

REPORT

The Optimization of the
Northumberland MRF Material
Stream and Equipment Review

County of Northumberland
Transportation & Waste Department

Project No. 1003531.

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REPORT TO

County of Northumberland

860 William Street
Cobourg, Ontario
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ON

**THE OPTIMIZATION OF THE
NORTHUMBERLAND MRF
MATERIAL STREAM AND
EQUIPMENT REVIEW**

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EXECUTIVE SUMMARY

The report on 'The Optimization of the Northumberland Material Recovery Facility (MRF) Feedstock (Material Stream) and Equipment Review' has been prepared to present the results for Part 2 of the updated plan for the waste management system of the County of Northumberland.

This project is the second component in the County's plans to update its long-term strategy for waste collection, diversion and disposal. For the past ten (10) years, the Northumberland MRF has been processing a fully co-mingled dry waste material stream (single stream). The County is now at the point, based largely on first hand experience of operating its own MRF, of considering a more contemporary recycling material stream (remove dry component of single stream).

The Northumberland public is relatively satisfied with the current Wet-Dry collection program due to the user friendly approach with the method of sorting at the household therefore, it is important to ensure that any changes to the current program have minimal negative impact on the public.

Changes to the current material stream will have implications on the overall performance of the MRF and offers opportunities for equipment retrofits and modifications.

This report focuses on the following:

- Recommending the removal of the dry waste component from the current inbound material stream delivered to the Northumberland MRF;
- The impact a cleaner co-mingled material stream (expanded blue box stream) has on existing MRF equipment and efficiency (processing rate and residual rate);
- The impact equipment modifications has to the single stream MRF with the cleaner material stream (with comparisons depicting impact of maintaining the dry material stream);
- The effect population growth will have on material generation rates and equipment sustainability; and,
- Communication tools to support recycling program modifications, as a heavier dependence will be placed on the resident for at- source sorting of recyclable material.

With projected population growth, there is a need for some equipment improvements to meet daily facility receipt / processing rate requirements (approximately \$800,000 in identified capital improvements is estimated to provide approximately 50% increased throughput). Based on current recycling generation rates within the County of Northumberland, and anticipated growth rates specifically to the County, the improved throughput

rates from equipment retrofits and cleaner material stream should not be exceeded within the next 15 years. The County will need to consider overall equipment retrofits / replacements (balers, conveyors) based on normal wear rates during this time period.

Based on a cleaner inbound blue box material stream accompanied with retrofits to the existing equipment, the improvements to the daily production rates should remain constant over the next 15 years. If the County focuses on an aggressive education campaign to increase total recyclable tonnages entering the MRF, or chooses to process additional tonnages from outside the County boundaries, there is processing capacity flexibility for a single shift to operate until blue box tonnages exceed 17,000 per year. At this point, an additional production shift or adding staff to the existing shift can be considered based on total tonnes entering the system.

The risks associated with changing the material stream rest primarily with the generator and source-separators. With a move from a Wet-Dry to a three-stream type sort, some loss in participation and at-source capture is inevitable. The imposition of additional effort, or worse, confusion on the part of the user could lead to lower participation rates or some refusal to place or misplace certain materials in appropriate containers which, in turn, will lower overall recovery. The 'trick' will be to keep such losses at or below losses currently being experienced at the facility.

Any change to a municipal waste management program is only effective if the change is understood by the participants (residents) and the program has full participation by the target audience. Retrofitting equipment to the Northumberland MRF cannot be conducted in isolation. **The equipment modifications must be accompanied with positive and continual education to ensure effectiveness of the changes to the recycling program.** The modifications to the Northumberland MRF and changes to the material stream are part of an integrated waste management program for the residents of the County. Extensive and continual public education designed to focus on public awareness, and maintenance of a sense of equity or justice on the part of the user will be key in maintaining participation, capture and overall recovery at desirable levels.

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PART A - INTRODUCTION & BACKGROUND

1.0 INTRODUCTION

Jacques Whitford Limited (Jacques Whitford) is pleased to submit the MRF Material Stream and Equipment Review Optimization Study to the County of Northumberland (County). The study has resulted in definition of the effectiveness and efficiency of the current “dry-stream” system and in recommendations for modifications to the material stream collected, and to equipment at the MRF, which would optimize the management of recyclables and their overall diversion in Northumberland County.

1.1 Study Components

The key components of the study performed by the consultant team in accordance with the study terms of reference were as follows:

- **Background Data Collection and Review**, which develops baseline cost and performance information on the current recycling system;
- **Material Stream Review and Evaluation**, which examines inbound residential waste characteristics and material processing flow;
- **Residue Auditing and Material Stream Characterization**, which examines current MRF residual generation and composition;
- **Public Consultation & Communications Tool Kit** to assist the County with development of public education strategies;
- **Equipment Review and Cost Recovery Assessment**, which provides equipment modification recommendations, throughput improvements and estimated cost recovery timeframe; and,
- **Reporting** which provides the relevant background on the Northumberland Wet-Dry system and step-by-step results of the material stream review and evaluation process, including proposed recommendations on changes to the material stream, modifications and replacement of processing equipment and information about effective public education tools to assist County staff with the delivery of a new recycling program.

Additional Considerations

The dry / recyclable side collection changes contemplated in this report, future consideration of changes to the wet / organics side collection and the potential consideration of a separate garbage collection stream are inter-related and should be considered in an integrated manner.

1.2 Overview of Report Contents

The report is organized in the following parts and appendices:

- Part A - Introduction & Background**, which includes the first four sections describing the study purpose, objectives, methodologies, and relevant background.
- Part B - Definition of Baseline Conditions**, which includes Sections 5 to 9 defining and describing the efficiency and effectiveness of the current dry stream processing system.
- Part C - Efficiency and Effectiveness Review**, which includes Sections 10 to 12 reviewing measures which may be incorporated to optimize the processing of those materials currently managed in the dry stream including communications requirements for any future changes.
- Part D - MRF Equipment Review**, which includes Section 13 recommending equipment retrofits and cleaning up material stream.
- Part E - Recommendations** which includes Sections 14 and 15 summarizing our key findings and recommendations from the study.

Supporting information for the tasks performed within this report is outlined in the following appendices:

- Appendix A - Waste Diversion Ontario Effectiveness and Efficiency Graph**
- Appendix B - Detailed waste audit data, residential sorting costs, residual waste sorting costs, and projected lost revenue from recyclables in residual waste**
- Appendix C - Equipment review and cost analysis**
- Appendix D - Communication strategy, online survey results, and communication toolkit information**
- Appendix E - MRF tonnage projections and population growth**
- Appendix F - Report Photographs**
- Appendix G - Glossary of Terms**
- Appendix H - Material Recovery Facility Process**

2.0 PURPOSE OF THE STUDY

The objective of this study is to determine if the County has the potential to capture more recyclable material at a lower processing cost per tonne by changing the material stream that is currently being delivered to the MRF.

The study examines the optimum balance between a fully 'inclusive' program (co-mingled dry system) and a more 'restrictive' program (co-mingled recyclables only system), to maximize the capture of dedicated blue box recyclables, as defined by the Waste Diversion Act, and to improve the efficiency of the MRF operation.

The following activities have been undertaken by the consultant team, in discussion with key County staff, to achieve the study goal:

- Determination of an efficient and effective material stream considering:
 - Economics (processing and residual disposal costs);
 - Environmental Impacts (diversion from local landfill sites);
 - Health and Safety (of MRF sorters); and,
 - Expected public acceptance / reaction.
- Identification of opportunities presented by use of existing MRF equipment with a cleaner 'blue box stream', including:
 - Throughput efficiency;
 - Processing costs; and,
 - Residual rates.
- Identification of opportunities presented by modifying existing MRF equipment including:
 - Throughput efficiency;
 - Processing costs; and,
 - Residual rates.
- Development of effective communication tools to assist County staff in promoting any changes to the public and educating the public on future set-out and collection practices.

The 2004 diversion rate in the County of Northumberland is 38%.

2.1 Importance of this Study

The Ontario Ministry of the Environment recently announced an objective to divert 60% of the waste stream from disposal by 2008. To expedite this target, Waste Diversion Ontario (WDO) has presented all participating municipal recycling programs with a funding ranking system based on their effectiveness and efficiency factor (refer to Section 2.2). This entitles municipal programs to maximum funding if they achieve high diversion rates in a cost effective manner.

Currently, the County has a waste diversion rate of approximately 38% and a net recycling processing and collection cost of \$263/tonne, placing their costs slightly above the provincial average \$233/tonne for their municipal grouping. Based on this information, the County has decided to take a leadership role in waste management planning by proactively seeking out alternatives to improve their current waste diversion rates and determine strategies to effectively capture and process additional recyclable material cost effectively.

2.2 Effectiveness and Efficiency Factor

WDO is presenting municipalities with two basic principals for measuring the success of their recycling programs:

Efficiency (cost reduction)

- The efficiency of an individual recycling program is measured by dividing the net program costs (gross cost minus gross revenue) by the tonnes of blue box material marketed.

Effectiveness (recovery rate)

The effectiveness is measured by dividing the quantity of dedicated blue box material marketed by the quantity of dedicated blue box material available in the total waste stream. This calculation measures recovery of available blue box materials in the community's waste stream.

