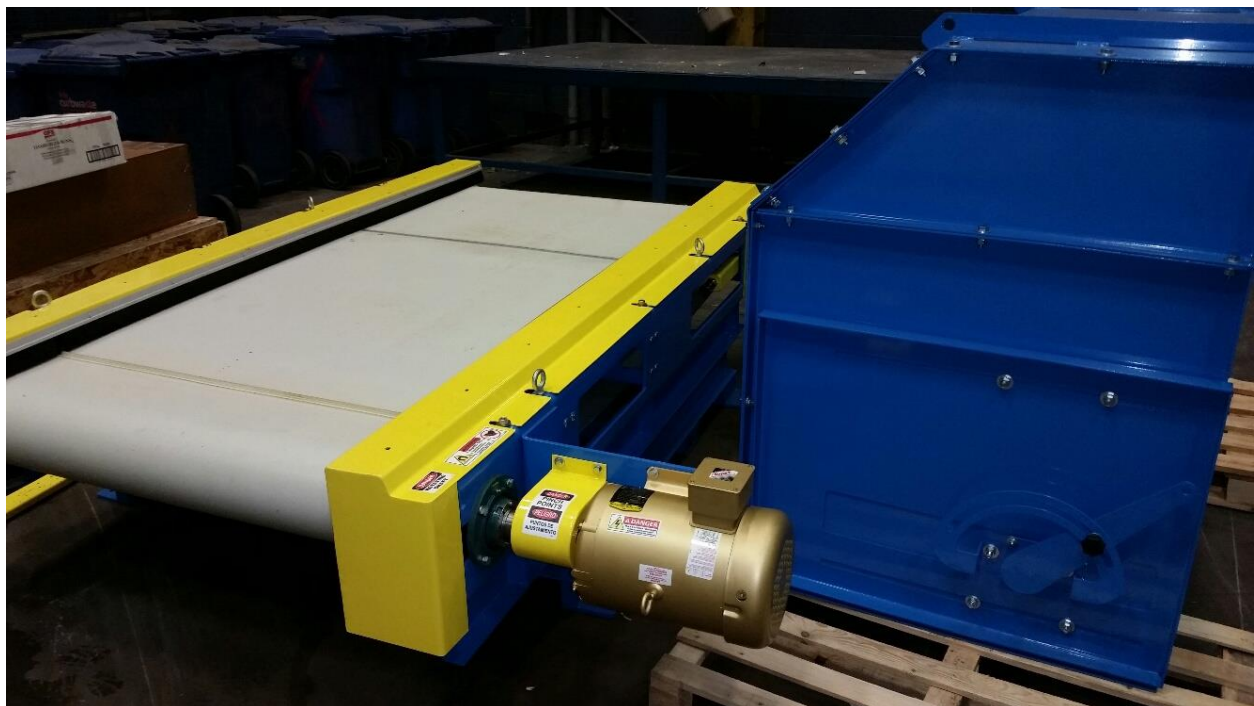


Eddy Current Separator System Niagara Region

CIF Project No. **821.3.3**

Final Report
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Prepared for:
Waste Diversion Ontario
Continuous Improvement Fund Office
132 Commerce Park Dr., Unit K, Suite 511
Barrie, Ontario L4N 0Z7



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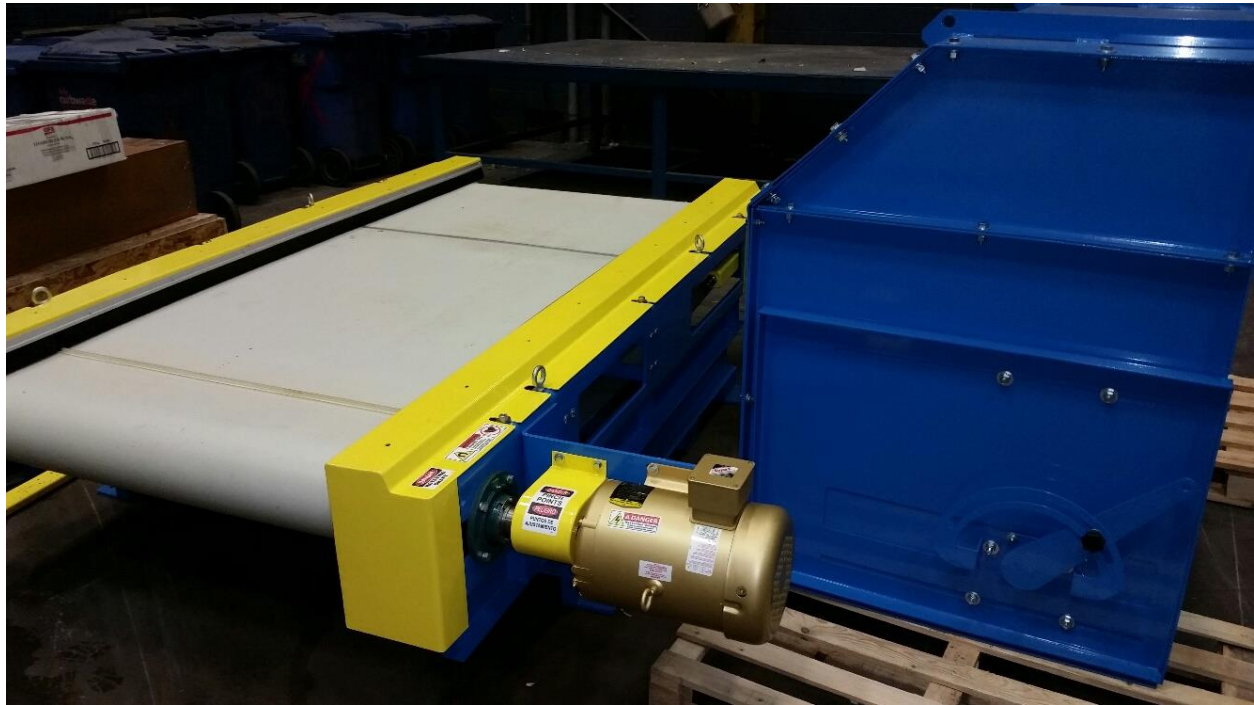
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1. INTRODUCTION

1.1 Introduction

Niagara Region installed a new Eddy Current Separator System (ECSS) at its Materials Recycling Facility (MRF). The ECSS was purchased through a competitive process from Javelin Manufacturing L.L.C. and installed by Ayr Welding. The ECSS was commissioned in December 2014.



