Comox Valley REGIONAL DISTRICT

Staff report

DATE: April 12, 2018

FILE: 5360-60

TO: Chair and Directors
Comox Valley Regional District (Comox Strathcona Waste Management Board)

FROM: James Warren
Acting/ Chief Administrative Officer

Supported by James Warren
Acting/ Chief Administrative Officer
J. Warren

RE: Waste to Energy Business Case Assessment – Scope Change #2 results

Purpose
The purpose of this report is to present final results and recommendations regarding the Comox Strathcona Waste Management (CSWM) Waste to Energy (WTE) business case assessment.

Recommendation from the Chief Administrative Officer:

1. THAT the Comox Strathcona Waste Management Board invite Sustane Technologies Inc. and Waste Treatment Technologies (WTT) Netherlands B.V. to present information regarding each company's waste management technologies to a future CSWM Board meeting.

2. THAT the Comox Strathcona Waste Management (CSWM) Board invite the Ministry of Environment to explain the provincial regulations associated with waste to energy technologies including a discussion on definitions associated with the objectives for 70% diversion and the reduce, reuse and recycle approach to solid waste management to a future CSWM Board meeting.

3. THAT the Comox Strathcona Waste Management Board direct staff to monitor waste management technology proposed by Sustane Technologies Inc., in Nova Scotia, for up to one year of full operations;

   AND FURTHER THAT a report on its effectiveness and efficiencies be presented to the CSWM Board following the monitoring period.

4. THAT the Waste to Energy Business Case Assessment staff report dated April 12, 2018, including the Waste to Energy Assessment report dated April 9, 2018 prepared by Morrison Hershfield, be referred to the Association of Vancouver Island Coastal Communities Special Committee on Waste Management for information.

Executive Summary
In the summer of 2017 CSWM posted a Request for Information (RFI) for WTE technologies. Six submissions were received and evaluated based on evaluation criteria with Waste Treatment Technologies (WTT) Netherlands B.V., Eco Waste Solutions and Sustane Technologies Inc. (Sustane) ranked as the top technologies/vendors. These vendors were then carried forward through a more detailed assessment including cost and greenhouse gas modelling.

The draft report and presentation was provided to the WTE Select Committee on November 27, 2017. Eco Waste Solutions technology was removed from further investigation and the committee requested further analysis of the impact of costs should the remaining technologies be provided

additional volumes of waste. In addition, the committee also requested that the final results be presented as a full system cost assessment of all waste stream costs in order to better understand the implications of WTE on total system costs.

Waste to Energy Technology Assessment:

The second version of the WTE technologies evaluation includes further analysis of the following technologies:

1. Sustane – which produces biomass fuel pellets, synthetic diesel and metals; and
2. WTT – which produces refuse derived fuel and biogas (from anaerobic digestion)

These technologies have been further analyzed for increased capacity to determine how higher waste throughputs might affect long term capital and operating costs. The following key points summarize the results.

- Four potential sites were considered and evaluated for siting a WTE facility. It was concluded that all sites could theoretically be used and that future transportation and site servicing costs will be important factors in any final siting. Siting at the Comox Valley Waste Management Center (CVWMC) was shown most cost effective.
- Regulatory requirements to proceed with WTE include an update of the Solid Waste Management Plan (SWMP) along with extensive public engagement and education. An environmental assessment, although not necessarily required by regulation, may be requested by the BC Ministry of Environment due to public concern.
- Guidelines released by the BC Ministry of Environment indicate that a SWMP must have plans for 70 per cent diversion before WTE should be considered for the remaining residuals. The 70 per cent target is calculated only from *Reduce, Reuse, and Recycle* (3R's) initiatives.
- BC Ministry of Environment stated that each regional district must show that they have maximized the amount of diversion from the 3 Rs (Reduce, re-use and recycle) before they start looking at energy recovery and WTE.
- Further, it is highly likely that recyclables recovered in a mixed waste processing facility will not be considered recycled under 3R's but would be considered recovery.
- The assessment compares the cost of conventional landfilling (status quo) to modeled scenarios for two WTE technologies over 10, 30, 40 and 50 year time periods to determine the most cost effective solution. Currently landfilling costs for final disposal are approximately $75/tonne.
- Conventional landfilling as per the 2012 SWMP continues to be the most cost effective final disposal solution by approximately $29 to $110 per tonne or $89M to $347M over a 50 year period than WTE.
- Of the WTE technologies evaluated, Sustane offers lower costs than WTT, however they attract greater risk for the Comox Valley Regional District due to lack of installed infrastructure and untested technology. This risk will be addressed in the near future with the installation of the first full scale facility in eastern Canada.
- Creating a solid fuel (RDF or bio-pellets) is substantially less expensive than traditional WTE, however the risk with RDF or bio-pellets is finding long term markets for the product.
- Within the local market, the bio pellet is assumed to not have value and the current wood waste processing environment could be disrupted with additional material in the market place.
- WTE can provide an approximate 78.20 per cent to 197.11 per cent reduction in Green House Gas (GHG) emissions over landfilling.

Increasing Waste Volumes Assessment:

Increasing the WTE technology capacity by providing more waste for processing was presented to the two remaining technology providers – WTT and Sustane. Both providers updated their cost structure to accept all Municipal Solid Waste (MSW) available given the current volumes within the CSWM service and assuming that no additional diversion, beyond the removal of organics, takes place. This equates to an estimated 52,000 tonnes in 2021 increasing to 70,000 tonnes in 2067.

- The WTE technologies provide an estimated increase in landfill life, benefiting the future resident of the service area.
    - 69 years for WTT
    - 160 years for Sustane
- The higher amounts of MSW for processing increases capital costs for each technology.
    - WTT originally at $26.0M now increased to $28.4M with increasing capacity.
    - Sustane originally at $25.0M now increased to $27.5M with increasing capacity.
- Reduced landfill costs were considered in the financial model, including:
    - Elimination of some equipment plus reduced equipment replacement frequency
    - Staffing reductions for both operations and management staff
    - Extended life of the landfill cells

For the lowest cost WTE technology – Sustane, the impact on taxpayers over the first 30 years is an increase of $40 per tonne to tip MSW, or a possible $2.0M to $2.5M annual taxation increase. Comparing the status quo against the best cost option for waste to energy (Sustane in Comox Valley), the potential impact on the tax payer is an additional 87.1 million dollars over the next 50 years.

Full System Cost Assessment:

Full system costs for the solid waste service were analyzed and prepared by CVRD staff by reviewing each line item within the service's financial plan, determining the purpose for the costs being incurred, evaluating whether or not the costs remain after implementation of WTE and then allocating to one of ten cost categories. The following seven categories are not affected by the future implementation of WTE and continue to be incurred by the service regardless of the final waste disposal option:

1. Host community agreements – operational costs
2. Diversion programs - capital and operational costs
3. Illegal dumping - operational costs
4. Organics processing – capital and operational costs
5. Solid waste corporate support services – operational costs
6. Transfer stations and remote landfills - capital and operational costs
7. Landfilling costs unaffected by WTE – capital and operational costs

The following three categories of costs are affected by the installation of WTE and vary depending on the technology selected and the location installed:

8. Landfill costs – landfill operation, development and closure costs are reduced as a result of the implementation of WTE
9. Transfer stations and waste transfer – the cost of transferring waste is highly dependent on the final location of the waste to energy facility
10. WTE capital and operating cost – this category includes the combined capital and operating cost of the specific waste to energy technology selected

The select committee requested full itemization of all existing programs and costs including accurate cost per tonne comparison to the status quo. These amounts are based on a ten year model for

expected costs and form the base case for comparison to the WTE options. The base case cost breakdown for the service, is as follows and equates to $243 per tonne total:

- Host community agreements – $7
- Diversion programs - $78
- Illegal dumping - $4
- Organics processing (future estimate in model) - $21
- Solid waste corporate support services – $9
- Transfer stations and remote landfills - $34
- Landfilling - $77
- Transfer of waste received at CV & CR waste management centres - $13

The status quo is then compared to WTE for each of the technology and location options. Results are summarized in Morrison Hershfield's report over several stacked bar graphs.

Although WTE can provide benefits in terms of reduced GHG emissions and the further use and re-purposing of materials the results of the long term cost modeling show that landfilling remains the most cost effective waste disposal option for the region.

As technologies continue to advance and improve over time it is suggested that CSWM revisit an assessment of alternative waste disposal technologies in over the next year, at very least the CSWM will, in conjunction with a full update to the SWMP and prior to expansion of the Comox Valley Waste Management Centre landfill. The Nova Scotia facility will be toured by directors in June of 2018 through the FCM conference.

It is also recommended that the report be referred to the Association of Vancouver Island and Coastal Communities so that it can be further disseminated to other local governments for their information and consideration.

The mission and mandate of the WTE Select Committee was to consider matters related to reviewing WTE and other emerging technologies and the development of a business case assessment in relation to the management of waste in the Comox Strathcona area. The committee would exist until such time as the committee reports its final findings to the CSWM board or until the CSWM board formally disbands the committee.

Prepared by:	Concurrence:
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Attachments: Appendix A – "Final Report-Comox Strathcona Waste Management Waste to Energy Assessment, dated April 9, 2018"

MORRISON HERSHFIELD

FINAL REPORT

COMOX STRATHCONA WASTE MANAGEMENT

Waste to Energy Assessment

Version II

Prepared for: **Comox Valley Regional District**

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Project No. 5170574.00 April 9, 2018

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EXECUTIVE SUMMARY

Comox Strathcona Waste Management (CSWM) provides solid waste management services to the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD). The Solid Waste Management Plan (SWMP) adopted in 2013 identifies the long-range preference to explore and pursue energy recovery from residual waste through Waste to Energy (WTE) technologies. The purpose of this WTE assessment is to compare the cost of conventional landfilling to modeled scenarios which include a new WTE facility as part of the CSWM system.

There is a need to ensure long-term waste management solutions are the best value for the tax payer and meet environmental and social standards and expectations. This study has been commissioned to re-evaluate WTE as a means to reduce waste management costs in the long term, while providing the region with secure long term processing and disposal capacity for solid waste.

For the purpose of this study, the definition of WTE has been expanded to include energy from organics through anaerobic digestion (AD) and converting waste into fuel for burning by a third party (refuse-derived fuel [RDF] and bio-pellets). Within this report, references to WTE technologies or facilities encompasses this definition of WTE.

To gather essential information for this assessment, a public request for information (RFI) was posted on BC Bid and resulted in the submission of six responses from vendors offering energy recovery technologies:

- Eco Waste Solutions (EWS)
- REDWAVE, a Division of BT-Wolfgang Binder GmbH
- SALT Canada Inc.
- Sustane Technologies Inc. (Sustane)
- WastAway
- WTT Netherlands BV (WTT)

EWS was the only vendor offering conventional combustion with energy recovery in the form of electricity and heat. Redwave, Sustane, WastAway and WTT all offered some form of recyclables recovery plus the preparation of waste derived solid fuel for sale to third parties. SALT offered a form of aerobic landfill stabilization with subsequent mining of the landfill for recyclables and organics. Vendors were made aware of the additional diversion up to 70% may be required prior to the consideration of WTE under BC MOE policy.

All submissions were subjected to an evaluation to determine a ranking of suitability for the region. The evaluation was based on criteria developed with the CVRD and endorsed by the Select Committee and Board. The evaluation resulted in the following technologies being chosen (jointly with the CVRD and Select Committee) for further assessment and comparison:

- WTT because it offers a combination of proven technologies to recover energy biologically (AD), recover additional recyclables, and create RDF for sale to third parties;
- EWS because it offers a conventional and proven combustion technology which will produce energy in the form of electricity and for which markets generally are available; and
- Sustane because it offers innovative technology to convert plastics to a synthetic diesel, recycle metals and convert organics into bio-pellets for sale to third parties.

This was not a selection process. The selection of a vendor would occur at a later date through a competitive and public procurement process, should the decision be made to proceed with the implementation of a WTE facility after this study.

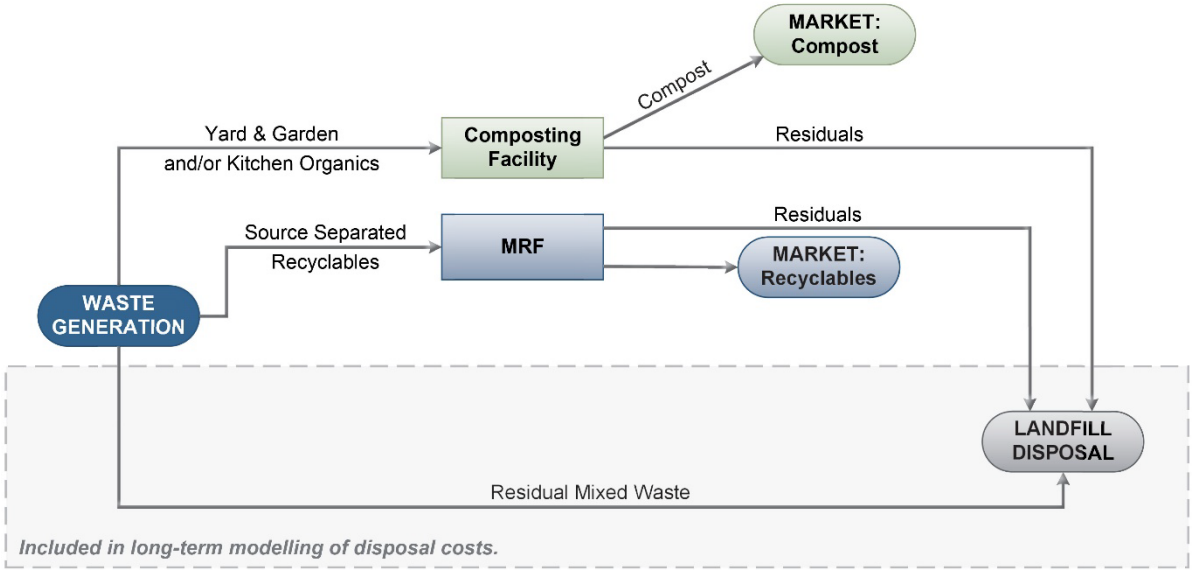
Three locations were considered for the potential facility; Comox Valley, Campbell River and Gold River. Four potential sites in these areas were reviewed in detail looking at zoning, transportation, proximity to waste sources, access to utilities, buffers, air-shed, and site suitability. Essentially, all sites could be used and each has some advantages and disadvantages. Being close to where most of the waste is generated reduces hauling costs and makes the CVWMC attractive, as it also has existing waste management infrastructure that could serve dual purposes. However, lack of adequate process water and sanitary sewer is a drawback. Gold River would be attractive from infrastructure and permitting perspectives, but transportation costs make this site considerably more expensive. Ultimate selection of a site will depend on the technology and could be finalized once a decision has been made to proceed with a procurement process for the implementation of a WTE facility. All three areas are considered during the analysis of options.

Regulatory requirements are limited to an amendment of the solid waste management plan (SWMP), along with public engagement and education. As part of the SWMP amendment, the Ministry of Environment (MOE) will direct necessary actions for obtaining an operating certificate (OC). An environmental assessment is likely not required due to the small scale of the proposed facility, however, at the request of special interest groups, the general public, or other interested parties, the MOE may mandate an environmental assessment.

Applying the three preferred technologies to the study region resulted in the following options:

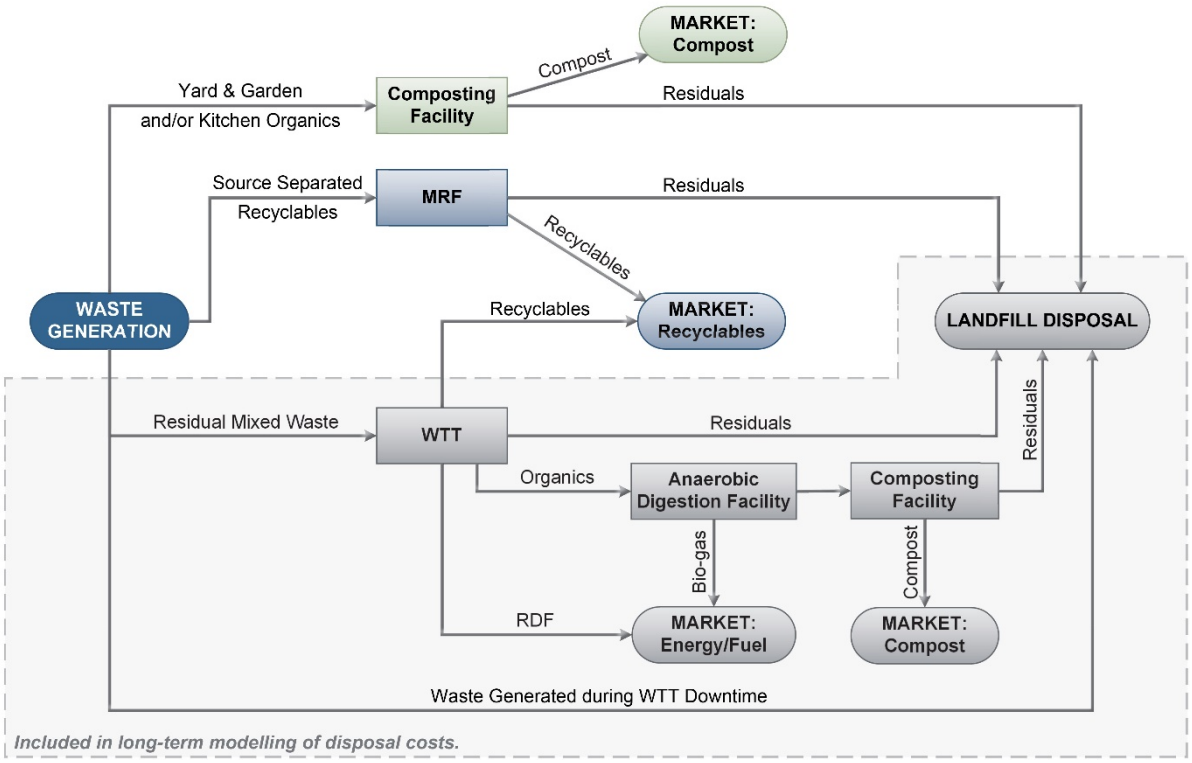
Option 0 – Status Quo

In order to determine whether to proceed further with evaluating WTE options and confirm potential costs or savings, the status quo is reviewed and compared to the WTE options. Under this status quo option, waste generated in the SRD is landfilled at the CRWMC Landfill until closure, after which time the existing transfer station is utilized to transfer waste to the CVWMC Landfill for disposal. The CRWMC Landfill is expected to reach capacity in 2023 and final closure would occur after that. Flow of the various waste streams under Option 0 is shown in the figure below. The grey-shaded area in the figure below and in subsequent figures shows the portion of the current CSWM system and, where applicable, the WTE technology processes that are included in the long-term disposal cost model options. The entire CSWM system, including the grey-shaded areas, are included and considered in the full system cost assessment.



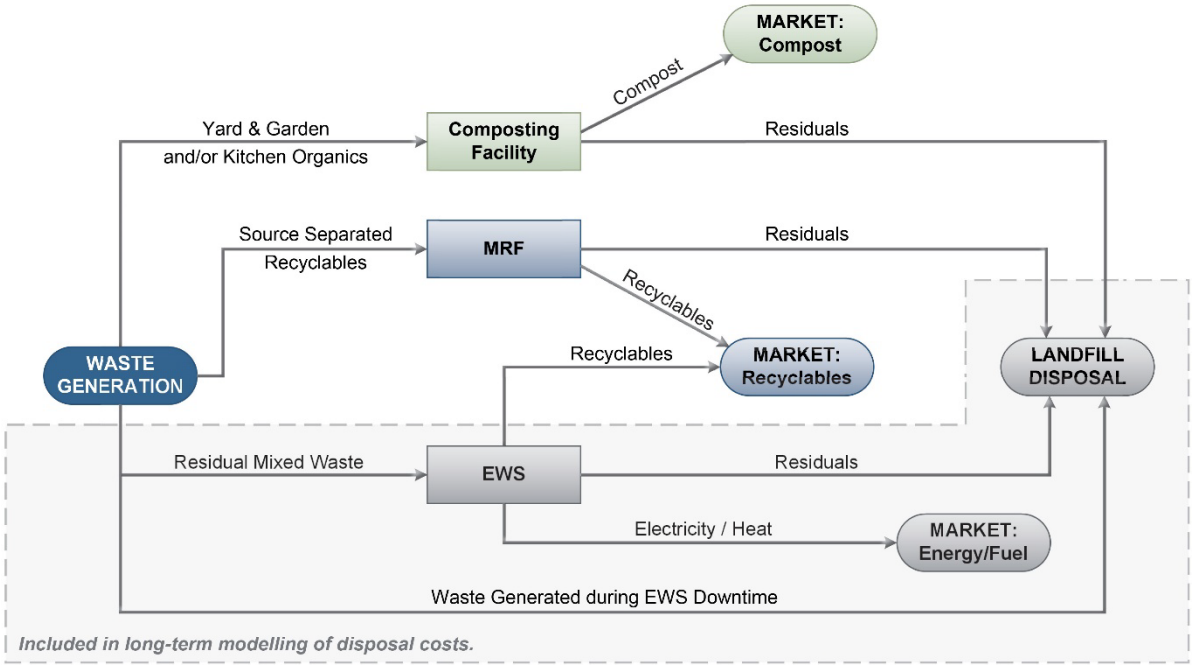
Option 1 – WTT (Mixed waste processing with anaerobic digestions and production of RDF)

Under this option a WTT facility would be added into the system and constructed in either of the three locations under consideration. The facility would divert organics, metal and cardboard and generate biogas and RDF. The residual stream is estimated to 33.5% of the input waste tonnages. A flow diagram showing the various components of the WTT system is shown below.



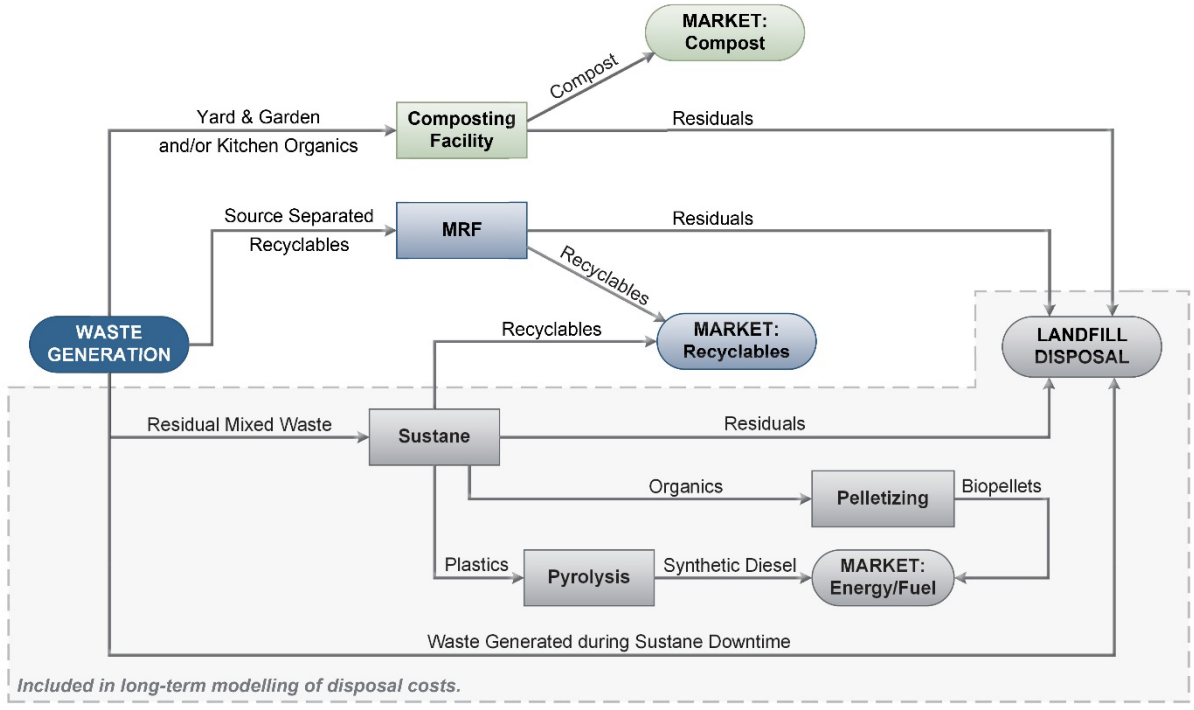
Option 2 – EWS (Conventional combustion WTE technology)

Under this option an EWS facility would be added into the system and constructed in either of the three locations under consideration. The received waste would be incinerated without prior sorting or diversion, however metals could be recycled from the bottom ash. The residual ash is estimated to be 17% of the input waste based on the vendor submission. A flow diagram showing the EWS system is shown below.



Option 3 – Sustane (Mixed waste processing with production of bio-pellets and synthetic diesel through pyrolysis)

Under this option a Sustane facility would be added into the system and constructed in either of the three locations presented above. The received waste would be processed, metals and plastics would be diverted, and bio-pellets and synthetic diesel would be produced. The residual waste for landfilling is considered inert and is estimated at 11% of the input waste. A flow chart of the Sustane system is shown in the figure below.



Cost Model

In order to evaluate the long-term system costs of each option, coupled with the different potential locations, the long-term cost models developed by AECOM in 2011 were updated. For the technology options, specific aspects of the model were updated along with capital and operational costs. All costs were projected over 50 years. The following 4 options plus sub-options (for a total of 10) were compared:

- **Option 0 - Status Quo**
- **Option 1 – WTT**
  - 1(a) - WTT located in Comox Valley
  - 1(b) - WTT located in Campbell River
  - 1(c) - WTT located in Gold River
- **Option 2 – EWS**
  - 2(a) - EWS located in Comox Valley
  - 2(b) - EWS located in Campbell River
  - 2(c) - EWS located in Gold River
- **Option 3 – Sustane**
  - 3(a) - Sustane located in Comox Valley
  - 3(b) - Sustane located in Campbell River
  - 3(c) - Sustane located in Gold River

The model was run for two waste capacity scenarios. First, the model was run assuming the throughput is constant over time, since conventional WTE facilities have a set capacity. This means that a larger portion of the generated waste is landfilled over time, as the annual waste generation is expected to increase over time. In the first model run, the landfill disposal costs were compared with the processing costs (including capital) provided by the WTE vendors. It was determined that the status quo of landfilling remains the lowest cost option.

These results were presented at an interim meeting with the CVRD. It was requested that the investigation be expanded in the following manner:

1. EWS be excluded from further consideration;

2. The remaining two vendors Sustane and WTT would be requested to provide costs to provide facilities that could expand along with increasing waste quantities over the next 50 years; and

3. All costs would be shown in comparison to the full cost of waste management at the CVRD, including costs for recycling, composting, planning, long term landfill care and management

Subsequently, in the second model run, the technology capacity and annual throughput was increased over time at the same rate as population growth and waste generation. This way the WTE to landfill ratio for accepted waste remains constant. Increased capital and operating costs as a result of the increasing capacity, as reported by the vendors, were taken into considerations as well as consequent reduction in landfill operating costs and prolonged life of landfill cells at the CVWMC Landfill.

Full System Cost Assessment

As requested by the CSWM, the results from the long-term modelling presented above were presented as a part of the full CSWM cost. The costs included in the long-term cost modelling for disposal cost was broken into four categories:

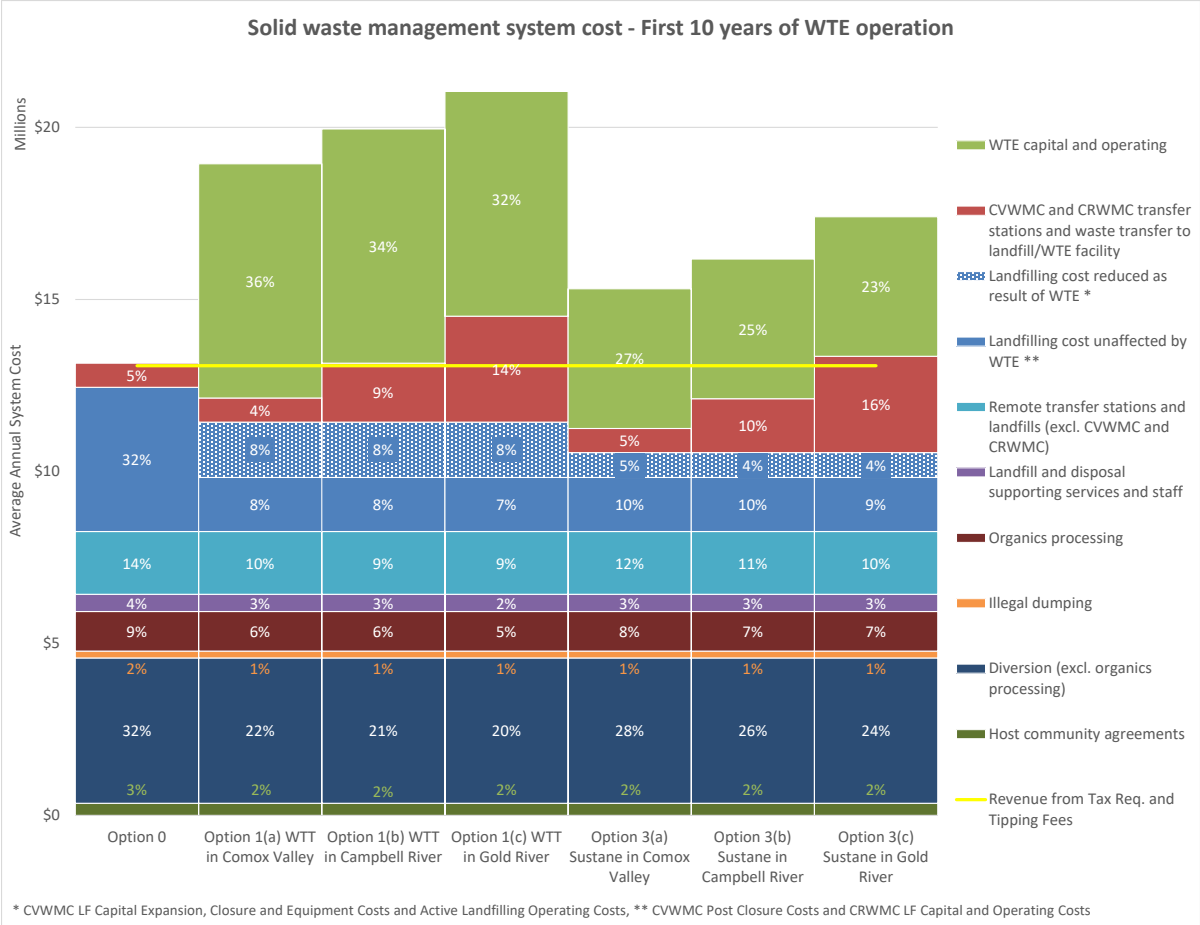
- Landfill operation, development and closure cost reduced as result of the WTE facility.
- Landfill operation, development and closure cost unaffected by the WTE facility.
- Transfer stations and waste transfer.
- WTE capital and operating cost.

The CWMS budgets were reviewed in detail and broken into an additional six categories:

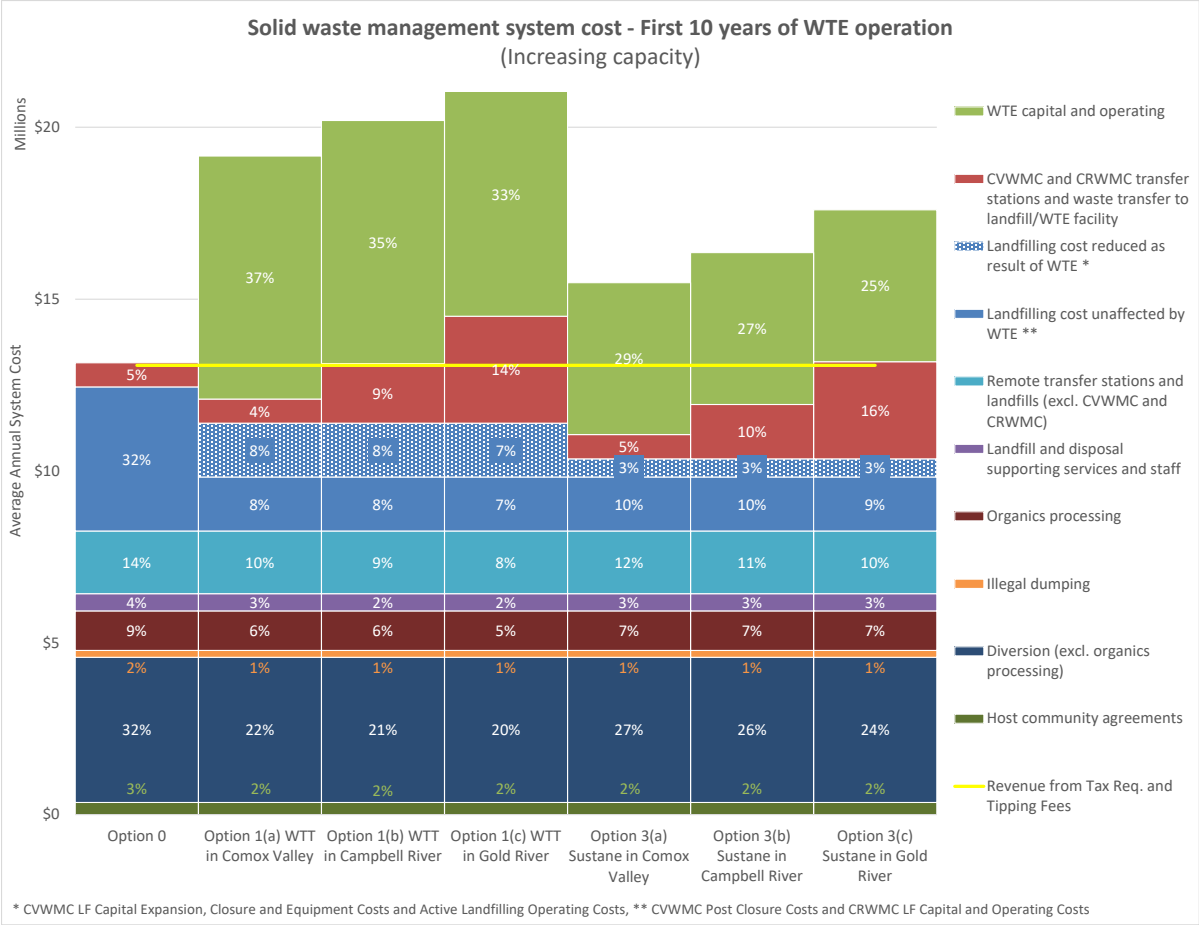
- Organics processing.
- Transfer stations and remote landfills.
- Host community agreements.
- Diversion (excl. organics).
- Disposal support services and staff (costs not affected by changes in disposal option).
- Illegal dumping.

The analysis also includes a comparison of the cost toward the current tax requisition of $4.0M (2017-2018) and $6.0M (2019-2067) plus the revenue generated by tipping fees.

The two figures below show the annual average full system costs for the first 10 years of operating the facility at fixed and increasing capacity. As can be noted, the total system cost is higher for the WTE options though the landfilling cost is reduced as a result of in the inclusion of a WTE facility. Note that the lower landfilling cost for Sustane is a result of extended life of the active landfill cell and that not capital investment in the subsequent cell is required during the 10 year period.

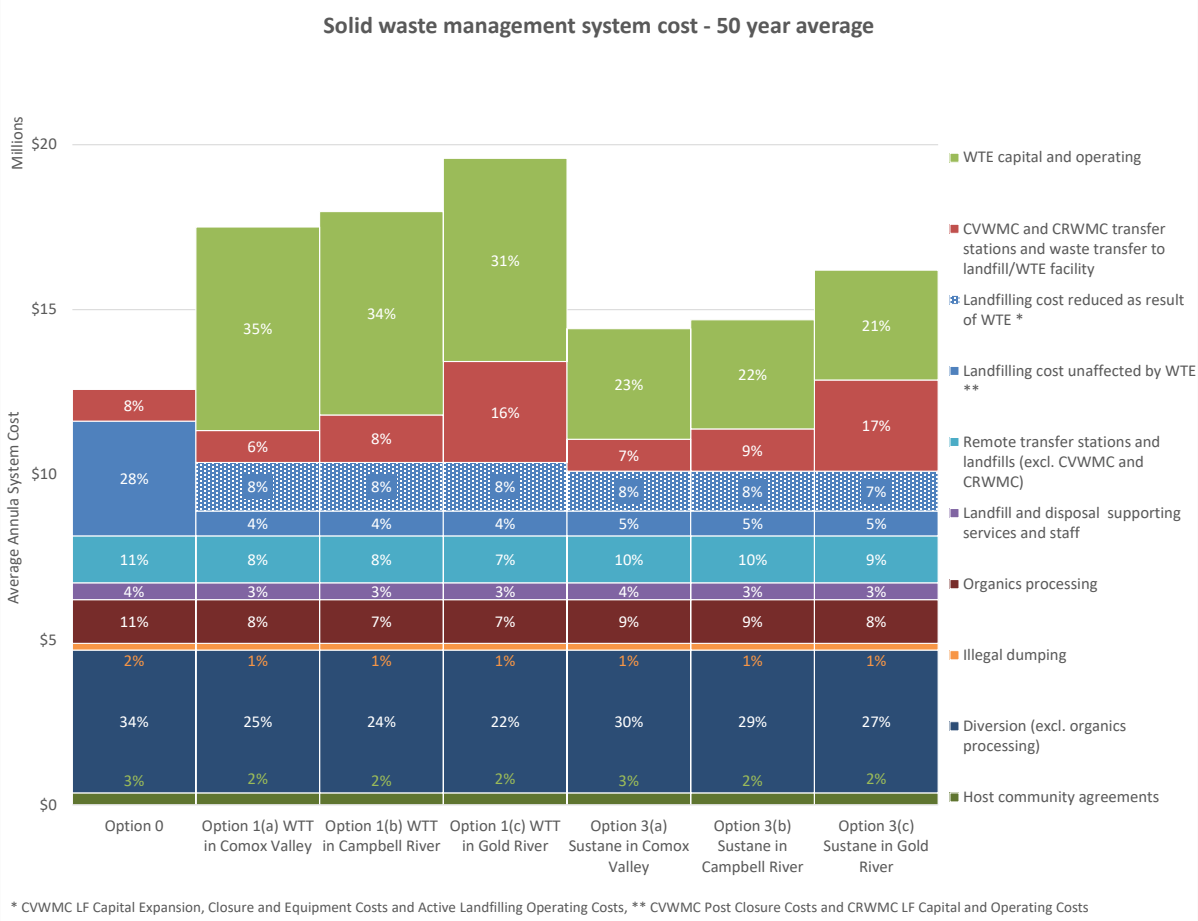


* CVWMC LF Capital Expansion, Closure and Equipment Costs and Active Landfilling Operating Costs, ** CVWMC Post Closure Costs and CRWMC LF Capital and Operating Costs



* CVWMC LF Capital Expansion, Closure and Equipment Costs and Active Landfilling Operating Costs, ** CVWMC Post Closure Costs and CRWMC LF Capital and Operating Costs

The two figures below show the annual average full system costs over the 50 years modelling period for the facilities operated at fixed and increasing capacity. When calculated over the longer time period the difference in landfilling cost between the two technologies is reduced.



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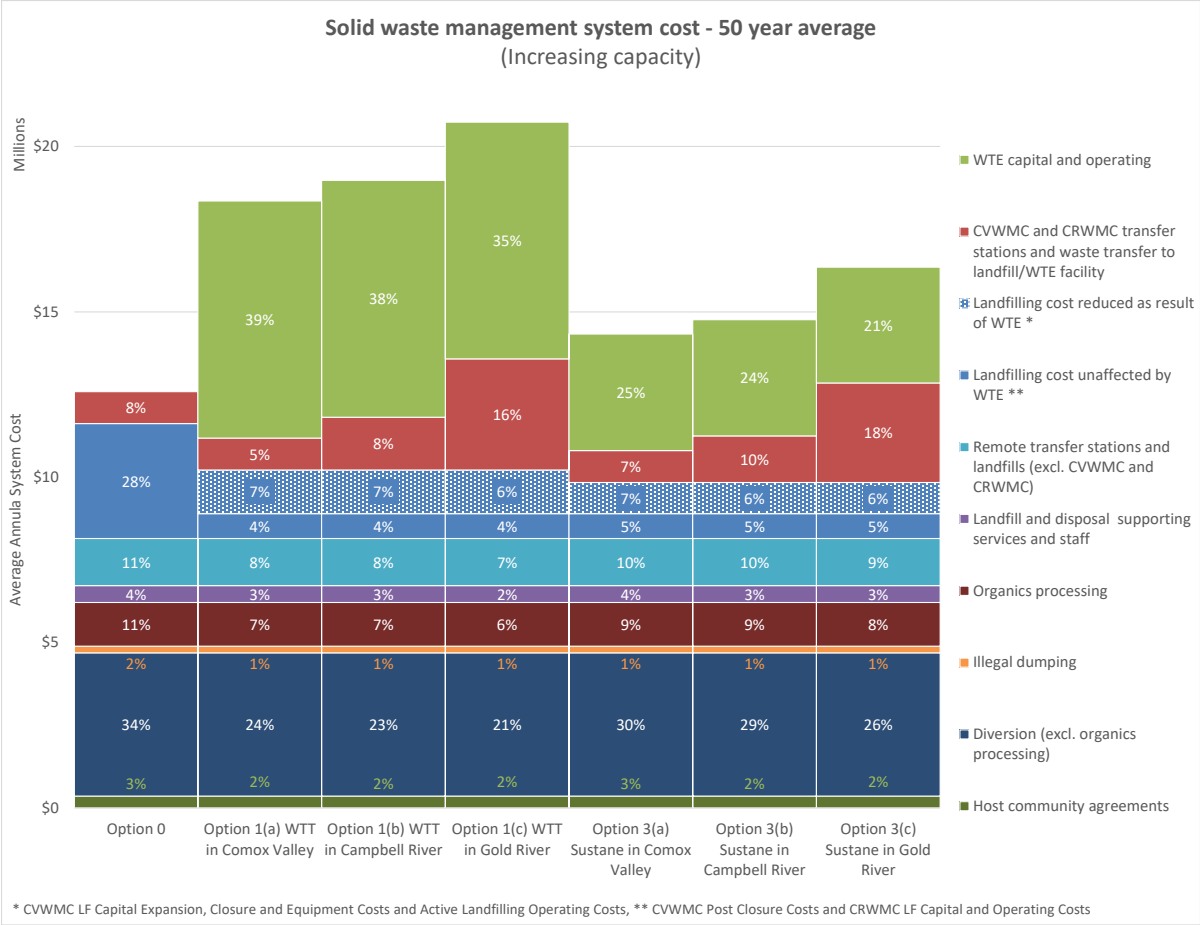

* CVWMC LF Capital Expansion, Closure and Equipment Costs and Active Landfilling Operating Costs, ** CVWMC Post Closure Costs and CRWMC LF Capital and Operating Costs

Greenhouse Gas Emissions (GHG)

The GHG emissions for each of the options, including status quo, was assessed for a period of 40 years. The assessment included the GHG emissions for the technology options, landfilling and transfer station operations (including waste hauling). The location of a WTE facility has a relatively small impact on the overall GHG emissions. However, the recycling of metals, cardboard and plastics contribute to large GHG offsets. The net GHG emissions range from -873 tonnes CO_2e (Option 1(a)) to 899 tonnes CO_2e (Option 0) over the assessed 40 year period.

In terms of GHG emissions, each WTE technology is favourable when compared to the status quo landfilling option. In particular, the WTT technology offers a net negative GHG emissions which is mainly attributed to the recycling of non-ferrous metals and cardboard.

Conclusion

The results from the long-term cost modeling presented in this report indicate that the estimated cost to continue landfilling at the CRWMC Landfill until closure and to continue landfilling and expanding The CVWMC Landfill is approximately $75/tonne. The respective cost was estimated to approximately $80/tonne in Version I of this report (November, 2017). In Version II, a decreased diversion rate is assumed for the regions based on updated diversion estimates. Consequently an increased disposal rate is applied to the fixed landfilling cost which results in a decreased cost per tonne. Waste processing through one of the assessed WTE technology options would increase this

cost by $29 to $110 per tonne, or $89M-$347M over a 50 year period. This cost per tonne represents the total disposal cost and include capital and operational costs related waste disposal (WTE and/or landfilling), waste transfer (transfer station and waste hauling) as well as any WTE revenue from diverted materials or generated product or energy.

The lowest cost option that incorporates WTE would utilize the technology provided by Sustane located at in the Comox Valley area with system costs of $117 per tonne for the first 30 years, which drops to $99 per tonne at 50 years of operation. This cost per tonne remains higher than the status quo landfill operation. Sustane technology is an advanced combination of processes and individual technologies with only one identified reference facility in Europe. Very little is known about this plant and the effectiveness of the individual components. There is therefore a technical and commercial risk associated with this technology which may impact its feasibility and cost. A full scale system is being built in Nova Scotia which could provide performance data in the near future for further evaluation.

The costs presented above are based on WTE facilities run at fixed capacity. If the technologies are accepting increasing tonnages from year to year the average cost per tonne waste requiring disposal will generally increase. The reason for the increased cost is that more waste is processed at a higher cost, i.e. through one of the WTE technologies instead of through landfilling.

The two main factors affecting the overall system cost for the options is the facility capital and operations cost, along with transportation cost of waste, ash and residuals. Once new facilities are in operation, landfill operational costs are reduced by up to 34% and the landfill capital cost by up to 57% over the 50 year projection period. The respective numbers are 44% and 60% if the facilities were to accept increasing amounts of waste. The capital and operational costs for a WTE facility are then added to that reduced landfilling cost.

The siting and regulatory review indicate no significant barriers to implementing a WTE facility within the CSWM system. A consultation plan should be developed once a site and technology is selected. A SWMP amendment would also be required should WTE be implemented. It is recommended that consultation for WTE and a SWMP amendment occur at the same time.

Traditional WTE is a proven technology with generally available markets for the energy and a high degree of landfill space savings, however, it is expensive compared to most other technologies. Creating a solid fuel (RDF or bio-pellets) is substantially less expensive than WTE, mostly because capital and operational costs of the actual combustion component is borne by a third party. The main risk with RDF and bio-pellets is finding long term markets for the product. Anecdotally, it is known that there are large supplies of wood waste available in the region. Creating additional organic product could disrupt current wood waste recovery and utilization operations by adding more product into an already well supplied market.

WTE offers many benefits, however, the results from the long-term cost model show that landfilling remains the most cost effective waste disposal option for the region.

1. INTRODUCTION

1.1 Background

Comox Strathcona Waste Management (CSWM) provides solid waste management services to the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD). The Solid Waste Management Plan (SWMP) adopted in 2013 identifies the long range preference to explore and pursue energy recovery from residual waste through Waste to Energy (WTE) technologies. WTE, also defined as thermal processing or thermal treatment, involves the conversion of municipal solid waste into gaseous, liquid and solid products and a concurrent or subsequent release of heat energy. The heat energy is then used in many cases to generate electricity.

Two main landfills are used for disposal of the majority of the region's waste. The Campbell River Waste Management Centre (CRWMC), located near Campbell River, handles waste from the SRD while the Comox Valley Waste Management Centre (CVWMC), located in Cumberland, handles waste from the CVRD. The Landfill at CVWMC is currently being expanded with a new engineered landfill and the Landfill at CRWMC is expected to close in the next 5-6 years. The total amount of landfill disposal for 2016 was 63,390 tonnes[1].

There are extensive recycling programs throughout the region and centralized composting is also being implemented to remove organics from the disposed waste stream.

There is continued interest in WTE technologies for managing of the residual waste component of the municipal solid waste (MSW) due to the current high cost of landfilling and the anticipated need for ongoing investments for landfill expansion.

WTE was studied in detail in 2011 by the CSWM. The most recent work involved expanding on and updating the previous study. There have been new developments in the WTE industry which involve integrating systems for the combined processing of waste to recover energy biologically and thermally, while making best use of residuals coming off the processes, e.g. compost and ash.

1.2 Scope and Timeline

Morrison Hershfield was engaged by the CSWM to assess WTE technologies. The project commenced in May 2017 with the preparation of a Request for Information (RFI). It was issued to suppliers of WTE and refuse derived fuel (RDF) production systems.

All information received in the response to the RFI was evaluated. Three technologies were selected for further research and assessment. The potential costs of the options were assessed against projected landfill costs. Other considerations such as siting, regulatory requirements, and environmental impacts (such as waste diversion potential and greenhouse gas (GHG) emissions) were compared to the current status quo systems.

1.3 Objectives

Tipping fees in the region are currently $130 per tonne and the overall solid waste system is also supported by taxation. The CSWM is concerned about continued increases in solid waste management costs and about placing an even heavier financial burden on its taxpayers. This study

[1] CSWM 2016 Disposal Tonnages

identifies WTE technologies that are able to recover energy while substantially reducing the volume of waste/residuals going to landfill. This study also identifies the potential for cost savings from reduced landfill costs and compares them to the costs of WTE. This information should enable the CSWM to make an informed decision on whether or not to include WTE in its integrated system.

For the purpose of this study, the definition of WTE has been expanded to include energy from organics (anaerobic digestion or AD) and converting waste into fuel for burning by a third party (refuse derived fuel (RDF) and bio-pellets). Within this report, references to WTE technologies or facilities encompasses this definition of WTE.

2. REQUEST FOR INFORMATION PROCESS

Vendors of the various WTE technologies were invited to submit responses to a Request for Information (RFI) posted on BC Bid on June 13, 2017. Appendix A includes a memo outlining the detailed evaluation of the RFI submissions. In addition, specific vendors, primarily based in Europe, were approached and referred to the BC Bid website for access to the RFI. The European vendors were selected on the basis of the Consultant team's knowledge of firms who provide the selected technologies. The vendors were given until July 14, 2017, to submit responses to the RFI.

The purpose of the RFI was to obtain vendor specific information so that technologies could be ranked for suitability to CSWM. The RFI provided background information and clarified that technologies must be capable of processing quantities equivalent to approximately 125 tonnes MSW per day from the CSWM area. The vendors were requested to assume that waste reduction initiatives are being implemented to achieve a 70% diversion rate, which results in an estimated heating value of the residual waste that could range from 11 to 13 GJ/tonne. BC MOE developed a policy in 2010, requiring regional districts to plan to reach 70% diversion prior to considering WTE (BC MOE, 2010). This policy was considered during the development of the CSWM SWMP.

This section provides a summary of the RFI responses and evaluation.

2.1 Overview of RFI Responses

A total of six different vendors of mixed municipal solid waste (MSW) processing and energy recovery technologies responded. A brief summary of vendor claims, with additional comments by MH, follows:

- Eco Waste Solutions (EWS)
- REDWAVE, a Division of BT-Wolfgang Binder GmbH
- SALT Canada Inc.
- Sustane Technologies Inc. (Sustane)
- WastAway
- WTT Netherlands BV (WTT)

2.1.1 Eco Waste Solutions (EWS)

EWS is a well-known Canadian supplier of smaller conventional incineration systems. EWS is proposing that the WTE facility will comprise two EWS Enercon Thermal Conversion Modules. Each module will have a capacity of 100 tonnes per day. The system operates under excess air conditions with precisely controlled combustion through temperature and oxygen level controls and flue gas recirculation.

Air pollution control systems are included and are generally provided by companies specialized in supplying this equipment. Air pollution control equipment can be specified to meet current emission limits, or even stay well below them if desired.

The system is designed to produce electricity or steam, or both. The bottom ash by-product has been tested according to U.S. EPA Toxicity Characteristic Leachate Procedure (TCLP) for incinerator ash. The vendor has stated that all test results have been well below any standards set by the U.S. EPA and have proven the ash to be non-hazardous, non-leaching and essentially inert. The vendor claims that beneficial use can include road construction backfill, road re-surfacing material, aggregate replacement in cement, landfill cover or a beneficial additive to some soils to improve drainage or correct pH.

There are numerous facilities currently using this technology, and it is well proven.

2.1.2 REDWAVE, a Division of BT-Wolfgang Binder GmbH

REDWAVE offers a mechanical-biological waste treatment technology for the mixed residual MSW. Mixed waste is mechanically separated into wet (organics) and dry components and sensor-based sorting recovers recyclables from the dry component. The wet organics are biologically dried and stabilized, and together with the residue from dry sorting are converted into a refuse derived fuel (RDF). RDF can be utilized in cement kilns, pulp mills and or other industry with high energy demand to offset fossil fuels. The vendor mentions two pulp mills located on the Island, in Port Alberni and Crofton, as potential markets, however no market for the RDF has been established.

This is a proven technology in Europe. It is generally not used in Canada due to its cost and difficulties in establishing long term markets for the RDF.

2.1.3 SALT Canada Inc.

SALT Canada Inc. offers a technology that consists of two distinct steps. In the first step, conventional landfill cells are made aerobic (similar to composting) by injecting large amounts of air. The waste is stabilized and the cell can be opened and mined within four years. In a second step, valuable materials (recyclables) are then mechanically extracted and the remaining waste is processed into fuel or RDF while the landfill cell can be used for repeat filling. This requires an overall time frame of six years between final cell filling and preparation for the cell for further waste acceptance.

This is a somewhat unusual approach and to the best of our knowledge has not yet been successfully applied in its entirety. Anecdotally, landfills are rarely mined due to cost, and when they are mined it is generally to create new space for disposal. There is a substantial risk that the recovered materials will be contaminated and have a low value. As with any RDF, the challenge is finding long term markets for the fuel.

2.1.4 Sustane Technologies Inc.

The technology offered by Sustane uses proprietary de-bonding, separation and cleaning processes, to obtain end products including clean biomass pellets, synthetic diesel, and metals. The biomass pellets are not considered RDF as they contain virtually no plastics. The vendor claims that this has been done in Nova Scotia where the fuel has been certified by the Department of Environment, Nova Scotia, as recovered biomass, with all the attributes of forest based biomass.

Plastics are separated and the low-density plastics fraction is processed into a synthetic diesel product for internal use (25%) and also for sale (75%).The remaining part of the MSW is bio dried and pelletized to create a fuel for local markets, which the vendor claims will be biomass. The synthetic diesel product will achieve ASTM specifications, typically at a 50% blend and will be sold as a marine diesel or industrial/commercial fuel oil (No. 2) replacement.

Based on the vendor's experience in Nova Scotia, the proposed facility will generate recovered materials that can stimulate additional "green" businesses. The vendor suggests that CSWM may wish to consider an "Eco-Park" concept to reap the benefit of this enabling technology.

The vendor stated that they can offer the biomass pellets at a price discount to forestry-based biomass to facilitate the sale process for use in pulp and paper boiler applications.

This technology has been proven in Europe and the first Canadian plant is currently under construction in Chester, Nova Scotia. This operation will process 200 tonnes per day of MSW. A facility in Madrid, Spain, has a relatively similar throughput to the one requested processing 100 tonnes per day (built in 2010).

2.1.5 WastAway

WastAway proposes a technology which processes MSW into RDF. A multi-stage process includes pre-shredding of MSW, metals removal, inerts screening, a Hydrolyzer (a form of continuous-flow autoclave), dryer and pelletizer to form RDF. Only one operational plant exists in the U.S., and this facility is mainly a demonstration facility. The preparation of fuel is relatively recent for this reference plant.

WastAway identified Nanaimo Forest Products – Harmac Pacific Pulp as a potential buyer of the RDF for use in their boilers. The submission names David Bramley, Environmental Superintendent, to be available to confirm interest if required. The interest has not been confirmed at this stage.

2.1.6 WTT Netherlands BV

Waste Treatment Technologies (WTT) has numerous reference facilities across Europe and proposed two combinations of technologies feasible for CSWM:

- RDF production and biodrying, or
- RDF production, AD and biodrying.

Both of the aforementioned options offer production of RDF. As stated previously for other vendors, RDF can replace fossil fuels at cement manufacturers in BC. The option with AD also produces biogas, which can be converted into electricity/heat. The bio-dried product can be upgraded/refined to make RDF. Alternatively, the AD residue can be composted. The quality of the compost that comes from the processing of mixed MSW can have numerous contaminants, which may limit end markets for land application.

If a facility is selected to generate AD, the bio drying and AD tunnels can be built as hybrid or dual purpose tunnels. These hybrid tunnels can operate under both anaerobic and aerobic conditions. By operating an AD tunnel as composting tunnel the capacity of the tunnel will be tripled. This technology is therefore very flexible to handle smaller or larger volumes.

This is a proven technology in Europe. No facility using WTT technology to produce RDF is in operation in Canada, however WTT technology is being used in the Surrey Biofuel Facility to produce compost and biogas.

2.2 Evaluation of RFI Submissions

2.2.1 Evaluation Criteria

Each vendor submission was evaluated by two members of the Consultant's project team through a two-tier process. Each submission was evaluated against Essential evaluation criteria and Desirable evaluation criteria. All submissions met the Essential Criteria, and were assessed further against Desirable Criteria.

The major categories of Desirable Criteria are:

- Innovation and Risk.
- Technology.
- Environmental and Social.
- Economics and Affordability.
- Submission Completeness.

Weighting was allocated to the key categories based on knowledge of local conditions and client priorities. A sensitivity analysis of these weightings was also completed.

Where information gaps were identified, the vendors were approached for further information. If data gaps remained after follow up, the evaluator used their best judgement based on professional experience to evaluate the vendor's submission. Where no information was available from the vendor and it was not possible to fill remaining data gaps with any confidence, a score of 1 (out of 3, 3 being the best score) was given against the relevant criteria.

2.2.2 Rankings of Submissions

The RFI received a total of six submissions, of which five were directly related to the production of conventional RDF from MSW. Only one submission was for conventional (thermal) WTE.

All six vendors provided sufficient details to carry out the evaluation process effectively and all (with limited reference facility information from SALT) had a number of reference facilities operating at or above the potential feedstock generation rates anticipated for the CSWM service area.

On completion of the evaluation process for technology providers in accordance with the evaluation criteria and weighting shown above, the submissions were ranked as shown in Table 1.

Table 1: Ranking of submissions.

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
EWS	Thermal WTE	81%
REDWAVE	RDF	79%
Sustane	RDF and pyrolysis	77%
WastAway	RDF	75%
SALT	Aerobic Landfill, RDF	54%

A summary of the scoring justification for each vendor is presented below:

- WTT has the highest score because the technology produce both energy and fuel. Markets for the energy (electricity or bio-gas) are proven and available; while the markets for the RDF are uncertain at this time. The technology is proven and less costly than thermal WTE. Emissions are minimal at the location of the facility, but there will be emissions where the RDF is burned and these cannot be determined until the user of the RDF is known.
- The conventional WTE offered by EWS is proven, reliable, and the markets for the main energy recovered (electricity) are generally available. Additional waste heat will be available which could lead to the development of facilities that require heat, such as greenhouses. The major downside to traditional WTE is the cost, which is substantially higher than for the offered RDF technologies.
- REDWAVE is an advanced mechanical recycling and RDF production technology. They have good reference facilities and the system is expected to be reliable. A major unanswered question, as with the other RDF technologies is finding markets for the product, and determining the actual emissions when (and where) the product is burned as fuel.
- Sustane offers a separation of plastics from organic materials and the creation of biomass pellets. The separated plastics are subjected to pyrolysis to create a diesel equivalent fuel. While highly desirable, there have been very limited commercially successful applications of pyrolysis for waste products.
- WastAway offers an RDF process with a special process step that breaks down the microbial structure of the organic materials in the waste. WastAway claims it makes a better fuel,

however, the process seems much more complex than other RDF technologies. The firm only has one full scale demonstration facility operating at this time. However, WastAway has gone farther than other firms in establishing potential markets for RDF.

- The SALT technology, while in the end making an RDF, is highly unconventional, and there are many unanswered questions and lacking reference facilities, which resulted in lower scoring.

Vecoplan LLC, which is a well-known and reputable German company, also provides a technology for the production of RDF. Vecoplan did not submit a response to the RFI, but provided to Morrison Hershfield a web link to a video showing both actual video and concept animations of its energy recovery facility installation with the City of Edmonton. Vecoplan could not be evaluated without a formal submission to the RFI, however, their information supports the feasibility of recovering recyclables and making of RDF through modern mechanical systems, as offered by other vendors.

2.3 Conclusions from RFI Evaluation

Of the six submissions, only one offered a conventional WTE technology. All others provided some form of conversion to RDF or other fuel.

Conventional WTE ranked near the top primarily because the technology is well proven and markets for energy (electricity and heat) and recovered metals are generally available. In addition, the bottom ash could be recycled or used for various purposes, resulting in very little residue going to landfill.

RDF processing offered by the various vendors is also proven, although the degree varies with the technology. The greatest challenge with RDF or biomass is finding long term markets for the fuel, and without the markets, the technologies are – simply put – very expensive ways of extracting recyclables and stabilizing the balance of residual waste.

Currently in Canada conversion of waste into fuels is appealing as a solution to reduce landfill disposal needs and to extract the most value from the waste stream. However, some of the technologies that are proposed by the vendors are still not proven in Canada. For example it must be seen how the facility using Sustane technology in Halifax, Nova Scotia, which is currently under construction, will deliver and prove the viability of the biomass market. The Halifax facility also plans to convert the plastics fraction of the MSW into a liquid fuel, similar to diesel fuel, while the organics will be converted into burnable pellets. While basically attractive from a technical perspective, it must be recognized that there is a technical, and subsequently commercial risk with this technology, since newer, unproven technologies often experience longer start-up times and higher costs than anticipated.

Morrison Hershfield presented the evaluation process and rankings to the CSWM Board and Select Committee subsequently identified three preferred WTE technologies:

- EWS
- WTT
- Sustane

EWS provides a conventional WTE technology which involves immediate generation of electricity and heat on the site. The other two vendors (WTT and Sustane) provide technologies that involve preparing the waste into a fuel on the site, and then shipping the waste derived fuel to a third party for combustion. These three technologies were considered in the options and cost assessments as outlined in this report.

3. ASSESSMENT OF SITING AND REGULATORY REQUIREMENTS

3.1 Overview of Potential Sites

Three locations were considered for the potential WTE facility; Comox Valley, Campbell River and Gold River. A total of four sites were considered – two sites within the Campbell River area were reviewed in the siting assessment.

3.1.1 Comox Valley Area

In the Comox Valley area, the Comox Valley Waste Management Centre (CVWMC) has been identified as a potential site for a WTE facility. The Comox Valley Waste Management Centre (CVWMC) covers an area of approximately 90 hectares and is located approximately 1 km northwest of the Village of Cumberland, BC, at 3699 Bevan Road.

The CVWMC is owned and operated by the CSWM service. The CVWMC is operated under a host community agreement entered with the Village of Cumberland in July 2013. The agreement expires at the end of 2032 (AECOM, 2017). The Landfill currently operates under Amended OC MR-5050, issued on September 20, 2016 by the BC MOE.

The CVWMC is transitioning from an unlined landfill with limited environmental controls to an engineered site with a double-lined cell and landfill gas and leachate management systems. The landfill expansion of Cell 1 was completed in 2017 and the leachate management system was completed in October 2017. The site has a landfill gas collection and flaring system, recycling and waste drop-off/storage areas, a biosolids compositing facility at the north end of the CVWMC, an organics composting pilot project facility at the south end of the CVWMC and a closed asbestos disposal area which lies immediately to the northeast of the landfilled area.

3.1.2 Campbell River Area

In the Campbell River area, two potential sites have been identified: the Campbell River Waste Management Centre (CRWMC) and the former Elk Falls mill site.

The CRWMC is located approximately 6.5 km east of the City of Campbell River, on Argonaut Road. The site is composed of two land parcels, Blocks C and J within District Lot 85 of the Sayward Land District. The site covers 29.7 hectares. It is owned by the CVRD and operated by Berry and Vale under contract with the CVRD.

The CRWMC site is authorized for the purpose of landfilling under the Operational Certificate defined as Block C of District Lot 85, Sayward Land District. The property to the north that may be used in the future for landfill purposes is defined as Block J of District Lot 85, Sayward Land District. Both properties are under Crown Land Leases, with titles being transferred from the District of Campbell River to the CVRD. The landfill is currently operated under OC MR-02401. The landfill is expected to close in 2023, pending Ministry of Environment approval. There is currently a transfer station at this site and it is assumed that the long term plan for the remainder of the site is to remain a closed landfill.

The Elk Falls mill site is located approximately 5.5 km north of Campbell River on 4405 Island Highway. The land parcel covers 174 ha. The Elk Falls mill was in operation between 1952 and 2009, and the portion of the property where the mill was located is currently not used.

3.1.3 Gold River Area

In Gold River, the former pulp mill site has been identified by the CSWM as a potential site for a WTE facility. This site has been discussed as an option for WTE for over ten years. In 2003 Muchalaht Industries Inc. was formed and bought the site and formed Green Island Energy (GIE). Since 2003 Covanta, who operates numerous WTE facilities in North America, and GIE have sought environmental permits to operate a WTE facility at this site and have held local public meetings The development was endorsed by the Village of Gold River and the neighbouring Mowachaht Muchalaht First Nations Band Council (Letter from Village of Gold River Mayor to the Fraser Valley Regional District. July 9, 2012).

As of 2012 the proposed project was fully permitted and had achieved all operation approvals through the Ministry of Environment. The project was put on hold due to delay in commitment from various regional districts on Vancouver Island and Metro Vancouver (CVRD 2012).

3.2 Siting Criteria

Each of the four potential sites were assessed against the following siting criteria:

- Zoning
- Transportation
- Proximity to feedstock sources
- Access to utilities
- Buffers to neighbours
- Air-shed and prevailing winds
- Siting suitability

A summary of the evaluation is provided in Table 2 through Table 5 below.

Table 2: Siting assessment of the Comox Valley area - CVWMC site.

Location	Comox Valley - CVWMC
Zoning	The site is zoned as I-3 under the Village of Cumberland Bylaw No. 1027 for use of compost, recycling, and refuse disposal.
Transportation access	The CVWMC has one public entrance that serves both residential and commercial customers. The scalehouse is located at the site entrance and close to the public recyclable drop-off area. The CVWMC also has a site operations entrance located approximately 500 m northwest of the main site access road along Bevan Road that is used for access to the biosolids mulching facility, and is currently being used by contractors during construction of Cell 1 (GHD, 2016a).
Proximity to feedstock sources	Close to generators in Comox Valley. Feedstock from Campbell River needs to be hauled 60 km. Since this site is closest to the largest concentration of generated waste, it will, on a regional basis, incur the lowest hauling costs.
Access to utilities	The site has access to gas and power, but water and sanitary sewer are not available at this time.
Buffers to neighbours	Already sited as landfill with adequate buffer zone requirements as per the Landfill Criteria. The landfill footprint is required to maintain a 50 m buffer from the property boundary. The closest residential dwellings are located approximately 1.5 km south east of the site.
Air-shed and prevailing winds	The predominant wind direction in the neighbouring town of Courtenay varies throughout the year. The wind is most often from the south (February to May, and October to November) and from the west from (May to October), and from the east (November to February) (Weather Spark, 2017a).

Location	Comox Valley - CVWMC
Air emissions	Due to the existing proximity to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas. The well-known process utilizes meteorological information from local data sources such as those measured by Environment Canada at nearby stations (if available) or obtained from the Ministry of Environment. Emissions from combustion facilities are generally managed with assistance from a dispersion analysis. A stack size can then be determined so that any potential emissions are dispersed in a manner that does not impact human receptors. This is also possible for odours provided they are captured. The Surrey biofuel plant uses a stack for dispersing odours.
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site use is compatible with other waste management uses ▪ It is located near the largest concentration of solid waste generated in the region, thus direct-haul (without a transfer station) is possible for the majority of waste ▪ Infrastructure needed for waste acceptance is already in place, such as scales, access roads, fencing, and buffers. ▪ Utilities are available on-site except water and sanitary sewer. There is a leachate treatment system onsite may have the potential for use to treat other wastewater from the site.

Table 3: Siting assessment of the Campbell River area – CRWMC site.

Location	Campbell River - CRWMC
Zoning	The site is currently zoned as Industrial Four (I-4) under the City of Campbell River Bylaw No. 3250, 2006.
Transportation access	The site has one entrance, a weigh scale and scalehouse with a full-time attendant. The site is located on Argonaut Road, off Highway 28, just east of Campbell River.
Proximity to feedstock sources	Close to generators in Campbell River. Feedstock from Comox Valley needs to be hauled 60 km.
Access to utilities	There is access to power and water but there is no leachate collection system at the site.
Buffers to neighbours	The property directly west of Block C is owned by Island Ready Mix and houses operations and equipment for concrete manufacturing and a gravel pit. Directly south of the Site is a gravel pit. Mature forests situated on Crown Land are located to the north and east of the Site. There are three residential dwellings located approximately 500 meters to the northeast of the landfill footprint. The property immediately to the east of Block J is occupied by a single dwelling residential lot (GHD, 2016b)
Air-shed and prevailing winds	In Campbell River, the wind is most often from the west from April to October and most often from the east for the rest of the year (Weather Spark, 2017b).
Air emissions	Due to the existing proximity to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas.

Location	Campbell River - CRWMC
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site use is compatible with other waste management uses ▪ It is located near the second largest concentration of waste in the region. However, the largest amount of waste would have to be transferred to this site. ▪ Infrastructure needed for waste acceptance is already in place, such as scales, access roads, fencing, and buffers. ▪ Some, but not all utilities are available on-site.

Table 4: Siting assessment of the Campbell River area – Elk Falls Mill site.

Location	Campbell River – Elk Falls Mill
Zoning	The site is currently zoned as Industrial Two (I-2) under the City of Campbell River Bylaw No. 3250, 2006. This zoning covers areas for manufacturing, processing, fabricating assembling, packaging, and transport or shipping of goods and services, including marine transport and water based industrial activities. Permitted uses includes recycle centre and/or scrap metal yard. Re-zoning is required before the site can be used for waste management purposes.
Transportation access	The site can be accessed from the North Island Highway via Top Road or Duncan Bay road.
Proximity to feedstock sources	Close to generators in Campbell River. Feedstock from Comox Valley needs to be hauled 60 km.
Access to utilities	Unclear regarding status of utilities on-site, however the site is assumed to have gas, power, water and sewer within close proximity thanks to neighbouring land use.
Buffers to neighbours	Proximity to residential properties on the east side of the land parcel. Residential land uses within 100 from property boundary.
Air-shed and prevailing winds	In Campbell River, the wind is most often from the west from April to October and most often from the east for the rest of the year (Weather Spark, 2017b).
Air emissions	Due to the existing proximity to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas.
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site is not currently used for waste management and would require rezoning ▪ It is located near the second largest concentration of waste in the region. However, the largest amount of waste would have to be transferred to this site. ▪ The site has road access, but it is not known how increased traffic will impact residents. ▪ Some utilities are near the site from previous industrial activity ▪ The development of a WTE facility at this location is constrained by proximity to residences.

Table 5: Siting assessment of the Gold River area – former pulp mill site.

Location	Gold River – Former Pulp Mill Site
Zoning	The area of the site is zoned as heavy industrial (M-1), service industrial (M-2), waterfront industrial (M-3), aquaculture industrial (M-4) as per Bylaw No. 635, "Village of Gold River Zoning Bylaw, 2003.
Transportation access	The site is accessed from the Gold River Highway (Number 28). The status of the access road within the site is unconfirmed since the site is not currently in use.
Proximity to feedstock sources	Located 160 km and 100km from the two major feedstock sources, Comox Valley and Campbell River. This will require two transfer stations and substantial transportation costs.
Access to utilities	Unconfirmed since the site is not currently in use, but because of its previous industrial use, it is assumed that access to utilities is possible.
Buffers to neighbours	Large buffer with over 10 km to the closest residential dwellings.
Air-shed and prevailing winds	Not confirmed
Air emissions	Although large buffer distances to neighbours, an air dispersion model may be appropriate to determine how air emissions, especially odorous emissions, might affect surrounding receptor areas.
Siting suitability	The following factors should be considered when assessing this as a potential site for a WTE facility: ▪ The site is not currently used for waste management, but was supported by the Village of Gold River for WTE in the past (CVRD 2012). ▪ It is located far from the two largest waste sources and will require two transfer stations. Operations will incur high transportation costs ▪ The site has road access, but its suitability is unknown ▪ Some utilities are near the site from previous industrial activity ▪ The site has local support in the community for WTE

In summary, all sites described above could be used for a WTE facility, and each have advantages and disadvantages. Proximity to the largest amount of waste generated reduces hauling costs and makes the CVWMC attractive, as it also has existing waste management infrastructure that could serve dual purposes. However, lack of adequate process water and sanitary sewer is a drawback. Gold River is suitable from infrastructure and permitting perspectives, but it is likely that the distance to haul make transportation costs for this site considerably more expensive. The Elk Falls Mill is an unused former industrial site with utilities; therefore, it may not require significant utility upgrades. However, it is sited within 100 m of a residential development, which may present public consultation challenges. Ultimate selection of a site will depend on the technology and could be finalized once a decision has been made to proceed with WTE and begin a procurement process. The three general areas: Comox Valley, Campbell River and Gold River are considered in the long-term cost model and analysis in Section 4.

3.3 Overview of Regulatory Requirements

WTE is an allowable activity under the *Environmental Management Act*. All local governments that plan to direct a portion of their municipal solid waste (MSW) to a WTE facility must seek an amendment to their SWMP to reflect this intention. The CSWM has already signalled the intention to consider WTE as a part of the solid waste management system.

The SWMP highlighted opportunities for integrated resource recovery, which the CSWM will be pursuing during implementation of the plan. In particular, integrated resource recovery will be considered when assessing organics processing and WTE options.

In the SWMP 2013 it is stated that "...it is anticipated that WTE may become part of the solid waste management system for CSWM in the future and that solid waste planning must consider WTE technologies and include such consideration in reporting to the Board for all related authorizations."

If the CSWM deems WTE feasible to implement, this must also be reflected in the SWMP.

A WTE facility would require public consultation as part of the following requirements:

- **Solid Waste Management Plan** (SWMP) - as noted above, previous consultation between 2010 and 2012 included the consideration of a WTE facility. If CSWM intended to proceed with a WTE facility, the SWMP would require amendment and there would be consultation requirements, with the minimum requirements determined by BC Ministry of Environment (MOE).

  Guidelines released by the MOE in 2010 and 2011 indicate that a Region must have plans for 70% diversion before WTE should be considered for the remaining residuals.