Waste Diversion Ontario has presented all participating municipal blue box programs with a funding ranking based on their Efficiency and Effectiveness Factor (E&E Factor), which is expressed by dividing a program's net cost per tonne with the percent of materials recovered.

It is important to note that the cost band range will decrease from 2006 to 2007 to reflect anticipated improved performances within the Rural Regional municipal grouping, which will directly impact the percentage of funding allocation for Northumberland. Based on this anticipated funding formula adjustment, it is important for Northumberland to reduce MRF processing

costs and increase recoverable blue box tonnages to maintain maximum funding in the future.

Refer to Appendix A for municipal comparisons of the E&E factor for rural regional municipalities.

3.0 BACKGROUND

The County is recognized as a leader in the municipal waste management industry with their decision to implement one of the first modern co-mingled dry MRF systems and co-collection programs within the Province.

The County Material Recovery Facility (MRF), began operations in April 1996. The Ministry of the Environment (MOE) Provisional Certificate of Approval (CofA) dated May 4, 1994, for the Northumberland MRF (A311713) was amended June 22, 1994, to permit the County to operate the MRF as a demonstration project, utilizing a two stream processing system for a period of approximately five (5) years. If the MRF does not meet the expectations of the County, the CofA stipulates that the County shall conduct a study on different options to improve the system, including the consideration of a three stream collection system, which incorporates an uncontaminated recycling component, a separate waste component, and an organics component.

The MRF has now been in operation for ten (10) years, during which time the County has had the opportunity to review the effectiveness and efficiency of the co-mingled dry processing system and the impact of the residual component on recovery rates and processing efficiencies.

Following the outcome of the Optimization of the MRF Material Stream and Equipment Review, the County can consider the next steps toward possibly amending the existing C of A to remove the dry waste component of the inbound material stream.

The foresight and leadership of the County has played a significant role in the development of current waste diversion programs throughout the Province and must not be forgotten when considering the results of this current review and contemplating a potential move towards a three-stream collection approach. Indeed, many of the municipalities implementing three-stream collection only recently have benefited significantly by the experience of Northumberland. With the completion of this efficiency and effectiveness review and other elements of the County's long-term waste management strategy, it is anticipated that the County will again be at the leading edge of diversion achievement.

3.1 Overview of Waste Management in Ontario

In the Province of Ontario, municipal waste management infrastructure is typically organized as follows:

- Recycling programs (i.e. Blue Box) and facilities to manage recyclable materials that can be captured and marketed as a commodity;
- Composting programs (i.e. leaf and yard waste collection and household organics separation) and facilities to manage organic materials that can be captured and processed into a marketable/useable compost, soil amendment or landscaping product;
- Disposal programs and facilities (primarily landfill) to dispose of all non-recyclable, non-compostable, or otherwise non-processable materials in the waste stream; and,
- The trend for municipal collection programs across Ontario in recent years has been towards the source separation and separate collection of recyclables, organics and garbage at designated recycling, composting and disposal facilities.

3.2 Overview of Northumberland Waste Management System

Waste Management services offered by the County include the collection, processing and disposal of residential, industrial, commercial and institutional (IC&I) wet waste and dry recyclables, the composting of leaf and yard materials, and the management of household hazardous waste (HHW). To complement the waste management services within the County, an aggressive three (3) bag limit and \$2/bag user fee is enforced by a County waste management by-law for all waste collected by the County curbside collection contract.

The County operates two (2) landfill sites, Seymour and Brighton, and two (2) transfer stations, Bewdley and Hope Township. With the exception of Hope Site, all waste disposal sites within the County offer drop off depots for scrap metal recycling, drywall recycling, tire recycling, centralized leaf and yard waste composting, and household hazardous waste.

3.3 Long-term Waste Management Strategy

The long-term waste management strategy developed by County waste management staff includes plans to update waste collection, diversion and disposal components. The updates are intended to address four (4) key areas of the County waste management system in four (4) parts:

- Part 1 Landfill Design and Landfill Recycling Project
- Part 2 Optimize MRF Material Stream and Review of MRF Processing Equipment
- Part 3 Composting Feasibility Study
- Part 4 Identify and Evaluate Alternative Waste Management Technologies

This report addresses the activities involved in Part 2 of the update of the County waste management system, with emphasis on improving the effectiveness and efficiency of the recycling operation of the Northumberland single stream MRF.

3.4 The Northumberland Wet-Dry Approach and Relevant Statistics

The County currently offers a two-stream Wet-Dry waste management system for its residents. A Wet-Dry system is a unique management concept, whereby all waste, with the exception of household hazardous waste, is categorized and sorted by the generator into two separate groupings: wet and dry.

With a typical Wet-Dry management system, the dry stream is processed at a Materials Recycling Facility (MRF) and the wet stream is processed at a Centralized Composting Facility (CCF). The Northumberland system does not include a composting facility and therefore, the wet stream is currently landfilled at a County waste disposal site. [Refer to Glossary of Terms in Appendix G.](#)

Incorporated within each of the wet and dry categories, is a portion of non-processable waste that cannot be easily diverted from disposal by way of a recycling facility or an organics facility and is classified as residue. Residual is currently found in both the wet and dry streams of Northumberland County.

The Wet-Dry waste handling system was originally selected by the County based on the simplicity of the sorting requirements for the ratepayer and the efficiency of the collection process. It was determined by the County that residents would choose to participate in a program that did not have a high component of material handling at the curbside or in the home.

Within the Wet-Dry system, Northumberland residents have the opportunity to set out for recycling collection, an expanded list of blue box material that can be mixed together (co-mingled), including:

- All grades of container plastics;
- All grades of fibre materials;
- All food and beverage container glass;
- All steel and aluminium food and beverage containers;
- Household scrap metal;
- All expanded polystyrene material; and,
- All film plastic bags and food wrap.



In addition to the expanded blue box list, the following list of materials are classified as residual waste with no market value but these items are considered green material that is accepted in the Wet-Dry system;

- All textiles, including shoes, belts, nylons, curtains;
- Video cassette tapes;
- Small household appliances;
- Small furnishings;
- Ceramics, window pane glass, light bulbs; and,
- Coated wiring, rope, string.

To offer processing flexibility to surrounding municipalities outside the Northumberland County boundaries, the County entered into a processing contract with the City of Kawartha Lakes (2001) to process co-mingled containers (plastic bottles, metal / aluminum containers) for a five year period.

The total amount of material processed at the MRF has increased by 37% since its initial operation in 1996. The MRF processed a total of 15,420 tonnes of dry material in 2004, which was made up of material from the following sources:

- 65% from the County municipal collection;
- 16% from the City of Kawartha Lakes; and,
- 19% from local businesses.

The County markets 15 materials from the inbound dry material stream. The recovered materials include old newsprint, corrugated cardboard, polyethylene (PET), high density polyethylene (HDPE), film plastics, steel, and mixed plastics. The total revenue for all material recovered at the MRF in 2004 was approximately \$1.4 million (refer to Table No. 1 in Appendix B).

The 2004 capture rate in the County is 204 kg per household per year.

3.4.1 Current County Recyclable Recovery Rate

Information gathered by Waste Diversion Ontario (WDO) in the 2004 Datacall indicates that the Countys dry program diverted an average of 204 kilograms per household per year of marketable recyclable material from the waste stream. This recovery rate is higher than the provincial average recovery rate of 178 kilograms per household per year, which indicates that the dry program has been an effective diversion system for the public.

The challenge facing the County are the rising costs associated with processing the current dry material stream entering the MRF. The low throughput rate (tonnages / hour) and high residual deteriorates the program efficiency on an annual basis. The processing costs at the MRF are problematic; therefore there is a need to review changes in the current material stream to enhance the program efficiency and effectiveness.

The 2004 recycling collection costs in the County were \$1.58 per household per month.

3.4.2 Current County Collection Costs

A two stream collection system offers potential for collection cost efficiencies. Collection contractors are not required to sort recyclable material at the curbside and can co-collect wet and dry material in a split truck system. The waste collection contract is a seven year contract that commenced in 2001. Collection of waste from year-round households is completed Tuesday through Friday, with collection in the seasonal areas being conducted on Mondays from May through October. In 2004, the municipal waste collection system collected at the curbside from approximately 35,000 households, 10,000 tonnes of dry waste and 8,311 tonnes of wet waste.

In 2004, the County Wet-Dry collection contract represented the lowest collection cost per household for Northumberland County waste and recyclables since the implementation of the County-wide collection program in 1992. Co-collection costs are \$3.97 per household per month. Based on Waste Diversion Ontario Tonnage Datacall calculations, approximately 41% of the collection costs are attributed to recycling, which represents a recycling collection cost of \$1.58 per household per month for a full County-wide curbside collection service to approximately 35,000 households over a predominately rural area.

County residents prefer bags to boxes.

3.4.3 Current Curbside Collection Efficiency

As part of the Wet-Dry system implementation, the County considered the importance of giving residents access to larger curbside collection containers with a dry system assuming that the standard blue boxes would have insufficient capacity to handle all of the dry stream material. At the time of program implementation (1996) the cost associated with providing and maintaining roll-out carts for all residents, in a rural demographic was not practical. To achieve flexibility for the resident with the Wet-Dry

collection program however, the County permits residents to set out dry material in the following containers:

- A blue box;
- A transparent clear or blue bag; and,
- A garbage can that is marked 'Dry'.