1.2 Project Goals and Objectives

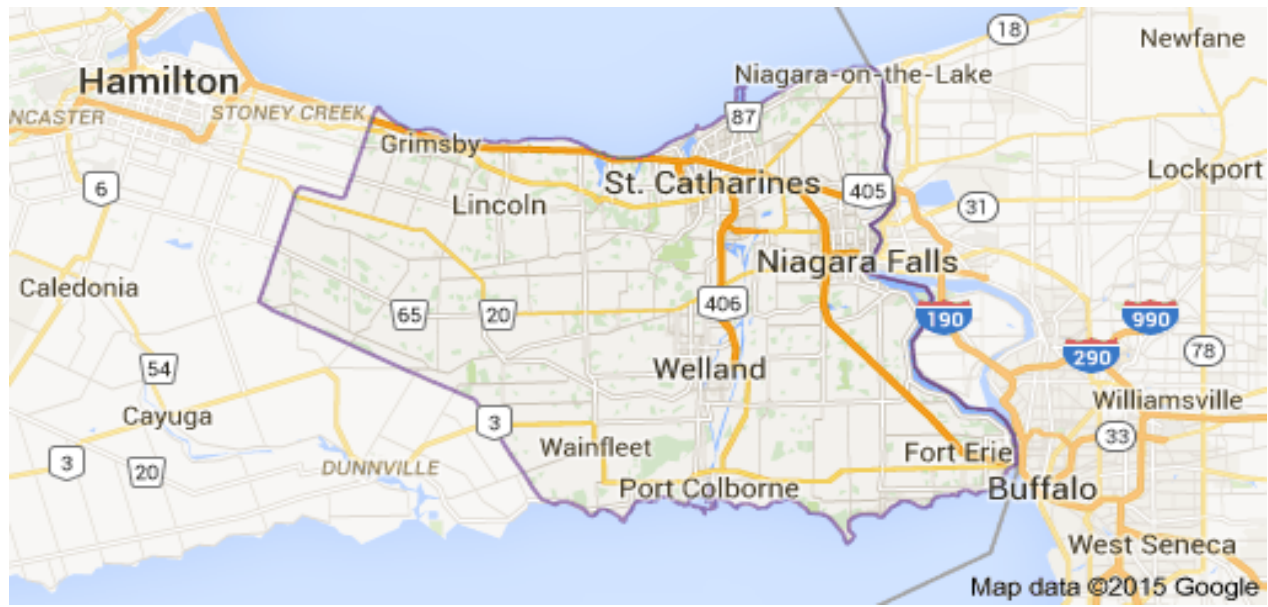
The ECSS was installed in the MRF to increase separation efficiencies and produce higher revenues from curbside-collected, Used Aluminum Beverage Container (herein referred to as UBC's) material produced by the MRF. Specifically, the ECSS will enable Niagara Region to increase the recovery and resale value of UBC's.

2. BACKGROUND

2.1 Community Profile

Known world-wide as both the home of Niagara Falls and as a wine producing region, the Regional Municipality of Niagara (herein referred to as Niagara Region) is comprised of 12 local municipalities: Fort Erie, Grimsby, Lincoln, Niagara-on-the-Lake, Niagara Falls, Pelham, Port Colborne, St. Catharines, Thorold, Wainfleet, Welland and West Lincoln.

Geographically, Niagara Region has a total area of 1,852 km² and is situated on the Niagara Peninsula, bordered on the north by Lake Ontario, on the south by Lake Erie, on the east by New York State and the Niagara River, and to the west by the City of Hamilton and the County of Haldimand. The population of Niagara Region, according to the 2014 Statistics Canada population estimate, is 446,192.



Niagara Region reported to Waste Diversion Ontario (WDO) in 2013 that Blue Box recycling included 170,201 single-family residences and apartments with two (2) to six (6) units, and 22,134 multi-residential units with seven (7) or more units. At that time, Niagara Region reported that 38,702 tonnes of residential Blue Box recyclables were marketed.

2.2 Waste Management System

Niagara Region provides all waste collection, processing and disposal services for the residential sector and eligible Industrial, Commercial and Institutional (IC&I) sector for its member municipalities, including:

- A weekly, two-stream recycling collection and processing program. Collection services are contracted out to Emterra Environmental Inc.; processing services are contracted out to Niagara Recycling;
- Weekly organics (Green Bin/Cart) diversion program;
- Weekly garbage collection with garbage limits;
- Bulky/white goods and leaf & yard waste collection;
- Two permanent Household Hazardous Waste Drop-off Depots located in Welland and Grimsby (A third depot opening in Spring 2016);
- Four landfill/drop-off depot locations, including a privately-owned site at Walker Industries, are available to serve the public as recycling centres, where typically the following residential materials are accepted:
 - Tipping fees apply to:
 - Household waste;
 - Scrap metal;
 - Construction and Demolition materials;
 - Appliances containing CFC's;
 - Shingles
 - Accepted, at no charge:
 - Leaf & Yard Waste;
 - Blue and Grey Box Recyclables;
 - Tires;
 - Electronics;
 - HHW materials

Niagara Region is also responsible for by-law enforcement, public education and promotion of the programs offered.

2.3 Current Waste Management Performance

Based on posted WDO Generally Accepted Principles (GAP) data, Niagara Region's 2013 diversion rate exceeded 50% of waste generated. Less than 25% of Niagara Region's 2013 residential waste stream was recycled through the Blue Box program. The performance information is summarized in Table 1.

