Regional Municipality of Durham

Pre-Sort / Transfer & Organics Management

Preliminary Business Case Financial Analysis

June 2017

GHD

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Appendices

Notice

Ernst & Young Orenda Corporate Finance Inc. ("EY") and GHD limited ("GHD") (collectively, the "Consultants") was engaged by the Regional Municipality of Durham (the "Region" or "Clients") to investigate the inclusion of mixed waste processing and organics management of the Region's waste streams.

This Report was prepared on the Client instructions solely for the purposes of the Client. It should not be relied upon for any other purpose. The Report is based on objective analysis and information provided to us by the Client and third parties and does not necessarily represent EY view, comments, conclusions and opinions.

The Report may not have considered issues relevant to all third parties. Any use such third parties may choose to make of the Report is entirely at their own risk and we shall have no responsibility whatsoever in relation to any such use and to the fullest extent permitted by law we do not accept or assume responsibility to anyone other than the Clients for our work, for this report or for the opinions formed.

We have not undertaken any form of investigation, audit, substantiation or verification procedures for the information, data and projections provided to us. We have not sought to verify the accuracy of the data or the information and explanations provided.

Our work has been limited in time and a more detailed / lengthy exercise may reveal material issues that this review has not. No obligation is assumed by EY to revise this Report to reflect any circumstances or information that become available subsequent to the date of this Report.

1. Introduction

Ernst & Young Orenda Corporate Finance Inc. ("**EY**") and GHD limited ("**GHD**") (collectively, the "**Consultants**") in collaboration with the Regional Municipality of Durham (the "**Region**" or "**Durham**"), conducted a financial analysis for the mixed waste pre-sorting and organics management project (the "**Project**"). This report provides an overview of the methodology used to perform the financial analysis and highlights the outcomes of the analysis.

2. Assessment Methodology

The Consultants developed a robust cash-flow financial model (the "**Model**") to conduct a financial analysis of the Project. This involved establishing a period by period cash-flow profile for each option based on procuring the Project on a "like for like" basis (i.e. assuming consistent timeline, specifications, performance standards etc.). The Model included the analysis of the following options:

- Status quo option;
- Pre-sort/merchant capacity option;
- Pre-sort/in-vessel composting option; and
- Pre-sort/anaerobic digestion option.

For each of the options, the Model calculated a cash-flow profile that was adjusted for the time value of money by discounting them using an appropriate discount rate to provide a Net Present Value ("**NPV**").

The NPV was calculated as the sum of the net present value of all the revenues and costs of the Project during the construction and operation phases over the 20-year projection period.

The preliminary business case had been predicated on assessing organic processing system options in addition to the status quo. In this context, the status quo was not considered viable, as it does not address the study drivers and was, therefore, concluded to not be a go-forward option for the Region.

Each of the options include a mixed waste pre-sort facility and transfer station (pre-sort) to process the mixed waste to harvest recyclables and organics. Three organics processing options were evaluated and included merchant capacity, in-vessel aerobic composting and anaerobic digestion. Typical costs for the design and construction of the in-vessel and anaerobic digestion options were utilized for the assessment. An option was included to consider merchant capacity for SSO and organics from the mixed waste pre-sort system.

The objective of the analysis was to compare forecasted net operating cash-flows between the pre-sort/merchant capacity option, the Pre-sort/in-vessel composting option and the pre-sort/anaerobic digestion option. Key assumptions used in the analysis are highlighted below. A detailed assumptions table can be found in Appendix A.

- 20-year projection period
- Mixed waste pre-sort capacity based on 160,000 tonnes per year to reflect growth over time, with various levels of recovery of metals and hard plastics, and recovery of 80 percent of organics fraction from mixed waste
- 110,000 tonnes per year of organics processing to include existing and future SSO tonnages, and tonnages of the organics fraction from the mixed waste pre-sort system

- Excess capacity at the organics facility sold and excess capacity created at the DYEC as a result of reduced volumes also sold
- No revenues from cap-and-trade funding or offsets, or from high-value biogas sales from anaerobic digestion systems
- Inflation and escalation for consumables and operating costs over time, and a 5 percent discount rate
- High and low capital and operating costs for mixed waste pre-sort, in-vessel anaerobic composting and anaerobic digestion systems were taken from costs noted for constructed facilities, and merchant capacity costs were estimated

3. Model Outputs

3.1 NPV Results

As highlighted above, the Model calculates the NPV of the current status quo and the three other options with the objective to conduct a comparative analysis of the forecasted net operating cash-flows. High and low estimates have been applied to the three options to provide a range for the total net operating cash flow on a NPV basis. The net operating cash flow calculated on a nominal basis can be found in Model.

Status Quo Option

The forecasted net operating cash flow for the status quo option is -$279 million on a NPV basis as shown in the table below:

Option	Category	NPV
Status quo option	Revenues	$8,080,013.80
	Operating costs	-$287,448,516.83
	Net operating cash flows	**-$279,368,503.03**

Pre-sort/Merchant Capacity Option

The forecasted net operating cash flows for the pre-sort/merchant capacity option range between -$496 million and -$634 million as shown in the breakdown in the table below.

Option	Category	Low (NPV)	High (NPV)
Pre-sort/merchant capacity option	Revenues	$30,807,731.94	$30,807,731.94
	Construction costs	-$32,202,674.66	-$37,444,970.54
	Operating costs	-$493,311,839.60	-$625,478,339.52
	Ancillary costs	-$1,646,282.14	-$1,646,282.14
	Net operating cash flows	**-$496,353,064.46**	**-$633,761,860.26**

Pre-sort/In-Vessel Composting Option

The forecasted net operating cash flows for the pre-sort/in-vessel composting option range between -$445 million and -$548 million as shown in the breakdown in the table below.