As the County program has matured, it has been observed that residents have chosen a preference for the transparent clear or blue bags.

A study entitled, [Northumberland Public Attitudes on Recycling Containers](#), (May 1998) indicated that:

“69% of the respondents ranked the see-through bag as the overall preferred recycling container, based on ease of use and reduction of wind blown litter.”

Further supporting the curbside bag based program, the survey conducted by Jacques Whitford in November 2005 as part of this study, indicated that almost 50% of the survey respondents preferred clear bags as the overall preferred recycling container when given the choice of blue boxes, blue bags or container marked 'Dry'.

[Refer to online survey results in Appendix D.](#)

3.5 MRF Operation



The County owns and operates the Material Recovery Facility (MRF) located in Grafton, Ontario. Currently, this facility is the only single-stream dry waste processing facility that is operating within the Province. The facility processes materials that are co-collected curbside with split (two compartment) vehicles designed to collect the wet and dry waste streams simultaneously (i.e. with one pass of the collection vehicle).

[Refer to Figure No. 2 in Appendix H which represents an illustration of the Northumberland MRF current processing structure \(flow\) through the facility.](#)

Receiving Material

All inbound material (i.e. material received at the MRF) is weighed and electronically tracked through a computer system, prior to entering the facility to determine daily material stream quantities and origin of material. The dry material arrives at the MRF Tuesday through Friday (4 days per week) each week. The MRF processing shift operates on a five day shift, Monday through Friday, 8.5 hours per day (5 days per week).

Typically, the dry material is delivered to the MRF semi-compacted, and deposited directly onto the facility tipping floor. The majority of the dry

material is contained in a clear or blue transparent plastic bag. The CofA for the facility stipulates that all material must be tipped inside the facility and outside storage of material (processed or non-processed) is not permitted.

Pre-Processing/Infeed



A loader removes each load from the tipping floor entrance and piles the material at the back of the tipping floor to ensure maximum space for maneuverability and to maintain inside storage capacity of all inbound and processed material. The loader operator is responsible for the feeding of the dry waste material onto an incline sorting conveyor that moves the co-mingled material into the first sorting station. This primary sorting station (C200 line or presort booth) is where bulky items such as large cardboard boxes, scrap metal, small appliances, residual, and bundles of newspaper are removed manually by sorting personnel and dropped into segregated sorting bunkers. Once the majority of bulky items are removed, the remaining smaller sized material flows out of the presort booth and drops onto a wide vibrating conveyor belt (bounce adhesion belt), designed to segregate flat material (fibre products) from round material (container products). At this point, material is mechanically segregated into two dry material streams; containers and fibres, with both material streams containing a portion of the residual waste in the dry stream.

Fibre Sorting



The flat material (primarily fibre) flows along a series of conveyor belts that lead to a secondary sorting station (C 500 line), where recyclable material such as smaller sheets of paper fibres, cereal boxes, smaller pieces of cardboard, as well as flattened containers, and aluminum foil, are manually pulled out of the dry waste material on the conveyor line by sorting personnel and deposited into segregated bunkers. Material remaining on the sorting conveyor flows out of the sorting stations and into a bunker designated for residual waste representing product that is either non-recyclable waste, contaminated recyclables or recyclable material that is missed by sorting equipment and personnel. This residual is disposed (currently by landfill).

Container Sorting

The container material that was segregated into a round category on the vibrating sorting belt flows through a series of automated sorting equipment (trommel screen, magnets, eddy current separators and, air classifiers) designed to further segregate small pieces of mixed broken glass and ceramic material and residual waste, magnetically separate steel from aluminum containers, and separate the lighter weight material (plastic containers) from the heavier material (unbroken glass bottles and jars). Once the container material is mechanically separated and the majority of the dry waste material has been removed from the sorting conveyor into

designated bunkers, further manual sorting of material is conducted to remove varying grades of plastic and glass.

All sorted material within the MRF is either baled or loaded into roll-off containers and stored within the facility until there are sufficient quantities for sale to market.

4.0 STUDY METHODOLOGY

4.1 Overview of Study Methodology

The consultant team initially established a baseline of information pertaining to the MRF and the material stream being processed at the MRF. By spending several days at the County MRF, along with the co-operation of County staff, observations of process flow, inbound material composition and, method of material delivery were completed by the consultant team. The team examined the effect a co-mingled dry system has on the following:

- Processing costs;
- Material quality;
- Material throughput rates;
- Residual waste rates;
- Facility capacity; and,
- Health and safety of the staff within the facility.

A composition analysis of inbound material was conducted to understand how material is being prepared by the homeowner as it reaches the curbside. A detailed residual waste audit was conducted on a two (2) tonne sample of processed residual from the Northumberland residential material to determine the following:

- Recyclable materials not captured in the current system (recyclable but non-processable);
- Marketability of the non-captured materials (recyclable contamination); and,
- The percentage of dry waste material entering the MRF (non-marketable and non-processable material).

Based on the information gathered from the baseline costs, the review of the inbound material composition and residual audits, the consultant team presented a preferred material stream composition to Northumberland County staff.

To determine the effect of the preferred material stream on the existing Northumberland equipment, a pilot test was conducted with material that was similar to the preferred material stream. A residual audit of the pilot material and the throughput rates were examined. The information gathered in the baseline review and audit work was presented to the public for feedback in the form of two (2) public meetings and an online survey.

Upon completion of the audit work and determination of preferred material stream an examination of equipment improvements was conducted by the consultant team. Recommendations on partial equipment replacements and anticipated cost recovery timeframes were also prepared.

Finally, a communications strategy and associated toolkit designed to assist County staff with the potential introduction of a new approach to source separating recyclables was developed recognizing the potential for impacts on participation and capture rates. Also, in this regard, consideration was given to some of the more system-wide implications of such change and related public reaction, which is discussed in the key findings section at the end of this report.

Detailed methodologies of specific tasks described above are outlined in the balance of this section.

4.2 Costing Methodology

As this project is funded under the Effectiveness and Efficiency Fund, all information must be restricted to residential processing only; therefore diversion rates and processing costs reflect material processed from the Northumberland County residential sector and excludes material processed from the IC&I sectors or materials arriving from outside the County boundaries (i.e. City of Kawartha Lakes).

Residential process costs gathered from the 2004 WDO datacall information were cross-referenced with the 2005 residential costs provided by County staff outlining MRF staff activities and associated residential sorting costs of the dry waste material.

4.3 Flow Methodology

To examine the effectiveness of a recycling facility processing operation, observations on how the material physically flows through the various sorting stations within the plant were conducted to determine common sorting challenges and processing inefficiencies.

In October 2005, throughput rates of the dry material were examined, by reviewing the total daily tonnage processing records maintained by County staff and comparing the data with on-site visual observations by the consultant team using a stop watch and recording sorter activities throughout the MRF. The observations included:

- Consistency of product flow on the sorting belts, (including frequency of belt stops, and burden depth of material);
- Sorter activities (including sorter time spent pulling material apart or spreading material on the belt to find recyclables); and,
- Health and safety considerations were part of the material flow observation as they directly impact processing throughput and overall MRF capacity.

4.4 Composition Methodology



A visual assessment of inbound material entering the MRF tipping floor was conducted to determine the percentage of loose material entering the MRF compared to bagged material. It was established that approximately 90% of residential inbound material was prepared in either transparent blue or clear bags. Random samplings of 50 inbound residential bags were gathered from various sections of the residential pile on the MRF tipping floor. With the assistance of MRF staff, each bag was cut open and the contents were examined and photographed by the consultant team.

4.5 Residual Audit Methodology (Northumberland and Pilot Audit)

The County is now at a point, based largely on the experience of operating its own MRF for over ten (10) years, of considering a more contemporary three-stream collection system (recyclable, organics, waste). The County also recognizes that these systems place greater onus on the generator (homeowner) to manage the materials they generate at source. Changes to the mode of source-separation and MRF material stream will have implications on the performance of the facility. These material stream changes must be considered, therefore it is important to examine the current composition of the inbound material stream to determine common trends in material preparation and to inspect what residents are including in their curbside recycling bag.

Equipment modifications are another consideration to improve the efficiency of the MRF however it is critical to review what is currently being missed in the processing system prior to implementing design changes.

Based on this information, it was determined that a detailed audit be conducted of the residential residual waste to understand:

- What material is entering the MRF;
- How material is prepared by the homeowner before it enters the MRF; and,
- What material is missed by the processing equipment and sorting personnel.

The County provided the consultant team with four (4) qualified MRF sorters to conduct the sorting of residual material. A sampling of residual was removed from the main infeed booth (C200 line) and the secondary fibre sorting line (C504), representing a total of two (2) tonnes of material. Material was sorted into the following categories:

- Non-recyclable (residual);
- Recyclable, non-processable (missed in process); and,
- Recyclable, non-economical (small pieces).

Once the material was sorted and weighed, a detailed waste audit of all three categories was conducted to determine overall composition. The audit classified material by weight into approximately 60 categories.