  Recent conversations with the MOE (from the Clean Communities department) indicated that the MOE is not intending to update their guidelines from 2010 on resource recovery and WTE. They said that each Regional District (RD) will need to show that they have maximized the amount of diversion from the 3 Rs (Reduce, Re-use and Recycle) before they start looking at energy recovery and WTE. If a RD is not able to achieve a 70% diversion rate, the RD needs to justify why. The MOE recognizes that some RDs face greater challenges than others in achieving 70% (or equivalent) diversion through the 3R's and will deal with each RD's wishes to utilize energy recovery and WTE, on a case-by-case basis.

  It is highly likely that recyclables recovered in a mixed waste processing facility will not be considered recycled under 3R's but would be considered recovery. Any form of energy recovery, including anaerobic digestion, as well as the making of fuel from waste would be considered recovery. Composting is considered recycling.

  As the MOE seems to understand the challenges in measuring diversion performance, they are discussing the potential to move to a kg/capita disposal target rather than the 70% diversion target. However this policy shift is unlikely to take place in the near future.

- **Environmental Assessment** - A new WTE facility must comply with the *Environmental Assessment Act* if it meets the thresholds specified in the Reviewable Projects Regulation. There are two potential environmental assessment triggers that could apply to this project:

  1. If it has a rated nameplate capacity > 50MW of electricity, or
  2. If it has a design capacity of processing > 225 tonnes of MSW/day.

  Neither of these apply to a potential WTE facility in the CSWM service area. The capacity will be closer to 5MW and the daily throughput is likely to be approximately 130 tonnes per day. An Environmental Assessment (EA) may be required if one is requested by the public, and the decision is made by the minister, or their delegate.

- **Operational Certificate** (OC)[2] - In the letter approving the SWMP, the Ministry of Environment (MOE) will direct the regional district to consult with the regional operations

[2] A certificate issued under section 28 of the *Environment Act* for the design, operation, maintenance, performance and closure of sites or facilities used for the storage, treatment or disposal of waste or recyclable material.

branch of the MOE in the finalization of the necessary operational certificates (OCs), which give authorization to a WTE facility.

The approval of OCs will be based on the detailed operating and environmental protections measures for the solid waste management facility specified in the SWMP. Amendments to an OC may require an amendment to the SWMP requiring minster approval. It is thus important to achieve the right balance between ensuring the site will be operated in accordance with standards agreed to in the approval process and providing sufficient flexibility to make minor changes easily. The SWMP, together with the required OCs, will form the basis of the authority to operate these facilities.

- **Other Permit Requirements** - Municipal approvals may be required including zoning and development permits.

A facility must be designed and operated in a manner that protects the receiving environment. Additional regulatory requirements include:

- **BC Approved and Working Water Quality Guidelines** (WQGs) – All surface water monitoring results collected at a WTE facility site must be compared to the applicable WQGs.
- **Contaminated Sites Regulation** (CSR) - All environmental monitoring results collected at a WTE facility site must be compared to the applicable CSR standards. Groundwater monitoring results fall under CSR standards.
- **Regional Solid Waste Plan Local Service Area Establishment Bylaw No. 1822, 1996** - The establishment of a WTE facility must be aligned with the Regional Solid Waste Plan Local Service Area Establishment Bylaw No. 1822, 1996. The purpose of the bylaw to "establish the local service of collection, removal and disposal of waste, noxious, offensive or unwholesome substances and provide for the regulation, storage and management of municipal solid waste and recyclable material including the regulation of facilities and commercial vehicles." The bylaw may need to be updated to allow the processing of waste.

4. SYSTEM OPTIONS AND COST ANALYSIS

4.1 Introduction

Based on the vendor submissions received as part of the RFI process, it was determined that three potential technologies would be evaluated further. The three selected technologies are:

1. Waste Treatment Technologies Netherlands BV (WTT)
2. Eco Waste Solutions (EWS)
3. Sustane Technologies Inc. (Sustane)

For each technology option, a potential tipping fee was determined based on the vendor's submissions, supplemented with additional information and calculations. This information was applied to waste projections developed for the CVRD and SRD waste catchments to determine long-term costs. Capital and operating costs were estimated and included in the model. Costs were adjusted as needed to account for reduced waste management as a result of the different WTE technology options. The options were evaluated over a 50-year time horizon, based on the assumption a new facility would be operational in five years and start receiving waste in 2021.

Three potential general areas were assessed in the long-term model and considerations around these are presented in Section 4.2. The three technology options and associated assumptions are presented in Sections 4.3 - 4.4.3 below. The modelling and resulting estimated costs are presented in Sections 0 - 4.6.

4.2 Facility Location

For the purpose of the long-term cost model, three general areas for facility siting were considered; Comox Valley area, Campbell River area and Gold River. The capital and operating costs of the different technology options was assumed to be independent of the chosen location. Considering the CRWMC Landfill is expected to reach capacity in 2023, there will only be one landfill option in the region after that date, the Landfill at the CVWMC.

Depending on the location of the new facility, one or two transfer stations will be required to transport the waste from Campbell River, Comox Valley or both. For the purpose of this assessment and the long term modelling it was assumed that such a facility will be located at the existing waste management centers in Campbell River and Comox Valley.

Ash, residuals and excess waste would be landfilled at the CVWMC Landfill. Excess waste includes waste that is generated during facility shut-downs longer than 3 days (the transfer station and facility receiving building design capacity) as well as that in excess of the facility design capacity. No waste would be sent to the new facility from the SRD until the CRWMC Landfill has reached capacity.

Ash and residuals from a facility located in Campbell River would not be sent to the CRWMC Landfill for three reasons:

- The CRWMC Landfill is unlined and is unlikely to be approved for disposal of WTE ash.
- It would be more practical to landfill all ash at one location.
- Though residuals (excluding ash) could be landfilled at the CRWMC Landfill it has been assumed they are landfilled at the CVWMC Landfill to provide an apples to apples comparison between the technology options.

Waste would be hauled to the WTE facility location and ash/residuals hauled from the WTE facility to the CVWM Landfill. For the long-term cost model, it was assumed that ash and residuals would not be back-hauled. Though this would provide cost savings, it may not be possible due to the nature of the ash and residuals. The hauling cost associated with waste transferred from Gold River and other remote communities was not included in the assessment. These tonnages are small (<5%) of CSWM's total residual waste.

Table 6 below summarizes the hauling routes and siting options for the potential WTE facility.

Table 6: Hauling and siting options for the potential WTE facility

Facility identifier	Facility location	Hauling of Waste	Hauling of Residuals/Ash	Transfer station required	Ash, residual and excess waste disposal location
a	Comox Valley area	SRD waste to Comox Valley	N/A	Campbell River	CVWMC Landfill
b	Campbell River area	CVRD waste to Campbell River	Campbell River to Comox Valley	Comox Valley	CVWMC Landfill
c	Gold River	SRD and CVRD waste to Gold River	Gold River to Comox Valley	Campbell River and Comox Valley	CVWMC Landfill

4.3 Option 0 – Status Quo

In order to determine whether to proceed further with evaluating WTE options and confirm potential costs or savings, the status quo is reviewed and compared to the WTE options. The inclusion of status quo also facilitates evaluation of the effect a new WTE facility would have on landfill capacity and operations. Under this option waste generated in the SRD is landfilled at the CRWMC Landfill until closure, after which time the existing transfer station is utilized to transfer waste to the CVWMC Landfill for disposal. The CRWMC Landfill is expected to reach capacity in 2023 and closure would occur a year later.

Waste generated in Comox Valley is landfilled at the CVWMC Landfill. The Landfill is currently being expanded with a projected capacity of 5,200,000 m^3 to 5,700,000 m^3 depending on the approach chosen, as presented in the Comox Valley Waste Management Centre Master Plan (AECOM, 2017). For the purpose of this assessment it has been assumed the CVWMC Landfill will be developed according to the masterplan including Cell 1-4, 5a and 6, which offers 5,200,000 m^3 of airspace. Filling of Cell 1 begins in 2017.

Capital costs associated with closure and landfill expansion are presented in Appendix B.

4.4 Waste-to-Energy Options

Some of the assumptions for modeling the WTE technologies are relevant for each technology. These assumptions include:

- A new WTE facility would be constructed in any of the three locations presented in Section 4.2 above.
- The annual throughput at the facility would be approximately 51,000 tonnes with the exception of the first 3 years when waste generated in SRD would be landfilled at the CRWMC Landfill until capacity is reached.
- The facility is assumed to be in operation 2021, as suggested in the RFI. This allows for permitting, finding an established market for the potential RDF or other end product as well

as emission testing and permitting of the use of the end product as fuel at the receiving market.

- The facilities have a reported availability of 90% (330 days per year) or better.
- The residual waste (including ash) would be transported to, and landfilled at CVWMC Landfill. Cell development, closure, life of operating equipment and operating costs are adjusted to account for the reduced waste placement compared to status quo.

4.4.1 Option 1 – WTT

In Option 1, the WTE facility would divert organics, metal and cardboard, and generate biogas and RDF. Though the WTT technology has the ability to separate plastics, it was assumed that this fraction is landfilled based on the following:

- The value of the material is currently uncertain due to market and China's operation green fence.
- The vendor did not include the cost of equipment used to separate PET and HDPE in the submitted capital cost.

The residual stream is estimated to 33.5% of the input waste tonnages.

The WTE facility would be operated 6 days a week allowing for regular maintenance during which time waste can be stockpiled and processed. It was assumed the WTE facility is unavailable for 14 days per year, in periods longer than 3 days, during which time waste would be sent to the CVWMC Landfill for disposal.

Capital and operating costs provided by the vendor were examined for inclusion in the long-term cost model. The value of the generated product, bio gas and metals, was estimated as well. Diverted cardboard, RDF and compost/biodried product were assumed to have no net value, due to market conditions and geographic location. This is discussed further in Section 4.5.3.

A regional compost facility is being planned and developed for operation in Campbell River. Some of the organics that could be used for AD will therefore be diverted directly to composting. The waste volumes used as a basis for WTT's concept take this into account, meaning the WTT concept is based on a reduced volume of organics being available. Without a regional compost facility, WTT's AD capacity would be greater, which would increase economies of scale and could slightly reduce total costs per tonne. If, on the other hand, composting capacity in Campbell River is increased substantially, it would make the AD and composting component of the WTT process superfluous, and the WTT technology would be limited to extracting recyclables and producing RDF from the residual waste stream.

4.4.2 Option 2 – EWS

In Option 2, the received waste is incinerated at the WTE facility without prior sorting or diversion; however, metals could be recycled from the bottom ash. The residual ash is estimated to be 17% of the input waste, this based on the vendor submission.

The vendor reports that the 2 module system would allow for continuous operations, where one module would be run at increased capacity while the other is serviced. However, for the purpose of this assessment, it was assumed the entire facility will need to be shut down for an extended period for maintenance of the generator and emission control units. It was assumed the facility is unavailable for 28 days per year, in periods longer than 3 days, during which time waste is sent to the CVWMC Landfill. The facility is assumed to be unavailable an additional non-continuous 7 days, during which time the waste would be temporarily stockpiled.

The permitting process may be longer than for the other two WTE options assessed, due the nature of the technology. However, this could be balanced out by the additional time required to establish a market for the waste-derived fuel, along with emission testing and permitting by the third party proposing to use the fuel.

Capital and operating costs provided by the vendor were examined for inclusion in the long-term cost model. The value of the generated electricity and diverted metals was estimated as well. This is discussed further in Section 4.5.3.

The proposed regional compost facility at Campbell River would have a positive effect on the EWS technology. Removal of wet organics from the waste stream could result in a net increase in waste heating value, thus enabling more power output coming from a smaller amount of waste being burned. In addition, a smaller facility would be required for the remaining waste after organics for composting have been removed, resulting in beneficial impact on the overall facility costs.

4.4.3 Option 3 – Sustane

In Option 3, the received waste would be processed, metals and plastics would be diverted, and bio-pellets and synthetic diesel produced. The residual waste for landfilling is considered inert and is estimated at 11% of the input waste, this based on the vendor submission.

According to the vendor, the facility would operate 350 planned days per year and 6.5 days per week, allowing time for regular maintenance, during which time waste is temporarily stockpiled. It was assumed the facility is unavailable for 15 days per year, in periods longer than 3 days, during which time waste is sent to the CVWMC Landfill for disposal.

Capital and operating costs provided by the vendor were examined for inclusion in the long-term cost model. The value of the generated synthetic diesel and diverted metals was estimated as well. Bio-pellets were assumed to having no market value at this time, due to market conditions and geographic location. This is discussed further in Section 4.5.3.

The development of the regional composting facility at Campbell River will have no impact on the Sustane technology as presented, since the proponent already took into account the reduced organics when developing the concept. Any further reduction in organics through increased organics capture and composting (beyond what is currently planned for the Campbell River facility) would reduce the amount of bio-pellets being produced, thus reducing the economies of scale. The result would be that the pelletizing facility would be idle and not producing product for part of the time. If the operator's finances depend on the sale of pellets, then this could have a financial impact on operations. Conversely, if more organics are available, the Sustane technology could produce more bio-pellets, thus achieving better economies of scale and the sale of more fuel pellets.

4.5 Long-term Cost Models

In order to evaluate the long-term costs of each option, coupled with the different potential locations, the long-term cost models developed by AECOM in 2011 were updated. Population and waste generation projections were performed and coupled with available airspace and updated landfill construction schedule and associated costs. For the WTE technology options, specific aspects of the model were updated along with capital and operational costs.

All costs were projected over 50 years. Appendix B includes the detailed projections of 10 different options:

- **Option 0 - Status Quo**
- **Option 1 – WTT**
  - 1(a) - WTT located in Comox Valley
  - 1(b) - WTT located in Campbell River
  - 1(c) - WTT located in Gold River
- **Option 2 – EWS**
  - 2(a) - EWS located in Comox Valley
  - 2(b) - EWS located in Campbell River
  - 2(c) - EWS located in Gold River
- **Option 3 – Sustane**
  - 3(a) - Sustane located in Comox Valley
  - 3(b) - Sustane located in Campbell River
  - 3(c) - Sustane located in Gold River

For comparison between the options and against the results from the previous assessment, results were obtained for the total cost and per-tonne cost for each option over 30, 40 and 50 years. The total cost for the WTE technology options, transfer stations and landfill within each option were also determined for the stated periods.

All cost estimates were evaluated and summarised in “today’s dollars”. The net present value calculation was not used to compare the results. Determining the net present value of each option may provide a better indication of the true cost of each option, but it is not deemed necessary for comparing the options over the long term. Net present value calculations would add a level of complexity to the analysis that is unnecessary for the comparison of options.

4.5.1 Populations and Waste Projections

Population was projected over the evaluation period to determine annual waste generation. Projections for the period 2009-2041 are based on BC STATS, BC Ministry of Citizens' Services PEOPLE projections (August 2017) (BC STATS, 2017). An annual population growth rate of 1% was applied to the CVRD and 0.5% to the SRD, based on the average growth of the projection period 2009-2041. The average annual waste generation rate was assumed to be 0.57 tonnes/capita (46% diversion) for the 2015-2016 time period, 0.55 tonnes/capita (48% diversion) for the 2017-2020 time period and reduced to 0.44 tonnes/capita (58% diversion) thereafter. Implementation of a regional organics processing facility is assumed to result in a boost to the diversion rate by 10%.

4.5.2 WTE Facility Capacity

The capacity of the new WTE facility was determined based on the combined projected waste generation in the SRD and CVRD in 2024 (the year after expected closure of the CRWMC Landfill) and the facility availability. As the different technologies are expected to have varying availability, the capacity in 2024 varies between technologies. For comparison purposes, the highest capacity offered in 2024 (WTT) was applied to all three WTE technology options. The annual capacity was estimated to approximately 51,000 tonnes. For the purpose of this assessment, it was assumed that the estimated waste generation in the SRD and CVRD does not warrant for the facility to be expanded over the 50-year projection period. Therefore, annual throughput has been projected as constant over the period. All technology options were expected to operate at reduced capacity for the first 3 years until the CRWMC Landfill is closed and waste transferred to the new facility. In addition, due to facility availability and waste generation, an EWS facility would operate on a slightly reduced schedule for the first few years.

4.5.3 WTE Facility Cost and Revenue

A per tonne tipping fee for the different technologies was determined based on operating costs provided by the vendors, then assessed and compared to similar facilities and adjusted as required, as well as revenue from sale of recyclables and/or energy. The capital cost was amortized over 25 years at an assumed interest rate of 4.75%. The tipping fee over the first 25 years is comprised of an amortized capital cost and annual operating cost. The tipping fee after 25 years is assumed to be comprised of operational costs only.

The capital costs include design, fabrication, shipping allowance to Vancouver Island, construction and supervision, commissioning and start-up, trial operation, manuals and training of operators, initial emissions testing, one year of spare parts and 50% performance bond for 5 years, as requested in the RFI. As the capital cost provided by WTT does not include the cost for HDPE and PET separation nor a drum dryer, it was assumed that plastics are not separated through the WTT process. The WTT response to the RFI does not identify what is included in the capital cost provided. However, comparison to other similar facilities shows that the cost is reasonable and is assumed to include all of the requested items. The capital cost provided by EWS does not include the cost of a building for waste receiving, storing and processing. It is assumed that a fairly basic building would be required for receiving, storing and processing, similar to the current transfer station located at the CRWMC. The capital cost for EWS was therefore adjusted and increased by $680,000 (capital cost of the Campbell River transfer station inflated to 2017 dollars). Sustane identifies that buildings and offices are included in the submitted cost, as well as 20% contingency. No adjustment to the Sustane capital cost was deemed necessary.

The operating costs include labour, fixed operating expenses, variable operating costs, spare parts and other (specified by vendor), as requested in the RFI. The operating cost per tonne processed at the WTT facility is reported to range between $80 and $120 per tonne input. No further detail was provided; therefore, the operating cost was conservatively assumed to be $120 per tonne. No adjustment was needed for the operating cost presented by EWS. Sustane reported a comparably low operating cost relative to the other two WTE technology options. The different fixed and variable cost components were reviewed. The cost of electricity was compared to market value and the cost of water to local water use rates, which both aligned. The hourly labour was adjusted to $20/hr plus benefits and salaries increased by 20%, which was applied to the overall operating cost per tonne for Sustane.

The value and potential revenue associated with recyclables extracted and product derived from the different WTE technology options were assessed. The operating cost of the different technology options could fully or partially be offset by the revenue associated with the sale of metals, synthetic

diesel, bio gas and electricity. Due to uncertainties in the current recycling market along with distance to market, it was assumed that no net commercial value was associated with the following:

- Plastics
- Cardboard
- Bio-pellets
- RDF
- Compost/biodried product

The following rates were assumed when estimating revenue streams:

- Metals: $100/ tonne (from waste stream), $80/tonne (from bottom ash)
- Synthetic diesel: $0.61/L
- Bio gas: $0.06/kWh (when converted to electricity)
- Electricity: $0.06/kWh

Table 7 below summarizes the capital and operating costs as well as estimated revenues per tonne of waste processed. The total estimated annual break-even tipping fees for the three WTE technology options are also presented. Note that the facilities are run at lower capacity until CRWMC Landfill is closed hence the range in the first 25 years.

Table 7: Technology option tipping fee including capital and operating cost as well as estimated associated revenue.

		Capital Cost WTE Facility *(one time lump sum $)*	**Capital Cost Annual Payment** *($/year)*	**Operating Cost** *($/tonne)*	**Revenue** *($/tonne)*	**Total Break-Even Tipping Fee** *($/tonne)*
Year 1-25	WTT	$26.00M	$1,778,766	$120.00	-$7.20	$147.70-$173.55
	EWS	$52.68M	$3,604,054	$116.00	-$31.90	$154.82-$212.31
	Sustane	$25.00M	$1,710,3352	$82.07	-$29.33	$86.30-$111.32
Years 26-50	WTT	N/A	N/A	$120.00	-$7.20	$112.80
	EWS	N/A	N/A	$116.00	-$31.90	$84.10
	Sustane	N/A	N/A	$82.07	-$29.33	$52.74

It was assumed permits and approvals represent 1% of the capital cost.

The required lot size reported by the three technology vendors varied between 2 and 5 ha. The cost of industrial land in the three examined locations was estimated, based on the costs used in the 2011 model and increased values of real estate in the region. Conservatively, it was assumed that for any location, the property would need to be purchased for the WTE facility. It is understood that the CVRD currently owns potentially suitable property for locating the WTE facility, such as the CVWMC. Elimination or reduction of the cost to purchase property will reduce the capital costs overall; however, this capital cost remains a small portion (<1%) of the overall system costs for each option.

4.5.4 Landfill, Transfer Station and Hauling Costs

The need for landfilling would be reduced to different levels, depending on the WTE technology option selected. The increased diversion from applying one of the WTE technologies would affect the life of the landfill and subsequently the timing of capital projects (cell construction and closure). The

capital projects for the landfills are directly tied to available airspace and filling rate. The annual operating cost would also be affected along with the life of the operating equipment. Landfill-specific costs were therefore identified, adjusted where applicable, and included in the long-term cost model.

It was assumed that the CRWMC Landfill will continue current operations until landfill closure. The available airspace at the CRWMC Landfill as of the end of 2016 was assumed to be 288,500 m^3, based on estimates provided in 2016 Closure and Post-Closure Fund Estimates (GHD, 2017). Capital costs associated with phasing and closure, as well as post-closure costs applied to the long-term cost model, are based on those presented in the same document. Under status quo conditions, it is projected the landfill capacity at the CVWMC will be reached 4 years prior to the end of the modelling period. It was assumed that Cell 6 would be expanded to accommodate an additional 4 years of disposal and a capital expansion cost was estimated based on the average capital expansion cost per tonne for Cell 2-6. This was done to allow a fair comparison between status quo and the technology options.

Operating costs were estimated based on CVRD operating budget for CRWMC as well as the 2018-2022 budget for the same facility. The CRWMC is operated under contract, which includes operation of the entire facility and the landfill. In developing the annual operating cost for the CRWMC Landfill, the following was assumed:

- 100% of the budgeted cost of bird control is associated with landfilling.
- 50% of the operating contract is used for landfill operation.
- 50% of the $100,000 allowance for CRWMC operating contract.
- 2% of the operating budget covers utilities, office supplies etc. directly related to landfilling.

All ash, residuals and excess waste was assumed to be landfilled at the CVWMC Landfill. Available airspace, cell development and closure, including associated capital costs of the CVWMC Landfill expansion, are based on 2016 Closure and Post-Closure Fund Estimates (GHD, 2017) and the CVWMC Masterplan (AECOM, 2017). Post-closure cost is based on the GHD estimate. The operating cost was developed though detailed review of the CVRD 2017 budget, where line item costs associated with the CVWMC were identified and a percentage thereof allocated to landfill operations. The staffing requirement was assumed to include 1 FTE landfill manager, 2 FTE operators and 0.5 FTE engineering analyst, which is based on input from CVRD staff. Operating costs for leachate treatment were also added to estimated total annual operating cost. It was assumed that leachate treatment associated cost would increase from $250,000 per year to $500,000, based on input from CVRD staff. The staggering of leachate treatment costs was linked to landfill cell development as follows: $250,000 per year during filling of Cell 1, $375,000 per year during filling of Cell 2, and $500,000 per year during filling of all subsequent cells.

A transfer station would be required in Campbell River should the new facility be located in Comox Valley or Gold River. It was assumed that the current transfer station, constructed in 2012, would be utilized to its expected end of life (2051), with some capital upgrades and repaving in 2032. The transfer station would then be replaced in 2052. Waste transportation trailers would require replacement every 8 years.

A transfer station would be required in Comox Valley should the new facility be located in Campbell River or Gold River. It was assumed a new transfer station would be built at the CVWMC. The transfer station would require capital upgrades every 20 years, and waste transportation trailers would require replacement every 8 years.

The transfer stations were assumed to be staffed 10 hours per day, 7 days a week. Operating costs associated with the two potential transfer stations were developed assuming the following staffing requirements:

- 1 Superintendent
- 2 Scale house operators (0.75FTE)
- 2 Spotters/Labourers (0.75FTE) Campbell River / 3 Spotters/Labourers (0.75FTE) Comox Valley
- 2 Loader operators (0.75FTE)
- 1 Administration staff (0.2FTE)

The transportation cost between Campbell River and Comox Valley was estimated to be $370 per load, assuming an average load of 25 tonnes. This cost is estimated based on hauling contracts in place in 2014 and information provided by the hauling contractor. The per-load transportation cost between Gold River, Campbell River and Comox Valley is based on current hauling contact, and was estimated to $500 and $700 per load respectively, assuming an average load of 25 tonnes. The hauling cost does not include trailers. The number of trailers required specific to the amount of waste requiring hauling was estimated. The cost was estimated to $100,000 per trailer with an assumed life of 8 years. This cost was included in the transfer station capital costs.

4.6 Summary of Results

Detailed long-term cost model tables are presented in Appendix B. The costs related to disposal activities include the costs of construction, operating and maintaining transfer station(s) and landfills, transportation of waste, residuals and ash and the calculated tipping fee associated with the different WTE technology options. All costs are presented in 2017 dollars. The capital costs for the WTE technology options were amortized to calculate a tipping fee, however amortization of other capital costs and inflation were not included in the cost models. Each table shows the transfer station and landfill capital and operating costs over the analysed 50 years. Short notes are included to identify capital projects and upgrades. Totals for capital, operating and WTE options costs are included as well as the calculated cost per tonne for the next 30, 40 and 50 years. Waste projections and the WTE technology options' effect on landfill phasing is also presented in the tables.

The total disposal cost over 30, 40 and 50 years associated with each WTE technology option and sub-option is presented Table 8 below. Option 3(a) – Sustane located in Comox Valley offers the lowest overall system cost.

Table 8: Summary of total disposal cost over 30, 40, and 50 years.

Option		30 years	40 years	50 years
1(a)	WTT in Comox Valley	$289,603,000	$384,813,000	$467,777,000
1(b)	WTT in Campbell River	$307,442,000	$403,446,000	$491,048,000
1(c)	WTT in Gold River	$350,784,000	$466,790,000	$571,820,000
2(a)	EWS in Comox Valley	$296,299,000	$365,859,000	$432,946,000
2(b)	EWS in Campbell River	$310,749,000	$379,852,000	$450,325,000
2(c)	EWS in Gold River	$345,297,000	$433,088,000	$518,123,000
3(a)	Sustane in Comox Valley	$208,998,000	$262,575,000	$313,679,000
3(b)	Sustane in Campbell River	$220,442,000	$273,106,000	$327,140,000
3(c)	Sustane in Gold River	$261,241,000	$332,392,000	$402,342,000

The cost per tonne waste for each option (including Option 0) over 30, 40 and 50 years is presented in Table 9. The results from the previous assessment developed in 2011 have been included as well for comparison purposes.

The cost per tonne found for the different options in the assessment are comparable to that found for a small-scale conventional combustion WTE facility in 2011. The difference between status quo and the least expensive technology option is $40 per tonne if calculated over 30 years. The difference decreases to $28 per tonne when calculated over 50 years. The cost per tonne is calculated by dividing the total disposal system cost by the total tonnes requiring disposal during the same time period, i.e. not the tonnes of waste processed though one of the technology options.

Table 9: Summary of cost per tonne waste for each technology options and status quo, calculated over 30, 40 and 50 years, including results from the 2011 long-term cost model.

Estimated average disposal cost per tonne				
Option		**30 years**	**40 years**	**50 years**
2017 Long-Term Cost Model				
0	Status Quo*	$77	$75	$70
1(a)	WTT in Comox Valley	$162	$157	$148
1(b)	WTT in Campbell River	$172	$165	$155
1(c)	WTT in Gold River	$196	$191	$181
2(a)	EWS in Comox Valley	$165	$149	$137
2(b)	EWS in Campbell River	$173	$155	$143
2(c)	EWS in Gold River	$193	$177	$164
3(a)	Sustane in Comox Valley	$117	$107	$99
3(b)	Sustane in Campbell River	$123	$112	$104
3(c)	Sustane in Gold River	$146	$136	$127

Estimated average disposal cost per tonne				
Option		**30 years**	**40 years**	**50 years**
2011 Long-Term Cost Model (AECOM, 2011)				
1	Small-scale conventional combustion WTE facility in Comox/Courtney	$164	$143	$130
2	Large-scale conventional combustion WTE facility in Campbell River	$89	$88	$88
3	Large-scale conventional combustion WTE facility in Gold River	$114	$113	$113
A	CVWMC Landfill – one regional landfill	$69	$62	$74
B	Campbell River – one regional landfill	$74	$71	$83
C	CVWMC and CRWMC Landfills – two regional landfills	$73	$68	$65

**Note:* *The respective cost was estimated to $80/tonne in Version I of this report (November, 2017). In Version II, a decreased diversion rate is assumed for the regions. Consequently, an increased disposal rate is applied to the fixed landfilling cost which results in a decreased cost per tonne.*

4.7 Discussion

4.7.1 Long-Term Cost and Landfill Lifespan

The estimated cost to continue landfilling at the CRWMC Landfill until closure and to continue landfilling and expanding CVWMC Landfill is approximately $75/tonne. Waste processing through one of the assessed WTE technology options would increase this cost by $29 to $110 per tonne, or $89M-$347M over a 50 year period. This cost per tonne represents the total system cost and include capital and operational costs related waste disposal (WTE and/or landfilling), waste transfer (transfer station and waste hauling) as well as any revenue from diverted materials or generated product or energy.

It is important to note that the per-tonne costs outlined in the paragraph above do not include the entire CSWM system costs. Services outside of the residuals management such as the future composting facility and recycling services are not included within this cost analysis as these services would continue with or without the implementation of a WTE facility. Inclusion of these costs are presented and discussed in Section 6.

The two main factors affecting the overall disposal system cost for the options is the facility break-even tipping fee, along with transportation cost of waste, ash and residuals. Once new WTE facilities are in operation, landfill operational costs are reduced by up to 34% and the landfill capital cost by up to 57% over the 50 year projection period.

Revenue from sale of RDF (options 1(a)-(c)), should a market be established, would have little effect on the overall results. Each $10/tonne increment of RDF revenue (assuming 12% of input as per vendor submission) would reduce the system cost per tonne by one dollar

The most cost effective location for a new facility is in Comox Valley. This location offers the lowest hauling cost as less waste is generated in the SRD than the CVRD and no haul of ash/residual is required. Locating the facility in Comox Valley would also allow for use of the current transfer station in Campbell River which has an estimated remaining life of 35 years. Other factors affect the suitably of the locations which include access to processing water and potential cost savings associated with integration of organics transfer and processing.

Though a WTE facility will reduce the amount of waste that is landfilled and lower the landfill costs, it will not eliminate the need for a landfill. Costs related to construction and operation of a WTE facility would be added to the reduced costs of landfilling.

Processing of waste through one of the three WTE technology options would extend the life of the CVWMC Landfill. The estimated available airspace as of the end of 2016 was 5,220,000 m^3. This capacity of planned Cell 1-6 at the CVWMC Landfill is projected to be reached in 2064, should landfilling remain the only waste disposal option. For modelling purposed it was assumed that Cell 6 will be expanded provide airspace throughout the modelling period. The approximate available airspace at the CVWMC Landfill at the end of 2067 for the WTE technology options are as follow:

- WTT - 2,845,000 m^3
- EWS - 3,641,000 m^3
- Sustane - 3,706,000 m^3

This would increase the life of the CVWMC Landfill by 36 years (WTT), 49 years (EWS) and 50 years (Sustane), assuming the capacity of the WTE facilities remain unchanged over time and the, by the vendors, reported diversion is reached. There are some technical risks associated with the Sustane technology which are not factored into these figures; refer to Section 8 for further discussion.

4.7.2 Integrated Resource Recovery

Integrated resource recovery addresses the issue of maximizing the use of technology or process outputs under consideration of local conditions and opportunities. RFI proponents were asked to comment on opportunities to enhance local businesses and identify additional opportunities. Based on the submissions and the MH knowledge of the technologies and the local conditions, the following opportunities have been identified:

- WTT – The technology offered by WTT is already fairly comprehensive in removing materials for recycling and making best use of the remaining resources in the waste stream. It has been noted that sorting of PET and HDPE is not included, although these materials generally have some value. There may be an opportunity for a local recycler to work with WTT to recover these materials and convert them locally into recycled products.
- In addition, WTT technology is fairly complex, and training would be provided to local operators and firms for maintenance and repair. These skills would then rest in the community and could spawn business that service other communities that are not yet as advanced and just beginning to look at such technologies.
- EWS – Conventional combustion does not leave much room for making additional use of individual materials, but does offer two possibilities for local initiatives:
    - Waste heat – This is generally a fairly low grade heat that needs to be dissipated by cooling towers when electricity is made with a steam turbine generator. Instead of losing this heat, it could be made available to local entrepreneurs at a low cost who wish to use it for commercial purposes, such as heating greenhouses. The cost of heat transfer and transport would need to be considered by the local entrepreneur and if this is low enough through close proximity to the facility, then this could be an interesting opportunity.

  - Bottom ash – Bottom ash is generally non-toxic and can be landfilled. It represents about 20% of the incoming waste by weight and less than 10% by volume. Nevertheless, there are still costs associated with landfilling the ash. In Europe, ash is often processed and upgraded so that it can be used as a building or road construction material. There could be an opportunity for a local construction company to develop the expertise to treat and condition the ash for other uses, thus establishing themselves as an expert in this field, while making a profit from the re-use of the ash itself.

- Sustane – Sustane is proposing several new technologies and as with WTT, training would be provided to local operators and firms for maintenance and repair. These skills would then rest in the community and could spawn business that service other communities that are not yet as advanced and just beginning to look at such technologies. Sustane is also offering a unique and rarely used technology, namely the pyrolysis of plastics, which could spawn a whole new industry of bringing in plastics from other regions to enhance the production of synthetic diesel fuel.

5. INCREASING TECHNOLOGY CAPACITY

5.1 Introduction

Traditional WTE incineration facilities are built to a process a specific tonnage of waste and are limited to that capacity. The model and analysis was completed with the assumption that the WTE facilities would accept a fixed amount of waste generated by the CSWM in 2024. The technology vendors WTT and Sustane do not incinerate waste and therefore have flexibility in capacity to accept increasing waste tonnages.

At the request of the CSWM, the technology vendors WTT (Option 1) and Sustane (Option 3) were approached for additional information, which included the capital and operation expenses for accepting an increasing amount of waste over the next 50 years. The estimated tonnages are shown in Table 10 below.

Table 10: Estimate of increasing tonnages accepted for processing at WTT and Sustane over the modelling period.

Year	Tonnes processed
2021	29,000
2026	52,000
2031	54,000
2036	56,000
2041	57,000
2046	60,000
2051	62,000
2056	65,000
2061	68,000
2066	70,000

5.2 Vendor Responses

The updated vendor questions were developed by SLR Consulting and the responses reviewed. The memo from SLR can be found in Appendix C. A summary of the memo is presented below.

WTT and Sustane were requested to elaborate on how they would handle the proposed growth of the waste stream over time and how this would affect costs.

Sustane indicated that an increase of feedstock inputs from 29,000 to 70,000 tonnes per year (over the 50 year planning period) could be accommodated by the proposed design with minor adjustments. The change would increase the capital costs from around $25M to $27.5M, as set out in their original RFI submission. In addition, an annual allowance of $150,000 was added for unspecified capital works for future improvements and upgrades of the plant. This allowance is equivalent to adding a further $2 per tonne to the operations costs (at full capacity).

Operating costs for Sustane would benefit from economies of scale and would decrease incrementally from $75.42 per tonne at the lower throughput to $54.45 per tonne at 70,000 tonnes per year (before the $2 per tonne capital works allowance).

WTT indicated that an increase in feedstock inputs from 29,000 to 70,000 tonnes per year could be accommodated. For the mechanical separation part of the process, this would only require

implementation of a third shift. For the other plant components, the capital costs would change as follows:

- Anaerobic digestion - Additional $1.4 – 1.6 million;
- Composting - Additional $0.8 – 1.0 million.

Operational costs for the WTT technology are expected to increase in proportion with increased throughput.

At this time, WTT is recommending that HDPE and PET not be separated for recycling due to poor markets for these materials, which would negatively affect overall economics. The materials would still be utilized, but would comprise part of the refused derived fuel. Should secondary markets for these two plastic materials improve, a separate extraction could be installed once it is deemed economical.

5.3 Increasing Technology Capacity and Associated Costs

The impact of increasing the capacity of the WTE technologies resulted in less waste to landfill and an increase in life span of the landfill cells. The proportion of residual waste from the technology processing was assumed to remain constant.

The vendors provided updated capital costs associated with an increasing capacity, which were used to update the model. The adjustment in capital costs are shown in Table 11 below. In their original response to the RFI, WTT included a capital estimate to separate PET and HDPE from the waste stream. Separating out these materials does not impact the waste to landfill proportion as these materials would be included in the RDF. Therefore, it was assumed that the separation of these materials is an increase in cost and at this point a cost-prohibitive investment as it has no impact on residuals to landfill.

Table 11: Increase in capital cost as result of increasing waste throughput.

Technology	Capital Cost – Fixed Capacity	Capital Cost – Increasing Capacity
WTT	$26,000,000	$28,400,000
Sustane	$25,000,000	$27,500,000

Operating costs per tonne for the WTT was assumed to remain at $120 per tonne, as the vendor indicated that a third shift would need to be added to manage the additional incoming tonnages. WTT did not indicate whether the addition of one shift would affect the processing cost per tonne and have therefore been assumed as unaffected. Sustane provided decreasing costs per tonne as the tonnages increased. The costs per tonne were reviewed and the labour costs increasing slightly to reflect realistic costs in the region. The operating costs used for the Sustane technology are shown in Table 12 below. Sustane indicated that an additional $150,000 would be required annually for unspecified capital works related to future improvements and upgrades of the plant.

Table 12: Operating cost per tonne related to facility throughput at the Sustane facility.

Year	Tonnage Processed Annually	Sustane Operating Cost per Tonne (excl. Capital Costs)
2021-2046	29,000 to 59,800	$82.07
2047-2065	60,000 to 69,800	$65.39
2066-2067	70,000 to 70,900	$58.88

Adjustments were made to the landfilling costs to reflect the increasing technology capacity and resulting decrease in landfilling required compared to current conditions, as well as technology

operations with constant throughput (resulting in increasing tonnes of waste requiring landfilling as a result of increasing population and waste generation). Consideration was also given to the reported diversion achieved by the two technologies. The different adjustments made are summarized below.

CVWMC Landfill - Minor Capital

- Increase life (2 times) of dozer, gravel truck and excavator (compared to current conditions).
- Compactor and front-end loader shared with recycling activities considered redundant for the small amounts landfilled on an annual basis, and no replacements were included post 2020.

CVWMC Landfill - Operating Cost

- Sustane:
  - Operator: 25% compared to current conditions
  - Landfill analyst: 80% compared to current conditions
  - Landfill manager: 40% compared to current conditions
  - Other operating expenses: 15% compared to current conditions
  - Leachate treatment cost: $200K Cell 1, $300K Cell 2, $375 Cell 3 and following cells
- WTT
  - Operator: 50% compared to current conditions
  - Landfill analyst: 100% compared to current conditions
  - Landfill manager: 50% compared to current conditions
  - Other operating expenses: 25% compared to current conditions
  - Leachate treatment cost: $225K Cell 1, $300K Cell 2, $375 Cell 3 and following cells

CVWMC Landfill - Capital Expansion and Closure

The total cost for each cell expansion and closure remains the same, but the average annual cost is reduced, as the cell life is prolonged as a result of reduced landfilling. Over the 50 year projection period capital investment is required for:

- Construction of Cell 1 and 2, and closure of Phase 2 and Cell 1 if WTT is selected, and
- Construction of Cell 1 and closure of Phase 2 if Sustane is selected.

No adjustments were made to the capital and operating costs associated with transfer stations although it can be expected that these cost increase slightly as the accepted tonnes increase.

5.4 Summary of Results and Discussion

The long-term cost model was run applying the adjustments presented in Section 5.1 - 5.3. The results are summarized below and detailed long-term cost model tables are presented in Appendix D.

The total disposal cost over 30, 40 and 50 years associated with the WTT and the Sustane technology options and sub-options are presented Table 13 below.

Table 13: Summary of total disposal cost over 30, 40, and 50 years – increasing technology capacity.

Option		30 years	40 years	50 years
1(a)	WTT in Comox Valley	$303,298,000	$399,286,000	$509,931,000
1(b)	WTT in Campbell River	$323,319,000	$422,490,000	$541,216,000
1(c)	WTT in Gold River	$368,611,000	$489,912,000	$629,138,000
3(a)	Sustane in Comox Valley	$214,839,000	$262,617,000	$308,930,000
3(b)	Sustane in Campbell River	$229,749,000	$278,570,000	$330,644,000
3(c)	Sustane in Gold River	$270,394,000	$339,443,000	$409,949,000

The cost per tonne waste for each option (including Option 0) over 30, 40 and 50 years is presented in Table 14. The difference compared to cost associated with running the technology at constant capacity is presented within brackets. The cost per tonne increases with increasing technology throughout for almost all options and modelling periods (except 40 and 50 average for Sustane in Comox Valley). The main reason for the increasing cost is that more waste is being processed by the technology which is more expensive per tonne than disposal through landfill.

Table 14: Summary of cost per tonne waste for each technology options and status quo, calculated over 30, 40 and 50 years, including results from the 2011 long-term cost model.

		Estimated average disposal cost per tonne		
Option		30 years	40 years	50 years
2017 Long-Term Cost Model				
0	Status Quo	$77	$75	$70
1(a)	WTT in Comox Valley	$169 (+$8)	$163 (+$6)	$161 (+$13)
1(b)	WTT in Campbell River	$180 (+$9)	$173 (+$8)	$171 (+$16)
1(c)	WTT in Gold River	$206 (+$10)	$200 (+$9)	$199 (+$18)
3(a)	Sustane in Comox Valley	$120 (+$3)	$107 ($0)	$98 (-$2)
3(b)	Sustane in Campbell River	$128 (+$5)	$114 (+$2)	$105 (+$1)
3(c)	Sustane in Gold River	$151 (+$5)	$139 (+$3)	$130 (+$2)

The difference between status quo and the least expensive technology option is $43 per tonne if calculated over 30 years. The difference decreases to $28 per tonne when calculated over 50 years. The cost per tonne is calculated by dividing the total disposal system cost by the total tonnes requiring disposal during the same time period, i.e. not the tonnes of waste processed though one of the technology options.

The increasing technology capacity increases the landfill life by 69 years (WTT) and 160 years (Sustane), compared to continued landfilling without adding new technologies.

6. FULL SYSTEM COST ASSESSMENT

6.1 Introduction

The System Options and Cost Assessment was presented originally to the CSWM as a comparison of transfer and landfilling costs between the Status-Quo landfill scenario and the WTE scenarios. At the request of the CSWM, an additional assessment was completed to present the technology cost for WTT (Option 1) and Sustane (Option 3) as part of the full CSWM system cost and compare this to continued landfilling under Option 0 – Status Quo.

The analysis is built on capital and operating costs for the current service, divided into categories representing the main cost drivers. The costs were provided by the CSWM and categorized in collaboration with the Morrison Hershfield team. The analysis also includes a comparison of the cost toward the current tax requisition of $4.0M (2017-2018) and $6.0M (2019-2067) plus the revenue generated by tipping fees. The costs that remain unaffected by the applied disposal options were identified.

6.2 Cost Break-Down and Assumptions

To capture the full cost of the CSWM solid waste management system, ten cost categories were developed. Thereof, six categories were developed, including waste management costs associated with activities not affected by potential inclusion of a WTE technology. These categories are based on the categorized costs provided by the CSWM staff, which in turn were developed based on the approved 2018 operating budget and an updated 10-year capital projects plan. In addition, an estimate of the operating cost of the planned organics facility in Campbell River was developed and included. The seven categories are:

- **Organics Processing**
  - Capital cost – Processing facility in Campbell River and transfer station in Comox Valley.
  - Operating cost – Processing facility, transfer station and transfer of waste from Comox Valley to Campbell River.
- **Remote Transfer Stations and Landfills**
  - Capital cost – Development of transfer stations (excl. Comox Valley and Campbell River) and closure of remote landfills.
  - Operating cost – Operation of landfills until closure, post-closure costs and operations of transfer stations[3].
- **Host Community Agreements**
  - Operating cost.
- **Diversion (excl. organics)**
  - Capital cost – Regular capital upgrades and equipment replacement schedule.
  - Operating cost – 2018 operating costs associated with diversion activities. No adjustment to increased generation of recyclables.

[3] Assuming the 2018 operating cost of remote landfills will be the same as the post-closure costs and transfer stations operating cost, post landfill closures.

  - One-time cost included in 2018 budget, only applied to 2018 in the long-term model.
- **Disposal Support Services and Staff (costs not affected by changes in disposal option)**
  - Operating cost – cost associated with disposal but not directly tied to facility or affected by applied disposal technology.
- **Illegal Dumping**
  - Operating cost.

Note that interest and capital contributions (included in the annual operating budget) are not included, as the model includes only capital project costs.

The remaining four categories include the disposal-related cost presented in Section 4, which was divided into three categories to easier identify costs affected by the scenario applied and to what extent. The categories include both capital and operating costs:

- Landfill operation, development and closure cost reduced as result of the WTE facility.
- Landfill operation, development and closure cost unaffected by the WTE facility.
- CVWMC and CRWMC transfer stations and waste transfer to WTE facility.
- WTE capital and operating cost.

All cost categories were projected over the 50 year long-term cost model project period and compared to the revenue collected through tax requisition ($4M 2017-2018, $6M 2019-2067) and tipping fees ($130/tonne MSW). The results of the full system cost assessment is presented in Section 6.3 below.

6.3 Results

6.3.1 Full System Costs – Fixed Technology Capacity

A summary of the full system cost for the CSWM system is presented in Figure 1 through Figure 5 below. Detailed long-term cost model for the full system cost (excl. the disposal costs) is presented in Appendix E.

Figure 1 shows the full system cost per tonne waste requiring disposal as an average over the first 10 years of operation of the WTE facility (2021-2030). As shown in the figure, costs associated with host community agreements, organics processing, landfill and disposal supporting services and staff as well as transfer stations and remote landfills (excl. CRWMC and CVWMC) remain unaffected by the inclusion of a WTE facility in the CSWM system.

The overall landfilling cost is reduced compared to current conditions but not enough to cover the additional cost of a new facility. A portion of the landfilling cost is fixed and not affected by the introduction of WTE; this cost include CRWMC Landfill capital and operating costs (incl. post-closure costs) and CVWMC Landfill post-closure costs. The capital cost for expansion and closure work at the CVWMC Landfill remains the same, however the scheduling of the projects are shifted due to reduced tonnes (MSW and processing residuals) requiring landfilling. As Sustane reports higher diversion than WTT the CVWMC Landfill will fill at a slower rate and the capital investment of Cell 2 will occur later in time. This explains why the landfilling cost reduced as a result of WTE is lower for Option 3(a)-(c) compared to Option 1(a)-(c); Cell 2 development is required within the first 10 years of WTE operation of a WTT facility but not until 15 years later for operation of a Sustane facility.

The total average annual full system cost and the percent each cost category is represented for the first 10 years of operation of a WTE facility as shown in Figure 2. The yellow line shows the average annual revenue collected and includes $6M tax requisition as well as revenue collected from tipping fees. Additional revenue sources would be required to cover the increased cost resulting from the introduction of a new waste processing facility (sale of recyclables and energy from the process is taken into consideration).

The average annual costs calculated over 30, 40 and 50 years are shown in Figure 3 through Figure 5 and include the percent of cost that each category represents. There are no major differences between the three averages, however one can note that:

- The landfilling costs represent a smaller portion of the full system cost if averaged over 50 years compared to 30 years.
- The transfer stations and waste transfer cost represent a larger portion of the full system cost if averaged over 50 years compared to 30 years.
- The average annual full system cost is lower if calculated over a 50 year period compared to a 30 year period.

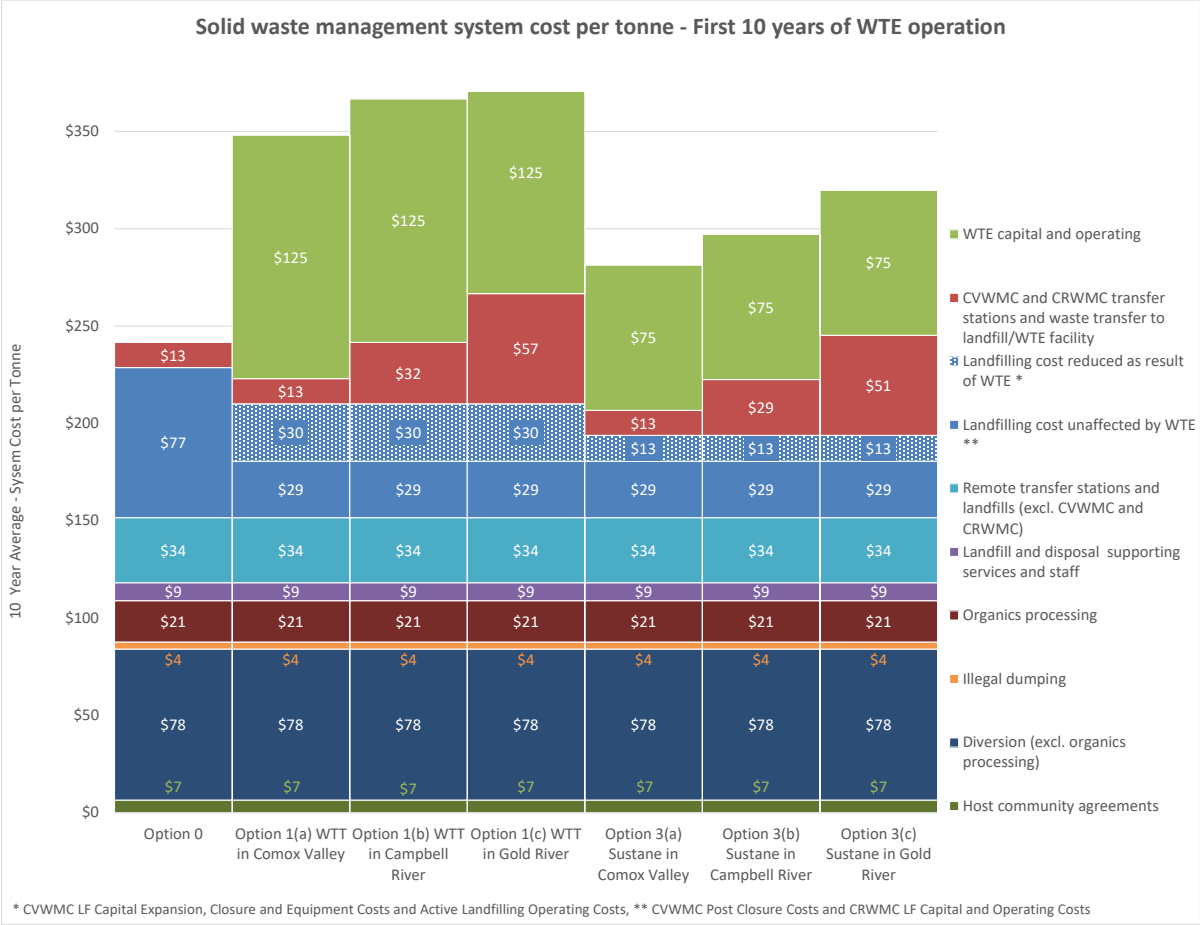

Figure 1: Average full system cost per tonne waste requiring disposal calculated over the first 10 years of WTE facility operations with fixed capacity.

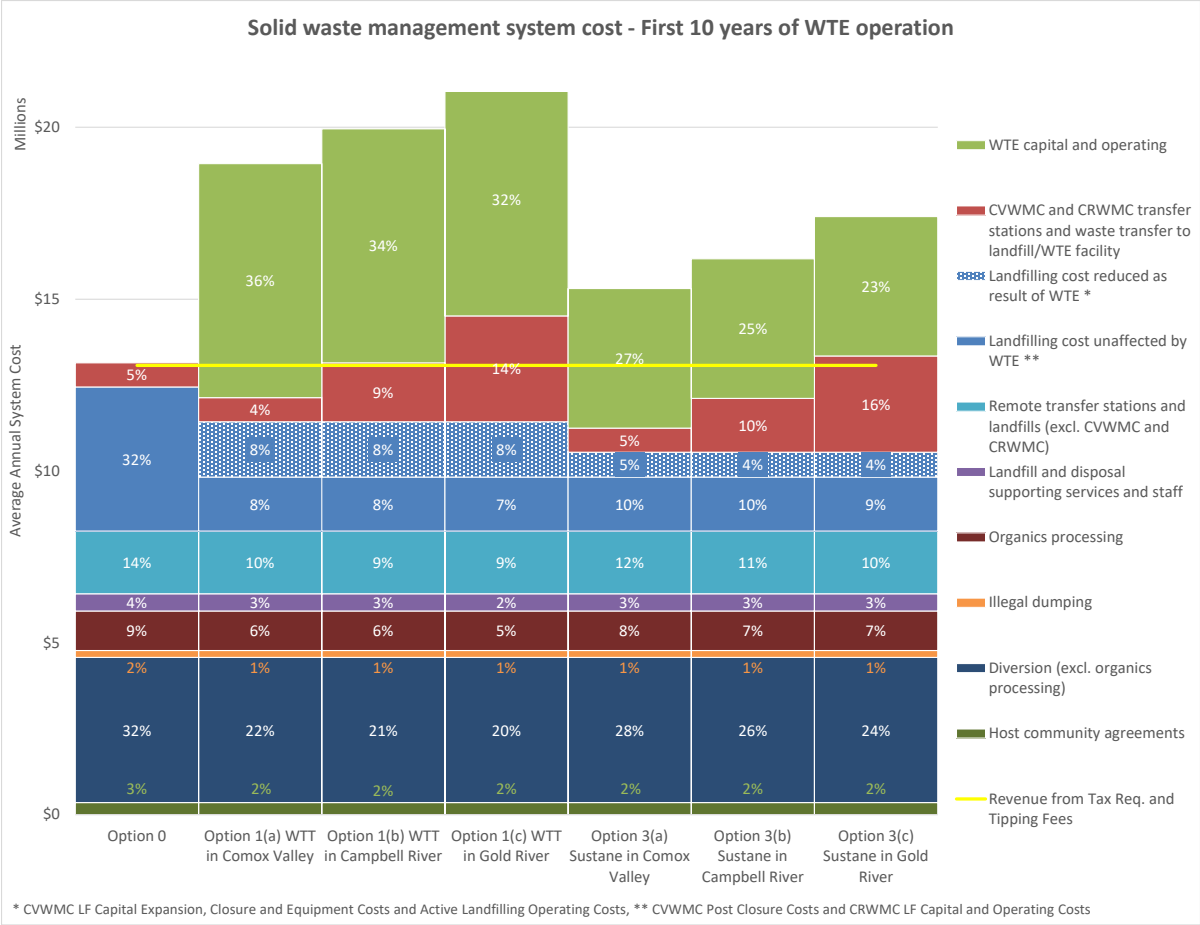

Figure 2: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 10 years of WTE facility operations with fixed capacity.

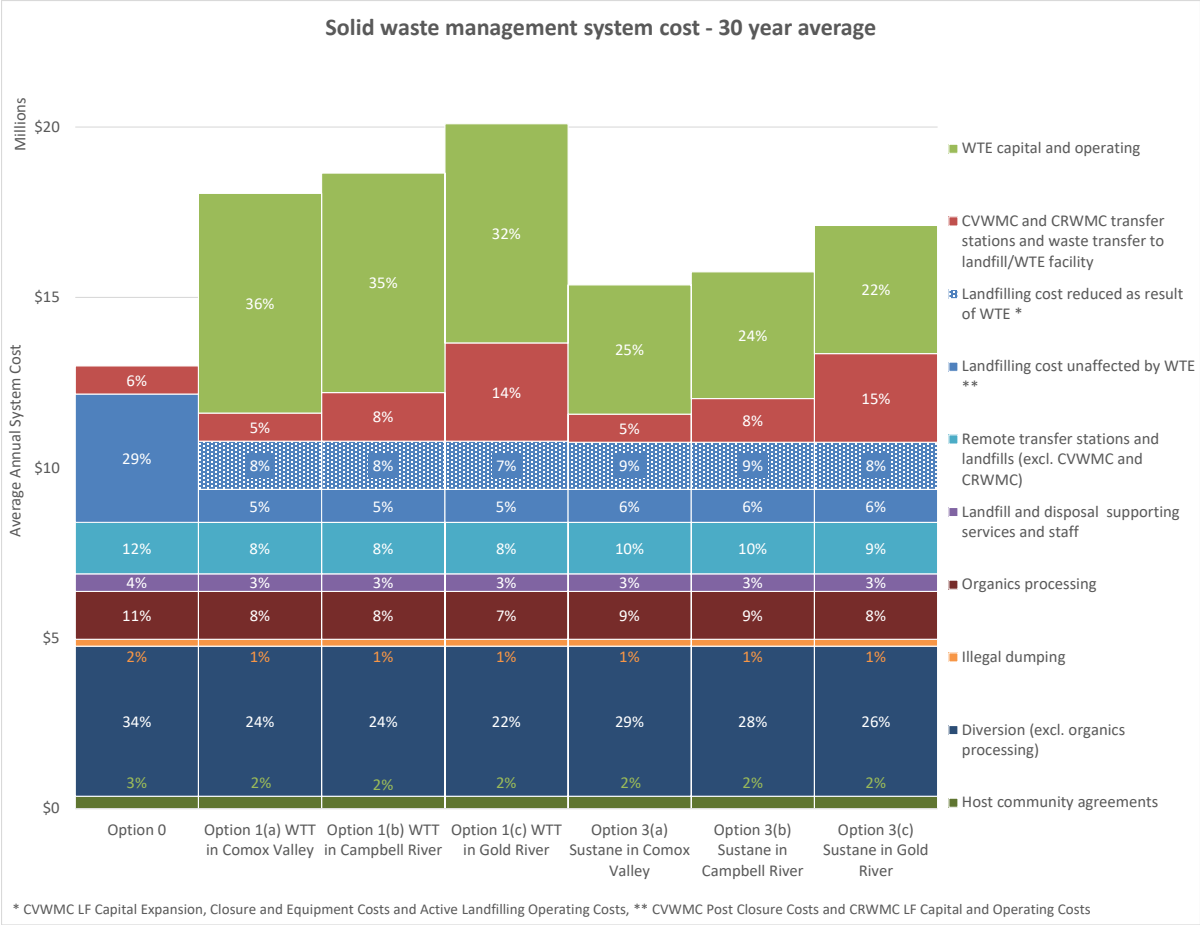

Figure 3: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 30 years of the modelling period and facility operations with fixed capacity.

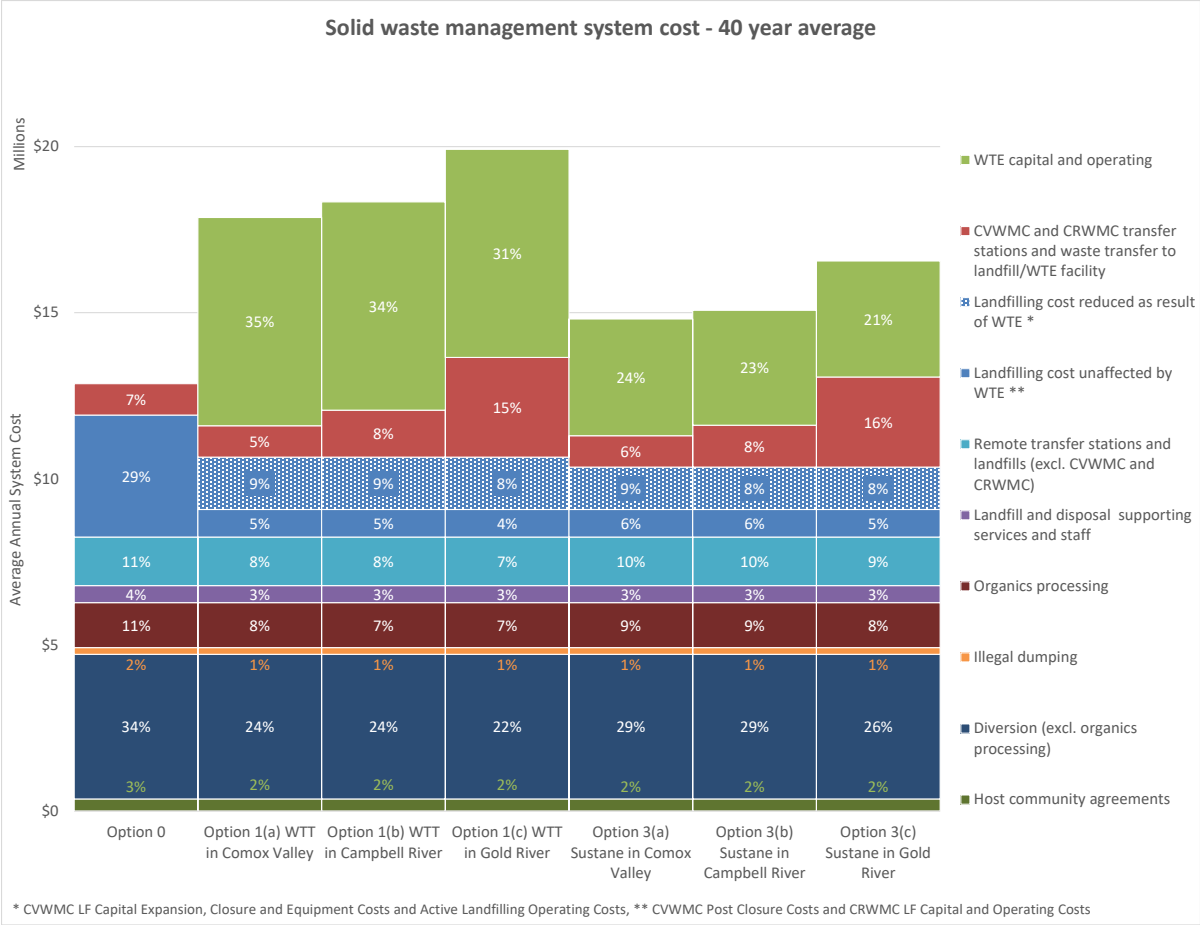

Figure 4: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 40 years of the modelling period and facility operations with fixed capacity.

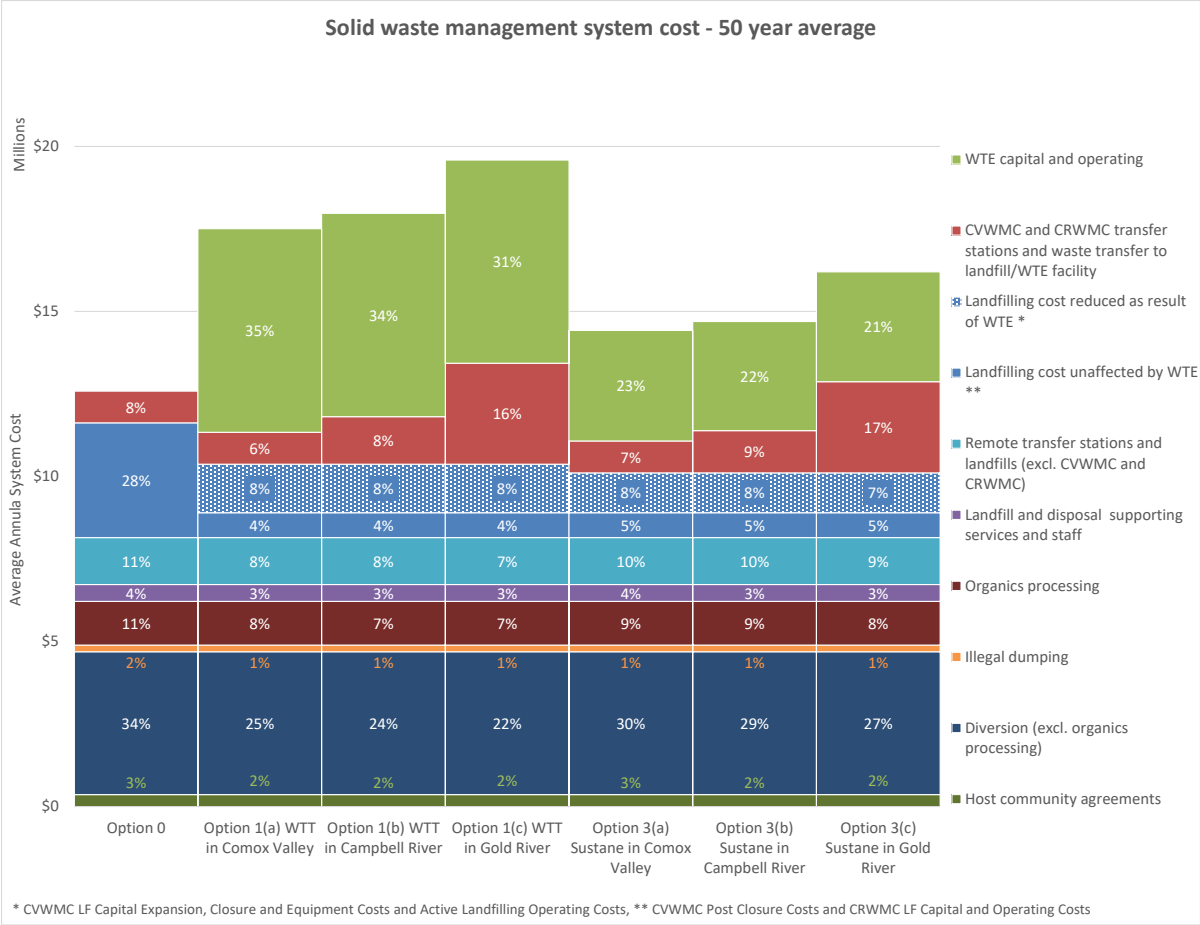

Figure 5: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 50 years of the modelling period and facility operations with fixed capacity.

6.3.2 Full System Costs – Increasing Technology Capacity

Full system cost for the technologies with increasing technology capacity is presented in Figure 6 through Figure 10 below. The comparative results are very similar to those presented in Section 6.3.1. Notable differences include:

- The portion of the full cost represented by landfilling is reduced with increasing technology capacity, especially for the Sustane technology as less residuals are generated and landfilled compared to WTT.
- The average annual full system cost is higher with increasing technology capacity for all options except the 50 year average for Sustane located in Comox Valley. As a result the capital and operating cost for the WTE facility with increasing capacity represent a larger portion of the full system cost than for that with fixed processing capacity.
- The reduced landfilling costs and potential increased WTE processing efficiencies do not offset the higher disposal cost through WTE compared to landfilling and current operations.

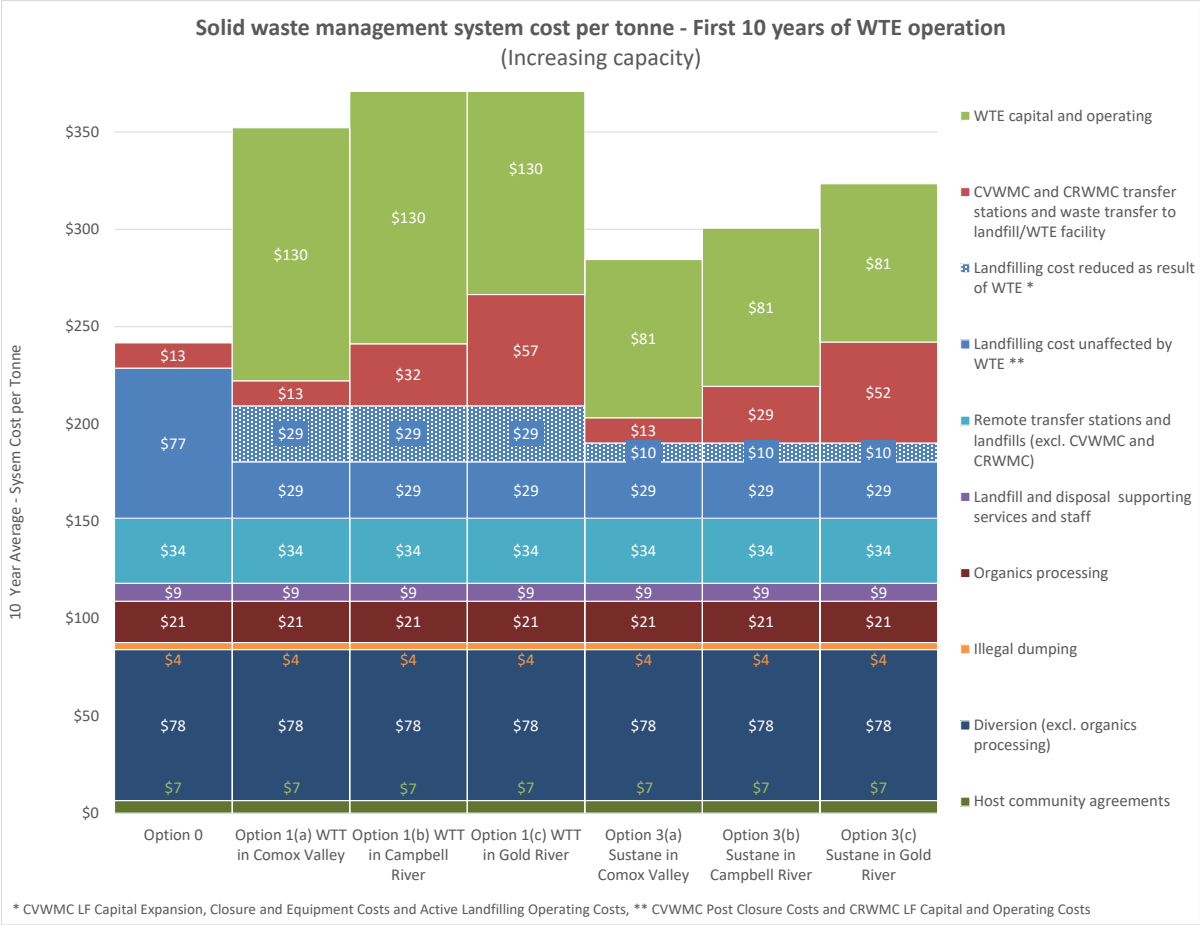

Figure 6: Average full system cost per tonne waste requiring disposal calculated over the first 10 years of WTE facility operations with increasing capacity.

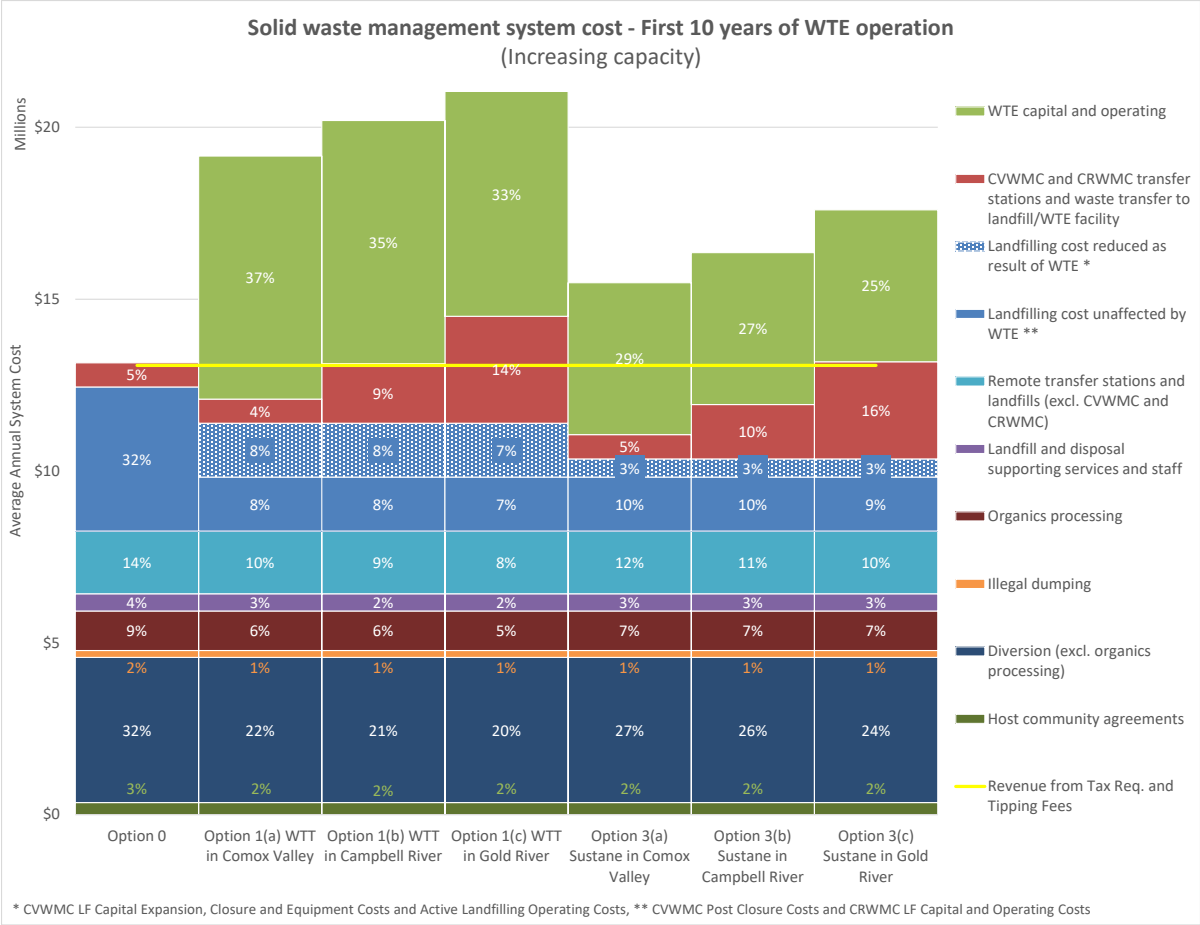

Figure 7: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 10 years of WTE facility operations with increasing capacity.

