Volume 1: Executive Summary

A Study of the Optimization of the Blue Box Material Processing System in Ontario
Final Report

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Prepared for Waste Diversion Ontario by:

Resource Recycling Systems
Sustainable Systems for a Waste-Free Future

STEWARDEDGE

Volume 1: Executive Summary

At the direction of Waste Diversion Ontario's Municipal Industry Program Committee (MIPC) a request for proposals (RFP) was issued by the Continuous Improvement Fund (CIF) to undertake *A Study of Optimization of the Blue Box Materials Processing System in Ontario* on October 12, 2011. The CIF subsequently recommended and received direction to undertake consultation on the methodology and assumptions of the study.

Study Objectives

The objectives of the study were to produce a model that would:

- Theoretically reflect a cost-effective, efficient and successful recovery system for packaging & printed paper in Ontario, and
- Inform decision-making toward an optimized provincial system for the transfer, hauling and sorting of Blue Box recyclables for market

Study Deliverables

- A computer model and project data
- Model output consisting of maps, tables and charts
- High-level transition plans
- A report documenting the model, analysis and output

Study Scope

1. Model an optimized (greenfield) system of Materials Recovery Facilities (MRFs) and transfer stations (TS) to handle a standard suite of materials province-wide
2. Compare that to existing public and private infrastructure and conditions
3. Identify gaps in the existing infrastructure
4. Develop options to guide the transition to an optimized system, taking into consideration the costs, benefits and trade-offs
5. Propose a high-level plan for the transition

Consultation

In developing the optimization modelling tools and the analysis presented below, the Project Team consulted with municipalities and private sector waste management companies regarding details of the approach to the analysis and the assumptions used. This was accomplished through three events:

- Ontario Recyclers Workshop – April 18,2012
- Ontario Waste Management Association
  - 2 meetings – February 22, 2012 and April 13, 2012

CIF and AMO staff also kept municipal staff informed of the project and solicited their input through updates in the December 2011 and March 2012 issues of the CIF newsletter "Connections", the spring 2012 ORW invitation and post ORW follow-up survey and website postings. The comments received were summarized and where applicable have been incorporated into the report.

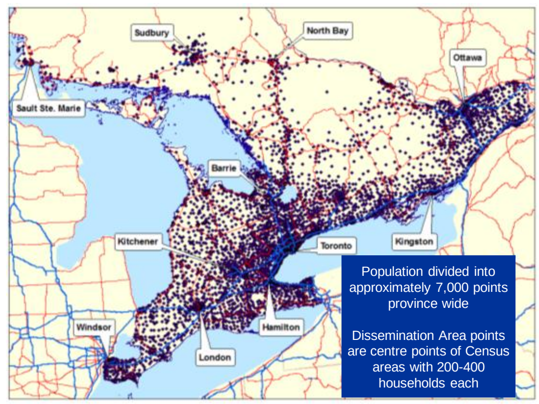
Structure of Report

This report has ten volumes:

1. Executive Summary
2. Methodology & Model
3. Cost Modelling
4. Eastern Ontario
5. Central Ontario & GTA
6. Southwestern Ontario
7. Northern Ontario
8. Transition Plans & Decision Trees
9. Consultation Report
10. Province-Wide Summary & Study Conclusions

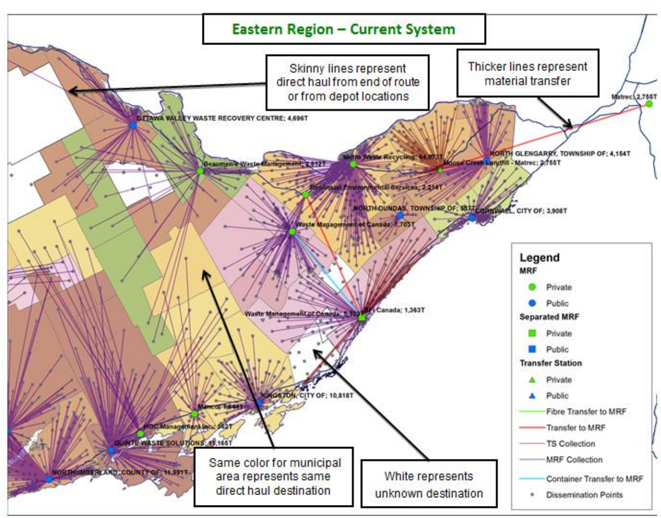
Model Overview

- The model was built using ESRI's ArcGIS for Desktop v10
  - Geo-statistical Analyst and Network Analyst tools
- Model Capability
  - Represent existing and alternate systems
  - Adjust volume to be processed for targeted year
  - Determine waste sheds
  - Determine direct haul and transfer haul routes
  - Determine facility locations, size and capabilities (MRFs, transfer)
  - Assess system costs (processing and transfer)
  - Assess the effect of changing key parameters