Table 1: Niagara Region's Waste Management System Overview (2013 WDO GAP)

Total Residential Waste Generated		Total Residential Waste Diverted		Total Residential Waste Disposed		Residential Recyclables Diverted	Total Residential Diversion Rate	Total Residential Disposal Rate
Tonnes	Kg/Cap	Tonnes	Kg/Cap	Tonnes	Kg/Cap	%	%	%
196,228	437.13	101,589	226.31	94,639	210.82	24.57%	51.77%	48.23%

2.4 Program Challenges

In April 2013, Niagara Region applied for Continuous Improvement Fund (CIF) funding to purchase and install a new ECSS in its MRF. The main motivation for the installation was to increase separation efficiencies and produce higher revenues from curbside collected UBC material produced by the MRF. Specifically, the ECSS will enable Niagara Region to increase the recovery and resale value of UBC's.

At the time, Niagara Region was shipping out its processed UBC's to a secondary end market, at a substantially discounted price, due to contamination levels of approximately 8%. In 2014, the pricing spread between primary grade MRF UBC's and secondary grade MRF UBC's was approximately \$330 per metric tonne. In addition, the new ECSS was anticipated to improve the recovery of UBC's by approximately 10% over current levels. Between recovery and resale value, it was projected that the new ECSS would generate over \$185,000 per year in additional revenue.

The CIF funding request for the ECSS was \$138,500 and would have a payback period, based on the CIF grant amount, of 0.75 years or 9 months.

3. APPROACH

3.1 Set Up and Implementation

An RFP was issued for the manufacture and delivery of an ECSS. The vendor selected was Javelin Manufacturing L.L.C. Ayr Welding was selected for the installation of the ECSS. Table 2 below provides a summary of the budgeted and actual procurement and installation dates for the ECSS.

Table 2: Procurement and Installation Process of the Eddy Current Separator System

#	Item	Budgeted Date	Actual Date	Actual Date Comments
1	Procurement process begins	January 2014	January 2014	Contract issued Purchase of ECSS Installation of ECSS
2	Vendor selected	March 2014	March 18, 2014	
3	Purchase order issued	March 2014	June 12, 2014	
		June 2014	December 3, 2014	
4	Fabrication	March 2014	August 8, 2014	
5	Installation commences	June 2014	December 12, 2014	
6	Installation complete	June 2014	December 14, 2014	
7	Component testing	June 2014	December 14, 2014	
8	Dry run testing	June 2014	December 14, 2014	
9	Fully loaded testing	June 2014	December 18, 2014	
10	Commissioning complete	July 2014	April 2, 2015	Date of last audit
11	System accepted	July 2014	April 2, 2015	
12	System operational	July 2014	December 18, 2014	

3.2 Monitoring and Measurement Methodology

In order to effectively measure and monitor the performance of the ECSS, sales revenue reports and pre-installation audits from 2011-12 and 2014 of the material passing through the ECSS were used as baseline information. The post-installation performance of the ECSS was measured and reported against 2015 sales and audit data (Tables 3 and 4). The true measurement of the ECSS performance is whether prime UBC's can be produced and the degree of additional recovery of UBC's from the residual stream.

Niagara Region dedicated staff to developing and conducting composition studies. Over the years, Niagara Region has developed a comprehensive program designed to rigorously assess both feedstock and end products quality. In regards to MRF UBC's, Appendix B provides the auditing protocol, which was used to determine the post-installation performance of the ECSS.

3.2.1 MRF Residue Audits

Table 3 summarizes the MRF residue audit results, pre- and post-installation of the ECSS (detailed audit results in Appendix A).

Table 3: Niagara Region's Average lbs. per Audit Event of UBC's in Residue Stream

Auditing Period	Avg. lbs. of UBC's in Residue Stream	% of Total Residue Stream	Average MRF Residue Tonnes	Tonnes of UBC's in Residue
Pre-Installation of ECSS (based on October 2011 to September 2012 (baseline) and August to December 2014 residue audits)	13.2 lbs.	5.1%	1,435 MT (2012-14)	73 MT
Post Installation of ECSS (based on January to December 2015 audits)	9.5 lbs.	4.4%	1,376 MT (2015)	60 MT
Pre-Installation vs. Post-Installation of ECSS Change	3.7 lbs.	0.7%	59 MT	13 MT
% Change - Pre-Installation vs. Post-Installation of ECSS	28%		4%	18%

The amount of UBC's present in the pre-installation residue audits (October 2011 to September 2012 (baseline) and August to December 2014) averaged 13.2 lbs. or 5.1%. After implementation of the ECSS, the amount of UBC's present in the residue stream decreased to an average of 9.5 lbs. or 4.4%. As a result, Niagara Region increased its recovery of UBC's from its residue stream by approximately 3.7 lbs. or 28%.

Niagara Region shipped an annual average of 1,435 MT of residue to landfill in 2012-14. Based on the audit result of 5.1%, UBC's accounted for 73 MT of this total. In 2015, Niagara Region shipped 1,376 MT of residue to landfill. Based on the audit result of 4.4%, UBC's accounted for 60 MT of this total. As a result, the amount of UBC's recovered from the residue stream increased by 13 MT or 18%.

3.2.2 Recovery and Revenue

Table 4 provides the quarterly tonnage and revenue performance, pre-installation (2014) and post-installation (2015) of the ECSS at Niagara Region's MRF. As revenue comparisons are subject to commodity price fluctuations, of more significance is the impact in the outbound tonnes of UBC's. Figures are based on tonnes sold to end market by Niagara Region and the sales revenues received.