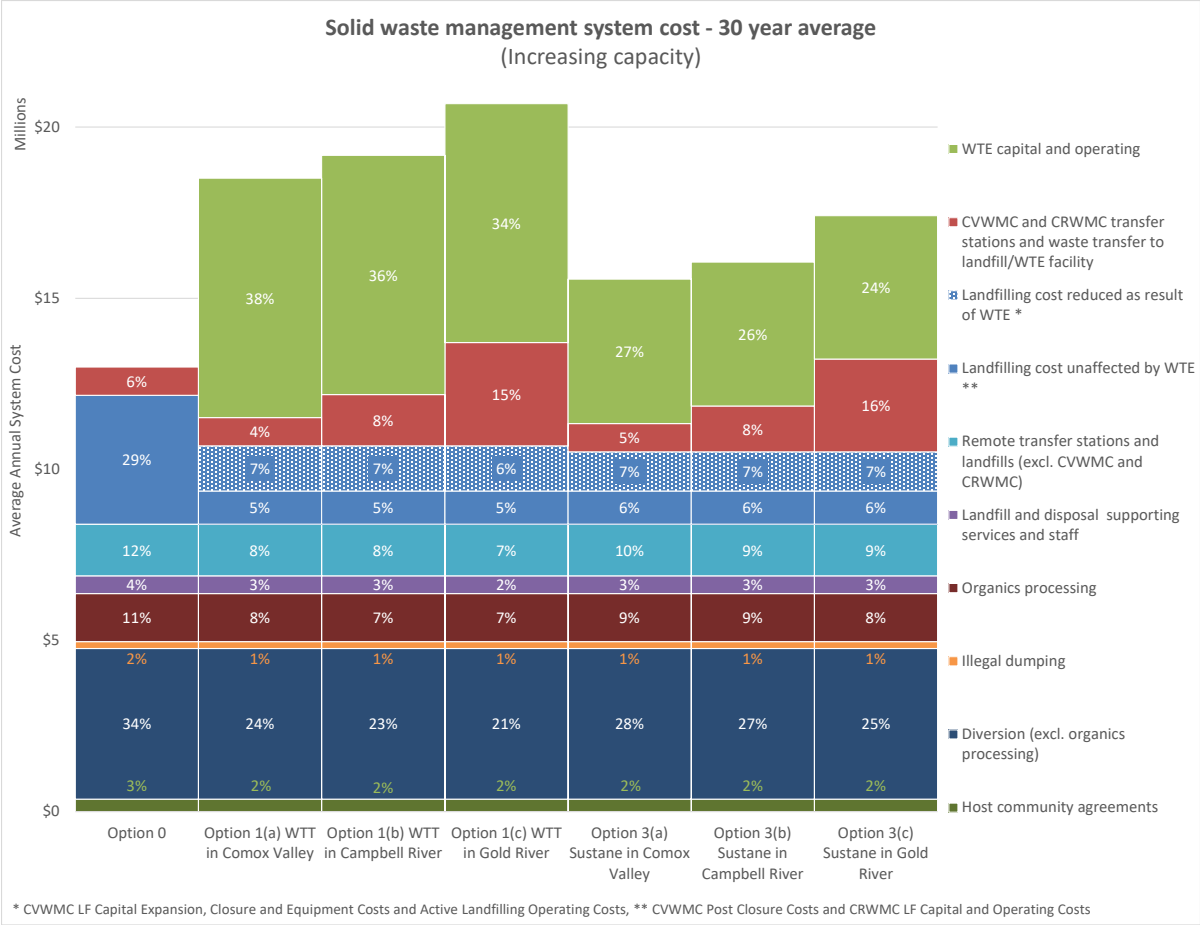

Figure 8: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 30 years of the modelling period and facility operations with increasing capacity.

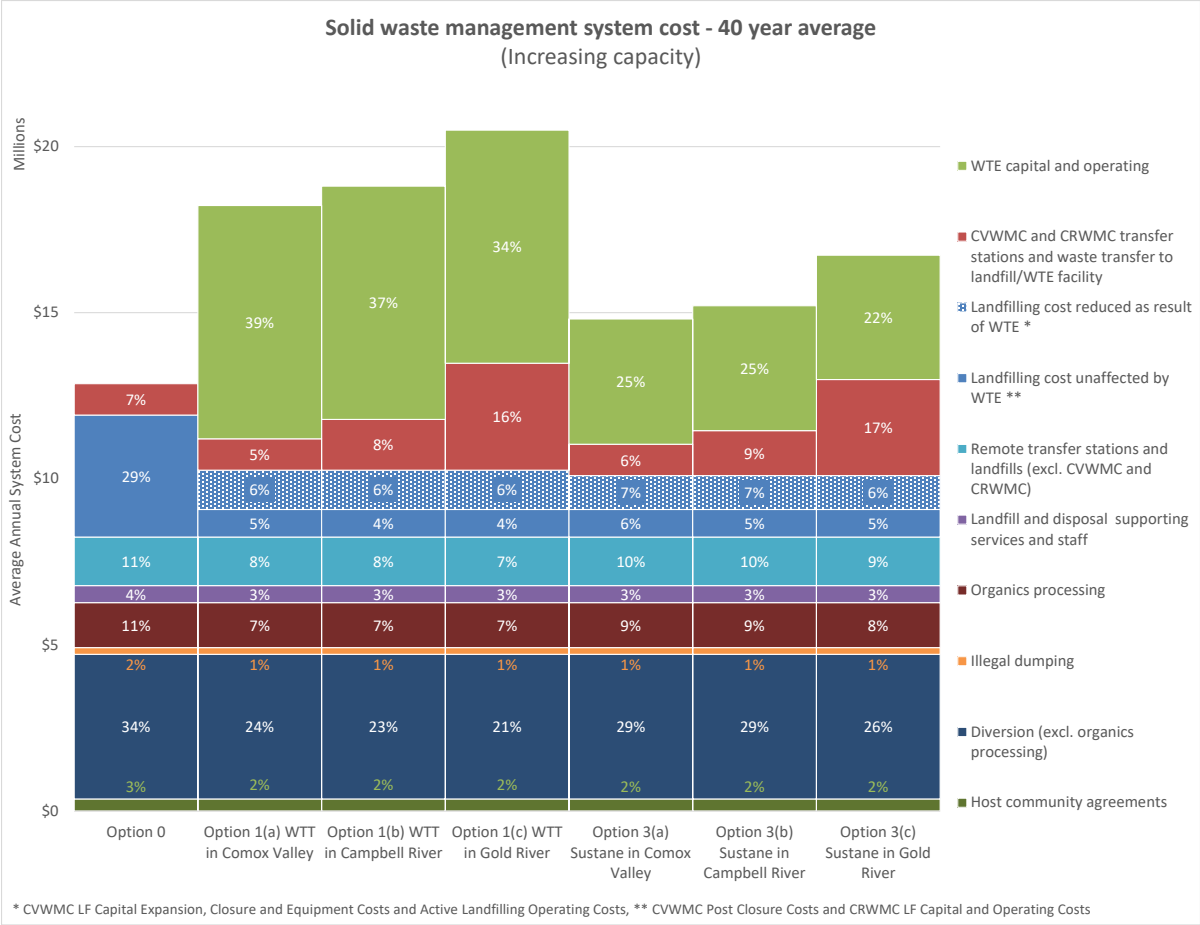

Figure 9: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 40 years of the modelling period and facility operations with increasing capacity.

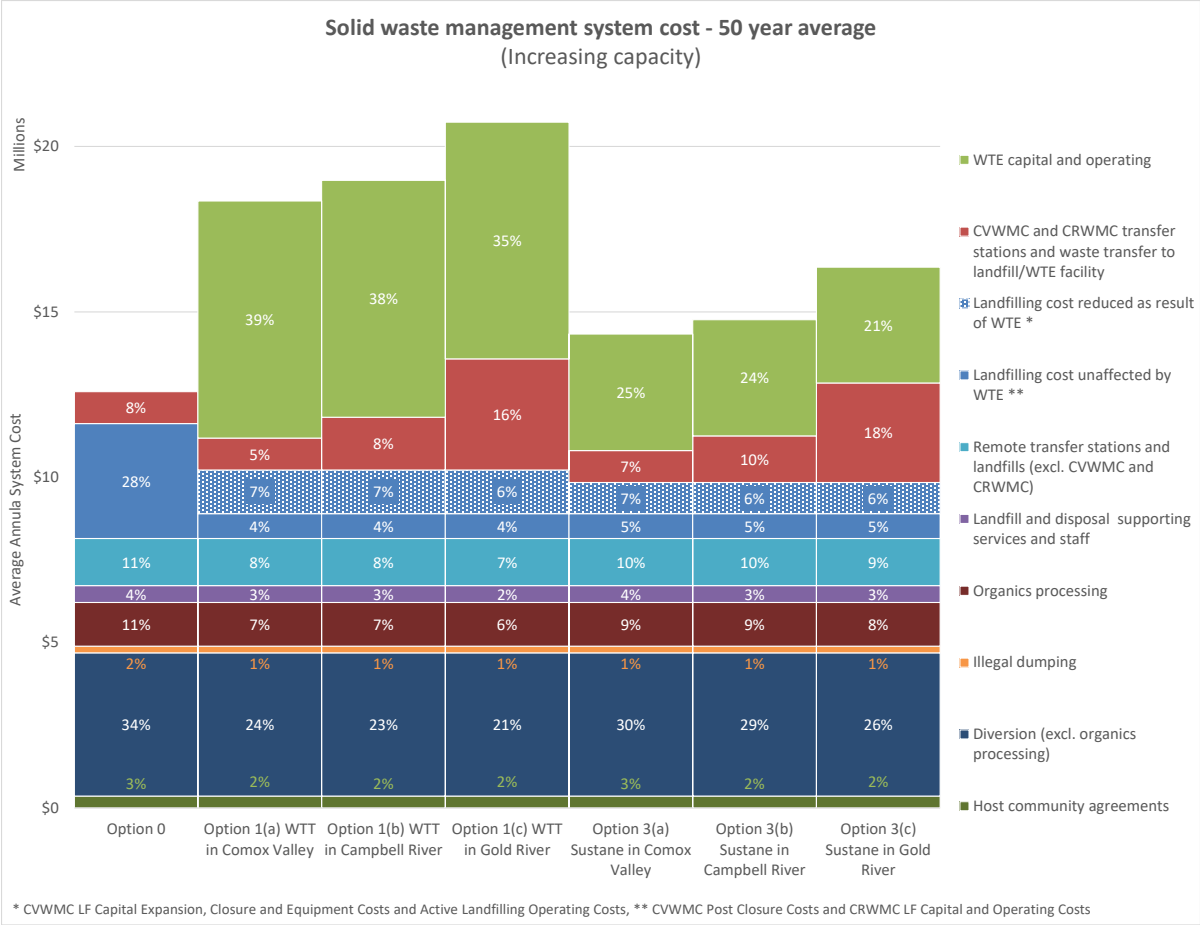

Figure 10: Average annual full waste management system cost and percent each cost category represents. Average is calculated over the first 50 years of the modelling period and facility operations with increasing capacity.

7. GREENHOUSE GAS EMISSIONS ASSESSMENT

7.1 Greenhouse Gases Overview

In 2014, the contribution of waste to BC's GHG emissions was 9% as presented in the 2016 Climate Leadership Plan (see Figure 11 below). The main source of GHG emissions within the waste sector is municipal solid waste landfills which contribute to approximately 95% of BC's waste sourced GHG emissions.

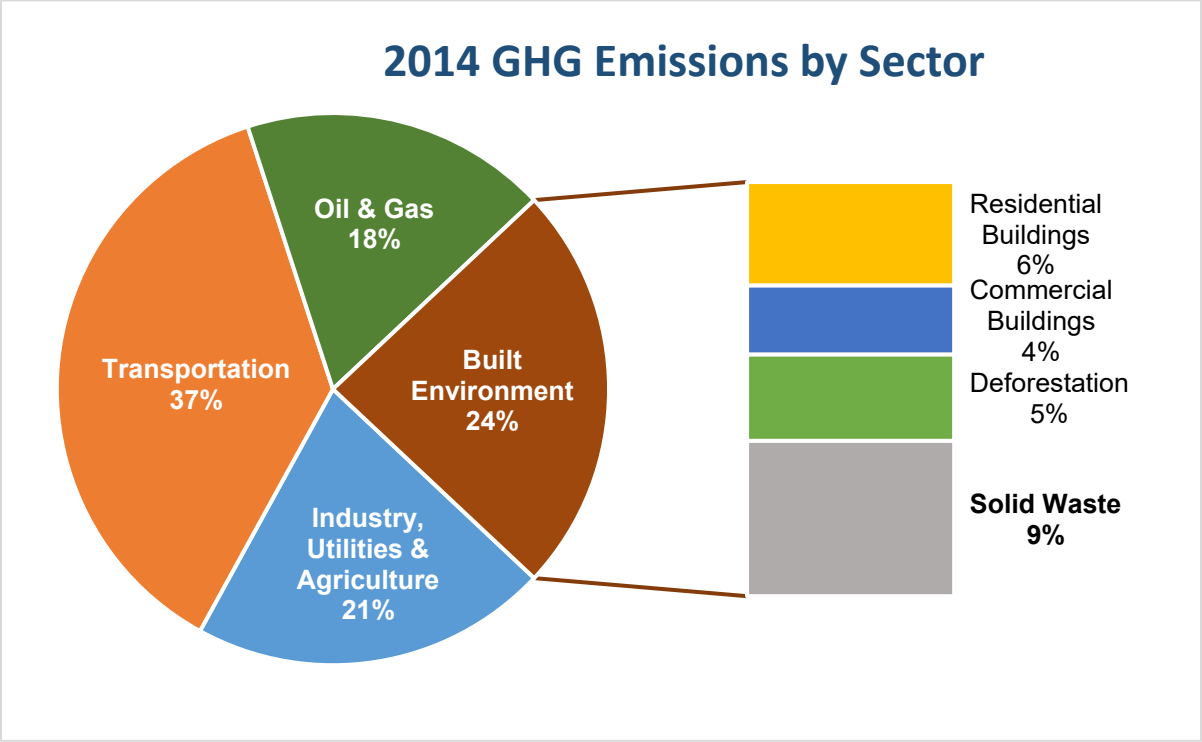

Figure 11: 2014 GHG Emissions by Sector (Adapted from: BC Government, 2016).

The BC government outlined actions to create a waste-to-resource strategy to reduce GHG emissions from organic waste, in the Climate Leadership Plan. These actions are:

- Supporting materials exchange pilot projects that create innovative uses for waste products.
- Creating a waste-to-resource strategy to reduce waste to landfill.
- Establishing a food waste prevention target of 30% and increasing the organics diverted from landfills to 90%.

Conventional WTE facilities produce GHGs through combustion which consist mostly of mostly carbon dioxide, some nitrous oxide and other trace substances. Since methane is 21 times more potent as a greenhouse gas than carbon dioxide, combusting waste rather than landfilling it reduces some of the GHG impact from waste management (a landfill that collects and flares methane operates on the same principle, except that the energy value is lost).

A part of the residual waste combusted is biogenic, meaning it is organic in nature. Combustion of biogenic waste does not contribute to increased GHG emissions, the process is considered carbon neutral. The biogenic portion of the waste stream is generally 50% to 60% and this depends highly on

local conditions and programs that are in place. Energy recovered from the biogenic portion of the waste is not considered a GHG contributor and can be used to offset energy generated using fossil fuels. Since BC generated electricity is mostly from hydro sources, there are no substantial offsets available from selling green electricity in the province.

7.2 Methodology and Assumptions

A detailed Greenhouse Gas Emissions Assessment was completed by AECOM as part of the 2011 WTE assessment. The scope of this GHG assessment is to update the analysis that was completed by AECOM in 2011. Therefore, the methodology and assumptions largely remain the same as those presented in the 2011 report.

For each option as presented in Section 4, estimates were made of the net GHG emissions from the WTE facility, the landfill and transfer stations, which includes transportation of waste to the facility, and residual waste and ash therefrom. GHG emissions were projected over a 40 year period. The analysis and results are summarized in Table 16; the detailed analysis is presented in Appendix F.

7.2.1 Technology Options

The GHG assessment was performed for all WTE technology options, including Option 0 - Status Quo, assuming the same waste generation, diversion and disposal as that used for the long-term cost model (refer to Section 4.5.2). For the purpose of this analysis and comparison between the different options, it was also assumed that the waste composition remains unchanged over the projection period. Though the waste composition will change as diversion increases it would not change the comparison between the options as all would be affected by the change. (Note that increased diversion was not applied to the GHG assessment performed in 2011, this to provide an “apples to apples” comparison of the WTE options and the previously landfill options assessment.)

For emissions from the EWS WTE facility, calculations for CO_2, N_2O and CH_4 emissions are based on the methodology presented in IPCC (2006) and U.S. EPA (2016a). Consistent with IPCC (2006) guidelines, only the combustion of carbon of fossil origin (plastics, certain textiles, rubber, liquid solvents, and waste oil) is considered to contribute to net increase in CO_2 emissions. The combustion of biogenic portion of the waste stream is considered to be CO_2 neutral since it is part of the natural carbon cycle so long as it does not cause a long term decline in the total carbon embodied in living biomass (e.g. forests) (IPCC, 2006).

Nitrous oxide (N_2O) emissions from waste combustion originate from components of the waste stream that contain nitrogen. In addition to waste composition, N_2O emissions can also differ depending on the waste combustion technology, combustion conditions and the technology applied for NOx reduction (IPCC, 2006).

Methane emissions are typically a very minor source of emissions from waste incineration. Methane emissions are dependent on the continuity of the incineration process, the incineration technology and management practices. Methane emissions are the result of incomplete combustion which is influenced by the combustion conditions in the combustor’s (temperature, residence time, and air ratio) (IPCC, 2006). In large well-functioning facilities CH_4 emissions should be very small (IPCC, 2006).

As for the 2011 AECOM GHG emission assessment, the WTE emission factors found in the 2009 Metro Vancouver study (CH2M Hill, 2009) were assumed appropriate and applied to this assessment. The greenhouse gas emissions analysis was conducted for Metro Vancouver and calculations were based on Metro Vancouver 2008 waste composition and 52% effective diversion until 2015 after which an estimated composition was applied based of 70% diversion.

The emissions factors found the in the Metro Vancouver study (CH2M Hill, 2009) and applied to this greenhouse gas assessment are listed below.

- CO_2 – 0.320 tonnes CO_2e / tonne MSW;
- CH_4 – 0.0000031 tonnes CO_2e / tonne MSW; and
- N_2O – 0.016 tonnes CO_2e / tonne MSW.

For the purpose of this assessment it was assumed that the same emission factors apply to incineration of RDF produced at the WTT facility. However, if the RDF is used to offset the use of natural gas in industrial boilers, or coal in cement plants, then additional GHG credits should be available for the biogenic portion of the fuel.

Synthetic diesel generated through the Sustane process is produced through pyrolysis of plastics. Combustion of the synthetic diesel does, therefore, contribute to GHG emissions. The vendor estimates that approximately 2,000 m^3 synthetic diesel will be produced per year, which equals 43.45 L/tonne waste processed. The emission factor for the synthetic diesel is estimated to 0.0027 CO_2e/L and was calculated based on the average of light fuel oil, diesel fuel and marine diesel (BC MOE, 2014).

All technology options offer recycling opportunities. The EWS technology provides the opportunity for ferrous metal recovery from the bottom ash, metals that would otherwise be disposed in a landfill. WTE plants with a ferrous metal recovery system can recover 90% of steel in MSW (U.S. EPA, 2010). WTT offer separation and diversion of ferrous and non-ferrous metals as well as cardboard. Though WTT offer the technology to divert plastics, diversion of plastic have not been included in this assessment as it was not included in the vendor RFI submission. The Sustane technology would also separate and divert ferrous and non-ferrous metals as well as plastics. The avoided GHG emissions per tonne material are listed below (U.S. EPA, 2016b and U.S. EPA, 2016c):

- Ferrous metal (steel) – incineration: 1.78 tonnes CO_2e per tonne metal
  Ferrous metal (steel) – recycling: 1.99 tonnes CO_2e per tonne metal
- Non-ferrous metal (assumed aluminium): 10.01 CO_2e per tonne metal
- PET plastics: 1.23 CO_2e per tonne plastics
- HDPE plastics: 0.96 CO_2e per tonne plastics
- Low density plastics: 0
- Cardboard: 6.15 CO_2e per tonne cardboard

Experience at the Burnaby WTE facility is that metal recovery from bottom ash is approximately 3% by weight of the incoming MSW. This recovery rate was applied to the EWS option. It was also assumed that the diversion rate of ferrous metal through the WTT and Sustane processes is 3% of the waste throughput. The diversion of non-ferrous metal was assumed 1.8% of throughput based on the Sustane vendor submission. The diversion of cardboard and plastics was estimated to 7% of throughout which is approximately half of the available materials based on the waste composition presented the CSWM SWMP (AECOM, 2012).

Generation of electricity also contributes to GHG offsets. However, the offsets are small in BC as the power to a large extent is generated from hydro. Power generation from the EWS facility was estimated assuming the lower heating value (LHV) of the waste is 10.5 GJ/tonne and the net electricity conversion efficiency is 16%. Biogas, generated through the WTT anaerobic digestion, was assumed to generate 200kWh per tonne organics processed.

The operation of either of the assessed WTE facilities will contribute to GHG emissions as all of the options will require some electricity as well as fuel (natural gas, propane etc.). However, operational GHG contributions cannot be measured until the processes are at a much more advanced state of development and design. Operational GHG emissions are not included in this assessment and it was assumed the emissions are relatively comparable between the WTE technology options.

The total emissions from the WTE technology options were determined by subtracting offsets created by recycling and power generation from the emissions created by combustion. Activities that either contribute to or offset GHG emissions for the different WTE technology options are summarized in Table 15 below.

Table 15 Summary of GHG contributions and offsets associated with the three technology options.

Technology Option	GHG Contribution	GHG Offsets
WTT	▪ Landfilling of residual waste ▪ Combustion of RDF	▪ Recycling of ferrous and non-ferrous metals and cardboard. ▪ Generation of electricity from biogas
EWS	▪ Landfilling of residual waste ▪ Combustion of MSW	▪ Recycling of ferrous metals ▪ Generation of electricity
Sustane	▪ Landfilling of residual waste ▪ Combustion of synthetic diesel	▪ Recycling of ferrous and non-ferrous metals and plastics

7.2.2 Landfilling

For the purpose of this assessment and comparison of the different options, landfill gas generation and associated GHG emissions were only estimated for the CVWMC Landfill. All analyzed options include unchanged landfilling at the CRWMC Landfill until closure. Inclusion of GHG emissions from the CRWMC Landfill would not change the comparative results of the options assessed. The landfill gas generation was assumed the same for all technology options since all are assumed to have the same capacity which results in the same amount of excess waste being sent to landfill. Ash and processing residuals are considered inert and do not contribute to landfill gas generation.

The U.S. Environmental Protection Agency's Landfill Gas Emissions Model (LandGEM) was used to estimate the quantity of landfill gas generated on an annual basis at the CVWMC Landfill. LandGEM provides results for total landfill gas, methane, carbon dioxide and non-methane organic compounds (NMOCs).

Based on the results from LandGEM, two similar methodologies (California Air Resources Board, et. al., 2010 and U.S. EPA, 2004) were used to determine the net emissions of GHGs. The methodology consists of the following steps:

1. Determine the amount of methane generated (from LandGEM);
2. Determine the amount of methane collected using an assumed collection efficiency;
3. Determine the amount of methane destroyed (typically 99% of that collected);
4. Determine the amount of methane oxidized by soil cover (10%); and
5. Determine the amount of methane emitted, which is equal to the amount generated minus the amounts destroyed and oxidized.

Landfill gas was assumed collected with an efficiency of 75%, which is the required minimum under BC's Landfill Gas Regulation and related guidelines. Carbon dioxide emissions from destruction of methane as well as decomposition of organics in the landfill are considered biogenic and part of the natural carbon cycle and are therefore not considered contributing to greenhouse gas emissions.

The amount of methane emitted was multiplied by 21 times to provide a total landfill GHG emissions equivalent in tonnes of CO_2e. It was assumed LFG is flared and no LFG to energy offsets applied.

Emissions are also generated through electricity and fuel consumption by on-site facilities and by landfill operations equipment. While relatively minor, these emissions were included in the total GHG emissions from landfills. Emissions factors for CO_2e per tonne of waste for these emissions were obtained from Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions (Government of Canada, 2005). The total emissions from the landfill were determined by summing the emissions from landfill gas, on-site facilities and operations equipment.

While carbon from waste will be stored in the landfills, this was not included in the accounting of net GHGs. The IPCC provides guidance on determining the carbon storage for landfills, but this is only estimated for inclusion as an information item and it is not included in inventory estimates of GHG emissions.

7.2.3 Transfer Station Operation and Waste Hauling

For the transfer stations emissions were estimated for transfer station operations and for waste hauling.

Transfer station operations activities that contribute to GHG emissions include natural gas use (e.g. for forklifts), diesel fuel use (e.g., heavy equipment) and various use of electricity. Emissions from these sources can vary greatly depending on the design of the transfer station and its operations. To be conservative, a factor of 0.0044 tonnes of CO_2e / tonne of waste (Eisted et. al., 2009) was selected for the analysis. The emissions for hauling of waste, residuals and ash were determined by estimating fuel consumption per tonne waste hauled, which was multiplied with the emission factor for diesel fuel of 0.00269 tonnes of CO_2e/L (Canadian diesel fuel factor, California Air Resources Board et. al., 2010).

The total emissions from transfer stations were determined by summing the emissions from transfer station operations and hauling of waste, ash and residuals.

7.3 Summary of Results

The net GHG emissions estimated for the 10 assessed options are presented in Table 16. A period of 40 years was used to assess the GHG emissions, and the totals for the WTE technology options, landfilling and transfer station operations (including waste hauling) are detailed in Table 16. The location of a facility has relatively small impact on the overall GHG emissions. However, the recycling of metals, cardboard and plastics contribute to large GHG offsets. The net GHG emissions range from -873 tonnes CO_2e (option 1(a)) to 899 tonnes CO_2e (option 0) over the assessed 40-year period.

Table 16: GHG emission summary over 40 years.

Options		Technology	Landfill	Transfer Station(s)	Total
		tonnes CO_2e	*tonnes CO_2e*	*tonnes CO_2e*	*tonnes CO_2e*
0	Status Quo	0	890,000	9,000	899,000
1(a)	WTT in Comox Valley	-1,060,000	178,000	9,000	-873,000
1(b)	WTT in Campbell River	-1,060,000	178,000	15,000	-867,000
1(c)	WTT in Gold River	-1,060,000	178,000	45,000	-837,000
2(a)	EWS in Comox Valley	491,000	183,000	9,000	192,000
2(b)	EWS in Campbell River	491,000	183,000	13,000	196,000
2(c)	EWS in Gold River	491,000	183,000	39,000	222,000
3(a)	Sustane in Comox Valley	-339,000	178,000	9,000	187,000
3(b)	Sustane in Campbell River	-339,000	178,000	13,000	191,000
3(c)	Sustane in Gold River	-339,000	178,000	38,000	216,000

7.4 Discussion

Removal of organics by 2021 will reduce the GHG emissions from the landfill, however the GHG generation estimates for the WTE technologies are significantly less than from the landfill. In particular WTT offers significant GHG reduction which is mainly attributed to the recycling of non-ferrous metals and cardboard.

The GHG generated from transfer station(s) and waste transfer is a small portion of the overall generation, therefore the location of the WTE facility does not have a significant impact on GHG emissions. The landfill gas generated is the same for WTT and Sustane options and slightly higher for EWS. The facilities are assumed to have the same capacity resulting in equal amounts of waste in excess of the capacity being landfilled, however EWS will receive waste slightly below capacity for three years as a result of longer downtime periods for repairs. This generation of GHG would be reduced if the WTE facilities had sufficient capacity to process all of the waste generated in the next 50 years.

The landfill gas collection efficiency for the landfill is assumed at 75% for the model, however the actual efficiency of collection would impact the GHG generation for the landfill in all scenarios. In addition, in the WTE options, the proportion of organics to landfill is significantly reduced when compared to status quo.

8. CONSTRAINTS, RISKS AND TIMELINES

This section summarizes a qualitative assessment of the constraints, risk and timelines for the selected options. WTE has a reputation of carrying a variety of risks which may be technical, financial and social. The overview of risks and constraints as presented in the 2011 WTE Assessment (AECOM, 2011) are based on experience of professionals who have worked in the WTE field. A more detailed and quantitative assessment of risks and constraints will be necessary, should the project proceed.

As part of this WTE assessment a high level overview of a Consultation Strategy was provided as a separate report. A summary of the key elements of the Consultation Strategy are provided below. A specific Consultation Plan will need to be developed should the CVRD proceed with WTE.

Furthermore an assessment of the siting and regulatory review was provided in Section 3. A summary of the siting constraints and risks is provided below.

8.1 Technical Risks and Constraints

Sustane, located in Comox Valley, is the lowest-cost WTE option. However, the Sustane technology requires about 20,000 litres of water per day. It is not known at this time what the cost would be to supply that amount of water to a facility located at the CVWMC, however it must be anticipated that this will increase capital costs for this site.

Water supply could also be an issue for EWS and to a lesser degree for WTT if they are located at the CVWMC site.

Sustane is also introducing pyrolysis of plastics. While this is an ideal way of converting plastics into a form of energy that can be readily sold and used, this type of technology, to the best of our knowledge, has found very little use on a commercial scale. There is a risk that the technology is still relatively new and may face start-up issues during implementation.

A technical (and also commercial) risk with Sustane and WTT technologies is that the recovered recyclables may not be clean enough to sell to the recycling markets. This has been accounted for with some materials by giving them no commercial value in the financial assessment. It should be noted that no consideration has been given to the worst case scenario where no market is available for the materials and disposal is the only remaining option.

8.2 Environmental and Regulatory Risks and Constraints

Emissions from modern WTE facilities must meet high emissions standards. As discussed in the 2011 WTE Assessment (AECOM, 2011), management of emissions from WTE facilities is done by proven technologies and any risks to the environment or human health can be considered mitigated.

As presented in Section 5, a WTE facility is more favourable than landfilling with consideration given to GHG emissions.

There are no regulatory risks as discussed in Section 3. It is assumed given the small size of the WTE facilities presented in this report, there will be no trigger for an Environmental Assessment (EA). However, if there is significant public pressure, MOE may require and EA.

8.3 Financial Risks and Constraints

One of the greatest financial risks is not finding markets for the products recovered. In the case of WTT, this would be recyclables, compost and RDF (electricity can usually be sold to BC Hydro). Without markets, these products would have to be landfilled, following an expensive process to extract and process them. The financial risk for Sustane would be not finding markets that pay enough for their bio-pellets to offset their production cost as well as finding a market for the recovered recyclables.

Often funding for new and only marginally proven technologies can be difficult to obtain. If banks were called upon to finance a project with new technologies, they may be reluctant to proceed unless they can be convinced that the technologies are proven and are functioning full time on a commercial basis in other locations.

Similarly, it may be difficult to fund a project where there is a lot of public opposition. Conventional combustion based WTE has faced this in numerous locations in North America, and there has been only one commercial full scale WTE plant built in Canada in the past 20 years, which is located in Ontario.

8.4 Social Risks and Constraints

Public acceptance of any waste management system or technology is of greatest importance to the CSWM and Morrison Hershfield has proposed a Consultation Strategy that provides the overall direction for the consultation process. The consultation process and associated strategies will be refined when the CSWM selects the final preferred WTE technology and site. A summary of the consultation strategy is presented in Section 8.4.1 below.

8.4.1 Overview of Consultation Strategy

Regulatory requirements, including consultation requirements, are outlined in Section 3.3. The CSWM may want to adopt the following objectives for the consultation:

1. To ***inform*** the general public and potentially affected stakeholders about the potential need for a WTE facility, its potential locations and potential effects and benefits;
2. To *obtain* ***input*** from affected stakeholders (including general public) on the potential facility and locations components; and
3. To ***collaborate*** with member municipalities to undertake consultation events that broadly engage with the community on the topic.

The following communication strategies can be used by the CSWM and member municipalities to meet the objectives listed above:

- Organize Open Houses staffed with local experts at suitable locations.
- Hold targeted presentations to:
  - Councils of affected municipalities.
  - First Nation Councils.
  - Other stakeholder groups/organizations.
- Provide online information on website of the CVRD, SRD and member municipalities.
- Piggyback on municipal and CSWM communications (newsletters, mailers, utility bills, billboards, etc.).

- Use of social media (e.g. Facebook).
- Provide public information via TV/radio commercials/ radio advertisements.
- Opinion pieces published in local newspapers.
- Undertake feedback surveys (online, exit surveys at open houses, at other waste management facilities or via phone interviews).

Depending on MOE requirements, these strategies could be part of the SWMP revision process, the EA process (if an EA is required) or both.

Key stakeholder groups that will need to be consulted in regards to a potential WTE facility in the CSWM service area include First Nation communities, member municipality councils, neighbouring regional districts and municipalities as well as the public community.

The consultation methods should be selected to include three primary elements – process communications that clarify the planning process, targeted stakeholder engagement, and broad public consultation.

8.5 Siting Risks and Constraints

A siting review was undertaken and presented in Section 3. The major risk associated with siting is public opposition to the establishment of a WTE facility. This risk would need to be addressed through a Consultation Plan as discussed in the Consultation Strategy.

Technical constraints were identified in Section 3 with no significant constraints identified based on the preliminary siting review. Some locations do not have all utilities to site which have been considered in the capital costs associated with locating a WTE facility in that location.

8.6 Timelines

The proposed start date for a WTE facility as presented and modelled in this report is 2021. This is the earliest possible timeline which allows for permitting and the establish markets for any end-products. The consultation timeline remains a risk for delaying the start date of the facility. It is recommended that the CSWM integrate consultation on a SWMP amendment with consultation on a WTE facility. Firstly, consultation on a SWMP amendment can build support for a WTE facility in principle by clearly identifying the need, and the provision of information showing that WTE is a preferable option to meet that need. Once public support for WTE in principle is obtained, CWSM could begin the process of consultation on specific potential locations for a facility to obtain municipal and provincial approvals.

In addition, the proposed start date aligns with the diversion target of 70% with the removal of organics from the waste stream. The technology vendors have utilized the waste tonnage and composition assumed after organics diversion.

9. CONCLUSION

The results from the long-term cost modeling presented in this report indicate that the estimated cost to continue landfilling at the CRWMC Landfill until closure and to continue landfilling and expanding The CVWMC Landfill is approximately $75/tonne. The cost was estimated to be approximately $80/tonne in Version I of this report (November, 2017). In Version II, a decreased diversion rate is assumed for the regions based on updated diversion estimates. Consequently an increased disposal rate is applied to the fixed landfilling cost, which results in a decreased cost per tonne. Waste processing through one of the assessed WTE technology options would increase this cost by $29 to $110 per tonne, or $89M-$347M over a 50-year period. This cost per tonne represents the total disposal cost and includes capital and operational costs related to waste disposal (WTE and/or landfilling) and waste transfer (transfer station and waste hauling), as well as any WTE revenue from diverted materials or generated product or energy.

The lowest-cost option would be a WTE facility using the technology provided by Sustane (or equal), located in the Comox Valley area, with system costs of $117 per tonne for the first 30 years and dropping to $99 per tonne at 50 years in operation. This cost per tonne is still higher than the status quo landfill operation. Sustane technology is an advanced combination of processes and individual technologies, with only one identified reference facility in Europe. Very little is known about this plant and the effectiveness of the individual components. There is therefore a technical and commercial risk associated with this technology that may impact its feasibility and cost.

The costs presented above are based on WTE facilities run at fixed capacity. If the technologies are accepting increasing tonnages from year to year, the average cost per tonne waste requiring disposal will generally increase. The reason for the increased cost is that more waste is processed at a higher cost, i.e. through one of the WTE technologies instead of through landfilling.

The two main factors affecting the overall system cost for the options is the facility capital and operating costs, along with transportation cost of waste, ash and residuals. Once new facilities are in operation, landfill operational costs are reduced by up to 34% and the landfill capital cost by up to 57% over the 50-year projection period. The respective numbers are 44% and 60% if the facilities were to accept increasing amounts of waste. The capital and operational costs for a WTE facility are then added to that reduced landfilling cost.

The primary unknowns at this time are the market for and value of the RDF, bio-pellets or biodried product/compost and extracted recyclables. Consideration has been given to the revenues from some recyclables; however, without a confirmed market, it is assumed there would be no revenue from the sale of RDF, bio-pellets or biodried product/compost.

A high-level review of the potential technical, social and financial risks was provided. Viability of the WTE facility with respect to social risks is dependent on the success of the Consultation Plan, which should be developed once site and technology are selected. The siting review indicated that the four investigated sites all have potential for development of a WTE facility, with some potentially requiring service upgrades like water and sanitary sewer.

If the project proceeds to a formal public procurement process, it is recommended the RFP be written with very specific performance outputs based on realistic targets and attainable performance criteria. Appropriate safeguards will be required to manage performance liability and performance achievement.

In conclusion, traditional WTE is a proven technology with generally available markets for the energy and a high degree of landfill space savings; however, it is expensive compared to most other technologies. Creating a solid fuel (RDF or bio-pellets) is substantially less expensive than

conventional WTE, mostly because capital and operational cost associated with the actual combustion component is borne by a third party. Anecdotally, it is known that there are large supplies of wood waste available in the region. Creating additional organic product could disrupt current wood waste recovery and utilization operations by adding more product into an already well supplied market. The main risk with RDF and bio-pellets is finding long-term markets for the product. Without a market, both WTT and Sustane would not meet their goal of being net energy producers, nor would diversion of a large amount of waste from landfilling be possible. While WTE offers many benefits, the results from the long-term cost model show that landfilling remains the most cost effective waste disposal option for the region.

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APPENDIX A: RFI Evaluation Memo

MEMORANDUM

MORRISON HERSHFIELD

TO:	Lisa Butler, P.Eng., Engineering Analyst, CVRD	ACTION BY:	NA
FROM:	Konrad Fichtner, P.Eng.	FOR INFO OF:	The CSWM Select Committee
PLEASE RESPOND BY:		PROJECT No.:	5170574
RE:	Technical Memo – Evaluation of RFI Submissions for Energy Recovery Technologies	DATE:	August 3, 2017

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1. EXECUTIVE SUMMARY

On behalf of Comox Strathcona Waste Management (CSWM), Morrison Hershfield is conducting research into the feasibility of applying waste to energy (WTE) technologies to the solid waste generated in the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD). As part of the process, a request for information (RFI) was issued to suppliers of WTE systems and also refuse derived fuel (RDF) suppliers. This memo summarizes the evaluation of the submissions received.

The RFI received a total of six submissions, of which five were directly related to the production of conventional RDF from municipal solid waste (MSW). Only one submission was for traditional (thermal) WTE:

- Eco Waste Solutions ("EWS") – Traditional WTE through combustion
- REDWAVE, a Division of BT-Wolfgang Binder GmbH – RDF production
- SALT Canada Inc. – Aerobic landfill with subsequent mining and RDF production
- Sustane Technologies Inc. – Mechanical separation, pyrolysis of plastics and RDF from balance
- Wastaway – RDF production
- WTT Netherlands BV – Anaerobic Digestion (AD) of organics and RDF from balance

Each submission was evaluated through a two-tier process, first against Essential Criteria and then against Desirable Criteria. The Essential Criteria include suitability for volumes and types of materials expected, ability to produce surplus energy/fuel, and be mature enough for commercial implementation. All the submissions met the Essential Criteria, and were assessed further against Desirable Criteria.

The major categories of Desirable Criteria are:

- Innovation and Risk.
- Technology.
- Environmental and Social.
- Economics and Affordability.

All six vendors provided sufficient details to carry out the evaluation process effectively and all (with limited reference facility information from SALT) had a number of reference facilities operating at or above the potential feedstock generation rates anticipated for the CSWM service area.

On completion of the evaluation process the submissions were ranked as shown in Table ES1.

Table ES1: Ranking of Submissions

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
EWS	Thermal WTE	81%
REDWAVE	RDF	79%
Sustane	RDF and pyrolysis	77%
WastAway	RDF	75%
SALT	Aerobic Landfill, RDF	54%

As can be seen in the above rating table, the top two technologies/vendors have very similar scoring. However, the scores are achieved for different reasons:

- WTT has the highest score because they produce both energy and fuel. Markets for the energy (electricity or bio-gas) are proven and available; while the markets for the RDF are somewhat speculative at this time. The technology is proven and less costly than thermal WTE. Emissions are minimal at the location of the facility, but there will be emissions where the RDF is burned and these cannot be determined until the user of the RDF is known.
- The traditional WTE offered by EWS is proven, reliable, and the markets for the main energy recovered (electricity) are always there. Additional waste heat will be available which could lead to the development of facilities that require heat, such as greenhouses. The major downside to traditional WTE is the cost, which is substantially higher than for the offered RDF technologies.

The other RDF technologies have slightly to substantially lower scoring, depending on the performance of the technology and the information provided.

In summary, traditional WTE is a proven technology with secure markets for the energy and a high degree of landfill space savings, but it is expensive compared to most other technologies. RDF is substantially less expensive than WTE, mostly because the actual combustion takes place at an existing facility somewhere else that will burn the fuel produced. The biggest risk with RDF is finding long term markets for the product, without which none of the proposed RDF technologies would meet their goal of being net energy producers and diverting a large amount of waste from landfilling.

It is proposed to continue work carrying forward the WTT technology combination of AD and RDF, and the EWS technology of conventional WTE. These will be researched in more detail so that cost information can be put into the existing model to determine ultimately how these technologies compare financially with landfill expansion. Other components of the study, such as siting issues, regulatory requirements and consultation plan development will take place in parallel. The final report will also include levels of residuals, integration options, timelines, and GHG emissions.

2. PURPOSE

Morrison Hershfield (MH) has been retained by Comox Strathcona Waste Management (CSWM) to seek information from qualified waste-to-energy (WTE) technology vendors through a request for information process. The purpose is to gather and compare technology information and costs from technology suppliers/vendors interested in participating in an assessment of WTE for managing municipal solid waste (MSW) in the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD).

Morrison Hershfield was commissioned to evaluate the Vendor submissions and present results to the CSWM WTE Select Committee for discussion. This technical memorandum (Memo) describes the evaluation process for the vendors, summarizes the vendor technologies and identifies the top scoring submissions.

3. RFI PROCESS

Vendors of the various energy recovery technologies were invited to submit responses to a Request for Information (RFI) posted on BC Bid on June 13, 2017. Appendix A contains the RFI documents that were posted publically. In addition, specific vendors, primarily based in Europe, were approached and referred to the BC Bid website for access to the RFI. The European vendors were selected on the basis of the Consultant team's knowledge of firms who provide the selected technologies. The vendors were given until July 14 to submit responses to the RFI.

The purpose of the RFI was to obtain vendor specific information so that technologies could be ranked for suitability to CSWM. The RFI provided background information and clarified that technologies must be capable of processing quantities equivalent to approximately 125 tonnes MSW per day from the CSWM area.

A total of six different vendors of mixed municipal solid waste (MSW) processing and energy recovery technologies responded, as follows:

- Eco Waste Solutions ("EWS")
- REDWAVE, a Division of BT-Wolfgang Binder GmbH
- SALT Canada Inc.
- Sustane Technologies Inc.
- Wastaway
- WTT Netherlands BV

4. SUMMARY OF TECHNOLOGIES OFFERED BY VENDORS

4.1 Eco Waste Solutions ("EWS")

EWS is a well-known Canadian supplier of smaller conventional incineration systems. EWS is proposing that the WTE facility will comprise two EWS Enercon Thermal Conversion Modules. Each module will have a capacity of 100 tonnes per day. The system operates under excess air conditions with precisely controlled combustion through temperature and oxygen level controls and flue gas recirculation.

Air pollution systems are included and are generally provided by companies specialized in supplying this equipment. Air pollution equipment can be specified to meet emission limits, or even stay well below them if desired.

The system is designed to produce electricity or steam, or both. The bottom ash by-product has been tested according to U.S. EPA. All test results have been well below any standards set by these regulatory agencies and have proven the ash to be non-hazardous, non-leaching and essentially inert. The vendor claims that beneficial use can include road construction backfill, road re-surfacing material, aggregate replacement in cement, landfill cover or a beneficial additive to some soils to improve drainage or correct pH.

There are numerous facilities currently using this technology and it is well proven.

4.2 REDWAVE, a Division of BT-Wolfgang Binder GmbH

REDWAVE offers a mechanical-biological waste treatment technology for the mixed residual MSW. Mixed waste is mechanically separated into wet (organics) and dry components and sensor-based sorting recovers recyclables from the dry component. The wet organics are biologically dried and stabilized, and together with the residue from dry sorting are converted into a refuse derived fuel (RDF). RDF can be utilized in cement kilns, pulp mills and or other industry with high energy demand to offset fossil fuels. The vendor mentions two pulp mills located on the Island, in Port Alberni and Crofton, as potential markets, however no market for the RDF has been established.

This is a proven technology in Europe. It is generally not used in Canada due to its cost and difficulties in establishing long term markets for the RDF.

4.3 SALT Canada Inc.

SALT Canada Inc. offers a technology that consists of two distinct steps. In the first step, conventional landfill cells are made aerobic (similar to composting) by injecting large amounts of air. The waste is stabilized and the cell can be opened and mined within four years. In a second step, valuable materials (recyclables) are then mechanically extracted and the remaining waste is processed into fuel or RDF while the landfill cell can be used for repeat filling. This requires an overall time frame of six years between final cell filling and preparation for the cell for further waste acceptance.

This is a somewhat unusual approach and to the best of our knowledge has not yet been successfully applied in its entirety. Anecdotally, landfills are rarely mined due to high cost, and when they are mined it is generally to create new space for disposal. There is a substantial risk that the recovered materials will be contaminated and have a low value. As with any RDF, the challenge is finding long term markets for the fuel.

4.4 Sustane Technologies Inc.

The technology offered by Sustane is using a proprietary de-bonding, separation and cleaning processes, to obtain end products including clean biomass pellets, synthetic diesel, and metals. The biomass pellets are not considered a refuse derived fuel (RDF) as they contain virtually zero plastics. The vendor claims that this has been done in Nova Scotia where the fuel has been certified by the Department of Environment, Nova Scotia, as recovered biomass, with all the attributes of forest based biomass.

Plastics are separated and the low-density plastics fraction is processed into a synthetic diesel product for internal use (25%) and also for sale (75%).The remaining part of the MSW is bio dried and pelletized to create biomass and biodiesel for local markets. The synthetic diesel product will achieve ASTM specifications, typically at a 50% blend and will be sold as a marine diesel or industrial/commercial fuel oil (No. 2) replacement.

Based on the Vendor’s experience in Nova Scotia, the proposed facility will generate recovered materials that can stimulate additional “green” businesses at the location. The submission suggests that CSWM may wish to consider an “Eco-Park” concept to reap the benefit of this enabling technology.

The vendor stated that they can offer the biomass pellets at a price discount to forestry-based biomass to facilitate the sale process for use in pulp and paper boiler applications.

This technology has been proven in Europe and the first Canadian plant is currently under construction in Chester, Nova Scotia. This operation will process 200 tonnes per day of MSW. A facility in Madrid, Spain, has a relatively similar throughput to the one requested with a 100 tonne per day (built in 2010).

4.5 WastAway

WastAway proposes a technology which processes MSW to RDF. A multi-stage process includes pre-shredding of MSW, metals removal, inerts screening, a Hydrolyzer (a form of continuous-flow autoclave), dryer and pelletizer to form RDF. Only one operational plant exists in the U.S., and this facility is more of a demonstration facility than a commercial one. The preparation fuel is relatively recent for this reference plant.

WastAway identified Nanaimo Forest Products – Harmac Pacific Pulp as a potential buyer of the RDF for use in their boilers. The submission names David Bramley, Environmental Superintendent, to be available to confirm interest if required. The interest has not been confirmed at this stage.

4.6 WTT Netherlands BV

Waste Treatment Technologies (WTT) has numerous reference facilities across Europe and proposed two combinations of technologies feasible for CSWM:

- RDF production and biodrying, or
- RDF production, AD and biodrying.

Both these options produce RDF. RDF can replace fossil fuels at cement manufacturers in BC. The option with AD also produces biogas, which can be converted into electricity/heat. The biodried product can be upgraded/refined to compost for land application. The quality of the compost that comes from the processing of mixed MSW can have numerous contaminants, which may limit end markets for land application.

If a facility is selected to generate AD, the bio drying and AD tunnels can be built as hybrid or dual purpose tunnels. These hybrid tunnels can operate under both anaerobic and aerobic conditions. By operating an AD tunnel as composting tunnel the capacity of the tunnel will be tripled. This technology is therefore very flexible to handle smaller or larger volumes.

This is a proven technology in Europe. No facility using WTT technology to produce RDF is in operation in Canada, however WTT technology is used in the Surrey Biofuel Facility to produce compost and biogas.

5. EVALUATION CRITERIA FOR VENDORS

Each submission was evaluated by two team members through a two-tier process. Each submission was evaluated against Essential evaluation criteria (Table 1) and Desirable evaluation criteria (

Table 2). All the submissions met the Essential Criteria, and were assessed further against Desirable Criteria.

The major categories of Desirable Criteria are:

- Innovation and Risk.
- Technology.
- Environmental and Social.

- Economics and Affordability.
- Submission Completeness.

The team allocated weighting to the key categories based on knowledge of local conditions and client priorities. A sensitivity of these weightings is summarized later in this memo.

Table 1: Essential Criteria Used for Evaluating Technology Categories

ESSENTIAL CRITERIA	GUIDANCE ON EVALUATION	EVALUATION RATING
Suitable for volumes expected	Technologies must have practical applications between 20% and 100% of the expected materials to be processed	Yes/ No
Suitable for types of materials expected	Must be able to process/recover types of waste materials expected in the residual waste	Yes/No
Energy recovery	If technology recovery energy, there must be a new surplus of energy after satisfying plant internal requirements	Yes/ No
Maturity	Technology must be proven with at least one full scale facility that has been in successful continuous operation for a year or more	Yes/ No

Table 2: Desirable Criteria Used for Evaluating Technology Categories with Allocated Weighting

DESIRABLE CRITERIA (WEIGHTING)		GUIDANCE ON EVALUATION RATING
Innovation and Risk (25%)	Technology readiness	1. No commercially operating plant, only pilot scale or demonstration facilities. 2. At least one full scale demonstration facility operating successfully for a year or more. 3. One or more commercially operating facilities for one+ years.
	Energy recovery efficiency/ potential	1. Low energy production (up to 100kWh per tonne of feedstock) or unlikely to find markets as fuel. 2. Moderate energy recovery (100 to 250 kWh per tonne of feedstock) or questionable markets for fuel. 3. High energy recovery (over 250 kWh per tonne of feedstock) or firm markets for fuel.
	Technology risk	1. Emerging technology, can be commercialized but scale-up factor greater than 3 forms significant risk. 2. Emerging technology, full scale systems have been trialed but may be difficult to get bank funding. 3. Proven technology, easy to commercialize, commercial funding should be available with good business case.
Technology (25%)	Operational flexibility	1. Modules can accept only designed throughput, no flexibility for higher or lower volumes of feedstock. 2. Moderate flexibility, can operate efficiently with plus/minus 20% of design capacity. 3. Highly flexible, up to 50% more or less feedstock can be handled.
	Complexity	1. Complex technology with sophisticated control requirements, high maintenance needs, and requires highly skilled operators.

DESIRABLE CRITERIA (WEIGHTING)		GUIDANCE ON EVALUATION RATING
		2. Can be operated with common industrial technical skills; requires regular maintenance and replacement of worn parts. 3. Simple and robust process which can be operated with basic trainable skills.
	Feedstock quality requirements	1. Very strict quality requirements requiring extra processing. 2. Moderate processing required. 3. Can take waste with minimal processing.
	Utility requirements	1. Requires full access to utilities, gas, water, power, and sewer. 2. Requires access to power and water. 3. Power access is all that is required.
	Expected availability and reliability	1. Questionable reliance, unproven. 2. Moderate reliance, availability of 80% expected. 3. Proven High reliability and availability of 90% achievable.
	Suitability for CSWM waste volumes and types	1. Technology modules too large for waste volumes expected. 2. Modules too small and many smaller modules must be used. 3. Well suited for CSWM waste volumes and types.
Environmental and Social (25%)	Emission control	1. Questionable ability to treat all emissions to best achievable standard. 2. Emission control systems fully proven. 3. No stack emissions from this process.
	Greenhouse gas (GHG) emissions	1. Questionable ability to reduce emissions in the local context. 2. GHG reduction likely but depends on end product. 3. GHG reduction guaranteed.
	Social benefits	1. Marginal benefits to the local community (small employment opportunities or limited opportunities for local use of end products, etc.). 2. Some social benefits 3. High potential for social benefits (many employment opportunities or opportunities for local use of end products, etc.).
	Residue to landfill (per tonne input)	4. High (more than 20% by weight). 5. Medium (5% to 20% by weight). 6. Low (under 5% by weight).
Economics and Affordability (25%)	Capital costs ($/tonne of installed annual capacity)	1. High, more than $800 per tonne. 2. Medium, $400 - $799 per tonne. 3. Low, under $400 per tonne.
	Operating costs ($/tonne), excluding capital but including profits from product or energy sales	1. High, over $100 per tonne. 2. Medium, $50 - $99 per tonne. 3. Low, under $50 per tonne.
	Quality of end products	1. Quality product moderate with questionable markets. 2. Good market potential but not yet established. 3. Firm markets already exist.

Where information gaps were identified, the Vendors were approached for further information. If data gaps still existed, the evaluator used his/her best judgement based on professional experience to score the Vendor. All scoring was justified with comments to provide transparency and consistency. Where no information was available from the Vendor and it was not possible to fill remaining data gaps with any confidence, a score of 1 was given against the relevant criteria.

Appendix B provides a summary spreadsheet for evaluation of all vendors.

6. RATING OF SUBMISSIONS

The RFI received a total of six submissions, of which five were directly related to the production of conventional RDF from MSW. Only one submission was for traditional (thermal) WTE.

All six vendors provided sufficient details to carry out the evaluation process effectively and all (with limited reference facility information from SALT) had a number of reference facilities operating at or above the potential feedstock generation rates anticipated for the CSWM service area.

On completion of the evaluation process for technology providers in accordance with the evaluation criteria and weighting shown above, the submissions were ranked as shown in Table 3.

Table 3: Ranking of Submissions

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
EWS	Thermal WTE	81%
REDWAVE	RDF	79%
Sustane	RDF and pyrolysis	77%
WastAway	RDF	75%
SALT	Aerobic Landfill, RDF	54%

A summary of the scoring justification for each vendor is presented below:

- WTT has the highest score because they produce both energy and fuel. Markets for the energy (electricity or bio-gas) are proven and available; while the markets for the RDF are somewhat speculative at this time. The technology is proven and less costly than thermal WTE. Emissions are minimal at the location of the facility, but there will be emissions where the RDF is burned and these cannot be determined until the user of the RDF is known.
- The traditional WTE offered by EWS is proven, reliable, and the markets for the main energy recovered (electricity) are always there. Additional waste heat will be available which could lead to the development of facilities that require heat, such as greenhouses. The major downside to traditional WTE is the cost, which is substantially higher than for the offered RDF technologies.
- REDWAVE is an advanced mechanical recycling and RDF production technology. They have good reference facilities and the system is expected to be reliable. A major unanswered question, as with the other RDF technologies is finding markets for the product, and determining the actual emissions when (and where) the product is burned as fuel.

- Sustane adds to its RDF technology the separation of plastics which are subjected to pyrolysis to create a diesel equivalent fuel. While highly desirable, there have been very limited commercially successful applications of pyrolysis for waste products.
- WastAway offers an RDF process with a special process step that breaks down the microbial structure of the organic materials in the waste. WastAway claims it makes a better fuel, however, the process seems much more complex than other RDF technologies. The firm only has one full scale demonstration facility operating at this time. However, WastAway has gone farther than other firms in establishing potential markets for RDF.
- The SALT technology, while in the end making an RDF, is highly untraditional, and there are many unanswered questions and lacking reference facilities, which resulted in lower scoring.

Vecoplan LLC, which is a well-known and reputable German company, also provides a technology for the production of RDF. Vecoplan did not submit a response to the RFI, but provided to Morrison Hershfield a web link to a video showing both actual video and concept animations of its energy recovery facility installation with the City of Edmonton. Vecoplan could therefore not be evaluated, however, their information supports the feasibility of recovering recyclables and making of RDF through modern mechanical systems, as offered by other Vendors.

7. SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to see what would happen if weighting criteria were changed to focus on **economics/affordability**. With 50% of the weighting on economics/affordability, 20% on environmental and 15% each on technology and innovation, the rankings are modified as shown in Table 4.

Table 4: Submission Rankings with Emphasis on Economics/Affordability

VENDOR	TECHNOLOGY	SCORE
WTT	AD AND RDF	81%
WASTAWAY	RDF	76%
REDWAVE	RDF	75%
SUSTANE	RDF AND PYROLYSIS	74%
EWS	THERMAL WTE	72%
SALT	AEROBIC LANDFILL, RDF	48%

This change in ranking demonstrates the high cost of thermal WTE compared to RDF systems.

The next sensitivity analysis was conducted to see what would happen if weighting criteria were changed to focus on **social/environmental**. With 50% of the weighting on social/environmental, 20% on economics/affordability and 15% each on technology and innovation, the rankings are modified as shown in Table 5.

Table 5: Submission Ranking with Emphasis on Social/Environmental

VENDOR	TECHNOLOGY	SCORE
WTT	AD and RDF	83%
Sustane	RDF and pyrolysis	82%
EWS	Thermal WTE	80%
REDWAVE	RDF	80%
WastAway	RDF	78%
SALT	Aerobic Landfill, RDF	58%

The social/environmental bias results in WTT staying the preferred technology because they recover energy with secure markets through AD in addition to RDF. Sustane benefits from the pyrolysis of plastics to oil.

Overall, the combination of AD with RDF is the preferred technology in all situations. Conventional WTE will rank higher or lower, depending on the emphasis on costs.

8. CONCLUSIONS

Of the six submissions, only one offered conventional WTE technology. All others provided some form of conversion to RDF or other fuel.

Conventional WTE ranked near the top primarily because the technology is well proven and markets for energy (electricity and heat) and recovered metals are also proven. In addition, the bottom ash could be recycled or used for various purposes, resulting in very little residue going to landfill.

RDF processing offered by the various Vendors is also proven, although the degree varies with the technology. The greatest challenge with RDF is finding long term markets for the fuel, and without the markets, the technologies are – simply put – very expensive ways of extracting recyclables and stabilizing the balance of residual waste.

Currently in Canada conversion of waste into fuels is appealing as a solution to reduce landfill disposal needs and to extract the most value from the waste stream. However, some of the technologies that are proposed by the vendors are still not proven in Canada. For example it must be seen how the WTE facility in Halifax, Nova Scotia, which is currently under construction, will deliver and prove the viability for RDF markets. The Halifax facility, which will use the Sustane technology plans to convert the plastics fraction of the MSW into a liquid fuel, similar to diesel fuel, while the organics will be converted into burnable pellets. As a point of interest, a larger waste to liquid fuel plant in Edmonton, which is based on the Canadian Enerkem gasification technology, is considerably larger than what is required for CSWM. Enerkem is considering new facilities only where a minimum of 200,000 tonnes per year of waste are available, which is presumably why they did not respond to this RFI.

Conventional WTE costs can be expected to be over $50 million to build the plant and over $80 per tonne to operate it, after the sale of energy.

RDF plants of the conventional and proven variety will be about $20 million to $30 million to build and $50 to $80 per tonne to operate. The primary unknowns are the market for and value of the RDF. Without a confirmed market, the operating costs would be much higher, since there would be no revenue from the sale of RDF and an additional disposal fee for the stabilized RDF at a landfill.

In summary, traditional WTE is a proven technology with secure markets for the energy and a high degree of landfill space savings, but it is expensive compared to most other technologies. RDF is substantially less expensive than WTE, mostly because the actual combustion component is an existing facility somewhere else that will burn the fuel produced. The biggest risk with RDF is finding long term markets for the product, without which none of the proposed RDF technologies would meet their goal of being net energy producers and diverting a large amount of waste from landfilling.

9. Next Steps

The project will proceed in accordance with the established work plan, carrying forward the two preferred technologies: RDF combined with AD, and traditional WTE. The next tasks are the Assessment of Siting and Regulatory Requirements and Consultation Plan Development. While these are being conducted, outstanding information will be gathered for the two top ranked technologies to enable a more detailed financial evaluation and comparison with current landfill expansion plans.

The final project task is the preparation of a summary report, which will:

- Look at residual waste from the two technology options and potential reuse and disposal options;
- Review possibilities for integrating the technologies with existing infrastructure (Integrated Resource Recovery);
- Integrate the technical options into the existing cost model;
- Develop cost and benefit comparison of a viable WTE alternative vs. the proposed CVWMC Cell 2 and 3 engineered landfill;
- Assess constraints, risks and timelines for selected options;
- Develop key tasks and timelines to commission a viable WTE technology as per the RFP requirements; and
- Provide estimates for potential net GHG emissions of selected WTE options and landfill operations.

The result will be a draft assessment report, which after review will be finalized and presented to the CSWM Board.

APPENDIX 1:
REQUEST FOR INFORMATION

Comox Strathcona Waste Management

Request For Information

Waste-to-Energy Technologies

Closing Date and Time:

Friday July 14, 2017 at 4:00 PM PDT

Contact Person:

Nathalie Maurer, P. Eng.
Environmental Engineer
Morrison Hershfield
nmaurer@morrisonhershfield.com

1. INTRODUCTION

Comox Strathcona Waste Management (CSWM), a function of the Comox Valley Regional District (CVRD), is seeking information from qualified waste-to-energy (WTE) technology vendors interested in participating in a feasibility assessment of WTE for managing municipal solid waste (MSW) in the Comox Valley Regional District (CVRD) and the Strathcona Regional District (SRD).

There is interest in WTE technologies for managing the residual waste component of the MSW stream. This is due to the current high cost of landfilling and the anticipated need for substantial investments for landfill expansion. Information being requested from WTE technology vendors will be used to undertake an assessment of whether there are financial, social and environmental benefits of applying WTE instead of increasing landfill capacity.

Information from vendors will be used to undertake the WTE feasibility assessment and these vendors will be recognized in the final assessment report as contributors. The final report will become a public document.

2. ACKNOWLEDGMENT LETTER

Upon receipt of the Request for Information document the Proponent shall complete the Acknowledgement Letter at the back of this document and submit the letter to Nathalie Maurer at nmaurer@morrisonhershfield.com or via fax at 604-454-0403.

3. BACKGROUND

3.1 Physical Setting

The Comox Valley Regional District (CVRD) is located approximately 70 km North West of Nanaimo, BC on the east coast of Vancouver Island. The majority of the CVRD's residents reside in Comox, Courtenay and Cumberland. The Strathcona Regional District (SRD) is located immediately north of the CVRD. The majority of SRD's residents reside in Campbell River. The two regional district centres are located approximately 50 km apart. The CVRD covers 1,725 km^2 and the SRD covers approximately 20,000 km^2. The region's climate is one of the mildest in Canada due to moderation by the Pacific Ocean, which also contributes heavy precipitation to the western coast of Vancouver Island.

3.2 Population and Community Growth

Over the next 10 years the southern waste-shed population (CVRD) is expected to grow at an average rate of 1.1% per year and the northern waste-shed (SRD) population is expected to grow at an average rate of 0.6% per year. From 2027 onwards, the population growth is expected to grow at an average rate of 0.9% and 0.3% for the southern and northern waste-sheds respectively. Table 1 below shows the estimated combined population growth for the next 50 years.

Table 1 Projected Population for next 50 years[1]

Year	CVRD Population	SRD Population	Combined Population
2016	66,527	44,671	111,198
2021	69,280	47,390	116,670
2026	73,002	48,661	121,663
2036	79,411	50,269	129,680
2046	86,855	51,798	138,652
2056	94,996	53,373	148,368
2066	103,900	54,996	158,896

3.3 Solid Waste Management System and Waste Generation

The Comox Strathcona Waste Management (CSWM) service covers waste management for both regional districts (CVRD and SRD). For additional information on the CSWM system the 2012 CSWM Solid Waste Plan can be found at the following link: http://www.cswm.ca/files/CSWM_amended_solid_waste_plan_2013.pdf.

Two main landfills are used for disposal of the majority of the region's waste. The Campbell River Waste Management Centre (CRWMC), located near Campbell River, handles waste from the SRD while the Comox Valley Waste Management Centre (CVWMC), located in

[1] Sub-Provincial Population Projections - P.E.O.P.L.E. 2016 (Aug 2016)

Cumberland, handles waste from the CVRD. The CVWMC is currently being expanded with a new engineered landfill and the CRWMC is expected to close in the next 5-6 years.

There are extensive recycling programs throughout the regions and centralized composting is also being implemented to remove organics from the waste stream. The goal of both regions is to achieve 70% diversion through recycling and composting by 2022 according to the Comox Strathcona Solid Waste Management Plan.

The landfill disposal for 2016 was 63,390 tonnes[2]. Of the total, approximately 58% of the waste was landfilled at the CVWMC and 37% went to the CRWMC. The remainder of the waste was disposed at small, remote landfills in Tahsis, Zeballos and Gold River.

To estimate the projected waste disposal tonnages, it was assumed that with the implementation of composting and additional recycling will result in a 30% decrease in the disposal rate. The estimated disposal tonnages for the next 50 years are shown in Table 2 below. Respondents to this RFI should assume 2021 tonnages for implementation of a WTE facility (this is after implementation of a regional organics management program, and the earliest that a WTE facility could conceivably be built).

Table 2 Projected Disposal Tonnages for next 50 years (based on 2016 per capita disposal rate less 30%)

Year	CVRD Disposal (tonnes)	SRD Disposal (Tonnes)	Total Disposal
2016	37,925	25,465	63,390
2021	27,646	18,911	46,557
2026	29,131	19,418	48,549
2036	31,689	20,060	51,748
2046	34,659	20,670	55,328
2056	37,908	21,298	59,206
2066	41,461	21,946	63,407

There is no waste composition analysis currently available for the CSWM area. Typical waste composition for mid-sized communities in BC may be used if required. Waste composition studies conducted by Nanaimo, BC would have similar values to the study region and the 2012 CSWM Solid Waste Management Plan provides an estimated composition of waste disposed.

3.4 Heating Value of MSW

Waste reduction initiatives are being implemented to achieve a 70% diversion rate, which results in an estimated heating value that could range from 11 – 13 GJ/tonne. New waste diversion is being achieved through the Province of BC's Product Stewardship expansion, which targets primarily packaging, and waste diversion will also be substantially improved

[2] CSWM 2016 Disposal Tonnages

through the construction of a regional composting facility. The reduction of food waste will increase the heating value of the waste, although this will be partially offset by the removal of large amounts of plastic and paper/cardboard packaging. It has been conservatively estimated by Morrison Hershfield that the lower heating value of waste, as received, will be 11 FGJ/tonne in the future once 70% diversion has been achieved.

3.5 Provincial Regulations and Guidelines

The BC Ministry of Environment (MoE) has issued a guideline document for the inclusion of WTE in solid waste management plans. The document may be found at http://www.env.gov.bc.ca/epd/mun-waste/guidelines.htm. The primary elements of the document that apply to this information request are:

- The Ministry expects local governments to have a minimum target of 70% reduction of waste before utilizing a WTE facility as a waste management option. The 70% target is calculated only from Reduce, Reuse, and Recycling initiatives.

- The Ministry expects that resource recovery facilities (4th R) will obtain at least 60% of the potential energy from the MSW used as a fuel.

- If a WTE facility does not achieve 60% energy efficiency, the Ministry will consider the WTE facility as a residual management facility (5th R).

The BC MoE has established air quality standards for MSW incinerators. The criteria may be found at http://www2.gov.bc.ca/gov/content/environment/air-land-water/air/air-quality-management/regulatory-framework/objectives-standards. All new facilities must meet the standards set out in the MOE document.

4. WTE ASSESSMENT

4.1 Purpose and Objectives

On behalf of the CSWM, Morrison Hershfield is conducting a detailed review of WTE as a means of substantially reducing reliance on landfilling. Tipping fees in the region are currently $130 per tonne and the overall solid waste system is also supported by taxation. The region is concerned about continued increases in solid waste management costs and about placing an even heavier burden on its taxpayers. This study will enable the CSWM to make an informed decision on whether or not to include WTE in its integrated system. It will identify the cost savings from reduced landfill costs and compare them to the increased costs of WTE. It is expected to result in an apples to apples comparison of an integrated system (which includes diversion, transfer, etc.) with an integrated system that continues to rely primarily on landfilling for disposal.

A previous assessment of WTE was conducted in 2011 and focused on conventional, well proven WTE technologies. The approach in 2017 is to continue to include traditional WTE technologies, but also to open the door to innovative systems that show reasonable promise of being commercially viable and reliable. While the generation of energy and its use is an important aspect of financial viability and GHG reduction (compared to landfilling), the main focus is on the removal of residual waste (after recycling and composting) from the need for landfill disposal.

This study is driven primarily by the high unit cost of landfilling and the high capital cost of landfill expansion. The intent is to identify those WTE technologies that are able to recover energy while substantially reducing the volume of waste/residuals going to landfill at a cost lower than current landfill practices.

The proposed technologies should focus on the waste volumes projected to come from the CSWM service area. A major import of waste from other jurisdictions is not envisioned, however a smaller amount from neighbouring regional districts may be considered in the future. Proposed units could be centrally located or smaller decentralized units could be suggested to reduce transportation requirements should it be economically viable. Creation of local employment and potential spinoff benefits will be considered by the CSWM.

Environmental protection is an important component. It is expected that any proposed technology will meet current emission guidelines in BC for WTE technologies. Vendors are also requested to demonstrate the ability of their proposed technology to remain substantially below current emission limits. The reduction of GHG and a technology's ability to demonstrate this is an essential consideration.

This RFI is intended to inform the CSWM of the possibilities available to them and to guide their future decision making and ultimately, their procurement process. Vendors supporting this process with information will be recognized in the summary report.

4.2 Confidentiality

Information provided as part of this RFI will be summarized for the final assessment report, which will become a public document. Only summary information will be used from the submissions and qualifications of the vendors. Detailed submissions will not be included in the final assessment report. If it is necessary for a vendor to withhold information, the vendor should indicate what information is being withheld and for what reason (e.g. proprietary information).

4.3 Intent

The information requested in this document is intended to be used as information only and the submission of information does not create a legal or contractual relationship between the vendor and the CVRD. This is not intended to be a request for qualifications leading to a request for detailed proposals, nor is it intended to be a request for proposals that would result in legal obligations by either party.

4.4 Vendor's Expense

Costs for preparing the submission shall be borne by the vendor.

4.5 Ownership of Submissions and Freedom of Information

All documents and information submitted to the CVRD become the property of the CVRD. Each respondent should clearly identify any information that is considered to be confidential or proprietary information.

The CVRD is subject to the provisions of the Freedom of Information and Protection of Privacy Act. As a result, while section 21 of the Freedom of Information and Protection of Privacy Act does offer some protection for confidential third party business, financial and proprietary information, the CVRD cannot guarantee that any such information provided to the CVRD will remain confidential if a request for access is made under the Freedom of Information and Protection of Privacy Act.

4.6 Submission Requirements

To be considered for the assessment of WTE, interested technology vendors must submit the requested information (as specified in section 5: Questionnaire) by 4:00PM PDT, Friday, July 14, 2017.

Submissions may be sent electronically to Nathalie Maurer at Morrison Hershfield, at nmaurer@morrisonhershfield.com.

Late submissions will not be considered.

The person(s) authorized to sign on behalf of the vendor and to bind the vendor to statements made in response to this request for information must sign the submission form. Unsigned submissions will not be accepted.

The vendor shall be solely responsible for the delivery of their submission in the manner and time prescribed.

4.6.1 Enquiries

All enquiries related to this request for information are to be directed by email, no later than 4:00PM PDT, Friday, July 7, 2017, to:

Nathalie Maurer
Email: nmaurer@morrisonhershfield.com
Ph: 604-454-0402
Fax: 604-454-0403

Information obtained from any other source is not official and should not be relied upon.

4.6.2 Addenda

Addenda may be issued during the submission period in response to queries received. Addenda will be in written form and sent to all vendors who have responded to the acknowledgement letter (section 6). All addenda must be considered when responding to this request for information.

Verbal answers are binding only when confirmed by written addenda.

4.7 Submission Evaluation

This is a request for information and not a competitive process. There will not be a formal evaluation of submissions. Submissions will be reviewed with considerations given to the following categories: Innovation, Technology, Environmental/Social and Economics. Therefore, there may be a ranking of submissions to identify technologies that best meet the CSWM's needs and requirements. Contributions made by vendors will be recognized in the final report, which will become a public document.

4.8 Project Description

The following information, assumptions and instructions will assist vendors with preparing the requested information. For additional details, please address them to Morrison Hershfield's contact person. Information must be provided in the form provided in section 5.

4.8.1 Feedstock

- All residual waste that currently goes to landfill (after diversion) generated in the CSWM service area will be made available as feedstock for the WTE facility.
- Waste will be delivered to the facility 5 days per week with only typical fluctuations due to seasons and climate expected.

- Waste will be delivered as-is and no further processing will be undertaken by CSWM.

- Heating value for the purpose of this study can be assumed to be 11 GJ per tonne (lower heating value, as received). Typical seasonal fluctuations must be expected.

4.8.2 Technology

- All technologies that process residual waste for the purpose of recovering energy and substantially reducing volumes going to landfill will be considered. These include but are not limited to:
    - Small scale mass burn technology
    - Controlled air combustion systems
    - Fluidized bed systems
    - Rotary kiln combustion processes
    - Close coupled two stage gasification
    - True gasification (with syngas cleaning before further processing or combustion)
    - Other gasification or pyrolysis systems
    - Newer technologies not identified above

- In addition to complete systems that process residual waste into energy, consideration will also be given to technologies that convert residual waste into fuel. The viability of markets for this fuel must be demonstrated. Typical technologies might include:
    - Dirty material recovery facility (MRF) for additional recovery of recyclables and conversion of remaining waste to refuse derived fuel (RDF) or solid recovered fuel (SRF), either in pellet form or as fluff
    - Other fuel conversion technology

4.8.3 Size

- The facility shall be sized for the full amount of feedstock available in 2021 identified in Section 3.3. The technology's ability to handle more or less feedstock than the rated capacity must be defined. Note: it is recognized that WTE facilities may take longer to implement (as much as 5 – 7 years), however, 2021 was chosen as a theoretical earliest possible date for the purpose of this RFI).

- Module sizes need to be identified should any increase in capacity be required in the future.

- Vendors of newer technologies that are not commercially operating in other jurisdictions should include the scenario of a pilot demonstration facility as a first step, clearly outlining costs and potential benefits of this newer technology.

4.8.4 Site Location

- A site location has not been determined at this time. It may be located at one of the existing landfills. There may be other potential locations available – vendors are encouraged to investigate options for privately owned sites.
- Assume that costs for land are not part of the Vendor's responsibility.
- Assume that major utilities (water, power, sewer and natural gas) are available.
- Identify any synergies that the proposed process could benefit from if located at landfills (e.g. landfill gas utilization) or close to other industries in the region.
- Identify whether a preferred site has already been identified and provide a description of the site.