Option	Category	Low (NPV)	High (NPV)
Pre-sort/in-vessel composting option	Revenues	$81,950,216.27	$90,975,360.56
	Construction costs	-$100,071,683.76	-$173,182,988.73
	Operating costs	-$423,877,333.43	-$463,154,277.00
	Ancillary costs	-$2,548,800.11	-$2,548,800.11
	Net operating cash flows	**-$444,547,601.02**	**-$547,910,705.27**

Pre-Sort/Anaerobic Digestion Option

The forecasted net operating cash flows for the pre-sort/anaerobic digestion option range between -$446 million and -$555 million as shown in the breakdown in the table below.

Option	Category	Low (NPV)	High (NPV)
Pre-sort/anaerobic digestion option	Revenues	$93,356,979.19	$102,382,123.49
	Construction costs	-$96,561,217.77	-$140,418,639.51
	Operating costs	-$440,099,278.87	-$513,830,043.29
	Ancillary costs	-$2,774,429.60	-$2,774,429.60
	Net operating cash flows	**-$446,077,947.05**	**-$554,640,988.91**

One of the key sensitivities that were tested on the pre-sort/anaerobic digestion option is to the impact of the method of energy use on the net operating cash flows. Going from the biogas assumed in the base case to electricity generation results in a net operating cash flows between -$416 million and -$525 million, which represents approximately $30 million net benefit on an NPV basis.

As demonstrated in the results above, all the options analysed require an increase in overall costs when compared to the status quo option. As noted, however, the status quo option does not represent a viable option going forward, as it does not fully address the Project's key drivers and objectives.

3.2 Incremental Analysis

An incremental analysis was performed to illustrate the incremental cost/benefit of each option when compared to the status quo option and the pre-sort/merchant capacity option.

The incremental analysis of the status quo option against the pre-sort/merchant capacity option, the pre-sort/in-vessel option and the pre-sort/anaerobic digestion option shows the variances in revenues, construction costs, operating costs, and ancillary costs. The following tables highlight the difference of

moving from the status quo option to the other three options. The net operating cash flows are broken out into their respective components and include both a low and high NPV.

Incremental analysis	Category	Low (NPV)	High (NPV)
Status quo and pre-sort/merchant capacity	Incremental revenues	$22,727,718	$22,727,718
	Incremental construction costs	-$32,202,675	-$37,444,971
	Incremental operating costs	-$205,863,323	-$338,029,823
	Incremental ancillary costs	-$1,646,282	-$1,646,282
	Incremental net operating cash flows	-$216,984,561	-$354,393,357
Status quo and pre-sort/in-vessel composting	Incremental revenues	73,870,202	82,895,347
	Incremental construction costs	-$100,071,684	-$173,182,989
	Incremental operating costs	-$136,428,817	-$175,705,760
	Incremental ancillary costs	-$2,548,800	-$2,548,800
	Incremental net operating cash flows	-$165,179,098	-$268,542,202
Status quo and pre-sort/anaerobic digestion	Incremental revenues	85,276,965	94,302,110
	Incremental construction costs	-$96,561,218	-$140,418,640
	Incremental operating costs	-$152,650,762	-$226,381,526
	Incremental ancillary costs	-$2,774,430	-$2,774,430
	Incremental net operating cash flows	-$166,709,444	-$275,272,486

Incremental analyses of the pre-sort/merchant capacity option against the pre-sort/in-vessel option and the pre-sort/anaerobic option were also conducted but not included in this overview but can be found in the Model.

4. Sensitivities

The following sensitivities were run in the financial model to study the impact of the following on the NPV of each option:

- Utilizing electricity in the pre-sort/anaerobic digestion option instead of biogas assumed in the base case
- Using a discount rate of 3% versus the base case discount rate of 5%
- Using a discount rate of 7% versus the base case discount rate of 5%
- Increasing inflation rates by 1% including general inflation, operating inflation and revenue escalation
- Decreasing inflation rates by 1%, including general inflation, operating inflation and revenue escalation
- Excluding revenues from sale of excess capacity from in-vessel composting and anaerobic digestion systems
- Applying a 2% decrease in growth to the tonnages
- Applying 60% organics recovery rate to the tonnages instead of the 80% assumed in the base case
- Decreasing organic waste in the tonnages
- Decreasing organics and applying no revenues from excess capacity from in-vessel or anaerobic digestion systems

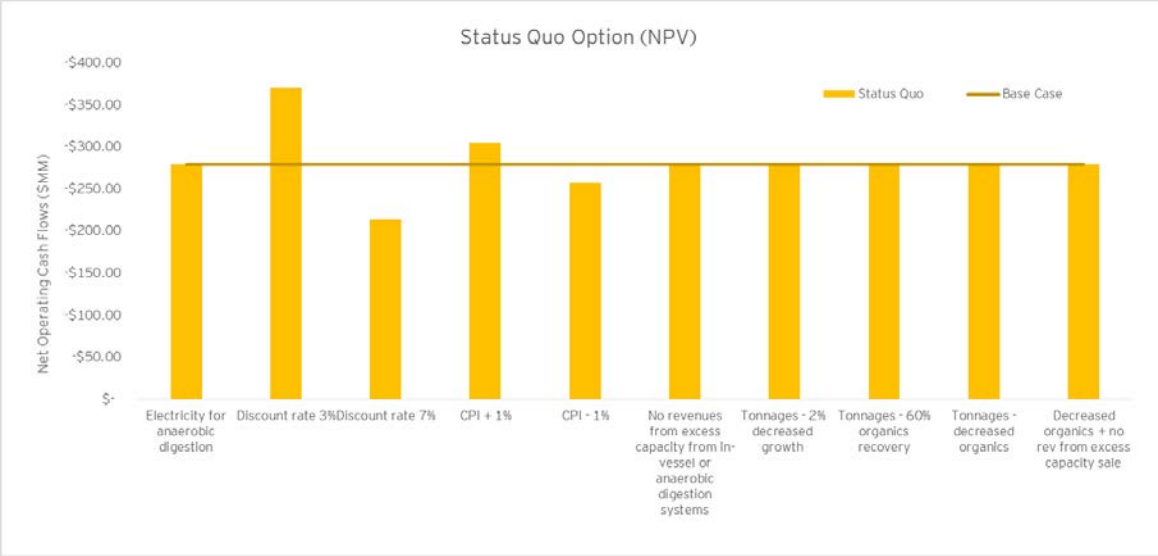
The sensitivities were then ranked based on the degree of impact on the analysis. For each sensitivity the option that was impacted the most was identified. The table below provides a summary of the sensitivity analysis conducted.