4.6 Equipment Review and Business Case Methodology

Using the information gathered from the preferred material stream review and discussions with County staff, the consultant team developed equipment modifications suitable for the new recycling material stream. Based on material stream review, the majority of material that is processed through the MRF represents a fibre category. Fibre sorting in the MRF has minimal automation and represents the higher revenue source for the facility. The container sort line within the MRF is fairly automated and consideration of modification to equipment on this line was not conducted based on current material volumes. Annual cost savings have been projected based on the implementation of a cleaner MRF material stream and the replacement and modification of equipment for the infeed and fibre sorting line of the facility.

4.7 Communication Strategy Methodology

The consultant team met with County staff to review the existing communication program and to determine the needs of the County. Through feedback from County staff, the consultant team prepared an online public survey that was accessible to residents within the County through the County website as well as hardcopy access from the County office, local municipal offices and the County MRF.

The availability of the survey was advertised in local media (newspaper and radio) to encourage participants to provide comment on what was considered effective communication tools within their service area. Residents were asked a series of questions designed to determine effectiveness of current education strategies the County is using and to determine response (negative or positive) to potential changes to the current recycling program.

The online survey received 112 partial responses from households within the County and 73 completed responses. **The survey responses represented household participants, therefore it may be estimated based on Statistics Canada household count that approximately 2.2 people reside per household therefore the survey responses represent a total of 160 people out of a total available population of approximately 85,000.**

In addition to the online survey, two (2) Public Open House Events were scheduled within the County (Brighton and Cobourg). The events offered computer access to the online survey as well as hard copy surveys. At the Open House events, participants were given a visual overview of the project including current MRF material stream challenges and proposed changes to the recycling system. **The Town of Brighton Open House experienced approximately twenty-five (25) attendees and the Town of Cobourg Open House had approximately 20 attendees.**

Based on the responses from the surveys and open house event, and assistance from the County Communication Coordinator, a communication tool kit has been developed to assist the County in preparation of a promotional strategy. **Refer to Appendix D for details of the Communications Tool Kit and recommendations.**

4.8 Consideration of Growth in County

To address growth in the County in the coming years, the following was considered and undertaken:

- Growth projections as they relate to population and expected future waste generation and characteristics were considered;
- The existing situation at the MRF with regard to material flow and available capacity were reviewed to assess whether any or how much capacity exists for growth given the status quo (i.e. maintenance of Wet-Dry system and existing equipment);
- Any increases to the material throughput rate from changes to the material stream and / or processing equipment were determined and then assessed with regards to the ability of the system / facility to operate efficiently and effectively into the future; and,
- The range of potential material stream (dry vs. expanded blue box) and equipment changes / modifications were considered in terms of a potential implementation timeframe and with regards to potential implementation triggers relative to projected County growth scenarios.
- Generally it was known going into the project that the current MRF processing system is already somewhat at capacity and unsuited to handle additional material. The implementation timeframe and triggers

are still being developed by the County and will be designed subject to initial County acceptance of recommendations.

- Refer to Section 14.1 and Tables in Appendix E for further details

PART B - DEFINITION OF BASELINE CONDITIONS

5.0 BASELINE COSTS

Baseline data was developed to examine key efficiency indicators including;

- Associated labour costs to sort residential material (recyclables and residual);
- Overall facility throughput;
- Residential residual rate; and,
- Material composition.

Details of the information are outlined within this section.

5.1 Residential Sorting Costs

23% of sorting cost is attributed to residual sorting.

The MRF has an average sorter complement of thirty (30) sorters per shift to process residential and IC&I material. Based on discussions with County staff, it was determined that approximately twenty-six (26) sorters are dedicated to processing residential material generated from Northumberland County. Within the residential sorter accompaniment, the following sorting costs have been determined:

- **Newspaper sorting represents 31% of residential sorting costs per year (\$298,261.00), 45% of material revenue per year (\$361,745.00), 30% of the total material marketed per year (3,158 tonnes);**
- Residual sorting represents 23% of residential sorting costs per year (\$223,696.00), 0% of the revenue share, 0% of the material marketed per year,
- Corrugated cardboard represents 15% of residential sorting costs per year (\$149,130.00), 30% of the revenue share (\$244,000) and 28% of the total residential tonnes marketed per year (2,929 tonnes),
- Plastic bags, which can be characterized as only the larger clean plastic bags (no grocery bags or plastic wrap) represent 8% of the share of residential sorting costs (\$74,565.00) per year, 0.1% (\$1,200.00) of the material revenue and 0.9% of the total residential tonnes marketed (99 tonnes) per year.

Detailed processing / costing information is available in Section 12.0.

The remaining sorting costs of lower volume material can be reviewed in the tables in Appendix B (refer to Table No. 2) outlining sorting costs per material.

The 2004 WDO datacall indicates that the gross annual cost to process residential material is \$1,936,049, with annualized revenue from the marketing of this material representing \$787,985. The 2004 net residential recycling cost for Northumberland to process 7,424 tonnes of co-mingled dry residential material is \$1,148,064, which represents a total processing cost of \$155/tonne or approximately \$33/household (approx. 35,000 households).

5.2 Residential Throughput

Currently, the MRF has a processing rate of approximately 5 tonnes per hour to process co-mingled dry residential material. The total MRF processing rate of all inbound material which includes residential and IC&I material is 7.8 tonnes per hour. **For the purpose of this study, the residential throughput rate of 5 tonnes per hour has been evaluated to determine that the MRF has a daily residential production rate of approximately 40 tonnes per day.**

CHALLENGE

Inbound material exceeds processing capacity.

The continuous operational challenge within the MRF is that the total inbound tonnage entering the facility averages 60 tonnes per day (50 tonnes residential and 10 tonnes IC&I material) resulting in approximately 18 tonnes of material that has not been processed remaining on the tipping floor at the end of an 8.5 hour processing shift.

5.3 Residential Residual Rate

The total residual waste from the MRF represents 30% of the inbound IC&I and residential material. **The percentage of residential residual is somewhat higher with 36% of the residential material diverted into the residual waste stream.** A high residual rate directly impacts the efficiency of the MRF processing costs. Currently, six (6) sorters are devoted to handling/sorting MRF residual, in addition to sorting costs; the following operational costs are associated with processing residual material:

- The Baler Operator and the Skidsteer Operator within the MRF dedicate approximately 30% of their daily operational time processing residual;
- Approximately 25% of baling wire cost can be attributed to baling the residual material; and,
- The hauling costs to deliver the material to the County waste disposal site.



5.4 Baseline Cost Summary

To maintain the current throughput rate of five (5) tonnes per hour at the MRF, limits MRF capacity and effectiveness. **In 2005, the MRF operated 23 overtime shifts to maintain throughput of the inbound residential**

Existing sorting equipment is operating at maximum rate.

material. The challenge facing County staff is that there is insufficient volume to justify a second shift but too much material to process on the current shift with the current staff complement (26 sorters). The sorting equipment and conveyors are running at maximum speed with the existing variable frequency drives, therefore material cannot be processed through the facility at a faster rate. Within this current facility structure (processing dry waste), to increase the sorter staff complement and the number of daily production hours within a shift, amplifies operational costs, which reduces the overall processing efficiency.

6.0 RESIDENTIAL MATERIAL FLOW

Throughout all sorting lines of the facility, the material depth on the conveyor belts is inconsistent. The efficiency of the material flow through the facility begins at the infeed belt where material is loaded directly onto the line by a front-end loader. If material is compressed or has a high concentration of dry waste within the mix (shrink wrap, carpet, rope) or corrugated cardboard, the material will not separate as it ascends the incline belt to the presort booth (C200 line). Sorters must stop the conveyor belt to be able to pull material apart and 'dig' into the pile to find marketable product.

In October, 2005, the consultant team found that during the course of a one-day facility visit, staff at the pre-sort booth stopped the belt 12 times during the processing shift for an average of 2 minutes per stop over the course of the processing day. The reasons for belt stoppages were as follows:

- High material depth (product too thick on the conveyor) requiring sorters to spread material around on the belt to effectively capture material;
- High waste contamination, whereby sorters must search through non-marketable material to uncover processable product;
- Hazardous waste contamination of pesticide or syringes causing the sorters to clear the area and run all the product remaining on the belt (marketable and non-marketable) directly into residual; and,
- Material was placed within smaller bags requiring sorters to spend time ripping open the bag to find marketable product or to default the entire contents of the smaller bag directly into residual in the interest of efficiency.

Handling solutions are included in Part E.

6.1 Material Flow Summary

The stopping of a conveyor belt represents lost productivity within the facility. The consultant team observed that the regular stopping of a conveyor belt over the course of the production shift reduced momentum and motivation of the employees within the facility thereby further reducing processing efficiency.

The consultant team also observed that film plastic has a constant presence throughout the facility as it is found on all sorting lines. The film floats to the surface of the infeed material on the conveyor lines causing it to enter into all material categories.

The team observed that film is removed at the first two sorting stations within the presort booth (C200 line) and any film that is not pulled off at this location, will flow through the facility. Film remaining on the sorting line covers other material or adheres to the material causing contamination and reduction in overall material capture rate as sorters must search for processable product underneath the film or pull film off of recyclable material.