4.8.5 Development and Operating Timelines

- No development timeline is available at this time. Vendors are requested to provide realistic time estimates for the design, construction and commissioning of their equipment.
- Assume that the facility will operate for 25 years and include cost provisions for appropriate maintenance and upgrades of major components, if required.

4.8.6 Emissions and Residuals

- Emissions shall meet the criteria identified in Section 3.5.
- Due to the sensitivity of the airshed of the CSWM service area, vendors shall provide an indication of expected actual emissions of an operating plant and show how much key emissions are below regulated values. Expected emissions must be based on experience with similar operating facilities.
- Effluent must meet applicable municipal and provincial regulatory standards.
- Residuals shall be quantified and compared to process input tonnage.
- Types of residuals must be identified (e.g. ash, sludge, char, baghouse fines, etc.).

4.8.7 Transport and Hauling

- Assume that no transportation or hauling is required and all waste will be delivered by others to the facility.
- Assume hauling of residuals to a landfill, as identified by the vendor, will be handled by others. Residuals must be treated at the facility so that they can be safely landfilled.

4.8.8 Energy Recovery

- Assume the current value of electricity sold to the grid is $65/MWh.
- Assume the current value of natural gas is $3/GJ.
- District energy: Assume that there is no infrastructure to absorb excess heat at this time. For the possibility of planning future infrastructure around the WTE facility, please indicate how much heat (GJ/hr) could be available for heating purposes (without sacrificing power production efficiency).
- Assume current market value for recovered metals and assume that metals will be marketed by the vendor.

4.8.9 Ownership

- In a base case, the facility would be privately owned and operated. The CSWM will provide land and a long term (up to 25 year) commitment to supply waste as feedstock for a tipping fee.
- Vendors are requested to comment on alternative procurement/ownership models and indicate and quantify any advantages that may be derived from alternate models.

5. QUESTIONNAIRE

Vendors are requested to provide the following information. Incomplete submissions may be excluded from the review and may not be used for the WTE assessment.

1. Technology

    a. Technology type (combustion, gasification, pyrolysis, RDF, other)

    b. Identify key components (pre-processing, combustion, energy recovery, air pollution control):
        i. Describe pre-processing, if required
        ii. Identify type of combustion or gasification technology and describe briefly
        iii. Indicate what energy is recovered and how (e.g. electricity through steam turbine generator, or methanol from syngas)
        iv. Identify utility requirements, such as natural gas, propane, electricity, water, sewer, etc.

    c. Identify proposed module size:
        i. Include rated capacity
        ii. Indicate flexibility to operate full time at above or below rated capacity (give %)
        iii. Provide approximate footprint and height

    d. Provide high-level mass balance, including:
        i. Tonnes of waste being fed (before any processing)
        ii. Additional inputs (e.g. chemicals, reagents, etc.)
        iii. Water consumption
        iv. Discharges solid (bottom ash, fly ash, metals recycled, etc.)
        v. Discharges liquid

    e. Provide high level energy balance, including:
        i. Waste energy input
        ii. Auxiliary energy input (e.g. natural gas, electricity)
        iii. Total energy generated
        iv. Internal energy consumption
        v. Net energy for sale

    f. Provide expected availability of the technology (e.g. number of hours the plant operates per year at capacity and how many hours is the plant down for scheduled maintenance, plus allowance for unscheduled maintenance).

2. Energy Recovery

    a. Indicate the type of energy recovered

    b. Provide the net energy for sale per tonne of waste received

    c. Provide the potential additional waste-heat energy available per tonne of waste received

d. In the case of RDF/fuel preparation, identify potential markets and the energy amount that would be sold as fuel

e. Identify any potential use or reuse opportunities for any residual generated

3. Environmental

    a. Greenhouse gas (GHG) emissions
        i. Provide the expected net GHG benefits of the process per tonne of waste processed. Also include any assumptions for deriving the benefits.

    b. Other emissions
        i. Confirm that regulatory emission levels can be consistently maintained
        ii. Provide estimate (and basis of that estimate) of what typical emissions will be of the following during normal operations in mg/Rm^3 (based on a temperature of 25°C and a pressure of 101.3 kilopascal, corrected to 11% oxygen and 0% moisture):
            1. Particulates (PM10 and PM2.5)
            2. Carbon monoxide
            3. NOx
            4. Sulfur dioxide
            5. Hydrogen chloride
            6. Lead
            7. Mercury
            8. Dioxins/Furans I-TEQ (International Toxic Equivalents)

    c. Residue
        i. Indicate the total residue to landfill from the process for each tonne of waste processed (in tonnes).
    d. Effluent
        i. Identify effluent (if any) with indication of volumes, characteristics, and hazard level.

4. Social

    a. Provide the size of facility approximately in m^2.

    b. Include the desired size of site in hectares.

    c. Provide the typical number of employees (full time equivalents), including:
        i. Management
        ii. Skilled trades
        iii. Unskilled
        iv. If possible, provide staffing plan from an existing, similar facility showing types of skills needed.

    d. Indicate any spinoff benefits from the facility. May include creation of local jobs (outside of the facility boundaries) or other spinoff businesses, activities, etc.

5. Capital costs

    a. Provide estimated capital costs for the size of facility proposed. Base costs on site specific estimates and/or cost experience from existing, similar facilities:
        i. Provide costs in CAD$, based on theoretical project construction in 2021 and an expected plant life of 25 years.
        ii. Include in costs: Design, fabrication, shipping allowance to Vancouver Island, construction and supervision, commissioning and start-up, trial operation, manuals and training of operators, initial emissions testing, one year of spare parts and 50% performance bond for 5 years.
        iii. Exclude: Taxes, site/land costs, grid tie-in, financing, legal, insurance, environmental and building permits.

6. Operating costs

    a. Provide an estimate of operating costs per tonne of waste processed. Please also provide an approximate breakdown of the operating cost into:
        i. Labour %
        ii. Fixed operating expenses %
        iii. Variable operating costs %
        iv. Spare parts %
        v. Other (define) %

7. Reference facilities

    a. Indicate maturity of technology by identifying how many plants there are world-wide and in North America using this technology.

    b. Provide information on three reference facilities utilizing the same or similar technology and as close to the proposed size as possible. Information should include:
        i. Name and location of the facility
        ii. Brief description of the facility
        iii. Capacity and type of feedstock
        iv. Years in continuous commercial operation
        v. Type of energy recovery
        vi. Manager and/or contact person with email and phone number

8. Additional Information

Please provide additional information to demonstrate the technology track record and/or performance, to supplement the estimated costs, to supplement the information requested above and/or to indicate interest in the potential project.

6. ACKNOWLEDGEMENT LETTER

The undersigned has received a CSWM Request for Information package regarding waste-to-energy technologies and has the intent to submit the requested information. Failure to return this form may result in no further communication regarding this Request for Information.

Company

Address

Contact name and title

Contact phone number

Contact email address

Fax number

Signature Date

The acknowledgement letter is to be signed and returned immediately to:

Nathalie Maurer, P.Eng.
Environmental Engineer
Morrison Hershfield
Email: nmaurer@morrisonhershfield.com
Ph: 604-454-0402
Fax: 604-454-0403

7. SUBMISSION FORM

Comox Strathcona Waste Management
Request-For-Information
Waste-to-Energy Technologies

Closing Date and Time: 4:00 p.m. PDT, Friday, July 14, 2017.

This form must be completed, signed and included with the submission.

The undersigned confirms that their submission is in response to the Request for information for Comox Strathcona Waste Management regarding Waste-to-Energy Technologies, and the Proponent acknowledges receipt of addenda # _____ through addenda #_____

_____
Company

_____
Address

_____
Contact name and title

_____
Contact phone number

_____
Contact email address

_____
Fax number

_____ _____
Signature Date

600 Comox Road, Courtenay, BC V9N 3P6
Tel: 250-334-6000 Fax: 250-334-4358
Toll free: 1-800-331-6007
www.comoxvalleyrd.ca

Comox Strathcona Waste Management

Addendum #1

RFI - Waste-to-Energy Technologies

Closing Date and Time: Friday July 14, 2017 at 4:00 PM PDT

This addendum is issued in response to questions received regarding the above request for information.

Q: Can you confirm, that process water such as condensate can be discharged to the available sewer system and no consideration must be given to an on-site treatment system?

A: Process water can be discharged into an existing sewer system if one exists in the area, or trucked to a WWTP (at the proponent's expense). However, any discharge to into a sewer system must meet local sewer discharge guidelines or standard, and treatment of process water (if required) would be the proponent's responsibility.

Q: The information provided with the RFI state that there is an existing centralized composting in the CVRD, but does not include handling of bio-solids.

Must biosolids and / or digestate be considered in this RFI or are other solutions in place?

A: Proponents should assume that biosolids and digestate are not included in the feedstock. However, we welcome proponents to include information on ability of a technology to deal with biosolids and/or digestate as part of Additional Information.

Please confirm receipt of this addendum by return email to Nathalie Maurer, via email: nmaurer@morrisonhershfield.com. The receipt of the addendum should also be acknowledged in the RFI Submission Form.

600 Comox Road, Courtenay, BC V9N 3P6
Tel: 250-334-6000 Fax: 250-334-4358
Toll free: 1-800-331-6007
www.comoxvalleyrd.ca

Comox Strathcona Waste Management

Addendum #2

RFI - Waste-to-Energy Technologies

Closing Date and Time: Friday July 14, 2017 at 4:00 PM PDT

This addendum is issued in order to clarify the confidentiality of vendors' submissions.

Vendors are encouraged to submit as much information as possible to enable the review of their technology and proposed solution. It is recognized that this may require the inclusion of confidential information about technology performance or price. The CVRD is prepared to honour and keep confidential any sensitive information submitted, provided it is clearly marked in the RFI which information is to be kept confidential, so that there is no confusion on the part of the CVRD or Morrison Hershfield as to what can be included in the summary report/made public, and what cannot be included. Morrison Hershfield and the CVRD reserve the right to use sensitive information for their review along with drawing general conclusions from it, which will later be part of the public report on the technologies.

Please confirm receipt of this addendum by return email to Nathalie Maurer, via email: nmaurer@morrisonhershfield.com. The receipt of the addendum should also be acknowledged in the RFI Submission Form.

APPENDIX 2:
SUMMARY SCORING

APPENDIX 2: Detailed Evaluation Spreadsheet for Evaluation of Vendors - Summary Scoring

WTE Technologies

Evaluation Area	Allocated Weighting (%)	EWS	REDWAVE	SALT	Sustane	Wasteaway	WTT
Innovation	**25**	3.00	2.67	1.33	2.67	2.00	2.67
Technology	**25**	2.50	2.33	2.17	1.83	2.17	2.50
Environmental	**25**	2.50	2.50	2.00	2.75	2.50	2.50
Economics/Affordability	**25**	1.67	2.00	1.00	2.00	2.33	2.33
Submission completeness	**0**	3.00	2.00	1.00	2.00	2.00	2.00
	100	**2.42**	**2.38**	**1.63**	**2.31**	**2.25**	**2.50**

Ranking		
WTT	2.5	83%
EWS	2.4	81%
REDWAVE	2.4	79%
Sustane	2.3	77%
Wasteaway	2.3	75%
SALT	1.6	54%

APPENDIX B: Long-Term Cost Model

Table B1: Long Term Cost Model for Option 0 - Status Quo

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Campbell River TS	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes		tonnes
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443		26,149	36,652
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177		26,330	36,967
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113		25,521	36,007
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068		25,696	36,435
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003		25,864	36,856
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936		26,031	37,276
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819		21,152	30,446
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712		21,276	30,787
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	Landfill closure	21,401	31,131
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	21,521		52,995
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	21,640		53,456
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	21,754		53,911
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	21,862		54,357
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	21,967		54,798
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	22,069		55,231
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	22,166		55,655
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	22,259		56,069
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	22,349		56,476
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	22,435		56,878
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	22,513		57,259
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	22,588		57,632
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	22,661		58,003
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	22,730		58,363
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	22,795		58,713
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	22,857		59,056
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	22,917		59,394
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	22,977		59,728
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	23,091		60,210
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	23,207		60,697
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	23,323		61,188
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	23,440		61,683
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	23,557		62,183
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	23,675		62,687
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	23,793		63,195
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	23,912		63,708
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	24,031		64,226
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	24,152		64,748
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	24,272		65,274
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	24,394		65,806
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	24,516		66,342
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	24,638		66,883
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	24,761		67,428
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	24,885		67,979
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	25,010		68,534
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	25,135		69,095
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	25,260		69,660
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	25,387		70,230
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	25,514		70,805
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,641		71,386
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	25,769		71,972
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	25,898		72,562
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	26,028		73,159
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	26,158		73,760
	Totals	4,336,251	1,950,808	2,680,786	1,208,445	3,159,253		5,544,695	1,041,504	166,941	2,992,312

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 tonnes per person per year (46% diversion)
CVRD disposal rate 2017-2020= 0.55 tonnes per person per year (48% diversion)
CVRD disposal rate 2021-2067= 0.44 tonnes per person per year (58% diversion)
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 tonnes per person per year (46% diversion)
SRD disposal rate 2017-2020= 0.55 tonnes per person per year (48% diversion)
SRD disposal rate 2021-2067= 0.44 tonnes per person per year (58% diversion)

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

In-situ MSW waste density = 0.7 tonnes per m³
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³			
	2015	52,360	17,453	1,047	1,047	69,813				
	2016	52,810	17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	43,494	14,498	870	870	57,992	337,181	Cell 1	Cell 1	
5	2022	43,981	14,660	880	880	58,641	395,822	Cell 1	Cell 1	
6	2023	44,473	14,824	889	889	59,298	455,120	Cell 1	Cell 1	
7	2024	75,708	25,236	1,514	1,514	100,944	556,064	Cell 2	Cell 1	**517,470**
8	2025	76,366	25,455	1,527	1,527	101,821	657,885	Cell 2	Cell 2	
9	2026	77,016	25,672	1,540	1,540	102,688	760,573	Cell 2	Cell 2	
10	2027	77,654	25,885	1,553	1,553	103,538	864,111	Cell 2	Cell 2	
11	2028	78,282	26,094	1,566	1,566	104,377	968,488	Cell 2	Cell 2	
12	2029	78,902	26,301	1,578	1,578	105,203	1,073,690	Cell 2	Cell 2	
13	2030	79,507	26,502	1,590	1,590	106,009	1,179,700	Cell 2	Cell 2	
14	2031	80,099	26,700	1,602	1,602	106,799	1,286,498	Cell 2	Cell 2	
15	2032	80,681	26,894	1,614	1,614	107,574	1,394,072	Cell 2	Cell 2	
16	2033	81,254	27,085	1,625	1,625	108,338	1,502,411	Cell 2	Cell 2	
17	2034	81,799	27,266	1,636	1,636	109,065	1,611,476	Cell 3	Cell 2	**1,563,942**
18	2035	82,332	27,444	1,647	1,647	109,776	1,721,251	Cell 3	Cell 3	
19	2036	82,862	27,621	1,657	1,657	110,483	1,831,734	Cell 3	Cell 3	
20	2037	83,376	27,792	1,668	1,668	111,168	1,942,902	Cell 3	Cell 3	
21	2038	83,876	27,959	1,678	1,678	111,835	2,054,736	Cell 3	Cell 3	
22	2039	84,366	28,122	1,687	1,687	112,488	2,167,224	Cell 3	Cell 3	
23	2040	84,848	28,283	1,697	1,697	113,131	2,280,355	Cell 3	Cell 3	
24	2041	85,325	28,442	1,707	1,707	113,767	2,394,122	Cell 3	Cell 3	
25	2042	86,014	28,671	1,720	1,720	114,686	2,508,808	Cell 3	Cell 3	
26	2043	86,710	28,903	1,734	1,734	115,613	2,624,421	Cell 4	Cell 3	**2,604,832**
27	2044	87,411	29,137	1,748	1,748	116,548	2,740,969	Cell 4	Cell 4	
28	2045	88,119	29,373	1,762	1,762	117,491	2,858,460	Cell 4	Cell 4	
29	2046	88,832	29,611	1,777	1,777	118,443	2,976,903	Cell 4	Cell 4	
30	2047	89,552	29,851	1,791	1,791	119,403	3,096,306	Cell 4	Cell 4	
31	2048	90,279	30,093	1,806	1,806	120,372	3,216,678	Cell 4	Cell 4	
32	2049	91,012	30,337	1,820	1,820	121,349	3,338,027	Cell 4	Cell 4	
33	2050	91,751	30,584	1,835	1,835	122,335	3,460,361	Cell 4	Cell 4	
34	2051	92,497	30,832	1,850	1,850	123,329	3,583,690	Cell 5a	Cell 4	**3,559,580**
35	2052	93,249	31,083	1,865	1,865	124,332	3,708,023	Cell 5a	Cell 5a	
36	2053	94,008	31,336	1,880	1,880	125,344	3,833,367	Cell 5a	Cell 5a	
37	2054	94,774	31,591	1,895	1,895	126,366	3,959,733	Cell 5a	Cell 5a	
38	2055	95,547	31,849	1,911	1,911	127,396	4,087,128	Cell 5a	Cell 5a	
39	2056	96,326	32,109	1,927	1,927	128,435	4,215,563	Cell 5a	Cell 5a	
40	2057	97,113	32,371	1,942	1,942	129,484	4,345,047	Cell 6	Cell 5a	**4,334,704**
41	2058	97,906	32,635	1,958	1,958	130,541	4,475,588	Cell 6	Cell 6	
42	2059	98,706	32,902	1,974	1,974	131,609	4,607,197	Cell 6	Cell 6	
43	2060	99,514	33,171	1,990	1,990	132,685	4,739,882	Cell 6	Cell 6	
44	2061	100,329	33,443	2,007	2,007	133,772	4,873,654	Cell 6	Cell 6	
45	2062	101,151	33,717	2,023	2,023	134,868	5,008,521	Cell 6	Cell 6	
46	2063	101,980	33,993	2,040	2,040	135,973	5,144,495	Cell 6	Cell 6	
47	2064	102,817	34,272	2,056	2,056	137,089	5,281,583	Cell 6 expa	Cell 6	**5,220,264**
48	2065	103,661	34,554	2,073	2,073	138,214	5,281,583	Cell 6 expa	Cell 6 expa	
49	2066	104,512	34,837	2,090	2,090	139,350	5,281,583	Cell 6 expa	Cell 6 expanded	
50	2067	105,372	35,124	2,107	2,107	140,495	5,281,583	Cell 6 expa	Cell 6 expanded	

In-situ MSW waste density = 0.7 tonnes per m³
Operational soil = 2% of waste volume per year
Waste to cover ratio = 3:1
Settlement = 2% of waste volume per year

Table B1: Long Term Cost Model for Option 0 - Status Quo

Capital and Operating Costs

Year		Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating & Post-Closure	Total System	Campbell River TS Notes	CVWMC LF Notes	CRWMC LF Notes
	2015											$0			
	2016				$16,000,000							$16,000,000	New Transfer station constructed 2012-2013	Construction of leachate management system and Cell 1	
0	2017					$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000		Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018					$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000		Closure Phase 2	Phase 2 Surface water management construction
2	2019					$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000			Phase 2 Design and construction
3	2020	$200,000				$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$4,176,000	New trailers every 8 years		Phase 2 LFG and final cover design
4	2021					$ 35,000		$1,166,495	$190,000	$5,630,329	$1,052,753	$8,075,000			Phase 2 LFG and final cover construction
5	2022					$ 550,000		$1,166,495	$190,000	$0	$1,052,753	$2,959,000			
6	2023					$ 585,000		$1,166,495	$190,000	$218,613	$1,052,753	$3,213,000			Phase 3 LFG and final cover design
7	2024		$651,040	$318,516	$8,850,000	$ -		$1,166,495	$390,000	$3,108,685	$190,000	$14,675,000		Construction Cell 2	Phase 3 LFG and final cover construction
8	2025		$651,040	$320,269		$ 175,000		$1,291,495	$190,000		$190,000	$2,818,000			
9	2026		$651,040	$321,962		$ -	$ 1,350,000	$1,291,495	$190,000		$190,000	$3,994,000		Closure Cell 1	
10	2027		$651,040	$323,556		$ 585,000		$1,291,495	$190,000		$190,000	$3,231,000			
11	2028	$200,000	$651,040	$325,105		$ 200,000		$1,291,495	$190,000		$190,000	$3,048,000	New trailers every 8 years		
12	2029		$651,040	$326,614		$ 385,000		$1,291,495	$390,000		$190,000	$3,234,000			
13	2030		$651,040	$328,051		$ 1,075,000		$1,291,495	$190,000		$190,000	$3,726,000			
14	2031		$651,040	$329,436		$ -		$1,291,495	$190,000		$190,000	$2,652,000			
15	2032	$346,000	$651,040	$330,761		$ 550,000		$1,291,495	$190,000		$190,000	$3,549,000	Transfer station - parking and roads (20 yr life) + capital upgrades		
16	2033		$651,040	$332,041		$ 235,000		$1,291,495	$190,000		$190,000	$2,890,000			
17	2034		$651,040	$333,189	$7,800,000	$ -		$1,291,495	$390,000		$190,000	$10,656,000		Construction Cell 3	
18	2035		$651,040	$334,298		$ 560,000		$1,416,495	$190,000		$190,000	$3,342,000			
19	2036	$200,000	$651,040	$335,388		$ -	$ 2,850,000	$1,416,495	$190,000		$190,000	$5,833,000	New trailers every 8 years	Closure Cell 2	
20	2037		$651,040	$336,405		$ 550,000		$1,416,495	$190,000		$190,000	$3,334,000			
21	2038		$651,040	$337,363		$ 200,000		$1,416,495	$190,000		$190,000	$2,985,000			
22	2039		$651,040	$338,281		$ 35,000		$1,416,495	$390,000		$190,000	$3,021,000			
23	2040		$651,040	$339,167		$ 1,075,000		$1,416,495	$190,000		$190,000	$3,862,000			
24	2041		$651,040	$340,053		$ 385,000		$1,416,495	$190,000		$190,000	$3,173,000			
25	2042		$651,040	$341,753		$ 550,000		$1,416,495	$190,000		$190,000	$3,339,000			
26	2043		$651,040	$343,462	$5,440,000	$ 200,000		$1,416,495	$190,000		$190,000	$8,431,000		Construction Cell 4	
27	2044	$200,000	$651,040	$345,180		$ -		$1,416,495	$390,000		$190,000	$3,193,000	New trailers every 8 years		
28	2045		$651,040	$346,905		$ 210,000	$ 3,010,000	$1,416,495	$190,000		$190,000	$6,014,000		Closure Cell 3	
29	2046		$651,040	$348,640		$ -		$1,416,495	$190,000		$190,000	$2,796,000			
30	2047		$651,040	$350,383		$ 935,000		$1,416,495	$190,000		$190,000	$3,733,000			
31	2048		$651,040	$352,135		$ 200,000		$1,416,495	$190,000		$190,000	$3,000,000			
32	2049		$651,040	$353,896		$ -		$1,416,495	$390,000		$190,000	$3,001,000			
33	2050		$651,040	$355,665		$ 1,075,000		$1,416,495	$190,000		$190,000	$3,878,000			
34	2051	$241,000	$651,040	$357,444	$4,450,000	$ 35,000		$1,416,495	$190,000		$190,000	$7,531,000	Transfer station permits etc	Construction Cell 5a	
35	2052	$2,615,000	$651,040	$359,231		$ 550,000		$1,416,495	$190,000		$190,000	$5,972,000	Transfer station - new facility + new trailers		
36	2053		$651,040	$361,027		$ 585,000	$ 2,530,000	$1,416,495	$190,000		$190,000	$5,924,000		Closure Cell 4	
37	2054		$651,040	$362,832		$ -		$1,416,495	$390,000		$190,000	$3,010,000			
38	2055		$651,040	$364,646		$ 175,000		$1,416,495	$190,000		$190,000	$2,987,000			
39	2056		$651,040	$366,469		$ -		$1,416,495	$190,000		$190,000	$2,814,000			
40	2057		$651,040	$368,302	$5,330,000	$ 585,000		$1,416,495	$190,000		$190,000	$8,731,000		Construction Cell 6	
41	2058		$651,040	$370,143		$ 200,000		$1,416,495	$190,000		$190,000	$3,018,000			
42	2059		$651,040	$371,994		$ 385,000	$ 4,400,000	$1,416,495	$390,000		$190,000	$7,805,000		Closure Cell 5a	
43	2060	$200,000	$651,040	$373,854		$ 1,075,000		$1,416,495	$190,000		$190,000	$4,096,000	New trailers every 8 years		
44	2061		$651,040	$375,723		$ -		$1,416,495	$190,000		$190,000	$2,823,000			
45	2062		$651,040	$377,602		$ 550,000		$1,416,495	$190,000		$190,000	$3,375,000			
46	2063		$651,040	$379,490		$ 235,000		$1,416,495	$190,000		$190,000	$3,062,000			
47	2064		$651,040	$381,387	$424,134	$ -		$1,416,495	$390,000		$190,000	$3,453,000		Cell 6 expansion	
48	2065		$651,040	$383,294		$ 560,000		$1,416,495	$190,000		$190,000	$3,391,000			
49	2066		$651,040	$385,211		$ -		$1,416,495	$190,000		$190,000	$2,833,000			
50	2067		$651,040	$387,137		$ 550,000		$1,416,495	$190,000		$190,000	$3,385,000			
Totals		$4,202,000	$28,645,760	$15,414,260	$32,294,134	$17,970,000	$16,905,000	$68,991,258	$11,310,000	$10,382,338	$15,729,269	$221,847,000			

30 years
$137,758,000 1,792,501 tonnes
$77 per tonne over 30 years

40 years
$184,606,000 2,448,090 tonnes
$75 per tonne over 40 years

50 years
$221,847,000 3,159,253 tonnes
$70 per tonne over 50 years

Table B2: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819			29,278	83	21,152	1,168	9,808
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712			29,606	84	21,276	1,181	9,918
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614		Landfill closure	29,937	85	21,401	1,194	10,029
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507		21,521	50,963	145		2,032	17,073
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398		21,640	50,963	145		2,493	17,073
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281		21,754	50,963	145		2,948	17,073
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152		21,862	50,963	145		3,394	17,073
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014		21,967	50,963	145		3,835	17,073
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864		22,069	50,963	145		4,268	17,073
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697		22,166	50,963	145		4,692	17,073
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514		22,259	50,963	145		5,106	17,073
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320		22,349	50,963	145		5,513	17,073
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116		22,435	50,963	145		5,915	17,073
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879		22,513	50,963	145		6,296	17,073
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627		22,588	50,963	145		6,669	17,073
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371		22,661	50,963	145		7,040	17,073
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096		22,730	50,963	145		7,400	17,073
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805		22,795	50,963	145		7,750	17,073
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500		22,857	50,963	145		8,093	17,073
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187		22,917	50,963	145		8,431	17,073
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865		22,977	50,963	145		8,765	17,073
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808		23,091	50,963	145		9,247	17,073
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761		23,207	50,963	145		9,734	17,073
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723		23,323	50,963	145		10,225	17,073
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693		23,440	50,963	145		10,720	17,073
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673		23,557	50,963	145		11,220	17,073
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662		23,675	50,963	145		11,724	17,073
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660		23,793	50,963	145		12,232	17,073
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668		23,912	50,963	145		12,745	17,073
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,686		24,031	50,963	145		13,263	17,073
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712		24,152	50,963	145		13,785	17,073
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748		24,272	50,963	145		14,311	17,073
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794		24,394	50,963	145		14,843	17,073
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850		24,516	50,963	145		15,379	17,073
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916		24,638	50,963	145		15,920	17,073
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992		24,761	50,963	145		16,465	17,073
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078		24,885	50,963	145		17,016	17,073
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174		25,010	50,963	145		17,571	17,073
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281		25,135	50,963	145		18,132	17,073
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398		25,260	50,963	145		18,697	17,073
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526		25,387	50,963	145		19,267	17,073
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664		25,514	50,963	145		19,842	17,073
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813		25,641	50,963	145		20,423	17,073
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973		25,769	50,963	145		21,009	17,073
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144		25,898	50,963	145		21,599	17,073
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326		26,028	50,963	145		22,196	17,073
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519		26,158	50,963	145		22,797	17,073
Totals		4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	0	1,041,504	2,331,193			734,738	780,950

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,668	14,012	556	33	33	16,236	295,425	Cell 1	Cell 1	
5	2022	1,687	14,169	562	34	34	16,418	311,843	Cell 1	Cell 1	
6	2023	1,706	14,327	569	34	34	16,602	328,444	Cell 1	Cell 1	
7	2024	2,903	24,389	968	58	58	28,261	356,705	Cell 1	Cell 1	
8	2025	3,562	24,389	1,187	71	71	29,138	385,843	Cell 1	Cell 1	
9	2026	4,212	24,389	1,404	84	84	30,005	415,849	Cell 1	Cell 1	
10	2027	4,849	24,389	1,616	97	97	30,855	446,704	Cell 1	Cell 1	
11	2028	5,478	24,389	1,826	110	110	31,694	478,397	Cell 1	Cell 1	
12	2029	6,098	24,389	2,033	122	122	32,520	510,917	Cell 1	Cell 1	
13	2030	6,703	24,389	2,234	134	134	33,326	544,243	Cell 2	Cell 1	**517,470**
14	2031	7,295	24,389	2,432	146	146	34,116	578,359	Cell 2	Cell 2	
15	2032	7,876	24,389	2,625	158	158	34,891	613,250	Cell 2	Cell 2	
16	2033	8,449	24,389	2,816	169	169	35,655	648,906	Cell 2	Cell 2	
17	2034	8,994	24,389	2,998	180	180	36,382	685,287	Cell 2	Cell 2	
18	2035	9,528	24,389	3,176	191	191	37,093	722,380	Cell 2	Cell 2	
19	2036	10,058	24,389	3,353	201	201	37,800	760,180	Cell 2	Cell 2	
20	2037	10,571	24,389	3,524	211	211	38,485	798,665	Cell 2	Cell 2	
21	2038	11,072	24,389	3,691	221	221	39,152	837,816	Cell 2	Cell 2	
22	2039	11,561	24,389	3,854	231	231	39,805	877,621	Cell 2	Cell 2	
23	2040	12,044	24,389	4,015	241	241	40,448	918,069	Cell 2	Cell 2	
24	2041	12,521	24,389	4,174	250	250	41,084	959,153	Cell 2	Cell 2	
25	2042	13,210	24,389	4,403	264	264	42,003	1,001,156	Cell 2	Cell 2	
26	2043	13,905	24,389	4,635	278	278	42,930	1,044,086	Cell 2	Cell 2	
27	2044	14,607	24,389	4,869	292	292	43,865	1,087,951	Cell 2	Cell 2	
28	2045	15,314	24,389	5,105	306	306	44,808	1,132,760	Cell 2	Cell 2	
29	2046	16,028	24,389	5,343	321	321	45,760	1,178,520	Cell 2	Cell 2	
30	2047	16,748	24,389	5,583	335	335	46,720	1,225,240	Cell 2	Cell 2	
31	2048	17,474	24,389	5,825	349	349	47,689	1,272,929	Cell 2	Cell 2	
32	2049	18,207	24,389	6,069	364	364	48,666	1,321,594	Cell 2	Cell 2	
33	2050	18,947	24,389	6,316	379	379	49,652	1,371,246	Cell 2	Cell 2	
34	2051	19,692	24,389	6,564	394	394	50,647	1,421,892	Cell 2	Cell 2	
35	2052	20,445	24,389	6,815	409	409	51,649	1,473,541	Cell 2	Cell 2	
36	2053	21,204	24,389	7,068	424	424	52,661	1,526,203	Cell 2	Cell 2	
37	2054	21,970	24,389	7,323	439	439	53,683	1,579,885	Cell 3	Cell 2	**1,563,942**
38	2055	22,743	24,389	7,581	455	455	54,713	1,634,598	Cell 3	Cell 3	
39	2056	23,522	24,389	7,841	470	470	55,752	1,690,350	Cell 3	Cell 3	
40	2057	24,308	24,389	8,103	486	486	56,801	1,747,151	Cell 3	Cell 3	
41	2058	25,102	24,389	8,367	502	502	57,858	1,805,009	Cell 3	Cell 3	
42	2059	25,902	24,389	8,634	518	518	58,926	1,863,935	Cell 3	Cell 3	
43	2060	26,710	24,389	8,903	534	534	60,002	1,923,938	Cell 3	Cell 3	
44	2061	27,524	24,389	9,175	550	550	61,089	1,985,026	Cell 3	Cell 3	
45	2062	28,346	24,389	9,449	567	567	62,185	2,047,211	Cell 3	Cell 3	
46	2063	29,176	24,389	9,725	584	584	63,296	2,110,501	Cell 3	Cell 3	
47	2064	30,012	24,389	10,004	600	600	64,406	2,174,907	Cell 3	Cell 3	
48	2065	30,856	24,389	10,285	617	617	65,531	2,240,438	Cell 3	Cell 3	
49	2066	31,708	24,389	10,569	634	634	66,667	2,307,105	Cell 3	Cell 3	
50	2067	32,567	24,389	10,856	651	651	67,812	2,374,917	Cell 3	Cell 3	

CVRD growth rate beyond 2041 =	*1%*	
CVRD disposal rate 2015-2016=	*0.57*	*tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020=	*0.55*	*tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067=	*0.44*	*tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 =	*0.50%*	
SRD disposal rate 2015-2016=	*0.57*	*tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020=	*0.55*	*tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067=	*0.44*	*tonnes per person per year (58% diversion)*
Days of operation =	351	*days per year*
Bottom ash/residuals to landfill =	34%	*% of input*

In-situ MSW waste density =	*0.7*	*tonnes per m³*
Operational soil =	*2%*	*of waste volume per year*
Waste to cover ratio =	*3:1*	
Settlement =	*2%*	*of waste volume per year*

In-situ ash / residuals waste density =	*0.7*	*tonnes per m³*
In-situ MSW waste density =	*0.7*	*tonnes per m³*
Operational soil =	*2%*	*of waste volume per year*
Waste to cover ratio =	*3:1*	
Settlement =	*2%*	*of waste volume per year*

Table B2: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley

Capital and Operating Costs

	Year	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0				
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000			Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000			Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000				Phase 2 Design and construction
3	2020	$200,000			$882,279		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$5,058,000	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021				$5,081,326		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$12,590,000		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022				$5,118,312		$ -		$600,124	$190,000	$0	$1,052,753	$6,961,000				
6	2023				$5,155,682		$ 35,000		$600,124	$190,000	$218,613	$1,052,753	$7,252,000				Phase 3 LFG and final cover design
7	2024		$651,040	$318,516	$7,527,393		$ -		$600,124	$390,000	$3,108,685	$190,000	$12,786,000				Phase 3 LFG and final cover construction
8	2025		$651,040	$320,269	$7,527,393		$ -		$600,124	$190,000		$190,000	$9,479,000				
9	2026		$651,040	$321,962	$7,527,393		$ -		$600,124	$190,000		$190,000	$9,481,000				
10	2027		$651,040	$323,556	$7,527,393		$ 585,000		$600,124	$190,000		$190,000	$10,067,000				
11	2028	$200,000	$651,040	$325,105	$7,527,393		$ -		$600,124	$190,000		$190,000	$9,684,000	New trailers every 8 years			
12	2029		$651,040	$326,614	$7,527,393		$ 385,000		$600,124	$390,000		$190,000	$10,070,000				
13	2030		$651,040	$328,051	$7,527,393	$8,850,000	$ 175,000		$600,124	$190,000		$190,000	$18,512,000			Construction Cell 2	
14	2031		$651,040	$329,436	$7,527,393		$ -		$725,124	$190,000		$190,000	$9,613,000				
15	2032	$346,000	$651,040	$330,761	$7,527,393		$ -	$ 1,350,000	$725,124	$190,000		$190,000	$11,310,000	Transfer station - parking and roads (20 yr life) + capital upgrades		Closure Cell 1	
16	2033		$651,040	$332,041	$7,527,393		$ 235,000		$725,124	$190,000		$190,000	$9,851,000				
17	2034		$651,040	$333,189	$7,527,393		$ -		$725,124	$390,000		$190,000	$9,817,000				
18	2035		$651,040	$334,298	$7,527,393		$ 935,000		$725,124	$190,000		$190,000	$10,553,000				
19	2036	$200,000	$651,040	$335,388	$7,527,393		$ -		$725,124	$190,000		$190,000	$9,819,000	New trailers every 8 years			
20	2037		$651,040	$336,405	$7,527,393		$ 550,000		$725,124	$190,000		$190,000	$10,170,000				
21	2038		$651,040	$337,363	$7,527,393		$ -		$725,124	$190,000		$190,000	$9,621,000				
22	2039		$651,040	$338,281	$7,527,393		$ 35,000		$725,124	$390,000		$190,000	$9,857,000				
23	2040		$651,040	$339,167	$7,527,393		$ 175,000		$725,124	$190,000		$190,000	$9,798,000				
24	2041		$651,040	$340,053	$7,527,393		$ 385,000		$725,124	$190,000		$190,000	$10,009,000				
25	2042		$651,040	$341,753	$7,527,393		$ -		$725,124	$190,000		$190,000	$9,625,000				
26	2043		$651,040	$343,462	$7,527,393		$ 200,000		$725,124	$190,000		$190,000	$9,827,000				
27	2044	$200,000	$651,040	$345,180	$7,527,393		$ -		$725,124	$390,000		$190,000	$10,029,000	New trailers every 8 years			
28	2045		$651,040	$346,905	$7,527,393		$ 35,000		$725,124	$190,000		$190,000	$9,665,000				
29	2046		$651,040	$348,640	$5,748,626		$ -		$725,124	$190,000		$190,000	$7,853,000		Amotization period over		
30	2047		$651,040	$350,383	$5,748,626		$ 585,000		$725,124	$190,000		$190,000	$8,440,000				
31	2048		$651,040	$352,135	$5,748,626		$ -		$725,124	$190,000		$190,000	$7,857,000				
32	2049		$651,040	$353,896	$5,748,626		$ -		$725,124	$390,000		$190,000	$8,059,000				
33	2050		$651,040	$355,665	$5,748,626		$ 1,075,000		$725,124	$190,000		$190,000	$8,935,000				
34	2051	$241,000	$651,040	$357,444	$5,748,626		$ 35,000		$725,124	$190,000		$190,000	$8,138,000	Transfer station permits etc			
35	2052	$2,615,000	$651,040	$359,231	$5,748,626		$ -		$725,124	$190,000		$190,000	$10,479,000	Transfer station - new facility + new trailers			
36	2053		$651,040	$361,027	$5,748,626		$ 585,000		$725,124	$190,000		$190,000	$8,451,000				
37	2054		$651,040	$362,832	$5,748,626	$7,800,000	$ -		$725,124	$390,000		$190,000	$15,868,000			Construction Cell 3	
38	2055		$651,040	$364,646	$5,748,626		$ -		$850,124	$190,000		$190,000	$7,994,000				
39	2056		$651,040	$366,469	$5,748,626		$ -	$ 2,850,000	$850,124	$190,000		$190,000	$10,846,000			Closure Cell 2	
40	2057		$651,040	$368,302	$5,748,626		$ 585,000		$850,124	$190,000		$190,000	$8,583,000				
41	2058		$651,040	$370,143	$5,748,626		$ -		$850,124	$190,000		$190,000	$8,000,000				
42	2059		$651,040	$371,994	$5,748,626		$ 35,000		$850,124	$390,000		$190,000	$8,237,000				
43	2060	$200,000	$651,040	$373,854	$5,748,626		$ 175,000		$850,124	$190,000		$190,000	$8,379,000	New trailers every 8 years			
44	2061		$651,040	$375,723	$5,748,626		$ -		$850,124	$190,000		$190,000	$8,006,000				
45	2062		$651,040	$377,602	$5,748,626		$ -		$850,124	$190,000		$190,000	$8,007,000				
46	2063		$651,040	$379,490	$5,748,626		$ 235,000		$850,124	$190,000		$190,000	$8,244,000				
47	2064		$651,040	$381,387	$5,748,626		$ -		$850,124	$390,000		$190,000	$8,211,000				
48	2065		$651,040	$383,294	$5,748,626		$ 1,285,000		$850,124	$190,000		$190,000	$9,298,000				
49	2066		$651,040	$385,211	$5,748,626		$ -		$850,124	$190,000		$190,000	$8,015,000				
50	2067		$651,040	$387,137	$5,748,626		$ 550,000		$850,124	$190,000		$190,000	$8,567,000				
Totals		**$4,202,000**	**$28,645,760**	**$15,414,260**	**$308,310,015**	**$16,650,000**	**$11,045,000**	**$6,965,000**	**$39,121,800**	**$11,310,000**	**$10,382,338**	**$15,729,269**	**$467,777,000**				

WTT Facility Tipping Fee (operating cost & revenue) = *$113* per tonne
Capital cost annual payment = *$1,778,766* per year

30 years
$289,603,000 1,792,501 tonnes
$162 per tonne over 30 years

40 years
$384,813,000 2,448,090 tonnes
$157 per tonne over 40 years

50 years
$467,777,000 3,159,253 tonnes
$148 per tonne over 50 years

Table B3: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,278		29,278	83	21,152	1,168	9,808
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,606		29,606	84	21,276	1,181	9,918
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,937	Landfill closure	29,937	85	21,401	1,194	10,029
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,441		50,963	145		2,033	17,072
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,323		50,963	145		2,493	17,072
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	29,209		50,963	145		2,949	17,072
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	29,101		50,963	145		3,395	17,072
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	28,996		50,963	145		3,835	17,072
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	28,894		50,963	145		4,269	17,072
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	28,797		50,963	145		4,692	17,072
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	28,704		50,963	145		5,107	17,072
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	28,614		50,963	145		5,514	17,072
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	28,527		50,963	145		5,915	17,072
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	28,450		50,963	145		6,296	17,072
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	28,375		50,963	145		6,670	17,072
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	28,301		50,963	145		7,041	17,072
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	28,233		50,963	145		7,400	17,072
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	28,168		50,963	145		7,751	17,072
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	28,106		50,963	145		8,093	17,072
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	28,046		50,963	145		8,431	17,072
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	27,986		50,963	145		8,765	17,072
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	27,871		50,963	145		9,247	17,072
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	27,756		50,963	145		9,734	17,072
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	27,640		50,963	145		10,225	17,072
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	27,523		50,963	145		10,720	17,072
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	27,406		50,963	145		11,220	17,072
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	27,288		50,963	145		11,724	17,072
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	27,170		50,963	145		12,232	17,072
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	27,051		50,963	145		12,745	17,072
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	26,931		50,963	145		13,263	17,072
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	26,811		50,963	145		13,785	17,072
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	26,690		50,963	145		14,312	17,072
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	26,569		50,963	145		14,843	17,072
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	26,447		50,963	145		15,379	17,072
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	26,324		50,963	145		15,920	17,072
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	26,201		50,963	145		16,466	17,072
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	26,077		50,963	145		17,016	17,072
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	25,953		50,963	145		17,572	17,072
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	25,828		50,963	145		18,132	17,072
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	25,702		50,963	145		18,697	17,072
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	25,576		50,963	145		19,267	17,072
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	25,449		50,963	145		19,843	17,072
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,321		50,963	145		20,423	17,072
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	25,193		50,963	145		21,009	17,072
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	25,064		50,963	145		21,600	17,072
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	24,935		50,963	145		22,196	17,072
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	24,805		50,963	145		22,797	17,072
	Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,289,675	0	2,331,179		219,420	734,752	780,945

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,668	14,012	556	33	33	16,236	295,425	Cell 1	Cell 1	
5	2022	1,687	14,169	562	34	34	16,418	311,843	Cell 1	Cell 1	
6	2023	1,706	14,327	569	34	34	16,602	328,444	Cell 1	Cell 1	
7	2024	2,904	24,389	968	58	58	28,261	356,705	Cell 1	Cell 1	
8	2025	3,562	24,389	1,187	71	71	29,139	385,844	Cell 1	Cell 1	
9	2026	4,212	24,389	1,404	84	84	30,006	415,850	Cell 1	Cell 1	
10	2027	4,850	24,389	1,617	97	97	30,856	446,705	Cell 1	Cell 1	
11	2028	5,479	24,389	1,826	110	110	31,694	478,400	Cell 1	Cell 1	
12	2029	6,098	24,389	2,033	122	122	32,520	510,920	Cell 1	Cell 1	
13	2030	6,703	24,389	2,234	134	134	33,327	544,246	Cell 2	Cell 1	**517,470**
14	2031	7,295	24,389	2,432	146	146	34,116	578,363	Cell 2	Cell 2	
15	2032	7,877	24,389	2,626	158	158	34,892	613,254	Cell 2	Cell 2	
16	2033	8,450	24,389	2,817	169	169	35,656	648,910	Cell 2	Cell 2	
17	2034	8,995	24,389	2,998	180	180	36,382	685,292	Cell 2	Cell 2	
18	2035	9,528	24,389	3,176	191	191	37,093	722,386	Cell 2	Cell 2	
19	2036	10,058	24,389	3,353	201	201	37,800	760,186	Cell 2	Cell 2	
20	2037	10,572	24,389	3,524	211	211	38,485	798,671	Cell 2	Cell 2	
21	2038	11,072	24,389	3,691	221	221	39,152	837,823	Cell 2	Cell 2	
22	2039	11,562	24,389	3,854	231	231	39,805	877,628	Cell 2	Cell 2	
23	2040	12,045	24,389	4,015	241	241	40,449	918,077	Cell 2	Cell 2	
24	2041	12,521	24,389	4,174	250	250	41,085	959,161	Cell 2	Cell 2	
25	2042	13,211	24,389	4,404	264	264	42,003	1,001,165	Cell 2	Cell 2	
26	2043	13,906	24,389	4,635	278	278	42,930	1,044,095	Cell 2	Cell 2	
27	2044	14,607	24,389	4,869	292	292	43,865	1,087,961	Cell 2	Cell 2	
28	2045	15,315	24,389	5,105	306	306	44,809	1,132,770	Cell 2	Cell 2	
29	2046	16,028	24,389	5,343	321	321	45,761	1,178,530	Cell 2	Cell 2	
30	2047	16,748	24,389	5,583	335	335	46,721	1,225,251	Cell 2	Cell 2	
31	2048	17,475	24,389	5,825	349	349	47,689	1,272,940	Cell 2	Cell 2	
32	2049	18,208	24,389	6,069	364	364	48,666	1,321,606	Cell 2	Cell 2	
33	2050	18,947	24,389	6,316	379	379	49,652	1,371,258	Cell 2	Cell 2	
34	2051	19,693	24,389	6,564	394	394	50,647	1,421,905	Cell 2	Cell 2	
35	2052	20,445	24,389	6,815	409	409	51,650	1,473,554	Cell 2	Cell 2	
36	2053	21,204	24,389	7,068	424	424	52,662	1,526,216	Cell 2	Cell 2	
37	2054	21,970	24,389	7,323	439	439	53,683	1,579,899	Cell 3	Cell 2	**1,563,942**
38	2055	22,743	24,389	7,581	455	455	54,713	1,634,613	Cell 3	Cell 3	
39	2056	23,522	24,389	7,841	470	470	55,753	1,690,365	Cell 3	Cell 3	
40	2057	24,309	24,389	8,103	486	486	56,801	1,747,166	Cell 3	Cell 3	
41	2058	25,102	24,389	8,367	502	502	57,859	1,805,025	Cell 3	Cell 3	
42	2059	25,903	24,389	8,634	518	518	58,926	1,863,951	Cell 3	Cell 3	
43	2060	26,710	24,389	8,903	534	534	60,003	1,923,954	Cell 3	Cell 3	
44	2061	27,525	24,389	9,175	550	550	61,089	1,985,043	Cell 3	Cell 3	
45	2062	28,347	24,389	9,449	567	567	62,185	2,047,228	Cell 3	Cell 3	
46	2063	29,176	24,389	9,725	584	584	63,291	2,110,519	Cell 3	Cell 3	
47	2064	30,013	24,389	10,004	600	600	64,406	2,174,925	Cell 3	Cell 3	
48	2065	30,857	24,389	10,286	617	617	65,532	2,240,457	Cell 3	Cell 3	
49	2066	31,708	24,389	10,569	634	634	66,667	2,307,124	Cell 3	Cell 3	
50	2067	32,568	24,389	10,856	651	651	67,813	2,374,937	Cell 3	Cell 3	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 33.5% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 0.7 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B3: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0		New Transfer station constructed 2012-2013			
	2016						$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$691,115		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$4,978,000	Permits		Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$433,315	$145,160	$5,081,326		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$17,188,000	New transfer station		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$438,167	$146,786	$5,118,312		$ -		$600,124	$190,000	$0	$1,052,753	$8,256,000					
6	2023		$709,508	$443,070	$148,429	$5,155,682		$ 35,000		$600,124	$190,000	$218,613	$1,052,753	$8,553,000					Phase 3 LFG and final cover design
7	2024		$709,508	$435,731	$252,673	$7,527,357		$ -		$600,124	$390,000	$3,108,685	$190,000	$13,214,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$433,979	$252,673	$7,527,357		$ -		$600,124	$190,000		$190,000	$9,904,000					
9	2026		$709,508	$432,286	$252,673	$7,527,357		$ -		$600,124	$190,000		$190,000	$9,902,000					
10	2027		$709,508	$430,692	$252,673	$7,527,357		$ 585,000		$600,124	$190,000		$190,000	$10,485,000					
11	2028		$709,508	$429,143	$252,673	$7,527,357		$ -		$600,124	$190,000		$190,000	$9,899,000					
12	2029	$200,000	$709,508	$427,634	$252,673	$7,527,357		$ 385,000		$600,124	$390,000		$190,000	$10,682,000	New trailers every 8 years				
13	2030		$709,508	$426,197	$252,673	$7,527,357	$8,850,000	$ 175,000		$600,124	$190,000		$190,000	$18,921,000				Construction Cell 2	
14	2031		$709,508	$424,812	$252,673	$7,527,357		$ -		$725,124	$190,000		$190,000	$10,019,000					
15	2032		$709,508	$423,486	$252,673	$7,527,357		$ -	$ 1,350,000	$725,124	$190,000		$190,000	$11,368,000				Closure Cell 1	
16	2033		$709,508	$422,207	$252,673	$7,527,357		$ 235,000		$725,124	$190,000		$190,000	$10,252,000					
17	2034		$709,508	$421,059	$252,673	$7,527,357		$ -		$725,124	$390,000		$190,000	$10,216,000					
18	2035		$709,508	$419,950	$252,673	$7,527,357		$ 935,000		$725,124	$190,000		$190,000	$10,950,000					
19	2036		$709,508	$418,860	$252,673	$7,527,357		$ -		$725,124	$190,000		$190,000	$10,014,000					
20	2037	$200,000	$709,508	$417,843	$252,673	$7,527,357		$ 550,000		$725,124	$190,000		$190,000	$10,763,000	New trailers every 8 years				
21	2038		$709,508	$416,885	$252,673	$7,527,357		$ -		$725,124	$190,000		$190,000	$10,012,000					
22	2039		$709,508	$415,966	$252,673	$7,527,357		$ 35,000		$725,124	$390,000		$190,000	$10,246,000					
23	2040		$709,508	$415,080	$252,673	$7,527,357		$ 175,000		$725,124	$190,000		$190,000	$10,185,000					
24	2041	$1,555,125	$709,508	$414,195	$252,673	$7,527,357		$ 385,000		$725,124	$190,000		$190,000	$11,949,000	Major capital upgrade every 20 years				
25	2042		$709,508	$412,494	$252,673	$7,527,357		$ -		$725,124	$190,000		$190,000	$10,007,000					
26	2043		$709,508	$410,786	$252,673	$7,527,357		$ 200,000		$725,124	$190,000		$190,000	$10,205,000					
27	2044		$709,508	$409,068	$252,673	$7,527,357		$ -		$725,124	$390,000		$190,000	$10,204,000					
28	2045	$200,000	$709,508	$407,342	$252,673	$7,527,357		$ 35,000		$725,124	$190,000		$190,000	$10,237,000	New trailers every 8 years				
29	2046		$709,508	$405,608	$252,673	$5,748,591		$ -		$725,124	$190,000		$190,000	$8,222,000			Amotization period over		
30	2047		$709,508	$403,865	$252,673	$5,748,591		$ 585,000		$725,124	$190,000		$190,000	$8,805,000					
31	2048		$709,508	$402,113	$252,673	$5,748,591		$ -		$725,124	$190,000		$190,000	$8,218,000					
32	2049		$709,508	$400,352	$252,673	$5,748,591		$ -		$725,124	$390,000		$190,000	$8,416,000					
33	2050		$709,508	$398,583	$252,673	$5,748,591		$ 1,075,000		$725,124	$190,000		$190,000	$9,289,000					
34	2051		$709,508	$396,804	$252,673	$5,748,591		$ 35,000		$725,124	$190,000		$190,000	$8,248,000					
35	2052		$709,508	$395,017	$252,673	$5,748,591		$ -		$725,124	$190,000		$190,000	$8,211,000					
36	2053	$200,000	$709,508	$393,221	$252,673	$5,748,591		$ 585,000		$725,124	$190,000		$190,000	$8,994,000	New trailers every 8 years				
37	2054		$709,508	$391,416	$252,673	$5,748,591	$7,800,000	$ -		$725,124	$390,000		$190,000	$16,207,000				Construction Cell 3	
38	2055		$709,508	$389,602	$252,673	$5,748,591		$ -		$850,124	$190,000		$190,000	$8,330,000					
39	2056		$709,508	$387,778	$252,673	$5,748,591		$ -	$ 2,850,000	$850,124	$190,000		$190,000	$11,179,000				Closure Cell 2	
40	2057		$709,508	$385,946	$252,673	$5,748,591		$ 585,000		$850,124	$190,000		$190,000	$8,912,000					
41	2058		$709,508	$384,104	$252,673	$5,748,591		$ -		$850,124	$190,000		$190,000	$8,325,000					
42	2059		$709,508	$382,254	$252,673	$5,748,591		$ 35,000		$850,124	$390,000		$190,000	$8,558,000					
43	2060		$709,508	$380,394	$252,673	$5,748,591		$ 175,000		$850,124	$190,000		$190,000	$8,496,000					
44	2061	$1,755,125	$709,508	$378,525	$252,673	$5,748,591		$ -		$850,124	$190,000		$190,000	$10,075,000	Major capital upgrade every 20 years				
45	2062		$709,508	$376,646	$252,673	$5,748,591		$ -		$850,124	$190,000		$190,000	$8,318,000					
46	2063		$709,508	$374,758	$252,673	$5,748,591		$ 235,000		$850,124	$190,000		$190,000	$8,551,000					
47	2064		$709,508	$372,860	$252,673	$5,748,591		$ -		$850,124	$390,000		$190,000	$8,514,000					
48	2065		$709,508	$370,954	$252,673	$5,748,591		$ 1,285,000		$850,124	$190,000		$190,000	$9,597,000					
49	2066		$709,508	$369,037	$252,673	$5,748,591		$ -		$850,124	$190,000		$190,000	$8,310,000					
50	2067		$709,508	$367,111	$252,673	$5,748,591		$ 550,000		$850,124	$190,000		$190,000	$8,858,000					
	Totals	$7,731,275	$33,346,853	$19,087,194	$11,557,987	$308,117,294	$16,650,000	$11,045,000	$6,965,000	$39,121,800	$11,310,000	$10,382,338	$15,729,269	$491,048,000					

WTT Facility Tipping Fee (operating cost & revenue) = *$113* per tonne
Capital cost annual payment = *$1,778,766* per year

30 years
$307,442,000 1,792,501 tonnes
$172 per tonne over 30 years

40 years
$403,446,000 2,448,090 tonnes
$165 per tonne over 40 years

50 years
$491,048,000 3,159,253 tonnes
$155 per tonne over 50 years

Table B4: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes					tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,278		29,278	83	21,152	1,168	9,808
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,606		29,606	84	21,276	1,181	9,918
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,937	Landfill closure	29,937	85	21,401	1,194	10,029
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,441	21,521	50,963	145		2,033	17,072
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,323	21,640	50,963	145		2,493	17,072
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	29,209	21,754	50,963	145		2,949	17,072
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	29,101	21,862	50,963	145		3,395	17,072
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	28,996	21,967	50,963	145		3,835	17,072
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	28,894	22,069	50,963	145		4,269	17,072
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	28,797	22,166	50,963	145		4,692	17,072
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	28,704	22,259	50,963	145		5,107	17,072
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	28,614	22,349	50,963	145		5,514	17,072
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	28,527	22,435	50,963	145		5,915	17,072
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	28,450	22,513	50,963	145		6,296	17,072
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	28,375	22,588	50,963	145		6,670	17,072
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	28,301	22,661	50,963	145		7,041	17,072
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	28,233	22,730	50,963	145		7,400	17,072
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	28,168	22,795	50,963	145		7,751	17,072
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	28,106	22,857	50,963	145		8,093	17,072
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	28,046	22,917	50,963	145		8,431	17,072
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	27,986	22,977	50,963	145		8,765	17,072
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	27,871	23,091	50,963	145		9,247	17,072
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	27,756	23,207	50,963	145		9,734	17,072
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	27,640	23,323	50,963	145		10,225	17,072
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	27,523	23,440	50,963	145		10,720	17,072
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	27,406	23,557	50,963	145		11,220	17,072
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	27,288	23,675	50,963	145		11,724	17,072
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	27,170	23,793	50,963	145		12,232	17,072
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	27,051	23,912	50,963	145		12,745	17,072
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	26,931	24,031	50,963	145		13,263	17,072
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	26,811	24,152	50,963	145		13,785	17,072
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	26,690	24,272	50,963	145		14,312	17,072
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	26,569	24,394	50,963	145		14,843	17,072
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	26,447	24,516	50,963	145		15,378	17,072
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	26,324	24,638	50,963	145		15,920	17,072
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	26,201	24,761	50,963	145		16,466	17,072
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	26,077	24,885	50,963	145		17,016	17,072
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	25,953	25,010	50,963	145		17,572	17,072
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	25,828	25,135	50,963	145		18,132	17,072
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	25,702	25,260	50,963	145		18,697	17,072
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	25,576	25,387	50,963	145		19,267	17,072
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	25,449	25,514	50,963	145		19,843	17,072
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,321	25,641	50,963	145		20,423	17,072
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	25,193	25,769	50,963	145		21,009	17,072
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	25,064	25,898	50,963	145		21,600	17,072
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	24,935	26,028	50,963	145		22,196	17,072
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	24,805	26,158	50,963	145		22,797	17,072
Totals			4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,289,675	1,041,504	2,331,179		219,420	734,752	780,945

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 34% *% of input*

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,668	14,012	556	33	33	16,236	295,425	Cell 1	Cell 1	
5	2022	1,687	14,169	562	34	34	16,418	311,843	Cell 1	Cell 1	
6	2023	1,706	14,327	569	34	34	16,602	328,444	Cell 1	Cell 1	
7	2024	2,904	24,389	968	58	58	28,261	356,705	Cell 1	Cell 1	
8	2025	3,562	24,389	1,187	71	71	29,139	385,844	Cell 1	Cell 1	
9	2026	4,212	24,389	1,404	84	84	30,006	415,850	Cell 1	Cell 1	
10	2027	4,850	24,389	1,617	97	97	30,856	446,705	Cell 1	Cell 1	
11	2028	5,479	24,389	1,826	110	110	31,694	478,400	Cell 1	Cell 1	
12	2029	6,098	24,389	2,033	122	122	32,520	510,920	Cell 1	Cell 1	
13	2030	6,703	24,389	2,234	134	134	33,327	544,246	Cell 2	Cell 1	**517,470**
14	2031	7,295	24,389	2,432	146	146	34,116	578,363	Cell 2	Cell 2	
15	2032	7,877	24,389	2,626	158	158	34,892	613,254	Cell 2	Cell 2	
16	2033	8,450	24,389	2,817	169	169	35,656	648,910	Cell 2	Cell 2	
17	2034	8,995	24,389	2,998	180	180	36,382	685,292	Cell 2	Cell 2	
18	2035	9,528	24,389	3,176	191	191	37,093	722,386	Cell 2	Cell 2	
19	2036	10,058	24,389	3,353	201	201	37,800	760,186	Cell 2	Cell 2	
20	2037	10,572	24,389	3,524	211	211	38,485	798,671	Cell 2	Cell 2	
21	2038	11,072	24,389	3,691	221	221	39,152	837,823	Cell 2	Cell 2	
22	2039	11,562	24,389	3,854	231	231	39,805	877,628	Cell 2	Cell 2	
23	2040	12,045	24,389	4,015	241	241	40,449	918,077	Cell 2	Cell 2	
24	2041	12,521	24,389	4,174	250	250	41,085	959,161	Cell 2	Cell 2	
25	2042	13,211	24,389	4,404	264	264	42,003	1,001,165	Cell 2	Cell 2	
26	2043	13,906	24,389	4,635	278	278	42,930	1,044,095	Cell 2	Cell 2	
27	2044	14,607	24,389	4,869	292	292	43,865	1,087,961	Cell 2	Cell 2	
28	2045	15,315	24,389	5,105	306	306	44,809	1,132,770	Cell 2	Cell 2	
29	2046	16,028	24,389	5,343	321	321	45,761	1,178,530	Cell 2	Cell 2	
30	2047	16,748	24,389	5,583	335	335	46,721	1,225,251	Cell 2	Cell 2	
31	2048	17,475	24,389	5,825	349	349	47,689	1,272,940	Cell 2	Cell 2	
32	2049	18,208	24,389	6,069	364	364	48,666	1,321,606	Cell 2	Cell 2	
33	2050	18,947	24,389	6,316	379	379	49,652	1,371,258	Cell 2	Cell 2	
34	2051	19,693	24,389	6,564	394	394	50,647	1,421,905	Cell 2	Cell 2	
35	2052	20,445	24,389	6,815	409	409	51,650	1,473,554	Cell 2	Cell 2	
36	2053	21,204	24,389	7,068	424	424	52,662	1,526,216	Cell 2	Cell 2	
37	2054	21,970	24,389	7,323	439	439	53,683	1,579,899	Cell 3	Cell 2	
38	2055	22,743	24,389	7,581	455	455	54,713	1,634,613	Cell 3	Cell 3	**1,563,942**
39	2056	23,522	24,389	7,841	470	470	55,753	1,690,365	Cell 3	Cell 3	
40	2057	24,309	24,389	8,103	486	486	56,801	1,747,166	Cell 3	Cell 3	
41	2058	25,102	24,389	8,367	502	502	57,859	1,805,025	Cell 3	Cell 3	
42	2059	25,903	24,389	8,634	518	518	58,926	1,863,951	Cell 3	Cell 3	
43	2060	26,710	24,389	8,903	534	534	60,003	1,923,954	Cell 3	Cell 3	
44	2061	27,525	24,389	9,175	550	550	61,089	1,985,043	Cell 3	Cell 3	
45	2062	28,347	24,389	9,449	567	567	62,185	2,047,228	Cell 3	Cell 3	
46	2063	29,176	24,389	9,725	584	584	63,291	2,110,519	Cell 3	Cell 3	
47	2064	30,013	24,389	10,004	600	600	64,406	2,174,925	Cell 3	Cell 3	
48	2065	30,857	24,389	10,286	617	617	65,532	2,240,457	Cell 3	Cell 3	
49	2066	31,708	24,389	10,569	634	634	66,667	2,307,124	Cell 3	Cell 3	
50	2067	32,568	24,389	10,856	651	651	67,813	2,374,937	Cell 3	Cell 3	

In-situ ash / residuals waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B4: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0					
	2016									$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$460,000		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$4,947,000	Permits	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$819,784			$0	$274,628	$5,081,326		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$17,703,000	New transfer station		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$828,965			$0	$277,703	$5,118,312		$ -		$600,124	$190,000	$0	$1,052,753	$8,777,000					
6	2023		$709,508	$838,241			$0	$280,811	$5,155,682		$ 35,000		$600,124	$190,000	$218,613	$1,052,753	$9,081,000					Phase 3 LFG and final cover design
7	2024		$709,508	$824,357		$651,040	$430,428	$478,030	$7,527,357		$ -		$600,124	$390,000	$3,108,685	$190,000	$14,910,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$821,042		$651,040	$432,795	$478,030	$7,527,357		$ -		$600,124	$190,000		$190,000	$11,600,000					
9	2026		$709,508	$817,839		$651,040	$435,083	$478,030	$7,527,357		$ -		$600,124	$190,000		$190,000	$11,599,000					
10	2027		$709,508	$814,822		$651,040	$437,238	$478,030	$7,527,357		$ 585,000		$600,124	$190,000		$190,000	$12,183,000					
11	2028		$709,508	$811,892	$200,000	$651,040	$439,331	$478,030	$7,527,357		$ -		$600,124	$190,000		$190,000	$11,797,000		New trailers every 8 years		Construction Cell 2	
12	2029	$200,000	$709,508	$809,037		$651,040	$441,370	$478,030	$7,527,357		$ 385,000		$600,124	$390,000		$190,000	$12,381,000	New trailers every 8 years				
13	2030		$709,508	$806,318		$651,040	$443,312	$478,030	$7,527,357	$8,850,000	$ 175,000		$600,124	$190,000		$190,000	$20,621,000				Closure Cell 1	
14	2031		$709,508	$803,698		$651,040	$445,183	$478,030	$7,527,357		$ -		$725,124	$190,000		$190,000	$11,720,000					
15	2032		$709,508	$801,191	$346,000	$651,040	$446,975	$478,030	$7,527,357		$ -	$ 1,350,000	$725,124	$190,000		$190,000	$13,415,000		Transfer station - parking and roads (20 yr life) + capital upgrades			
16	2033		$709,508	$798,770		$651,040	$448,704	$478,030	$7,527,357		$ 235,000		$725,124	$190,000		$190,000	$11,954,000					
17	2034		$709,508	$796,597		$651,040	$450,256	$478,030	$7,527,357		$ -		$725,124	$390,000		$190,000	$11,918,000					
18	2035		$709,508	$794,499		$651,040	$451,754	$478,030	$7,527,357		$ 935,000		$725,124	$190,000		$190,000	$12,652,000					
19	2036		$709,508	$792,438	$200,000	$651,040	$453,226	$478,030	$7,527,357		$ -		$725,124	$190,000		$190,000	$11,917,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$790,514		$651,040	$454,601	$478,030	$7,527,357		$ 550,000		$725,124	$190,000		$190,000	$12,466,000	New trailers every 8 years				
21	2038		$709,508	$788,701		$651,040	$455,896	$478,030	$7,527,357		$ -		$725,124	$190,000		$190,000	$11,716,000					
22	2039		$709,508	$786,963		$651,040	$457,137	$478,030	$7,527,357		$ 35,000		$725,124	$390,000		$190,000	$11,950,000					
23	2040		$709,508	$785,287		$651,040	$458,334	$478,030	$7,527,357		$ 175,000		$725,124	$190,000		$190,000	$11,890,000					
24	2041	$1,555,125	$709,508	$783,611		$651,040	$459,531	$478,030	$7,527,357		$ 385,000		$725,124	$190,000		$190,000	$13,654,000	Major capital upgrade every 20 years				
25	2042		$709,508	$780,395		$651,040	$461,829	$478,030	$7,527,357		$ -		$725,124	$190,000		$190,000	$11,713,000					
26	2043		$709,508	$777,162		$651,040	$464,138	$478,030	$7,527,357		$ 200,000		$725,124	$190,000		$190,000	$11,912,000					
27	2044		$709,508	$773,913	$200,000	$651,040	$466,459	$478,030	$7,527,357		$ -		$725,124	$390,000		$190,000	$12,111,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$770,648		$651,040	$468,791	$478,030	$7,527,357		$ 35,000		$725,124	$190,000		$190,000	$11,945,000	New trailers every 8 years				
29	2046		$709,508	$767,366		$651,040	$471,135	$478,030	$5,748,591		$ -		$725,124	$190,000		$190,000	$9,931,000			Amotization period over		
30	2047		$709,508	$764,068		$651,040	$473,491	$478,030	$5,748,591		$ 585,000		$725,124	$190,000		$190,000	$10,515,000					
31	2048		$709,508	$760,754		$651,040	$475,858	$478,030	$5,748,591		$ -		$725,124	$190,000		$190,000	$9,929,000					
32	2049		$709,508	$757,423		$651,040	$478,237	$478,030	$5,748,591		$ -		$725,124	$390,000		$190,000	$10,128,000					
33	2050		$709,508	$754,075		$651,040	$480,629	$478,030	$5,748,591		$ 1,075,000		$725,124	$190,000		$190,000	$11,002,000					
34	2051		$709,508	$750,711	$241,000	$651,040	$483,032	$478,030	$5,748,591		$ 35,000		$725,124	$190,000		$190,000	$10,202,000		Transfer station permits etc			
35	2052		$709,508	$747,329	$2,615,000	$651,040	$485,447	$478,030	$5,748,591		$ -		$725,124	$190,000		$190,000	$12,540,000		Transfer station - new facility + new trailer:			
36	2053	$200,000	$709,508	$743,931		$651,040	$487,874	$478,030	$5,748,591		$ 585,000		$725,124	$190,000		$190,000	$10,709,000	New trailers every 8 years				
37	2054		$709,508	$740,516		$651,040	$490,314	$478,030	$5,748,591	$7,800,000	$ -		$725,124	$390,000		$190,000	$17,923,000				Construction Cell 3	
38	2055		$709,508	$737,084		$651,040	$492,765	$478,030	$5,748,591		$ -		$850,124	$190,000		$190,000	$10,047,000					
39	2056		$709,508	$733,635		$651,040	$495,229	$478,030	$5,748,591		$ -	$ 2,850,000	$850,124	$190,000		$190,000	$12,896,000				Closure Cell 2	
40	2057		$709,508	$730,168		$651,040	$497,705	$478,030	$5,748,591		$ 585,000		$850,124	$190,000		$190,000	$10,630,000					
41	2058		$709,508	$726,684		$651,040	$500,194	$478,030	$5,748,591		$ -		$850,124	$190,000		$190,000	$10,044,000					
42	2059		$709,508	$723,183		$651,040	$502,695	$478,030	$5,748,591		$ 35,000		$850,124	$390,000		$190,000	$10,278,000					
43	2060		$709,508	$719,664	$200,000	$651,040	$505,208	$478,030	$5,748,591		$ 175,000		$850,124	$190,000		$190,000	$10,417,000		New trailers every 8 years			
44	2061	$1,755,125	$709,508	$716,127		$651,040	$507,734	$478,030	$5,748,591		$ -		$850,124	$190,000		$190,000	$11,796,000	Major capital upgrade every 20 years				
45	2062		$709,508	$712,573		$651,040	$510,273	$478,030	$5,748,591		$ -		$850,124	$190,000		$190,000	$10,040,000					
46	2063		$709,508	$709,001		$651,040	$512,824	$478,030	$5,748,591		$ 235,000		$850,124	$190,000		$190,000	$10,274,000					
47	2064		$709,508	$705,412		$651,040	$515,388	$478,030	$5,748,591		$ -		$850,124	$390,000		$190,000	$10,238,000					
48	2065		$709,508	$701,804		$651,040	$517,965	$478,030	$5,748,591		$ 1,285,000		$850,124	$190,000		$190,000	$11,322,000					
49	2066		$709,508	$698,178		$651,040	$520,555	$478,030	$5,748,591		$ -		$850,124	$190,000		$190,000	$10,036,000					
50	2067		$709,508	$694,534		$651,040	$523,158	$478,030	$5,748,591		$ 550,000		$850,124	$190,000		$190,000	$10,585,000					
	Totals	$7,731,275	$33,346,853	$36,110,907	$4,202,000	$28,645,760	$20,830,081	$21,866,462	$307,886,179	$16,650,000	$11,045,000	$6,965,000	$39,121,800	$11,310,000	$10,382,338	$15,729,269	$571,820,000					

WTT Facility Tipping Fee (operating cost & revenue) = *$113* per tonne
Capital cost annual payment = *$1,778,766* per year

30 years
$350,784,000 1,792,501 tonnes
$196 per tonne over 30 years

40 years
$466,790,000 2,448,090 tonnes
$191 per tonne over 40 years

50 years
$571,820,000 3,159,253 tonnes
$181 per tonne over 50 years

Table B5: Long Term Cost Model for Option 2(a) - EWS facility located in Comox Valley

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to EWS Facility	Tonnes per day to EWS facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819			28,110	83	21,152	2,336	4,752
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712			28,425	84	21,276	2,362	4,805
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614		Landfill closure	28,743	85	21,401	2,388	4,859
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507		21,521	48,930	145		4,065	8,271
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398		21,640	49,355	146		4,101	8,343
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281		21,754	49,776	148		4,136	8,414
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152		21,862	50,188	149		4,170	8,484
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014		21,967	50,594	150		4,204	8,552
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864		22,069	50,963	151		4,268	8,615
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697		22,166	50,963	151		4,692	8,615
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514		22,259	50,963	151		5,106	8,615
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320		22,349	50,963	151		5,513	8,615
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116		22,435	50,963	151		5,915	8,615
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879		22,513	50,963	151		6,296	8,615
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627		22,588	50,963	151		6,669	8,615
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371		22,661	50,963	151		7,040	8,615
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096		22,730	50,963	151		7,400	8,615
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805		22,795	50,963	151		7,750	8,615
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500		22,857	50,963	151		8,093	8,615
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187		22,917	50,963	151		8,431	8,615
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865		22,977	50,963	151		8,765	8,615
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808		23,091	50,963	151		9,247	8,615
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761		23,207	50,963	151		9,734	8,615
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723		23,323	50,963	151		10,225	8,615
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693		23,440	50,963	151		10,720	8,615
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673		23,557	50,963	151		11,220	8,615
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662		23,675	50,963	151		11,724	8,615
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660		23,793	50,963	151		12,232	8,615
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668		23,912	50,963	151		12,745	8,615
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685		24,031	50,963	151		13,263	8,615
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712		24,152	50,963	151		13,785	8,615
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748		24,272	50,963	151		14,311	8,615
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794		24,394	50,963	151		14,843	8,615
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850		24,516	50,963	151		15,379	8,615
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916		24,638	50,963	151		15,920	8,615
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992		24,761	50,963	151		16,465	8,615
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078		24,885	50,963	151		17,016	8,615
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174		25,010	50,963	151		17,571	8,615
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281		25,135	50,963	151		18,132	8,615
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398		25,260	50,963	151		18,697	8,615
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526		25,387	50,963	151		19,267	8,615
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664		25,514	50,963	151		19,842	8,615
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813		25,641	50,963	151		20,423	8,615
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973		25,769	50,963	151		21,009	8,615
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144		25,898	50,963	151		21,599	8,615
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326		26,028	50,963	151		22,196	8,615
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519		26,158	50,963	151		22,797	8,615
	Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	0	1,041,504	2,321,678		219,420	744,253	392,452