Existing Transfer & Processing System

- Maps document where material is flowing
  - direct haul from collection routes or depot locations, transfer & processing
  - includes all public and private Blue Box facilities
- They are based only on WDO data, CIF and Stewardship Ontario studies and knowledge
- On the direction of the project Steering Committee, there has been no direct contact with municipalities to verify information
- Maps have been developed for each region of the province
  - East, Central/GTA, Southwest & North



Existing Transfer & Processing System Cost

- Cost data reported by municipalities for 2010, verified by WDO and stored in the WDO Database have been used as the basis of cost estimates for the existing system
  - these data represent the most current and complete data on the actual cost of Ontario's Blue Box system
- However, since this analysis covers processing and transfer alone, there are many limitations to these data because in many instances municipalities report combined figures because of the structure of contracts
- Therefore, data for programs that reported processing costs and revenue separately were extracted and used to estimate the cost of programs for which data were not reported explicitly
- Approximately 77% of the cost is the actual reported cost, while the remaining 23% is modelled either on the actual cost in similar representative programs or on a theoretical unit cost

	Tonnes	Annual Capital & Operating Cost ($)
Cost data from 27 of the largest 30 programs + 5 smaller programs for which processing and revenue are reported separately	767,914	$93,633,000
Theoretical costs for the remaining 3 of the 30 largest programs	38,689	$4,596,000
11 smaller programs with cost data for which processing and revenue are reported separately	7,915	$1,508,000
Estimate of costs for the 177 small programs based on the 11 representative smaller programs	72,725	$13,860,000
Total Processing	887,242	$113,596,000
Theoretical transfer cost for known transfer operations	284,363	$9,505,000
Transfer cost for programs with unknown material flows based on costs from known transfer operations	3,487	$117,000
Total Transfer	287,849	$9,622,000
TOTALS	**887,242**	**$123,218,000**

Projected 2025 Transfer & Processing System Cost under Natural Growth

- The cost of the Existing System has been projected to 2025 to compare to the Optimized System options estimated for 2025
- The cost of the Existing System in 2025 is expressed as a range +/- 5%, reflecting that:
  - tonnes recovered will increase due to population growth and natural growth in recovery rates
  - the change in composition toward lighter weight, more complex and in some cases lower value material will tend to result in a higher management cost

	Tonnes	Annual Capital & Operating Cost ($)
Cost data from 27 of the largest 30 programs + 5 smaller programs for which processing cost and revenue are reported separately	901,067	$104,328,000 - $115,310,000
Theoretical costs for the remaining 3 of the 30 largest programs	45,955	$5,122,000 - $5,122,000
11 smaller programs with cost data for which processing and revenue are reported separately	11,366	$2,131,000 - $2,355,000
Estimate of costs for the 177 small programs based on the 11 representative smaller programs	88,066	$15,944,000 - $17,623,000
Total Processing	1,046,453	$127,524,000 - $140,409,000
Theoretical transfer cost for known transfer operations	351,235	$10,662,000 - $11,410,000
Transfer cost for programs with unknown material flows based on costs from known transfer operations	4,207	$125,000 - $132,000
Total Transfer	355,441	$10,787,000 - $11,542,000
TOTALS	**1,046,453**	**$138,311,000 - $151,951,000**

Waste Generation Estimates

- Stewardship Ontario (SO) waste generation figures have been used for current generation based on:
  - waste audits conducted from 2005 to 2007 under the Effectiveness and Efficiency Fund administered by SO
  - trends in stewards' sales data from 2007 to 2010, provided by SO
- Projections for 2025 reflect changes to material composition and population, assuming:
  - household and population growth are equal
  - a 20% increase in population from 2012 to 2025 based on Statistics Canada figures
  - changes to material profile based on:
    - qualitative research on lifestyle, technological and economic trends[1]
    - quantitative trends over recent years
- Generation in 2025 is estimated to be 1,511,086 tonnes, an overall increase of about 15% over current (2010) generation of 1,312,350 tonnes