Sensitivity	Ranking of sensitivity by highest impact on analysis	Option most impacted by sensitivity
Discount rate 3%	1	Pre-sort/merchant capacity option
Discount rate 7%	2	Pre-sort/merchant capacity option
Tonnages - 2% decreased growth	3	Pre-sort/anaerobic digestion option
CPI + 1%	4	Pre-sort/merchant capacity option
CPI - 1%	5	Pre-sort/merchant capacity option
Electricity for anaerobic digestion	6	Pre-sort/anaerobic digestion option
No revenues from excess capacity from in-vessel or anaerobic digestion systems	7	Pre-sort/in-vessel composting option
Decreased organics + no rev from excess capacity sale	8	Pre-sort/anaerobic digestion option
Tonnages - 60% organics recovery	9	Pre-sort/merchant capacity option
Tonnages - decreased organics	10	Pre-sort/merchant capacity option

The following chart shows the results of the sensitivity analysis for the Status Quo option on a NPV basis.

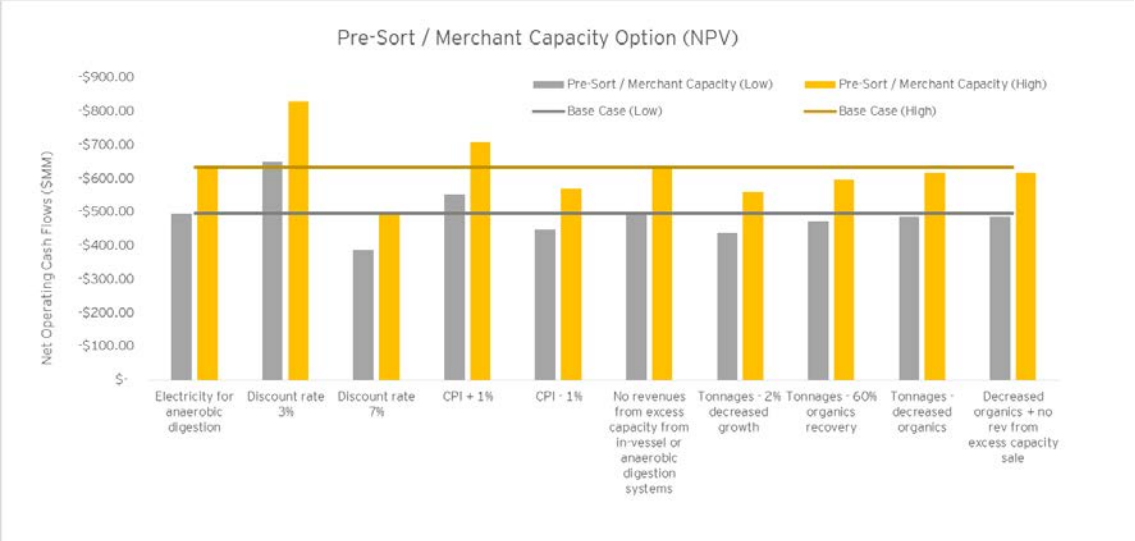
The line graph represents the NPV of the base case of the Status Quo Option. Each bar graph represents the NPV of the sensitivity described on the x-axis of the graph.

It can be seen that the highest impacts to the status quo option result from changing the discount rate from 5% to 3% and 7%.



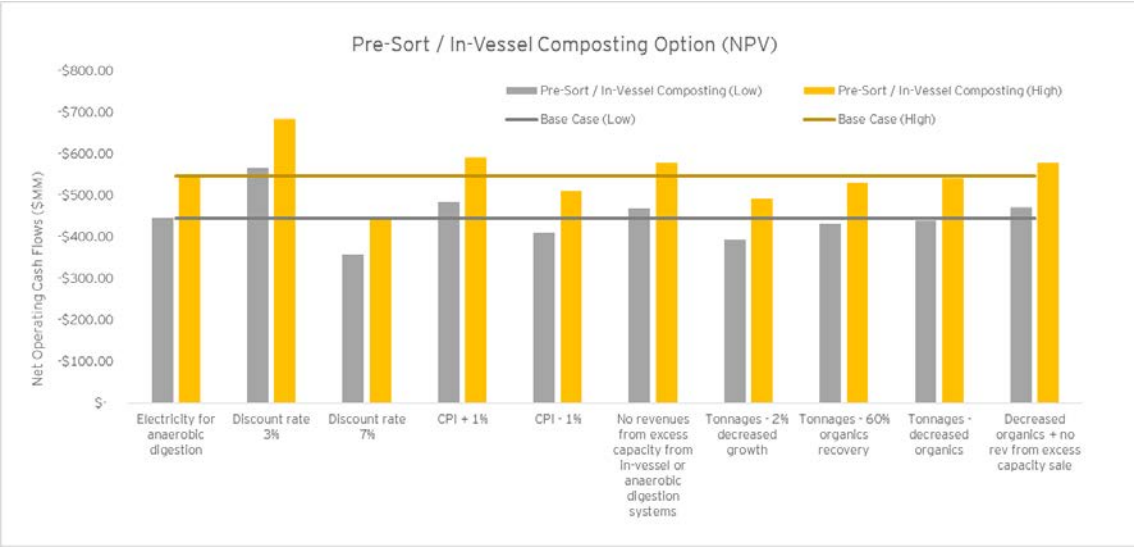
The following chart shows the results of the sensitivity analysis for the pre-sort/merchant capacity option on a NPV basis. The line graphs represent the high and low NPV results of the base case of the pre-sort/merchant capacity option. The bar graphs represents the high and low NPV results of the sensitivities described on the x-axis of the graph.