Table 4: Niagara Region's Tonnage and Revenue Performance for UBC's – Pre-Installation (2014) vs. Post-Installation (2015) of the Eddy Current Separator System

Pre-Installation UBC's Revenue (2014)

#	Item	Revenue/Tonne	Sales Revenue	Tonnes Sold
1	January - March	\$1,440.88	\$160,974.74	111.72
2	April - June	\$1,532.87	\$178,134.78	116.21
3	July - September	\$1,642.95	\$192,176.20	116.97
4	October - December	\$1,716.72	\$196,461.30	114.44
5	Total	\$1,584.33	\$727,747.02	459.34

Post-Installation UBC's Revenue (2015)

#	Item	Revenue/Tonne	Sales Revenue	Tonnes Sold
1	January - March	\$2,035.75	\$238,752.85	117.28
2	April - June	\$1,697.35	\$222,895.80	131.32
3	July - September	\$1,619.16	\$243,425.03	150.34
4	October - December	\$1,678.76	\$193,276.06	115.13
5	Total	\$1,747.52	\$898,349.74	514.07

Difference between Pre- vs. Post- Installation Change

#	Item	Revenue/Tonne	Sales Revenue	Tonnes Sold
1	Pre- vs. Post-Installation Change	\$163.19	\$170,602.72	54.73
2	Percentage Change	10.30%	23.44%	11.91%

Tonnage of UBC's sold to end markets increased in 2015 by approximately 55 tonnes, or 12%. Approximately 13 tonnes of this increase can be attributed to the increased recovery of UBC's, as a result of the implementation of the ECSS. The remaining 42 tonnes can be attributed to the re-instatement of a third party municipal contract, which was on hiatus from June 1, 2014 to April 1, 2015, as well as an increase in IC&I tonnage. Sales revenues increased by \$170,600, or 23%. This increase in revenue is primarily due to the sale of UBC's as a primary grade in 2015.

Table 5 provides another perspective on the impact of selling UBC's as a primary versus secondary grade, based on the average market differential between the two grades in 2014 and 2015. In 2014, UBC's were sold as a secondary grade, at approximately \$330 per tonne less than the primary price, resulting in a lost revenue opportunity of approximately \$151,061. In 2015, UBC's was sold as a primary grade, at approximately \$344 per tonne more than the secondary price, resulting in a post-ECSS revenue gain of approximately \$176,868. The average revenue impact for each scenario was based on the

difference between the primary and secondary price paid for UBC's and the impact of the U.S. exchange rate (Appendix C).

Table 5: 2014 and 2015 Comparison of Price Differential between Secondary and Primary Grade UBC's

	Amount
2014 Average Total Revenue (based on selling UBC's as secondary grade)	\$728,392.65
2014 Average Total Revenue (based on selling UBC's as primary grade)	\$879,454.09
2014 Average Revenue Impact	(\$151,061.44)
2015 Average Total Revenue (based on selling UBC's as primary grade)	\$904,405.03
2015 Average Total Revenue (based on selling UBC's as secondary grade)	\$727,536.78
2015 Average Revenue Impact	\$176,868.25

The results of this analysis support the findings in Table 4 that Niagara Region realized an increase in revenue of approximately \$170,000 by implementing the ECSS.

3.2.3 Monitoring Challenges, Limitations and Solutions

The main metrics for measurement of this project did not present any unusual challenges. Records for material recovery and sales are tracked as part of the day-to-day management of the facility, and readily available for year-to-year comparison. Systems are in place to manage and report this data annually to the WDO. The residue audit procedure is clear and replicable.

4. PROJECT RESULTS AND ANALYSIS

4.1 Project Results and Analysis

Niagara Region installed and commissioned the ECSS in the fall of 2014, replacing a 10 year-old, 30 inch-wide, less-efficient ECSS. The new ECSS is 48 inches wide, with enhanced throwing capabilities, and has met Niagara Region's project objectives for UBC's recovery and revenue generation.

As previously noted, residue audits conducted post installation revealed that UBC's recovery from the residue stream increased by 28%. In general, the installation of the ECSS has resulted in the following:

- Improved overall capture of UBC's; and,
- Higher revenue generation.

4.2 Lessons Learned and Next Steps

There are a number of lessons to be shared by Niagara Region's experience, particularly for those programs which might be considering replacing their existing ECSS.

At Niagara Region's MRF, the ECSS is located at the end of the container line, prior to the residue bunker. Removal of loose film, fibre and expanded polystyrene upstream are key to minimizing quality control requirements after the ECSS. If not removed, these items can make the transition with the UBC's due to their shape and weight.

It is important to note that although the purity of the UBC's ejected by the new ECSS is very high, other aluminum-based products will be ejected along with the UBC's, due to the strength of the ECSS rotor. As detailed in the Composition Audits of UBC's Recovered (Appendix A), 92.32% of the UBC's ejected is aluminum and aluminum tins. However, 5.11% is other aluminum-based products such as pouches, aluminum foil packaging, aerosol cans, tetra paks, etc., and another 2.57% is residue. This remaining 7.68% of contamination must be manually removed by quality control staff during and after the baling process, in order to achieve primary grade UBC's. The final target is to have non-aluminum

contamination at or below 1%. As a result, there are no labour savings with the new ECSS. Staff that perform the daily quality control functions are existing staff that have been relocated from other MRF functions.

5. PROJECT BUDGET

5.1 Project Budget

The budgeted vs. actual procurement and installation costs for the ECSS appear in Table 6.

Table 6: Budgeted vs. Actual Procurement and Installation Costs for the Eddy Current Separator System

Budgeted Procurement and Installation Costs

#	Item	Cost	Date
1	Place Order with Vendor - 30% deposit	\$25,256.12	March 2014
2	Delivery of Equipment - 40% deposit	\$33,674.83	May 2014
3	Installation of Equipment/Electrical	\$50,000.00	June 2014
4	Commissioning and Final Payment, 30% deposit	\$25,256.12	July 2014
5	Engineering and Contract Administration	\$4,000.00	July 2014
6	Total Budgeted Procurement & Installation Costs:	\$138,187.07	

Actual Procurement and Installation Costs

#	Item	Cost	Date
1	Place Order with Vendor - 30% deposit	\$28,400.04	August 2014
2	Delivery of Equipment - 40% deposit	\$33,458.91	December 2014
3	Installation of Equipment/Electrical	\$21,157.54	December 2014
4	Commissioning and Final Payment, 30% deposit	\$33,853.85	April 2015
5	Engineering and Contract Administration	\$1,124.10	December 2014
6	Total Actual Procurement & Installation Costs:	\$117,994.44	

Difference between Budgeted vs. Actual Procurement and Installation Costs

#	Item	Difference
1	Place Order with Vendor - 30% deposit	(\$3,143.92)
2	Delivery of Equipment - 40% deposit	\$215.92
3	Installation of Equipment/Electrical	\$28,842.46
4	Commissioning and Final Payment, 30% deposit	(\$8,597.73)
5	Engineering and Contract Administration	\$2,875.90
6	Total:	\$17,316.73

5.2 Payback Period

Table 7 provides a breakdown of the payback calculation for the ECSS. These results are based on the total capital and installation cost, with and without CIF funding, divided by the difference in revenue between the pre-installation (2014) and post-installation (2015) of the ECSS.