Material	Assumed Change to Per Household Generation	2025 Generation (tonnes)
Newspaper	-40%	242,227
Telephone Books	-75%	3,175
Old Magazines	-25%	76,121
Other Printed Paper	10%	153,352
OCC	35%	283,329
Gable Top	40%	24,303
Paper Laminants	25%	61,784
Aseptic	40%	7,266
OBB	0%	157,159
PET	30%	73,642
HDPE	-10%	30,091
PS	-50%	12,957
Film	-10%	53,681
Plastic Laminants	30%	53,417
Other Plastics	60%	108,704
Aluminum Food & Beverage Cans	-10%	23,297
Foil and Other Aluminum	-10%	4,108
Steel Cans	-20%	46,669
Aerosol	0%	5,152
Paint Cans from Steward Reports	-30%	4,422
Food & Beverage Glass Clear	-30%	65,290
Food & Beverage Glass Coloured	-30%	20,940
Total Generation		**1,511,086**

Recovery Estimates

- Current Recovery
  - based on data reported by municipalities into WDO Datacall
- Projections for 2025
  - Two different scenarios were modelled
  - *Natural Growth*: trends continue, but no substantially different approaches or initiatives
  - *High Recovery*: system is enhanced to:
    - collect a consistent set of materials
    - promote them widely
    - ensure best practices in collection to provide access and incentives
- The total tonnes recovered in 2025:
  - Natural Growth: 1,007,700 tonnes
  - High Recovery: 1,181,6000 tonnes
- The assumed changes in composition and recovery result in a reduction in loose density of collected materials of about 30%

Material	Current 2010	Natural Growth 2025	High Recovery 2025
Newspaper	97%	98%	98%
Telephone Books	97%	98%	98%
Old Magazines	97%	98%	98%
Other Printed Paper	56%	60%	75%
OCC	87%	88%	95%
Gable Top	34%	50%	75%
Paper Laminants	1%	5%	30%
Aseptic	12%	30%	75%
OBB	55%	60%	80%
PET	61%	65%	75%
HDPE	57%	60%	75%
PS	4%	10%	50%
Film	6%	15%	40%
Plastic Laminants	1%	1%	10%
Other Plastics	19%	40%	60%
Aluminum Food & Beverage Cans	50%	55%	75%
Foil and Other Aluminum	9%	20%	50%
Steel Cans	61%	65%	75%
Aerosol	28%	30%	50%
Paint Cans from Steward Reports	18%	20%	50%
Food & Beverage Glass Clear	89%	90%	95%
Food & Beverage Glass Coloured	71%	72%	80%
Total	**68%**	**67%**	**78%**

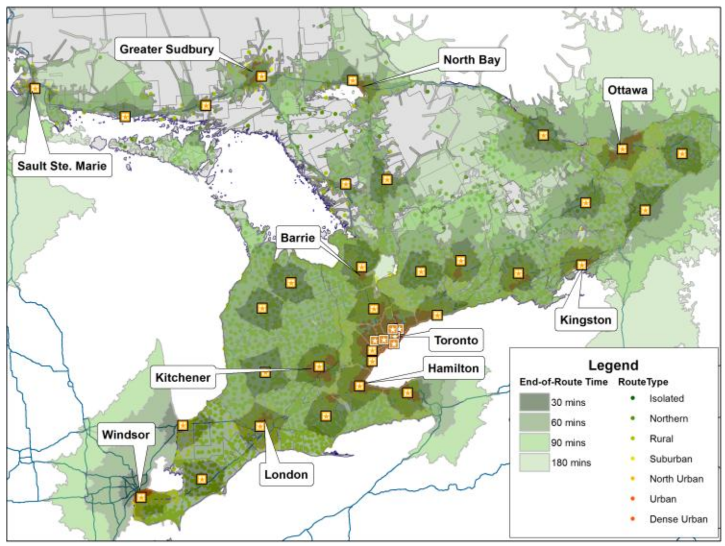
[1] Research undertaken by Kelleher and Associates for the City of Toronto in 2010 and provided by Toronto staff

General Model Assumptions

- General model assumptions include:
  - A standard list of materials accepted province wide
  - A move toward single-stream collection
    - This approach provides a conservatively high cost estimate for processing since single-stream processing generally is more expensive than multi-stream processing
    - Some dual stream transfer stations and MRFs are assumed for some options in the North
- Municipal boundaries are removed from the analysis and transfer stations (TS) and MRFs would be placed based on location of material

Points of Aggregation

- Aggregation points are located based on assumptions about how far material likely would be hauled from collection routes or depot locations according to the population density or proximity to population centres
  - Shading on the map presented represents the limits of different haul times from collection routes or depot locations
- The minimum number of aggregation points is determined given the quantities and location of material
- Any aggregation point could be a MRF or transfer station