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	3,337	3,655	1,112	67	67	8,104	287,293	Cell 1	Cell 1	
5	2022	3,374	3,696	1,125	67	67	8,195	295,487	Cell 1	Cell 1	
6	2023	3,412	3,737	1,137	68	68	8,286	303,774	Cell 1	Cell 1	
7	2024	5,808	6,362	1,936	116	116	14,106	317,880	Cell 1	Cell 1	
8	2025	5,858	6,418	1,953	117	117	14,229	332,108	Cell 1	Cell 1	
9	2026	5,908	6,472	1,969	118	118	14,350	346,458	Cell 1	Cell 1	
10	2027	5,957	6,526	1,986	119	119	14,469	360,927	Cell 1	Cell 1	
11	2028	6,005	6,579	2,002	120	120	14,586	375,512	Cell 1	Cell 1	
12	2029	6,098	6,627	2,033	122	122	14,757	390,269	Cell 1	Cell 1	
13	2030	6,703	6,627	2,234	134	134	15,563	405,833	Cell 1	Cell 1	
14	2031	7,295	6,627	2,432	146	146	16,353	422,186	Cell 1	Cell 1	
15	2032	7,876	6,627	2,625	158	158	17,128	439,314	Cell 1	Cell 1	
16	2033	8,449	6,627	2,816	169	169	17,893	457,207	Cell 1	Cell 1	
17	2034	8,994	6,627	2,998	180	180	18,619	475,826	Cell 1	Cell 1	
18	2035	9,528	6,627	3,176	191	191	19,330	495,156	Cell 1	Cell 1	
19	2036	10,058	6,627	3,353	201	201	20,037	515,193	Cell 1	Cell 1	
20	2037	10,571	6,627	3,524	211	211	20,722	535,915	Cell 2	Cell 1	
21	2038	11,072	6,627	3,691	221	221	21,389	557,304	Cell 2	Cell 2	**517,470**
22	2039	11,561	6,627	3,854	231	231	22,042	579,346	Cell 2	Cell 2	
23	2040	12,044	6,627	4,015	241	241	22,685	602,031	Cell 2	Cell 2	
24	2041	12,521	6,627	4,174	250	250	23,321	625,353	Cell 2	Cell 2	
25	2042	13,210	6,627	4,403	264	264	24,240	649,593	Cell 2	Cell 2	
26	2043	13,905	6,627	4,635	278	278	25,167	674,760	Cell 2	Cell 2	
27	2044	14,607	6,627	4,869	292	292	26,102	700,862	Cell 2	Cell 2	
28	2045	15,314	6,627	5,105	306	306	27,046	727,908	Cell 2	Cell 2	
29	2046	16,028	6,627	5,343	321	321	27,997	755,905	Cell 2	Cell 2	
30	2047	16,748	6,627	5,583	335	335	28,957	784,863	Cell 2	Cell 2	
31	2048	17,474	6,627	5,825	349	349	29,926	814,789	Cell 2	Cell 2	
32	2049	18,207	6,627	6,069	364	364	30,903	845,692	Cell 2	Cell 2	
33	2050	18,947	6,627	6,316	379	379	31,889	877,581	Cell 2	Cell 2	
34	2051	19,692	6,627	6,564	394	394	32,883	910,464	Cell 2	Cell 2	
35	2052	20,445	6,627	6,815	409	409	33,887	944,350	Cell 2	Cell 2	
36	2053	21,204	6,627	7,068	424	424	34,899	979,249	Cell 2	Cell 2	
37	2054	21,970	6,627	7,323	439	439	35,920	1,015,169	Cell 2	Cell 2	
38	2055	22,743	6,627	7,581	455	455	36,950	1,052,119	Cell 2	Cell 2	
39	2056	23,522	6,627	7,841	470	470	37,989	1,090,108	Cell 2	Cell 2	
40	2057	24,308	6,627	8,103	486	486	39,038	1,129,146	Cell 2	Cell 2	
41	2058	25,102	6,627	8,367	502	502	40,096	1,169,242	Cell 2	Cell 2	
42	2059	25,902	6,627	8,634	518	518	41,163	1,210,405	Cell 2	Cell 2	
43	2060	26,710	6,627	8,903	534	534	42,240	1,252,645	Cell 2	Cell 2	
44	2061	27,524	6,627	9,175	550	550	43,326	1,295,971	Cell 2	Cell 2	
45	2062	28,346	6,627	9,449	567	567	44,422	1,340,392	Cell 2	Cell 2	
46	2063	29,176	6,627	9,725	584	584	45,528	1,385,920	Cell 2	Cell 2	
47	2064	30,012	6,627	10,004	600	600	46,643	1,432,563	Cell 2	Cell 2	
48	2065	30,856	6,627	10,285	617	617	47,769	1,480,332	Cell 2	Cell 2	
49	2066	31,708	6,627	10,569	634	634	48,904	1,529,236	Cell 2	Cell 2	
50	2067	32,567	6,627	10,856	651	651	50,050	1,579,285	Cell 3	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 337 *days per year*
Bottom ash/residuals to landfill = 17% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1.3 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B5: Long Term Cost Model for Option 2(a) - EWS facility located in Comox Valley

Capital and Operating Costs

	Year	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	EWS Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	Comox Valley TS Notes	EWS Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0					
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013			Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$200,000			$1,149,079		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$5,325,000	New trailers every 8 years		Permits and land		Phase 2 LFG and final cover design
4	2021				$5,968,151		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$13,476,000			EWS facility begins operating		Phase 2 LFG and final cover construction
5	2022				$5,994,627		$ -		$600,124	$190,000	$218,613	$1,052,753	$8,056,000					Phase 3 LFG and final cover design
6	2023				$6,021,378		$ 35,000		$600,124	$190,000	$3,108,685	$1,052,753	$11,008,000					Phase 3 LFG and final cover construction
7	2024		$651,040	$318,516	$7,719,113		$ -		$600,124	$390,000		$190,000	$9,869,000					
8	2025		$651,040	$320,269	$7,754,884		$ -		$600,124	$190,000		$190,000	$9,706,000					
9	2026		$651,040	$321,962	$7,790,242		$ -		$600,124	$190,000		$190,000	$9,743,000					
10	2027		$651,040	$323,556	$7,824,877		$ 585,000		$600,124	$190,000		$190,000	$10,365,000					
11	2028	$200,000	$651,040	$325,105	$7,859,064		$ -		$600,124	$190,000		$190,000	$10,015,000	New trailers every 8 years				
12	2029		$651,040	$326,614	$7,890,091		$ 385,000		$600,124	$390,000		$190,000	$10,433,000					
13	2030		$651,040	$328,051	$7,890,091		$ 175,000		$600,124	$190,000		$190,000	$10,024,000					
14	2031		$651,040	$329,436	$7,890,091		$ -		$600,124	$190,000		$190,000	$9,851,000					
15	2032	$346,000	$651,040	$330,761	$7,890,091		$ -		$600,124	$190,000		$190,000	$10,198,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
16	2033		$651,040	$332,041	$7,890,091		$ 235,000		$600,124	$190,000		$190,000	$10,088,000					
17	2034		$651,040	$333,189	$7,890,091		$ -		$600,124	$390,000		$190,000	$10,054,000					
18	2035		$651,040	$334,298	$7,890,091		$ 935,000		$600,124	$190,000		$190,000	$10,791,000					
19	2036	$200,000	$651,040	$335,388	$7,890,091		$ -		$600,124	$190,000		$190,000	$10,057,000	New trailers every 8 years				
20	2037		$651,040	$336,405	$7,890,091	$8,850,000	$ 550,000		$725,124	$190,000		$190,000	$19,383,000				Construction Cell 2	
21	2038		$651,040	$337,363	$7,890,091		$ -		$725,124	$190,000		$190,000	$9,984,000					
22	2039		$651,040	$338,281	$7,890,091		$ 35,000	$ 1,350,000	$725,124	$390,000		$190,000	$11,570,000				Closure Cell 1	
23	2040		$651,040	$339,167	$7,890,091		$ 175,000		$725,124	$190,000		$190,000	$10,160,000					
24	2041		$651,040	$340,053	$7,890,091		$ 385,000		$725,124	$190,000		$190,000	$10,371,000					
25	2042		$651,040	$341,753	$7,890,091		$ -		$725,124	$190,000		$190,000	$9,988,000					
26	2043		$651,040	$343,462	$7,890,091		$ 200,000		$725,124	$190,000		$190,000	$10,190,000					
27	2044	$200,000	$651,040	$345,180	$7,890,091		$ -		$725,124	$390,000		$190,000	$10,391,000	New trailers every 8 years				
28	2045		$651,040	$346,905	$7,890,091		$ 35,000		$725,124	$190,000		$190,000	$10,028,000					
29	2046		$651,040	$348,640	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,391,000			Amotization period over		
30	2047		$651,040	$350,383	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$6,978,000					
31	2048		$651,040	$352,135	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,394,000					
32	2049		$651,040	$353,896	$4,286,037		$ -		$725,124	$390,000		$190,000	$6,596,000					
33	2050		$651,040	$355,665	$4,286,037		$ 1,075,000		$725,124	$190,000		$190,000	$7,473,000					
34	2051	$241,000	$651,040	$357,444	$4,286,037		$ 35,000		$725,124	$190,000		$190,000	$6,676,000	Transfer station permits etc				
35	2052	$2,615,000	$651,040	$359,231	$4,286,037		$ -		$725,124	$190,000		$190,000	$9,016,000	Transfer station - new facility + new trailer	Locate, site and permit perm TS			
36	2053		$651,040	$361,027	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$6,988,000		Construct perm TS			
37	2054		$651,040	$362,832	$4,286,037		$ -		$725,124	$390,000		$190,000	$6,605,000		Off island export begins @ $100/tonne			
38	2055		$651,040	$364,646	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,407,000					
39	2056		$651,040	$366,469	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,409,000					
40	2057		$651,040	$368,302	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$6,996,000					
41	2058		$651,040	$370,143	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,412,000					
42	2059		$651,040	$371,994	$4,286,037		$ 35,000		$725,124	$390,000		$190,000	$6,649,000					
43	2060	$200,000	$651,040	$373,854	$4,286,037		$ 175,000		$725,124	$190,000		$190,000	$6,791,000	New trailers every 8 years				
44	2061		$651,040	$375,723	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,418,000		New trailers every 8 years			
45	2062		$651,040	$377,602	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,420,000					
46	2063		$651,040	$379,490	$4,286,037		$ 235,000		$725,124	$190,000		$190,000	$6,657,000					
47	2064		$651,040	$381,387	$4,286,037		$ -		$725,124	$390,000		$190,000	$6,624,000					
48	2065		$651,040	$383,294	$4,286,037		$ 1,285,000		$725,124	$190,000		$190,000	$7,710,000					
49	2066		$651,040	$385,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,427,000					
50	2067		$651,040	$387,137	$4,286,037		$ 550,000		$725,124	$190,000		$190,000	$6,979,000					
	Totals	$4,202,000	$28,645,760	$15,414,260	$286,505,773	$8,850,000	$11,045,000	$4,115,000	$36,746,800	$11,310,000	$10,382,338	$15,729,269	$432,946,000					

EWS Facility Tipping Fee (operating cost & revenue) = *$84* per tonne
Capital cost annual payment = *$3,604,054* per year

30 years
$296,299,000 1,792,501 tonnes
$165 per tonne over 30 years

40 years
$365,859,000 2,448,090 tonnes
$149 per tonne over 40 years

50 years
$432,946,000 3,159,253 tonnes
$137 per tonne over 50 years

Table B6: Long Term Cost Model for Option 2(b) - EWS facility located in Campbell River

Population and Disposal Rates

Year		Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to EWS Facility	Tonnes per day to EWS facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	28,110		28,110	83	21,152	2,336	4,752
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	28,425		28,425	84	21,276	2,362	4,805
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	28,743	Landfill closure	28,743	85	21,401	2,388	4,859
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	27,409		48,930	145		4,065	8,271
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	27,716		49,355	146		4,101	8,343
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	28,022		49,776	148		4,136	8,414
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	28,326		50,188	149		4,170	8,484
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	28,628		50,594	150		4,204	8,552
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	28,894		50,963	151		4,268	8,615
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	28,797		50,963	151		4,692	8,615
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	28,704		50,963	151		5,106	8,615
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	28,614		50,963	151		5,513	8,615
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	28,528		50,963	151		5,915	8,615
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	28,450		50,963	151		6,296	8,615
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	28,375		50,963	151		6,669	8,615
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	28,302		50,963	151		7,040	8,615
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	28,233		50,963	151		7,400	8,615
21	2038	81,010	35,919	51,411	22,795	58,713	161	103,805	28,168		50,963	151		7,750	8,615
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	28,106		50,963	151		8,093	8,615
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	28,046		50,963	151		8,431	8,615
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	27,986		50,963	151		8,765	8,615
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	27,872		50,963	151		9,247	8,615
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	27,756		50,963	151		9,734	8,615
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	27,640		50,963	151		10,225	8,615
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	27,523		50,963	151		10,720	8,615
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	27,406		50,963	151		11,220	8,615
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	27,288		50,963	151		11,724	8,615
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	27,170		50,963	151		12,232	8,615
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	27,051		50,963	151		12,745	8,615
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	26,932		50,963	151		13,263	8,615
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	26,811		50,963	151		13,785	8,615
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	26,691		50,963	151		14,311	8,615
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	26,569		50,963	151		14,843	8,615
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	26,447		50,963	151		15,379	8,615
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	26,325		50,963	151		15,920	8,615
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	26,202		50,963	151		16,465	8,615
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	26,078		50,963	151		17,016	8,615
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	25,953		50,963	151		17,571	8,615
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	25,828		50,963	151		18,132	8,615
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	25,703		50,963	151		18,697	8,615
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	25,576		50,963	151		19,267	8,615
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	25,449		50,963	151		19,842	8,615
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,322		50,963	151		20,423	8,615
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	25,194		50,963	151		21,009	8,615
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	25,065		50,963	151		21,599	8,615
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	24,935		50,963	151		22,196	8,615
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	24,805		50,963	151		22,797	8,615
Totals		4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,280,174	0	2,321,678		219,420	744,253	392,452

CRWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

Year		Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3	m^3			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	3,337	3,655	1,112	67	67	8,104	287,293	Cell 1	Cell 1	
5	2022	3,374	3,696	1,125	67	67	8,195	295,487	Cell 1	Cell 1	
6	2023	3,412	3,737	1,137	68	68	8,286	303,774	Cell 1	Cell 1	
7	2024	5,808	6,362	1,936	116	116	14,106	317,880	Cell 1	Cell 1	
8	2025	5,858	6,418	1,953	117	117	14,229	332,108	Cell 1	Cell 1	
9	2026	5,908	6,472	1,969	118	118	14,350	346,458	Cell 1	Cell 1	
10	2027	5,957	6,526	1,986	119	119	14,469	360,927	Cell 1	Cell 1	
11	2028	6,005	6,579	2,002	120	120	14,586	375,512	Cell 1	Cell 1	
12	2029	6,098	6,627	2,033	122	122	14,757	390,269	Cell 1	Cell 1	
13	2030	6,703	6,627	2,234	134	134	15,563	405,833	Cell 1	Cell 1	
14	2031	7,295	6,627	2,432	146	146	16,353	422,186	Cell 1	Cell 1	
15	2032	7,876	6,627	2,625	158	158	17,128	439,314	Cell 1	Cell 1	
16	2033	8,449	6,627	2,816	169	169	17,893	457,207	Cell 1	Cell 1	
17	2034	8,994	6,627	2,998	180	180	18,619	475,826	Cell 1	Cell 1	
18	2035	9,528	6,627	3,176	191	191	19,330	495,156	Cell 1	Cell 1	
19	2036	10,058	6,627	3,353	201	201	20,037	515,193	Cell 1	Cell 1	
20	2037	10,571	6,627	3,524	211	211	20,722	535,915	Cell 2	Cell 1	**517,470**
21	2038	11,072	6,627	3,691	221	221	21,389	557,304	Cell 2	Cell 2	
22	2039	11,561	6,627	3,854	231	231	22,042	579,346	Cell 2	Cell 2	
23	2040	12,044	6,627	4,015	241	241	22,685	602,031	Cell 2	Cell 2	
24	2041	12,521	6,627	4,174	250	250	23,321	625,353	Cell 2	Cell 2	
25	2042	13,210	6,627	4,403	264	264	24,240	649,593	Cell 2	Cell 2	
26	2043	13,905	6,627	4,635	278	278	25,167	674,760	Cell 2	Cell 2	
27	2044	14,607	6,627	4,869	292	292	26,102	700,862	Cell 2	Cell 2	
28	2045	15,314	6,627	5,105	306	306	27,046	727,908	Cell 2	Cell 2	
29	2046	16,028	6,627	5,343	321	321	27,997	755,905	Cell 2	Cell 2	
30	2047	16,748	6,627	5,583	335	335	28,957	784,863	Cell 2	Cell 2	
31	2048	17,474	6,627	5,825	349	349	29,926	814,789	Cell 2	Cell 2	
32	2049	18,207	6,627	6,069	364	364	30,903	845,692	Cell 2	Cell 2	
33	2050	18,947	6,627	6,316	379	379	31,889	877,581	Cell 2	Cell 2	
34	2051	19,692	6,627	6,564	394	394	32,883	910,464	Cell 2	Cell 2	
35	2052	20,445	6,627	6,815	409	409	33,887	944,350	Cell 2	Cell 2	
36	2053	21,204	6,627	7,068	424	424	34,899	979,249	Cell 2	Cell 2	
37	2054	21,970	6,627	7,323	439	439	35,920	1,015,169	Cell 2	Cell 2	
38	2055	22,743	6,627	7,581	455	455	36,950	1,052,119	Cell 2	Cell 2	
39	2056	23,522	6,627	7,841	470	470	37,989	1,090,108	Cell 2	Cell 2	
40	2057	24,308	6,627	8,103	486	486	39,038	1,129,146	Cell 2	Cell 2	
41	2058	25,102	6,627	8,367	502	502	40,096	1,169,242	Cell 2	Cell 2	
42	2059	25,902	6,627	8,634	518	518	41,163	1,210,405	Cell 2	Cell 2	
43	2060	26,710	6,627	8,903	534	534	42,240	1,252,645	Cell 2	Cell 2	
44	2061	27,524	6,627	9,175	550	550	43,326	1,295,971	Cell 2	Cell 2	
45	2062	28,346	6,627	9,449	567	567	44,422	1,340,392	Cell 2	Cell 2	
46	2063	29,176	6,627	9,725	584	584	45,528	1,385,920	Cell 2	Cell 2	
47	2064	30,012	6,627	10,004	600	600	46,643	1,432,563	Cell 2	Cell 2	
48	2065	30,856	6,627	10,285	617	617	47,769	1,480,332	Cell 2	Cell 2	
49	2066	31,708	6,627	10,569	634	634	48,904	1,529,236	Cell 2	Cell 2	
50	2067	32,567	6,627	10,856	651	651	50,050	1,579,285	Cell 3	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
Days of operation = 337 *days per year*
Bottom ash/residuals to landfill = 17% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1.3 *tonnes per m^3*
In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B6: Long Term Cost Model for Option 2(b) - EWS facility located in Campbell River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	EWS Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	EWS Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0					
	2016						$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$957,915		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$5,245,000	Permits	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$416,031	$70,325	$5,968,151		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$17,982,000	New transfer station		EWS facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$420,691	$71,113	$5,994,627		$ -		$600,124	$190,000	$218,613	$1,052,753	$9,257,000					Phase 3 LFG and final cover design
6	2023		$709,508	$425,398	$71,909	$6,021,378		$ 35,000		$600,124	$190,000	$3,108,685	$1,052,753	$12,215,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$405,647	$122,411	$7,719,113		$ -		$600,124	$390,000		$190,000	$10,137,000					
8	2025		$709,508	$410,190	$123,475	$7,754,884		$ -		$600,124	$190,000		$190,000	$9,978,000					
9	2026		$709,508	$414,720	$124,527	$7,790,242		$ -		$600,124	$190,000		$190,000	$10,019,000					
10	2027		$709,508	$419,220	$125,558	$7,824,877		$ 585,000		$600,124	$190,000		$190,000	$10,644,000					
11	2028		$709,508	$423,688	$126,575	$7,859,064		$ -		$600,124	$190,000		$190,000	$10,099,000		New trailers every 8 years			
12	2029	$200,000	$709,508	$427,638	$127,497	$7,890,091		$ 385,000		$600,124	$390,000		$190,000	$10,920,000	New trailers every 8 years				
13	2030		$709,508	$426,201	$127,497	$7,890,091		$ 175,000		$600,124	$190,000		$190,000	$10,308,000					
14	2031		$709,508	$424,817	$127,497	$7,890,091		$ -		$600,124	$190,000		$190,000	$10,132,000					
15	2032		$709,508	$423,491	$127,497	$7,890,091		$ -		$600,124	$190,000		$190,000	$10,131,000		Transfer station - parking and roads (20 yr life) + capital upgrades			
16	2033		$709,508	$422,212	$127,497	$7,890,091		$ 235,000		$600,124	$190,000		$190,000	$10,364,000					
17	2034		$709,508	$421,063	$127,497	$7,890,091		$ -		$600,124	$390,000		$190,000	$10,328,000					
18	2035		$709,508	$419,954	$127,497	$7,890,091		$ 935,000		$600,124	$190,000		$190,000	$11,062,000					
19	2036		$709,508	$418,865	$127,497	$7,890,091		$ -		$600,124	$190,000		$190,000	$10,126,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$417,848	$127,497	$7,890,091	$8,850,000	$ 550,000		$725,124	$190,000		$190,000	$19,850,000	New trailers every 8 years			Construction Cell 2	
21	2038		$709,508	$416,890	$127,497	$7,890,091		$ -		$725,124	$190,000		$190,000	$10,249,000					
22	2039		$709,508	$415,971	$127,497	$7,890,091		$ 35,000	$ 1,350,000	$725,124	$390,000		$190,000	$11,833,000				Closure Cell 1	
23	2040		$709,508	$415,085	$127,497	$7,890,091		$ 175,000		$725,124	$190,000		$190,000	$10,422,000					
24	2041	$1,555,125	$709,508	$414,199	$127,497	$7,890,091		$ 385,000		$725,124	$190,000		$190,000	$12,187,000	Major capital upgrade every 20 years				
25	2042		$709,508	$412,499	$127,497	$7,890,091		$ -		$725,124	$190,000		$190,000	$10,245,000					
26	2043		$709,508	$410,790	$127,497	$7,890,091		$ 200,000		$725,124	$190,000		$190,000	$10,443,000					
27	2044		$709,508	$409,073	$127,497	$7,890,091		$ -		$725,124	$390,000		$190,000	$10,441,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$407,347	$127,497	$7,890,091		$ 35,000		$725,124	$190,000		$190,000	$10,475,000	New trailers every 8 years				
29	2046		$709,508	$405,612	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,634,000			Amotization period over		
30	2047		$709,508	$403,869	$127,497	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$7,217,000					
31	2048		$709,508	$402,117	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,630,000					
32	2049		$709,508	$400,357	$127,497	$4,286,037		$ -		$725,124	$390,000		$190,000	$6,829,000					
33	2050		$709,508	$398,587	$127,497	$4,286,037		$ 1,075,000		$725,124	$190,000		$190,000	$7,702,000					
34	2051		$709,508	$396,809	$127,497	$4,286,037		$ 35,000		$725,124	$190,000		$190,000	$6,660,000		Transfer station permits etc			
35	2052		$709,508	$395,022	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,623,000		Transfer station - new facility + new trailer:			
36	2053	$200,000	$709,508	$393,226	$127,497	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$7,406,000	New trailers every 8 year:				
37	2054		$709,508	$391,420	$127,497	$4,286,037		$ -		$725,124	$390,000		$190,000	$6,820,000					
38	2055		$709,508	$389,606	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,618,000					
39	2056		$709,508	$387,783	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,616,000					
40	2057		$709,508	$385,951	$127,497	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$7,199,000					
41	2058		$709,508	$384,109	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,612,000					
42	2059		$709,508	$382,258	$127,497	$4,286,037		$ 35,000		$725,124	$390,000		$190,000	$6,845,000					
43	2060		$709,508	$380,398	$127,497	$4,286,037		$ 175,000		$725,124	$190,000		$190,000	$6,784,000		New trailers every 8 years			
44	2061	$1,755,125	$709,508	$378,529	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,362,000	Major capital upgrade every 20 years				
45	2062		$709,508	$376,651	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,605,000					
46	2063		$709,508	$374,763	$127,497	$4,286,037		$ 235,000		$725,124	$190,000		$190,000	$6,838,000					
47	2064		$709,508	$372,865	$127,497	$4,286,037		$ -		$725,124	$390,000		$190,000	$6,801,000					
48	2065		$709,508	$370,958	$127,497	$4,286,037		$ 1,285,000		$725,124	$190,000		$190,000	$7,884,000					
49	2066		$709,508	$369,042	$127,497	$4,286,037		$ -		$725,124	$190,000		$190,000	$6,597,000					
50	2067		$709,508	$367,116	$127,497	$4,286,037		$ 550,000		$725,124	$190,000		$190,000	$7,145,000					
	Totals	$7,731,275	$33,346,853	$18,946,576	$5,808,295	$286,314,610	$8,850,000	$11,045,000	$4,115,000	$36,746,800	$11,310,000	$10,382,338	$15,729,269	$450,325,000					

EWS Facility Tipping Fee (operating cost & revenue) = *$84* per tonne
Capital cost annual payment = *$3,604,054* per year

30 years
$310,749,000 1,792,501 tonnes
$173 per tonne over 30 years

40 years
$379,852,000 2,448,090 tonnes
$155 per tonne over 40 years

50 years
$450,325,000 3,159,253 tonnes
$143 per tonne over 50 years

Table B7: Long Term Cost Model for Option 2(c) - EWS facility located in Gold River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to EWS Facility	Tonnes per day to EWS facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes		tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	28,110		28,110	83	21,152	2,336	4,752
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	28,425		28,425	84	21,276	2,362	4,805
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	28,743	Landfill closure	28,743	85	21,401	2,388	4,859
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	27,409	21,521	48,930	145		4,065	8,271
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	27,716	21,640	49,355	146		4,101	8,343
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	28,022	21,754	49,776	148		4,136	8,414
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	28,326	21,862	50,188	149		4,170	8,484
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	28,628	21,967	50,594	150		4,204	8,552
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	28,894	22,069	50,963	151		4,268	8,615
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	28,797	22,166	50,963	151		4,692	8,615
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	28,704	22,259	50,963	151		5,106	8,615
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	28,614	22,349	50,963	151		5,513	8,615
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	28,528	22,435	50,963	151		5,915	8,615
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	28,450	22,513	50,963	151		6,296	8,615
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	28,375	22,588	50,963	151		6,669	8,615
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	28,302	22,661	50,963	151		7,040	8,615
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	28,233	22,730	50,963	151		7,400	8,615
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	28,168	22,795	50,963	151		7,750	8,615
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	28,106	22,857	50,963	151		8,093	8,615
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	28,046	22,917	50,963	151		8,431	8,615
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	27,986	22,977	50,963	151		8,765	8,615
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	27,872	23,091	50,963	151		9,247	8,615
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	27,756	23,207	50,963	151		9,734	8,615
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	27,640	23,323	50,963	151		10,225	8,615
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	27,523	23,440	50,963	151		10,720	8,615
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	27,406	23,557	50,963	151		11,220	8,615
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	27,288	23,675	50,963	151		11,724	8,615
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	27,170	23,793	50,963	151		12,232	8,615
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	27,051	23,912	50,963	151		12,745	8,615
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	26,932	24,031	50,963	151		13,263	8,615
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	26,811	24,152	50,963	151		13,785	8,615
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	26,691	24,272	50,963	151		14,311	8,615
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	26,569	24,394	50,963	151		14,843	8,615
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	26,447	24,516	50,963	151		15,379	8,615
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	26,325	24,638	50,963	151		15,920	8,615
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	26,202	24,761	50,963	151		16,465	8,615
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	26,078	24,885	50,963	151		17,016	8,615
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	25,953	25,010	50,963	151		17,571	8,615
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	25,828	25,135	50,963	151		18,132	8,615
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	25,703	25,260	50,963	151		18,697	8,615
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	25,576	25,387	50,963	151		19,267	8,615
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	25,449	25,514	50,963	151		19,842	8,615
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,322	25,641	50,963	151		20,423	8,615
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	25,194	25,769	50,963	151		21,009	8,615
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	25,065	25,898	50,963	151		21,599	8,615
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	24,935	26,028	50,963	151		22,196	8,615
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	24,805	26,158	50,963	151		22,797	8,615
Totals		4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,280,174	1,041,504	2,321,678		219,420	744,253	392,452

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	3,337	3,655	1,112	67	67	8,104	287,293	Cell 1	Cell 1	
5	2022	3,374	3,696	1,125	67	67	8,195	295,487	Cell 1	Cell 1	
6	2023	3,412	3,737	1,137	68	68	8,286	303,774	Cell 1	Cell 1	
7	2024	5,808	6,362	1,936	116	116	14,106	317,880	Cell 1	Cell 1	
8	2025	5,858	6,418	1,953	117	117	14,229	332,108	Cell 1	Cell 1	
9	2026	5,908	6,472	1,969	118	118	14,350	346,458	Cell 1	Cell 1	
10	2027	5,957	6,526	1,986	119	119	14,469	360,927	Cell 1	Cell 1	
11	2028	6,005	6,579	2,002	120	120	14,586	375,512	Cell 1	Cell 1	
12	2029	6,098	6,627	2,033	122	122	14,757	390,269	Cell 1	Cell 1	
13	2030	6,703	6,627	2,234	134	134	15,563	405,833	Cell 1	Cell 1	
14	2031	7,295	6,627	2,432	146	146	16,353	422,186	Cell 1	Cell 1	
15	2032	7,876	6,627	2,625	158	158	17,128	439,314	Cell 1	Cell 1	
16	2033	8,449	6,627	2,816	169	169	17,893	457,207	Cell 1	Cell 1	
17	2034	8,994	6,627	2,998	180	180	18,619	475,826	Cell 1	Cell 1	
18	2035	9,528	6,627	3,176	191	191	19,330	495,156	Cell 1	Cell 1	
19	2036	10,058	6,627	3,353	201	201	20,037	515,193	Cell 1	Cell 1	
20	2037	10,571	6,627	3,524	211	211	20,722	535,915	Cell 2	Cell 1	**517,470**
21	2038	11,072	6,627	3,691	221	221	21,389	557,304	Cell 2	Cell 2	
22	2039	11,561	6,627	3,854	231	231	22,042	579,346	Cell 2	Cell 2	
23	2040	12,044	6,627	4,015	241	241	22,685	602,031	Cell 2	Cell 2	
24	2041	12,521	6,627	4,174	250	250	23,321	625,353	Cell 2	Cell 2	
25	2042	13,210	6,627	4,403	264	264	24,240	649,593	Cell 2	Cell 2	
26	2043	13,905	6,627	4,635	278	278	25,167	674,760	Cell 2	Cell 2	
27	2044	14,607	6,627	4,869	292	292	26,102	700,862	Cell 2	Cell 2	
28	2045	15,314	6,627	5,105	306	306	27,046	727,908	Cell 2	Cell 2	
29	2046	16,028	6,627	5,343	321	321	27,997	755,905	Cell 2	Cell 2	
30	2047	16,748	6,627	5,583	335	335	28,957	784,863	Cell 2	Cell 2	
31	2048	17,474	6,627	5,825	349	349	29,926	814,789	Cell 2	Cell 2	
32	2049	18,207	6,627	6,069	364	364	30,903	845,692	Cell 2	Cell 2	
33	2050	18,947	6,627	6,316	379	379	31,889	877,581	Cell 2	Cell 2	
34	2051	19,692	6,627	6,564	394	394	32,883	910,464	Cell 2	Cell 2	
35	2052	20,445	6,627	6,815	409	409	33,887	944,350	Cell 2	Cell 2	
36	2053	21,204	6,627	7,068	424	424	34,899	979,249	Cell 2	Cell 2	
37	2054	21,970	6,627	7,323	439	439	35,920	1,015,169	Cell 2	Cell 2	
38	2055	22,743	6,627	7,581	455	455	36,950	1,052,119	Cell 2	Cell 2	
39	2056	23,522	6,627	7,841	470	470	37,989	1,090,108	Cell 2	Cell 2	
40	2057	24,308	6,627	8,103	486	486	39,038	1,129,146	Cell 2	Cell 2	
41	2058	25,102	6,627	8,367	502	502	40,096	1,169,242	Cell 2	Cell 2	
42	2059	25,902	6,627	8,634	518	518	41,163	1,210,405	Cell 2	Cell 2	
43	2060	26,710	6,627	8,903	534	534	42,240	1,252,645	Cell 2	Cell 2	
44	2061	27,524	6,627	9,175	550	550	43,326	1,295,971	Cell 2	Cell 2	
45	2062	28,346	6,627	9,449	567	567	44,422	1,340,392	Cell 2	Cell 2	
46	2063	29,176	6,627	9,725	584	584	45,528	1,385,920	Cell 2	Cell 2	
47	2064	30,012	6,627	10,004	600	600	46,643	1,432,563	Cell 2	Cell 2	
48	2065	30,856	6,627	10,285	617	617	47,769	1,480,332	Cell 2	Cell 2	
49	2066	31,708	6,627	10,569	634	634	48,904	1,529,236	Cell 2	Cell 2	
50	2067	32,567	6,627	10,856	651	651	50,050	1,579,285	Cell 3	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
Days of operation = 337 *days per year*
Bottom ash/residuals to landfill = 17% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1.3 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B7: Long Term Cost Model for Option 2(c) - EWS facility located in Gold River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	EWS Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	EWS Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0		New Transfer station constructed 2012-2013			
	2016									$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$726,800		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$4,903,000	Construct TS	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$787,086			$0	$133,048	$5,968,151		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$15,106,000	New trailers every 8 years		EWS facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$795,901			$0	$134,538	$5,994,627		$ -		$600,124	$190,000	$218,613	$1,052,753	$9,696,000					Phase 3 LFG and final cover design
6	2023		$709,508	$804,807			$0	$136,043	$6,021,378		$ 35,000		$600,124	$190,000	$3,108,685	$1,052,753	$12,658,000					Phase 3 LFG and final cover construction
7	2024		$709,508	$767,441		$651,040	$430,428	$231,589	$7,719,113		$ -		$600,124	$390,000		$190,000	$11,689,000					
8	2025		$709,508	$776,036		$651,040	$432,795	$233,602	$7,754,884		$ -		$600,124	$190,000		$190,000	$11,538,000					
9	2026		$709,508	$784,604		$651,040	$435,083	$235,592	$7,790,242		$ -		$600,124	$190,000		$190,000	$11,586,000					
10	2027		$709,508	$793,119		$651,040	$437,238	$237,541	$7,824,877		$ 585,000		$600,124	$190,000		$190,000	$12,218,000					
11	2028		$709,508	$801,571	$200,000	$651,040	$439,331	$239,465	$7,859,064		$ -		$600,124	$190,000		$190,000	$11,880,000		New trailers every 8 years			
12	2029	$200,000	$709,508	$809,046		$651,040	$441,370	$241,211	$7,890,091		$ 385,000		$600,124	$390,000		$190,000	$12,307,000	New trailers every 8 years				
13	2030		$709,508	$806,327		$651,040	$443,312	$241,211	$7,890,091		$ 175,000		$600,124	$190,000		$190,000	$11,897,000					
14	2031		$709,508	$803,707		$651,040	$445,183	$241,211	$7,890,091		$ -		$600,124	$190,000		$190,000	$11,721,000					
15	2032		$709,508	$801,199	$346,000	$651,040	$446,975	$241,211	$7,890,091		$ -		$600,124	$190,000		$190,000	$12,066,000					
16	2033		$709,508	$798,779		$651,040	$448,704	$241,211	$7,890,091		$ 235,000		$600,124	$190,000		$190,000	$11,954,000					
17	2034		$709,508	$796,606		$651,040	$450,256	$241,211	$7,890,091		$ -		$600,124	$390,000		$190,000	$11,919,000					
18	2035		$709,508	$794,508		$651,040	$451,754	$241,211	$7,890,091		$ 935,000		$600,124	$190,000		$190,000	$12,653,000					
19	2036		$709,508	$792,447	$200,000	$651,040	$453,226	$241,211	$7,890,091		$ -		$600,124	$190,000		$190,000	$11,918,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$790,523		$651,040	$454,601	$241,211	$7,890,091	$8,850,000	$ 550,000		$725,124	$190,000		$190,000	$21,242,000	New trailers every 8 years			Construction Cell 2	
21	2038		$709,508	$788,710		$651,040	$455,896	$241,211	$7,890,091		$ -		$725,124	$190,000		$190,000	$11,842,000					
22	2039		$709,508	$786,972		$651,040	$457,137	$241,211	$7,890,091		$ 35,000	$ 1,350,000	$725,124	$390,000		$190,000	$13,426,000				Closure Cell 1	
23	2040		$709,508	$785,296		$651,040	$458,334	$241,211	$7,890,091		$ 175,000		$725,124	$190,000		$190,000	$12,016,000	Major capital upgrade every 20 years				
24	2041	$1,555,125	$709,508	$783,620		$651,040	$459,531	$241,211	$7,890,091		$ 385,000		$725,124	$190,000		$190,000	$12,225,000					
25	2042		$709,508	$780,403		$651,040	$461,829	$241,211	$7,890,091		$ -		$725,124	$190,000		$190,000	$11,839,000					
26	2043		$709,508	$777,171		$651,040	$464,138	$241,211	$7,890,091		$ 200,000		$725,124	$190,000		$190,000	$12,038,000					
27	2044		$709,508	$773,922	$200,000	$651,040	$466,459	$241,211	$7,890,091		$ -		$725,124	$390,000		$190,000	$12,237,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$770,656		$651,040	$468,791	$241,211	$7,890,091		$ 35,000		$725,124	$190,000		$190,000	$11,871,000	New trailers every 8 years				
29	2046		$709,508	$767,375		$651,040	$471,135	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,231,000			Amotization period over		
30	2047		$709,508	$764,077		$651,040	$473,491	$241,211	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$8,815,000					
31	2048		$709,508	$760,763		$651,040	$475,858	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,230,000					
32	2049		$709,508	$757,432		$651,040	$478,237	$241,211	$4,286,037		$ -		$725,124	$390,000		$190,000	$8,429,000					
33	2050		$709,508	$754,084		$651,040	$480,629	$241,211	$4,286,037		$ 1,075,000		$725,124	$190,000		$190,000	$9,303,000					
34	2051		$709,508	$750,720	$241,000	$651,040	$483,032	$241,211	$4,286,037		$ 35,000		$725,124	$190,000		$190,000	$8,503,000					
35	2052		$709,508	$747,338	$2,615,000	$651,040	$485,447	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$10,841,000		New trailers every 8 years			
36	2053	$200,000	$709,508	$743,940		$651,040	$487,874	$241,211	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$8,810,000	New trailers every 8 years				
37	2054		$709,508	$740,525		$651,040	$490,314	$241,211	$4,286,037		$ -		$725,124	$390,000		$190,000	$8,424,000					
38	2055		$709,508	$737,093		$651,040	$492,765	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,223,000					
39	2056		$709,508	$733,643		$651,040	$495,229	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,222,000					
40	2057		$709,508	$730,177		$651,040	$497,705	$241,211	$4,286,037		$ 585,000		$725,124	$190,000		$190,000	$8,806,000					
41	2058		$709,508	$726,693		$651,040	$500,194	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,220,000					
42	2059		$709,508	$723,192		$651,040	$502,695	$241,211	$4,286,037		$ 35,000		$725,124	$390,000		$190,000	$8,454,000					
43	2060		$709,508	$719,673	$200,000	$651,040	$505,208	$241,211	$4,286,037		$ 175,000		$725,124	$190,000		$190,000	$8,593,000	Major capital upgrade every 20 years	New trailers every 8 years			
44	2061	$1,755,125	$709,508	$716,136		$651,040	$507,734	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,217,000	New trailers every 8 years				
45	2062		$709,508	$712,582		$651,040	$510,273	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,216,000					
46	2063		$709,508	$709,010		$651,040	$512,824	$241,211	$4,286,037		$ 235,000		$725,124	$190,000		$190,000	$8,450,000					
47	2064		$709,508	$705,420		$651,040	$515,388	$241,211	$4,286,037		$ -		$725,124	$390,000		$190,000	$8,414,000					
48	2065		$709,508	$701,813		$651,040	$517,965	$241,211	$4,286,037		$ 1,285,000		$725,124	$190,000		$190,000	$9,498,000					
49	2066		$709,508	$698,187		$651,040	$520,555	$241,211	$4,286,037		$ -		$725,124	$190,000		$190,000	$8,212,000					
50	2067		$709,508	$694,543		$651,040	$523,158	$241,211	$4,286,037		$ 550,000		$725,124	$190,000		$190,000	$8,761,000					
	Totals	$7,731,275	$33,346,853	$35,844,873	$4,202,000	$28,645,760	$20,830,081	$10,988,666	$286,083,494	$8,850,000	$11,045,000	$4,115,000	$36,746,800	$11,310,000	$10,382,338	$15,729,269	$518,123,000					

EWS Facility Tipping Fee (operating cost & revenue) = *$84* per tonne $212.31
Capital cost annual payment = *$3,604,054* per year $154.82

30 years
$345,297,000 1,792,501 tonnes
$193 per tonne over 30 years

40 years
$433,088,000 2,448,090 tonnes
$177 per tonne over 40 years

50 years
$518,123,000 3,159,253 tonnes
$164 per tonne over 50 years

Table B8: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819			29,195	83	21,152	1,251	3,187
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712			29,522	84	21,276	1,265	3,222
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614		Landfill closure	29,852	85	21,401	1,279	3,259
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507		21,521	50,817	145		2,178	5,547
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398		21,640	50,963	146		2,493	5,563
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281		21,754	50,963	146		2,948	5,563
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152		21,862	50,963	146		3,394	5,563
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014		21,967	50,963	146		3,835	5,563
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864		22,069	50,963	146		4,268	5,563
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697		22,166	50,963	146		4,692	5,563
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514		22,259	50,963	146		5,106	5,563
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320		22,349	50,963	146		5,513	5,563
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116		22,435	50,963	146		5,915	5,563
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879		22,513	50,963	146		6,296	5,563
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627		22,588	50,963	146		6,669	5,563
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371		22,661	50,963	146		7,040	5,563
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096		22,730	50,963	146		7,400	5,563
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805		22,795	50,963	146		7,750	5,563
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500		22,857	50,963	146		8,093	5,563
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187		22,917	50,963	146		8,431	5,563
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865		22,977	50,963	146		8,765	5,563
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808		23,091	50,963	146		9,247	5,563
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761		23,207	50,963	146		9,734	5,563
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723		23,323	50,963	146		10,225	5,563
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693		23,440	50,963	146		10,720	5,563
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673		23,557	50,963	146		11,220	5,563
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662		23,675	50,963	146		11,724	5,563
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660		23,793	50,963	146		12,232	5,563
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668		23,912	50,963	146		12,745	5,563
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685		24,031	50,963	146		13,263	5,563
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712		24,152	50,963	146		13,785	5,563
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748		24,272	50,963	146		14,311	5,563
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794		24,394	50,963	146		14,843	5,563
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850		24,516	50,963	146		15,379	5,563
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916		24,638	50,963	146		15,920	5,563
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992		24,761	50,963	146		16,465	5,563
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078		24,885	50,963	146		17,016	5,563
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174		25,010	50,963	146		17,571	5,563
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281		25,135	50,963	146		18,132	5,563
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398		25,260	50,963	146		18,697	5,563
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526		25,387	50,963	146		19,267	5,563
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664		25,514	50,963	146		19,842	5,563
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813		25,641	50,963	146		20,423	5,563
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973		25,769	50,963	146		21,009	5,563
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144		25,898	50,963	146		21,599	5,563
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326		26,028	50,963	146		22,196	5,563
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519		26,158	50,963	146		22,797	5,563
	Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	0	1,041,504	2,330,795		219,420	735,137	254,421

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,787	3,187	596	36	36	5,570	284,759	Cell 1	Cell 1	
5	2022	1,807	3,222	602	36	36	5,632	290,391	Cell 1	Cell 1	
6	2023	1,828	3,259	609	37	37	5,695	296,087	Cell 1	Cell 1	
7	2024	3,111	5,547	1,037	62	62	9,695	305,782	Cell 1	Cell 1	
8	2025	3,562	5,563	1,187	71	71	10,312	316,094	Cell 1	Cell 1	
9	2026	4,212	5,563	1,404	84	84	11,179	327,273	Cell 1	Cell 1	
10	2027	4,849	5,563	1,616	97	97	12,029	339,301	Cell 1	Cell 1	
11	2028	5,478	5,563	1,826	110	110	12,867	352,169	Cell 1	Cell 1	
12	2029	6,098	5,563	2,033	122	122	13,693	365,862	Cell 1	Cell 1	
13	2030	6,703	5,563	2,234	134	134	14,500	380,362	Cell 1	Cell 1	
14	2031	7,295	5,563	2,432	146	146	15,289	395,651	Cell 1	Cell 1	
15	2032	7,876	5,563	2,625	158	158	16,065	411,716	Cell 1	Cell 1	
16	2033	8,449	5,563	2,816	169	169	16,829	428,544	Cell 1	Cell 1	
17	2034	8,994	5,563	2,998	180	180	17,555	446,100	Cell 1	Cell 1	
18	2035	9,528	5,563	3,176	191	191	18,266	464,366	Cell 1	Cell 1	
19	2036	10,058	5,563	3,353	201	201	18,973	483,339	Cell 1	Cell 1	
20	2037	10,571	5,563	3,524	211	211	19,658	502,997	Cell 1	Cell 1	
21	2038	11,072	5,563	3,691	221	221	20,325	523,323	Cell 2	Cell 1	**517,470**
22	2039	11,561	5,563	3,854	231	231	20,978	544,301	Cell 2	Cell 2	
23	2040	12,044	5,563	4,015	241	241	21,622	565,923	Cell 2	Cell 2	
24	2041	12,521	5,563	4,174	250	250	22,258	588,180	Cell 2	Cell 2	
25	2042	13,210	5,563	4,403	264	264	23,176	611,357	Cell 2	Cell 2	
26	2043	13,905	5,563	4,635	278	278	24,103	635,460	Cell 2	Cell 2	
27	2044	14,607	5,563	4,869	292	292	25,039	660,499	Cell 2	Cell 2	
28	2045	15,314	5,563	5,105	306	306	25,982	686,481	Cell 2	Cell 2	
29	2046	16,028	5,563	5,343	321	321	26,934	713,414	Cell 2	Cell 2	
30	2047	16,748	5,563	5,583	335	335	27,894	741,308	Cell 2	Cell 2	
31	2048	17,474	5,563	5,825	349	349	28,862	770,170	Cell 2	Cell 2	
32	2049	18,207	5,563	6,069	364	364	29,839	800,009	Cell 2	Cell 2	
33	2050	18,947	5,563	6,316	379	379	30,825	830,835	Cell 2	Cell 2	
34	2051	19,692	5,563	6,564	394	394	31,820	862,654	Cell 2	Cell 2	
35	2052	20,445	5,563	6,815	409	409	32,823	895,477	Cell 2	Cell 2	
36	2053	21,204	5,563	7,068	424	424	33,835	929,312	Cell 2	Cell 2	
37	2054	21,970	5,563	7,323	439	439	34,856	964,168	Cell 2	Cell 2	
38	2055	22,743	5,563	7,581	455	455	35,886	1,000,054	Cell 2	Cell 2	
39	2056	23,522	5,563	7,841	470	470	36,926	1,036,980	Cell 2	Cell 2	
40	2057	24,308	5,563	8,103	486	486	37,974	1,074,954	Cell 2	Cell 2	
41	2058	25,102	5,563	8,367	502	502	39,032	1,113,986	Cell 2	Cell 2	
42	2059	25,902	5,563	8,634	518	518	40,099	1,154,085	Cell 2	Cell 2	
43	2060	26,710	5,563	8,903	534	534	41,176	1,195,261	Cell 2	Cell 2	
44	2061	27,524	5,563	9,175	550	550	42,262	1,237,523	Cell 2	Cell 2	
45	2062	28,346	5,563	9,449	567	567	43,358	1,280,881	Cell 2	Cell 2	
46	2063	29,176	5,563	9,725	584	584	44,464	1,325,345	Cell 2	Cell 2	
47	2064	30,012	5,563	10,004	600	600	45,579	1,370,925	Cell 2	Cell 2	
48	2065	30,856	5,563	10,285	617	617	46,705	1,417,629	Cell 2	Cell 2	
49	2066	31,708	5,563	10,569	634	634	47,840	1,465,470	Cell 2	Cell 2	
50	2067	32,567	5,563	10,856	651	651	48,986	1,514,455	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 350 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B8: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley

Capital and Operating Costs

	Year	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	Comox Valley TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0					
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013			Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$200,000			$1,805,696		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$5,982,000	New trailers every 8 years		Permits and land		Phase 2 LFG and final cover design
4	2021				$3,250,037		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$10,758,000			Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022				$3,267,280		$ -		$600,124	$190,000	$0	$1,052,753	$5,110,000					
6	2023				$3,284,702		$ 35,000		$600,124	$190,000	$218,613	$1,052,753	$5,381,000					Phase 3 LFG and final cover design
7	2024		$651,040	$318,516	$4,390,399		$ -		$600,124	$390,000	$3,108,685	$190,000	$9,649,000					Phase 3 LFG and final cover construction
8	2025		$651,040	$320,269	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,350,000					
9	2026		$651,040	$321,962	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,351,000					
10	2027		$651,040	$323,556	$4,398,073		$ 585,000		$600,124	$190,000		$190,000	$6,938,000					
11	2028	$200,000	$651,040	$325,105	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,554,000	New trailers every 8 years				
12	2029		$651,040	$326,614	$4,398,073		$ 385,000		$600,124	$390,000		$190,000	$6,941,000					
13	2030		$651,040	$328,051	$4,398,073		$ 175,000		$600,124	$190,000		$190,000	$6,532,000					
14	2031		$651,040	$329,436	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,359,000					
15	2032	$346,000	$651,040	$330,761	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,706,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
16	2033		$651,040	$332,041	$4,398,073		$ 235,000		$600,124	$190,000		$190,000	$6,596,000					
17	2034		$651,040	$333,189	$4,398,073		$ -		$600,124	$390,000		$190,000	$6,562,000					
18	2035		$651,040	$334,298	$4,398,073		$ 935,000		$600,124	$190,000		$190,000	$7,299,000					
19	2036	$200,000	$651,040	$335,388	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,565,000	New trailers every 8 years				
20	2037		$651,040	$336,405	$4,398,073		$ 550,000		$600,124	$190,000		$190,000	$6,916,000					
21	2038		$651,040	$337,363	$4,398,073	$8,850,000	$ -		$600,124	$190,000		$190,000	$15,217,000				Construction Cell 2	
22	2039		$651,040	$338,281	$4,398,073		$ 35,000		$725,124	$390,000		$190,000	$6,728,000					
23	2040		$651,040	$339,167	$4,398,073		$ 175,000	$ 1,350,000	$725,124	$190,000		$190,000	$8,018,000				Closure Cell 1	
24	2041		$651,040	$340,053	$4,398,073		$ 385,000		$725,124	$190,000		$190,000	$6,879,000					
25	2042		$651,040	$341,753	$4,398,073		$ -		$725,124	$190,000		$190,000	$6,496,000					
26	2043		$651,040	$343,462	$4,398,073		$ 200,000		$725,124	$190,000		$190,000	$6,698,000					
27	2044	$200,000	$651,040	$345,180	$4,398,073		$ -		$725,124	$390,000		$190,000	$6,899,000	New trailers every 8 years				
28	2045		$651,040	$346,905	$4,398,073		$ 35,000		$725,124	$190,000		$190,000	$6,536,000			Amotization period over		
29	2046		$651,040	$348,640	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,793,000					
30	2047		$651,040	$350,383	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$5,379,000					
31	2048		$651,040	$352,135	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,796,000					
32	2049		$651,040	$353,896	$2,687,721		$ -		$725,124	$390,000		$190,000	$4,998,000					
33	2050		$651,040	$355,665	$2,687,721		$ 1,075,000		$725,124	$190,000		$190,000	$5,875,000					
34	2051	$241,000	$651,040	$357,444	$2,687,721		$ 35,000		$725,124	$190,000		$190,000	$5,077,000	Transfer station permits etc				
35	2052	$2,615,000	$651,040	$359,231	$2,687,721		$ -		$725,124	$190,000		$190,000	$7,418,000	Transfer station - new facility + new trailers	Locate, site and permit perm TS			
36	2053		$651,040	$361,027	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$5,390,000		Construct perm TS			
37	2054		$651,040	$362,832	$2,687,721		$ -		$725,124	$390,000		$190,000	$5,007,000		Off island export begins @ $100/tonne			
38	2055		$651,040	$364,646	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,809,000					
39	2056		$651,040	$366,469	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,810,000					
40	2057		$651,040	$368,302	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$5,397,000					
41	2058		$651,040	$370,143	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,814,000					
42	2059		$651,040	$371,994	$2,687,721		$ 35,000		$725,124	$390,000		$190,000	$5,051,000					
43	2060	$200,000	$651,040	$373,854	$2,687,721		$ 175,000		$725,124	$190,000		$190,000	$5,193,000	New trailers every 8 years				
44	2061		$651,040	$375,723	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,820,000		New trailers every 8 years			
45	2062		$651,040	$377,602	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,821,000					
46	2063		$651,040	$379,490	$2,687,721		$ 235,000		$725,124	$190,000		$190,000	$5,058,000					
47	2064		$651,040	$381,387	$2,687,721		$ -		$725,124	$390,000		$190,000	$5,025,000					
48	2065		$651,040	$383,294	$2,687,721		$ 1,285,000		$725,124	$190,000		$190,000	$6,112,000					
49	2066		$651,040	$385,211	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,829,000					
50	2067		$651,040	$387,137	$2,687,721		$ 550,000		$725,124	$190,000		$190,000	$5,381,000					
	Totals	$4,202,000	$28,645,760	$15,414,260	$167,487,521	$8,850,000	$11,045,000	$4,115,000	$36,496,800	$11,310,000	$10,382,338	$15,729,269	$313,679,000					

Sustane Facility Tipping Fee (operating cost & revenue) = *$53* per tonne
Capital cost annual payment = *$1,710,352* per year

30 years
$208,998,000 1,792,501 tonnes
$117 per tonne over 30 years

40 years
$262,575,000 2,448,090 tonnes
$107 per tonne over 40 years

50 years
$313,679,000 3,159,253 tonnes
$99 per tonne over 50 years

Table B9: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,195		29,195	83	21,152	1,251	3,187
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,522		29,522	84	21,276	1,265	3,222
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,852	Landfill closure	29,852	85	21,401	1,279	3,259
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,296		50,817	145		2,178	5,547
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,323		50,963	146		2,493	5,563
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	29,209		50,963	146		2,948	5,563
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	29,101		50,963	146		3,394	5,563
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	28,996		50,963	146		3,835	5,563
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	28,894		50,963	146		4,268	5,563
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	28,797		50,963	146		4,692	5,563
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	28,704		50,963	146		5,106	5,563
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	28,614		50,963	146		5,513	5,563
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	28,528		50,963	146		5,915	5,563
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	28,450		50,963	146		6,296	5,563
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	28,375		50,963	146		6,669	5,563
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	28,302		50,963	146		7,040	5,563
20	2037	80,386	35,633	51,265	22,730	58,363	160	103,096	28,233		50,963	146		7,400	5,563
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	28,168		50,963	146		7,750	5,563
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	28,106		50,963	146		8,093	5,563
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	28,046		50,963	146		8,431	5,563
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	27,986		50,963	146		8,765	5,563
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	27,872		50,963	146		9,247	5,563
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	27,756		50,963	146		9,734	5,563
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	27,640		50,963	146		10,225	5,563
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	27,523		50,963	146		10,720	5,563
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	27,406		50,963	146		11,220	5,563
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	27,288		50,963	146		11,724	5,563
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	27,170		50,963	146		12,232	5,563
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	27,051		50,963	146		12,745	5,563
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	26,932		50,963	146		13,263	5,563
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	26,811		50,963	146		13,785	5,563
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	26,691		50,963	146		14,311	5,563
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	26,569		50,963	146		14,843	5,563
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	26,447		50,963	146		15,379	5,563
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	26,325		50,963	146		15,920	5,563
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	26,202		50,963	146		16,465	5,563
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	26,078		50,963	146		17,016	5,563
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	25,953		50,963	146		17,571	5,563
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	25,828		50,963	146		18,132	5,563
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	25,703		50,963	146		18,697	5,563
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	25,576		50,963	146		19,267	5,563
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	25,449		50,963	146		19,842	5,563
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,322		50,963	146		20,423	5,563
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	25,194		50,963	146		21,009	5,563
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	25,065		50,963	146		21,599	5,563
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	24,935		50,963	146		22,196	5,563
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	24,805		50,963	146		22,797	5,563
	Totals		4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,289,291	0	2,330,795		219,420	735,137	254,421

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,787	3,187	596	36	36	5,570	284,759	Cell 1	Cell 1	
5	2022	1,807	3,222	602	36	36	5,632	290,391	Cell 1	Cell 1	
6	2023	1,828	3,259	609	37	37	5,695	296,087	Cell 1	Cell 1	
7	2024	3,111	5,547	1,037	62	62	9,695	305,782	Cell 1	Cell 1	
8	2025	3,562	5,563	1,187	71	71	10,312	316,094	Cell 1	Cell 1	
9	2026	4,212	5,563	1,404	84	84	11,179	327,273	Cell 1	Cell 1	
10	2027	4,849	5,563	1,616	97	97	12,029	339,301	Cell 1	Cell 1	
11	2028	5,478	5,563	1,826	110	110	12,867	352,169	Cell 1	Cell 1	
12	2029	6,098	5,563	2,033	122	122	13,693	365,862	Cell 1	Cell 1	
13	2030	6,703	5,563	2,234	134	134	14,500	380,362	Cell 1	Cell 1	
14	2031	7,295	5,563	2,432	146	146	15,289	395,651	Cell 1	Cell 1	
15	2032	7,876	5,563	2,625	158	158	16,065	411,716	Cell 1	Cell 1	
16	2033	8,449	5,563	2,816	169	169	16,829	428,544	Cell 1	Cell 1	
17	2034	8,994	5,563	2,998	180	180	17,555	446,100	Cell 1	Cell 1	
18	2035	9,528	5,563	3,176	191	191	18,266	464,366	Cell 1	Cell 1	
19	2036	10,058	5,563	3,353	201	201	18,973	483,339	Cell 1	Cell 1	
20	2037	10,571	5,563	3,524	211	211	19,658	502,997	Cell 1	Cell 1	
21	2038	11,072	5,563	3,691	221	221	20,325	523,323	Cell 2	Cell 1	**517,470**
22	2039	11,561	5,563	3,854	231	231	20,978	544,301	Cell 2	Cell 2	
23	2040	12,044	5,563	4,015	241	241	21,622	565,923	Cell 2	Cell 2	
24	2041	12,521	5,563	4,174	250	250	22,258	588,180	Cell 2	Cell 2	
25	2042	13,210	5,563	4,403	264	264	23,176	611,357	Cell 2	Cell 2	
26	2043	13,905	5,563	4,635	278	278	24,103	635,460	Cell 2	Cell 2	
27	2044	14,607	5,563	4,869	292	292	25,039	660,499	Cell 2	Cell 2	
28	2045	15,314	5,563	5,105	306	306	25,982	686,481	Cell 2	Cell 2	
29	2046	16,028	5,563	5,343	321	321	26,934	713,414	Cell 2	Cell 2	
30	2047	16,748	5,563	5,583	335	335	27,894	741,308	Cell 2	Cell 2	
31	2048	17,474	5,563	5,825	349	349	28,862	770,170	Cell 2	Cell 2	
32	2049	18,207	5,563	6,069	364	364	29,839	800,009	Cell 2	Cell 2	
33	2050	18,947	5,563	6,316	379	379	30,825	830,835	Cell 2	Cell 2	
34	2051	19,692	5,563	6,564	394	394	31,820	862,654	Cell 2	Cell 2	
35	2052	20,445	5,563	6,815	409	409	32,823	895,477	Cell 2	Cell 2	
36	2053	21,204	5,563	7,068	424	424	33,835	929,312	Cell 2	Cell 2	
37	2054	21,970	5,563	7,323	439	439	34,856	964,168	Cell 2	Cell 2	
38	2055	22,743	5,563	7,581	455	455	35,886	1,000,054	Cell 2	Cell 2	
39	2056	23,522	5,563	7,841	470	470	36,926	1,036,980	Cell 2	Cell 2	
40	2057	24,308	5,563	8,103	486	486	37,974	1,074,954	Cell 2	Cell 2	
41	2058	25,102	5,563	8,367	502	502	39,032	1,113,986	Cell 2	Cell 2	
42	2059	25,902	5,563	8,634	518	518	40,099	1,154,085	Cell 2	Cell 2	
43	2060	26,710	5,563	8,903	534	534	41,176	1,195,261	Cell 2	Cell 2	
44	2061	27,524	5,563	9,175	550	550	42,262	1,237,523	Cell 2	Cell 2	
45	2062	28,346	5,563	9,449	567	567	43,358	1,280,881	Cell 2	Cell 2	
46	2063	29,176	5,563	9,725	584	584	44,464	1,325,345	Cell 2	Cell 2	
47	2064	30,012	5,563	10,004	600	600	45,579	1,370,925	Cell 2	Cell 2	
48	2065	30,856	5,563	10,285	617	617	46,705	1,417,629	Cell 2	Cell 2	
49	2066	31,708	5,563	10,569	634	634	47,840	1,465,470	Cell 2	Cell 2	
50	2067	32,567	5,563	10,856	651	651	48,986	1,514,455	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 350 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B9: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0					
	2016						$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$1,327,789		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$5,615,000	Permits		Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$432,080	$47,000	$3,250,037		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$15,257,000	New transfer station		Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$436,919	$48,000	$3,267,280		$ -		$600,124	$190,000	$0	$1,052,753	$6,305,000					
6	2023		$709,508	$441,808	$48,000	$3,284,702		$ 35,000		$600,124	$190,000	$218,613	$1,052,753	$6,581,000					Phase 3 LFG and final cover design
7	2024		$709,508	$433,582	$82,000	$4,390,399		$ -		$600,124	$390,000	$3,108,685	$190,000	$9,904,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$433,984	$82,000	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,604,000					
9	2026		$709,508	$432,291	$82,000	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,602,000					
10	2027		$709,508	$430,696	$82,000	$4,398,073		$ 585,000		$600,124	$190,000		$190,000	$7,185,000					
11	2028		$709,508	$429,148	$82,000	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,599,000					
12	2029	$200,000	$709,508	$427,638	$82,000	$4,398,073		$ 385,000		$600,124	$390,000		$190,000	$7,382,000	New trailers every 8 years				
13	2030		$709,508	$426,201	$82,000	$4,398,073		$ 175,000		$600,124	$190,000		$190,000	$6,771,000					
14	2031		$709,508	$424,817	$82,000	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,595,000					
15	2032		$709,508	$423,491	$82,000	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,593,000					
16	2033		$709,508	$422,212	$82,000	$4,398,073		$ 235,000		$600,124	$190,000		$190,000	$6,827,000					
17	2034		$709,508	$421,063	$82,000	$4,398,073		$ -		$600,124	$390,000		$190,000	$6,791,000					
18	2035		$709,508	$419,954	$82,000	$4,398,073		$ 935,000		$600,124	$190,000		$190,000	$7,525,000					
19	2036		$709,508	$418,865	$82,000	$4,398,073		$ -		$600,124	$190,000		$190,000	$6,589,000					
20	2037	$200,000	$709,508	$417,848	$82,000	$4,398,073		$ 550,000		$600,124	$190,000		$190,000	$7,338,000	New trailers every 8 years				
21	2038		$709,508	$416,890	$82,000	$4,398,073	$8,850,000	$ -		$600,124	$190,000		$190,000	$15,437,000				Construction Cell 2	
22	2039		$709,508	$415,971	$82,000	$4,398,073		$ 35,000		$725,124	$390,000		$190,000	$6,946,000					
23	2040		$709,508	$415,085	$82,000	$4,398,073		$ 175,000	$ 1,350,000	$725,124	$190,000		$190,000	$8,235,000				Closure Cell 1	
24	2041	$1,555,125	$709,508	$414,199	$82,000	$4,398,073		$ 385,000		$725,124	$190,000		$190,000	$8,649,000	Major capital upgrade every 20 years				
25	2042		$709,508	$412,499	$82,000	$4,398,073		$ -		$725,124	$190,000		$190,000	$6,707,000					
26	2043		$709,508	$410,790	$82,000	$4,398,073		$ 200,000		$725,124	$190,000		$190,000	$6,905,000					
27	2044		$709,508	$409,073	$82,000	$4,398,073		$ -		$725,124	$390,000		$190,000	$6,904,000					
28	2045	$200,000	$709,508	$407,347	$82,000	$2,687,721		$ 35,000		$725,124	$190,000		$190,000	$5,227,000	New trailers every 8 years		Amortization period over		
29	2046		$709,508	$405,612	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,990,000					
30	2047		$709,508	$403,869	$82,000	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$5,573,000					
31	2048		$709,508	$402,117	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,986,000					
32	2049		$709,508	$400,357	$82,000	$2,687,721		$ -		$725,124	$390,000		$190,000	$5,185,000					
33	2050		$709,508	$398,587	$82,000	$2,687,721		$ 1,075,000		$725,124	$190,000		$190,000	$6,058,000					
34	2051		$709,508	$396,809	$82,000	$2,687,721		$ 35,000		$725,124	$190,000		$190,000	$5,016,000					
35	2052		$709,508	$395,022	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,979,000					
36	2053	$200,000	$709,508	$393,226	$82,000	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$5,763,000	New trailers every 8 years				
37	2054		$709,508	$391,420	$82,000	$2,687,721		$ -		$725,124	$390,000		$190,000	$5,176,000					
38	2055		$709,508	$389,606	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,974,000					
39	2056		$709,508	$387,783	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,972,000					
40	2057		$709,508	$385,951	$82,000	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$5,555,000					
41	2058		$709,508	$384,109	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,968,000					
42	2059		$709,508	$382,258	$82,000	$2,687,721		$ 35,000		$725,124	$390,000		$190,000	$5,202,000					
43	2060		$709,508	$380,398	$82,000	$2,687,721		$ 175,000		$725,124	$190,000		$190,000	$5,140,000					
44	2061	$1,755,125	$709,508	$378,529	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,718,000	Major capital upgrade every 20 years				
45	2062		$709,508	$376,651	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,961,000					
46	2063		$709,508	$374,763	$82,000	$2,687,721		$ 235,000		$725,124	$190,000		$190,000	$5,194,000					
47	2064		$709,508	$372,865	$82,000	$2,687,721		$ -		$725,124	$390,000		$190,000	$5,157,000					
48	2065		$709,508	$370,958	$82,000	$2,687,721		$ 1,285,000		$725,124	$190,000		$190,000	$6,240,000					
49	2066		$709,508	$369,042	$82,000	$2,687,721		$ -		$725,124	$190,000		$190,000	$4,953,000					
50	2067		$709,508	$367,116	$82,000	$2,687,721		$ 550,000		$725,124	$190,000		$190,000	$5,501,000					
	Totals	$7,731,275	$33,346,853	$19,081,500	$3,751,000	$165,299,261	$8,850,000	$11,045,000	$4,115,000	$36,496,800	$11,310,000	$10,382,338	$15,729,269	$327,140,000					

Sustane Facility Tipping Fee (operating cost & revenue) = *$53* per tonne
Capital cost annual payment = *$1,710,352* per year

30 years
$220,442,000 1,792,501 tonnes
$123 per tonne over 30 years

40 years
$273,106,000 2,448,090
$112 per tonne over 40 years

50 years
$327,140,000 3,159,253
$104 per tonne over 50 years

Table B10: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,195		29,195	83	21,152	1,251	3,187
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,522		29,522	84	21,276	1,265	3,222
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,852	Landfill closure	29,852	85	21,401	1,279	3,259
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,296	21,521	50,817	145		2,178	5,547
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,323	21,640	50,963	146		2,493	5,563
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	29,209	21,754	50,963	146		2,948	5,563
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	29,101	21,862	50,963	146		3,394	5,563
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	28,996	21,967	50,963	146		3,835	5,563
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	28,894	22,069	50,963	146		4,268	5,563
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	28,797	22,166	50,963	146		4,692	5,563
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	28,704	22,259	50,963	146		5,106	5,563
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	28,614	22,349	50,963	146		5,513	5,563
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	28,528	22,435	50,963	146		5,915	5,563
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	28,450	22,513	50,963	146		6,296	5,563
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	28,375	22,588	50,963	146		6,669	5,563
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	28,302	22,661	50,963	146		7,040	5,563
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	28,233	22,730	50,963	146		7,400	5,563
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	28,168	22,795	50,963	146		7,750	5,563
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	28,106	22,857	50,963	146		8,093	5,563
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	28,046	22,917	50,963	146		8,431	5,563
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	27,986	22,977	50,963	146		8,765	5,563
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	27,872	23,091	50,963	146		9,247	5,563
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	27,756	23,207	50,963	146		9,734	5,563
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	27,640	23,323	50,963	146		10,225	5,563
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	27,523	23,440	50,963	146		10,720	5,563
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	27,406	23,557	50,963	146		11,220	5,563
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	27,288	23,675	50,963	146		11,724	5,563
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	27,170	23,793	50,963	146		12,232	5,563
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	27,051	23,912	50,963	146		12,745	5,563
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	26,932	24,031	50,963	146		13,263	5,563
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	26,811	24,152	50,963	146		13,785	5,563
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	26,691	24,272	50,963	146		14,311	5,563
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	26,569	24,394	50,963	146		14,843	5,563
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	26,447	24,516	50,963	146		15,379	5,563
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	26,325	24,638	50,963	146		15,920	5,563
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	26,202	24,761	50,963	146		16,465	5,563
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	26,078	24,885	50,963	146		17,016	5,563
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	25,953	25,010	50,963	146		17,571	5,563
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	25,828	25,135	50,963	146		18,132	5,563
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	25,703	25,260	50,963	146		18,697	5,563
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	25,576	25,387	50,963	146		19,267	5,563
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	25,449	25,514	50,963	146		19,842	5,563
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	25,322	25,641	50,963	146		20,423	5,563
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	25,194	25,769	50,963	146		21,009	5,563
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	25,065	25,898	50,963	146		21,599	5,563
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	24,935	26,028	50,963	146		22,196	5,563
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	24,805	26,158	50,963	146		22,797	5,563
	Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,289,291	1,041,504	2,330,795		219,420	735,137	254,421

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,787	3,187	596	36	36	5,570	284,759	Cell 1	Cell 1	
5	2022	1,807	3,222	602	36	36	5,632	290,391	Cell 1	Cell 1	
6	2023	1,828	3,259	609	37	37	5,695	296,087	Cell 1	Cell 1	
7	2024	3,111	5,547	1,037	62	62	9,695	305,782	Cell 1	Cell 1	
8	2025	3,562	5,563	1,187	71	71	10,312	316,094	Cell 1	Cell 1	
9	2026	4,212	5,563	1,404	84	84	11,179	327,273	Cell 1	Cell 1	
10	2027	4,849	5,563	1,616	97	97	12,029	339,301	Cell 1	Cell 1	
11	2028	5,478	5,563	1,826	110	110	12,867	352,169	Cell 1	Cell 1	
12	2029	6,098	5,563	2,033	122	122	13,693	365,862	Cell 1	Cell 1	
13	2030	6,703	5,563	2,234	134	134	14,500	380,362	Cell 1	Cell 1	
14	2031	7,295	5,563	2,432	146	146	15,289	395,651	Cell 1	Cell 1	
15	2032	7,876	5,563	2,625	158	158	16,065	411,716	Cell 1	Cell 1	
16	2033	8,449	5,563	2,816	169	169	16,829	428,544	Cell 1	Cell 1	
17	2034	8,994	5,563	2,998	180	180	17,555	446,100	Cell 1	Cell 1	
18	2035	9,528	5,563	3,176	191	191	18,266	464,366	Cell 1	Cell 1	
19	2036	10,058	5,563	3,353	201	201	18,973	483,339	Cell 1	Cell 1	
20	2037	10,571	5,563	3,524	211	211	19,658	502,997	Cell 1	Cell 1	
21	2038	11,072	5,563	3,691	221	221	20,325	523,323	Cell 2	Cell 1	**517,470**
22	2039	11,561	5,563	3,854	231	231	20,978	544,301	Cell 2	Cell 2	
23	2040	12,044	5,563	4,015	241	241	21,622	565,923	Cell 2	Cell 2	
24	2041	12,521	5,563	4,174	250	250	22,258	588,180	Cell 2	Cell 2	
25	2042	13,210	5,563	4,403	264	264	23,176	611,357	Cell 2	Cell 2	
26	2043	13,905	5,563	4,635	278	278	24,103	635,460	Cell 2	Cell 2	
27	2044	14,607	5,563	4,869	292	292	25,039	660,499	Cell 2	Cell 2	
28	2045	15,314	5,563	5,105	306	306	25,982	686,481	Cell 2	Cell 2	
29	2046	16,028	5,563	5,343	321	321	26,934	713,414	Cell 2	Cell 2	
30	2047	16,748	5,563	5,583	335	335	27,894	741,308	Cell 2	Cell 2	
31	2048	17,474	5,563	5,825	349	349	28,862	770,170	Cell 2	Cell 2	
32	2049	18,207	5,563	6,069	364	364	29,839	800,009	Cell 2	Cell 2	
33	2050	18,947	5,563	6,316	379	379	30,825	830,835	Cell 2	Cell 2	
34	2051	19,692	5,563	6,564	394	394	31,820	862,654	Cell 2	Cell 2	
35	2052	20,445	5,563	6,815	409	409	32,823	895,477	Cell 2	Cell 2	
36	2053	21,204	5,563	7,068	424	424	33,835	929,312	Cell 2	Cell 2	
37	2054	21,970	5,563	7,323	439	439	34,856	964,168	Cell 2	Cell 2	
38	2055	22,743	5,563	7,581	455	455	35,886	1,000,054	Cell 2	Cell 2	
39	2056	23,522	5,563	7,841	470	470	36,926	1,036,980	Cell 2	Cell 2	
40	2057	24,308	5,563	8,103	486	486	37,974	1,074,954	Cell 2	Cell 2	
41	2058	25,102	5,563	8,367	502	502	39,032	1,113,986	Cell 2	Cell 2	
42	2059	25,902	5,563	8,634	518	518	40,099	1,154,085	Cell 2	Cell 2	
43	2060	26,710	5,563	8,903	534	534	41,176	1,195,261	Cell 2	Cell 2	
44	2061	27,524	5,563	9,175	550	550	42,262	1,237,523	Cell 2	Cell 2	
45	2062	28,346	5,563	9,449	567	567	43,358	1,280,881	Cell 2	Cell 2	
46	2063	29,176	5,563	9,725	584	584	44,464	1,325,345	Cell 2	Cell 2	
47	2064	30,012	5,563	10,004	600	600	45,579	1,370,925	Cell 2	Cell 2	
48	2065	30,856	5,563	10,285	617	617	46,705	1,417,629	Cell 2	Cell 2	
49	2066	31,708	5,563	10,569	634	634	47,840	1,465,470	Cell 2	Cell 2	
50	2067	32,567	5,563	10,856	651	651	48,986	1,514,455	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 350 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table B10: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0		New Transfer station constructed 2012-2013			
	2016									$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,166,495		$250,868	$1,052,753	$3,595,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,166,495		$490,358	$1,052,753	$5,410,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,166,495	$390,000	$191,695	$1,052,753	$2,801,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$750,000		$ 1,075,000		$1,166,495	$190,000	$491,790	$1,052,753	$5,237,000	Construct TS	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$817,449				$89,230	$3,250,037		$ 35,000		$600,124	$190,000	$5,630,329	$1,052,753	$15,684,000	New trailers every 8 years		Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$826,603				$90,229	$3,267,280		$ -		$600,124	$190,000	$0	$1,052,753	$6,736,000					
6	2023		$709,508	$835,853				$91,239	$3,284,702		$ 35,000		$600,124	$190,000	$218,613	$1,052,753	$7,018,000					Phase 3 LFG and final cover design
7	2024		$709,508	$820,291		$651,040	$430,428	$155,318	$4,390,399		$ -		$600,124	$390,000	$3,108,685	$190,000	$11,446,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$821,051		$651,040	$432,795	$155,762	$4,398,073		$ -		$600,124	$190,000		$190,000	$8,148,000					
9	2026		$709,508	$817,848		$651,040	$435,083	$155,762	$4,398,073		$ -		$600,124	$190,000		$190,000	$8,147,000					
10	2027		$709,508	$814,831		$651,040	$437,238	$155,762	$4,398,073		$ 585,000		$600,124	$190,000		$190,000	$8,732,000					
11	2028		$709,508	$811,901	$200,000	$651,040	$439,331	$155,762	$4,398,073		$ -		$600,124	$190,000		$190,000	$8,346,000		New trailers every 8 years			
12	2029	$200,000	$709,508	$809,046		$651,040	$441,370	$155,762	$4,398,073		$ 385,000		$600,124	$390,000		$190,000	$8,930,000	New trailers every 8 years				
13	2030		$709,508	$806,327		$651,040	$443,312	$155,762	$4,398,073		$ 175,000		$600,124	$190,000		$190,000	$8,319,000					
14	2031		$709,508	$803,707		$651,040	$445,183	$155,762	$4,398,073		$ -		$600,124	$190,000		$190,000	$8,143,000					
15	2032		$709,508	$801,199	$346,000	$651,040	$446,975	$155,762	$4,398,073		$ -		$600,124	$190,000		$190,000	$8,489,000					
16	2033		$709,508	$798,779		$651,040	$448,704	$155,762	$4,398,073		$ 235,000		$600,124	$190,000		$190,000	$8,377,000					
17	2034		$709,508	$796,606		$651,040	$450,256	$155,762	$4,398,073		$ -		$600,124	$390,000		$190,000	$8,341,000					
18	2035		$709,508	$794,508		$651,040	$451,754	$155,762	$4,398,073		$ 935,000		$600,124	$190,000		$190,000	$9,076,000					
19	2036		$709,508	$792,447	$200,000	$651,040	$453,226	$155,762	$4,398,073		$ -		$600,124	$190,000		$190,000	$8,340,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$790,523		$651,040	$454,601	$155,762	$4,398,073		$ 550,000		$600,124	$190,000		$190,000	$8,890,000	New trailers every 8 years				
21	2038		$709,508	$788,710		$651,040	$455,896	$155,762	$4,398,073	$8,850,000	$ -		$600,124	$190,000		$190,000	$16,989,000				Construction Cell 2	
22	2039		$709,508	$786,972		$651,040	$457,137	$155,762	$4,398,073		$ 35,000		$725,124	$390,000		$190,000	$8,499,000					
23	2040		$709,508	$785,296		$651,040	$458,334	$155,762	$4,398,073		$ 175,000	$ 1,350,000	$725,124	$190,000		$190,000	$9,788,000	Major capital upgrade every 20 years			Closure Cell 1	
24	2041	$1,555,125	$709,508	$783,620		$651,040	$459,531	$155,762	$4,398,073		$ 385,000		$725,124	$190,000		$190,000	$10,203,000					
25	2042		$709,508	$780,403		$651,040	$461,829	$155,762	$4,398,073		$ -		$725,124	$190,000		$190,000	$8,262,000					
26	2043		$709,508	$777,171		$651,040	$464,138	$155,762	$4,398,073		$ 200,000		$725,124	$190,000		$190,000	$8,461,000					
27	2044		$709,508	$773,922	$200,000	$651,040	$466,459	$155,762	$4,398,073		$ -		$725,124	$390,000		$190,000	$8,660,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$770,656		$651,040	$468,791	$155,762	$4,398,073		$ 35,000		$725,124	$190,000		$190,000	$8,494,000	New trailers every 8 years		Amotization period over		
29	2046		$709,508	$767,375		$651,040	$471,135	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,548,000					
30	2047		$709,508	$764,077		$651,040	$473,491	$155,762	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$7,132,000					
31	2048		$709,508	$760,763		$651,040	$475,858	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,546,000					
32	2049		$709,508	$757,432		$651,040	$478,237	$155,762	$2,687,721		$ -		$725,124	$390,000		$190,000	$6,745,000					
33	2050		$709,508	$754,084		$651,040	$480,629	$155,762	$2,687,721		$ 1,075,000		$725,124	$190,000		$190,000	$7,619,000					
34	2051		$709,508	$750,720	$241,000	$651,040	$483,032	$155,762	$2,687,721		$ 35,000		$725,124	$190,000		$190,000	$6,819,000					
35	2052		$709,508	$747,338	$2,615,000	$651,040	$485,447	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$9,157,000		New trailers every 8 years			
36	2053	$200,000	$709,508	$743,940		$651,040	$487,874	$155,762	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$7,326,000	New trailers every 8 years				
37	2054		$709,508	$740,525		$651,040	$490,314	$155,762	$2,687,721		$ -		$725,124	$390,000		$190,000	$6,740,000					
38	2055		$709,508	$737,093		$651,040	$492,765	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,539,000					
39	2056		$709,508	$733,643		$651,040	$495,229	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,538,000					
40	2057		$709,508	$730,177		$651,040	$497,705	$155,762	$2,687,721		$ 585,000		$725,124	$190,000		$190,000	$7,122,000					
41	2058		$709,508	$726,693		$651,040	$500,194	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,536,000					
42	2059		$709,508	$723,192		$651,040	$502,695	$155,762	$2,687,721		$ 35,000		$725,124	$390,000		$190,000	$6,770,000					
43	2060		$709,508	$719,673	$200,000	$651,040	$505,208	$155,762	$2,687,721		$ 175,000		$725,124	$190,000		$190,000	$6,909,000	Major capital upgrade every 20 years	New trailers every 8 years			
44	2061	$1,755,125	$709,508	$716,136		$651,040	$507,734	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$8,288,000	New trailers every 8 years				
45	2062		$709,508	$712,582		$651,040	$510,273	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,532,000					
46	2063		$709,508	$709,010		$651,040	$512,824	$155,762	$2,687,721		$ 235,000		$725,124	$190,000		$190,000	$6,766,000					
47	2064		$709,508	$705,420		$651,040	$515,388	$155,762	$2,687,721		$ -		$725,124	$390,000		$190,000	$6,730,000					
48	2065		$709,508	$701,813		$651,040	$517,965	$155,762	$2,687,721		$ 1,285,000		$725,124	$190,000		$190,000	$7,814,000					
49	2066		$709,508	$698,187		$651,040	$520,555	$155,762	$2,687,721		$ -		$725,124	$190,000		$190,000	$6,528,000					
50	2067		$709,508	$694,543		$651,040	$523,158	$155,762	$2,687,721		$ 550,000		$725,124	$190,000		$190,000	$7,077,000					
	Totals	$7,731,275	$33,346,853	$36,100,134	$4,202,000	$28,645,760	$20,830,081	$7,123,800	$166,431,825	$8,850,000	$11,045,000	$4,115,000	$36,496,800	$11,310,000	$10,382,338	$15,729,269	$402,342,000					

Sustane Facility Tipping Fee (operating cost & revenue) = *$53* per tonne
Capital cost annual payment = *$1,710,352* per year

30 years
$261,241,000 1,792,501 tonnes
$146 per tonne over 30 years

40 years
$332,392,000 2,448,090 tonnes
$136 per tonne over 40 years

50 years
$402,342,000 3,159,253 tonnes
$127 per tonne over 50 years

APPENDIX C: Vendor Response Memo – Increasing Capacity

Report on Follow-up Consultation with Technology Vendors

1.0 BACKGROUND

As part of a Waste to Energy Update Report for Comox Strathcona Waste Management (CSWM), SLR Consulting (SLR) was requested to assist Morrison Hershfield (MH) in some follow-up consultation with selected Technology Vendors, following an RfI process. The purpose of the consultation was to clarify the responses from two of the three Vendors selected by MH, from the evaluation of RfI responses, to represent a potentially suitable technology choice for future waste management in the two Regional Districts.