The consultant team observed that the majority of the film entering the MRF was already contaminated by food waste or other material (flattened cans, grease, and paper) rendering the film non-marketable before it could be sorted on the C200 line. As a result, residual sorters within the presort booth divert the majority of film into the garbage bunkers. It was noted that recyclable material such as flattened aluminum beverage cans or pop bottles would often be attached to the film entering the waste bunkers causing greater potential for lost revenue of marketable material.

7.0 INBOUND RESIDENTIAL DRY-STREAM COMPOSITION AUDIT



To determine how residents prepare their blue box material prior to setting it out for collection, a composition audit was conducted from a sample of inbound residential recyclable material that had entered the MRF via the curbside collection vehicles. Observations included the following:

- 87% (43 bags) of the sampling contained recyclables and waste material nested inside smaller plastic shopping bags. Within the 43 sampling bags that had material nested within smaller shopping bags, every bag had at least one small shopping bag containing 100% non-recyclable material (razors, facial tissue, sanitary products, kitchen waste, cat litter, batteries, and diapers).



Residents deliberately hiding waste.

- Within the 43 bags that had material nested within smaller shopping bags 28 bags of the sampling had mixed containers (cans, glass and plastic) as the contents of the small shopping bags (Refer to side margin photos)
- Within the 50 bag sampling, 20% (10 bags) of the material contained no recyclable content and were completely full of non-recyclable dry material and wet waste organics (kitchen scraps, facial tissues, cigarette butts).

7.1 Summary of Composition Audit

There appears to be a high instance of residents within the County who are choosing to use shopping bags as their method of collection within their household. **In addition to the 'nesting' of material, residents are deliberately hiding waste material within shopping bags and placing the material in the bag dedicated for recycling that is collected at the curb and delivered to the MRF.** These observations emphasize the need for an aggressive public education campaign designed to instruct residents on proper household sorting techniques prior to placing material at the curbside. Another observation is that residents are actually taking the time to sort material into individual bags prior to placing material out for collection.

8.0 MRF RESIDUAL WASTE AUDIT

The MRF has two (2) main residual collection bunkers within the facility (C200 and C504). A composition audit was conducted for material contained in each bunker.

8.1 Pre-Sort (C200 Line) Audit

The following information was collected from the audit sampling of the bunker of the Pre-Sort line:

- Approximately 67% of the material by weight is classified as recyclable material (cans, paper, plastic) that is non-processable because it was bagged inside smaller bags or it was attached to waste material entering the bunker;
- An average of 23% of the material by weight is classified as non-recyclable waste material (Refer to side margin photos depicting, sanitary products, cigarette butts, razors, etc);
- Approximately 7% of the material by weight is classified as polycoat material that is recyclable but not economical to process because of material being inside smaller shopping bags or lost inside residual material such as rolled carpet or textile material;
- An average of 10% of the material by weight is classified as aluminium beverage containers that are recyclable but not economical to process because of material being flattened and adhered to another material or because of the cans being inside smaller shopping bags that were not ripped open by sorters;
- Approximately 9% of the material by weight is classified as PET material that is recyclable but non-processable because material was flattened and adhered to a waste product; and,
- Less than 0.5% of the material by weight is classified as hazardous material however any hazardous material encountered by sorting personnel is a health and safety concern within the facility and affects processing efficiency.
- Using the audit sample from the pre-sort line, and relating the current market value to the material, it can be anticipated that approximately **\$22,800 per year could be considered lost revenue from material that was not captured in the processing system of the MRF.**
- Refer to Appendix B for Waste Audit Data (refer to Chart Nos. 1 and 3) and Projected Lost Revenues (refer to Table No. 4).



8.2 Secondary Fibre Line Residual Composition (C504 Line)

The following information was collected from the audit sampling of the bunker of the C504 line (Refer to side margin photos for audit sampling procedure):



- Approximately 62% of the material by weight is classified as recyclable but non-processable paper. Most of the material consisted of single sheets of paper or pieces of ripped paper that are difficult to manually remove from the sort line due to material size;
- Approximately 13% of the material by weight is classified as recyclable non-processable aluminium. Based on audit information, an aluminium can weighs approximately 10 grams, therefore there is approximately 110 marketable aluminium cans within this waste stream sampling of 11 kilograms of aluminium;
- Approximately 6% of the material by weight is classified as recyclable non-processable polycoat containers. Most of the material consisted of loose polycoat that was clean and not adhered to any material; and,
- The remaining 19% of the material is classified by weight as non-recyclable dry material with no market value (organics, soiled material).
- Using the audit sample from the 504 sort line, and relating the current market value to the material, it can be anticipated that **approximately \$51,900 per year could be considered lost revenue from material that was not captured in the processing system of the MRF. Refer to table insert below.**

Table No. 1 Estimated MRF Residual Sorting Costs

<ul style="list-style-type: none"> ■ Average Residual Sorting Costs (6 sorters) 	<ul style="list-style-type: none"> ■ \$223,696.00
<ul style="list-style-type: none"> ■ Estimated Residual Processing Costs (baling and equipment operator costs) 	<ul style="list-style-type: none"> ■ \$31,500.00
<ul style="list-style-type: none"> ■ Average Residual Hauling Costs (to Brighton Landfill Site) 	<ul style="list-style-type: none"> ■ \$60,000.00
<ul style="list-style-type: none"> ■ Potential Lost Revenue (Refer to Table Nos. 3 and 4 in Appendix B) 	<ul style="list-style-type: none"> ■ \$74,700.00
<ul style="list-style-type: none"> ■ Estimated Total Costs (inclusive of projected revenue loss) 	<ul style="list-style-type: none"> ■ \$389,896.00

Refer to Appendix B for Waste Audit Data (refer to Chart Nos. 2 and 3).

CHALLENGE

MRF loses paper into residual. Refer to Section D for equipment upgrades.

8.3 Summary of Residual Audits

When considering the composition of the total material marketed from the MRF, only 30% by weight is represented by newspaper. Based on WDO datacall statistics, municipalities typically average a 50% paper fibre composition for their total materials sold to market. The audit indicates that Northumberland is losing paper fibres into the residual stream. Based on the information gathered in the material flow analysis and audit data, the high percentage of recyclable fibre entering the waste stream within the MRF appears to be a result of two key factors:

- First and foremost, the dry waste in the material stream:
 - Paper is a heavier product and will settle on the bottom of all the inbound material stream material that is sorted on the conveyor. Sorters must dig into the pile on the conveyor to extract the paper material.
- Second, the equipment design:
 - Paper is positively pulled off the sorting line because of the volume of dry residual in the infeed mix. If the contributing factor of the dry waste were removed from the material stream, an equipment redesign is possible that would include paper fibres having a negative sort off the line and contaminates (non-recyclable material) positively removed from the material, to offer a greater capture rate of fibres and increase throughput.

9.0 BASELINE DATA SUMMARY & PROBLEM DEFINITION

Baseline information gathered indicates that the current MRF material stream composition has approximately 20% dry waste (non-marketable material) when it enters the MRF prior to being sorted. Based on results of the audits, it can be determined that the presence of non-marketable material directly impacts the capture rate of marketable recyclable product. It can also be determined that the 'nesting' of material inside smaller shopping bags further increases the MRF residual rate.

- When considering the cost associated with processing residual is approximately \$389,000, benefits can be realized with a cleaner blue box material stream that does not incorporate dry waste. In addition to examining a cleaner material stream, consideration should be made on the potential of retrofitting or replacing existing equipment on the fibre sorting line with automated system designs to improve throughput.

- The container line efficiently processes the residential tonnages entering the MRF, with approximately two (2) sorters dedicated to the sortation of PET, HDPE, Mixed Plastic, Clear Glass and Coloured Glass.
- Based on current inbound material composition, the majority of material represents the fibre stream, therefore modifications to the container sorting lines is not necessary at this time. Increasing material throughput on the container line can be effectively done with the addition of manual sortation on this line. If the County were to enter into a long-term contract (5 to 10 years) to process container specific material (+5000 tonnes per year), there is justification for additional mechanical sortation systems (optical).
- Observed inefficiencies include;
 - The bounce adhesion belt (flat-round separator), does not efficiently segregate partially flattened containers from fibres. Based on visual observation, approximately 60% of the material volume crossing the belt is properly separated; therefore 40% of the material must be manually sorted. Material that cannot be efficiently sorted by hand defaults into the residual stream, therefore this unit requires modification.
 - The MRF infeed line does not effectively disperse the burden depth on the conveyor lines throughout the MRF and requires modification.
 - The fibre sorting lines within the plant require modifications and replacement to increase material throughput rates.

PART C - EFFICIENCY & EFFECTIVENESS REVIEW

10.0 DETERMINATION OF PREFERRED INBOUND MATERIAL

To ensure that any material stream change is not rejected by the residents of Northumberland, the preferred material stream should be as similar to the current program as possible to minimize impact on participation rates. Undoubtedly, there will be some negative impact on participation as with the Wet-Dry program, residents automatically are achieving in effect a 100% participation rate. The challenge will be maintaining the overall recyclable recovery rate within the modified program by way of ensuring that less recyclable material enters the residual stream within the MRF. Relying on the baseline cost data and waste audit information, the following materials were determined as undesirable material in the Northumberland dry waste material stream.