Table 7: Payback Calculation for the Eddy Current Separator System**Payback Period**

#	Item	Cost / Revenue
1	Capital and Installation Cost without CIF Funding	\$117,994.44
2	Pre Installation UBC's Sales Revenue	\$727,747.02
3	Post Installation UBC's Sales Revenue	\$898,349.74
4	Profit / (Loss) Total before Capital and Installation Cost	\$170,602.72
5	Capital Payback Period (years) without CIF Funding	0.69
6	CIF Funding for Purchase and Delivery of ECSS (assuming full funding, excluding Milestone #3)	\$41,022.00
7	Capital and Installation Cost with CIF Funding	\$76,972.44
8	Capital Payback Period (years) with CIF Funding	0.45

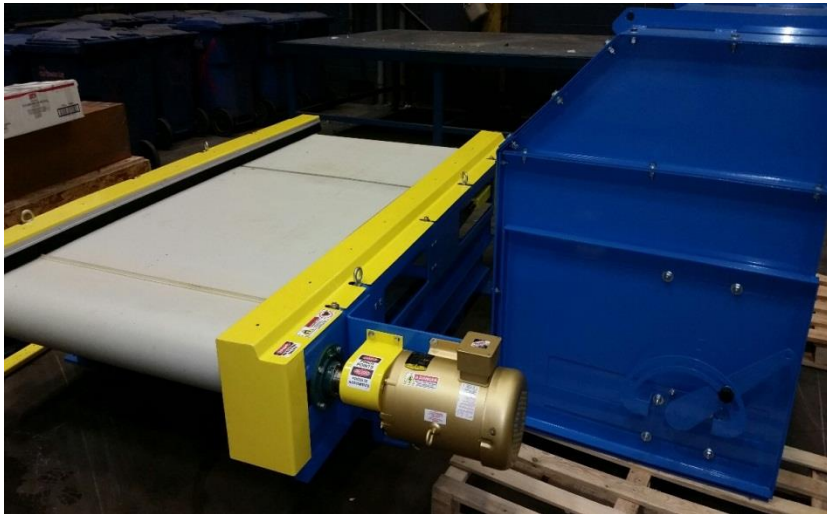
Based on the above payback calculations, the ECSS would pay for itself in approximately 0.69 years, or 8.3 months, without the CIF funding. If the CIF funding is applied to the Capital and Installation Cost, the Capital Payback Period decreases to approximately 0.45 years, or 5.4 months.

6. CONCLUSIONS

The installation of the ECSS has been a tremendous success for Niagara Region, resulting in higher recovery rates of UBC's and significantly higher revenues. Other MRFs contemplating the installation of an ECSS can learn from Niagara Region's experience in a number of ways:

- 1) The ECSS selected by Niagara Region provides the necessary means to achieve primary grade UBC's. The width and strength of the ECSS ensures non-UBC's contamination is maintained at manageable levels for post-ECSS quality control.
- 2) Location of the ECSS is an important consideration. In Niagara Region's MRF, the ECSS is located at the very end of the container line. This design has proven to be successful as upstream equipment, such as the optical sorter, which automatically removes PET and mixed plastics, a film vacuum system, combined with manual labour for removal of UBC's foil, polycoat cartons and plastics missed by the optical sorter, are key to ensuring successful separation at the ECSS. If the input stream to the ECSS contains excessive plastics, fibre and other contamination, producing a primary grade UBC's that will not be subject to mill downgrades or rejection will be difficult and prove to be costly for MRF operations.
- 3) Due to very stringent market specifications for primary UBC's, MRF's utilizing ECSS technology must continue to allocate resources to quality control the positively-ejected UBC's after the ECSS. As packaging trends evolve, this issue may become more of a challenge for MRF's to produce primary grade UBC's. Therefore, it is important that appropriate financial resources be allocated for quality control.
- 4) Programs considering upgrading their ECSS to produce primary grade UBC's should collect audit data on the current composition of their UBC bales and determine the net financial impact of removing all the contaminants and selling their UBC's at a premium price. The gap between primary and secondary grade UBC's in the first quarter of 2016 is approximately \$400 per metric tonne. This is a significant premium that should make the transition from secondary to primary grade an important consideration.

7. PHOTOS OF EDDY CURRENT SEPARATOR SYSTEM



APPENDIX A

Quarterly Composition Audits of Residue Stream - Pre- and Post-Installation of ECSS