Economic Haul Distance

- A key variable in the GIS transportation model is the distance that material can be transferred economically from a transfer station to a hub MRF
- This parameter is determined by comparing the cost to load and haul the tonnes at each transfer station and process them at a regional destination MRF to the cost to build and operate a MRF locally
  - Cost curves have been developed to define the relationship between processing cost and throughput, covering both capital and operating cost
  - Corresponding cost curves have been developed for transfer cost at different throughput
  - From these curves the relationship between haul distance and throughput was developed

Base MRF and Transfer Station Model Assumptions

- Detailed cost models have been developed to simulate transfer and processing operations
- MRFs and transfer stations of different sizes were modelled considering all capital, labour and operating costs, except the cost of land
- These costs were based on:
  - Operating parameters in existing facilities in the US and Canada
  - Good management and operating practices and systems
  - State-of-the-art technology
- Amortised capital was included in all operating costs
- Separate estimates for initial capital investment consider whether greenfield facilities or existing facilities are assumed to be used
  - The cost of upgrading or converting existing facilities was estimated and included in initial investment costs where applicable

Cost Parameters

Assumptions have been made for the following key parameters

- All building and equipment capital costs for MRFs and TS
- Wage rates for all labour
- Sorting productivity for labour
- Operating costs – maintenance, utilities, etc.
- Residual rates
- Compaction rates
- Overhead – financing, taxes and profit, etc.
- Land cost excluded, as highly variable

Sensitivity Analysis

- An analysis was conducted to understand the sensitivity of the results to changes in key variables, summarized below

Fuel Cost

- Doubling the fuel cost from current cost to over $2.50/L would decrease the economic haul distance by 30%
- This would affect only 1 potential transfer in the modelled options:
  - Waterloo to Hamilton
  - All other modelled transfers still would be economical
- This would increase overall system costs by 4.3% in the scenario with the highest haul distances

Compaction

- A 20% reduction in tonnes per truck was assumed in all baseline scenarios
  - due to the 30% reduction in loose density of material resulting from assumed changes to material composition and recovery, together with an increase in compaction
- An analysis was conducted of the sensitivity to maintaining payloads at current levels
- This would reduce overall system costs by 2.2% in the scenario with the highest haul distance

Sorter Productivity

- Reducing sorter productivity by 26% (from 1.35 to 1.0 tonnes/sorter/hour) would reduce economic 1-way haul distance by 20%
- It also increases operating cost of the large MRFs by 10%
- The only modelled transfer that would be affected by this change is that from Waterloo to Hamilton
- This would increase overall system cost by 6.2% in the lowest cost scenario with the largest MRFs

Expanded Polystyrene and Film Plastic

- The sorting of expanded polystyrene and film is addressed by increasing the number of sorters in greenfield MRFs to handle the amount of these materials collected in Ontario over past 3 years
- Adding this requirement to all MRFs increases the total system cost by 4.1%

Development of Options – Starting Assumptions

- Modelling was done for four regions: Eastern Ontario; Central Ontario & GTA; Southwestern Ontario; Northern Ontario
- Modelling covers transfer loading and hauling and processing, but excludes collection
  - the potential effect on haul times is acknowledged, but the impact is not determined
- Private sector facilities were identified that could be included in the system
  - greenfield cost estimates were used to represent private sector operations since no cost and capacity data were available for them
- Facilities outside Ontario were identified that could potentially provide capacity
  - greenfield cost estimates were used to represent such operations since no cost data were available for them

Development of Options – Steps 1 to 4

1. Modelling addressed each region independently, noting that material that is part of one region in the baseline can flow to a neighbouring region depending on the options being modelled
2. First a baseline was established
   - this is the greenfield, natural growth scenario with the lowest number of MRFs
3. Then options were established
   - the number of MRFs was increased
   - the cost implications for the natural and high growth scenarios were defined
   - the potential benefits, e.g. redundancy, were identified
     - if the benefits were not considered significant, no further options were considered
4. Then variations using different numbers of existing facilities were considered:
   - A. Nearby public facilities with a population base similar to or greater than the greenfield aggregation points were used instead of greenfield points
     - the same number of transfer stations as the greenfield scenario was maintained
   - B. All existing public facilities were used, replacing nearby greenfield aggregation points, either the greenfield hub MRFs or the transfer stations
     - by doing this the number of aggregation points was increased to reduce the impact on the end-of-route haul time and therefore possibly collection costs
   - C. All existing public and private facilities were used either as the greenfield hub MRFs (if feasible) or as transfer stations
     - this minimizes the impact on end-of-route haul times and therefore possibly collection costs