It can be seen that reducing the discount rate to 3% or increasing inflation by 1% results in an NPV higher than that of the base case for this option. All other sensitivities result in reduced cost of this option when compared to the base case.

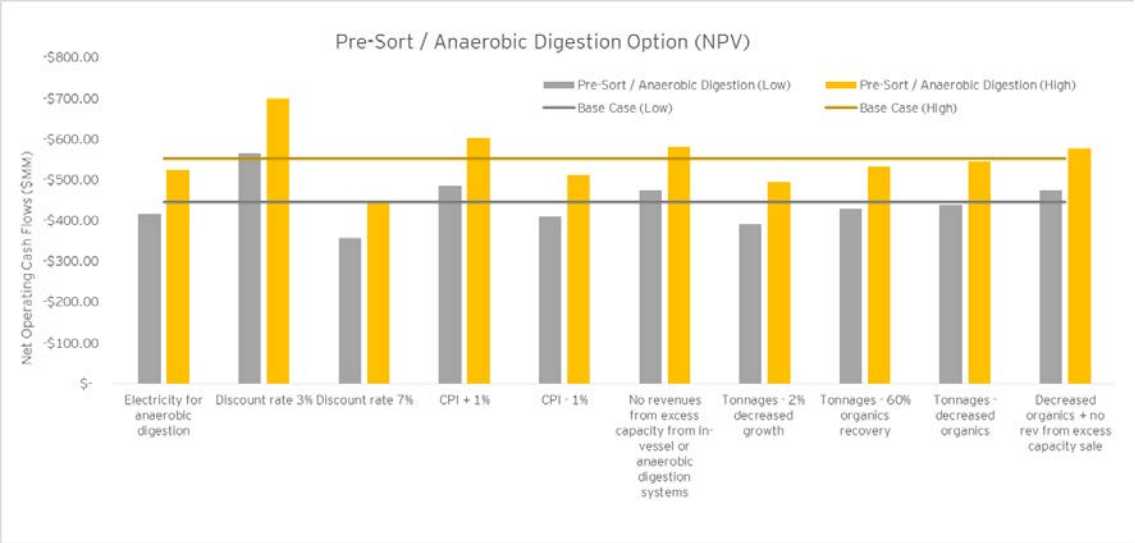


The following chart shows the results of the sensitivity analysis for the pre-sort/in-vessel composting option on a NPV basis. The line graphs represent the high and low NPV results of the base case of the pre-sort/in-vessel composting option. The bar graphs represents the high and low NPV results of the sensitivities described on the x-axis of the graph.

It can be seen that reducing the discount rate to 3%, increasing inflation by 1%, or excluding excess capacity revenues combined with a decrease in organics each results in an NPV higher than that of the base case for this option. All other sensitivities result in reduced cost of this option when compared to the base case.



The following chart shows the results of the sensitivity analysis for the pre-sort/anaerobic digestion option on a NPV basis. The line graphs represent the high and low NPV results of the base case of the pre-sort/ anaerobic digestion option. The bar graphs represents the high and low NPV results of the sensitivities described on the x-axis of the graph.
It can be seen that reducing the discount rate to 3%, increasing inflation by 1%, or excluding excess capacity revenues combined with a decrease in organics each results in an NPV higher than that of the base case for this option. All other sensitivities result in reduced cost of this option when compared to the base case.



5. Conclusion

The preliminary business case illustrated the following NPV result for the status quo option and the high and low NPV ranges for the other options studied:

- Status quo option: -$279 million
- Pre-sort/merchant capacity option: -$496 million to -$634 million
- Pre-sort/in-vessel composting option: -$445 million to -$548 million
- Pre-sort/anaerobic digestion option: -$446 million to -$555 million

The options studied present increases in overall costs compared to the status quo option. As noted, the status quo does not represent a viable option going forward, as it does not address the study drivers.

Based on the analysis above it can be concluded that the relative NPV cost differences between in-vessel composting option and anaerobic digestion option are relatively modest. The pre-sort/merchant capacity option results in the highest NPV. It should be noted that additional revenues from biogas and greenhouse gas credits from biogas have not been considered in the analysis of the pre-sort/anaerobic digestion option. As demonstrated in the sensitivity analysis (electricity for anaerobic digestion), the optimal use of the energy would result in a further reduction in cost of the pre-sort/ anaerobic digestion options.