The two firms selected for further engagement were:

- Sustane Technologies Inc. (Sustane); and
- Waste Treatment Technologies Netherlands B.V. (WTT).

An initial set of questions, common to both Vendors, was developed by MH, to improve understanding of the firms' abilities to respond to higher annual plant throughputs than had been proposed in the original RfI and to provide more details of the cost implications of such increased waste volumes.

SLR were also asked to review the RfI submissions from the two Vendors and to develop any additional questions which might assist in better understanding the nature and suitability of the proposed technologies.

This report summarizes the findings of these two sets of questions. It should be read in conjunction with the documentation submitted by the two Vendors, which is included as Appendices 1 and 2, for Sustane and WTT respectively.

2.0 SUSTANE TECHNOLOGIES INC

Sustane acknowledge that their particular technology mix has not yet been fully tested on a commercial basis. They strongly assert however that the evidence from the operation of the Madrid plant, combined with the additional proprietary processes included in the mix, allow them to make a number of projections regarding the anticipated performance of their process. No operational performance evidence has been provided, however. In our view these performance assertions can only be indicative until full mass and energy balances have been made available.

2.1 Assessment by NS Dept. of Environment

Evidence has been provided to substantiate the assertions in Sustane's previous submissions that the technology mix has been subject to consideration by the Nova Scotia Dept. of Environment (DoE). While Sustane now stress that this was not a formal assessment process, it has enabled the DoE to state that Sustane's biomass fuel pellets segregated from mixed MSW "*would be considered a recovered product derived from the waste stream and eligible for inclusion in the* (Province's) *diversion credits program*". This is a slightly different statement than was given in Sustane's original RfI response, which suggested that the biomass pellets had been "*certified as recovered biomass, by the DoE*".

2.2 Thermal De-bonding Process

Sustane have confirmed that the preliminary "*thermal de-bonding process*" referred to in their submission is some form of autoclave. In SLR's experience this means that Sustane will need significant odour control and steam recovery post/during operation. Subject to exact operating conditions this is likely to require significant water removal treatment, either as a vapour when opening the vessel post-operation and/or during the operating process.

The autoclave is said to operate at a temperature above 130°C. At this temperature the autoclaving process must be at ~2.7 Bar. There is energy used in achieving this pressure and in the time and temperature elements of such a scheme. Such energy is in addition to a similar amount of energy required by a non-autoclaving separation scheme; therefore we cannot see how such a scheme could operate at lower energy consumption than comparable schemes, as stated in the Sustane submission. It is possible that they are somehow discounting the re-used energy from diesel generated from plastics, but if so this should not be double-counted in other energy balance assertions.

2.3 Moisture Content Post-autoclaving

The material entering the trommel screening process is said to have a moisture content of only 30%. This is an extremely low figure for biomass output from an autoclave and needs some further clarification as to how the process can achieve this. Further, Sustane give different figures for the moisture content reduction achieved by the belt dryer, in their answers to Questions 3 (15%) and 4 (10%).

2.4 Process Residues

Process residues are stated to be around 10% by weight and to comprise rubber, wood pieces & some fabrics, which will go to landfill, plus glass & grit which should be clean enough for beneficial use, although no chemical analyses were provided by Sustane. We are skeptical about this until chemical analysis evidence is available and indeed Sustane acknowledge that they intend to landfill this stream until it is proven safe to divert.

2.5 Impacts of Increased Feedstock Delivery

An increase of feedstock inputs from 29Ktpa to 70Ktpa can be accommodated by Sustane and would involve an increase in Capex from around $25 to $27.5M, as set out in their original RfI submission. In their responses to our new questions, the firm also indicated that they would expect to make an annual allowance of $150,000 for unspecified capital works related to future improvements and upgrades of the plant. At 75Ktpa this allowance would be equivalent to adding a further $2 per tonne to the Opex costs.

Sustane indicate that increasing throughput should not impact on equipment downtime or operating availability. Opex would decrease incrementally from $75.42/t at around £47Ktpa throughput, to $54.45/t at 70Ktpa, before allowing for the capital works allowance referred to above.

2.6 Progress Monitoring

Subject to the timing by which CSWM propose to reach a conclusion on the selection of a preferred technology, we would recommend that they monitor the progress of developments at Sustane's Chester, NS plant and take up the invitation to visit the site once actual performance data have been corroborated by the advisory team.

3.0 WASTE TREATMENT TECHNOLOGIES NETHERLANDS B.V.

Unlike Sustane, WTT is an established company with a track record of numerous operational installations. They recently responded to an RfI process which SLR is managing on behalf of an Ontario Municipality and this has provided reference material which is consistent with the data provided to CSWM.

3.1 Compost Quality

In response to our question regarding how the use of a compost product from the process will align with current BC regulations, WTT have simply quoted an extract from the OMRR. Compost, even as Class B, is required to be "…*only derived from organic matter*…" It is our understanding that such compost can only be derived from source-segregated organic matter (which would be in line with EU and UK regulation).

We therefore suggest that the material may not be suited to land application except under special circumstances which may be defined elsewhere in BC legislation. It is recommended that clarification is sought from BC MoE as to the precise nature of the applications that composted MSW can be utilised for.

3.2 RDF/SRF Specification

In responding to our enquiry regarding potential materials which could be extracted in an optimized recycling system, WTT's response seems to imply that any rejects can go into RDF generation. However, they are also advocating an SRF specification for use in cement kilns, which requires a tight specification which might be in conflict with this concept. It is likely that the potentially conflicting responses simply reflect the very early conceptualization stage of a new facility to serve the CSWM area.

3.3 Plastics Contamination

WTT indicate that segregated plastics from their process will have a purity of "*over 80%*". This is a surprisingly low figure for a modern plant using infrared sensors and may reflect a misunderstanding of the question. It may be because they are rejecting plastics from organic streams to improve the organics quality as far as possible, resulting in a very low purity plastic. The inclusion of the HDPE and PET segregation options would be beneficial to improving the purity of plastics collected.

3.4 Impacts of Increased Feedstock Delivery

An increase of feedstock inputs from 29Ktpa to 70Ktpa could be accommodated by WTT, by running a 3 shift system for the mechanical separation stage of the process. This would give a modest margin of spare capacity with no significant increase in Capex and only a pro-rata increase in Opex, relating to labour, power and consumables. The alternative approach, using higher capacity processing equipment would result in a higher Capex, but could allow a lower unit Opex, from the lower labour costs of a 2 shift system as well as from extended life of plant operating below capacity.

WTT only provided limited numerical data to indicate how Capex would change with increased feedstock deliveries, as follows:

- Mechanical separation - None if change to 3 shift system;
- Anaerobic digestion - Additional $1.4 – 1.6M Capex;
- Composting - Additional £0.8 – 1.0M Capex.

WTT did not provide any information on additional Opex costs of increased throughput. They state that "*labour costs per tonne would go up as soon as new shift needs to be started",* but in our view this is unlikely. While overall labour costs of the operation will go up, the labour costs per tonne should stay the same, assuming management costs are measured separately.

3.5 Impacts of Including HDPE & PET Extraction

In their original RfI response WTT indicated an option to include extra equipment allowing the segregation of HDPE and PET plastics. The firm indicates that this would involve the overall Capex increasing by $1.5M. It is not made clear whether this figure applies to the lower or higher proposed plant throughput, but given the context of the response, we believe that it is based on a 70Ktpa plant.

WTT estimate that addition of the HDPE & PET separation will increase Opex by only $3 – 4/t processed.

4.0 CONCLUSION

Overall we do not think either Vendor is saying anything unexpected. However in many instances they are making comment about what **might** be possible in a proposed system, rather than what they would expect to be achieved from a facility, with the given technology mix and market circumstances.

If the project is to proceed through a formal RfP process or ITT, specifications for performance and for outputs will need to be very tightly managed in the supporting documents and in the final contract, to ensure that there are appropriate safeguards with respect to performance liability and performance achievement. This may seem obvious but it will need some careful consideration to ensure that business models and technical assumptions can be realised and followed, along with realistic targets and attainable performance criteria.

Appendix 1

Clarification responses from Sustane

Follow-up Questions for Selected Technology Providers

1. We note the following statements in your RfI submissions:

   a) "*The biomass pellets are not considered a refuse derived fuel (RDF) as they contain virtually zero plastics and have been certified by Dept. of Environment, Nova Scotia as recovered biomass, with all the attributes of forest based biomass*". (Page 2 of RfI response, July 14th 2017).

   b) *"From a technical and environmental viewpoint burning conventional RDF in a paper mill biomass boiler is a non-starter. In contrast, Sustane's clean, dry biomass is already enthusiastically greeted by the local mills. Note that it is endorsed by Nova Scotia department of Environment and we have a long term off-take from Emera Energy in Nova Scotia".* (Letter to Morrison Hershfield, Aug 8th 2017).

Please explain the basis upon which the technology has been formally assessed by the Nova Scotia Dept. of Environment and provide any relevant supporting documentary evidence. This relates specifically to the nature of the original feedstock and the extent of any trials used to generate a representative sample for testing. Also what analysis has been made with regard to heavy metals and other contaminants excluding plastics?

Answer:

I do not believe that we suggested that the Nova Scotia (NS) Department of Environment "formally assessed" the technology at a detailed level. What they did do is review the general process flows and product specifications, specifically the contaminants characterization, and made a determination that the process was classified as recycling. This means that under the NS rules, the products are designated as non-waste, when consumed. A copy of this letter, signed by the NS Minister of Environment is attached.

Regarding trials, Sustane's co-founder operated a facility in Spain utilizing his original (patented) thermal de-bonding and separation system with over 5 years of successful operation. In 2014, Sustane was founded to take this base to the next level by adding proprietary biomass cleaning stages and then subsequently by separating and selectively pyrolyzing the plastics stream to synthetic diesel. We performed extensive trials of this cleaning process at a scale of 200 metric tonnes per day stream rate until it was perfected. We achieved sustained plastics levels of less than 0.2% in the biomass. Glass and silica is under 1% and heavy metals were within NS composting levels.

For the biomass offtake on Vancouver Island, I have many years of personal work experience in many of the pulp and paper mills on the coast (from my pulp and paper career). These mills have strong interest in an offtake already, based on our product specification and we are working on formalizing expressions of interest from the mills in the near future. The synthetic diesel is suited to direct combustion or marine use (among many other applications) and we are currently developing this offtake as well. For interest sake, in Nova Scotia we have already secured offtake for 1.0 million litres and 1.5 million litres respectively with industrial fuel oil customers. In addition, we have commitments to burn volumes in commercial, municipal and provincial buildings.

2. Section 7. on P10 of your RfI submission refers to the original Madrid plant from which the Sustane technology has been developed. We appreciate that there is no commercial relationship between Sustane and the current operator of this plant. However, in the absence of data from a current operational Sustane facility, we would be interested in any further information you can

provide regarding the operating performance of the Madrid plant. This could include the following:

- Feedstock origin and description/specification;
- Overall mass & energy balance for the facility, including:
  - Biomass feedstock generated, as % of waste input by weight;
  - Actual calorific value of the biomass pellets;
  - Actual calorific value of the synthetic diesel product;
  - Char residues generated through the pyrolysis process, as a % of waste input;
  - Indicative chemical analysis for any typical residues generated;
  - Typical residue to final disposal, as % of waste input by weight;
- Any information on actual air emissions from the operations.

Answer:

Feedstock origin was Madrid mixed MSW. Note that the material was designated as post recycling, but we noted high levels of food and also high levels of yard waste, some C&D waste and significant sand (street sweepings).

As noted above, the Madrid facility is only similar in the first three stages (shredding, autoclaving and trommel separation). The Sustane process adds several additional stages to fully separate components, clean the biomass plus plastics separation, preparation, pyrolysis and distillation. We have tested all components at full scale however the Chester facility is the first full implementation of the overall concept. It will be operational in the Summer of 2018. That said, we can share our general understanding of the Madrid process details as follows:

- Biomass feedstock generated, as % of waste input by weight;
  Biomass generated was approx. 55% of MSW by weight. Note that in Madrid, this biomass was then further processed in an anaerobic digester which is not the path Sustane has followed.

- Actual calorific value of the biomass pellets;
  No pellets were produced in Madrid. Biomass product was going to A.D. Testing for our pellets produced in trials in Spain indicate a range from 15 mj/kg to 16 mj/kg (at 10% moisture). Note that ash levels in Spanish MSW are much higher than we will see in Canada so we project 17 mj/kg in Canada.

- Actual calorific value of the synthetic diesel product;
  Again, no diesel was produced in Spain. We have licensed a system that is operating in the US and it delivers a product of 46 mj/kg.

- Char residues generated through the pyrolysis process, as a % of waste input;
  1% to 2% of plastic input to the pyrolysis system so assuming 20% plastics in MSW and 70% of plastics as suitable it will be a maximum of 0.14% to 0.28% of the MSW input, assuming optimal utilization of plastics.

- Indicative chemical analysis for any typical residues generated;
  Residues are sand, glass and light inorganics plus odd materials such as rubber, wood pieces and some fabrics. We have chemical analysis on the glass, grit stream which indicates is does not need to be landfilled and we expect to find a beneficial use. We will landfill this stream however until it is tested and proven safe to divert.

- Typical residue to final disposal, as % of waste input by weight;
  Based on our tests and process modelling from Nova Scotia MSW characterizations, we project residue between 8% and 12% of input MSW by weight.

- Any information on actual air emissions from the operations.
  For the Madrid plant there were no designated air emissions points. Note that the cooking process is fully closed with no vapour venting. For the Chester plant we have detailed projections based on testing of individual processes.
  This data is part of our operating/environmental permit application. In summary, there is no liquid effluent and air emissions are limited to a low level of VOC from the biomass dryer plus typical combustion by-products from the combustion of a portion of the synthetic diesel (approx. 25%) which is used to fuel the boiler and biomass dryer and approximately 10% of the vaporized plastic in non-condensable form that is used to heat the pyrolysis reactors.

3. Para (b) on P3 of your submission includes a simple process flow sketch which provides a helpful overview. A number of other Technology Vendors have provided a more detailed process flow diagram which incorporates the anticipated tonnages of materials at each step in their process. We recognize that Sustane does not yet have a full-scale reference facility from which to obtain operating data, however it would be helpful to have a diagram which enables us to understand how the tonnage data in the table on P5, is derived.

Answer:

Unfortunately, many of our internal process flows are highly proprietary with several process technologies and configurations and are the basis of Sustane's unique value proposition. At this time, we are not prepared to share this information, even under an NDA.

Pages 2 and 3 of the RfI response references your "*proprietary de-bonding, separation and cleaning processes…*", "*…thermo-mechanical de-bonding…*"and "*…patented continuous thermal de-bonding unit*" among the descriptions of process operations. Can you provide clear information about how this plant will achieve the stated high levels of separation, cleaning and efficiency, including:

a. Process operations employed to pulp and 'slurrify' the feedstock;
b. Temperatures employed for the thermo-mechanical de-bonding;
c. Types of separation schemes used i.e. screening methods i.e. ballistic separation, trommel, vibratory screens etc;
d. De-watering and drying processes to achieve clean dried outputs and/or water content of any outputs from the process.

Answer:

a. Process operations employed to pulp and 'slurrify' the feedstock;
   This is achieved using a series of proprietary thermal de-bonding, conditioning chambers. Shredded MSW is subjected to a temperature above 130C for an extended period while exerting a unique mechanical action that has the effect of causing plastics to soften and shrink while not sticking to the biogenic material (fibres).
b. Temperatures employed for the thermo-mechanical de-bonding;
   See above
c. Types of separation schemes used i.e. screening methods i.e. ballistic separation, trommel, vibratory screens etc;

For metals we use magnets and eddy current separators. For initial separation of biomass stream we use a proprietary trommel. For separation of the residual plastics and inorganics from the biomass stream, we use a proprietary mechanical technology developed in house.

d. De-watering and drying processes to achieve clean dried outputs and/or water content of any outputs from the process.
Biomass separated from the first trommel enters a low temperature belt dryer at approximately 30% moisture and exits at 15% moisture. The dryer is a fabric belt design that uses air at 110C to perform the drying. Fuel for the dryer is from a portion of the synthetic diesel produced.

4. Do the operating costs set out on P10 of your submission fully incorporate all costs associated with the drying of the output material from the thermal de-bonding stage and the management of related process waters?

Answer:

Yes, it is all inclusive of drying biomass to 10% moisture. Note that at higher production volumes, the operating costs will be reduced (see below)

5. We note in para (c) on P5 of your RfI submission that your technology should have the capacity to accommodate increasing tonnages as projected in the table below. Please confirm this is correct, subject to provision of the necessary additional equipment.

Year	Projected tonnage
2021	29,000
2026	52,000
2031	54,000
2036	56,000
2041	57,000
2046	60,000
2051	62,000
2056	65,000
2061	68,000
2066	70,000

Answer:

Yes, the proposed design and equipment configuration can accommodate up to 75,000 tonnes per year of MSW capacity.

6. How would these increased throughputs affect planned downtime? (We note in para (f) on P6 of your RfI submission, that you anticipate an operating availability of 90%). Please advise anticipated operating performance and any changes resulting from increased throughputs.

Answer:

Increasing capacity will not affect the expected downtime or operating availability as all equipment is correctly sized for 75,000 tonnes per year and can readily process the proposed volumes.

7. How would the increased throughput affect operating and maintenance cost? (Provide additional $/tonne or % change).

Answer:

Assuming operation at 75,000 tonnes per year, operating costs (which includes maintenance costs) will be reduced as per the following table;

Annual Capacity (MSW Tonnes)	**46,557**	**50,000**	**60,000**	**70,000**
VARIABLE	$/t MSW	$/t MSW	$/t MSW	$/t MSW
Pellet transport	5.57	5.57	5.57	5.57
Diesel transport	1.09	1.11	1.07	1.13
Royalties for technology	11.56	11.59	11.54	11.61
Energy (steam)	0.94	0.94	0.94	0.94
Energy (electricity)	11.37	10.58	8.82	7.56
Water treatment	0.11	0.10	0.08	0.07
Residue disposal	3.32	0.00	0.00	0.00
FIXED				
Water supply	0.21	0.20	0.17	0.14
Waste water management	0.21	0.20	0.17	0.14
Maintenance (spares and materials)	8.00	7.45	6.21	5.32
Equipment lease	3.76	3.50	2.92	2.50
Operating consumables	0.54	0.50	0.42	0.36
Hourly labour	15.45	14.39	11.99	10.28
Salaries	7.80	7.27	6.06	5.19
Other fixed	5.48	5.10	4.25	3.64
TOTAL	**75.42**	**68.50**	**60.20**	**54.45**

8. How would the increased throughput affect the capital cost of the facility? (Consider the facility and overall waste management system costs are projected over 50 years. Include anticipated potential minor and major upgrades, along with proposed scheduling thereof).

Answer:

As noted in our submission on page 9, 5 (b), assuming an increase in capacity to 75,000 tonnes per year (from the original design basis), the additional capital cost is estimated to be 2.5 million for a total of $27.5 million. We would allow for $150,000 per year for "maintenance of business" capital improvements and upgrades.

9. Processes need to be optimized for recycling, within reasonable expectations of market conditions (but without going overboard). Please advise which additional materials could be extracted, at what cost, and what the ultimate residual going to landfill would be as a percentage of input (by weight).

Answer:

Sustane's process will recover approximately 90% of the MSW destined for landfill. We are performing additional analysis on the residual product (glass/grit stream) that comprises the remaining 10% to better understand its composition and potential future value. In addition to this research, our team is currently working with companies in the construction industry to explore possible uses for these mixtures that currently are not included in the 90% diversion.

NOVA SCOTIA
Environment
Office of the Minister

PO Box 442, Halifax, Nova Scotia, Canada B3J 2P8 • www.novascotia.ca/nse

DEC 22 2015

Our File number:

Mr. Peter Vinall
Sustane Technologies Inc.
3770 Kempt Road, Suite 110
Halifax NS B3K 4X8

Dear Mr. Vinall:

Thank you for your email of December 7, 2015, regarding Sustane Technologies Inc. and your system for producing fuel pellets from components of the mixed municipal solid waste stream.

Nova Scotia Environment considers that the proposed technology for separating and recovering biomass from mixed municipal solid waste is distinct from incineration and is a beneficial use of wastes that would otherwise be landfilled. This is consistent with the commonly accepted waste hierarchy, where recovery is a preferred option to landfilling.

The resulting biomass fuel pellets along with other recyclable materials would be considered a recovered product derived from the waste stream and eligible for inclusion in the diversion credits program. Please note that payment of the credit is to the municipality that generated the waste materials and not to the processor.

Utilization of pellets by Nova Scotia Power in their Brooklyn facility will require an amendment to their industrial approval. Amendments can be considered by way of a formal application, which will be given every consideration. Nova Scotia Power can contact Johnathan MacDonald, District Manager at 902-527-5945 in our Bridgewater office to discuss the regulatory implications.

The mixed municipal solid waste required by the Sustane Technologies Inc. facility can be sourced from any municipality. However, Nova Scotia Environment does not possess the ability to direct a municipality to supply Sustane Technologies with waste resources. To discuss the regulatory implications of a proposed facility for the manufacture of fuel pellets, you should also contact our Bridgewater office.

In closing, thank you for your efforts to divert waste in NS. Through your efforts and the efforts of all Nova Scotians we will continue to lead the way in diverting waste from disposal.

Sincerely,

Randy Delorey, MLA
Minister of Environment

c: J. MacDonald, District Manager, Bridgewater

Appendix 2

Clarification responses from WTT

Follow-up Questions for Selected Technology Vendors

1. On P19 of your RfI submission you indicate that your process can generate a compost from MSW feedstock that will be suitable for land application. We note your comment that regulatory aspects would be elaborated in a subsequent project stage. However, it would be helpful for us to understand how this proposed use will align with the current regulatory regime in British Columbia, regarding application of wastes to land.

Answer:

Compost will be produced as defined in the BC Organic Material Recycling Regulation (OMRR) – section 1 - definitions:

> ***"compost"*** *means a product which is*
>
> *(a) a stabilized earthy matter having the properties and structure of humus,*
>
> *(b) beneficial to plant growth when used as a soil amendment,*
>
> *(c) produced by composting, and*
>
> *(d) only derived from organic matter*

It would be an Class B Compost – Division 6 of the OMRR:

> ***'Process and quality criteria***
>
> ***14*** *(1) Compost that meets the requirements of all of the following is Class B compost:*
>
> *(a) Schedule 1, Pathogen Reduction Processes;*
>
> *(b) Schedule 2, Vector Attraction Reduction;*
>
> *(c) Schedule 3, Pathogen Reduction Limits;*
>
> *(d) Column 3 of Schedule 4, Quality Criteria;*
>
> *(e) Schedule 5, Sampling and Analyses — Protocols and Frequency;*
>
> *(f) Schedule 6, Record-keeping.*
>
> *(2) Class B compost must be derived only from organic matter.*
>
> ***Land application***
>
> ***15*** *(1) Class B compost must only be applied to land in accordance with*
>
> *(a) a land application plan for Class B compost,*
>
> *(b) the methodology specified in Schedule 8, and*
>
> *(c) the soil substance concentrations specified in Schedule 10.1, or the site-specific numeric soil standards approved by a director.*
>
> *(2) The land application plan must, before land application, be made available to the registered owner of the land.*
>
> *(3) Class B compost must not be land applied in a watershed used as a permitted water supply under the Drinking Water Protection Regulation, B.C. Reg. 200/2003.'*

2. On P18 of your RfI submission you have set out your understanding of the specification requirements of the BC cement manufacturers. Can you provide evidence of RDF production from one of your reference facilities which is able to consistently meet this specification?

Answer:

Veolia Southwark is producing an Refuse Derived Fuel (RDF) which is a pre-Solid Refuse Fuel (SRF) for cement kiln fuel. The material of Veolia Southwark is complying as the RDF fraction of proposed mechanical separation process will comply with SUBCOAL® Production General Acceptance Guideline as provide in Appendix 1.

The RFD will be upgraded to a cement kiln grade quality fuel or SRF. Analyses of a SRF for cement kilns produced from RDF is provide in Appendix 2.

3. The Regional District has asked us to consider the implications of increasing volumes of feedstock being delivered to the facility over the next 50 years. Would the WTT technology have the capacity to accommodate increasing tonnages as projected in the table below?

Year	Projected tonnage
2021	29,000
2026	52,000
2031	54,000
2036	56,000
2041	57,000
2046	60,000
2051	62,000
2056	65,000
2061	68,000
2066	70,000

Answer:

Our RFI response was based on the process-flow mass balance as presented is Appendix B of our RFI submission. The presented capacity was 46,557 tpy.

Mechanical Treatment/Separation:
Equipment capacity: 10 – 15 tph/2 shifts resulting in a capacity of app. 50,000 tpy

- *up to 25,000 tpy only 1 shift is needed*
- *above 50,000 tpy 3 shifts are needed*

Life cycle analyses are indicating, that the main mechanical equipment, such as shredders and screens, should be replaced every 7-9 year. It could be considered to replace by a higher capacity equipment e.g. approximately 25 tpy, so that only 2 shifts remain necessary.

Anaerobic Digestion

10 AD reactors + 1 logistic AD reactor/28 days average cycle duration

- *25,000 tpy: 10 AD reactors + 1 logistic AD reactor are needed if 28 days cycle duration*
- *70,000 tpy: 14 AD reactors + 1 logistic AD reactor are needed if 28 days cycle duration*

The Anaerobic Digestion system is a modular system. For optimal operation/logistic conditions is calculated with one AD reactor for app. 5,000 tpy. An AD reactor can be designed smaller or bigger. The cycle duration or residence time will probably vary between 21 and 28 days: 28 days in the winter and 21 days during peak seasons Spring and Fall.

Composting
16 composting tunnels/14 days average cycle duration

- *25,000 tpy: 8 composting tunnels are needed for 14 days residence time*
- *70,000 tpy: 22 composting tunnels are needed for 14 days residence time*

The composting tunnels are a modular system. For optimal operation/logistic conditions is calculated with the same size anaerobic and composting tunnels. A composting tunnel can be designed smaller or bigger. In a final design the composting tunnels will probably be bigger e.g. at least 5,000 tpy per tunnel.

4. How would these increased throughputs affect planned downtime? (MH have currently assumed that most maintenance can be achieved in 3 days and that there is one plant shutdown for about 14-15 consecutive days per year). Please advise anticipated operating performance and any changes resulting from increased throughputs.

Answer:

Mechanical Separation: *The operations will be based on preventive maintenance (replacement before completely worn and unexpected stops may be expected). Daily cleaning and maintenance is included in the 2-shift operation. Periodic maintenance shutdowns will be carefully planned, prepared and executed within 3 days. All maintenance will be included in the maintenance management program and manuals.*

Anaerobic Digestion/Composting: *These 24/7 operations. Maintenance of reactors and/or tunnels will be planned when the supply of feedstock is minimal, which is during winter. It's our and others experience, that no other measures, such as diversion or storage of feedstock, are not necessary.*

5. How would these increased throughputs affect operating and maintenance cost? (Provide additional $/tonne or % change).

Answer:

Cost of maintenance and labour per tonne will be rather constant, because of modular approach and capacity increase by extension of the number of shifts. The labour costs per tonne will go up as soon as new shift needs to be started.

6. How would these increased throughputs affect the capital cost of the facility? (Consider the facility and overall waste management system costs are projected over 50 years. Include anticipated potential minor and major upgrades, along with proposed scheduling thereof).

Answer:

Mechanical Separation: *CAPEX will not be much affected if the production will be increased by extension of the number of shifts. If for a lifecycle replacement will be chosen for higher capacity equipment, it will probably be done because of a lower overall cost; a slightly higher invest in combination with a bigger operational/personal cost reduction*

Anaerobic Digestion/Composting:

- *Anaerobic Digestion Reactor: 1,400,000 – 1,600,000 $*
- *Composting Tunnel: 800,000 – 1,000,000 $*

7. Processes need to be optimized for recycling, within reasonable expectations of market conditions (but without going overboard). Please advise which additional materials can be extracted, at what cost, and what the ultimate residual going to landfill will be as a percentage of input (by weight).

Answer:

Additional extraction of additional recyclables e.g.. cardboard, paper and plastics, will not result in higher waste diversion rates. These Material would otherwise be part of the RDF fraction.

8. How much would the inclusion of HDPE separation, PET separation and a drum dryer add to the capital cost?

Answer:

- *HDPE-separation* *app. 750,000$*
- *PET-Separation* *app. 750,000 $*
- *Drum Dryer (inc.l Cyclone, Dust filter and stack):* *app. 2,400.0000 $*

9. How would the inclusion of HDPE and PET extraction affect:
    - The overall diversion rate and quantity of generated product?
    - The operation cost ($/tonne processed)?
    - The maintenance costs ($/tonne processed)?

Answer:

The decision of the implementation of HDPE and/or PET extraction would be based of financial analyses; what would be the cost to extract the recyclables versus the revenues of the recyclables.

- *Overall diversion rate would remain the same: HDPE and PET would otherwise be part of the RDF fraction.*
- *The operation cost : < 2 $/tonne processed*
- *The maintenance costs: 1 - 2 $/tonne processed (depending on the volumes*

10. At the staffing and equipment levels upon which your suggested operating costs are based, what would be the typical levels of contamination that you would expect to see in the individual stockpiles of recycled materials?

Answer:

The contamination levels would be at a level as required by the processing industry. Plastics will have a purity of over 80% and will not contain metals and/or mineral grid. Other recyclables, such as metals and plastic, will contain much less contaminants. The quality of the recyclables will result in such revenues that will legitimate the extractions costs.

11. We appreciate that the project parameters are not yet developed sufficiently to present accurate costs. It would however be very useful if you could provide an indication of typical figures for the main categories of operating costs, for a facility accepting MSW at the proposed initial input rate at CSRD ($/tonne processed)?

Answer:

The estimates for the overall capital and operating costs are presented in the table on page 24 of our RFI submission:

Costs	*Option 1*	*Option 2*	*Option 3**
Capital Cost ($)	*10,000,000*	*15,000,000*	*26,000,000*
Operating Costs ($/t)	*40 - 60*	*70 - 110*	*80 - 120*

**: Without options HDPE separation, PET separation and drum dryer*

Appendix 1: SUBCOAL® Production General Acceptance Guideline

SUBCOAL PRODUCTION GENERAL ACCEPTANCE GUIDELINE

MAY 2017

SUBCOAL®

SUBCOAL® INTERNATIONAL B.V.




GENERAL ACCEPTANCE SPECIFICATIONS GUIDELINE

Acceptance criteria guideline for non-recyclable paper-plastic waste fractions coming from various waste sources. This format acts as a guideline for the input feed into the Subcoal process, every individual case can choose to accept materials outside of the guideline if this fits in the input mix. Guideline is based on standard production but can differ depending on technology which is used.

Preferred European waste codes (eural):

- **19.12.10** *(preferred)*
- **19.12.12**
- **19.12.04**
- **03.03.07** *(only for waste from paper mills)*

Minimum acceptance criteria:

Preferred dry substance	**> 75%**
Max moisture	**50%**
Typical value of ash (815ºC)	< 15% on dry base
Max ash content	20%
Preferred value of chlorine	**< 0,7% on dry base**
Max value of chlorine	**< 1,2% on dry base**
Value of sulphur	< 0,1% on dry base
Particle size	< 500 mm x 500 mm
Calorific value	> 20 MJ on dry base
Sum heavy metals	< 800 mg/kg

Preferred values for:

Biomass-%	> 50%
Copper (Cu)	< 50 mg/kg on dry base
Nickel (Ni)	< 10 mg/kg on dry base
Aluminium (A)	< 10.000 mg/kg on dry base

General acceptance criteria:

Excluded from the waste acceptance are harmful to the technical equipment, the environment and the workers, such as in particular:

- Non-combustible materials and waste, such as Soil, gravel, stones, sand, slag, slag, glass and mineral wool
- Organic waste
- Mono batches of e.g. plastic granules, fine dusts
- Batteries, rechargeable batteries, refrigerators, televisions, computer screens, light-emitting fluorescent tubes
- Flammable and highly flammable substances, explosives, fireworks, ammunition
- Toxic substances
- acids, alkalis, corrosive substances
- Radioactive substances
- Hospital waste, carcasses

- Cytostatics
- Solid metal objects, e.g. the endanger the plant
- Metal and aluminum foils, metal dust or metal chips, in particular of light metals such as aluminum, magnesium, beryllium
- Outgassing, reactive substances
- Condensed gases
- All types of liquids

If upon inspection the input materials include the above mentioned items, the material can be rejected and send back to its original location.

Delivered materials should not include:

- Large particles (> 500 mm x 100 mm)
- String, tape, rope, or any form of binding material > 100 mm
- Heavy particles such as ferro, non-ferro, minerals, etc.
- Rubber and foam-like materials
- Textiles and clothing
- Large pieces of hard plastics (> 100mm)
- PVC

The above can be a reason for rejection!

Preferred input material includes:

- High content of light folios and plastics
- High CV
- Low chlorine
- Low paper content
- Very low ash content
- < 100 mm particle size
- Low aluminium content (cans, folio)
- Freshly produced material (no old stocks)

Bale preferences:

▪ Wrapping	Preferred; > 6 layers of film
▪ Ties	Plastic or twinces
▪ Size	(WxLxH) < 1,30m x 1,50m x 1,50m
▪ Weight	Max 1,200 kg per bale

Reference photos:

Appendix 1: SRF analyses

GBA GESELLSCHAFT FÜR BIOANALYTIK MBH
Wiedehopfstraße 30 • 45892 Gelsenkirchen

Qlyte Operations B.V.

Kranssteenweg 2

9936 TH Farmsum

Test Report No.: 2014P202043 / 1

Order/Sample-No.	14200276 / 002
Date of Arrival	17.01.2014
Taking of samples	durch den Auftraggeber
Material	Abfall
Sample Name	Datum: 10-1-2014: Mengmonster 8mm pellets - duwbak RWE
Start / End of analyses	17.01.2014 - 12.03.2014

Parameter	Result	Unit	Methods
Appearance	Pellets		
Colour	mehrfarbig		
Sample amount	0,92	kg	
Sample preparation	Reißmühle		analogous DIN ISO 11464[a]
Dry weight	94,1	W.-%	DIN ISO 11465[a]
Chlorine, total	0,84	W.-% DW	DIN EN 15408 / DIN EN ISO 10304-1[a] 22
Copper (Cu)	38	mg/kg DW	DIN EN ISO 16171[a] 5
Nickel (Ni)	9,3	mg/kg DW	DIN EN ISO 16171[a] 5
Aluminum	23000	mg/kg DW	DIN EN ISO 22036[a] 5
Aluminum, metallic	19000	mg/kg DW	CEN/TS 15412 5
Higher heating value (dry)	24500	kJ/kg	DIN 51900[a] 22
Lower heating value (dry)	22800	kJ/kg	DIN 51900[a] 22
Lower heating value (as received)	21300	kJ/kg	DIN 51900[a] 22
Lower heating value (water and ash free)	25900	kJ/kg	DIN 51900[a] 22
Ashes (815°C)	12,1	W.-% DW	DIN 51719[a]
Bromine, total	0,0020	W.-% DW	DIN EN 15408 / DIN EN ISO 10304-1[a] 22
Fluorine, total	0,0040	W.-% DW	DIN EN 15408 / DIN EN ISO 10304-1[a] 22
Sulfur, total	0,087	W.-% DW	DIN EN 15408 / DIN EN ISO 10304-1[a] 22

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IBAN: DE 67 2004 0000 0449 6444 00
BIC: COBADEHHXXX

USt.-Ident-Nr.: DE 118 554 138
St.-Nr.: 47/723/00196
Sitz der Gesellschaft: Hamburg
Handelsregister:
Hamburg HRB 42774

Geschäftsführer:
Manfred Giesecke
Ralf Murzen
Dr. Roland Bernerth
Carsten Schaffors
Dr. Herwig Döllefeld

GBA
GESELLSCHAFT FÜR BIOANALYTIK MBH

Parameter	Result	Unit	Methods
Biomass	65,1	W.-% DW	CEN/TS 15440[a]
TC	52,3	W.-% DW	DIN EN 13137[a]
TIC	0,5	W.-% DW	DIN EN 13137[a]
TOC	51,8	W.-% DW	DIN EN 13137[a]
TOC biomass residue	73,4	W.-%	DIN EN 13137[a]
TOC biogen	26,2	W.-% DW	CEN/TS 15440[a]
TOC fossil	25,6	W.-% DW	CEN/TS 15440[a]
Nitrogen	0,21	W.-% DW	elemental analysis (GE-MA M-7-1)[a]
Hydrogen	6,4	W.-% DW	elemental analysis (GE-MA M-7-1)[a]
Oxygen	24,3	W.-%	elemental analysis (GE-MA M-7-1)[a]
Antimony (Sb)	11	mg/kg DW	DIN EN ISO 16171[a] 5
Arsenic (As)	<1,0	mg/kg DW	DIN EN ISO 16171[a] 5
Lead (Pb)	26	mg/kg DW	DIN EN ISO 16171[a] 5
Cadmium (Cd)	0,53	mg/kg DW	DIN EN ISO 16171[a] 5
Chromium, total (Cr)	17	mg/kg DW	DIN EN ISO 16171[a] 5
Cobalt (Co)	2,0	mg/kg DW	DIN EN ISO 16171[a] 5
Manganese (Mn)	45	mg/kg DW	DIN EN ISO 16171[a] 5
Mercury	0,19	mg/kg DW	DIN EN ISO 16171[a] 5
Selenium (Se)	<0,20	mg/kg DW	DIN EN ISO 16171[a] 5
Tellurium	0,088	mg/kg DW	DIN EN ISO 16171[a] 5
Thallium	<0,30	mg/kg DW	DIN EN ISO 16171[a] 5
Vanadium (V)	3,3	mg/kg DW	DIN EN ISO 16171[a] 5
Zinc (Zn)	209	mg/kg DW	DIN EN ISO 16171[a] 5
Tin	12	mg/kg DW	DIN EN ISO 16171[a] 5
Barium (Ba)	203	mg/kg DW	DIN EN ISO 16171[a] 5
Calcium (Ca)	27190	mg/kg DW	DIN EN ISO 16171[a] 5
Iron, total	2630	mg/kg DW	DIN EN ISO 16171[a] 5
Potassium	306	mg/kg DW	DIN EN ISO 16171[a] 5
Magnesium (Mg)	1150	mg/kg DW	DIN EN ISO 16171[a] 5
Molybdenum (Mo)	3,2	mg/kg DW	DIN EN ISO 16171[a] 5
Sodium	900	mg/kg DW	DIN EN ISO 16171[a] 5
Phosphorus (P)	180	mg/kg DW	DIN EN ISO 22036[a] 5
Silicon (Si)	2000	mg/kg DW	DIN EN ISO 16171[a] 5

With [a] marked methods are accredited methods. Detection limits may vary depending on the matrix of the sample.

Testing laboratory: 22GBA Herten 5GBA Pinneberg

other units:

Higher heating value (dry)	10500 Btu/pound
Lower heating value (dry)	9800 Btu/pound
Lower heating value (as received)	9200 Btu/pound
Lower heating value (water and ash free)	11100 Btu/pound

GBA
GESELLSCHAFT FÜR BIOANALYTIK MBH

Gelsenkirchen, 08.07.2014

Dr. Büschler
Laborleiter

APPENDIX D: Long-Term Cost Model – Increasing Capacity

Table D1: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley - Increasing Capacity

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819			29,278	83	21,152	1,168	9,808
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712			29,606	84	21,276	1,181	9,918
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614		Landfill closure	29,937	85	21,401	1,194	10,029
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507		21,521	50,963	145		2,032	17,073
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398		21,640	51,406	146		2,050	17,221
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281		21,754	51,844	148		2,067	17,368
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152		21,862	52,273	149		2,084	17,511
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014		21,967	52,696	150		2,102	17,653
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864		22,069	53,113	151		2,118	17,793
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697		22,166	53,520	152		2,135	17,929
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514		22,259	53,919	154		2,150	18,063
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320		22,349	54,310	155		2,166	18,194
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116		22,435	54,696	156		2,182	18,323
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879		22,513	55,063	157		2,196	18,446
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627		22,588	55,422	158		2,210	18,566
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371		22,661	55,779	159		2,224	18,686
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096		22,730	56,124	160		2,239	18,802
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805		22,795	56,461	161		2,252	18,914
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500		22,857	56,791	162		2,265	19,025
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187		22,917	57,116	163		2,278	19,134
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865		22,977	57,437	164		2,291	19,241
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808		23,091	57,901	165		2,309	19,397
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761		23,207	58,369	166		2,328	19,554
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723		23,323	58,841	168		2,347	19,712
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693		23,440	59,317	169		2,366	19,871
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673		23,557	59,797	170		2,386	20,032
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662		23,675	60,282	172		2,405	20,194
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660		23,793	60,771	173		2,424	20,358
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668		23,912	61,265	175		2,443	20,524
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,686		24,031	61,762	176		2,464	20,690
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712		24,152	62,264	177		2,484	20,858
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748		24,272	62,771	179		2,503	21,028
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794		24,394	63,282	180		2,524	21,199
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850		24,516	63,797	182		2,545	21,372
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916		24,638	64,317	183		2,566	21,546
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992		24,761	64,842	185		2,586	21,722
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078		24,885	65,371	186		2,608	21,899
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174		25,010	65,906	188		2,628	22,079
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281		25,135	66,444	189		2,651	22,259
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398		25,260	66,988	191		2,672	22,441
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526		25,387	67,536	192		2,694	22,625
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664		25,514	68,090	194		2,715	22,810
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813		25,641	68,648	196		2,738	22,997
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973		25,769	69,211	197		2,761	23,186
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144		25,898	69,779	199		2,783	23,376
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326		26,028	70,353	200		2,806	23,568
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519		26,158	70,931	202		2,829	23,762
Totals		4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	0	1,041,504	2,736,589			329,342	916,757

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,668	14,012	556	33	33	16,236	295,425	Cell 1	Cell 1	
5	2022	1,687	14,169	562	34	34	16,418	311,843	Cell 1	Cell 1	
6	2023	1,706	14,327	569	34	34	16,602	328,444	Cell 1	Cell 1	
7	2024	2,903	24,389	968	58	58	28,261	356,705	Cell 1	Cell 1	
8	2025	2,929	24,601	976	59	59	28,506	385,211	Cell 1	Cell 1	
9	2026	2,953	24,811	984	59	59	28,749	413,960	Cell 1	Cell 1	
10	2027	2,978	25,016	993	60	60	28,987	442,947	Cell 1	Cell 1	
11	2028	3,002	25,219	1,001	60	60	29,222	472,169	Cell 1	Cell 1	
12	2029	3,026	25,418	1,009	61	61	29,453	501,622	Cell 1	Cell 1	
13	2030	3,050	25,613	1,017	61	61	29,679	531,302	Cell 2	Cell 1	**517,470**
14	2031	3,072	25,804	1,024	61	61	29,900	561,202	Cell 2	Cell 2	
15	2032	3,095	25,991	1,032	62	62	30,118	591,320	Cell 2	Cell 2	
16	2033	3,117	26,176	1,039	62	62	30,331	621,651	Cell 2	Cell 2	
17	2034	3,137	26,352	1,046	63	63	30,534	652,185	Cell 2	Cell 2	
18	2035	3,158	26,523	1,053	63	63	30,733	682,919	Cell 2	Cell 2	
19	2036	3,178	26,694	1,059	64	64	30,931	713,850	Cell 2	Cell 2	
20	2037	3,199	26,859	1,066	64	64	31,124	744,974	Cell 2	Cell 2	
21	2038	3,218	27,021	1,073	64	64	31,311	776,285	Cell 2	Cell 2	
22	2039	3,236	27,179	1,079	65	65	31,493	807,778	Cell 2	Cell 2	
23	2040	3,254	27,334	1,085	65	65	31,673	839,450	Cell 2	Cell 2	
24	2041	3,272	27,488	1,091	65	65	31,851	871,301	Cell 2	Cell 2	
25	2042	3,299	27,710	1,100	66	66	32,108	903,410	Cell 2	Cell 2	
26	2043	3,325	27,934	1,108	67	67	32,368	935,777	Cell 2	Cell 2	
27	2044	3,352	28,160	1,117	67	67	32,630	968,407	Cell 2	Cell 2	
28	2045	3,380	28,387	1,127	68	68	32,894	1,001,301	Cell 2	Cell 2	
29	2046	3,408	28,617	1,136	68	68	33,161	1,034,462	Cell 2	Cell 2	
30	2047	3,435	28,849	1,145	69	69	33,429	1,067,891	Cell 2	Cell 2	
31	2048	3,463	29,083	1,154	69	69	33,701	1,101,592	Cell 2	Cell 2	
32	2049	3,490	29,320	1,163	70	70	33,973	1,135,565	Cell 2	Cell 2	
33	2050	3,519	29,558	1,173	70	70	34,250	1,169,815	Cell 2	Cell 2	
34	2051	3,548	29,798	1,183	71	71	34,529	1,204,344	Cell 2	Cell 2	
35	2052	3,576	30,040	1,192	72	72	34,809	1,239,153	Cell 2	Cell 2	
36	2053	3,605	30,285	1,202	72	72	35,092	1,274,245	Cell 2	Cell 2	
37	2054	3,636	30,531	1,212	73	73	35,379	1,309,624	Cell 2	Cell 2	
38	2055	3,665	30,780	1,222	73	73	35,667	1,345,291	Cell 2	Cell 2	
39	2056	3,695	31,032	1,232	74	74	35,958	1,381,249	Cell 2	Cell 2	
40	2057	3,726	31,285	1,242	75	75	36,252	1,417,501	Cell 2	Cell 2	
41	2058	3,755	31,541	1,252	75	75	36,547	1,454,048	Cell 2	Cell 2	
42	2059	3,786	31,798	1,262	76	76	36,847	1,490,895	Cell 2	Cell 2	
43	2060	3,817	32,059	1,272	76	76	37,148	1,528,043	Cell 2	Cell 2	
44	2061	3,849	32,321	1,283	77	77	37,452	1,565,495	Cell 3	Cell 2	**1,563,942**
45	2062	3,879	32,586	1,293	78	78	37,758	1,603,253	Cell 3	Cell 3	
46	2063	3,911	32,853	1,304	78	78	38,068	1,641,321	Cell 3	Cell 3	
47	2064	3,944	33,122	1,315	79	79	38,381	1,679,702	Cell 3	Cell 3	
48	2065	3,976	33,394	1,325	80	80	38,696	1,718,398	Cell 3	Cell 3	
49	2066	4,008	33,669	1,336	80	80	39,013	1,757,411	Cell 3	Cell 3	
50	2067	4,042	33,946	1,347	81	81	39,334	1,796,745	Cell 3	Cell 3	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 34% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 0.7 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table D1: Long Term Cost Model for Option 1(a) - WTT facility located in Comox Valley - Increasing Capacity

Capital and Operating Costs

Year		Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0				
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,141,495		$250,868	$1,052,753	$3,570,000			Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,141,495		$490,358	$1,052,753	$5,385,000			Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,141,495	$390,000	$191,695	$1,052,753	$2,776,000				Phase 2 Design and construction
3	2020	$200,000			$906,279		$ 1,075,000		$1,141,495	$190,000	$491,790	$1,052,753	$5,057,000	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021				$5,245,520		$ 35,000		$575,124	$190,000	$5,630,329	$1,052,753	$12,729,000		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022				$5,282,505		$ -		$575,124	$190,000	$0	$1,052,753	$7,100,000				
6	2023				$5,319,875		$ 35,000		$575,124	$190,000	$218,613	$1,052,753	$7,391,000				Phase 3 LFG and final cover design
7	2024		$651,040	$318,516	$7,691,586		$ -		$575,124	$390,000	$3,108,685	$190,000	$12,925,000				Phase 3 LFG and final cover construction
8	2025		$651,040	$320,269	$7,741,557		$ -		$575,124	$190,000		$190,000	$9,668,000				
9	2026		$651,040	$321,962	$7,790,963		$ -		$575,124	$190,000		$190,000	$9,719,000				
10	2027		$651,040	$323,556	$7,839,354		$ 585,000		$575,124	$190,000		$190,000	$10,354,000				
11	2028	$200,000	$651,040	$325,105	$7,887,069		$ -		$575,124	$190,000		$190,000	$10,018,000	New trailers every 8 years			
12	2029		$651,040	$326,614	$7,934,106		$ 385,000		$575,124	$390,000		$190,000	$10,452,000				
13	2030		$651,040	$328,051	$7,980,016	$8,850,000	$ -		$575,124	$190,000		$190,000	$18,764,000			Construction Cell 2	
14	2031		$651,040	$329,436	$8,025,023		$ -		$650,124	$190,000		$190,000	$10,036,000				
15	2032	$346,000	$651,040	$330,761	$8,069,128		$ -	$ 1,350,000	$650,124	$190,000		$190,000	$11,777,000	Transfer station - parking and roads (20 yr life) + capital upgrades		Closure Cell 1	
16	2033		$651,040	$332,041	$8,112,669		$ 235,000		$650,124	$190,000		$190,000	$10,361,000				
17	2034		$651,040	$333,189	$8,154,066		$ -		$650,124	$390,000		$190,000	$10,368,000				
18	2035		$651,040	$334,298	$8,194,562		$ 35,000		$650,124	$190,000		$190,000	$10,245,000				
19	2036	$200,000	$651,040	$335,388	$8,234,831		$ -		$650,124	$190,000		$190,000	$10,451,000	New trailers every 8 years			
20	2037		$651,040	$336,405	$8,273,747		$ 550,000		$650,124	$190,000		$190,000	$10,841,000				
21	2038		$651,040	$337,363	$8,311,761		$ -		$650,124	$190,000		$190,000	$10,330,000				
22	2039		$651,040	$338,281	$8,348,985		$ 35,000		$650,124	$390,000		$190,000	$10,603,000				
23	2040		$651,040	$339,167	$8,385,645		$ -		$650,124	$190,000		$190,000	$10,406,000				
24	2041		$651,040	$340,053	$8,421,854		$ 385,000		$650,124	$190,000		$190,000	$10,828,000				
25	2042		$651,040	$341,753	$8,474,193		$ -		$650,124	$190,000		$190,000	$10,497,000				
26	2043		$651,040	$343,462	$8,526,983		$ 200,000		$650,124	$190,000		$190,000	$10,752,000				
27	2044	$200,000	$651,040	$345,180	$8,580,225		$ -		$650,124	$390,000		$190,000	$11,007,000	New trailers every 8 years			
28	2045		$651,040	$346,905	$8,633,918		$ 35,000		$650,124	$190,000		$190,000	$10,697,000				
29	2046		$651,040	$348,640	$6,745,102		$ -		$650,124	$190,000		$190,000	$8,775,000		Amotization period over		
30	2047		$651,040	$350,383	$6,799,810		$ 585,000		$650,124	$190,000		$190,000	$9,416,000				
31	2048		$651,040	$352,135	$6,854,969		$ -		$650,124	$190,000		$190,000	$8,888,000				
32	2049		$651,040	$353,896	$6,910,692		$ -		$650,124	$390,000		$190,000	$9,146,000				
33	2050		$651,040	$355,665	$6,966,754		$ -		$650,124	$190,000		$190,000	$9,004,000				
34	2051	$241,000	$651,040	$357,444	$7,023,379		$ 35,000		$650,124	$190,000		$190,000	$9,338,000	Transfer station permits etc			
35	2052	$2,615,000	$651,040	$359,231	$7,080,569		$ -		$650,124	$190,000		$190,000	$11,736,000	Transfer station - new facility + new trailers			
36	2053		$651,040	$361,027	$7,138,210		$ 585,000		$650,124	$190,000		$190,000	$9,765,000				
37	2054		$651,040	$362,832	$7,196,302		$ -		$650,124	$390,000		$190,000	$9,440,000				
38	2055		$651,040	$364,646	$7,254,958		$ -		$650,124	$190,000		$190,000	$9,301,000				
39	2056		$651,040	$366,469	$7,314,178		$ -		$650,124	$190,000		$190,000	$9,362,000				
40	2057		$651,040	$368,302	$7,373,849		$ 585,000		$650,124	$190,000		$190,000	$10,008,000				
41	2058		$651,040	$370,143	$7,434,197		$ -		$650,124	$190,000		$190,000	$9,486,000				
42	2059		$651,040	$371,994	$7,494,883		$ 35,000		$650,124	$390,000		$190,000	$9,783,000				
43	2060	$200,000	$651,040	$373,854	$7,556,246		$ -		$650,124	$190,000		$190,000	$9,811,000	New trailers every 8 years			
44	2061		$651,040	$375,723	$7,618,061	$7,800,000	$ -		$650,124	$190,000		$190,000	$17,475,000			Construction Cell 3	
45	2062		$651,040	$377,602	$7,680,552		$ -		$725,124	$190,000		$190,000	$9,814,000				
46	2063		$651,040	$379,490	$7,743,494		$ 235,000	$ 2,850,000	$725,124	$190,000		$190,000	$12,964,000			Closure Cell 2	
47	2064		$651,040	$381,387	$7,807,001		$ -		$725,124	$390,000		$190,000	$10,145,000				
48	2065		$651,040	$383,294	$7,871,071		$ 385,000		$725,124	$190,000		$190,000	$10,396,000				
49	2066		$651,040	$385,211	$7,935,818		$ -		$725,124	$190,000		$190,000	$10,077,000				
50	2067		$651,040	$387,137	$8,001,017		$ 550,000		$725,124	$190,000		$190,000	$10,694,000				
Totals		$4,202,000	$28,645,760	$15,414,260	$358,167,529	$16,650,000	$7,645,000	$6,965,000	$34,821,800	$11,310,000	$10,382,338	$15,729,269	$509,931,000				

30 years
$303,298,000 1,792,501 tonnes
$169 per tonne over 30 years

40 years
$399,286,000 2,448,090 tonnes
$163 per tonne over 40 years

50 years
$509,931,000 3,159,253 tonnes
$161 per tonne over 50 years

Table D2: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River - Increasing Capacity

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,278		29,278	83	21,152	1,168	9,808
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,606		29,606	84	21,276	1,181	9,918
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,937	Landfill closure	29,937	85	21,401	1,194	10,029
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,441		50,963	145		2,033	17,072
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,766		51,406	146		2,050	17,221
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	30,089		51,844	148		2,068	17,368
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	30,411		52,273	149		2,085	17,511
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	30,729		52,696	150		2,102	17,653
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	31,044		53,113	151		2,118	17,793
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	31,354		53,520	152		2,135	17,929
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	31,660		53,919	154		2,151	18,063
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	31,961		54,310	155		2,166	18,194
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	32,261		54,696	156		2,182	18,323
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	32,550		55,063	157		2,196	18,446
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	32,834		55,422	158		2,211	18,566
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	33,117		55,779	159		2,225	18,686
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	33,394		56,124	160		2,239	18,802
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	33,666		56,461	161		2,252	18,915
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	33,934		56,791	162		2,265	19,025
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	34,199		57,116	163		2,278	19,134
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	34,460		57,437	164		2,291	19,241
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	34,809		57,901	165		2,309	19,397
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	35,162		58,369	166		2,328	19,554
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	35,518		58,841	168		2,347	19,712
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	35,877		59,317	169		2,366	19,871
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	36,241		59,797	170		2,385	20,032
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	36,608		60,282	172		2,404	20,195
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	36,978		60,771	173		2,424	20,358
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	37,353		61,265	175		2,444	20,524
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	37,731		61,762	176		2,463	20,690
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	38,113		62,264	177		2,483	20,859
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	38,498		62,771	179		2,504	21,028
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	38,888		63,282	180		2,524	21,199
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	39,282		63,797	182		2,545	21,372
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	39,679		64,317	183		2,565	21,546
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	40,081		64,842	185		2,586	21,722
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	40,486		65,371	186		2,607	21,899
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	40,896		65,906	188		2,629	22,078
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	41,310		66,444	189		2,650	22,259
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	41,728		66,988	191		2,672	22,441
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	42,150		67,536	192		2,694	22,625
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	42,576		68,090	194		2,716	22,810
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	43,007		68,648	196		2,738	22,997
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	43,442		69,211	197		2,761	23,186
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	43,881		69,779	199		2,783	23,376
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	44,325		70,353	200		2,806	23,568
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	44,773		70,931	202		2,829	23,762
	Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,695,083	0	2,736,587		219,420	329,344	916,757

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m^3)
		m^3	m^3	m^3	m^3	m^3	m^3	m^3			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,668	14,012	556	33	33	16,236	295,425	Cell 1	Cell 1	
5	2022	1,687	14,169	562	34	34	16,418	311,843	Cell 1	Cell 1	
6	2023	1,706	14,327	569	34	34	16,602	328,444	Cell 1	Cell 1	
7	2024	2,904	24,389	968	58	58	28,261	356,705	Cell 1	Cell 1	
8	2025	2,929	24,601	976	59	59	28,507	385,212	Cell 1	Cell 1	
9	2026	2,954	24,811	985	59	59	28,750	413,962	Cell 1	Cell 1	
10	2027	2,978	25,016	993	60	60	28,987	442,949	Cell 1	Cell 1	
11	2028	3,003	25,219	1,001	60	60	29,222	472,171	Cell 1	Cell 1	
12	2029	3,026	25,418	1,009	61	61	29,453	501,625	Cell 1	Cell 1	
13	2030	3,050	25,613	1,017	61	61	29,679	531,304	Cell 2	Cell 1	**517,470**
14	2031	3,072	25,804	1,024	61	61	29,900	561,205	Cell 2	Cell 2	
15	2032	3,095	25,991	1,032	62	62	30,117	591,322	Cell 2	Cell 2	
16	2033	3,117	26,176	1,039	62	62	30,331	621,653	Cell 2	Cell 2	
17	2034	3,137	26,351	1,046	63	63	30,535	652,188	Cell 2	Cell 2	
18	2035	3,158	26,523	1,053	63	63	30,734	682,922	Cell 2	Cell 2	
19	2036	3,178	26,694	1,059	64	64	30,932	713,854	Cell 2	Cell 2	
20	2037	3,198	26,860	1,066	64	64	31,123	744,977	Cell 2	Cell 2	
21	2038	3,217	27,021	1,072	64	64	31,310	776,288	Cell 2	Cell 2	
22	2039	3,236	27,178	1,079	65	65	31,493	807,781	Cell 2	Cell 2	
23	2040	3,254	27,334	1,085	65	65	31,673	839,454	Cell 2	Cell 2	
24	2041	3,273	27,488	1,091	65	65	31,851	871,305	Cell 2	Cell 2	
25	2042	3,299	27,710	1,100	66	66	32,109	903,414	Cell 2	Cell 2	
26	2043	3,326	27,934	1,109	67	67	32,368	935,782	Cell 2	Cell 2	
27	2044	3,353	28,160	1,118	67	67	32,630	968,412	Cell 2	Cell 2	
28	2045	3,380	28,387	1,127	68	68	32,894	1,001,305	Cell 2	Cell 2	
29	2046	3,407	28,617	1,136	68	68	33,160	1,034,466	Cell 2	Cell 2	
30	2047	3,435	28,849	1,145	69	69	33,429	1,067,895	Cell 2	Cell 2	
31	2048	3,463	29,083	1,154	69	69	33,700	1,101,595	Cell 2	Cell 2	
32	2049	3,491	29,319	1,164	70	70	33,974	1,135,569	Cell 2	Cell 2	
33	2050	3,519	29,558	1,173	70	70	34,250	1,169,819	Cell 2	Cell 2	
34	2051	3,548	29,798	1,183	71	71	34,528	1,204,348	Cell 2	Cell 2	
35	2052	3,577	30,040	1,192	72	72	34,809	1,239,157	Cell 2	Cell 2	
36	2053	3,606	30,285	1,202	72	72	35,093	1,274,249	Cell 2	Cell 2	
37	2054	3,635	30,532	1,212	73	73	35,378	1,309,628	Cell 2	Cell 2	
38	2055	3,665	30,780	1,222	73	73	35,667	1,345,295	Cell 2	Cell 2	
39	2056	3,695	31,032	1,232	74	74	35,958	1,381,253	Cell 2	Cell 2	
40	2057	3,725	31,285	1,242	74	74	36,251	1,417,504	Cell 2	Cell 2	
41	2058	3,755	31,541	1,252	75	75	36,548	1,454,051	Cell 2	Cell 2	
42	2059	3,786	31,798	1,262	76	76	36,846	1,490,898	Cell 2	Cell 2	
43	2060	3,817	32,059	1,272	76	76	37,148	1,528,046	Cell 2	Cell 2	
44	2061	3,848	32,321	1,283	77	77	37,452	1,565,498	Cell 3	Cell 2	**1,563,942**
45	2062	3,880	32,586	1,293	78	78	37,759	1,603,256	Cell 3	Cell 3	
46	2063	3,912	32,853	1,304	78	78	38,068	1,641,325	Cell 3	Cell 3	
47	2064	3,944	33,122	1,315	79	79	38,381	1,679,705	Cell 3	Cell 3	
48	2065	3,976	33,394	1,325	80	80	38,696	1,718,401	Cell 3	Cell 3	
49	2066	4,009	33,669	1,336	80	80	39,014	1,757,415	Cell 3	Cell 3	
50	2067	4,042	33,946	1,347	81	81	39,334	1,796,749	Cell 3	Cell 3	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 33.5% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 0.7 *tonnes per m^3*
In-situ MSW waste density = 0.7 *tonnes per m^3*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table D2: Long Term Cost Model for Option 1(b) - WTT facility located in Campbell River - Increasing Capacity