Presenting the Results for Each Region

- No single system has been recommended for a given region since there were no discussions with municipal officials and to acknowledge the need to consider local factors and criteria and analyse collection impacts
- Maps for each region for the greenfield system and options are included in the report, showing:
  - the existing infrastructure, the flow of material to aggregation points and the transfer to MRFs
  - the quantity of material handled at each location
  - the total cost per tonne for transfer, haul and processing at each aggregation point
- Tables are included for each region, summarizing for each option:
  - the number of facilities
  - the required conversions of existing MRFs to TS and upgrades to existing MRFs and TS
  - the total annual capital and operating cost of the option
  - the investments in new facilities and conversions
  - the relative effect on direct haul among options
- The implication on neighbouring regions was quantified when material moved from one region to a different region than in the baseline so that the cost was not counted twice in the province-wide summary

Province-Wide Summary

The following table summarizes the savings of an optimized province-wide transfer and processing system over the existing transfer and processing system under different criteria.

Natural Growth	Total Annual Cost*	Total Annual Cost with Excess Capacity*	Percent Saving from Low Estimate of Projected Existing System Cost	Percent Saving from High Estimate of Projected Existing System Cost
Lowest Cost Scenario	$106,481,000	$111,805,050	19%	26%
Increased redundancy in Central Region	$107,787,000	$113,176,350	18%	26%
Increased redundancy in SW,C,N Regions	$113,510,000	$119,185,500	14%	22%
Lowest Cost No Collection Impact	$112,438,000	$118,059,900	15%	22%

* Costs include capital, labour and operating costs

** To be conservative, the costs of province-wide optimized options are increased by 5% to reflect the inclusion of additional excess capacity to that already built into the design and modelling

The table compares the lowest cost greenfield option (i.e. all new facilities), which is the baseline for each region and which have fewer MRFs, to:

- an option with an additional MRF in the Central Region
- an option with an additional MRF in each of the Southwestern, Central and Northern regions
- the lowest cost MRF option that minimizes the effect on collection systems
  - in this scenario existing municipal and private MRFs replace (where feasible) the hub MRFs in the greenfield options and all other existing facilities are used as transfer stations so that existing direct haul locations do not change

- The table shows that savings ranging from 14% to 26% below current transfer and processing system costs can be achieved through optimization of the system
- The optimized system for each region does not have to get to the minimum number of MRFs to realize significant savings

The following table presents the capital requirements in each of those optimized system options.

	Total capital for new MRFs	Total capital for upgrades to Existing MRFs	Total capital for new TS	Total capital for conversions from MRF to TS & upgrades to existing TS	Total
Lowest Cost Scenario	$201,940,600	$0	$42,270,000	$0	$244,210,600
Increased redundancy in Central Region	$201,295,000	$0	$40,180,000	$0	$241,475,000
Increased redundancy in SW, C, N Regions	$246,423,700	$0	$33,910,000	$0	$280,333,700
Lowest Cost No Collection Impact	$113,395,800	$37,065,000	$5,730,000	$25,700,000	$181,890,800
Lowest Cost Scenario Utilize Existing Facilities	$113,395,800	$37,065,000	$15,095,000	$10,595,000	$176,150,800

- The table shows that using existing facilities generally lowers the capital cost and initial capital investment and reduces the impact on collection

Summary of Regional Options

Eastern Ontario – Volume 4

Options considered for the Eastern Region include:

- Baseline (minimum facility analysis):
  - A MRF in Ottawa
- Option 1 (exploring the benefits of introducing additional MRF capital to provide redundancy and competition):
  - Add a MRF in Kingston
- Variations A,B & C explore the potential effects of using existing facilities (Step 4 of developing options described on page 7)

Conclusions that can be drawn from the analysis for the Eastern region are:

- Savings can be achieved in this region by reducing the number of MRFs from 12 down to 1 state-of-the-art MRF that would anchor the processing and transfer system
- In the Eastern Region, adding a second MRF in Kingston increases costs by 10% but may have some benefits for maintaining competition in the area
- In the Eastern Region, maximizing the use of existing facilities as transfer stations increases operating costs by 7% (higher than the other regions) but has minimal impact on capital costs
  - This is an exception to the general rule that the options with the lowest initial capital investment cost maximize the use of existing facilities and lower the impact on collection costs

- This is because much of the capital saving typically comes from the use of existing municipal MRFs and no options consider using existing municipal MRFs in the Eastern Region

The optimized Eastern Region system is based on the baseline:

- Having a regional MRF in Ottawa is the recommended solution, and
- Using existing facilities as transfer stations (e.g. RARE and Cornwall) may further optimize the system by minimizing impact on direct haul costs (not quantified in this study) that may offset the 7% increase in operating costs for the processing system

Establishing Ottawa as the hub MRF location and then balancing direct haul costs and the proposed transfer station network cost will be key to moving towards an optimized system for the Eastern Region.