Material to Remove	What is it?	Why Remove it?	Alternative Destination
Textiles	Curtains, clothing, shoes, belts, stockings	Not marketable Reduces throughput Damages equipment	Diabetes Association drop boxes Local thrift stores
Scrap metal	Tools, wire, electronic equipment, automotive parts	Reduces throughput Damages equipment Health and safety issue	Scrap Metal Dealers or Scrap metal depots at Landfill
Kitchen Utensils	Frying Pans, cutlery, toasters	Reduces throughput Damages equipment Health and safety issue	Scrap Metal Dealers or Scrap metal depots at Landfill
Composite Plastics	Chip Bags, Cookie Bags, toys, phones	Not Marketable	Reuse Centre or Waste if not usable
Household items	Carpet and underlay, furnishings, mirrors, cups, glasses	Not Marketable	Reuse Centre or Waste if not usable
Outdoor Implements	Garden hoses, lawn ornaments, lawn chairs, inflatable pools	Not marketable	Reuse Centre or Waste if not usable
Seasonal Decorations	Christmas Lights, Christmas Trees,	Not marketable	Reuse Centre or Landfill if not usable
Polystyrene	Styrofoam meat trays, packaging Styrofoam	Cost to process No revenue	Bundle Styrofoam together
Film Plastic	Plastic bags, plastic wrap	Reduces throughput Damages equipment	Separate from stream Bag separately

11.0 PILOT TESTING OF PREFERRED MATERIAL STREAM

To effectively evaluate material stream options involves conducting a pilot test to determine the sorting efficiencies and residual rates. Pilot tests can be completed in two (2) ways:

Virtually

- Based on design, operational experience in similar facilities, and waste composition.

or

Physically

- By running a particular material stream through the facility and measuring the differences in sorting efficiencies and residual rate against the County baseline data.

In discussions with County staff and the consultant team, it was determined that the pilot test would be most effective if it was a physical representation of a material stream was similar to the preferred material stream.

To select a material stream to test through the Northumberland MRF, it is important to consider the following criteria:

- Choose a material generated from a municipal program with similar rural, urban and seasonal demographics;
- Select material that is collected at the curbside in a bag based program; and,
- Ensure that the material represents an expanded blue box stream.

Based on discussion with County staff, it was mutually agreed by the consultant team and staff members present, that the City of Guelph material is considered the most effective sampling material based on the following:

- The Guelph material has been a dry single stream since its inception (1996) therefore residents have been extensively educated on the dry single stream recycling sorting system.
- Guelph switched to single stream expanded recycling program (no dry) in 2004. It was anticipated that the single stream Guelph material may have dry contamination therefore it was important to determine material composition of Guelph material one year after implementation of their program changes.
- The Guelph material is predominately collected in a clear or blue bag, system which is critical to the evaluation of the current structure of the

Northumberland MRF single stream system as 90% of Northumberland inbound material is in a bagged based format.

- The Guelph single stream material is predominately co-collected split compaction vehicles, similar to Northumberland therefore the compaction ratio is compatible to the Northumberland MRF processing system enabling an accurate testing of single stream expanded recyclable material with 2:1 compaction ratio through the single stream equipment of Northumberland MRF that is currently processing a dry single stream mix.
- It was determined by staff and the consultant team that the Northumberland MRF was initially designed as a single stream facility, therefore it is cost effective to consider improvements to the existing single stream configuration by offering inbound material stream improvements and equipment retrofits to the areas of the MRF generating the greatest associated costs (residual and fibre sort). Alterations of the Northumberland MRF from a single stream facility to a two or more stream processing operation increases the risk of higher equipment modification costs as the Northumberland MRF configuration is designed specifically for single stream processing.
- The County stressed the importance of maintaining low curbside collection costs by maintaining co-collection of a single stream material and garbage with potential organic material in the future, as well as maintaining a high participation rate by reducing impact of overall program changes by ensuring minimal curbside sorting changes for residents.
- The material from the Guelph material stream represented an expanded recycling stream. Residents are instructed to include the dry waste portion of their waste stream in with their green garbage bag. In addition to eliminating the dry waste portion of the material stream, Guelph has instructed residents not to include film plastic, textiles or polystyrene in with their recyclable material based on marketability of the material and processing efficiency of the material. The City of Guelph determined that removing these items from their residential recycling stream, gave them the flexibility of incorporating fibre sorting screen systems to effectively segregate container material from fibre material.

The Guelph material stream includes the following list of expanded blue box materials:

- All paper fibre grades;
- All plastic containers;
- All aluminium and steel food and beverage containers; and,
- All clear and coloured food and beverage container glass.

11.1 Flow Test of Pilot Material



Approximately 95% of the material tested within the Northumberland MRF was contained in transparent blue bags. There was little evidence of material nested within smaller shopping bags and very little presence of film plastic within the material stream. Material entering the primary presort line (C200 line) still had a heavy burden depth but there was less clumping of material as it was fed throughout the MRF.



The paper fibres in the Guelph material stream entered the primary sort line (C200 line) in a loose state, with minimal cross contamination from other materials such as film plastic or waste products. Sorting staff indicated that the paper fibres were easier to remove from the sort line as there was less 'digging' through debris to find the paper on the bottom of the conveyor.

Based on the Northumberland MRF material stream, the staffing and equipment configuration within the MRF has paper being positively pulled from the sorting belts and residual remaining on the belt. With the Guelph cleaner blue box material stream flowing through the Northumberland MRF, sorters found that they were missing the capture of paper as there was too much marketable material to positively pull from the belt.

**Equipment modifications
= higher capture rate of
paper.**

Using the Northumberland processing configuration for sorting staff and equipment layout, the Guelph material stream had a processing throughput rate of 4.8 tonnes per hour, which was similar to the Northumberland throughput rate of 5 tonnes per hour. **The consultant team observed that the Guelph material stream would have a greater efficiency and effectiveness factor if the newspaper was negatively sorted (remained on the conveyor line) and contamination removed. With the current Northumberland material stream composition (dry waste), paper fibres cannot be negatively sorted from the conveyor system effectively or efficiently.**

11.2 Pilot Audit

Using data gathered in the audit of the Guelph residual audit, the following information was compiled:

- Approximately 75% by weight of the pilot material residue represented single sheet paper fibres or ripped pieces of paper fibres (single sheets of newsprint, torn pieces of boxboard, shredded office paper, torn envelopes, small pieces of corrugated cardboard);
- Approximately 10% by weight of the pilot residue represented a waste product (dry waste such as carpet, vacuum cleaner bags, garden hoses);
- Approximately 5% by weight of the pilot residue represented container material (partially flattened cans, glass, plastic bottles); and

**Continuous public
education is critical to a
successful program
change.**

- Approximately 2% by weight of the pilot residue represented film plastic which was primarily the larger plastic bags that were used for the curbside collection unit.

Refer to Appendix B for Pilot Audit Results (refer to Table No. 5).

11.3 Summary of Guelph Pilot Material Sort

The quality of the paper fibres that were positively removed from the sorting line was better than the paper fibre quality of the Northumberland material. There was no evidence of loose plastic film within the sorted fibre bunkers. There was minimal evidence of material nested inside smaller shopping bags.

The fibre entering the residual on the secondary fibre sorting line (C502 and C504 line) could not be efficiently removed from the Northumberland MRF sorting line by positive manual sort based on the size of the material. The majority of the material was less than 10 cm in width therefore sorters could not effectively grasp these smaller sizes.

There was a presence of a dry waste stream (approx. 10%) within the Guelph pilot material stream one (1) year after they converted their Wet-Dry system into a cleaner three stream system.

The conveyor sorting lines within the Northumberland MRF were running at maximum speed but sorters found the belt speed to be slow based on the reduction of dry waste product in the material stream. There were empty spaces on the sorting conveyor (due to inconsistency in product flow from the primary infeed line) causing sorting staff to be idle thereby reducing momentum and efficiency.

12.0 EVALUATION OF PREFERRED MATERIAL STREAM

Using information gathered in the material flow analysis, the residual audits and the pilot testing of the Guelph material, a preferred material stream was determined based on the following key performance indicators:

- Processing costs;
- Material quality;
- Material throughput rates;
- Residual rates;
- Facility capacity;
- Health and safety; and,

- Environment.

Based on these performance indicators, the consultant team recommends a preferred material stream that eliminates the dry waste residual component and incorporates some additional curbside sorting of the recycling stream. The recommended preferred material stream is as follows:

Table No. 1 Recommended Preferred Material Stream

CURRENT DRY PROGRAM	PROPOSED RECYCLING PROGRAM	HIGHLIGHTS OF CHANGES
Paper	Paper	No Change
Plastic Containers	Plastic Containers	No Change
Film Plastic	Film Plastic	"Bag your bags"
Non-Container Plastic	-	Remove from program
Steel Cans	Steel Cans	No Change
Other Steel	-	Remove from program
Glass – bottles & jars	Glass – bottles & jars	No Change
Textiles	-	Remove from program
Polycoat	Polycoat	No Change
Aluminum	Aluminum	No Change
Dry Waste	-	Remove from program

The baseline data indicates that the dry waste residue increases residual rates and sorting costs, reduces material throughput rates and diminishes tipping floor capacity.