Quarterly Composition Audit Results – Post-Installation of ECSS

Date	UBC's (and other aluminum, if present)	%	Residue (HHW, Unsortables)	%	Total Weight (lbs.)	%
2011 Q4 Audit Dates:						
October 18, 2011	11.0	4.2%	68.0	25.7%	264.5	100.0%
November 21, 2011	13.0	5.3%	58.0	23.6%	246.0	100.0%
December 12, 2011	10.0	3.4%	59.0	20.0%	295.0	100.0%
2011 Q4 Average:	11.3	4.3%	61.7	23.1%	268.5	100.0%
2012 Q1 Audit Dates:						
January 16, 2012	15.5	4.9%	53.5	16.9%	317.0	100.0%
February 15, 2012	19.5	6.4%	56.0	18.5%	303.0	100.0%
March 12, 2012	14.0	3.4%	111.0	27.3%	407.0	100.0%
2012 Q1 Average:	16.3	4.9%	73.5	20.9%	342.3	100.0%
2012 Q2 Audit Dates:						
April 10, 2012	16.5	5.6%	46.0	15.6%	294.0	100.0%
May 16, 2012	8.5	4.1%	47.0	22.9%	205.0	100.0%
June 12, 2012	15.0	6.3%	76.0	31.9%	238.5	100.0%
2012 Q2 Average:	13.3	5.3%	56.3	23.5%	245.8	100.0%
2012 Q3 Audit Dates:						
July 17, 2012	13.5	6.7%	45.0	22.2%	202.5	100.0%
August 29, 2012	26.0	9.8%	52.5	19.7%	266.5	100.0%
September 19, 2012	15.5	6.4%	50.0	20.6%	242.5	100.0%
2012 Q3 Average:	18.3	7.6%	49.2	20.8%	237.2	100.0%
2014 Q3 Audit Dates:						
August 9, 2014	13.0	5.2%	51.8	20.6%	251.0	100.0%
August 20, 2014	8.5	4.3%	41.5	21.0%	197.5	100.0%
August 26, 2014	11.5	4.8%	45.0	18.9%	237.5	100.0%
September 29, 2014	11.0	5.8%	29.5	15.6%	189.5	100.0%
2014 Q3 Average:	11.0	5.0%	41.9	19.0%	218.9	100.0%
2014 Q4 Audit Dates:						
December 2, 2014	9.0	3.1%	84.5	29.4%	287.5	100.0%
Average- All Audits	13.2	5.1%	61.2	22.8%	266.7	100.0%

Quarterly Composition Audit Results – Post-Installation of ECSS

Date	UBC's (and other aluminum, if present)	%	%	Residue (HHW, Unsortables)	%	Total Weight (lbs.)	%
2015 Q1 Audit Dates:							
January 15, 2015	7.0	2.6%	18.4%	70.5	26.2%	269.0	100.0%
January 20, 2015	3.5	1.9%	28.6%	50.0	26.7%	187.0	100.0%
January 21, 2015	4.0	2.2%	29.1%	47.0	25.5%	184.0	100.0%
March 13, 2015	8.0	3.2%	28.8%	58.0	23.4%	248.0	100.0%
2015 Q1 Average:	5.6	2.5%	26.2%	56.4	25.5%	222.0	100.0%
2015 Q2 Audit Dates:							
April 2, 2015	7.5	2.8%	23.2%	58.0	21.8%	265.5	100.0%
2015 Q3 Audit Dates:							
August 11, 2015	15.0	7.0%	6.3%	13.0	6.1%	214.0	100.0%
August 31, 2015	6.5	3.5%	36.4%	25.0	13.3%	188.0	100.0%
September 28, 2015	10.5	5.5%	24.9%	36.5	19.0%	192.5	100.0%
2015 Q3 Average:	10.7	5.3%	22.6%	24.8	12.8%	198.2	100.0%
2015 Q4 Audit Dates:							
October 27, 2015	12.0	6.1%	25.8%	52.0	26.3%	198.0	100.0%
November 3, 2015	11.5	5.9%	27.0%	44.0	22.4%	196.5	100.0%
December 16, 2015	19.0	9.1%	24.6%	49.5	23.6%	209.5	100.0%
2015 Q4 Average:	14.2	7.0%	25.8%	48.5	24.1%	201.3	100.0%
Average- All Audits	9.5	4.4%	24.4%	46.9	21.0%	221.8	100.0%

Composition Audits of UBC's Recovered

Date	Aluminum Cans	%	Aluminum Foil	%	Aluminum Pouches (Kool Aid Jammers)	%	Tetra paks	%	Aluminum Tins-Cat Food/Tuna	%	Aerosol Cans	%	Aluminum (Other)	%	Residue	%	Total Weight (lbs.)
15-Jan-15	133	85.53%	3.5	2.25%	1	0.64%	0	0.00%	11.5	7.40%	1.5	0.96%	0.5	0.32%	4.5	2.89%	155.5
20-Jan-15	131	85.06%	3.5	2.27%	1	0.65%	0.5	0.32%	12.5	8.12%	1	0.65%	1	0.65%	3.5	2.27%	154
21-Jan-15	110	83.97%	3.5	2.67%	1	0.76%	1	0.76%	9.5	7.25%	1.5	1.15%	0.5	0.38%	4	3.05%	131
13-Mar-15	109.5	85.21%	3.5	2.72%	1	0.78%	1.5	1.17%	9.5	7.39%	0.5	0.39%	1	0.78%	2	1.56%	128.5
02-Apr-15	135.5	83.64%	4.5	2.78%	0.5	0.31%	1.5	0.93%	13	8.02%	1.5	0.93%	0.5	0.31%	5	3.09%	162
Total	619		18.5		4.5		4.5		56		6		3.5		19		731
Average	123.8	84.68%	3.7	2.54%	0.9	0.63%	0.9	0.64%	11.2	7.64%	1.2	0.81%	0.7	0.49%	3.8	2.57%	146.2

Note: These composition audits of UBC's recovered were taken prior to Quality Control.

APPENDIX B
Eddy Current Separator System
Audit Procedure

Niagara Region – Waste Management Services	Effective Date: July 23, 2014
Eddy Current Separator System (ECSS) Audit Procedure	Number: #2014
Revised by:	Revision date:
Approved by:	Approved date:
<p>1. Rationale/Background: The post-installation ECSS audits are completed to help rate the performance of the new ECSS which is projected to be installed in November 2014. In order to evaluate the effectiveness of the ECSS current performance will be determined by establishing the percentage of used UBC's beverage containers produced at the MRF. Niagara Region will conduct audits quarterly for the first year of installation which will be compared to pre-installation container audits.</p> <p>2. Purpose: The purpose of this procedure is to provide the information required for Waste Management Interns (WMIs) to conduct the ECSS residue audits and to document the audit results.</p> <p>3. When to use this Procedure: This procedure is to be used when conducting ECSS audits which are to be conducted quarterly.</p> <p>4. Roles and Responsibilities: The WMIs are responsible for the implementation and maintenance of this procedure.</p> <p>5. Tools: The tools required to conduct the audits are:</p> <ul style="list-style-type: none"> • Audit Form • Pen • Label Tags (optional) • Clipboard • Broom • Rake • Protective Clothing including: safety glasses, safety boots, vests, gloves and face mask (optional) • Carts/Boxes • Scale • Link to audit information L:\2007 Beyond\E09 Waste Diversion and Recycling\E0902 Plants\Recycling Centre\Audits <p>6. Procedure:</p> <p>a) Audit Preparation</p> <p>➤ Once the audit sample has been collected by Niagara Recycling and dumped onto the audit table, Niagara Recycling staff will record the weight of the material sample on the schedule posted on the Controller's office door. A blank copy of the 'Weekly Audit Schedule' can be found at the</p>	