Appendix A. Inputs and Assumptions

Table 1

Status Quo
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/Input	Value	Source	Rational
Waste Tonnages			
Base Waste Tonnage*	2015 waste tonnages	RMD 2015 Waste Report	Available waste tonnage data relevant to the management of residuals and organics in the RMD. Sensitivity: Decrease population growth by 1%.
Base Household Numbers*	SF – 197,499 MR – 24,009	RMD, 2015 data	Current available data. Sensitivity: based on population growth assumptions.
Waste Tonnage Growth*	SF and MF Growth	See SF and MF Growth.	Waste tonnage is collected from both the SF and MF sectors. Sensitivity based on population growth assumptions.
SSO Tonnage Growth*	SF Growth	See SF Growth.	SSO is collected from the SF sector. Sensitivity based on population growth assumptions.
WMF Tonnage Growth*	SF Growth	See SF Growth.	The growth of WMF tonnage is assumed to follow the growth of the SF sector.
Leaf & Yard Waste Tonnage Growth*	SF Growth	See SF Growth.	Leaf & Yard Waste is collected from the SF sector. The growth of the Leaf and Yard Waste tonnage is assumed to follow the growth of the SF sector.
Pickering SSO Compost Site	Varies (tonnage)	Calculated from RMD 2015 Waste Report.	Tonnages based on 2015 L&Y collected from Pickering and Ajax and 2015 SSO collected from Pickering, Ajax, Clarington, Scugog, Uxbridge, and Brock.
Clarington L&Y Compost Site	Varies (tonnage)	Calculated from RMD 2015 Waste Report.	Tonnages based on 2015 L&Y collected from Whitby, Oshawa, Clarington, Scugog, Uxbridge, and Brock.
Pebblestone Transfer Station	Varies (tonnage)	Calculated from RMD 2015 Waste Report.	Tonnages based on 2015 SSO collected from Oshawa and Whitby and transferred from Pebblestone Transfer Station.
Waste Composition			
SF Waste Composition*	2011 Audit	Region of Durham Large Blue Box Container Study. Average of June & November Audit Data AET Group. (2011).	Audit data provides an estimate of the composition of SF waste. The study included review of garbage in addition to the blue box. Model adjusts SF Waste organic content based on SSO Program Materials. Sensitivity: Decreasing organic content in waste by 5 percentage points.
MR Waste Composition*	2013 Audit	Region of Durham Multi-Residential Waste Composition Study AET Group. (2013).	Audit data provides an estimate of the composition of MR waste. Sensitivity: Decreasing organic content in waste by 5 percentage points.

Table 1

Status Quo
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/Input	Value	Source	Rational
WMF Waste Composition*	2010 Audit	Waste Audit & Facility Review, Oshawa WMF Audit & Review of Operations AET Consultants (2010).	Audit data provides an estimate of the composition of WMF waste. Review of data identified that there is little recyclables and organic matter in the waste stream from the WMF.
Growth Rates			
2016 and 2017 SF and MR Growth Rates*	2016 – 0% 2017 – 0%	RMD	Estimated growth rates reflective of steady waste tonnage projections for 2016 and 2017. Base case assumption for 2016 and 2017.
SF Growth Rates with Seaton*	2018-2021 – 3.0% 2022-2026 – 2.7% 2027-2031 – 2.7% 2032-2036 – 2.0% 2037-2041 – 2.1% 2042-2046 – 2.1%	Developed from development charges growth projections by housing type provided by RMD (October 2016 Planning Report). Average rate per period.	Current development forecast that includes the Seaton lands. SF base case assumption for 2018 to 2041. Sensitivity will consider growth changes that are different (decrease noted growth rates by 1.0 percentage point).
MR Growth Rates with Seaton*	2018-2021 – 3.1% 2022 2026 – 4.5% 2027-2031 – 2.7% 2032-2036 – 2.0% 2037-2041 – 2.1% 2042-2046 – 2.1%	Developed from development charges growth projections by housing type provided by RMD (October 2016 Planning Report). Average rate per period.	Current development forecast that includes the Seaton lands. MR base case assumption for 2018 to 2041. Sensitivity will consider growth changes that are different (decrease noted growth rates by 1.0 percentage point).
SSO Program Materials			
Existing System Program Materials*	Food Waste, Paper Fibre, Other Compostable Items, Compostable Liner Bags	RMD	Materials currently accepted by the RMD's SSO program.
Current SSO Capture Rates			
Existing System SSO Program Capture Rate*	54%	Calculated.	2015 SSO capture rate; percent of organics accepted by the SSO program in SF waste that were captured by the existing SSO program.

Table 1

Status Quo
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/Input	Value	Source	Rational
Operating Costs			
Waste Transfer and Disposal			
Waste transfer to DYEC	$21.89 /tonne	Standard Agreement: C002117	Current available data.
Quality Control prior to hauling to DYEC*	$3.10 /tonne	Standard Agreement: C00211	Current available data.
Waste transfer to Landfill through DYEC Bypass	$71.00 /tonne	RMD	Current available data.
Organic Waste			
Organic Waste - Haulage Pebblestone Transfer Station (Pebblestone Mulitservices Inc., PMS) to Pickering SSO Compost Site (Miller Waste Durham, MWD) to 2018	$12.50 /tonne	Standard Agreement: C001834	Current available data.
Pickering Compost – Organic Waste from Ajax and Pickering to 2018	$149.70 /tonne	Standard Agreement: C001834	Current available data.
Pickering Compost – Received, Processed & Composted at Pickering SSO Compost Site to 2018	$149.70 /tonne	Standard Agreement: C001834	Current available data.
Clarington Compost – Leaf & Yard Waste Processing to 2018	$61.50 /tonne	Standard Agreement: C002462	Current available data.
DYEC - Operator Fee*	$58.70 /tonne – Scenarios with Status Quo and DYEC Market Capacity Revenue $61.84 /tonne – Scenarios with Pre-Sort	RMD	Current available data. Excludes property tax. Pre-Sort scenario cost excludes revenue from metals at the DYEC. With Pre-Sort metals will be recovered at Pre-Sort facility. DYEC Market Capacity revenue assumes sale of capacity to York Region.

Notes:

(*) Common to all Options

(1) Assessment excludes waste collection costs.
(2) Operating fees are net of revenues.

Table 2

Site Location and Size of Facilities
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational
Site Location	Proxy Location	Draft GIS-based Waste Transfer Logistics Modelling for the Proposed Energy-from-Waste (EFW) Facility in the Region of Durham, Golder Associates, 2010. Waste Optimization Study for 4600 Garrard Road, AECOM, 2012.	The Pre-Sort/Transfer Facility and organics processing facilities will all be located at the same site. The proxy site is assumed to be the size required and have the services required for the development of the facilities.
Land Area Required for Facilities	2 hectares for Pre-Sort Facility 2 hectare for AD 2 hectares for in vessel 0.5 hectare for RNG	Estimated by GHD based on internal database of constructed facilities.	The land area required for the facilities is required to estimate the opportunity cost / land acquisition cost.
Land Opportunity Cost	$494,000 /hectare (2016)	RMD Works Real Estate Division, $200,000 / acre.	There is an opportunity cost to the RMD to utilize land for this project.
Land Acquisition Cost	$494,000 /hectare (2016)	RMD Works Real Estate Division, $200,000 / acre.	Estimated cost to acquire new/additional land for this project.