Difficult Materials To Process

It has also been determined that plastic film and textiles in a co-mingled single stream material stream reduces the flexibility of updating processing equipment based on the material composition and the effect the material has on sortation screens. In addition to the impact on processing equipment upgrades, material such as polystyrene have high associated processing cost based on limited storage capacity and low revenue returns. An overview of these 'difficult material' is outlined in the following section.

12.1 Impact of Film Plastic on the Northumberland Material stream

Loose film is problematic. See preferred material sort list in Section 12.0.

The MRF only markets the film plastic that is removed from the primary presort line (C200 line) with the remaining film plastic sorted into the residual stream. **Film entering the MRF is loose inside the blue bags and once the blue bag is opened, the film 'floats' through the dry material and becomes mixed with various material causing sorting difficulties throughout the facility.**

County staff found that the film must be removed at the beginning of the facility (C200 line) and that all other film beyond this point is lost to residual

due to ability to manually capture product from the conveyor lines efficiently. The consultant team also observed that any film entering the MRF bundled together inside other plastic bags, could be easily removed from the sorting lines.

In 2004, the MRF marketed a total of 99 tonnes of film plastic, from the residential and IC&I sector, representing total revenue of \$15,240. Only thirteen (13) tonnes of the film plastic was generated from the residential sector. **Based on this data, film plastic entering the MRF from the residential sector represents annual revenue of \$2,000 per year, representing 0.25% of the annual revenue from the total sale of residential material in 2004 (\$787,985).**

The proposed equipment modifications to the Northumberland MRF will not effectively process film plastic in a loose state. The fibre screens will immediately jam when encountered with film plastic. The consultant team considered the impact of loose film plastic on equipment modifications and determined that the majority of the marketable product flowing through the MRF is fibre based; therefore it is important to offer equipment modifications that effectively and efficiently process fibre material.

Based on the MRF material stream composition, it is critical to improve the throughput rates of fibre (newspapers, boxboard, corrugated cardboard) and reduce sorting costs of this material to increase the efficiency factor of this system.

Film plastic in the Northumberland single stream MRF affects material throughput rates because of the limited opportunity to consider equipment modifications that can effectively handle film plastic and fibre material simultaneously.

Refer to Appendix B for Processing Costs (refer to Table No.2)

12.2 Impact of Textiles on the Northumberland Material stream

Divert textiles to clothing bins throughout the County.

The MRF has not been marketing textile material since 2005. Therefore, all textile material entering the MRF has been processed as material residual. The end markets for textiles could no longer accept the material processed by the Northumberland MRF due to high contamination levels from broken glass and odour, moisture, and dirt that the single stream MRF was generating. County staff found that textile markets prefer product that is dry, relatively clean and with no cross contamination of material that is 'non-textile'. **Textile markets have indicated to County staff a preference for textiles to be collected separately from blue box recyclables (i.e. textile drop boxes, monthly textile drives, etc).**

The proposed equipment retrofits for the Northumberland MRF will require that textile material to be removed in the presort station (C200 line) if the

County continues to collect the material. Textiles will immediately jam fibre screening equipment and reduce processing efficiency.

12.3 Impact of Polystyrene on the Northumberland Material stream

The MRF has not been marketing polystyrene since the end-market (CPRA) was shut down for approximately one year due to a fire in 2003. Based on information gathered from County staff, when the MRF was marketing polystyrene in 2003, approximately one (1) tractor trailer load of polystyrene was generated per year, representing an estimated total weight of five (5) tonnes. County staff outlined that in 2003, there was no revenue generation from the sale of the polystyrene based on the associated cost with processing, storing and hauling the material to market. Staff determined that due to the overall low volume of polystyrene entering the MRF, and costs associated with processing the material, that recycling this material was cost prohibitive.

As an alternative to polystyrene, the County commenced the processing of gable top and aseptic containers in 2003, when the polystyrene market was unavailable and determined that the MRF could generate approximately six (6) tractor trailer loads of this material per year. The annual tonnage pulled from the MRF dry stream represented twenty (20) tonnes per load, for total revenue of approximately \$7,900 per year. The County has continued to segregate polycoat and landfill polystyrene based on economics and volume.

When considering modifications to the single stream Northumberland MRF, it will be important to determine if the material stream will continue to include polystyrene. The inclusion of polystyrene based on the equipment recommendations of the Northumberland MRF, will require that this material be removed at the primary presort line (C200 line), prior to the material flowing throughout the MRF as this material will not sort effectively in the fibre sorting screens that are recommended to replace the bounce adhesion belt. Any polystyrene entering onto the fibre sorting line will require manual removal as material coming off the end of this sort line.

12.4 Summary of Preferred Material stream

The recommended preferred material stream eliminates the presence of all dry waste material as well as the inclusion of non-dry waste material such as film plastic, textiles and polystyrene. To recommend exclusion of material that is classified as recyclable is typically a sensitive issue with municipal Council and staff. The recommendation to remove film plastic, textiles and polystyrene from the preferred material stream category is primarily based on the current single stream configuration of the MRF and secondarily on the overall operational costs associated with handling and storing the material.

Due to the inability to maintain the higher standards of the textile markets, it is recommended that textiles not be diverted through the single stream MRF as the product becomes degraded to the point that it is considered a waste stream. It is recommended to segregate this material and divert it through agencies such as the Canadian Diabetes Association or other Goodwill agencies within the County.

If the County is to consider the inclusion of film plastic and polystyrene in the preferred material stream, it will be important to instruct residents to conduct some minor sorting in the household prior to placing the material at the curbside. Some possible 'home-sort' recommendations are:

- Ensure residents place all recyclables 'loose' inside the transparent bag (clear bags are easier to see through than blue bags);
- Do not include loose plastic film plastic in with other recyclables;
- Bag all plastic film in a separate clear bag and place beside recyclables; and,
- Bundle all polystyrene together.

County staff may choose to conduct a test of preferred curbside sorting practices with members of Council and the Public Liaison Committee to determine effectiveness and efficiencies.

A comprehensive public education plan is needed to support changes to the material stream.

12.5 Communication and Education Strategy

Public education is critical to the success of the new recycling program. To fully educate the residents of Northumberland County on the preferred material stream sorting structure is the most important tool available to increase the effectiveness and efficiency of a single stream MRF. **The communications tool kit that is provided in Appendix D offers a source of public education information for the County to assist with the development of their communication strategy.** Based on the information outlined within the tool kit, there are four (4) key principals of effective promotion and education that are apparent within the specific activities and strategies in the tool kit:

- Develop an identity for the new recycling program;
- Ensure consistency of the promotion for the recycling program;
- Communicate the message regularly and to a large target audience; and,
- Maintain professionalism in method of communication delivery.

In order to assist the County with the promotion of their waste diversion initiatives, the project team also completed two specific tasks. The first task

was a review of existing promotion and education (P&E) tools from the County and other Ontario municipalities.

The results of the review of materials are included herein. We considered over 30 tools including some new ideas that have not yet been implemented.

The other task that we completed is that we included a specific question in the survey of residents of the County “Which of the following waste communications tools have you noticed? Pick as many as apply.” The table below summarizes the results.

Table No. 2 Current Communications Tools Survey Results

Promotion and Education Tool	Percentage of Respondents who noticed tool
Calendar	91%
Weekly column in community newspaper	55%
Watershed Magazine or Go Magazine	34%
Northumberland County Web site	30%
Waste Hotline (1-866-2wetdry)	25%
Info on the back of the waste bag tags	20%
New resident package	11%
Fridge magnets	11%
Ad in telephone book	7%
Radio ads	2%

12.6 Analysis

Northumberland has the foundations of a solid communications program. Like many other municipal programs, however, there are a number of suggestions on how to improve your existing P&E tools to ensure overall effectiveness. **Specific recommendations from the consultant team can be found in Appendix D.**

In addition, there is an overall need to secure regular feedback and to continuously improve the County communication system. It is important to monitor the success of promotion and education tools in ways that will help County staff determine which tools are most effective, which is important when dealing with limited budgets and resources. The survey question that we included as a part of the public consultation step suggests for example that the calendar is a very effective tool whereas radio ads go virtually unnoticed.

PART D - MRF EQUIPMENT REVIEW

13.0 MRF EQUIPMENT REVIEW

The existing equipment is ten (10) years old and therefore it is necessary to consider replacement and retrofits due to routine wear on the machinery. The current equipment infrastructure within the MRF is based on systems design that was used in the industry over fifteen (15) years ago therefore some of the equipment has become obsolete as new technology has improved within the past decade. Newer sorting screens and faster belt drives increase material productivity, reduce overall processing costs and increase facility capacity.

Based on the recommended equipment modifications for new material stream entering the Northumberland MRF, material throughput has the potential of increasing to approximately 10 tonnes per hour. A critical factor to the effectiveness of improved throughput rate is ensuring that the dry portion of the material stream is removed from the program and that loose film plastic is eliminated in the inbound material stream by having Northumberland residents conduct preliminary 'pre-sorting' activities prior to placing material at the curbside.