Central Ontario – Volume 5

Options considered for the Central Region include:

- Baseline (minimum facility analysis):
  - 2 MRFs in Toronto
  - 1 MRF in Peel
- Options (exploring the benefits of introducing additional MRF capital to provide redundancy):
  - Option 1 - Add a MRF in Durham
  - Option 1-Ba - Add a MRF in Barrie instead of Durham
  - Option 2 - Add a MRF in Barrie and Durham
- Notes:
  - Adding a MRF in Durham, pulls material from Kingston in the Eastern Region
  - Variations A,B & C explore the potential effects of using existing facilities (Step 4 of developing options described on page 7)

Conclusions that can be drawn from the analysis for the Central Region are:

- Savings can be achieved in this region by reducing the number of MRFs from 15 down to a minimum of 3 state-of-the-art MRFs that would anchor the processing and transfer system
- In the Central Region, adding a fourth MRF in Durham increases costs by 4% and a fifth MRF in Barrie increases costs by 6%
  - The optimized system for this region does not have to get to the minimum number of MRFs to realize significant savings
- In the Central Region, maximizing the use of existing facilities as transfer stations increases operating costs by only 5% and decreases capital costs by 23%

The optimized Central Region system may utilize more than the minimum number of MRFs:

- Regional hub MRFs would be situated in Peel and Toronto East and West as well as potential hub MRFs in Barrie and/or Durham
- It should utilize as many existing facilities as possible
- Given the large volume processed in this region, this approach provides the greatest redundancy, with minor cost impacts, and also minimizes impact on direct haul (not quantified in this study) that might offset the 5% increase in operating cost for the processing system

Thus, developing primary hub MRFs around Toronto and possibly secondary hub MRFs are promising options to moving towards an optimized system for the Central Region.

Southwestern Ontario – Volume 6

Options considered for the Southwestern Region include:

- Baseline (minimum facility analysis):
  - A MRF in Hamilton
  - A MRF in London
- Options (exploring the benefits of introducing additional MRF capital to provide redundancy):
  - Option 1: Add a MRF in Windsor
  - Option 1-So: Add a MRF in Southfield, Michigan instead of Windsor
  - Option 1-Wa: Add a MRF in Waterloo instead of London
  - Option 2: Add a MRF in Waterloo and London
  - Option 3: Add a MRF in Niagara
- Notes:
  - Adding the MRF in Waterloo brings in tonnes from the Bruce Peninsula area that were being sent to the Central Region in other scenarios
  - Variations A,B & C explore the potential effects of using existing facilities (Step 4 of developing options described on page 7)

Conclusions that can be drawn from the analysis for the Southwestern Region are:

- Savings can be achieved in this region by reducing the number of MRFs from 16 down to a minimum of 2 regional state-of-the-art MRFs that would anchor the processing and transfer system
- Developing a MRF in Waterloo instead of London increases the cost by 4% and replaces an existing asset with no obvious benefit
- Adding a Waterloo MRF in addition to London and Windsor increases costs by 7% but still achieves significant savings
- In the Southwestern Region, maximizing the use of existing facilities as transfer stations increases the costs by 7%, but could result in possible benefits from a lower effect on collection costs, especially given that long hauls already exist in the current system

The optimized Southwestern Region system could utilize more than the minimum number of MRFs:

- In the lowest cost option the transfer from Waterloo to Hamilton is at risk to escalating fuel costs
- Further using existing facilities in the Waterloo/Guelph areas as transfer stations lowers the impact on direct haul from collection routes
- This optimized strategy builds on the existing London MRF to anchor the processing and transfer system
- Given the large volume processed in this region, this approach provides greater redundancy with minor cost impacts, and also minimizes impact on direct haul (not quantified in this study), potentially offsetting the 7% increase in operating costs for using additional existing facilities

Developing additional supply into a London hub MRF together with a greenfield Hamilton hub MRF is likely a key part of moving towards an optimized system for the Southwestern Region.