following file path:

L:\2007 Beyond\E09 Waste Diversion and Recycling\+E0902 Plants\Recycling Centre\Audit\YEAR\Weekly Audit Schedule.docx

- On the day of the requested audit, the WMIs shall check the audit table and floor to ensure that all materials have been removed from the previous audit. If there is residual material left on the table and/or floor, it will need to be cleared prior to having the new audit sample dumped in order to prevent discrepancies in the new audit sample category weights.
- The WMIs shall check the audit table (located in Bay 1) to make sure the audit sample has been dumped. If the audit sample has not been dumped, the Intern shall follow up with the Niagara Recycling CEO or Controller to prepare the audit sample. It takes approximately 15 minutes for the sample to be collected and dumped onto the audit table.
- Samples will be collected from the end of the container line by Niagara Recycling staff and will be between 200 and 300 lbs. The collection sample will be segregated and manually sorted into material categories by the WMIs. Each category will be weighed, the percent composition determined and the results will be compared to similar audit results compiled in 2014 prior to the installation of the ECSS.
- The WMIs shall obtain a blank ECSS audit form and bring it to Bay 1 to document the audit results. Blank forms can be obtained from the WMI primarily responsible for the container audits, or on the L drive at the following file path:
L:\2007 Beyond\E09 Waste Diversion and Recycling\+E0902 Plants\Recycling Centre\Audit\YEAR\Container Audits\BLANK EPS residue Audit Sheet.xlsx
- WMIs shall wear the personal protective equipment listed in section 5, 'Tools', prior to entering the Bay 1 audit area of the Recycling Centre.

b) Conducting the Audit

- Once in the Bay 1 audit area, WMIs shall collect empty carts and boxes to separate the audit material by category. The carts and boxes required are located alongside the auditing table.
- WMIs shall ensure that all the containers are empty and weigh each container separately on the scale located on the north wall of the audit area. Most of the recycling carts have already been weighed, and the weight is recorded in black permanent marker along the outer rim of the cart. If there is no weight recorded, ensure that the empty cart is weighed prior to beginning the audit. WMIs shall record the tare weight of each cart or box in the "Before" column of the container audit sheet. **To ensure safety, WMIs are not permitted to travel beyond Bay 1.** WMIs shall separate the used UBC's beverage cans from the sample and place into a separate cart.

Waste Management Interns shall:

- Place the weighed empty containers beside the audit sample.
- Begin to sort the sample by placing the used UBC's beverage cans into one container and everything else into a separate container. *Note: Sometimes the containers will become full before the sorting of the sample is complete. If this happens, place the full container aside, find*

another empty container for the material and ensure a tare weight is obtained and recorded for the new container. Continue with the additional container.

- Remove all of the used UBC's beverage cans from the sample and place in a separate container. The original audit sample weight shall be as close as possible to the combined weight of all the separated audit categories.
- As the material continues to be sorted, use the rake to bring materials closer to the edge of the table where the WMIs are sorting so no one has to reach or stand on the table.
- Once the audit has been completed, bring all Blue Boxes and recycling carts to the scale at the north end of Bay 1 to be weighed.
- Ensure that all material that has fallen onto the floor during the audit is picked up and sorted to ensure that as much of the sample is being sorted as possible.

Note: If more than one container exists per category, each weight shall be documented separately and then added together.

- When the weighing has been completed, consolidate all the material into the totes and line up the totes to the side of the scale in Bay 1, with lids open. This will indicate to Niagara Recycling staff that the audit is complete and the totes may be emptied. *Note: Do not block the path to the fire hose located beside the scale with totes.*
- Clean the audit table of any leftover material from the audit. The leftover material can be placed in the garbage tote and lined up with the other totes to be emptied. This material will mainly be residual, and if it is too small for WMIs to sort manually, it does not need to go back through the line.
- Sweep the floor around the audit table after each audit to ensure that material from one audit does not get mixed with a new sample.
- The audit carts must be relocked after the audit is completed and the carts have been emptied by Niagara Recycling. *Note: Depending on the number of available interns and the size of the audit, it takes approximately 4/5 interns and 2/3 hours to complete one ECSS residue audit.*

c) Recording Audit Results

The WMI primarily responsible for audits shall:

- Input the audit results on the ECSS residue Audit Summary Form into the excel spreadsheets found at the following file path:
L:\2007 Beyond\E09 Waste Diversion and Recycling\+E0902 Plants\Recycling Centre\Audit\YEAR\Container Audits\ECSS Audit Summary
- In the excel spreadsheet, create a new tab after the previous audit, and rename it with the audit date. The previous tab will have Excel formulas in the boxes which makes it easier than starting from a blank form. Copy and paste the last audit results into the new tab, space everything

accordingly and input the new data.

- Complete the top portion of the form which includes: the condition of material, sample weight and weight sorted. Calculate the weights for the used UBC's beverage cans by subtracting the final weight from the starting weight. The percentages will change in the spreadsheet as the new numbers are inputted.
- Make sure the total percentage adds to a total of 100%. (If not, the WMI shall recheck their work).
- Develop a pie chart to show the results from the current audit.
- Save the work
- Send the file to the Contract Manager and the Controller for Niagara Recycling.