Table 3

Pre-Sort/Transfer
Facility Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational / Comment
Materials Sent to Pre-Sort Facility	SF Mixed Waste MR Mixed Waste		The Pre-Sort/Transfer Facility will receive SF mixed waste and MR mixed waste. • WMF residue will bypass the Pre-Sort Facility and will be hauled directly for disposal. (Not to be included in business case) • Recyclables will continue to be hauled directly to the MRF. Curbside collected SSO will be received at the organics processing Facility. SF and MR mixed waste will be directed to the Pre-Sort Facility where the organic fraction of mixed waste (OFMW) will be isolated and then directed to the organics processing facility. Excess capacity at the Pre-Sort Facility will not be utilized.
Pre-Sort Facility Capacity	160,000 tonnes per year	Residual Waste Projection tonnages.	Sized based on providing capacity for the Pre-Sort Facility at the 20 year period.
Recovery Rates – Non Organic			
Ferrous Metals	90%	GBB. (June 2015). The evolution of mixed waste processing facilities 1970-Today.	Ferrous metal recovery is well established at MRFs with an automated sorting system.
Non-Ferrous Metals	90%	GBB. (June 2015). The evolution of mixed waste processing facilities 1970-Today.	Non-Ferrous metal recovery is well established at MRFs with an automated sorting system.
Other Metals	0%	Assumption	Requires specialized equipment and/or hand sorting. Includes scrap metal, copper pipe, hardware, multi-material items that are mainly metal and empty propane tanks.
Paper	0%	Assumption.	As the Pre-Sorting Facility is managing mixed waste the removal of clean fibre material is not anticipated. In a blue box MRF with an automated sorting system recovery rate of 50-70% for mixed fibers and 65-75% of cardboard are cited (GBB. June 2015). The evolution of mixed waste processing facilities 1970-Today.)
Plastic PET	85%	GBB. (June 2015). The evolution of mixed waste processing facilities 1970-Today.	Plastic PET recovery is well established at MRFs with an automated sorting system.
Plastic HDPE	85%	GBB. (June 2015). The evolution of mixed waste processing facilities 1970-Today.	Plastic HDPE recovery is well established at MRFs with an automated sorting system.
Plastic Polystyrene	0%	Assumption.	Excluded as it is emerging.
Plastic Polyethylene	0%	GBB. (June 2015). The evolution of mixed waste processing facilities 1970-Today.	Plastic Polyethylene (film plastics) recovery is emerging.
Glass	0%	Assumption.	There is little to no value in recovered glass.

Table 3

Pre-Sort/Transfer
Facility Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational / Comment
			Glass will be removed from the OFMW stream by the Pre-Sorting system and by the organics facility pre-processing system. Removal of glass from the OFMW is required to reduce grit accumulation and wear on the organics processing facility equipment.
Recovery Rate – Organics			
Organic Fraction of Mixed Waste (OFMW)	80%	GBB. (June 2015). The evolution of mixed waste processing facilities 1970-Today. Comparable to GHD's internal database.	In the Pre-Sort Facility, the captured organics will be equal to 80 percent by weight of the available organics. Sensitivity: The captured organics will be equal to 60 percent by weight of the available organics.
Capital Cost			
Transfer Station Capital Cost	$7,000,000 (2013)	RMD Council Report entitled 2014 Annual Solid Waste Management Servicing and Financing Study, November 28, 2013 Waste Optimization Study, Table 12, AECOM (2012).	Demolition of existing facility at 4600 Garrad Road and construct a new centralized transfer facility with up to 200,000 tonnes per year capacity. Sensitivity: The costs of an independent transfer station are included in the event a sensitivity needs to be run on a separate transfer station.
Pre-Sort Facility Capital Cost	$34,400,000 to $40,000,000 (2016)	LOW end cost based on PPP Canada Energy From Waste Sector Study (September 2014). HIGH end cost based on published cost for Infinitus Alabama Facility and proposed Covanta Indianapolis Facility.	For a Pre-Sort facility with a capacity of 160,000 tonnes per year at LOW of $215 per design tonne to a HIGH of $250 per design tonne. This includes the capital costs of a transfer station at the pre-sort facility.
Lifecycle Costs	Approximately 26% of capital cost	Assumption	Asset refurbishment/replacement costs were determined for several broad categories of assets within each facility (e.g. building, mechanical equipment, process vessels, etc.). Each category was allocated a percentage of the estimated replacement value and within each category the percent of the asset that would be refurbished/replaced during the asset's service life was estimated. The service life of each category was established based on experience with similar facilities/equipment as was the refurbishment cycle.
Operation Cost			
Transfer Station Operating Cost	$8.03 /tonne (2013)	RMD Council Report entitled 2014 Annual Solid Waste Management Servicing and Financing Study, November 28, 2013. Waste Optimization Study, Table 12, AECOM (2012). Based on $1,289,000 operating cost for 165,517 tonnes in 2015.	Operation of a transfer station, inclusive of facility administration, utilities, personnel, equipment maintenance, building maintenance, and facility maintenance Estimated 2015 tonnage is comparable to the 2015 actual tonnage (less blue box and reuse). Sensitivity: The costs of an independent transfer station are included in the event sensitivity needs to be run on a separate transfer station.