Northern Ontario – Volume 7

Options considered for the Northern Region include:

- Baseline (minimum facility analysis):
  - A MRF in Sudbury
  - A MRF in Thunder Bay
  - A MRF in Winnipeg if available
- Option 1 (exploring the benefits of introducing additional MRF capital to provide redundancy):
  - Add a MRF in Timmins
- Notes:
  - Thunder Bay cannot economically haul to Winnipeg with the predicted tonnage for the area
  - Variations A,B & C explore the potential effects of using existing facilities (Step 4 of developing options described on page 7)

Conclusions that can be drawn from the analysis for the Northern Region are:

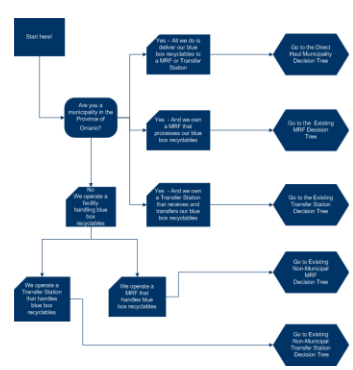
- Savings can be achieved in this region by reducing the number of MRFs from 14 down to a minimum of 3 state-of-the-art MRFs (though smaller in scale than optimum given the low density of the region) that would anchor the processing and transfer system
- Adding a fourth MRF in Timmins increases costs by 6% but still realizes significant savings
- Maximizing the use of existing facilities as transfer stations has minimal impact on operating costs and capital costs due to the low volumes, lack of existing facilities and the long haul distances
  - This means that decisions on transfer station locations should be based on direct haul collection optimization, not on the location of facilities determined by this processing optimization model

The optimized Northern Region system could utilize more than the minimum number of MRFs

- Regional hub MRFs should be situated in Sudbury, Thunder Bay and Winnipeg as well as a potential hub MRF in Timmins, and
- The optimal solution should utilize as many existing facilities as possible to minimize the effect on direct haul and to lower the capital investment

Thus, developing three primary hub MRFs and potentially a secondary hub MRF in Timmins could form an optimized system for the Northern Region.

Transition Plans



The transition path from current facilities and operational arrangements to more optimized Blue Box recyclables processing will vary for each current municipal MRF and/or transfer station location and for each community that delivers Blue Box material to that location.

A transition planning process has been prepared that provides a flexible and responsive road map for each of these municipal MRF and/or transfer station locations and affected communities to provide guidance for consideration and implementation of the most suitable approaches for optimization of the Blue Box recycling processing system. The transition road maps are not intended for privately-owned MRFs or transfer stations. However, municipalities should consider contracting with private sector facilities where applicable.

Transition road maps for the following types of situations have been developed:

- An existing municipal MRF will either a) remain a MRF in current or upgraded form; b) convert to a transfer station; or c) no longer have a role in the Blue Box system (i.e. be a stranded asset)
- An existing municipal transfer station (TS) will a) remain a TS; or b) no longer have a role in the Blue Box system (i.e. be a stranded asset)
- A new greenfield MRF or TS in a new location may be required and some communities with no facilities or with facilities that will become stranded assets may need to sponsor development of, or commit tonnage to that new greenfield MRF or TS
- Communities that are not directly sponsoring a MRF or TS in the new system (referred to in the guidance documents as "direct haul communities") will need to choose the MRF or TS facilities to which they will deliver their Blue Box recyclables, i.e. existing municipal facilities, new greenfield facilities or existing private sector facilities.

The transition plans outline key steps that will be unique to each location and situation. Specific information for the transition in each region is presented in Volumes 4 through 7, including the list of hub MRFs, the potential roles of existing facilities and the location for delivery of materials from each municipality under each option. The detailed transition decision processes are presented in Volume 8.

Study Conclusions

Computer modelling of the Blue Box materials transfer and processing network for Ontario has been completed. The results, together with the guidance documents presented in this report and summarized below, provide guidance on how stakeholder decisions can move towards an optimized system over time. The transfer-processing model tool and the data that drive it are now available to help define what an optimized, cost effective and efficient recovery system can be for the province.

Based on results from use of the computer model the following five conclusions can be drawn:

1. *Reducing the number of MRFs reduces overall processing and transfer system costs:*
   - Cost savings province-wide range from 14% to 26% as presented in the Province-Wide Summary table presented on page 8
   - Savings vary depending on number of MRFs and transfer stations in the system
   - The province could be served with as few as 9 MRFs (8 in Ontario and 1 in Winnipeg)
   - Increasing from the minimum number of MRFs to 16 MRFs province-wide increases the overall capital and operating costs by about 11% over the lowest cost scenario and could achieve additional redundancy and ensure greater competition among service providers
2. *The lowest cost modelled system is the one with the fewest MRFs, however regional dynamics will dictate how much savings can actually be achieved by getting to the minimum number of MRFs*
   - Regional dynamics arising from the characteristics of material generation density and geography, the location, capability and condition of the existing infrastructure and current contracts affect the potential savings
   - In the Eastern Region with Ottawa as the only major population center, adding a second MRF in Kingston significantly increases the overall capital and operating costs per tonne by 10% ($100.32/tonne to $110.64/tonne) over the lowest cost scenario
   - In the Southwestern Region in which the population is more widely distributed in cities adding MRFs to those proposed for Hamilton and London in the lowest cost, fewest MRFs scenario has

a less significant increase of 2% ($97.46/tonne to $99.85/tonne) in the overall capital and operating costs per tonne