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0		New Transfer station constructed 2012-2013			
	2016						$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,141,495		$250,868	$1,052,753	$3,570,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,141,495		$490,358	$1,052,753	$5,385,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,141,495	$390,000	$191,695	$1,052,753	$2,776,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$715,115		$ 1,075,000		$1,141,495	$190,000	$491,790	$1,052,753	$4,977,000	Permits		Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$433,315	$145,160	$5,245,520		$ 35,000		$575,124	$190,000	$5,630,329	$1,052,753	$17,327,000	New transfer station		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$438,167	$146,786	$5,282,505		$ -		$575,124	$190,000	$0	$1,052,753	$8,395,000					
6	2023		$709,508	$443,070	$148,429	$5,319,875		$ 35,000		$575,124	$190,000	$218,613	$1,052,753	$8,692,000					Phase 3 LFG and final cover design
7	2024		$709,508	$435,731	$252,673	$7,691,551		$ -		$575,124	$390,000	$3,108,685	$190,000	$13,353,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$440,536	$254,869	$7,741,522		$ -		$575,124	$190,000		$190,000	$10,102,000					
9	2026		$709,508	$445,323	$257,040	$7,790,916		$ -		$575,124	$190,000		$190,000	$10,158,000					
10	2027		$709,508	$450,077	$259,167	$7,839,300		$ 585,000		$575,124	$190,000		$190,000	$10,798,000					
11	2028		$709,508	$454,795	$261,266	$7,887,058		$ -		$575,124	$190,000		$190,000	$10,268,000					
12	2029	$200,000	$709,508	$459,457	$263,334	$7,934,096		$ 385,000		$575,124	$390,000		$190,000	$11,107,000	New trailers every 8 years				
13	2030		$709,508	$464,046	$265,353	$7,980,027	$8,850,000	$ -		$575,124	$190,000		$190,000	$19,224,000				Construction Cell 2	
14	2031		$709,508	$468,562	$267,329	$8,024,996		$ -		$650,124	$190,000		$190,000	$10,501,000					
15	2032		$709,508	$473,029	$269,270	$8,069,147		$ -	$ 1,350,000	$650,124	$190,000		$190,000	$11,901,000				Closure Cell 1	
16	2033		$709,508	$477,461	$271,183	$8,112,673		$ 235,000		$650,124	$190,000		$190,000	$10,836,000					
17	2034		$709,508	$481,739	$273,001	$8,154,035		$ -		$650,124	$390,000		$190,000	$10,848,000					
18	2035		$709,508	$485,943	$274,781	$8,194,532		$ 35,000		$650,124	$190,000		$190,000	$10,730,000					
19	2036		$709,508	$490,136	$276,550	$8,234,787		$ -		$650,124	$190,000		$190,000	$10,741,000					
20	2037	$200,000	$709,508	$494,237	$278,265	$8,273,793		$ 550,000		$650,124	$190,000		$190,000	$11,536,000	New trailers every 8 years				
21	2038		$709,508	$498,264	$279,935	$8,311,788		$ -		$650,124	$190,000		$190,000	$10,830,000					
22	2039		$709,508	$502,223	$281,569	$8,348,966		$ 35,000		$650,124	$390,000		$190,000	$11,107,000					
23	2040		$709,508	$506,146	$283,180	$8,385,614		$ -		$650,124	$190,000		$190,000	$10,915,000					
24	2041	$1,555,125	$709,508	$510,011	$284,772	$8,421,830		$ 385,000		$650,124	$190,000		$190,000	$12,896,000	Major capital upgrade every 20 years				
25	2042		$709,508	$515,177	$287,072	$8,474,157		$ -		$650,124	$190,000		$190,000	$11,016,000					
26	2043		$709,508	$520,394	$289,392	$8,526,945		$ 200,000		$650,124	$190,000		$190,000	$11,276,000					
27	2044		$709,508	$525,664	$291,733	$8,580,198		$ -		$650,124	$390,000		$190,000	$11,337,000					
28	2045	$200,000	$709,508	$530,987	$294,094	$8,633,921		$ 35,000		$650,124	$190,000		$190,000	$11,434,000	New trailers every 8 years				
29	2046		$709,508	$536,363	$296,476	$6,745,158		$ -		$650,124	$190,000		$190,000	$9,318,000			Amotization period over		
30	2047		$709,508	$541,794	$298,879	$6,799,833		$ 585,000		$650,124	$190,000		$190,000	$9,965,000					
31	2048		$709,508	$547,279	$301,304	$6,854,991		$ -		$650,124	$190,000		$190,000	$9,443,000					
32	2049		$709,508	$552,819	$303,749	$6,910,636		$ -		$650,124	$390,000		$190,000	$9,707,000					
33	2050		$709,508	$558,415	$306,217	$6,966,774		$ -		$650,124	$190,000		$190,000	$9,571,000					
34	2051		$709,508	$564,067	$308,706	$7,023,408		$ 35,000		$650,124	$190,000		$190,000	$9,671,000					
35	2052		$709,508	$569,777	$311,217	$7,080,543		$ -		$650,124	$190,000		$190,000	$9,701,000					
36	2053	$200,000	$709,508	$575,543	$313,751	$7,138,184		$ 585,000		$650,124	$190,000		$190,000	$10,552,000	New trailers every 8 years				
37	2054		$709,508	$581,368	$316,307	$7,196,335		$ -		$650,124	$390,000		$190,000	$10,034,000					
38	2055		$709,508	$587,251	$318,886	$7,255,002		$ -		$650,124	$190,000		$190,000	$9,901,000					
39	2056		$709,508	$593,194	$321,487	$7,314,189		$ -		$650,124	$190,000		$190,000	$9,969,000					
40	2057		$709,508	$599,196	$324,112	$7,373,901		$ 585,000		$650,124	$190,000		$190,000	$10,622,000					
41	2058		$709,508	$605,258	$326,760	$7,434,143		$ -		$650,124	$190,000		$190,000	$10,106,000					
42	2059		$709,508	$611,382	$329,431	$7,494,920		$ 35,000		$650,124	$390,000		$190,000	$10,410,000					
43	2060		$709,508	$617,567	$332,126	$7,556,237		$ -		$650,124	$190,000		$190,000	$10,246,000					
44	2061	$1,755,125	$709,508	$623,815	$334,845	$7,618,099	$7,800,000	$ -		$650,124	$190,000		$190,000	$19,872,000	Major capital upgrade every 20 years			Construction Cell 3	
45	2062		$709,508	$630,125	$337,588	$7,680,511		$ -		$725,124	$190,000		$190,000	$10,463,000					
46	2063		$709,508	$636,498	$340,356	$7,743,478		$ 235,000	$ 2,850,000	$725,124	$190,000		$190,000	$13,620,000				Closure Cell 2	
47	2064		$709,508	$642,936	$343,148	$7,807,006		$ -		$725,124	$390,000		$190,000	$10,808,000					
48	2065		$709,508	$649,439	$345,966	$7,871,100		$ 385,000		$725,124	$190,000		$190,000	$11,066,000					
49	2066		$709,508	$656,007	$348,808	$7,935,764		$ -		$725,124	$190,000		$190,000	$10,755,000					
50	2067		$709,508	$662,641	$351,675	$8,001,005		$ 550,000		$725,124	$190,000		$190,000	$11,380,000					
	Totals	$7,731,275	$33,346,853	$25,087,222	$13,567,996	$357,976,084	$16,650,000	$7,645,000	$6,965,000	$34,821,800	$11,310,000	$10,382,338	$15,729,269	$541,216,000					

30 years
$323,319,000 1,792,501 tonnes
$180 per tonne over 30 years

40 years
$422,490,000 2,448,090 tonnes
$173 per tonne over 40 years

50 years
$541,216,000 3,159,253 tonnes
$171 per tonne over 50 years

Table D3: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River - Increasing Capacity

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to WTT Facility	Tonnes per day to WTT facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes					tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,278		29,278	83	21,152	1,168	9,806
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,606		29,606	84	21,276	1,181	9,918
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,937	Landfill closure	29,937	85	21,401	1,194	10,029
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,441	21,521	50,963	145		2,033	17,072
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,766	21,640	51,406	146		2,050	17,221
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	30,089	21,754	51,844	148		2,068	17,368
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	30,411	21,862	52,273	149		2,085	17,511
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	30,729	21,967	52,696	150		2,102	17,653
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	31,044	22,069	53,113	151		2,118	17,793
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	31,354	22,166	53,520	152		2,135	17,929
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	31,660	22,259	53,919	154		2,151	18,063
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	31,961	22,349	54,310	155		2,166	18,194
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	32,261	22,435	54,696	156		2,182	18,323
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	32,550	22,513	55,063	157		2,196	18,446
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	32,834	22,588	55,422	158		2,211	18,566
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	33,117	22,661	55,779	159		2,225	18,686
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	33,394	22,730	56,124	160		2,239	18,802
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	33,666	22,795	56,461	161		2,252	18,915
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	33,934	22,857	56,791	162		2,265	19,025
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	34,199	22,917	57,116	163		2,278	19,134
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	34,460	22,977	57,437	164		2,291	19,241
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	34,809	23,091	57,901	165		2,309	19,397
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	35,162	23,207	58,369	166		2,328	19,554
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	35,518	23,323	58,841	168		2,347	19,712
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	35,877	23,440	59,317	169		2,366	19,871
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	36,241	23,557	59,797	170		2,385	20,032
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	36,608	23,675	60,282	172		2,404	20,195
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	36,978	23,793	60,771	173		2,424	20,358
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	37,353	23,912	61,265	175		2,444	20,524
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	37,731	24,031	61,762	176		2,463	20,690
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	38,113	24,152	62,264	177		2,483	20,859
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	38,498	24,272	62,771	179		2,504	21,028
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	38,888	24,394	63,282	180		2,524	21,199
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	39,282	24,516	63,797	182		2,545	21,372
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	39,679	24,638	64,317	183		2,565	21,546
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	40,081	24,761	64,842	185		2,586	21,722
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	40,486	24,885	65,371	186		2,607	21,899
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	40,896	25,010	65,906	188		2,629	22,078
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	41,310	25,135	66,444	189		2,650	22,259
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	41,728	25,260	66,988	191		2,672	22,441
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	42,150	25,387	67,536	192		2,694	22,625
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	42,576	25,514	68,090	194		2,716	22,810
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	43,007	25,641	68,648	196		2,738	22,997
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	43,442	25,769	69,211	197		2,761	23,186
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	43,881	25,898	69,779	199		2,783	23,376
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	44,325	26,028	70,353	200		2,806	23,568
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	44,773	26,158	70,931	202		2,829	23,762
Totals			4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,695,083	1,041,504	2,736,587		219,420	329,344	916,757

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 351 *days per year*
Bottom ash/residuals to landfill = 34% *% of input*

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,668	14,012	556	33	33	16,236	295,425	Cell 1	Cell 1	
5	2022	1,687	14,169	562	34	34	16,418	311,843	Cell 1	Cell 1	
6	2023	1,706	14,327	569	34	34	16,602	328,444	Cell 1	Cell 1	
7	2024	2,904	24,389	968	58	58	28,261	356,705	Cell 1	Cell 1	
8	2025	2,929	24,601	976	59	59	28,507	385,212	Cell 1	Cell 1	
9	2026	2,954	24,811	985	59	59	28,750	413,962	Cell 1	Cell 1	
10	2027	2,978	25,016	993	60	60	28,987	442,949	Cell 1	Cell 1	
11	2028	3,003	25,219	1,001	60	60	29,222	472,171	Cell 1	Cell 1	
12	2029	3,026	25,418	1,009	61	61	29,453	501,625	Cell 1	Cell 1	
13	2030	3,050	25,613	1,017	61	61	29,679	531,304	Cell 2	Cell 1	**517,470**
14	2031	3,072	25,804	1,024	61	61	29,900	561,205	Cell 2	Cell 2	
15	2032	3,095	25,991	1,032	62	62	30,117	591,322	Cell 2	Cell 2	
16	2033	3,117	26,176	1,039	62	62	30,331	621,653	Cell 2	Cell 2	
17	2034	3,137	26,351	1,046	63	63	30,535	652,188	Cell 2	Cell 2	
18	2035	3,158	26,523	1,053	63	63	30,734	682,922	Cell 2	Cell 2	
19	2036	3,178	26,694	1,059	64	64	30,932	713,854	Cell 2	Cell 2	
20	2037	3,198	26,860	1,066	64	64	31,123	744,977	Cell 2	Cell 2	
21	2038	3,217	27,021	1,072	64	64	31,310	776,288	Cell 2	Cell 2	
22	2039	3,236	27,178	1,079	65	65	31,493	807,781	Cell 2	Cell 2	
23	2040	3,254	27,334	1,085	65	65	31,673	839,454	Cell 2	Cell 2	
24	2041	3,273	27,488	1,091	65	65	31,851	871,305	Cell 2	Cell 2	
25	2042	3,299	27,710	1,100	66	66	32,109	903,414	Cell 2	Cell 2	
26	2043	3,326	27,934	1,109	67	67	32,368	935,782	Cell 2	Cell 2	
27	2044	3,353	28,160	1,118	67	67	32,630	968,412	Cell 2	Cell 2	
28	2045	3,380	28,387	1,127	68	68	32,894	1,001,305	Cell 2	Cell 2	
29	2046	3,407	28,617	1,136	68	68	33,160	1,034,466	Cell 2	Cell 2	
30	2047	3,435	28,849	1,145	69	69	33,429	1,067,895	Cell 2	Cell 2	
31	2048	3,463	29,083	1,154	69	69	33,700	1,101,595	Cell 2	Cell 2	
32	2049	3,491	29,319	1,164	70	70	33,974	1,135,569	Cell 2	Cell 2	
33	2050	3,519	29,558	1,173	70	70	34,250	1,169,819	Cell 2	Cell 2	
34	2051	3,548	29,798	1,183	71	71	34,528	1,204,348	Cell 2	Cell 2	
35	2052	3,577	30,040	1,192	72	72	34,809	1,239,157	Cell 2	Cell 2	
36	2053	3,606	30,285	1,202	72	72	35,093	1,274,249	Cell 2	Cell 2	
37	2054	3,635	30,532	1,212	73	73	35,378	1,309,628	Cell 2	Cell 2	
38	2055	3,665	30,780	1,222	73	73	35,667	1,345,295	Cell 2	Cell 2	
39	2056	3,695	31,032	1,232	74	74	35,958	1,381,253	Cell 2	Cell 2	
40	2057	3,725	31,285	1,242	74	74	36,251	1,417,504	Cell 2	Cell 2	
41	2058	3,755	31,541	1,252	75	75	36,548	1,454,051	Cell 2	Cell 2	
42	2059	3,786	31,798	1,262	76	76	36,846	1,490,898	Cell 2	Cell 2	
43	2060	3,817	32,059	1,272	76	76	37,148	1,528,046	Cell 2	Cell 2	
44	2061	3,848	32,321	1,283	77	77	37,452	1,565,498	Cell 3	Cell 2	**1,563,942**
45	2062	3,880	32,586	1,293	78	78	37,759	1,603,256	Cell 3	Cell 3	
46	2063	3,912	32,853	1,304	78	78	38,068	1,641,325	Cell 3	Cell 3	
47	2064	3,944	33,122	1,315	79	79	38,381	1,679,705	Cell 3	Cell 3	
48	2065	3,976	33,394	1,325	80	80	38,696	1,718,401	Cell 3	Cell 3	
49	2066	4,009	33,669	1,336	80	80	39,014	1,757,415	Cell 3	Cell 3	
50	2067	4,042	33,946	1,347	81	81	39,334	1,796,749	Cell 3	Cell 3	

In-situ ash / residuals waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table D3: Long Term Cost Model for Option 1(c) - WTT facility located in Gold River - Increasing Capacity

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	WTT Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	WTT Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0					
	2016									$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,141,495		$250,868	$1,052,753	$3,570,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,141,495		$490,358	$1,052,753	$5,385,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,141,495	$390,000	$191,695	$1,052,753	$2,776,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$484,000		$ 1,075,000		$1,141,495	$190,000	$491,790	$1,052,753	$4,946,000	Permits	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$819,784			$0	$274,628	$5,245,520		$ 35,000		$575,124	$190,000	$5,630,329	$1,052,753	$17,843,000	New transfer station		WTT facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$828,965			$0	$277,703	$5,282,505		$ -		$575,124	$190,000	$0	$1,052,753	$8,917,000					
6	2023		$709,508	$838,241			$0	$280,811	$5,319,875		$ 35,000		$575,124	$190,000	$218,613	$1,052,753	$9,220,000					Phase 3 LFG and final cover design
7	2024		$709,508	$824,357		$651,040	$430,428	$478,030	$7,691,551		$ -		$575,124	$390,000	$3,108,685	$190,000	$15,049,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$833,446		$651,040	$432,795	$482,185	$7,741,522		$ -		$575,124	$190,000		$190,000	$11,806,000					
9	2026		$709,508	$842,504		$651,040	$435,083	$486,293	$7,790,916		$ -		$575,124	$190,000		$190,000	$11,870,000					
10	2027		$709,508	$851,497		$651,040	$437,238	$490,316	$7,839,300		$ 585,000		$575,124	$190,000		$190,000	$12,519,000					
11	2028		$709,508	$860,422	$200,000	$651,040	$439,331	$494,288	$7,887,058		$ -		$575,124	$190,000		$190,000	$12,197,000		New trailers every 8 years		Construction Cell 2	
12	2029	$200,000	$709,508	$869,243		$651,040	$441,370	$498,199	$7,934,096		$ 385,000		$575,124	$390,000		$190,000	$12,844,000	New trailers every 8 years				
13	2030		$709,508	$877,925		$651,040	$443,312	$502,018	$7,980,027	$8,850,000	$ -		$575,124	$190,000		$190,000	$20,969,000				Closure Cell 1	
14	2031		$709,508	$886,468		$651,040	$445,183	$505,758	$8,024,996		$ -		$650,124	$190,000		$190,000	$12,253,000					
15	2032		$709,508	$894,920	$346,000	$651,040	$446,975	$509,429	$8,069,147		$ -	$ 1,350,000	$650,124	$190,000		$190,000	$14,007,000		Transfer station - parking and roads (20 yr life) + capital upgrades			
16	2033		$709,508	$903,304		$651,040	$448,704	$513,049	$8,112,673		$ 235,000		$650,124	$190,000		$190,000	$12,603,000					
17	2034		$709,508	$911,398		$651,040	$450,256	$516,488	$8,154,035		$ -		$650,124	$390,000		$190,000	$12,623,000					
18	2035		$709,508	$919,352		$651,040	$451,754	$519,856	$8,194,532		$ 35,000		$650,124	$190,000		$190,000	$12,511,000					
19	2036		$709,508	$927,284	$200,000	$651,040	$453,226	$523,203	$8,234,787		$ -		$650,124	$190,000		$190,000	$12,729,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$935,042		$651,040	$454,601	$526,447	$8,273,793		$ 550,000		$650,124	$190,000		$190,000	$13,331,000	New trailers every 8 years				
21	2038		$709,508	$942,661		$651,040	$455,896	$529,606	$8,311,788		$ -		$650,124	$190,000		$190,000	$12,631,000					
22	2039		$709,508	$950,151		$651,040	$457,137	$532,698	$8,348,966		$ 35,000		$650,124	$390,000		$190,000	$12,915,000					
23	2040		$709,508	$957,573		$651,040	$458,334	$535,746	$8,385,614		$ -		$650,124	$190,000		$190,000	$12,728,000					
24	2041	$1,555,125	$709,508	$964,886		$651,040	$459,531	$538,757	$8,421,830		$ 385,000		$650,124	$190,000		$190,000	$14,716,000	Major capital upgrade every 20 years				
25	2042		$709,508	$974,659		$651,040	$461,829	$543,108	$8,474,157		$ -		$650,124	$190,000		$190,000	$12,844,000					
26	2043		$709,508	$984,529		$651,040	$464,138	$547,498	$8,526,945		$ 200,000		$650,124	$190,000		$190,000	$13,114,000					
27	2044		$709,508	$994,499	$200,000	$651,040	$466,459	$551,926	$8,580,198		$ -		$650,124	$390,000		$190,000	$13,384,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$1,004,569		$651,040	$468,791	$556,394	$8,633,921		$ 35,000		$650,124	$190,000		$190,000	$13,289,000	New trailers every 8 years				
29	2046		$709,508	$1,014,741		$651,040	$471,135	$560,901	$6,745,158		$ -		$650,124	$190,000		$190,000	$11,183,000			Amotization period over		
30	2047		$709,508	$1,025,015		$651,040	$473,491	$565,447	$6,799,833		$ 585,000		$650,124	$190,000		$190,000	$11,839,000					
31	2048		$709,508	$1,035,392		$651,040	$475,858	$570,034	$6,854,991		$ -		$650,124	$190,000		$190,000	$11,327,000					
32	2049		$709,508	$1,045,874		$651,040	$478,237	$574,661	$6,910,636		$ -		$650,124	$390,000		$190,000	$11,600,000					
33	2050		$709,508	$1,056,461		$651,040	$480,629	$579,329	$6,966,774		$ -		$650,124	$190,000		$190,000	$11,474,000					
34	2051		$709,508	$1,067,155	$241,000	$651,040	$483,032	$584,039	$7,023,408		$ 35,000		$650,124	$190,000		$190,000	$11,824,000		Transfer station permits etc			
35	2052		$709,508	$1,077,956	$2,615,000	$651,040	$485,447	$588,790	$7,080,543		$ -		$650,124	$190,000		$190,000	$14,238,000		Transfer station - new facility + new trailer:			
36	2053	$200,000	$709,508	$1,088,866		$651,040	$487,874	$593,583	$7,138,184		$ 585,000		$650,124	$190,000		$190,000	$12,484,000	New trailers every 8 years				
37	2054		$709,508	$1,099,885		$651,040	$490,314	$598,419	$7,196,335		$ -		$650,124	$390,000		$190,000	$11,976,000					
38	2055		$709,508	$1,111,016		$651,040	$492,765	$603,297	$7,255,002		$ -		$650,124	$190,000		$190,000	$11,853,000					
39	2056		$709,508	$1,122,258		$651,040	$495,229	$608,219	$7,314,189		$ -		$650,124	$190,000		$190,000	$11,931,000					
40	2057		$709,508	$1,133,614		$651,040	$497,705	$613,184	$7,373,901		$ 585,000		$650,124	$190,000		$190,000	$12,594,000					
41	2058		$709,508	$1,145,084		$651,040	$500,194	$618,194	$7,434,143		$ -		$650,124	$190,000		$190,000	$12,088,000					
42	2059		$709,508	$1,156,669		$651,040	$502,695	$623,248	$7,494,920		$ 35,000		$650,124	$390,000		$190,000	$12,403,000					
43	2060		$709,508	$1,168,370	$200,000	$651,040	$505,208	$628,347	$7,556,237		$ -		$650,124	$190,000		$190,000	$12,449,000		New trailers every 8 years		Construction Cell 3	
44	2061	$1,755,125	$709,508	$1,180,190		$651,040	$507,734	$633,491	$7,618,099	$7,800,000	$ -		$650,124	$190,000		$190,000	$21,885,000	Major capital upgrade every 20 years				
45	2062		$709,508	$1,192,128		$651,040	$510,273	$638,681	$7,680,511		$ -		$725,124	$190,000		$190,000	$12,487,000				Closure Cell 2	
46	2063		$709,508	$1,204,186		$651,040	$512,824	$643,917	$7,743,478		$ 235,000	$ 2,850,000	$725,124	$190,000		$190,000	$15,655,000					
47	2064		$709,508	$1,216,366		$651,040	$515,388	$649,200	$7,807,006		$ -		$725,124	$390,000		$190,000	$12,854,000					
48	2065		$709,508	$1,228,668		$651,040	$517,965	$654,529	$7,871,100		$ 385,000		$725,124	$190,000		$190,000	$13,123,000					
49	2066		$709,508	$1,241,094		$651,040	$520,555	$659,907	$7,935,764		$ -		$725,124	$190,000		$190,000	$12,823,000					
50	2067		$709,508	$1,253,644		$651,040	$523,158	$665,332	$8,001,005		$ 550,000		$725,124	$190,000		$190,000	$13,459,000					
	Totals	$7,731,275	$33,346,853	$47,462,312	$4,202,000	$28,645,760	$20,830,081	$25,669,182	$357,744,968	$16,650,000	$7,645,000	$6,965,000	$34,821,800	$11,310,000	$10,382,338	$15,729,269	$629,138,000					

30 years
$368,611,000 1,792,501 tonnes
$206 per tonne over 30 years

40 years
$489,912,000 2,448,090 tonnes
$200 per tonne over 40 years

50 years
$629,138,000 3,159,253 tonnes
$199 per tonne over 50 years

Table D4: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley - Increasing Capacity

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819			29,195	83	21,152	1,251	3,187
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712			29,522	84	21,276	1,265	3,222
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614		Landfill closure	29,852	85	21,401	1,279	3,259
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507		21,521	50,817	145		2,178	5,547
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398		21,640	51,259	146		2,197	5,595
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281		21,754	51,696	148		2,216	5,643
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152		21,862	52,124	149		2,234	5,690
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014		21,967	52,546	150		2,252	5,736
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864		22,069	52,962	151		2,270	5,781
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697		22,166	53,368	152		2,287	5,825
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514		22,259	53,765	154		2,304	5,869
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320		22,349	54,155	155		2,321	5,911
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116		22,435	54,540	156		2,337	5,953
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879		22,513	54,906	157		2,353	5,993
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627		22,588	55,264	158		2,368	6,032
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371		22,661	55,620	159		2,384	6,071
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096		22,730	55,965	160		2,398	6,109
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805		22,795	56,300	161		2,413	6,146
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500		22,857	56,629	162		2,427	6,181
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187		22,917	56,953	163		2,441	6,217
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865		22,977	57,273	164		2,455	6,252
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808		23,091	57,736	165		2,474	6,302
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761		23,207	58,202	166		2,494	6,353
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723		23,323	58,673	168		2,515	6,405
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693		23,440	59,148	169		2,535	6,456
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673		23,557	59,627	170		2,555	6,509
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662		23,675	60,110	172		2,576	6,561
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660		23,793	60,598	173		2,597	6,615
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668		23,912	61,090	175		2,618	6,668
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685		24,031	61,586	176		2,639	6,723
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712		24,152	62,087	177		2,661	6,777
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748		24,272	62,592	179		2,683	6,832
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794		24,394	63,101	180		2,704	6,888
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850		24,516	63,616	182		2,726	6,944
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916		24,638	64,134	183		2,749	7,001
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992		24,761	64,657	185		2,771	7,058
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078		24,885	65,185	186		2,794	7,115
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174		25,010	65,718	188		2,816	7,174
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281		25,135	66,255	189		2,840	7,232
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398		25,260	66,797	191		2,863	7,291
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526		25,387	67,344	192		2,886	7,351
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664		25,514	67,896	194		2,910	7,411
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813		25,641	68,452	196		2,934	7,472
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973		25,769	69,014	197		2,958	7,533
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144		25,898	69,580	199		2,982	7,595
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326		26,028	70,152	200		3,007	7,658
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519		26,158	70,729	202		3,031	7,721
Totals		4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	0	1,041,504	2,728,790		219,420	337,141	297,865

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,787	3,187	596	36	36	5,570	284,759	Cell 1	Cell 1	
5	2022	1,807	3,222	602	36	36	5,632	290,391	Cell 1	Cell 1	
6	2023	1,828	3,259	609	37	37	5,695	296,087	Cell 1	Cell 1	
7	2024	3,111	5,547	1,037	62	62	9,695	305,782	Cell 1	Cell 1	
8	2025	3,138	5,595	1,046	63	63	9,780	315,562	Cell 1	Cell 1	
9	2026	3,165	5,643	1,055	63	63	9,863	325,425	Cell 1	Cell 1	
10	2027	3,191	5,690	1,064	64	64	9,945	335,370	Cell 1	Cell 1	
11	2028	3,217	5,736	1,072	64	64	10,025	345,395	Cell 1	Cell 1	
12	2029	3,243	5,781	1,081	65	65	10,104	355,499	Cell 1	Cell 1	
13	2030	3,267	5,825	1,089	65	65	10,182	365,681	Cell 1	Cell 1	
14	2031	3,292	5,869	1,097	66	66	10,258	375,939	Cell 1	Cell 1	
15	2032	3,316	5,911	1,105	66	66	10,332	386,271	Cell 1	Cell 1	
16	2033	3,339	5,953	1,113	67	67	10,406	396,677	Cell 1	Cell 1	
17	2034	3,362	5,993	1,121	67	67	10,475	407,152	Cell 1	Cell 1	
18	2035	3,384	6,032	1,128	68	68	10,544	417,696	Cell 1	Cell 1	
19	2036	3,405	6,071	1,135	68	68	10,612	428,308	Cell 1	Cell 1	
20	2037	3,426	6,109	1,142	69	69	10,677	438,985	Cell 1	Cell 1	
21	2038	3,447	6,146	1,149	69	69	10,742	449,727	Cell 1	Cell 1	
22	2039	3,467	6,181	1,156	69	69	10,804	460,531	Cell 1	Cell 1	
23	2040	3,487	6,217	1,162	70	70	10,866	471,397	Cell 1	Cell 1	
24	2041	3,507	6,252	1,169	70	70	10,927	482,324	Cell 1	Cell 1	
25	2042	3,535	6,302	1,178	71	71	11,015	493,339	Cell 1	Cell 1	
26	2043	3,563	6,353	1,188	71	71	11,104	504,444	Cell 1	Cell 1	
27	2044	3,592	6,405	1,197	72	72	11,194	515,638	Cell 1	Cell 1	
28	2045	3,621	6,456	1,207	72	72	11,285	526,923	Cell 2	Cell 1	**517,470**
29	2046	3,651	6,509	1,217	73	73	11,376	538,299	Cell 2	Cell 2	
30	2047	3,680	6,561	1,227	74	74	11,468	549,767	Cell 2	Cell 2	
31	2048	3,710	6,615	1,237	74	74	11,561	561,329	Cell 2	Cell 2	
32	2049	3,740	6,668	1,247	75	75	11,655	572,984	Cell 2	Cell 2	
33	2050	3,771	6,723	1,257	75	75	11,750	584,734	Cell 2	Cell 2	
34	2051	3,801	6,777	1,267	76	76	11,846	596,580	Cell 2	Cell 2	
35	2052	3,832	6,832	1,277	77	77	11,942	608,522	Cell 2	Cell 2	
36	2053	3,863	6,888	1,288	77	77	12,039	620,561	Cell 2	Cell 2	
37	2054	3,895	6,944	1,298	78	78	12,137	632,698	Cell 2	Cell 2	
38	2055	3,927	7,001	1,309	79	79	12,236	644,934	Cell 2	Cell 2	
39	2056	3,959	7,058	1,320	79	79	12,336	657,270	Cell 2	Cell 2	
40	2057	3,991	7,115	1,330	80	80	12,437	669,706	Cell 2	Cell 2	
41	2058	4,024	7,174	1,341	80	80	12,538	682,245	Cell 2	Cell 2	
42	2059	4,056	7,232	1,352	81	81	12,641	694,885	Cell 2	Cell 2	
43	2060	4,090	7,291	1,363	82	82	12,744	707,630	Cell 2	Cell 2	
44	2061	4,123	7,351	1,374	82	82	12,848	720,478	Cell 2	Cell 2	
45	2062	4,157	7,411	1,386	83	83	12,954	733,432	Cell 2	Cell 2	
46	2063	4,191	7,472	1,397	84	84	13,060	746,492	Cell 2	Cell 2	
47	2064	4,225	7,533	1,408	85	85	13,167	759,659	Cell 2	Cell 2	
48	2065	4,260	7,595	1,420	85	85	13,275	772,934	Cell 2	Cell 2	
49	2066	4,295	7,658	1,432	86	86	13,384	786,318	Cell 2	Cell 2	
50	2067	4,330	7,721	1,443	87	87	13,494	799,813	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 350 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table D4: Long Term Cost Model for Option 3(a) - Sustane facility located in Comox Valley - Increasing Capacity

Capital and Operating Costs

	Year	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Campbell River TS Notes	Comox Valley TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015												$0					
	2016					$16,000,000							$16,000,000	New Transfer station constructed 2012-2013			Construction of leachate management system and Cell 1	
0	2017						$ 860,000	$ 265,000	$1,116,495		$250,868	$1,052,753	$3,545,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018						$ 200,000	$ 2,500,000	$1,116,495		$490,358	$1,052,753	$5,360,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019						$ -		$1,116,495	$390,000	$191,695	$1,052,753	$2,751,000					Phase 2 Design and construction
3	2020	$200,000			$1,830,696		$ 1,075,000		$1,116,495	$190,000	$491,790	$1,052,753	$5,957,000	New trailers every 8 years		Permits and land		Phase 2 LFG and final cover design
4	2021				$3,571,072		$ 35,000		$423,924	$190,000	$5,630,329	$1,052,753	$10,903,000			Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022				$3,588,315		$ -		$423,924	$190,000	$0	$1,052,753	$5,255,000					
6	2023				$3,605,737		$ 35,000		$423,924	$190,000	$218,613	$1,052,753	$5,526,000					Phase 3 LFG and final cover design
7	2024		$651,040	$318,516	$4,711,435		$ -		$423,924	$390,000	$3,108,685	$190,000	$9,794,000					Phase 3 LFG and final cover construction
8	2025		$651,040	$320,269	$4,734,732		$ -		$423,924	$190,000		$190,000	$6,510,000					
9	2026		$651,040	$321,962	$4,757,760		$ -		$423,924	$190,000		$190,000	$6,535,000					
10	2027		$651,040	$323,556	$4,780,317		$ 585,000		$423,924	$190,000		$190,000	$7,144,000					
11	2028	$200,000	$651,040	$325,105	$4,802,582		$ -		$423,924	$190,000		$190,000	$6,783,000	New trailers every 8 years				
12	2029		$651,040	$326,614	$4,824,511		$ 385,000		$423,924	$390,000		$190,000	$7,191,000					
13	2030		$651,040	$328,051	$4,845,925		$ -		$423,924	$190,000		$190,000	$6,629,000					
14	2031		$651,040	$329,436	$4,866,890		$ -		$423,924	$190,000		$190,000	$6,651,000					
15	2032	$346,000	$651,040	$330,761	$4,887,474		$ -		$423,924	$190,000		$190,000	$7,019,000	Transfer station - parking and roads (20 yr life) + capital upgrades				
16	2033		$651,040	$332,041	$4,907,766		$ 235,000		$423,924	$190,000		$190,000	$6,930,000					
17	2034		$651,040	$333,189	$4,927,049		$ -		$423,924	$390,000		$190,000	$6,915,000					
18	2035		$651,040	$334,298	$4,945,929		$ 35,000		$423,924	$190,000		$190,000	$6,770,000					
19	2036	$200,000	$651,040	$335,388	$4,964,697		$ -		$423,924	$190,000		$190,000	$6,955,000	New trailers every 8 years				
20	2037		$651,040	$336,405	$4,982,881		$ 550,000		$423,924	$190,000		$190,000	$7,324,000					
21	2038		$651,040	$337,363	$5,000,595		$ -		$423,924	$190,000		$190,000	$6,793,000					
22	2039		$651,040	$338,281	$5,017,928		$ 35,000		$423,924	$390,000		$190,000	$7,046,000					
23	2040		$651,040	$339,167	$5,035,014		$ -		$423,924	$190,000		$190,000	$6,829,000					
24	2041		$651,040	$340,053	$5,051,898		$ 385,000		$423,924	$190,000		$190,000	$7,232,000					
25	2042		$651,040	$341,753	$5,076,293		$ -		$423,924	$190,000		$190,000	$6,873,000					
26	2043		$651,040	$343,462	$5,100,903		$ 200,000		$423,924	$190,000		$190,000	$7,099,000					
27	2044	$200,000	$651,040	$345,180	$5,125,730		$ -		$423,924	$390,000		$190,000	$7,326,000	New trailers every 8 years				
28	2045		$651,040	$346,905	$5,150,776	$8,850,000	$ 35,000		$423,924	$190,000		$190,000	$15,838,000			Amotization period over	Construction Cell 2	
29	2046		$651,040	$348,640	$3,294,656		$ -		$523,924	$190,000		$190,000	$5,198,000					
30	2047		$651,040	$350,383	$2,317,301		$ 585,000	$ 1,350,000	$523,924	$190,000		$190,000	$6,158,000				Closure Cell 1	
31	2048		$651,040	$352,135	$2,334,882		$ -		$523,924	$190,000		$190,000	$4,242,000					
32	2049		$651,040	$353,896	$2,352,618		$ -		$523,924	$390,000		$190,000	$4,461,000					
33	2050		$651,040	$355,665	$2,370,510		$ -		$523,924	$190,000		$190,000	$4,281,000					
34	2051	$241,000	$651,040	$357,444	$2,388,561		$ 35,000		$523,924	$190,000		$190,000	$4,577,000	Transfer station permits etc				
35	2052	$2,615,000	$651,040	$359,231	$2,406,772		$ -		$523,924	$190,000		$190,000	$6,936,000	Transfer station - new facility + new trailer	Locate, site and permit perm TS			
36	2053		$651,040	$361,027	$2,425,143		$ 585,000		$523,924	$190,000		$190,000	$4,926,000		Construct perm TS			
37	2054		$651,040	$362,832	$2,443,678		$ -		$523,924	$390,000		$190,000	$4,561,000		Off island export begins @ $100/tonne			
38	2055		$651,040	$364,646	$2,462,377		$ -		$523,924	$190,000		$190,000	$4,382,000					
39	2056		$651,040	$366,469	$2,481,241		$ -		$523,924	$190,000		$190,000	$4,403,000					
40	2057		$651,040	$368,302	$2,500,273		$ 585,000		$523,924	$190,000		$190,000	$5,009,000					
41	2058		$651,040	$370,143	$2,519,474		$ -		$523,924	$190,000		$190,000	$4,445,000					
42	2059		$651,040	$371,994	$2,538,845		$ 35,000		$523,924	$390,000		$190,000	$4,701,000					
43	2060	$200,000	$651,040	$373,854	$2,558,389		$ -		$523,924	$190,000		$190,000	$4,687,000	New trailers every 8 years				
44	2061		$651,040	$375,723	$2,578,106		$ -		$523,924	$190,000		$190,000	$4,509,000		New trailers every 8 years			
45	2062		$651,040	$377,602	$2,597,999		$ -		$523,924	$190,000		$190,000	$4,531,000					
46	2063		$651,040	$379,490	$2,618,068		$ 235,000		$523,924	$190,000		$190,000	$4,788,000					
47	2064		$651,040	$381,387	$2,638,316		$ -		$523,924	$390,000		$190,000	$4,775,000					
48	2065		$651,040	$383,294	$2,658,745		$ 385,000		$523,924	$190,000		$190,000	$4,982,000					
49	2066		$651,040	$385,211	$2,222,518		$ -		$523,924	$190,000		$190,000	$4,163,000					
50	2067		$651,040	$387,137	$2,239,557		$ 550,000		$523,924	$190,000		$190,000	$4,732,000					
	Totals	$4,202,000	$28,645,760	$15,414,260	$176,042,933	$8,850,000	$7,645,000	$4,115,000	$26,590,423	$11,310,000	$10,382,338	$15,729,269	$308,930,000					

30 years
$214,839,000 1,792,501 tonnes
$120 per tonne over 30 years

40 years
$262,617,000 2,448,090 tonnes
$107 per tonne over 40 years

50 years
$308,930,000 3,159,253 tonnes
$98 per tonne over 50 years

Table D5: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River - Increasing Capacity

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,195		29,195	83	21,152	1,251	3,187
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,522		29,522	84	21,276	1,265	3,222
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,852	Landfill closure	29,852	85	21,401	1,279	3,259
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,296		50,817	145		2,178	5,547
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,619		51,259	146		2,197	5,595
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	29,942		51,696	148		2,216	5,643
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	30,262		52,124	149		2,234	5,690
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	30,579		52,546	150		2,252	5,736
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	30,893		52,962	151		2,270	5,781
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	31,202		53,368	152		2,287	5,825
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	31,506		53,765	154		2,304	5,869
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	31,807		54,155	155		2,321	5,911
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	32,105		54,540	156		2,337	5,953
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	32,393		54,906	157		2,353	5,993
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	32,676		55,264	158		2,368	6,032
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	32,958		55,620	159		2,384	6,071
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	33,234		55,965	160		2,398	6,109
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	33,506		56,300	161		2,413	6,146
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	33,772		56,629	162		2,427	6,181
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	34,036		56,953	163		2,441	6,217
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	34,297		57,273	164		2,455	6,252
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	34,644		57,736	165		2,474	6,302
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	34,995		58,202	166		2,494	6,353
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	35,350		58,673	168		2,515	6,405
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	35,708		59,148	169		2,535	6,456
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	36,070		59,627	170		2,555	6,509
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	36,436		60,110	172		2,576	6,561
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	36,805		60,598	173		2,597	6,615
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	37,178		61,090	175		2,618	6,668
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	37,555		61,586	176		2,639	6,723
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	37,935		62,087	177		2,661	6,777
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	38,320		62,592	179		2,683	6,832
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	38,708		63,101	180		2,704	6,888
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	39,100		63,616	182		2,726	6,944
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	39,496		64,134	183		2,749	7,001
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	39,896		64,657	185		2,771	7,058
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	40,300		65,185	186		2,794	7,115
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	40,708		65,718	188		2,816	7,174
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	41,120		66,255	189		2,840	7,232
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	41,537		66,797	191		2,863	7,291
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	41,957		67,344	192		2,886	7,351
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	42,382		67,896	194		2,910	7,411
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	42,811		68,452	196		2,934	7,472
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	43,244		69,014	197		2,958	7,533
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	43,682		69,580	199		2,982	7,595
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	44,124		70,152	200		3,007	7,658
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	44,571		70,729	202		3,031	7,721
	Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,687,286	0	2,728,790		219,420	337,141	297,865

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,787	3,187	596	36	36	5,570	284,759	Cell 1	Cell 1	
5	2022	1,807	3,222	602	36	36	5,632	290,391	Cell 1	Cell 1	
6	2023	1,828	3,259	609	37	37	5,695	296,087	Cell 1	Cell 1	
7	2024	3,111	5,547	1,037	62	62	9,695	305,782	Cell 1	Cell 1	
8	2025	3,138	5,595	1,046	63	63	9,780	315,562	Cell 1	Cell 1	
9	2026	3,165	5,643	1,055	63	63	9,863	325,425	Cell 1	Cell 1	
10	2027	3,191	5,690	1,064	64	64	9,945	335,370	Cell 1	Cell 1	
11	2028	3,217	5,736	1,072	64	64	10,025	345,395	Cell 1	Cell 1	
12	2029	3,243	5,781	1,081	65	65	10,104	355,499	Cell 1	Cell 1	
13	2030	3,267	5,825	1,089	65	65	10,182	365,681	Cell 1	Cell 1	
14	2031	3,292	5,869	1,097	66	66	10,258	375,939	Cell 1	Cell 1	
15	2032	3,316	5,911	1,105	66	66	10,332	386,271	Cell 1	Cell 1	
16	2033	3,339	5,953	1,113	67	67	10,406	396,677	Cell 1	Cell 1	
17	2034	3,362	5,993	1,121	67	67	10,475	407,152	Cell 1	Cell 1	
18	2035	3,384	6,032	1,128	68	68	10,544	417,696	Cell 1	Cell 1	
19	2036	3,405	6,071	1,135	68	68	10,612	428,308	Cell 1	Cell 1	
20	2037	3,426	6,109	1,142	69	69	10,677	438,985	Cell 1	Cell 1	
21	2038	3,447	6,146	1,149	69	69	10,742	449,727	Cell 1	Cell 1	
22	2039	3,467	6,181	1,156	69	69	10,804	460,531	Cell 1	Cell 1	
23	2040	3,487	6,217	1,162	70	70	10,866	471,397	Cell 1	Cell 1	
24	2041	3,507	6,252	1,169	70	70	10,927	482,324	Cell 1	Cell 1	
25	2042	3,535	6,302	1,178	71	71	11,015	493,339	Cell 1	Cell 1	
26	2043	3,563	6,353	1,188	71	71	11,104	504,444	Cell 1	Cell 1	
27	2044	3,592	6,405	1,197	72	72	11,194	515,638	Cell 1	Cell 1	
28	2045	3,621	6,456	1,207	72	72	11,285	526,923	Cell 2	Cell 1	**517,470**
29	2046	3,651	6,509	1,217	73	73	11,376	538,299	Cell 2	Cell 2	
30	2047	3,680	6,561	1,227	74	74	11,468	549,767	Cell 2	Cell 2	
31	2048	3,710	6,615	1,237	74	74	11,561	561,329	Cell 2	Cell 2	
32	2049	3,740	6,668	1,247	75	75	11,655	572,984	Cell 2	Cell 2	
33	2050	3,771	6,723	1,257	75	75	11,750	584,734	Cell 2	Cell 2	
34	2051	3,801	6,777	1,267	76	76	11,846	596,580	Cell 2	Cell 2	
35	2052	3,832	6,832	1,277	77	77	11,942	608,522	Cell 2	Cell 2	
36	2053	3,863	6,888	1,288	77	77	12,039	620,561	Cell 2	Cell 2	
37	2054	3,895	6,944	1,298	78	78	12,137	632,698	Cell 2	Cell 2	
38	2055	3,927	7,001	1,309	79	79	12,236	644,934	Cell 2	Cell 2	
39	2056	3,959	7,058	1,320	79	79	12,336	657,270	Cell 2	Cell 2	
40	2057	3,991	7,115	1,330	80	80	12,437	669,706	Cell 2	Cell 2	
41	2058	4,024	7,174	1,341	80	80	12,538	682,245	Cell 2	Cell 2	
42	2059	4,056	7,232	1,352	81	81	12,641	694,885	Cell 2	Cell 2	
43	2060	4,090	7,291	1,363	82	82	12,744	707,630	Cell 2	Cell 2	
44	2061	4,123	7,351	1,374	82	82	12,848	720,478	Cell 2	Cell 2	
45	2062	4,157	7,411	1,386	83	83	12,954	733,432	Cell 2	Cell 2	
46	2063	4,191	7,472	1,397	84	84	13,060	746,492	Cell 2	Cell 2	
47	2064	4,225	7,533	1,408	85	85	13,167	759,659	Cell 2	Cell 2	
48	2065	4,260	7,595	1,420	85	85	13,275	772,934	Cell 2	Cell 2	
49	2066	4,295	7,658	1,432	86	86	13,384	786,318	Cell 2	Cell 2	
50	2067	4,330	7,721	1,443	87	87	13,494	799,813	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%
CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 350 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table D5: Long Term Cost Model for Option 3(b) - Sustane facility located in Campbell River - Increasing Capacity

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Transport	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015													$0					
	2016						$16,000,000							$16,000,000		New Transfer station constructed 2012-2013		Construction of leachate management system and Cell 1	
0	2017							$ 860,000	$ 265,000	$1,116,495		$250,868	$1,052,753	$3,545,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018							$ 200,000	$ 2,500,000	$1,116,495		$490,358	$1,052,753	$5,360,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019							$ -		$1,116,495	$390,000	$191,695	$1,052,753	$2,751,000					Phase 2 Design and construction
3	2020	$311,025			Ash / residuals	$1,352,789		$ 1,075,000		$1,116,495	$190,000	$491,790	$1,052,753	$5,590,000	Permits		Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$432,080	$47,000	$3,571,072		$ 35,000		$423,924	$190,000	$5,630,329	$1,052,753	$15,402,000	New transfer station		Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$436,919	$48,000	$3,588,315		$ -		$423,924	$190,000	$0	$1,052,753	$6,449,000					
6	2023		$709,508	$441,808	$48,000	$3,605,737		$ 35,000		$423,924	$190,000	$218,613	$1,052,753	$6,725,000					Phase 3 LFG and final cover design
7	2024		$709,508	$433,582	$82,000	$4,711,435		$ -		$423,924	$390,000	$3,108,685	$190,000	$10,049,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$438,368	$83,000	$4,734,732		$ -		$423,924	$190,000		$190,000	$6,770,000					
9	2026		$709,508	$443,137	$84,000	$4,757,760		$ -		$423,924	$190,000		$190,000	$6,798,000					
10	2027		$709,508	$447,873	$84,000	$4,780,317		$ 585,000		$423,924	$190,000		$190,000	$7,411,000					
11	2028		$709,508	$452,573	$85,000	$4,802,582		$ -		$423,924	$190,000		$190,000	$6,854,000					
12	2029	$200,000	$709,508	$457,217	$86,000	$4,824,511		$ 385,000		$423,924	$390,000		$190,000	$7,666,000	New trailers every 8 years				
13	2030		$709,508	$461,790	$86,000	$4,845,925		$ -		$423,924	$190,000		$190,000	$6,907,000					
14	2031		$709,508	$466,288	$87,000	$4,866,890		$ -		$423,924	$190,000		$190,000	$6,934,000					
15	2032		$709,508	$470,739	$87,000	$4,887,474		$ -		$423,924	$190,000		$190,000	$6,959,000					
16	2033		$709,508	$475,154	$88,000	$4,907,766		$ 235,000		$423,924	$190,000		$190,000	$7,219,000					
17	2034		$709,508	$479,417	$89,000	$4,927,049		$ -		$423,924	$390,000		$190,000	$7,209,000					
18	2035		$709,508	$483,607	$89,000	$4,945,929		$ 35,000		$423,924	$190,000		$190,000	$7,067,000					
19	2036		$709,508	$487,784	$90,000	$4,964,697		$ -		$423,924	$190,000		$190,000	$7,056,000					
20	2037	$200,000	$709,508	$491,870	$90,000	$4,982,881		$ 550,000		$423,924	$190,000		$190,000	$7,828,000	New trailers every 8 years				
21	2038		$709,508	$495,883	$91,000	$5,000,595		$ -		$423,924	$190,000		$190,000	$7,101,000					
22	2039		$709,508	$499,828	$91,000	$5,017,928		$ 35,000		$423,924	$390,000		$190,000	$7,357,000					
23	2040		$709,508	$503,737	$92,000	$5,035,014		$ -		$423,924	$190,000		$190,000	$7,144,000					
24	2041	$1,555,125	$709,508	$507,590	$93,000	$5,051,898		$ 385,000		$423,924	$190,000		$190,000	$9,106,000	Major capital upgrade every 20 years				
25	2042		$709,508	$512,735	$93,000	$5,076,293		$ -		$423,924	$190,000		$190,000	$7,195,000					
26	2043		$709,508	$517,933	$94,000	$5,100,903		$ 200,000		$423,924	$190,000		$190,000	$7,426,000					
27	2044		$709,508	$523,183	$95,000	$5,125,730		$ -		$423,924	$390,000		$190,000	$7,457,000					
28	2045	$200,000	$709,508	$528,486	$96,000	$5,150,776	$8,850,000	$ 35,000		$423,924	$190,000		$190,000	$16,374,000	New trailers every 8 years		Amortization period over	Construction Cell 2	
29	2046		$709,508	$533,842	$96,000	$3,294,656		$ -		$523,924	$190,000		$190,000	$5,538,000					
30	2047		$709,508	$539,252	$97,000	$2,317,301		$ 585,000	$ 1,350,000	$523,924	$190,000		$190,000	$6,502,000				Closure Cell 1	
31	2048		$709,508	$544,716	$98,000	$2,334,882		$ -		$523,924	$190,000		$190,000	$4,591,000					
32	2049		$709,508	$550,236	$99,000	$2,352,618		$ -		$523,924	$390,000		$190,000	$4,815,000					
33	2050		$709,508	$555,811	$99,000	$2,370,510		$ -		$523,924	$190,000		$190,000	$4,639,000					
34	2051		$709,508	$561,442	$100,000	$2,388,561		$ 35,000		$523,924	$190,000		$190,000	$4,698,000					
35	2052		$709,508	$567,130	$101,000	$2,406,772		$ -		$523,924	$190,000		$190,000	$4,688,000					
36	2053	$200,000	$709,508	$572,875	$102,000	$2,425,143		$ 585,000		$523,924	$190,000		$190,000	$5,498,000	New trailers every 8 years				
37	2054		$709,508	$578,678	$103,000	$2,443,678		$ -		$523,924	$390,000		$190,000	$4,939,000					
38	2055		$709,508	$584,539	$104,000	$2,462,377		$ -		$523,924	$190,000		$190,000	$4,764,000					
39	2056		$709,508	$590,460	$104,000	$2,481,241		$ -		$523,924	$190,000		$190,000	$4,789,000					
40	2057		$709,508	$596,439	$105,000	$2,500,273		$ 585,000		$523,924	$190,000		$190,000	$5,400,000					
41	2058		$709,508	$602,480	$106,000	$2,519,474		$ -		$523,924	$190,000		$190,000	$4,841,000					
42	2059		$709,508	$608,580	$107,000	$2,538,845		$ 35,000		$523,924	$390,000		$190,000	$5,103,000					
43	2060		$709,508	$614,743	$108,000	$2,558,389		$ -		$523,924	$190,000		$190,000	$4,895,000					
44	2061	$1,755,125	$709,508	$620,967	$109,000	$2,578,106		$ -		$523,924	$190,000		$190,000	$6,677,000	Major capital upgrade every 20 years				
45	2062		$709,508	$627,254	$110,000	$2,597,999		$ -		$523,924	$190,000		$190,000	$4,949,000					
46	2063		$709,508	$633,604	$111,000	$2,618,068		$ 235,000		$523,924	$190,000		$190,000	$5,211,000					
47	2064		$709,508	$640,018	$111,000	$2,638,316		$ -		$523,924	$390,000		$190,000	$5,203,000					
48	2065		$709,508	$646,496	$112,000	$2,658,745		$ 385,000		$523,924	$190,000		$190,000	$5,416,000					
49	2066		$709,508	$653,040	$113,000	$2,222,518		$ -		$523,924	$190,000		$190,000	$4,602,000					
50	2067		$709,508	$659,650	$114,000	$2,239,557		$ 550,000		$523,924	$190,000		$190,000	$5,177,000					
	Totals	$7,731,275	$33,346,853	$24,971,833	$4,407,000	$175,565,025	$8,850,000	$7,645,000	$4,115,000	$26,590,423	$11,310,000	$10,382,338	$15,729,269	$330,644,000					

30 years
$229,749,000 1,792,501 tonnes
$128 per tonne over 30 years

40 years
$278,570,000 2,448,090
$114 per tonne over 40 years

50 years
$330,644,000 3,159,253
$105 per tonne over 50 years

Table D6: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River - Increasing Capacity

Population and Disposal Rates

	Year	Projected CVRD Population	CVRD Waste	Projected SRD Population	SRD Waste	Total Annual Tonnage	Daily Tonnage	Combined Population	Tonnes to Comox Valley TS	Tonnes to Campbell River TS	Tonnes to Sustane Facility	Tonnes per day to Sustane facility	Tonnes MSW to CRWMC LF	Tonnes to MSW CVWMC LF	Tonnes Ash/Residuals to CVWMC LF
			tonnes		tonnes	tonnes / yr	tonnes / day		tonnes	tonnes	tonnes	tonnes / day		tonnes	
	2015	64,294	36,652	45,871	26,149	62,801	172	90,443					26,149	36,652	
	2016	64,847	36,967	46,187	26,330	63,297	173	91,177					26,330	36,967	
0	2017	65,592	36,007	46,490	25,521	61,527	169	91,113					25,521	36,007	0
1	2018	66,372	36,435	46,809	25,696	62,131	170	92,068					25,696	36,435	0
2	2019	67,139	36,856	47,116	25,864	62,720	172	93,003					25,864	36,856	0
3	2020	67,905	37,276	47,419	26,031	63,307	173	93,936					26,031	37,276	0
4	2021	68,667	30,446	47,706	21,152	51,598	141	89,819	29,195		29,195	83	21,152	1,251	3,187
5	2022	69,436	30,787	47,986	21,276	52,063	143	90,712	29,522		29,522	84	21,276	1,265	3,222
6	2023	70,213	31,131	48,267	21,401	52,532	144	91,614	29,852	Landfill closure	29,852	85	21,401	1,279	3,259
7	2024	70,986	31,474	48,539	21,521	52,995	145	92,507	29,296	21,521	50,817	145		2,178	5,547
8	2025	71,758	31,816	48,806	21,640	53,456	146	93,398	29,619	21,640	51,259	146		2,197	5,595
9	2026	72,527	32,157	49,064	21,754	53,911	148	94,281	29,942	21,754	51,696	148		2,216	5,643
10	2027	73,290	32,496	49,307	21,862	54,357	149	95,152	30,262	21,862	52,124	149		2,234	5,690
11	2028	74,047	32,831	49,543	21,967	54,798	150	96,014	30,579	21,967	52,546	150		2,252	5,736
12	2029	74,795	33,163	49,773	22,069	55,231	151	96,864	30,893	22,069	52,962	151		2,270	5,781
13	2030	75,531	33,489	49,992	22,166	55,655	152	97,697	31,202	22,166	53,368	152		2,287	5,825
14	2031	76,255	33,810	50,203	22,259	56,069	154	98,514	31,506	22,259	53,765	154		2,304	5,869
15	2032	76,971	34,128	50,405	22,349	56,476	155	99,320	31,807	22,349	54,155	155		2,321	5,911
16	2033	77,681	34,442	50,600	22,435	56,878	156	100,116	32,105	22,435	54,540	156		2,337	5,953
17	2034	78,366	34,746	50,775	22,513	57,259	157	100,879	32,393	22,513	54,906	157		2,353	5,993
18	2035	79,039	35,045	50,944	22,588	57,632	158	101,627	32,676	22,588	55,264	158		2,368	6,032
19	2036	79,710	35,342	51,110	22,661	58,003	159	102,371	32,958	22,661	55,620	159		2,384	6,071
20	2037	80,366	35,633	51,265	22,730	58,363	160	103,096	33,234	22,730	55,965	160		2,398	6,109
21	2038	81,010	35,918	51,411	22,795	58,713	161	103,805	33,506	22,795	56,300	161		2,413	6,146
22	2039	81,643	36,199	51,551	22,857	59,056	162	104,500	33,772	22,857	56,629	162		2,427	6,181
23	2040	82,270	36,477	51,686	22,917	59,394	163	105,187	34,036	22,917	56,953	163		2,441	6,217
24	2041	82,888	36,751	51,821	22,977	59,728	164	105,865	34,297	22,977	57,273	164		2,455	6,252
25	2042	83,717	37,119	52,080	23,091	60,210	165	106,808	34,644	23,091	57,736	165		2,474	6,302
26	2043	84,554	37,490	52,341	23,207	60,697	166	107,761	34,995	23,207	58,202	166		2,494	6,353
27	2044	85,400	37,865	52,602	23,323	61,188	168	108,723	35,350	23,323	58,673	168		2,515	6,405
28	2045	86,254	38,243	52,865	23,440	61,683	169	109,693	35,708	23,440	59,148	169		2,535	6,456
29	2046	87,116	38,626	53,130	23,557	62,183	170	110,673	36,070	23,557	59,627	170		2,555	6,509
30	2047	87,987	39,012	53,395	23,675	62,687	172	111,662	36,436	23,675	60,110	172		2,576	6,561
31	2048	88,867	39,402	53,662	23,793	63,195	173	112,660	36,805	23,793	60,598	173		2,597	6,615
32	2049	89,756	39,796	53,930	23,912	63,708	175	113,668	37,178	23,912	61,090	175		2,618	6,668
33	2050	90,653	40,194	54,200	24,031	64,226	176	114,685	37,555	24,031	61,586	176		2,639	6,723
34	2051	91,560	40,596	54,471	24,152	64,748	177	115,712	37,935	24,152	62,087	177		2,661	6,777
35	2052	92,476	41,002	54,743	24,272	65,274	179	116,748	38,320	24,272	62,592	179		2,683	6,832
36	2053	93,400	41,412	55,017	24,394	65,806	180	117,794	38,708	24,394	63,101	180		2,704	6,888
37	2054	94,334	41,826	55,292	24,516	66,342	182	118,850	39,100	24,516	63,616	182		2,726	6,944
38	2055	95,278	42,245	55,569	24,638	66,883	183	119,916	39,496	24,638	64,134	183		2,749	7,001
39	2056	96,230	42,667	55,847	24,761	67,428	185	120,992	39,896	24,761	64,657	185		2,771	7,058
40	2057	97,193	43,094	56,126	24,885	67,979	186	122,078	40,300	24,885	65,185	186		2,794	7,115
41	2058	98,165	43,525	56,406	25,010	68,534	188	123,174	40,708	25,010	65,718	188		2,816	7,174
42	2059	99,146	43,960	56,688	25,135	69,095	189	124,281	41,120	25,135	66,255	189		2,840	7,232
43	2060	100,138	44,399	56,972	25,260	69,660	191	125,398	41,537	25,260	66,797	191		2,863	7,291
44	2061	101,139	44,843	57,257	25,387	70,230	192	126,526	41,957	25,387	67,344	192		2,886	7,351
45	2062	102,151	45,292	57,543	25,514	70,805	194	127,664	42,382	25,514	67,896	194		2,910	7,411
46	2063	103,172	45,745	57,831	25,641	71,386	196	128,813	42,811	25,641	68,452	196		2,934	7,472
47	2064	104,204	46,202	58,120	25,769	71,972	197	129,973	43,244	25,769	69,014	197		2,958	7,533
48	2065	105,246	46,664	58,411	25,898	72,562	199	131,144	43,682	25,898	69,580	199		2,982	7,595
49	2066	106,298	47,131	58,703	26,028	73,159	200	132,326	44,124	26,028	70,152	200		3,007	7,658
50	2067	107,361	47,602	58,996	26,158	73,760	202	133,519	44,571	26,158	70,729	202		3,031	7,721
	Totals	4,465,392	2,024,427	2,772,844	1,260,924	3,285,351		5,726,315	1,687,286	1,041,504	2,728,790		219,420	337,141	297,865

CRWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³		
	2015	37,356	12,452	747	747	49,808			
	2016	37,614	12,538	752	752	50,152		Phase 3	
0	2017	36,458	12,153	729	729	48,611	48,611	Phase 3	
1	2018	36,708	12,236	734	734	48,944	97,555	Phase 3	
2	2019	36,949	12,316	739	739	49,265	146,821	Phase 3	
3	2020	37,187	12,396	744	744	49,582	196,403	Phase 3	
4	2021	30,217	10,072	604	604	40,290	236,693	Phase 3	
5	2022	30,395	10,132	608	608	40,526	277,219	Phase 3	
6	2023	30,573	10,191	611	611	40,763	317,982	Closed	**288,480**
7	2024	0	0	0	0	0	317,982	Closed	
8	2025	0	0	0	0	0	317,982	Closed	
9	2026	0	0	0	0	0	317,982	Closed	
10	2027	0	0	0	0	0	317,982	Closed	
11	2028	0	0	0	0	0	317,982	Closed	
12	2029	0	0	0	0	0	317,982	Closed	
13	2030	0	0	0	0	0	317,982	Closed	
14	2031	0	0	0	0	0	317,982	Closed	
15	2032	0	0	0	0	0	317,982	Closed	
16	2033	0	0	0	0	0	317,982	Closed	
17	2034	0	0	0	0	0	317,982	Closed	
18	2035	0	0	0	0	0	317,982	Closed	
19	2036	0	0	0	0	0	317,982	Closed	
20	2037	0	0	0	0	0	317,982	Closed	
21	2038	0	0	0	0	0	317,982	Closed	
22	2039	0	0	0	0	0	317,982	Closed	
23	2040	0	0	0	0	0	317,982	Closed	
24	2041	0	0	0	0	0	317,982	Closed	
25	2042	0	0	0	0	0	317,982	Closed	
26	2043	0	0	0	0	0	317,982	Closed	
27	2044	0	0	0	0	0	317,982	Closed	
28	2045	0	0	0	0	0	317,982	Closed	
29	2046	0	0	0	0	0	317,982	Closed	
30	2047	0	0	0	0	0	317,982	Closed	
31	2048	0	0	0	0	0	317,982	Closed	
32	2049	0	0	0	0	0	317,982	Closed	
33	2050	0	0	0	0	0	317,982	Closed	
34	2051	0	0	0	0	0	317,982	Closed	
35	2052	0	0	0	0	0	317,982	Closed	
36	2053	0	0	0	0	0	317,982	Closed	
37	2054	0	0	0	0	0	317,982	Closed	
38	2055	0	0	0	0	0	317,982	Closed	
39	2056	0	0	0	0	0	317,982	Closed	
40	2057	0	0	0	0	0	317,982	Closed	
41	2058	0	0	0	0	0	317,982	Closed	
42	2059	0	0	0	0	0	317,982	Closed	
43	2060	0	0	0	0	0	317,982	Closed	
44	2061	0	0	0	0	0	317,982	Closed	
45	2062	0	0	0	0	0	317,982	Closed	
46	2063	0	0	0	0	0	317,982	Closed	
47	2064	0	0	0	0	0	317,982	Closed	
48	2065	0	0	0	0	0	317,982	Closed	
49	2066	0	0	0	0	0	317,982	Closed	
50	2067	0	0	0	0	0	317,982	Closed	

CVWMC LF Fill Rate and Capacity

	Year	Volumetric MSW Disposal Rate	Volumetric Ash / Residuals Disposal Rate	Daily Cover Soil	Operational Soil	Settlement	Net Fill Volume	Cumulative Fill Volume	Phase / Cell	Phase / Cell	Volumetric Capacity (m³)
		m³	m³	m³	m³	m³	m³	m³			
	2015	52,360		17,453	1,047	1,047	69,813				
	2016	52,810		17,603	1,056	1,056	70,413		Phase 2	Phase 2	**46,525**
0	2017	51,438	0	17,146	1,029	1,029	68,584	68,584	Cell 1	Phase 2	
1	2018	52,050	0	17,350	1,041	1,041	69,400	137,984	Cell 1	Cell 1	
2	2019	52,651	0	17,550	1,053	1,053	70,202	208,186	Cell 1	Cell 1	
3	2020	53,252	0	17,751	1,065	1,065	71,003	279,189	Cell 1	Cell 1	
4	2021	1,787	3,187	596	36	36	5,570	284,759	Cell 1	Cell 1	
5	2022	1,807	3,222	602	36	36	5,632	290,391	Cell 1	Cell 1	
6	2023	1,828	3,259	609	37	37	5,695	296,087	Cell 1	Cell 1	
7	2024	3,111	5,547	1,037	62	62	9,695	305,782	Cell 1	Cell 1	
8	2025	3,138	5,595	1,046	63	63	9,780	315,562	Cell 1	Cell 1	
9	2026	3,165	5,643	1,055	63	63	9,863	325,425	Cell 1	Cell 1	
10	2027	3,191	5,690	1,064	64	64	9,945	335,370	Cell 1	Cell 1	
11	2028	3,217	5,736	1,072	64	64	10,025	345,395	Cell 1	Cell 1	
12	2029	3,243	5,781	1,081	65	65	10,104	355,499	Cell 1	Cell 1	
13	2030	3,267	5,825	1,089	65	65	10,182	365,681	Cell 1	Cell 1	
14	2031	3,292	5,869	1,097	66	66	10,258	375,939	Cell 1	Cell 1	
15	2032	3,316	5,911	1,105	66	66	10,332	386,271	Cell 1	Cell 1	
16	2033	3,339	5,953	1,113	67	67	10,406	396,677	Cell 1	Cell 1	
17	2034	3,362	5,993	1,121	67	67	10,475	407,152	Cell 1	Cell 1	
18	2035	3,384	6,032	1,128	68	68	10,544	417,696	Cell 1	Cell 1	
19	2036	3,405	6,071	1,135	68	68	10,612	428,308	Cell 1	Cell 1	
20	2037	3,426	6,109	1,142	69	69	10,677	438,985	Cell 1	Cell 1	
21	2038	3,447	6,146	1,149	69	69	10,742	449,727	Cell 1	Cell 1	
22	2039	3,467	6,181	1,156	69	69	10,804	460,531	Cell 1	Cell 1	
23	2040	3,487	6,217	1,162	70	70	10,866	471,397	Cell 1	Cell 1	
24	2041	3,507	6,252	1,169	70	70	10,927	482,324	Cell 1	Cell 1	
25	2042	3,535	6,302	1,178	71	71	11,015	493,339	Cell 1	Cell 1	
26	2043	3,563	6,353	1,188	71	71	11,104	504,444	Cell 1	Cell 1	
27	2044	3,592	6,405	1,197	72	72	11,194	515,638	Cell 1	Cell 1	
28	2045	3,621	6,456	1,207	72	72	11,285	526,923	Cell 2	Cell 1	**517,470**
29	2046	3,651	6,509	1,217	73	73	11,376	538,299	Cell 2	Cell 2	
30	2047	3,680	6,561	1,227	74	74	11,468	549,767	Cell 2	Cell 2	
31	2048	3,710	6,615	1,237	74	74	11,561	561,329	Cell 2	Cell 2	
32	2049	3,740	6,668	1,247	75	75	11,655	572,984	Cell 2	Cell 2	
33	2050	3,771	6,723	1,257	75	75	11,750	584,734	Cell 2	Cell 2	
34	2051	3,801	6,777	1,267	76	76	11,846	596,580	Cell 2	Cell 2	
35	2052	3,832	6,832	1,277	77	77	11,942	608,522	Cell 2	Cell 2	
36	2053	3,863	6,888	1,288	77	77	12,039	620,561	Cell 2	Cell 2	
37	2054	3,895	6,944	1,298	78	78	12,137	632,698	Cell 2	Cell 2	
38	2055	3,927	7,001	1,309	79	79	12,236	644,934	Cell 2	Cell 2	
39	2056	3,959	7,058	1,320	79	79	12,336	657,270	Cell 2	Cell 2	
40	2057	3,991	7,115	1,330	80	80	12,437	669,706	Cell 2	Cell 2	
41	2058	4,024	7,174	1,341	80	80	12,538	682,245	Cell 2	Cell 2	
42	2059	4,056	7,232	1,352	81	81	12,641	694,885	Cell 2	Cell 2	
43	2060	4,090	7,291	1,363	82	82	12,744	707,630	Cell 2	Cell 2	
44	2061	4,123	7,351	1,374	82	82	12,848	720,478	Cell 2	Cell 2	
45	2062	4,157	7,411	1,386	83	83	12,954	733,432	Cell 2	Cell 2	
46	2063	4,191	7,472	1,397	84	84	13,060	746,492	Cell 2	Cell 2	
47	2064	4,225	7,533	1,408	85	85	13,167	759,659	Cell 2	Cell 2	
48	2065	4,260	7,595	1,420	85	85	13,275	772,934	Cell 2	Cell 2	
49	2066	4,295	7,658	1,432	86	86	13,384	786,318	Cell 2	Cell 2	
50	2067	4,330	7,721	1,443	87	87	13,494	799,813	Cell 2	Cell 2	

CVRD growth rate beyond 2041 = 1%

CVRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
CVRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
CVRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*
SRD growth rate beyond 2041 = 0.50%
SRD disposal rate 2015-2016= 0.57 *tonnes per person per year (46% diversion)*
SRD disposal rate 2017-2020= 0.55 *tonnes per person per year (48% diversion)*
SRD disposal rate 2021-2067= 0.44 *tonnes per person per year (58% diversion)*

Days of operation = 350 *days per year*
Bottom ash/residuals to landfill = 11% *% of input*

In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

In-situ ash / residuals waste density = 1 *tonnes per m³*
In-situ MSW waste density = 0.7 *tonnes per m³*
Operational soil = 2% *of waste volume per year*
Waste to cover ratio = 3:1
Settlement = 2% *of waste volume per year*

Table D6: Long Term Cost Model for Option 3(c) - Sustane facility located in Gold River - Increasing Capacity

Capital and Operating Costs

	Year	Comox Valley TS Capital	Comox Valley TS Operating	Comox Valley TS Transport	Campbell River TS Capital	Campbell River TS Operating	Campbell River TS Transport	Ash/residuals Transport from Gold River	Sustane Facility Tipping Fees	CVWMC LF Capital - Expansion	CVWMC LF Capital - Minor Capital	CVWMC LF Capital - Closure	CVWMC LF Operating - Expansion	CVWMC LF Operating - Post-Closure	CRWMC LF Capital	CRWMC LF Operating	Total System	Comox Valley TS Notes	Campbell River TS Notes	Sustane Facility Notes	CVWMC LF Notes	CRWMC LF Notes
	2015																$0		New Transfer station constructed 2012-2013			
	2016									$16,000,000							$16,000,000				Construction of leachate management system and Cell 1	
0	2017										$ 860,000	$ 265,000	$1,116,495		$250,868	$1,052,753	$3,545,000				Closure Phase 2	Phase 2 SW mgmt design & partial construction
1	2018										$ 200,000	$ 2,500,000	$1,116,495		$490,358	$1,052,753	$5,360,000				Closure Phase 2	Phase 2 Surface water management construction
2	2019										$ -		$1,116,495	$390,000	$191,695	$1,052,753	$2,751,000					Phase 2 Design and construction
3	2020	$311,025			$200,000				$775,000		$ 1,075,000		$1,116,495	$190,000	$491,790	$1,052,753	$5,212,000	Construct TS	New trailers every 8 years	Permits and land		Phase 2 LFG and final cover design
4	2021	$3,310,000	$709,508	$817,449				$89,230	$3,571,072		$ 35,000		$423,924	$190,000	$5,630,329	$1,052,753	$15,829,000	New trailers every 8 years		Sustane facility begins operating		Phase 2 LFG and final cover construction
5	2022		$709,508	$826,603				$90,229	$3,588,315		$ -		$423,924	$190,000	$0	$1,052,753	$6,881,000					
6	2023		$709,508	$835,853				$91,239	$3,605,737		$ 35,000		$423,924	$190,000	$218,613	$1,052,753	$7,163,000					Phase 3 LFG and final cover design
7	2024		$709,508	$820,291		$651,040	$430,428	$155,318	$4,711,435		$ -		$423,924	$390,000	$3,108,685	$190,000	$11,591,000					Phase 3 LFG and final cover construction
8	2025		$709,508	$829,345		$651,040	$432,795	$156,668	$4,734,732		$ -		$423,924	$190,000		$190,000	$8,318,000					
9	2026		$709,508	$838,368		$651,040	$435,083	$158,002	$4,757,760		$ -		$423,924	$190,000		$190,000	$8,354,000					
10	2027		$709,508	$847,327		$651,040	$437,238	$159,310	$4,780,317		$ 585,000		$423,924	$190,000		$190,000	$8,974,000					
11	2028		$709,508	$856,219	$200,000	$651,040	$439,331	$160,600	$4,802,582		$ -		$423,924	$190,000		$190,000	$8,623,000		New trailers every 8 years			
12	2029	$200,000	$709,508	$865,006		$651,040	$441,370	$161,871	$4,824,511		$ 385,000		$423,924	$390,000		$190,000	$9,242,000	New trailers every 8 years				
13	2030		$709,508	$873,656		$651,040	$443,312	$163,112	$4,845,925		$ -		$423,924	$190,000		$190,000	$8,490,000					
14	2031		$709,508	$882,167		$651,040	$445,183	$164,327	$4,866,890		$ -		$423,924	$190,000		$190,000	$8,523,000					
15	2032		$709,508	$890,588	$346,000	$651,040	$446,975	$165,520	$4,887,474		$ -		$423,924	$190,000		$190,000	$8,901,000					
16	2033		$709,508	$898,941		$651,040	$448,704	$166,696	$4,907,766		$ 235,000		$423,924	$190,000		$190,000	$8,822,000					
17	2034		$709,508	$907,006		$651,040	$450,256	$167,813	$4,927,049		$ -		$423,924	$390,000		$190,000	$8,817,000					
18	2035		$709,508	$914,931		$651,040	$451,754	$168,907	$4,945,929		$ 35,000		$423,924	$190,000		$190,000	$8,681,000					
19	2036		$709,508	$922,835	$200,000	$651,040	$453,226	$169,995	$4,964,697		$ -		$423,924	$190,000		$190,000	$8,875,000		New trailers every 8 years			
20	2037	$200,000	$709,508	$930,565		$651,040	$454,601	$171,049	$4,982,881		$ 550,000		$423,924	$190,000		$190,000	$9,454,000	New trailers every 8 years				
21	2038		$709,508	$938,157		$651,040	$455,896	$172,076	$5,000,595		$ -		$423,924	$190,000		$190,000	$8,731,000					
22	2039		$709,508	$945,621		$651,040	$457,137	$173,080	$5,017,928		$ 35,000		$423,924	$390,000		$190,000	$8,993,000					
23	2040		$709,508	$953,016		$651,040	$458,334	$174,070	$5,035,014		$ -		$423,924	$190,000		$190,000	$8,785,000	Major capital upgrade every 20 years				
24	2041	$1,555,125	$709,508	$960,304		$651,040	$459,531	$175,049	$5,051,898		$ 385,000		$423,924	$190,000		$190,000	$10,751,000					
25	2042		$709,508	$970,040		$651,040	$461,829	$176,462	$5,076,293		$ -		$423,924	$190,000		$190,000	$8,849,000					
26	2043		$709,508	$979,873		$651,040	$464,138	$177,889	$5,100,903		$ 200,000		$423,924	$190,000		$190,000	$9,087,000					
27	2044		$709,508	$989,805	$200,000	$651,040	$466,459	$179,328	$5,125,730		$ -		$423,924	$390,000		$190,000	$9,326,000		New trailers every 8 years			
28	2045	$200,000	$709,508	$999,837		$651,040	$468,791	$180,779	$5,150,776	$8,850,000	$ 35,000		$423,924	$190,000		$190,000	$18,050,000	New trailers every 8 years		Amotization period over	Construction Cell 2	
29	2046		$709,508	$1,009,971		$651,040	$471,135	$182,243	$3,294,656		$ -		$523,924	$190,000		$190,000	$7,222,000					
30	2047		$709,508	$1,020,206		$651,040	$473,491	$183,721	$2,317,301		$ 585,000	$ 1,350,000	$523,924	$190,000		$190,000	$8,194,000				Closure Cell 1	
31	2048		$709,508	$1,030,544		$651,040	$475,858	$185,211	$2,334,882		$ -		$523,924	$190,000		$190,000	$6,291,000					
32	2049		$709,508	$1,040,987		$651,040	$478,237	$186,714	$2,352,618		$ -		$523,924	$390,000		$190,000	$6,523,000					
33	2050		$709,508	$1,051,534		$651,040	$480,629	$188,231	$2,370,510		$ -		$523,924	$190,000		$190,000	$6,355,000					
34	2051		$709,508	$1,062,188	$241,000	$651,040	$483,032	$189,761	$2,388,561		$ 35,000		$523,924	$190,000		$190,000	$6,664,000					
35	2052		$709,508	$1,072,948	$2,615,000	$651,040	$485,447	$191,305	$2,406,772		$ -		$523,924	$190,000		$190,000	$9,036,000		New trailers every 8 years			
36	2053	$200,000	$709,508	$1,083,818		$651,040	$487,874	$192,862	$2,425,143		$ 585,000		$523,924	$190,000		$190,000	$7,239,000	New trailers every 8 years				
37	2054		$709,508	$1,094,796		$651,040	$490,314	$194,433	$2,443,678		$ -		$523,924	$390,000		$190,000	$6,688,000					
38	2055		$709,508	$1,105,885		$651,040	$492,765	$196,018	$2,462,377		$ -		$523,924	$190,000		$190,000	$6,522,000					
39	2056		$709,508	$1,117,086		$651,040	$495,229	$197,618	$2,481,241		$ -		$523,924	$190,000		$190,000	$6,556,000					
40	2057		$709,508	$1,128,399		$651,040	$497,705	$199,231	$2,500,273		$ 585,000		$523,924	$190,000		$190,000	$7,175,000					
41	2058		$709,508	$1,139,826		$651,040	$500,194	$200,859	$2,519,474		$ -		$523,924	$190,000		$190,000	$6,625,000					
42	2059		$709,508	$1,151,368		$651,040	$502,695	$202,501	$2,538,845		$ 35,000		$523,924	$390,000		$190,000	$6,895,000					
43	2060		$709,508	$1,163,027	$200,000	$651,040	$505,208	$204,157	$2,558,389		$ -		$523,924	$190,000		$190,000	$6,895,000	Major capital upgrade every 20 years	New trailers every 8 years			
44	2061	$1,755,125	$709,508	$1,174,802		$651,040	$507,734	$205,829	$2,578,106		$ -		$523,924	$190,000		$190,000	$8,486,000	New trailers every 8 years				
45	2062		$709,508	$1,186,696		$651,040	$510,273	$207,515	$2,597,999		$ -		$523,924	$190,000		$190,000	$6,767,000					
46	2063		$709,508	$1,198,710		$651,040	$512,824	$209,216	$2,618,068		$ 235,000		$523,924	$190,000		$190,000	$7,038,000					
47	2064		$709,508	$1,210,845		$651,040	$515,388	$210,933	$2,638,316		$ -		$523,924	$390,000		$190,000	$7,040,000					
48	2065		$709,508	$1,223,101		$651,040	$517,965	$212,664	$2,658,745		$ 385,000		$523,924	$190,000		$190,000	$7,262,000					
49	2066		$709,508	$1,235,481		$651,040	$520,555	$214,412	$2,222,518		$ -		$523,924	$190,000		$190,000	$6,457,000					
50	2067		$709,508	$1,247,986		$651,040	$523,158	$216,174	$2,239,557		$ 550,000		$523,924	$190,000		$190,000	$7,041,000					
	Totals	$7,731,275	$33,346,853	$47,244,009	$4,202,000	$28,645,760	$20,830,081	$8,340,226	$174,987,236	$8,850,000	$7,645,000	$4,115,000	$26,590,423	$11,310,000	$10,382,338	$15,729,269	$409,949,000					

30 years
$270,394,000 1,792,501 tonnes
$151 per tonne over 30 years

40 years
$339,443,000 2,448,090 tonnes
$139 per tonne over 40 years

50 years
$409,949,000 3,159,253 tonnes
$130 per tonne over 50 years

APPENDIX E: Long-Term Cost Model – Full System Cost

Table E: Long-Term Model - Full System Cost (excl. capital and operating costs associated with WTE facility, CVWMC Landfill and CRWMC Landfill as well as transfer and hauling of waste and residuals).