Table 3

Pre-Sort/Transfer
Facility Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational / Comment
Pre-Sort Facility Operating Cost	$70 to $80 /tonne (2016)	GHD internal database of existing facilities information, site tours and industry reports (e.g., CIF Study of the Optimization of the Blue Box Material Processing System, 2012)	Operation of a Pre-Sort Facility, inclusive of facility administration, utilities, personnel, equipment maintenance, building maintenance, and facility maintenance. This includes the transfer station operating costs.
Residual Transfer to DYEC	$2.80 /tonne (2013)	RMD Council Report entitled 2014 Annual Solid Waste Management Servicing and Financing Study, November 28, 2013.	Transfer of residual material to DYEC for disposal.
Revenue – Non Organics			
Ferrous Metal	$174 /tonne	Continuous Improvement Fund (CIF), Price Sheet – October 2016.	Average revenue per CIF Price Sheet from May 2015 to October 16.
Non-Ferrous Metal	$1706 /tonne	Continuous Improvement Fund (CIF), Price Sheet – October 2016.	Average revenue per CIF Price Sheet from May 2015 to October 16.
Plastic PET	$344 /tonne	Continuous Improvement Fund (CIF), Price Sheet – October 2016.	Average revenue per CIF Price Sheet from May 2015 to October 16.
Plastic HDPE	$469 /tonne	Continuous Improvement Fund (CIF), Price Sheet – October 2016.	Average revenue per CIF Price Sheet from May 2015 to October 16.
EPR Revenues	$100 /tonne	RMD	Based on approximately $5,000,000 revenue in 2015, which is approximately $100/tonne for the 48,250 tonnes of blue box recyclables currently collected and processed by the RMD.

Table 4

In-Vessel Composting
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational / Comment
In-Vessel Composting Facility Capacity	145,000 tonnes (based on 110,000 tonnes of SSO and OFMW)	SSO and OFMW projections plus required carbon amendment	Size based on providing capacity for 20 year period. Carbon amendment provided by operator. Sensitivity: RMD generated Leaf and Yard Waste used for amendment at status quo rate.
AD Pre-processing Pass Through Rate			
Existing System SSO Program	97%	RMD	97 percent of the SSO material will pass to the In-Vessel phase. Assumes the residue is removed in the In-Vessel pre-processing phase. Material removed in the In-Vessel pre-processing phase may include grit, plastics, and unsolicited material. Equipment required to remove the unwanted material is proprietary to each technology vendor. Material received when there is excess capacity in the In-Vessel Facility will be organics from the RMD and will have a similar pass through rate as the RMD collected SSO.
OFMW from Pre-Sort Facility	80%	GHD internal database.	Material removed in the pre-processing phase may include grit, plastics, and unsolicited material. Equipment required to remove the unwanted material is proprietary to each technology vendor. Sensitivity: 60 percent pass through rate.
Excess Capacity Organics	97%	Assumption	Material received when there is excess capacity in the In-Vessel Facility will be organics similar in nature to SSO from within the RMD. This material will have a similar pass through rate as the RMD collected SSO.
Capital Cost			
In-Vessel Capital Cost	$72,500,000 to 145,000,000 (2016)	LOW prices based on undated Compost Council of Canada Compost Processing Technologies Report. HIGH price based on GHD Internal database for similar facilities, including Guelph, ON and Calgary, AB facilities.	Based on a 145,000 tonne per year facility at a LOW of $500 per design tonne and a HIGH of $1,000 per design tonne
Lifecycle Costs	Approximately 16% of capital costs.	Assumption	Asset refurbishment/replacement costs were determined for several broad categories of assets within each facility (e.g. building, mechanical equipment, process vessels, etc.). Each category was allocated a percentage of the estimated replacement value and within each category the percent of the asset that would be refurbished/replaced during the asset's service life was estimated. The service life of each category was established based on experience with similar facilities/equipment as was the refurbishment cycle.

Table 4

In-Vessel Composting
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Operating Cost			
In-Vessel Facility Operating Cost	$85 to $95 /tonne (2016)	LOW price based on PPP Canada Energy From Waste Sector Study (September 2014). HIGH price based on GHD Internal database for similar facilities	Operation of an In-Vessel Facility, inclusive of facility administration, utilities, personnel, equipment maintenance, building maintenance, and facility maintenance.
Residual Transfer to DYEC	$2.80 /tonne (2013)	RMD Council Report entitled 2014 Annual Solid Waste Management Servicing and Financing Study, November 28, 2013.	Transfer of residual material to DYEC for disposal.
NASM Application	$88 /tonne (2016)	GHD internal database	Includes haulage, land application, and winter storage by third party processor
Land Reclamation	$110 /tonne	GHD internal database.	Estimate of haulage and land application at land reclamation site.
Revenue			
Sale of Compost	$0 /tonne	GHD internal database.	Included as part of overall operating costs.
Sale of Excess Capacity	$200 /tonne	Assumption	Material received when there is excess capacity in the In-Vessel Facility will be organics similar in nature to SSO from with the RMD. Estimated based on consideration of RMD's existing contract rate, assumption of increased cost upon renewal, and capital upgrades likely required to meet current compost quality standards for AA compost from SSO. Sensitivity: Do not sell excess capacity.

Table 5

Merchant Capacity
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational / Comment
Merchant Capacity	Varies – generation (tonnes per year)	SSO and OFMW waste projection tonnages	Based on yearly SSO and OFWM waste projection tonnages.
Processing Cost			
SSO and OFMW	$175 to $225 /tonne (2016)	Assumption	Estimated based on consideration of RMD's existing contract rate, assumption of increased cost upon renewal, and capital upgrades likely required to meet current compost quality standards for AA compost. Also considerers that OFMW has a higher contamination level that will require more effort and equipment to process.
Haulage Cost			
SSO and OFMW	$25 to $50 /tonne (2016)	Assumption	Will vary based on location of merchant capacity. Estimate of haulage of 2 to 5 hours.