- In the Central and Northern regions adding MRFs to the lowest cost, fewest MRFs scenarios increases the capital and operating cost per tonne by 4% ($96.13/tonne to $99.79/tonne) and 6% ($164.69/tonne to $175.34/tonne) respectively

3. *The key to the hub and spoke system is highly efficient medium and large MRFs running 2-shifts per day*

- In the lowest cost, fewest MRFs scenario, processing costs still constitute 77% of the total transfer and processing system cost
- These highly efficient MRFs operate with a capacity ranging from 100k - 200k tonnes per year and have target operating costs of $71 - $78 per tonne when operating at full capacity
- The supply of material from the less dense areas (accessed through hub and spoke supply strategies) enables these efficiencies to be realized; for example, according to the model, a MRF in London (the “hub”) with just its own tonnes would have an operating cost of $114 per tonne, however, with the additional tonnes from regional transfers (the “spokes”) this operating cost can be reduced to $86 per tonne
- Transfer loading costs, including capital and operating costs, add between $14 and $34 per tonne depending on the size of the operation and these additional costs must be offset by lower MRF processing costs to justify the hub and spoke system
- The target operating costs for the MRFs can be reached through a combination of new equipment, new process design, and better management and operating practices and systems

4. *Material can be transferred economically long distances*

- Utilizing transfer stations allows smaller communities to accept a wider variety of materials (the standard suite of materials), while constructing a MRF locally that could separate such a wide variety of materials would be cost prohibitive
- The distance that a transfer station can economically haul depends on how many tonnes are aggregated there and what size of MRF is available to receive the materials
  - The fewer tonnes at the aggregation point and the larger, more efficient the receiving MRF, the farther the material may be transferred economically; for example, a transfer station with 5,000 tpy could economically haul 790 km to a medium sized 2-shift MRF or 830 km to a large sized 2-shift MRF
- The hub and spoke system will not be significantly affected by high increases in fuel costs
  - All but the largest long distance transfers (i.e. Waterloo to Hamilton) are significantly shorter than the maximum economical haul distance and will not be affected significantly, even by a doubling of the fuel cost

5. *Collection costs need to be studied to fully understand savings potential*

- The lowest cost scenarios achieve their efficiencies through consolidation of transfer stations and this can have a significant effect on collection routes, depending on the final location of these transfer stations – and quantifying that impact was not part of this study
- Collection impacts vary due to differing equipment utilized, the distances from the end of collection routes or depot locations to these aggregation points and local private infrastructure
- Modelled scenarios using all current infrastructure as transfer stations and thus having no impact on existing collection haul distances still showed 15% - 22% cost savings on the

processing and transfer cost over the Existing System, as presented in the Province-Wide Summary table on page 8

- The specific location of transfer stations can be adjusted with little effect on the overall regional or province costs
  - There is less than a 1.5% impact from moving the location of some of the transfer stations from the greenfield model to existing sites

Possible Next Steps

In order to achieve the benefits of optimization, the following would be required under the existing legislative and regulatory framework and the shared responsibility between industry and municipalities:

- Information needs to be provided to key municipal staff and decision-makers at regional and local level, regarding:
  - the level of potential system savings
  - guidance for transition planning depending on the situation
  - analysis of the capital investment requirements
  - additional analysis about impacts on local collection system
- Support is required for municipal staff and decision-makers to assess and evaluate the options, and
- A commitment and process is required to share the benefits and allocate costs equitably among all stakeholders

Therefore, potential next steps are:

- Present the results of this report to the municipalities focusing on the specific region and its implications
- Convene stakeholder groups, both the host community for a proposed hub or spoke location, as well as the affected communities that would haul to those MRFs, so that their specific concerns can be addressed in the development of a transition process
- Identify and establish mechanisms for sharing of benefits of the optimized system among all stakeholders
- Where applicable, study the impacts of differing options on local collection systems
- As the dialogue develops about any hub and spoke sub-system in a region then actual costs or next stage engineering estimates can replace those used in the model's database, allowing the model to more accurately inform decisions on hub and spoke development
- Potential merchant capacity should be taken into consideration – using best practice procurement approaches and public private partnership strategies to bring the best business deal and pricing to the public agencies as they seek to find their role in a more optimized system; this includes the question of how to utilize private sector capacity that is being built even as this study is being assembled