8. Contacts:

Norm Kraft
CEO, Niagara Recycling
905-356-4141 ext. 2522
norman.kraft@niagararegion.ca

Elinor King
Controller – Niagara Recycling
905-356-4141 ext. 2524
elinor.king@niagararegion.ca

Carly Burt
Contract Manager
905-356-4141 ext. 2538
carly.burt@niagararegion.ca

9. Revision History

APPENDIX C
Comparison of Price Differential Between
Secondary and Primary Grade UBC's

2014 – Pre-Installation of Eddy Current Separator System

Monthly Average	Currency	Can. Price per lb. (Secondary Grade) ⁽²⁾	U.S. to Can. \$ Monthly Avg. Conversion Rate ⁽¹⁾	Equivalent Can. Price per lb. (Adjustment for Primary Grade) ⁽³⁾	Can. Price per MT (Based on Secondary Grade)	Can. Price per MT (Based on Primary Grade)	2014 Outbound Tonnes	Total Revenue (Based on Secondary Grade)	Total Revenue (Based on Primary Grade)	Revenue Difference
January-14	Can. Dollars	0.6450	1.09419091	0.7927	\$1,422.27	\$1,748.00				
February-14	Can. Dollars	0.6475	1.10551053	0.7967	\$1,427.78	\$1,756.88				
March-14	Can. Dollars	0.6713	1.11071429	0.8212	\$1,480.15	\$1,810.80				
April-14	Can. Dollars	0.7175	1.09912857	0.8659	\$1,582.14	\$1,909.33				
May-14	Can. Dollars	0.6800	1.08937143	0.8271	\$1,499.45	\$1,823.74				
June-14	Can. Dollars	0.6900	1.08307143	0.8362	\$1,521.50	\$1,843.91				
July-14	Can. Dollars	0.7225	1.07391818	0.8675	\$1,593.16	\$1,912.85				
August-14	Can. Dollars	0.7400	1.092725	0.8875	\$1,631.75	\$1,957.04				
September-14	Can. Dollars	0.7575	1.10118095	0.9062	\$1,670.34	\$1,998.15				
October-14	Can. Dollars	0.7450	1.12125455	0.8964	\$1,642.78	\$1,976.56				
November-14	Can. Dollars	0.8000	1.13264737	0.9529	\$1,764.06	\$2,101.23				
December-14	Can. Dollars	0.8133	1.15325238	0.9690	\$1,793.46	\$2,136.76				
2014 Average		0.7191	1.104747133	0.8683	\$1,585.74	\$1,914.60	459.34	\$728,392.65	\$879,454.09	(\$151,061.44)

Notes:

1) Based on Bank of Canada's 2014 monthly average exchange rates from Can. to U.S. Dollars.

2) In 2014, all UBC's was sold as Secondary Grade.

3) An increase of 13.5 U.S. cents per lb., adjusted by the monthly U.S. \$ exchange rate, was made to the 2014 secondary rates, in order to demonstrate what rate Niagara Region would have received, as a primary grade, with implementation of the ECSS.

2015 – Post-Installation of Eddy Current Separator System

Monthly Average	Currency	U.S. Price per lb. (Primary Grade) ⁽²⁾	U.S. to Can. \$ Monthly Avg. Conversion Rate ⁽¹⁾	Equivalent Can. Price per lb. (Primary Grade)	Equivalent Can. Price per lb. (Adjustment for Secondary Grade) ⁽³⁾	Can. Price per MT (Based on Primary Grade)	Can. Price per MT (Based on Secondary Grade)	2015 Outbound Tonnes	Total Revenue (Based on Primary Grade)	Total Revenue (Based on Secondary Grade)	Revenue Difference
January-15	US Dollars	0.8625	1.2115	0.9487	0.7994	\$2,091.94	\$1,762.77				
February-15	US Dollars	0.7450	1.2500	0.9313	0.7625	\$2,053.48	\$1,681.37				
March-15	US Dollars	0.7150	1.2619	0.9023	0.7319	\$1,989.60	\$1,613.94				
April-15	US Dollars	0.7025	1.2331	0.8663	0.6998	\$1,910.17	\$1,543.09				
May-15	US Dollars	0.6650	1.2185	0.8103	0.6458	\$1,786.75	\$1,424.03				
June-15	US Dollars	0.5483	1.2366	0.6781	0.5111	\$1,495.20	\$1,127.08				
July-15	US Dollars	0.5367	1.2865	0.6904	0.5167	\$1,522.38	\$1,139.42				
August-15	US Dollars	0.5400	1.3149	0.7100	0.5325	\$1,565.67	\$1,174.25				
September-15	US Dollars	0.5800	1.3267	0.7695	0.5904	\$1,696.77	\$1,301.83				
October-15	US Dollars	0.5775	1.3073	0.7549	0.5785	\$1,664.71	\$1,275.56				
November-15	US Dollars	0.5675	1.3280	0.7537	0.5744	\$1,661.87	\$1,266.54				
December-15	US Dollars	0.5650	N/A (3)	0.7588	0.7588	\$1,673.10	\$1,673.10				
2015 Average		0.6338	1.2705	0.7978	0.6418	\$1,759.30	\$1,415.25	514.07	\$904,405.03	\$727,536.78	\$176,868.25

Notes:

1) Based on Bank of Canada's 2015 monthly average exchange rates from U.S. to Can. Dollars.

2) In 2015, after implementation of the ECSS, UBC's was sold as Primary Grade.

3) A decrease of 13.5 U.S. cents per lb., adjusted by the monthly U.S. \$ exchange rate, was made to the 2015 primary rates, in order to demonstrate what rate Niagara Region would have received, as a secondary grade, without implementation of the ECSS.

ⁱ The Measurement and Monitoring Plan for CIF Project No. 821.3.3, Eddy Current Separator System (ECSS) Section 3.1 identified pre-installation audit information from a baseline of 2011-2012. 2014 pre-installation audit data has also been included in this report, to provide further support with recent data.