Overall, it is estimated that the equipment retrofits will be approximately \$800,000, assuming equipment is financed over a ten year period, the annual cost is approximately \$111,000/year (assuming 6.5% annual cost of capital). Offsetting this cost at a minimum is the reduction in the production hours for the facility. **Based on the current tonnages entering the MRF, the equipment retrofits will eliminate the requirement for the 23 scheduled overtime Saturday shifts that occurred in 2004, representing a savings of approximately \$118,000 in sorter wages alone.**

In addition to the elimination of scheduled overtime, further sorting costs are realized as equipment retrofits double the throughput rate per hour (from 5 tonnes to 10 tonnes per hour) and the residual rate decreases from 36% of the total inbound residential material to 15% of inbound material. The residual rate is impacted by the removal of the dry waste from the material stream and complemented by the increase in material belt speed, and replacement of the bounce adhesion belt with a fibre sorting screen.

When the County develops a tender for equipment retrofits, it is recommended that the tender stipulate that the equipment supplier provide proper installation and commissioning of the equipment to ensure throughput rates on the new material stream. It is also important to maintain consistency with equipment component purchases, and reduce the

amount of varying equipment manufacturers supplying different processing components to the Northumberland MRF. Using equipment that is compatible with the existing system (CP manufacturing and Machinex) eliminates processing flow problems and overall system costs.

In summary, the Material Recovery Facility is only as effective as the material that is fed through the system. Equipment modifications and retrofits will have less of an impact on overall MRF performance and throughput rates if the material stream contains compacted dry waste material which incorporates loose film. Based on the pilot test of the Guelph material stream material the consultant team and County staff observed that a portion of residual material still remained in the material stream a full year after the program changed from Wet-Dry to three stream

Refer to Appendix C for the Equipment Review and Cost Analysis.

PART E - RECOMMENDATIONS

14.0 SUMMARY

The County has a proactive waste management system with strong support from its residents. Currently, the Northumberland MRF is the only single stream dry waste processing facility within Ontario. The facility has been the receiver of several awards from the Recycling Council of Ontario based on its overall diversion effectiveness. To maintain the program effectiveness and to be able to take advantage of the technological advancements of new recycling sorting equipment, Northumberland has realized the importance of reviewing the current MRF material stream and equipment design.

The challenges facing the Northumberland MRF are:

- The sorting equipment and conveyors are running at maximum speed, therefore material cannot be processed through the facility at a faster rate;
- Approximately 62% of the material entering the MRF residual on the 'flat' sorting lines (C500 lines) by weight is classified as recyclable but non-processable paper. Most of the material consisted of single sheets of paper or pieces of ripped paper that are difficult to manually remove from the sort line due to material size.

Removing the dry waste component from the Northumberland material stream will have a positive impact on the following key performance indicators of the facility:

- **Throughput Rate** - potential to increase from five (5) tonnes per hour to the original commissioning rate of eight (8) tonnes per hour without changing equipment design.
- **Residual Rate** - potential to reduce residential residual rate from 36% to 20-25% within a single stream enhanced recycling stream.
- **Processing Costs** - potential to reduce residual handling costs by approximately 60% based on changing of the material processing flow through the MRF (negatively sort the newspaper).
- **MRF Capacity** - reduce the number of overtime shifts by 70% based on less sorting time spent on residual material.
- **Health and Safety** - reduce the number of instances of staff injury from handling the mixed waste product.

By taking it one step further and asking residents to conduct a small amount of at-source sorting preparation of the recycling material

(bagging the film separately, removing textiles and bundling Styrofoam) offers an additional impact on the performance indicators by offering the flexibility of implementing equipment retrofits;

- **Throughput Rate** - provides flexibility to incorporate fibre sorting screening to replace bounce adhesion belt, representing a potential increase in throughput rate to ten (10) tonnes per hour.
- **Residual Rate** - opportunity to reduce residual rate of the single stream MRF to approximately 15% to 20% (dependent on extent of public education and curbside collection frequency).
- **Processing Costs** - opportunity to reduce residual handling costs by approximately 80% and reduce the number of staff dedicated to sorting non-marketable material (offers greater flexibility to enable the MRF to process additional material from recycling contracts outside Northumberland boundaries).
- **MRF Capacity** - potential to eliminate the required overtime shifts and offer shift flexibilities.
- **Health and Safety** - potential to further reduce the risk of injury from manually sorting material with the retrofit of automated fibre equipment.

14.1 Consideration of Growth in Northumberland County

Growth projections as they relate to population and expected future waste generation and characteristics were examined using information gathered from the County Economic Development Office. Projected population growth for the year 2021 is anticipated to reach 108,188 people. Considering the existing County-wide participation rate per household (200 kg/hh/year or approximately 7000 tonnes per year, of recyclable material) it can be anticipated at this generation rate, that by the year 2021, approximately 9000 tonnes of blue box material can be generated from the residential sector alone.

Considering the current throughput rates of the Northumberland dry waste processing system (36% of inbound material represents a dry waste component) by the year 2021, it is anticipated that the County MRF would receive in excess of 16,000 total tonnes of material (12,500 tonnes generated from the residential sector). Based on this scenario, the MRF would require two shifts within the next 3 to 5 years and potentially double their processing costs while still maintaining a high residual rate (perhaps higher depending on equipment maintenance scheduling between shifts). It is anticipated that the existing equipment would require full replacement after a few years of a double shift, based on overall system wear due to material composition and throughput. **Refer to Appendix E for MRF Tonnage Projections and Population Growth**, which outlines

Northumberland MRF projections with current dry waste stream and no equipment retrofits.

If the County chose to remove the dry component of the recyclable material stream, it is anticipated that the original processing rate of the equipment would be achievable. The equipment was commissioned at an average rate of 8 tonnes per hour however; this was using source separated non-compacted blue box recyclable material. It is likely that the County material stream would contain a certain level of contamination (waste) and compaction therefore, it is probable that the processing rate would average 6 tonnes per hour representing an annual processing rate of 10,600 tonnes per year compared to the current processing rate of 10,080 tonnes per year.

To maintain the dry waste stream and incorporate equipment retrofits is not recommended due to risk of the dry material causing 'jams' in the screens and thereby reducing overall throughput. [Refer to Appendix E for more details on the impact of MRF capacity with existing dry waste stream and equipment retrofits.](#)

To remove the dry waste component from the recycling stream and retrofitting the fibre sorting portion of the MRF (based on largest material volume and highest percentage of material currently entering the residual stream) the County has the potential to increase their annual MRF capacity by approximately 50% (17,000 tonnes per year). Considering the impact of population growth and the current recycling generation rates within the County, the equipment retrofits can be considered sustainable over the next 15 years. If the County choose to increase tonnage participation rates with an aggressive diversion program (i.e. two bag limit on garbage, and source separated organic program, multi-residential and seasonal population campaigns) then the County has capacity to process the additional volume without impacting the overall system costs due to extra wear on equipment with additional shifts.

15.0 RECOMMENDATIONS

The recommendation of removing the dry waste stream component from the Northumberland material stream is considered an effective method of improving the MRF effectiveness and efficiency. When considering changing the dry material stream to an expanded recycling material stream, the following recommendations are put forward for consideration:

- 1) If the County is to consider the inclusion of film plastic and polystyrene in the preferred material stream, it will be important to instruct residents to conduct some minor sorting in the household prior to placing the material at the curbside.**

- 2) **Instruct residents to bag their film plastic material separately from other recyclable materials. Refer to photos of sample 'at-source' sorting in Appendix F.** Residents are already pre-sorting their recyclables at the curb by choosing to use shopping bags as their internal method of separation within their household. If they are taking the time to sort material into individual bags prior to placing material out for collection there should be minimal impact on the residents to ask them to separate film plastic from the remaining recyclables and to bundle their polystyrene.
- 3) It is recommended that **textiles not be diverted through the single stream MRF** as the product becomes degraded to the point that it is considered a waste stream and is inefficient to processing within the MRF. It is recommended to segregate this material and divert it through agencies such as the Canadian Diabetes Association or other Goodwill agencies within the County.
- 4) Incorporate a **'phased-in' approach** to the program changes, to ensure residents understand the changes. Observations of the Guelph material indicated that there were still dry components within the recycling stream a full year after program implementation which amplifies the importance of an ongoing education program after the program launch year.
- 5) Conduct an **aggressive education campaign** a minimum of one year prior to equipment modifications and maintain the campaign during the program change, with a continual and positive approach to the forthcoming changes. Hosting open house events, conducting MRF tours, and presenting to school groups outlining the proactive changes Northumberland is doing to improve the recycling program, is all critical to maintaining positive reinforcement on program improvements.
- 6) Consider the need to **conduct waste and recycling audits and curbside set-out audits to determine 'pre-program composition and participation rates,** then conduct a follow-up audit six months to a year after program launch to determine gaps in the education program and common sorting issues.

APPENDIX A

WDO Efficiency and Effectiveness Graph

APPENDIX B

Waste Audit Data and Material Processing Costs

APPENDIX C

Equipment Review and Cost Analysis

APPENDIX D

Communications Tool Kit and Online Survey Results

APPENDIX E

MRF Tonnage Projections and Population Growth

APPENDIX F

Report Photographs

APPENDIX G

Glossary of Terms

APPENDIX H

Material Recovery Facility Process