Table 6

AD Facility
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational
AD Facility Capacity	110,000 tonnes per year	SSO and OWMF waste projection tonnages	Sized based on providing capacity for 20 year projections.
AD Pre-processing Pass Through Rate			
Existing System SSO Program	97%	RMD	97 percent of the SSO material will pass to the AD phase. Assumes the residue is removed in the AD pre-processing phase. Material removed in the AD pre-processing phase may include grit, plastics, and unsolicited material. Equipment required to remove the unwanted material is proprietary to each technology vendor. Material received when there is excess capacity in the AD Facility will be organics from the RMD and will have a similar pass through rate as the RMD collected SSO.
OFMW from Pre-Sort Facility	80%	GHD internal database.	Material removed in the pre-processing phase may include grit, plastics, and unsolicited material. Equipment required to remove the unwanted material is proprietary to each technology vendor. Sensitivity: 60 percent pass through rate.
Excess Capacity Organics	97%	Assumption	Material received when there is excess capacity in the AD Facility will be organics similar in nature to SSO from within the RMD. This material will have a similar pass through rate as the RMD collected SSO.
AD Post-Processing Pass Through Rate	100%	GHD internal database.	It has been assumed that all solid material will pass through the post-processing system.
Capital Cost			
Capital Cost	$68,750,000 to $110,00,000 (2016)	LOW price based on PPP Canada Energy From Waste Sector Study (September 2014). HIGH price based on GHD Internal database for similar facilities, including City of Toronto's Disco Road facility.	Based on a 110,000 tonne per year facility at a LOW of $625 per design tonne to a HIGH of $1000 per design tonne for capital cost
Lifecycle Costs	Approximately 21% of capital costs.	Assumption	Asset refurbishment/replacement costs were determined for several broad categories of assets within each facility (e.g. building, mechanical equipment, process vessels, etc.). Each category was allocated a percentage of the estimated replacement value and within each category the percent of the asset that would be refurbished/replaced during the asset's service life was estimated. The service life of each category was established based on experience with similar facilities/equipment as was the refurbishment cycle.

Table 6

AD Facility
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational
Operating Cost			
AD Facility Operating Cost	$75 to $110 /tonne (2016)	LOW operating cost based on Municipal Guide to Biogas (March 2015) HIGH operating cost based on GHD internal database.	Operation of an AD Facility, inclusive of facility administration, utilities, personnel, equipment maintenance, building maintenance, and facility maintenance.
Residual Transfer to DYEC	$2.80 /tonne (2013)	RMD Council Report entitled 2014 Annual Solid Waste Management Servicing and Financing Study, November 28, 2013.	Transfer of residual material to DYEC for disposal.
Third-Party Composting Operating Cost	$90 /tonne	GHD internal database.	Sensitivity based on RMD existing contracts with third-party processors.
NASM Application	$88 /tonne	GHD internal database.	Includes haulage, land application, and winter storage by third-party processor.
Land Reclamation	$110 /tonne	GHD internal database.	Estimate of haulage and land application at land reclamation site.
Biogas Upgrading System	$0.0082 /MJ	GHD internal database.	Operating cost is inclusive of utilities, personnel, equipment maintenance, and building maintenance.
Electricity Generation System	$0.03 /kWh	GHD internal database.	Operating cost is inclusive of utilities, personnel, equipment maintenance, and building maintenance.
Revenue			
Sale of Compost	$0 /tonne	GHD internal database.	Included in third-party composting operational cost
Renewable Identification No. Credits	$1.01 /credit	D5 (advanced fuels) RIN October 2016 Value.	Renewable identification numbers (RINs) are credits used for compliance, and are the “currency” of the US EPA Renewable Fuel Standard program.
Sale of RNG	$0.106439 /$m^3$	Ontario Energy Board.	Enbridge price for natural gas for October 1, 2016. Sensitivity is based on maximum and minimum price between January 2006 and October 2016.
Sale of Electricity	$0.168 /kWh (first 500 kW) $0.05 /kWh (>500 kW)	Independent Electricity System Operator	FIT contract based on January 1, 2016 rate. Base revenue is for feed behind the meter applications. Assumed as a portion of non-residential electricity cost.

Table 6

AD Facility
Assumptions and Inputs
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/ Input	Value	Source	Rational
Sale of Excess Capacity	$200 /tonne	Assumption	Estimated base on consideration of RMD's existing contract rate, assumption of increased cost upon renewal, and capital upgrades likely required to meet current compost quality standards for AA compost from SSO. Sensitivity: Do not sell excess capacity.
Biogas Assumptions			
Percentage of Methane AD	60%	Industry information.	
Biogas Conversion to RNG	97%	Industry information.	
RIN Calculations			
RNG Production Yield	90%	Industry information.	

Table 7

Economic Assumptions
Financial and Technical Consulting for Integrated Waste Management System Utility
Anaerobic Digestion
Regional Municipality of Durham

Assumption/Input	Data	Source
Escalation and discounting assumptions		
General Inflation	1.88%	Statistics Canada, Ontario, All items CPI, 2006 to 2016 (10y) = 1.88% http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ09g-eng.htm Sensitivities to be run by changing general inflation, operating inflation and revenue escalation by +1% and -1%
Diesel Inflation	2.50%	RMD
Revenue Inflation	1.88%	Statistics Canada, Ontario, All items CPI, 2006 to 2016 (10y) = 1.88% http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ09g-eng.htm Sensitivities to be run by changing general inflation, operating inflation and revenue escalation by +1% and -1%
Operating Inflation for existing Standard Agreements	1.84%	Statistics Canada, Ontario, All items CPI Excluding energy, 2006 to 2016(10y) = 1.84% http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/econ09g-eng.htm Sensitivities to be run by changing general inflation, operating inflation and revenue escalation by +1% and -1%
Construction Inflation	2.60%	Statistics Canada, Ontario, non-residential building construction, 2006 to 2016 (10y) = 2.60%http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=3270043&&pattern=&stByVal=1&p1=1&p2=37&tabMode=dataTable&csid=
EFW Operating Costs Inflation	2.20%	RMD
Discount Rate	5.00%	Estimated weighted cost of capital (including inflation) for the RMD. Sensitivities: Run at 3% and 7%.

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