	Year	Organics Facility (CR) and TS (CV) Capital	Organics Facility Operating	Organics TS Operating (CV)	Organics Transfer	Remote Transfer Stations and Landfills Capital - Development & Closure	Remote Transfer Stations and Landfills Operating	Host Community Agreements	Diversion Programs Capital	Diversion Programs Capital - Equipment	Diversion Programs Operating	Support Services and Staff Disposal - Operating	Illegal Dumping Operating	One Time Expenses Operating
	2015													
	2016													
0	2017						$1,279,881	$356,225		$90,000	$3,945,914	$500,480	$197,531	
1	2018	$5,410,000				$140,000	$1,279,881	$356,225	$455,000	$325,000	$3,945,914	$500,480	$197,531	$1,150,000
2	2019	$3,150,000				$0	$1,279,881	$356,225		$0	$3,945,914	$500,480	$197,531	
3	2020					$0	$1,279,881	$356,225		$205,000	$3,945,914	$500,480	$197,531	
4	2021		$781,000	$230,000	$ 134,106	$0	$1,279,881	$356,225		$35,000	$3,945,914	$500,480	$197,531	
5	2022		$781,000	$230,000	$ 135,608	$0	$1,279,881	$356,225		$375,000	$3,945,914	$500,480	$197,531	
6	2023		$781,000	$230,000	$ 137,126	$310,000	$1,279,881	$356,225	$455,000	$270,000	$3,945,914	$500,480	$197,531	
7	2024		$781,000	$230,000	$ 138,635	$1,995,000	$1,279,881	$356,225		$35,000	$3,945,914	$500,480	$197,531	
8	2025		$781,000	$230,000	$ 140,143	$1,505,000	$1,279,881	$356,225		$225,000	$3,945,914	$500,480	$197,531	
9	2026		$781,000	$230,000	$ 141,645	$414,600	$1,279,881	$356,225		$30,000	$3,945,914	$500,480	$197,531	
10	2027		$781,000	$230,000	$ 143,135	$1,210,700	$1,279,881	$356,225		$410,000	$3,945,914	$500,480	$197,531	
11	2028		$781,000	$230,000	$ 144,614		$1,279,881	$356,225	$455,000	$240,000	$3,945,914	$500,480	$197,531	
12	2029		$781,000	$230,000	$ 146,074		$1,279,881	$356,225		$30,000	$3,945,914	$500,480	$197,531	
13	2030		$781,000	$230,000	$ 147,512		$1,279,881	$356,225		$210,000	$3,945,914	$500,480	$197,531	
14	2031		$781,000	$230,000	$ 148,926		$1,279,881	$356,225		$0	$3,945,914	$500,480	$197,531	
15	2032		$781,000	$230,000	$ 150,324		$1,279,881	$356,225		$455,000	$3,945,914	$500,480	$197,531	
16	2033		$781,000	$230,000	$ 151,711		$1,279,881	$356,225	$455,000	$275,000	$3,945,914	$500,480	$197,531	
17	2034		$781,000	$230,000	$ 153,049		$1,279,881	$356,225		$0	$3,945,914	$500,480	$197,531	
18	2035		$781,000	$230,000	$ 154,363		$1,279,881	$356,225		$205,000	$3,945,914	$500,480	$197,531	
19	2036		$781,000	$230,000	$ 155,673		$1,279,881	$356,225		$35,000	$3,945,914	$500,480	$197,531	
20	2037		$781,000	$230,000	$ 156,955		$1,279,881	$356,225		$375,000	$3,945,914	$500,480	$197,531	
21	2038		$781,000	$230,000	$ 158,212		$1,279,881	$356,225	$455,000	$270,000	$3,945,914	$500,480	$197,531	
22	2039		$781,000	$230,000	$ 159,449		$1,279,881	$356,225		$85,000	$3,945,914	$500,480	$197,531	
23	2040		$781,000	$230,000	$ 160,673		$1,279,881	$356,225		$175,000	$3,945,914	$500,480	$197,531	
24	2041		$781,000	$230,000	$ 161,880		$1,279,881	$356,225		$30,000	$3,945,914	$500,480	$197,531	
25	2042		$781,000	$230,000	$ 163,499		$1,279,881	$356,225		$410,000	$3,945,914	$500,480	$197,531	
26	2043		$781,000	$230,000	$ 165,134		$1,279,881	$356,225	$455,000	$240,000	$3,945,914	$500,480	$197,531	
27	2044		$781,000	$230,000	$ 166,785		$1,279,881	$356,225		$30,000	$3,945,914	$500,480	$197,531	
28	2045		$781,000	$230,000	$ 168,453		$1,279,881	$356,225		$210,000	$3,945,914	$500,480	$197,531	
29	2046	$2,140,000	$781,000	$230,000	$ 170,138		$1,279,881	$356,225		$50,000	$3,945,914	$500,480	$197,531	
30	2047		$781,000	$230,000	$ 171,839		$1,279,881	$356,225		$405,000	$3,945,914	$500,480	$197,531	
31	2048		$781,000	$230,000	$ 173,557		$1,279,881	$356,225	$455,000	$275,000	$3,945,914	$500,480	$197,531	
32	2049		$781,000	$230,000	$ 175,293	$340,000	$1,279,881	$356,225		$0	$3,945,914	$500,480	$197,531	
33	2050		$781,000	$230,000	$ 177,046		$1,279,881	$356,225		$205,000	$3,945,914	$500,480	$197,531	
34	2051		$781,000	$230,000	$ 178,816		$1,279,881	$356,225		$35,000	$3,945,914	$500,480	$197,531	
35	2052		$781,000	$230,000	$ 180,604		$1,279,881	$356,225		$375,000	$3,945,914	$500,480	$197,531	
36	2053		$781,000	$230,000	$ 182,411		$1,279,881	$356,225	$455,000	$320,000	$3,945,914	$500,480	$197,531	
37	2054		$781,000	$230,000	$ 184,235		$1,279,881	$356,225		$35,000	$3,945,914	$500,480	$197,531	
38	2055		$781,000	$230,000	$ 186,077		$1,279,881	$356,225		$175,000	$3,945,914	$500,480	$197,531	
39	2056		$781,000	$230,000	$ 187,938		$1,279,881	$356,225		$30,000	$3,945,914	$500,480	$197,531	
40	2057		$781,000	$230,000	$ 189,817		$1,279,881	$356,225		$410,000	$3,945,914	$500,480	$197,531	
41	2058		$781,000	$230,000	$ 191,715		$1,279,881	$356,225	$455,000	$240,000	$3,945,914	$500,480	$197,531	
42	2059		$781,000	$230,000	$ 193,632		$1,279,881	$356,225		$30,000	$3,945,914	$500,480	$197,531	
43	2060		$781,000	$230,000	$ 195,569		$1,279,881	$356,225		$260,000	$3,945,914	$500,480	$197,531	
44	2061		$781,000	$230,000	$ 197,524		$1,279,881	$356,225		$0	$3,945,914	$500,480	$197,531	
45	2062		$781,000	$230,000	$ 199,500		$1,279,881	$356,225		$405,000	$3,945,914	$500,480	$197,531	
46	2063		$781,000	$230,000	$ 201,495		$1,279,881	$356,225	$455,000	$275,000	$3,945,914	$500,480	$197,531	
47	2064		$781,000	$230,000	$ 203,510		$1,279,881	$356,225		$0	$3,945,914	$500,480	$197,531	
48	2065		$781,000	$230,000	$ 205,545		$1,279,881	$356,225		$205,000	$3,945,914	$500,480	$197,531	
49	2066		$781,000	$230,000	$ 207,600		$1,279,881	$356,225		$35,000	$3,945,914	$500,480	$197,531	
50	2067		$781,000	$230,000	$ 209,676		$1,279,881	$356,225		$425,000	$3,945,914	$500,480	$197,531	
	Totals	$10,700,000	$36,707,000	$10,810,000	$7,947,222	$5,915,300	$65,273,955	$18,167,482	$4,550,000	$9,465,000	$201,241,631	$25,524,460	$10,074,083	$1,150,000

APPENDIX F: GHG Emissions Assessment

Table F1: GHG assessment of Option 0 - Status Quo

Year		Methane Captured, Destroyed, Oxidized and Emitted - CVWMC								LFG GHG Emissions Summary - CVWMC				Electricity Generation and Offsets - CVWMC LF			
		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed	CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG	Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
		From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3	21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions	From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
		m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4	tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e	ft^3/min	kW	GWh / year	tonnes CO_2e
0	2017													0	0	0	0
1	2018	603,415	452,561	448,036	155,379	15,085	140,294	94	299	1,965	299	10	1,965	30	61	0	0
2	2019	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570	3,749	570	19	3,749	58	116	0	0
3	2020	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817	5,370	817	27	5,370	83	166	0	0
4	2021	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041	6,845	1,041	35	6,845	106	212	0	0
5	2022	2,393,106	1,794,830	1,776,881	616,225	59,828	556,397	371	1,185	7,793	1,185	40	7,793	121	241	0	0
6	2023	2,659,762	1,994,822	1,974,873	684,889	66,494	618,395	412	1,317	8,662	1,317	44	8,662	134	268	0	0
7	2024	2,904,415	2,178,311	2,156,528	747,887	72,610	675,277	450	1,438	9,459	1,438	48	9,459	146	293	0	0
8	2025	3,489,991	2,617,493	2,591,318	898,673	87,250	811,423	541	1,728	11,366	1,728	58	11,366	176	352	0	0
9	2026	4,022,289	3,016,717	2,986,550	1,035,739	100,557	935,182	624	1,992	13,099	1,992	67	13,099	203	405	0	0
10	2027	4,506,772	3,380,079	3,346,278	1,160,494	112,669	1,047,824	699	2,232	14,677	2,232	75	14,677	227	454	0	0
11	2028	4,948,262	3,711,197	3,674,085	1,274,178	123,707	1,150,471	767	2,451	16,115	2,451	83	16,115	249	499	0	0
12	2029	5,351,143	4,013,357	3,973,224	1,377,919	133,779	1,244,141	830	2,650	17,427	2,650	89	17,427	270	539	0	0
13	2030	5,719,325	4,289,493	4,246,599	1,472,726	142,983	1,329,743	887	2,832	18,626	2,832	95	18,626	288	576	0	0
14	2031	6,056,250	4,542,188	4,496,766	1,559,484	151,406	1,408,078	939	2,999	19,723	2,999	101	19,723	305	610	0	0
15	2032	6,365,027	4,773,770	4,726,032	1,638,994	159,126	1,479,869	987	3,152	20,729	3,152	106	20,729	321	641	0	0
16	2033	6,648,461	4,986,345	4,936,482	1,711,979	166,212	1,545,767	1,031	3,293	21,652	3,293	111	21,652	335	670	0	0
17	2034	6,909,095	5,181,821	5,130,003	1,779,092	172,727	1,606,365	1,071	3,422	22,500	3,422	115	22,500	348	696	0	0
18	2035	7,148,970	5,361,727	5,308,110	1,840,860	178,724	1,662,136	1,109	3,541	23,282	3,541	119	23,282	360	721	0	0
19	2036	7,370,115	5,527,586	5,472,310	1,897,805	184,253	1,713,552	1,143	3,650	24,002	3,650	123	24,002	371	743	0	0
20	2037	7,574,443	5,680,832	5,624,024	1,950,419	189,361	1,761,058	1,175	3,751	24,667	3,751	126	24,667	382	763	0	0
21	2038	7,763,513	5,822,635	5,764,408	1,999,105	194,088	1,805,017	1,204	3,845	25,283	3,845	129	25,283	391	782	0	0
22	2039	7,938,759	5,954,069	5,894,528	2,044,230	198,469	1,845,761	1,231	3,932	25,854	3,932	132	25,854	400	800	0	0
23	2040	8,101,493	6,076,120	6,015,359	2,086,135	202,537	1,883,597	1,256	4,012	26,384	4,012	135	26,384	408	817	0	0
24	2041	8,252,938	6,189,704	6,127,807	2,125,132	206,323	1,918,808	1,280	4,087	26,877	4,087	138	26,877	416	832	0	0
25	2042	8,394,203	6,295,653	6,232,696	2,161,507	209,855	1,951,652	1,302	4,157	27,337	4,157	140	27,337	423	846	0	0
26	2043	8,528,837	6,396,628	6,332,662	2,196,176	213,221	1,982,955	1,323	4,224	27,775	4,224	142	27,775	430	860	0	0
27	2044	8,657,602	6,493,202	6,428,270	2,229,333	216,440	2,012,893	1,343	4,288	28,195	4,288	144	28,195	436	873	0	0
28	2045	8,781,182	6,585,886	6,520,028	2,261,154	219,530	2,041,625	1,362	4,349	28,597	4,349	146	28,597	443	885	0	0
29	2046	8,900,188	6,675,141	6,608,390	2,291,799	222,505	2,069,294	1,380	4,408	28,985	4,408	148	28,985	449	897	0	0
30	2047	9,015,171	6,761,379	6,693,765	2,321,407	225,379	2,096,027	1,398	4,465	29,359	4,465	150	29,359	454	909	0	0
31	2048	9,126,624	6,844,968	6,776,518	2,350,106	228,166	2,121,940	1,415	4,520	29,722	4,520	152	29,722	460	920	0	0
32	2049	9,234,989	6,926,242	6,856,979	2,378,010	230,875	2,147,135	1,432	4,574	30,075	4,574	154	30,075	465	931	0	0
33	2050	9,340,662	7,005,497	6,935,442	2,405,221	233,517	2,171,704	1,449	4,626	30,419	4,626	156	30,419	471	941	0	0
34	2051	9,444,001	7,083,001	7,012,171	2,431,830	236,100	2,195,730	1,465	4,677	30,756	4,677	157	30,756	476	952	0	0
35	2052	9,545,325	7,158,994	7,087,404	2,457,921	238,633	2,219,288	1,480	4,727	31,086	4,727	159	31,086	481	962	0	0
36	2053	9,644,921	7,233,691	7,161,354	2,483,567	241,123	2,242,444	1,496	4,777	31,410	4,777	161	31,410	486	972	0	0
37	2054	9,743,048	7,307,286	7,234,213	2,508,835	243,576	2,265,259	1,511	4,825	31,729	4,825	162	31,729	491	982	0	0
38	2055	9,839,938	7,379,953	7,306,154	2,533,784	245,998	2,287,786	1,526	4,873	32,045	4,873	164	32,045	496	992	0	0
39	2056	9,935,798	7,451,849	7,377,330	2,558,468	248,395	2,310,073	1,541	4,921	32,357	4,921	166	32,357	501	1,001	0	0
40	2057	10,030,818	7,523,113	7,447,882	2,582,936	250,770	2,332,165	1,556	4,968	32,667	4,968	167	32,667	505	1,011	0	0

Table F1: GHG assessment of Option 0 - Status Quo

Landfill Operations - CVWMC LF			CVWMC LF Emissions	Transfer Station Hauling and Operations			Net Transfer Station Emissions	Year	
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations		Fuel Consumption	Waste Hauling	Transfer Station Operations			
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations	2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste	Hauling + Operations		
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	L	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e		
36	144	180	180	0	0	0		0	2011
36	146	182	2,147	0	0	0	0	1	2012
37	147	184	3,933	0	0	0	0	2	2013
37	149	186	5,556	0	0	0	0	3	2014
30	122	152	6,997	0	0	0	0	4	2015
31	123	154	7,947	0	0	0	0	5	2016
31	125	156	8,818	0	0	0	0	6	2017
53	212	265	9,724	51,651	139	95	234	7	2018
53	214	267	11,633	51,935	140	95	235	8	2019
54	216	270	13,369	52,210	140	96	236	9	2020
54	217	272	14,949	52,469	141	96	237	10	2021
55	219	274	16,389	52,720	142	97	238	11	2022
55	221	276	17,703	52,964	142	97	240	12	2023
56	223	278	18,904	53,197	143	98	241	13	2024
56	224	280	20,003	53,422	144	98	242	14	2025
56	226	282	21,011	53,637	144	98	243	15	2026
57	228	284	21,936	53,844	145	99	244	16	2027
57	229	286	22,787	54,031	145	99	244	17	2028
58	231	288	23,570	54,211	146	99	245	18	2029
58	232	290	24,292	54,387	146	100	246	19	2030
58	233	292	24,959	54,552	147	100	247	20	2031
59	235	294	25,576	54,707	147	100	247	21	2032
59	236	295	26,149	54,856	148	101	248	22	2033
59	238	297	26,681	55,000	148	101	249	23	2034
60	239	299	27,175	55,144	148	101	249	24	2035
60	241	301	27,638	55,419	149	102	251	25	2036
61	243	303	28,079	55,697	150	102	252	26	2037
61	245	306	28,501	55,975	151	103	253	27	2038
62	247	308	28,905	56,255	151	103	254	28	2039
62	249	311	29,296	56,536	152	104	256	29	2040
63	251	313	29,672	56,819	153	104	257	30	2041
63	253	316	30,038	57,103	154	105	258	31	2042
64	255	319	30,393	57,388	154	105	260	32	2043
64	257	321	30,740	57,675	155	106	261	33	2044
65	259	324	31,079	57,964	156	106	262	34	2045
65	261	326	31,412	58,254	157	107	264	35	2046
66	263	329	31,739	58,545	157	107	265	36	2047
66	265	332	32,061	58,838	158	108	266	37	2048
67	268	334	32,379	59,132	159	108	267	38	2049
67	270	337	32,694	59,427	160	109	269	39	2050
68	272	340	33,007	59,725	161	109	270	40	2051

Total CVWMC LF GHGs - 40 years **890,020** **tonnes CO_2e**

Total TS GHGs - 40 years **8,530** **tonnes CO_2e**

Table F2: GHG assessment of Option 1(a) - WTT located in Comox Valley

		RDF GHG				Electricity Generation and Offsets - WTT					Net WTT Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		RDF Combustion GHG				Metal - ferrous	Metal - Non-Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	200 kWh/tonne organics	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	tonnes	tonnes	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	2,502	0	125	2,627	1,739	5,275	12,604	2	45	-17,037	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	2,530	0	126	2,656	1,759	5,334	12,745	2	46	-17,228	1,902,454	1,426,841	1,412,572	489,882	47,561	442,321	295	942
6	2023	2,558	0	128	2,686	1,778	5,394	12,888	2	46	-17,421	1,724,073	1,293,055	1,280,124	443,949	43,102	400,847	267	854
7	2024	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,564,494	1,173,370	1,161,637	402,857	39,112	363,745	243	775
8	2025	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,435,587	1,076,690	1,065,923	369,664	35,890	333,774	223	711
9	2026	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,327,827	995,870	985,912	341,915	33,196	308,720	206	658
10	2027	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,238,923	929,193	919,901	319,023	30,973	288,050	192	614
11	2028	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,166,756	875,067	866,316	300,440	29,169	271,271	181	578
12	2029	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,109,483	832,113	823,791	285,692	27,737	257,955	172	549
13	2030	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,065,444	799,083	791,092	274,352	26,636	247,716	165	528
14	2031	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,033,088	774,816	767,068	266,020	25,827	240,193	160	512
15	2032	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,011,050	758,287	750,705	260,345	25,276	235,069	157	501
16	2033	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	998,128	748,596	741,110	257,018	24,953	232,065	155	494
17	2034	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	993,277	744,958	737,508	255,769	24,832	230,937	154	492
18	2035	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	995,322	746,491	739,026	256,295	24,883	231,412	154	493
19	2036	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,003,410	752,557	745,032	258,378	25,085	233,293	156	497
20	2037	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,016,874	762,656	755,029	261,845	25,422	236,423	158	504
21	2038	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,034,962	776,222	768,460	266,503	25,874	240,629	160	513
22	2039	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,057,036	792,777	784,849	272,187	26,426	245,761	164	523
23	2040	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,082,555	811,916	803,797	278,758	27,064	251,694	168	536
24	2041	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,111,077	833,307	824,974	286,102	27,777	258,325	172	550
25	2042	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,142,223	856,667	848,100	294,122	28,556	265,567	177	566
26	2043	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,178,209	883,657	874,820	303,389	29,455	273,934	183	584
27	2044	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,218,601	913,951	904,812	313,790	30,465	283,325	189	604
28	2045	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,263,014	947,260	937,788	325,226	31,575	293,651	196	626
29	2046	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,311,100	983,325	973,492	337,608	32,777	304,831	203	649
30	2047	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,362,550	1,021,913	1,011,693	350,857	34,064	316,793	211	675
31	2048	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,417,088	1,062,816	1,052,188	364,900	35,427	329,473	220	702
32	2049	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,474,466	1,105,849	1,094,791	379,675	36,862	342,813	229	730
33	2050	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,534,464	1,150,848	1,139,340	395,125	38,362	356,763	238	760
34	2051	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,596,885	1,197,664	1,185,687	411,198	39,922	371,276	248	791
35	2052	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,661,554	1,246,165	1,233,704	427,850	41,539	386,311	258	823
36	2053	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,728,313	1,296,235	1,283,273	445,041	43,208	401,833	268	856
37	2054	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,797,024	1,347,768	1,334,290	462,734	44,926	417,808	279	890
38	2055	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,867,561	1,400,671	1,386,664	480,897	46,689	434,208	290	925
39	2056	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	1,939,814	1,454,860	1,440,312	499,502	48,495	451,007	301	961
40	2057	4,354	0	218	4,572	3,027	9,183	21,940	4	78	-29,656	2,013,685	1,510,264	1,495,161	518,524	50,342	468,182	312	997

Total Technology GHGs - 40 years -1,059,981 tonnes CO_2e

RDF per tonne waste throughput: 27%

WTE Emissions Factors

CO_2 = 0.32 tonnes / tonne MSW

CH_4 = 0.0000031 tonnes CO_2e / tonne MSW

N_2O = 0.016 tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW = 10.5 GJ/tonne
2917 kWh/tonne

Electrical Conversion Efficiency = 16%

Table F2: GHG assessment of Option 1(a) - WTT located in Comox Valley

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,196	942	32	6,196
5,615	854	29	5,615
5,095	775	26	5,095
4,675	711	24	4,675
4,324	658	22	4,324
4,035	614	21	4,035
3,800	578	19	3,800
3,613	549	19	3,613
3,470	528	18	3,470
3,364	512	17	3,364
3,293	501	17	3,293
3,251	494	17	3,251
3,235	492	17	3,235
3,241	493	17	3,241
3,268	497	17	3,268
3,312	504	17	3,312
3,370	513	17	3,370
3,442	523	18	3,442
3,525	536	18	3,525
3,618	550	19	3,618
3,720	566	19	3,720
3,837	584	20	3,837
3,969	604	20	3,969
4,113	626	21	4,113
4,270	649	22	4,270
4,437	675	23	4,437
4,615	702	24	4,615
4,802	730	25	4,802
4,997	760	26	4,997
5,200	791	27	5,200
5,411	823	28	5,411
5,628	856	29	5,628
5,852	890	30	5,852
6,082	925	31	6,082
6,317	961	32	6,317
6,558	997	34	6,558

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
96	192	0	0
87	174	0	0
79	158	0	0
72	145	0	0
67	134	0	0
62	125	0	0
59	118	0	0
56	112	0	0
54	107	0	0
52	104	0	0
51	102	0	0
50	101	0	0
50	100	0	0
50	100	0	0
51	101	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	109	0	0
56	112	0	0
58	115	0	0
59	119	0	0
61	123	0	0
64	127	0	0
66	132	0	0
69	137	0	0
71	143	0	0
74	149	0	0
77	155	0	0
80	161	0	0
84	167	0	0
87	174	0	0
91	181	0	0
94	188	0	0
98	196	0	0
101	203	0	0

Landfill Operations - CVWMC LF			
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180	180
36	146	182	2,147
37	147	184	3,933
37	149	186	5,556
1	5	6	6,851
1	5	6	6,201
1	5	6	5,621
2	8	10	5,105
2	10	12	4,688
3	12	15	4,339
3	14	17	4,052
4	15	19	3,819
4	17	21	3,635
5	19	23	3,493
5	20	26	3,390
6	22	28	3,320
6	24	30	3,280
6	25	31	3,266
7	27	33	3,275
7	28	35	3,303
7	30	37	3,349
8	31	39	3,409
8	32	40	3,483
8	34	42	3,568
9	35	44	3,662
9	37	46	3,766
10	39	49	3,886
10	41	51	4,020
11	43	54	4,167
11	45	56	4,326
12	47	59	4,496
12	49	61	4,676
13	51	64	4,866
13	53	66	5,063
14	55	69	5,269
14	57	72	5,483
15	59	74	5,703
15	62	77	5,929
16	64	80	6,162
16	66	82	6,400
17	68	85	6,643

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
51,651	139	95
51,935	140	95
52,210	140	96
52,469	141	96
52,720	142	97
52,964	142	97
53,197	143	98
53,422	144	98
53,637	144	98
53,844	145	99
54,031	145	99
54,211	146	99
54,387	146	100
54,552	147	100
54,707	147	100
54,856	148	101
55,000	148	101
55,144	148	101
55,419	149	102
55,697	150	102
55,975	151	103
56,255	151	103
56,536	152	104
56,819	153	104
57,103	154	105
57,388	154	105
57,675	155	106
57,964	156	106
58,254	157	107
58,545	157	107
58,838	158	108
59,132	159	108
59,427	160	109
59,725	161	109

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
234	7	2018
235	8	2019
236	9	2020
237	10	2021
238	11	2022
240	12	2023
241	13	2024
242	14	2025
243	15	2026
244	16	2027
244	17	2028
245	18	2029
246	19	2030
247	20	2031
247	21	2032
248	22	2033
249	23	2034
249	24	2035
251	25	2036
252	26	2037
253	27	2038
254	28	2039
256	29	2040
257	30	2041
258	31	2042
260	32	2043
261	33	2044
262	34	2045
264	35	2046
265	36	2047
266	37	2048
267	38	2049
269	39	2050
270	40	2051

Total CVWMC LF GHGs - 40 years **177,777** **tonnes CO_2e**

Total TS GHGs - 40 years **8,530** **tonnes CO_2e**

Table F3: GHG assessment of Option 1(b) - WTT located in Campbell River

RDF GHG						Electricity Generation and Offsets - WTT					Net WTT Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		RDF Combustion GHG				Metal - ferrous	Metal - Non-Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	200 kWh/tonne organics	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	tonnes	tonnes	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	2,502	0	125	2,627	1,739	5,275	12,604	2	45	-17,037	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	2,530	0	126	2,656	1,759	5,334	12,745	2	46	-17,228	1,902,454	1,426,841	1,412,572	489,882	47,561	442,321	295	942
6	2023	2,558	0	128	2,686	1,778	5,394	12,888	2	46	-17,421	1,724,073	1,293,055	1,280,124	443,949	43,102	400,847	267	854
7	2024	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,564,494	1,173,370	1,161,637	402,857	39,112	363,745	243	775
8	2025	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,435,587	1,076,690	1,065,923	369,664	35,890	333,774	223	711
9	2026	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,327,827	995,870	985,912	341,915	33,196	308,720	206	658
10	2027	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,238,923	929,193	919,901	319,023	30,973	288,050	192	614
11	2028	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,166,756	875,067	866,316	300,440	29,169	271,271	181	578
12	2029	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,109,483	832,113	823,791	285,692	27,737	257,955	172	549
13	2030	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,065,444	799,083	791,092	274,352	26,636	247,716	165	528
14	2031	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,033,088	774,816	767,068	266,020	25,827	240,193	160	512
15	2032	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,011,050	758,287	750,705	260,345	25,276	235,069	157	501
16	2033	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	998,128	748,596	741,110	257,018	24,953	232,065	155	494
17	2034	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	993,277	744,958	737,508	255,769	24,832	230,937	154	492
18	2035	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	995,322	746,491	739,026	256,295	24,883	231,412	154	493
19	2036	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,003,410	752,557	745,032	258,378	25,085	233,293	156	497
20	2037	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,016,874	762,656	755,029	261,845	25,422	236,423	158	504
21	2038	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,034,962	776,222	768,460	266,503	25,874	240,629	160	513
22	2039	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,057,036	792,777	784,849	272,187	26,426	245,761	164	523
23	2040	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,082,555	811,916	803,797	278,758	27,064	251,694	168	536
24	2041	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,111,077	833,307	824,974	286,102	27,777	258,325	172	550
25	2042	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,142,223	856,667	848,100	294,122	28,556	265,567	177	566
26	2043	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,178,209	883,657	874,820	303,389	29,455	273,934	183	584
27	2044	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,218,601	913,951	904,812	313,790	30,465	283,325	189	604
28	2045	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,263,014	947,260	937,788	325,226	31,575	293,651	196	626
29	2046	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,311,100	983,325	973,492	337,608	32,777	304,831	203	649
30	2047	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,362,550	1,021,913	1,011,693	350,857	34,064	316,793	211	675
31	2048	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,417,088	1,062,816	1,052,188	364,900	35,427	329,473	220	702
32	2049	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,474,466	1,105,849	1,094,791	379,675	36,862	342,813	229	730
33	2050	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,534,464	1,150,848	1,139,340	395,125	38,362	356,763	238	760
34	2051	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,596,885	1,197,664	1,185,687	411,198	39,922	371,276	248	791
35	2052	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,661,554	1,246,165	1,233,704	427,850	41,539	386,311	258	823
36	2053	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,728,313	1,296,235	1,283,273	445,041	43,208	401,833	268	856
37	2054	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,797,024	1,347,768	1,334,290	462,734	44,926	417,808	279	890
38	2055	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,867,561	1,400,671	1,386,664	480,897	46,689	434,208	290	925
39	2056	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,939,814	1,454,860	1,440,312	499,502	48,495	451,007	301	961
40	2057	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	2,013,685	1,510,264	1,495,161	518,524	50,342	468,182	312	997

Total Technology GHGs - 40 years -1,059,974 tonnes CO_2e

RDF per tonne waste throughput: 27%

WTE Emissions Factors

CO_2 = 0.32 tonnes / tonne MSW

CH_4 = 0.0000031 tonnes CO_2e / tonne MSW

N_2O = 0.016 tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW = 10.5 GJ/tonne
2917 kWh/tonne

Electrical Conversion Efficiency = 16%

Table F3: GHG assessment of Option 1(b) - WTT located in Campbell River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,196	942	32	6,196
5,615	854	29	5,615
5,095	775	26	5,095
4,675	711	24	4,675
4,324	658	22	4,324
4,035	614	21	4,035
3,800	578	19	3,800
3,613	549	19	3,613
3,470	528	18	3,470
3,364	512	17	3,364
3,293	501	17	3,293
3,251	494	17	3,251
3,235	492	17	3,235
3,241	493	17	3,241
3,268	497	17	3,268
3,312	504	17	3,312
3,370	513	17	3,370
3,442	523	18	3,442
3,525	536	18	3,525
3,618	550	19	3,618
3,720	566	19	3,720
3,837	584	20	3,837
3,969	604	20	3,969
4,113	626	21	4,113
4,270	649	22	4,270
4,437	675	23	4,437
4,615	702	24	4,615
4,802	730	25	4,802
4,997	760	26	4,997
5,200	791	27	5,200
5,411	823	28	5,411
5,628	856	29	5,628
5,852	890	30	5,852
6,082	925	31	6,082
6,317	961	32	6,317
6,558	997	34	6,558

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
96	192	0	0
87	174	0	0
79	158	0	0
72	145	0	0
67	134	0	0
62	125	0	0
59	118	0	0
56	112	0	0
54	107	0	0
52	104	0	0
51	102	0	0
50	101	0	0
50	100	0	0
50	100	0	0
51	101	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	109	0	0
56	112	0	0
58	115	0	0
59	119	0	0
61	123	0	0
64	127	0	0
66	132	0	0
69	137	0	0
71	143	0	0
74	149	0	0
77	155	0	0
80	161	0	0
84	167	0	0
87	174	0	0
91	181	0	0
94	188	0	0
98	196	0	0
101	203	0	0

Landfill Operations - CVWMC LF			
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180	180
36	146	182	2,147
37	147	184	3,933
37	149	186	5,556
1	5	6	6,851
1	5	6	6,201
1	5	6	5,621
2	8	10	5,105
2	10	12	4,688
3	12	15	4,339
3	14	17	4,052
4	15	19	3,819
4	17	21	3,635
5	19	23	3,493
5	20	26	3,390
6	22	28	3,320
6	24	30	3,280
6	25	31	3,266
7	27	33	3,275
7	28	35	3,303
7	30	37	3,349
8	31	39	3,409
8	32	40	3,483
8	34	42	3,568
9	35	44	3,662
9	37	46	3,766
10	39	49	3,886
10	41	51	4,020
11	43	54	4,167
11	45	56	4,326
12	47	59	4,496
12	49	61	4,676
13	51	64	4,866
13	53	66	5,063
14	55	69	5,269
14	57	72	5,483
15	59	74	5,703
15	62	77	5,929
16	64	80	6,162
16	66	82	6,400
17	68	85	6,643

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
93,807	252	129
94,857	255	130
95,919	258	132
111,633	300	130
111,349	300	129
111,074	299	129
110,816	298	128
110,565	297	128
110,320	297	127
110,087	296	127
109,862	296	126
109,647	295	126
109,440	294	126
109,254	294	125
109,074	293	125
108,897	293	125
108,732	292	124
108,577	292	124
108,428	292	124
108,284	291	123
108,141	291	123
107,865	290	123
107,588	289	122
107,309	289	122
107,030	288	121
106,748	287	121
106,466	286	120
106,181	286	120
105,896	285	119
105,609	284	118
105,321	283	118
105,031	283	117
104,740	282	117
104,447	281	116
104,153	280	116
103,857	279	115
103,560	279	115

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
381	4	2015
385	5	2016
390	6	2017
430	7	2018
429	8	2019
427	9	2020
426	10	2021
425	11	2022
424	12	2023
423	13	2024
422	14	2025
421	15	2026
420	16	2027
419	17	2028
418	18	2029
417	19	2030
417	20	2031
416	21	2032
415	22	2033
415	23	2034
414	24	2035
413	25	2036
412	26	2037
410	27	2038
409	28	2039
408	29	2040
406	30	2041
405	31	2042
404	32	2043
403	33	2044
401	34	2045
400	35	2046
399	36	2047
397	37	2048
396	38	2049
395	39	2050
393	40	2051

Total CVWMC LF GHGs - 40 years **177,777** **tonnes CO_2e**

Total TS GHGs - 40 years **15,185** **tonnes CO_2e**

Table F4: GHG assessment of Option 1(c) - WTT located in Gold River

RDF GHG						Electricity Generation and Offsets - WTT					Net WTT Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		RDF Combustion GHG				Metal - ferrous	Metal - Non-Ferrous	Cardboard	Bio-gas to electricity	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	200 kWh/tonne organics	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	tonnes	tonnes	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	2,502	0	125	2,627	1,739	5,275	12,604	2	45	-17,037	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	2,530	0	126	2,656	1,759	5,334	12,745	2	46	-17,228	1,902,454	1,426,841	1,412,572	489,882	47,561	442,321	295	942
6	2023	2,558	0	128	2,686	1,778	5,394	12,888	2	46	-17,421	1,724,073	1,293,055	1,280,124	443,949	43,102	400,847	267	854
7	2024	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,564,494	1,173,370	1,161,637	402,857	39,112	363,745	243	775
8	2025	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,435,587	1,076,690	1,065,923	369,664	35,890	333,774	223	711
9	2026	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,327,827	995,870	985,912	341,915	33,196	308,720	206	658
10	2027	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,238,923	929,193	919,901	319,023	30,973	288,050	192	614
11	2028	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,166,756	875,067	866,316	300,440	29,169	271,271	181	578
12	2029	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,109,483	832,113	823,791	285,692	27,737	257,955	172	549
13	2030	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,065,444	799,083	791,092	274,352	26,636	247,716	165	528
14	2031	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,033,088	774,816	767,068	266,020	25,827	240,193	160	512
15	2032	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,011,050	758,287	750,705	260,345	25,276	235,069	157	501
16	2033	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	998,128	748,596	741,110	257,018	24,953	232,065	155	494
17	2034	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	993,277	744,958	737,508	255,769	24,832	230,937	154	492
18	2035	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	995,322	746,491	739,026	256,295	24,883	231,412	154	493
19	2036	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,003,410	752,557	745,032	258,378	25,085	233,293	156	497
20	2037	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,016,874	762,656	755,029	261,845	25,422	236,423	158	504
21	2038	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,034,962	776,222	768,460	266,503	25,874	240,629	160	513
22	2039	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,057,036	792,777	784,849	272,187	26,426	245,761	164	523
23	2040	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,082,555	811,916	803,797	278,758	27,064	251,694	168	536
24	2041	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,111,077	833,307	824,974	286,102	27,777	258,325	172	550
25	2042	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,142,223	856,667	848,100	294,122	28,556	265,567	177	566
26	2043	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,178,209	883,657	874,820	303,389	29,455	273,934	183	584
27	2044	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,218,601	913,951	904,812	313,790	30,465	283,325	189	604
28	2045	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,263,014	947,260	937,788	325,226	31,575	293,651	196	626
29	2046	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,311,100	983,325	973,492	337,608	32,777	304,831	203	649
30	2047	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,362,550	1,021,913	1,011,693	350,857	34,064	316,793	211	675
31	2048	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,417,088	1,062,816	1,052,188	364,900	35,427	329,473	220	702
32	2049	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,474,466	1,105,849	1,094,791	379,675	36,862	342,813	229	730
33	2050	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,534,464	1,150,848	1,139,340	395,125	38,362	356,763	238	760
34	2051	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,596,885	1,197,664	1,185,687	411,198	39,922	371,276	248	791
35	2052	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,661,554	1,246,165	1,233,704	427,850	41,539	386,311	258	823
36	2053	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,728,313	1,296,235	1,283,273	445,041	43,208	401,833	268	856
37	2054	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,797,024	1,347,768	1,334,290	462,734	44,926	417,808	279	890
38	2055	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,867,561	1,400,671	1,386,664	480,897	46,689	434,208	290	925
39	2056	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	1,939,814	1,454,860	1,440,312	499,502	48,495	451,007	301	961
40	2057	4,354	0	218	4,572	3,027	9,182	21,939	4	78	-29,656	2,013,685	1,510,264	1,495,161	518,524	50,342	468,182	312	997

Total Technology GHGs - 40 years -1,059,974 tonnes CO_2e

RDF per tonne waste throughput: 27%

WTE Emissions Factors

CO_2 = 0.32 tonnes / tonne MSW

CH_4 = 0.0000031 tonnes CO_2e / tonne MSW

N_2O = 0.016 tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW = 10.5 GJ/tonne
2917 kWh/tonne

Electrical Conversion Efficiency = 16%

Table F4: GHG assessment of Option 1(c) - WTT located in Gold River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,196	942	32	6,196
5,615	854	29	5,615
5,095	775	26	5,095
4,675	711	24	4,675
4,324	658	22	4,324
4,035	614	21	4,035
3,800	578	19	3,800
3,613	549	19	3,613
3,470	528	18	3,470
3,364	512	17	3,364
3,293	501	17	3,293
3,251	494	17	3,251
3,235	492	17	3,235
3,241	493	17	3,241
3,268	497	17	3,268
3,312	504	17	3,312
3,370	513	17	3,370
3,442	523	18	3,442
3,525	536	18	3,525
3,618	550	19	3,618
3,720	566	19	3,720
3,837	584	20	3,837
3,969	604	20	3,969
4,113	626	21	4,113
4,270	649	22	4,270
4,437	675	23	4,437
4,615	702	24	4,615
4,802	730	25	4,802
4,997	760	26	4,997
5,200	791	27	5,200
5,411	823	28	5,411
5,628	856	29	5,628
5,852	890	30	5,852
6,082	925	31	6,082
6,317	961	32	6,317
6,558	997	34	6,558

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
96	192	0	0
87	174	0	0
79	158	0	0
72	145	0	0
67	134	0	0
62	125	0	0
59	118	0	0
56	112	0	0
54	107	0	0
52	104	0	0
51	102	0	0
50	101	0	0
50	100	0	0
50	100	0	0
51	101	0	0
51	102	0	0
52	104	0	0
53	107	0	0
55	109	0	0
56	112	0	0
58	115	0	0
59	119	0	0
61	123	0	0
64	127	0	0
66	132	0	0
69	137	0	0
71	143	0	0
74	149	0	0
77	155	0	0
80	161	0	0
84	167	0	0
87	174	0	0
91	181	0	0
94	188	0	0
98	196	0	0
101	203	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180
36	146	182
37	147	184
37	149	186
1	5	6
1	5	6
1	5	6
2	8	10
2	10	12
3	12	15
3	14	17
4	15	19
4	17	21
5	19	23
5	20	26
6	22	28
6	24	30
6	25	31
7	27	33
7	28	35
7	30	37
8	31	39
8	32	40
8	34	42
9	35	44
9	37	46
10	39	49
10	41	51
11	43	54
11	45	56
12	47	59
12	49	61
13	51	64
13	53	66
14	55	69
14	57	72
15	59	74
15	62	77
16	64	80
16	66	82
17	68	85

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
180
2,147
3,933
5,556
6,851
6,201
5,621
5,105
4,688
4,339
4,052
3,819
3,635
3,493
3,390
3,320
3,280
3,266
3,275
3,303
3,349
3,409
3,483
3,568
3,662
3,766
3,886
4,020
4,167
4,326
4,496
4,676
4,866
5,063
5,269
5,483
5,703
5,929
6,162
6,400
6,643

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
250,151	673	129
252,953	680	130
255,783	688	132
383,774	1,032	224
383,490	1,032	224
383,215	1,031	224
382,957	1,030	224
382,706	1,029	224
382,461	1,029	224
382,228	1,028	224
382,003	1,028	224
381,788	1,027	224
381,581	1,026	224
381,395	1,026	224
381,215	1,025	224
381,038	1,025	224
380,873	1,025	224
380,718	1,024	224
380,569	1,024	224
380,425	1,023	224
380,281	1,023	224
380,006	1,022	224
379,729	1,021	224
379,450	1,021	224
379,170	1,020	224
378,889	1,019	224
378,606	1,018	224
378,322	1,018	224
378,037	1,017	224
377,750	1,016	224
377,461	1,015	224
377,172	1,015	224
376,880	1,014	224
376,588	1,013	224
376,293	1,012	224
375,998	1,011	224
375,701	1,011	224

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
802	4	2015
811	5	2016
820	6	2017
1,257	7	2018
1,256	8	2019
1,255	9	2020
1,254	10	2021
1,254	11	2022
1,253	12	2023
1,252	13	2024
1,252	14	2025
1,251	15	2026
1,251	16	2027
1,250	17	2028
1,250	18	2029
1,249	19	2030
1,249	20	2031
1,248	21	2032
1,248	22	2033
1,248	23	2034
1,247	24	2035
1,246	25	2036
1,246	26	2037
1,245	27	2038
1,244	28	2039
1,243	29	2040
1,243	30	2041
1,242	31	2042
1,241	32	2043
1,240	33	2044
1,240	34	2045
1,239	35	2046
1,238	36	2047
1,237	37	2048
1,236	38	2049
1,236	39	2050
1,235	40	2051

Total CVWMC LF GHGs - 40 years **177,777** **tonnes CO_2e**

Total TS GHGs - 40 years **44,808** **tonnes CO_2e**

Table F5: GHG assessment of Option 2(a) -EWS located in Comox Valley

EWS GHG						Electricity Generation and Offsets - EWS				Net EWS Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		WTE Combustion GHG				Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	GWh	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	8,995	0	450	9,445	1,459	82	13	289	7,616	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	9,096	0	455	9,551	1,475	83	13	292	7,701	1,922,024	1,441,518	1,427,103	494,921	48,051	446,871	298	952
6	2023	9,198	0	460	9,658	1,492	84	13	295	7,787	1,761,394	1,321,045	1,307,835	453,559	44,035	409,524	273	872
7	2024	15,658	0	783	16,441	2,539	143	23	502	13,256	1,617,938	1,213,454	1,201,319	416,619	40,448	376,171	251	801
8	2025	15,794	0	790	16,584	2,562	144	23	507	13,371	1,517,534	1,138,150	1,126,769	390,765	37,938	352,827	235	752
9	2026	15,928	0	796	16,725	2,583	145	23	511	13,485	1,428,180	1,071,135	1,060,424	367,756	35,705	332,052	221	707
10	2027	16,060	0	803	16,863	2,605	146	23	515	13,597	1,348,720	1,011,540	1,001,424	347,295	33,718	313,577	209	668
11	2028	16,190	0	810	17,000	2,626	148	24	519	13,707	1,278,110	958,582	948,996	329,113	31,953	297,160	198	633
12	2029	16,308	0	815	17,124	2,645	149	24	523	13,807	1,215,421	911,566	902,450	312,971	30,386	282,585	188	602
13	2030	16,308	0	815	17,124	2,645	149	24	523	13,807	1,160,346	870,260	861,557	298,789	29,009	269,781	180	575
14	2031	16,308	0	815	17,124	2,645	149	24	523	13,807	1,118,105	838,579	830,193	287,912	27,953	259,959	173	554
15	2032	16,308	0	815	17,124	2,645	149	24	523	13,807	1,087,211	815,408	807,254	279,957	27,180	252,776	169	538
16	2033	16,308	0	815	17,124	2,645	149	24	523	13,807	1,066,356	799,767	791,769	274,587	26,659	247,928	165	528
17	2034	16,308	0	815	17,124	2,645	149	24	523	13,807	1,054,398	790,798	782,890	271,507	26,360	245,148	164	522
18	2035	16,308	0	815	17,124	2,645	149	24	523	13,807	1,050,076	787,557	779,681	270,394	26,252	244,143	163	520
19	2036	16,308	0	815	17,124	2,645	149	24	523	13,807	1,052,460	789,345	781,452	271,008	26,312	244,697	163	521
20	2037	16,308	0	815	17,124	2,645	149	24	523	13,807	1,060,815	795,611	787,655	273,160	26,520	246,640	165	525
21	2038	16,308	0	815	17,124	2,645	149	24	523	13,807	1,074,326	805,745	797,687	276,639	26,858	249,781	167	532
22	2039	16,308	0	815	17,124	2,645	149	24	523	13,807	1,092,300	819,225	811,033	281,267	27,307	253,960	169	541
23	2040	16,308	0	815	17,124	2,645	149	24	523	13,807	1,114,145	835,609	827,253	286,892	27,854	259,039	173	552
24	2041	16,308	0	815	17,124	2,645	149	24	523	13,807	1,139,376	854,532	845,987	293,389	28,484	264,905	177	564
25	2042	16,308	0	815	17,124	2,645	149	24	523	13,807	1,167,575	875,681	866,924	300,650	29,189	271,461	181	578
26	2043	16,308	0	815	17,124	2,645	149	24	523	13,807	1,200,920	900,690	891,683	309,237	30,023	279,214	186	595
27	2044	16,308	0	815	17,124	2,645	149	24	523	13,807	1,238,947	929,210	919,918	319,029	30,974	288,055	192	614
28	2045	16,308	0	815	17,124	2,645	149	24	523	13,807	1,281,240	960,930	951,321	329,919	32,031	297,888	199	635
29	2046	16,308	0	815	17,124	2,645	149	24	523	13,807	1,327,427	995,571	985,615	341,813	33,186	308,627	206	657
30	2047	16,308	0	815	17,124	2,645	149	24	523	13,807	1,377,177	1,032,883	1,022,554	354,623	34,429	320,194	214	682
31	2048	16,308	0	815	17,124	2,645	149	24	523	13,807	1,430,191	1,072,643	1,061,917	368,274	35,755	332,519	222	708
32	2049	16,308	0	815	17,124	2,645	149	24	523	13,807	1,486,204	1,114,653	1,103,507	382,698	37,155	345,542	230	736
33	2050	16,308	0	815	17,124	2,645	149	24	523	13,807	1,544,980	1,158,735	1,147,147	397,832	38,624	359,208	240	765
34	2051	16,308	0	815	17,124	2,645	149	24	523	13,807	1,606,305	1,204,729	1,192,682	413,624	40,158	373,466	249	796
35	2052	16,308	0	815	17,124	2,645	149	24	523	13,807	1,669,993	1,252,495	1,239,970	430,023	41,750	388,273	259	827
36	2053	16,308	0	815	17,124	2,645	149	24	523	13,807	1,735,873	1,301,905	1,288,886	446,987	43,397	403,591	269	860
37	2054	16,308	0	815	17,124	2,645	149	24	523	13,807	1,803,796	1,352,847	1,339,319	464,477	45,095	419,383	280	893
38	2055	16,308	0	815	17,124	2,645	149	24	523	13,807	1,873,628	1,405,221	1,391,169	482,459	46,841	435,618	291	928
39	2056	16,308	0	815	17,124	2,645	149	24	523	13,807	1,945,249	1,458,937	1,444,347	500,902	48,631	452,270	302	963
40	2057	16,308	0	815	17,124	2,645	149	24	523	13,807	2,018,554	1,513,915	1,498,776	519,778	50,464	469,314	313	1,000

Total Technology GHGs - 40 years **490,920** **tonnes CO_2e**

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table F5: GHG assessment of Option 2(a) -EWS located in Comox Valley

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,259	952	32	6,259
5,736	872	29	5,736
5,269	801	27	5,269
4,942	752	25	4,942
4,651	707	24	4,651
4,392	668	22	4,392
4,162	633	21	4,162
3,958	602	20	3,958
3,779	575	19	3,779
3,641	554	19	3,641
3,541	538	18	3,541
3,473	528	18	3,473
3,434	522	18	3,434
3,420	520	18	3,420
3,427	521	18	3,427
3,455	525	18	3,455
3,499	532	18	3,499
3,557	541	18	3,557
3,628	552	19	3,628
3,711	564	19	3,711
3,802	578	19	3,802
3,911	595	20	3,911
4,035	614	21	4,035
4,173	635	21	4,173
4,323	657	22	4,323
4,485	682	23	4,485
4,658	708	24	4,658
4,840	736	25	4,840
5,031	765	26	5,031
5,231	796	27	5,231
5,439	827	28	5,439
5,653	860	29	5,653
5,874	893	30	5,874
6,102	928	31	6,102
6,335	963	32	6,335
6,574	1,000	34	6,574

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
97	194	0	0
89	178	0	0
82	163	0	0
76	153	0	0
72	144	0	0
68	136	0	0
64	129	0	0
61	122	0	0
58	117	0	0
56	113	0	0
55	110	0	0
54	107	0	0
53	106	0	0
53	106	0	0
53	106	0	0
53	107	0	0
54	108	0	0
55	110	0	0
56	112	0	0
57	115	0	0
59	118	0	0
61	121	0	0
62	125	0	0
65	129	0	0
67	134	0	0
69	139	0	0
72	144	0	0
75	150	0	0
78	156	0	0
81	162	0	0
84	168	0	0
87	175	0	0
91	182	0	0
94	189	0	0
98	196	0	0
102	203	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180
36	146	182
37	147	184
37	149	186
2	9	12
2	9	12
2	10	12
4	16	20
4	16	21
4	17	21
4	17	21
4	17	21
4	17	21
5	19	23
5	20	26
6	22	28
6	24	30
6	25	31
7	27	33
7	28	35
7	30	37
8	31	39
8	32	40
8	34	42
9	35	44
9	37	46
10	39	49
10	41	51
11	43	54
11	45	56
12	47	59
12	49	61
13	51	64
13	53	66
14	55	69
14	57	72
15	59	74
15	62	77
16	64	80
16	66	82
17	68	85

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
180
2,147
3,933
5,556
6,857
6,271
5,748
5,289
4,963
4,672
4,413
4,183
3,980
3,802
3,667
3,568
3,502
3,465
3,453
3,463
3,492
3,537
3,598
3,671
3,754
3,849
3,960
4,086
4,226
4,379
4,544
4,719
4,904
5,098
5,300
5,510
5,727
5,951
6,181
6,417
6,659

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
51,651	139	95
51,935	140	95
52,210	140	96
52,469	141	96
52,720	142	97
52,964	142	97
53,197	143	98
53,422	144	98
53,637	144	98
53,844	145	99
54,031	145	99
54,211	146	99
54,387	146	100
54,552	147	100
54,707	147	100
54,856	148	101
55,000	148	101
55,144	148	101
55,419	149	102
55,697	150	102
55,975	151	103
56,255	151	103
56,536	152	104
56,819	153	104
57,103	154	105
57,388	154	105
57,675	155	106
57,964	156	106
58,254	157	107
58,545	157	107
58,838	158	108
59,132	159	108
59,427	160	109
59,725	161	109

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
234	7	2018
235	8	2019
236	9	2020
237	10	2021
238	11	2022
240	12	2023
241	13	2024
242	14	2025
243	15	2026
244	16	2027
244	17	2028
245	18	2029
246	19	2030
247	20	2031
247	21	2032
248	22	2033
249	23	2034
249	24	2035
251	25	2036
252	26	2037
253	27	2038
254	28	2039
256	29	2040
257	30	2041
258	31	2042
260	32	2043
261	33	2044
262	34	2045
264	35	2046
265	36	2047
266	37	2048
267	38	2049
269	39	2050
270	40	2051

Total CVWMC LF GHGs - 40 years **182,673** **tonnes CO_2e**

Total TS GHGs - 40 years **8,530** **tonnes CO_2e**

Table F6: GHG assessment of Option 2(b) - EWS located in Campbell River

EWS GHG						Electricity Generation and Offsets - EWS				Net EWS Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		WTE Combustion GHG				Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	GWh	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	8,995	0	450	9,445	1,459	82	13	289	7,616	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	9,096	0	455	9,551	1,475	83	13	292	7,701	1,922,024	1,441,518	1,427,103	494,921	48,051	446,871	298	952
6	2023	9,198	0	460	9,658	1,492	84	13	295	7,787	1,761,394	1,321,045	1,307,835	453,559	44,035	409,524	273	872
7	2024	15,658	0	783	16,441	2,539	143	23	502	13,256	1,617,938	1,213,454	1,201,319	416,619	40,448	376,171	251	801
8	2025	15,794	0	790	16,584	2,562	144	23	507	13,371	1,517,534	1,138,150	1,126,769	390,765	37,938	352,827	235	752
9	2026	15,928	0	796	16,725	2,583	145	23	511	13,485	1,428,180	1,071,135	1,060,424	367,756	35,705	332,052	221	707
10	2027	16,060	0	803	16,863	2,605	146	23	515	13,597	1,348,720	1,011,540	1,001,424	347,295	33,718	313,577	209	668
11	2028	16,190	0	810	17,000	2,626	148	24	519	13,707	1,278,110	958,582	948,996	329,113	31,953	297,160	198	633
12	2029	16,308	0	815	17,124	2,645	149	24	523	13,807	1,215,421	911,566	902,450	312,971	30,386	282,585	188	602
13	2030	16,308	0	815	17,124	2,645	149	24	523	13,807	1,160,346	870,260	861,557	298,789	29,009	269,781	180	575
14	2031	16,308	0	815	17,124	2,645	149	24	523	13,807	1,118,105	838,579	830,193	287,912	27,953	259,959	173	554
15	2032	16,308	0	815	17,124	2,645	149	24	523	13,807	1,087,211	815,408	807,254	279,957	27,180	252,776	169	538
16	2033	16,308	0	815	17,124	2,645	149	24	523	13,807	1,066,356	799,767	791,769	274,587	26,659	247,928	165	528
17	2034	16,308	0	815	17,124	2,645	149	24	523	13,807	1,054,398	790,798	782,890	271,507	26,360	245,148	164	522
18	2035	16,308	0	815	17,124	2,645	149	24	523	13,807	1,050,076	787,557	779,681	270,394	26,252	244,143	163	520
19	2036	16,308	0	815	17,124	2,645	149	24	523	13,807	1,052,460	789,345	781,452	271,008	26,312	244,697	163	521
20	2037	16,308	0	815	17,124	2,645	149	24	523	13,807	1,060,815	795,611	787,655	273,160	26,520	246,640	165	525
21	2038	16,308	0	815	17,124	2,645	149	24	523	13,807	1,074,326	805,745	797,687	276,639	26,858	249,781	167	532
22	2039	16,308	0	815	17,124	2,645	149	24	523	13,807	1,092,300	819,225	811,033	281,267	27,307	253,960	169	541
23	2040	16,308	0	815	17,124	2,645	149	24	523	13,807	1,114,145	835,609	827,253	286,892	27,854	259,039	173	552
24	2041	16,308	0	815	17,124	2,645	149	24	523	13,807	1,139,376	854,532	845,987	293,389	28,484	264,905	177	564
25	2042	16,308	0	815	17,124	2,645	149	24	523	13,807	1,167,575	875,681	866,924	300,650	29,189	271,461	181	578
26	2043	16,308	0	815	17,124	2,645	149	24	523	13,807	1,200,920	900,690	891,683	309,237	30,023	279,214	186	595
27	2044	16,308	0	815	17,124	2,645	149	24	523	13,807	1,238,947	929,210	919,918	319,029	30,974	288,055	192	614
28	2045	16,308	0	815	17,124	2,645	149	24	523	13,807	1,281,240	960,930	951,321	329,919	32,031	297,888	199	635
29	2046	16,308	0	815	17,124	2,645	149	24	523	13,807	1,327,427	995,571	985,615	341,813	33,186	308,627	206	657
30	2047	16,308	0	815	17,124	2,645	149	24	523	13,807	1,377,177	1,032,883	1,022,554	354,623	34,429	320,194	214	682
31	2048	16,308	0	815	17,124	2,645	149	24	523	13,807	1,430,191	1,072,643	1,061,917	368,274	35,755	332,519	222	708
32	2049	16,308	0	815	17,124	2,645	149	24	523	13,807	1,486,204	1,114,653	1,103,507	382,698	37,155	345,542	230	736
33	2050	16,308	0	815	17,124	2,645	149	24	523	13,807	1,544,980	1,158,735	1,147,147	397,832	38,624	359,208	240	765
34	2051	16,308	0	815	17,124	2,645	149	24	523	13,807	1,606,305	1,204,729	1,192,682	413,624	40,158	373,466	249	796
35	2052	16,308	0	815	17,124	2,645	149	24	523	13,807	1,669,993	1,252,495	1,239,970	430,023	41,750	388,273	259	827
36	2053	16,308	0	815	17,124	2,645	149	24	523	13,807	1,735,873	1,301,905	1,288,886	446,987	43,397	403,591	269	860
37	2054	16,308	0	815	17,124	2,645	149	24	523	13,807	1,803,796	1,352,847	1,339,319	464,477	45,095	419,383	280	893
38	2055	16,308	0	815	17,124	2,645	149	24	523	13,807	1,873,628	1,405,221	1,391,169	482,459	46,841	435,618	291	928
39	2056	16,308	0	815	17,124	2,645	149	24	523	13,807	1,945,249	1,458,937	1,444,347	500,902	48,631	452,270	302	963
40	2057	16,308	0	815	17,124	2,645	149	24	523	13,807	2,018,554	1,513,915	1,498,776	519,778	50,464	469,314	313	1,000

Total Technology GHGs - 40 years **490,920** **tonnes CO_2e**

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table F6: GHG assessment of Option 2(b) - EWS located in Campbell River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,259	952	32	6,259
5,736	872	29	5,736
5,269	801	27	5,269
4,942	752	25	4,942
4,651	707	24	4,651
4,392	668	22	4,392
4,162	633	21	4,162
3,958	602	20	3,958
3,779	575	19	3,779
3,641	554	19	3,641
3,541	538	18	3,541
3,473	528	18	3,473
3,434	522	18	3,434
3,420	520	18	3,420
3,427	521	18	3,427
3,455	525	18	3,455
3,499	532	18	3,499
3,557	541	18	3,557
3,628	552	19	3,628
3,711	564	19	3,711
3,802	578	19	3,802
3,911	595	20	3,911
4,035	614	21	4,035
4,173	635	21	4,173
4,323	657	22	4,323
4,485	682	23	4,485
4,658	708	24	4,658
4,840	736	25	4,840
5,031	765	26	5,031
5,231	796	27	5,231
5,439	827	28	5,439
5,653	860	29	5,653
5,874	893	30	5,874
6,102	928	31	6,102
6,335	963	32	6,335
6,574	1,000	34	6,574

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
97	194	0	0
89	178	0	0
82	163	0	0
76	153	0	0
72	144	0	0
68	136	0	0
64	129	0	0
61	122	0	0
58	117	0	0
56	113	0	0
55	110	0	0
54	107	0	0
53	106	0	0
53	106	0	0
53	106	0	0
53	107	0	0
54	108	0	0
55	110	0	0
56	112	0	0
57	115	0	0
59	118	0	0
61	121	0	0
62	125	0	0
65	129	0	0
67	134	0	0
69	139	0	0
72	144	0	0
75	150	0	0
78	156	0	0
81	162	0	0
84	168	0	0
87	175	0	0
91	182	0	0
94	189	0	0
98	196	0	0
102	203	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180
36	146	182
37	147	184
37	149	186
2	9	12
2	9	12
2	10	12
4	16	20
4	16	21
4	17	21
4	17	21
4	17	21
4	17	21
5	19	23
5	20	26
6	22	28
6	24	30
6	25	31
7	27	33
7	28	35
7	30	37
8	31	39
8	32	40
8	34	42
9	35	44
9	37	46
10	39	49
10	41	51
11	43	54
11	45	56
12	47	59
12	49	61
13	51	64
13	53	66
14	55	69
14	57	72
15	59	74
15	62	77
16	64	80
16	66	82
17	68	85

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
180
2,147
3,933
5,556
6,857
6,271
5,748
5,289
4,963
4,672
4,413
4,183
3,980
3,802
3,667
3,568
3,502
3,465
3,453
3,463
3,492
3,537
3,598
3,671
3,754
3,849
3,960
4,086
4,226
4,379
4,544
4,719
4,904
5,098
5,300
5,510
5,727
5,951
6,181
6,417
6,659

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
78,869	212	124
79,752	215	125
80,644	217	126
85,631	230	121
86,540	233	122
87,445	235	123
88,342	238	125
89,232	240	126
90,022	242	127
89,789	242	127
89,564	241	126
89,350	240	126
89,142	240	126
88,956	239	125
88,776	239	125
88,599	238	125
88,434	238	124
88,279	237	124
88,130	237	124
87,986	237	123
87,843	236	123
87,567	236	123
87,290	235	122
87,011	234	122
86,732	233	121
86,450	233	121
86,168	232	120
85,883	231	120
85,598	230	119
85,311	229	118
85,023	229	118
84,733	228	117
84,442	227	117
84,149	226	116
83,855	226	116
83,559	225	115
83,262	224	115

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
336	4	2015
340	5	2016
343	6	2017
351	7	2018
355	8	2019
359	9	2020
362	10	2021
366	11	2022
369	12	2023
368	13	2024
367	14	2025
366	15	2026
365	16	2027
364	17	2028
364	18	2029
363	19	2030
362	20	2031
361	21	2032
361	22	2033
360	23	2034
359	24	2035
358	25	2036
357	26	2037
356	27	2038
354	28	2039
353	29	2040
352	30	2041
351	31	2042
349	32	2043
348	33	2044
347	34	2045
345	35	2046
344	36	2047
343	37	2048
341	38	2049
340	39	2050
339	40	2051

Total CVWMC LF GHGs - 40 years **182,673** **tonnes CO_2e**

Total TS GHGs - 40 years **13,119** **tonnes CO_2e**

Table F7: GHG assessment of Option 2(c) - EWS located in Gold River

EWS GHG						Electricity Generation and Offsets - EWS				Net EWS Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		WTE Combustion GHG				Metal - ferrous	LHV of Waste	Potential Power	BC Electricity Offset		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		CO_2	CH_4 as CO_2e	N_2O as CO_2e	Total GHG CO_2e	3% of Throughput CO_2e Offset	10.5 GJ/tonne	at 16% Net Coversion Efficiency	BC Hydro Offset of 22 Tonnes CO_2e per GWh	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes	GWh	GWh	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	8,995	0	450	9,445	1,459	82	13	289	7,616	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	9,096	0	455	9,551	1,475	83	13	292	7,701	1,922,024	1,441,518	1,427,103	494,921	48,051	446,871	298	952
6	2023	9,198	0	460	9,658	1,492	84	13	295	7,787	1,761,394	1,321,045	1,307,835	453,559	44,035	409,524	273	872
7	2024	15,658	0	783	16,441	2,539	143	23	502	13,256	1,617,938	1,213,454	1,201,319	416,619	40,448	376,171	251	801
8	2025	15,794	0	790	16,584	2,562	144	23	507	13,371	1,517,534	1,138,150	1,126,769	390,765	37,938	352,827	235	752
9	2026	15,928	0	796	16,725	2,583	145	23	511	13,485	1,428,180	1,071,135	1,060,424	367,756	35,705	332,052	221	707
10	2027	16,060	0	803	16,863	2,605	146	23	515	13,597	1,348,720	1,011,540	1,001,424	347,295	33,718	313,577	209	668
11	2028	16,190	0	810	17,000	2,626	148	24	519	13,707	1,278,110	958,582	948,996	329,113	31,953	297,160	198	633
12	2029	16,308	0	815	17,124	2,645	149	24	523	13,807	1,215,421	911,566	902,450	312,971	30,386	282,585	188	602
13	2030	16,308	0	815	17,124	2,645	149	24	523	13,807	1,160,346	870,260	861,557	298,789	29,009	269,781	180	575
14	2031	16,308	0	815	17,124	2,645	149	24	523	13,807	1,118,105	838,579	830,193	287,912	27,953	259,959	173	554
15	2032	16,308	0	815	17,124	2,645	149	24	523	13,807	1,087,211	815,408	807,254	279,957	27,180	252,776	169	538
16	2033	16,308	0	815	17,124	2,645	149	24	523	13,807	1,066,356	799,767	791,769	274,587	26,659	247,928	165	528
17	2034	16,308	0	815	17,124	2,645	149	24	523	13,807	1,054,398	790,798	782,890	271,507	26,360	245,148	164	522
18	2035	16,308	0	815	17,124	2,645	149	24	523	13,807	1,050,076	787,557	779,681	270,394	26,252	244,143	163	520
19	2036	16,308	0	815	17,124	2,645	149	24	523	13,807	1,052,460	789,345	781,452	271,008	26,312	244,697	163	521
20	2037	16,308	0	815	17,124	2,645	149	24	523	13,807	1,060,815	795,611	787,655	273,160	26,520	246,640	165	525
21	2038	16,308	0	815	17,124	2,645	149	24	523	13,807	1,074,326	805,745	797,687	276,639	26,858	249,781	167	532
22	2039	16,308	0	815	17,124	2,645	149	24	523	13,807	1,092,300	819,225	811,033	281,267	27,307	253,960	169	541
23	2040	16,308	0	815	17,124	2,645	149	24	523	13,807	1,114,145	835,609	827,253	286,892	27,854	259,039	173	552
24	2041	16,308	0	815	17,124	2,645	149	24	523	13,807	1,139,376	854,532	845,987	293,389	28,484	264,905	177	564
25	2042	16,308	0	815	17,124	2,645	149	24	523	13,807	1,167,575	875,681	866,924	300,650	29,189	271,461	181	578
26	2043	16,308	0	815	17,124	2,645	149	24	523	13,807	1,200,920	900,690	891,683	309,237	30,023	279,214	186	595
27	2044	16,308	0	815	17,124	2,645	149	24	523	13,807	1,238,947	929,210	919,918	319,029	30,974	288,055	192	614
28	2045	16,308	0	815	17,124	2,645	149	24	523	13,807	1,281,240	960,930	951,321	329,919	32,031	297,888	199	635
29	2046	16,308	0	815	17,124	2,645	149	24	523	13,807	1,327,427	995,571	985,615	341,813	33,186	308,627	206	657
30	2047	16,308	0	815	17,124	2,645	149	24	523	13,807	1,377,177	1,032,883	1,022,554	354,623	34,429	320,194	214	682
31	2048	16,308	0	815	17,124	2,645	149	24	523	13,807	1,430,191	1,072,643	1,061,917	368,274	35,755	332,519	222	708
32	2049	16,308	0	815	17,124	2,645	149	24	523	13,807	1,486,204	1,114,653	1,103,507	382,698	37,155	345,542	230	736
33	2050	16,308	0	815	17,124	2,645	149	24	523	13,807	1,544,980	1,158,735	1,147,147	397,832	38,624	359,208	240	765
34	2051	16,308	0	815	17,124	2,645	149	24	523	13,807	1,606,305	1,204,729	1,192,682	413,624	40,158	373,466	249	796
35	2052	16,308	0	815	17,124	2,645	149	24	523	13,807	1,669,993	1,252,495	1,239,970	430,023	41,750	388,273	259	827
36	2053	16,308	0	815	17,124	2,645	149	24	523	13,807	1,735,873	1,301,905	1,288,886	446,987	43,397	403,591	269	860
37	2054	16,308	0	815	17,124	2,645	149	24	523	13,807	1,803,796	1,352,847	1,339,319	464,477	45,095	419,383	280	893
38	2055	16,308	0	815	17,124	2,645	149	24	523	13,807	1,873,628	1,405,221	1,391,169	482,459	46,841	435,618	291	928
39	2056	16,308	0	815	17,124	2,645	149	24	523	13,807	1,945,249	1,458,937	1,444,347	500,902	48,631	452,270	302	963
40	2057	16,308	0	815	17,124	2,645	149	24	523	13,807	2,018,554	1,513,915	1,498,776	519,778	50,464	469,314	313	1,000

Total Technology GHGs - 40 years **490,920** **tonnes CO_2e**

WTE Emissions Factors

CO_2 =	0.32	tonnes / tonne MSW
CH_4 =	0.0000031	tonnes CO_2e / tonne MSW
N_2O =	0.016	tones CO_2e / tonne MSW

Based on calculations for Vancouver waste for WTE at 70% diversion
Source: CH2M HILL (2009) Technical Memorandum Comparison of Greenhouse Gas Emissions from Waste-to-Energy Facilities and the Vancouver Landfill.

LHV MSW =	10.5	GJ/tonne
	2917	kWh/tonne
Electrical Conversion Efficiency =	16%	

Table F7: GHG assessment of Option 2(c) - EWS located in Gold River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,259	952	32	6,259
5,736	872	29	5,736
5,269	801	27	5,269
4,942	752	25	4,942
4,651	707	24	4,651
4,392	668	22	4,392
4,162	633	21	4,162
3,958	602	20	3,958
3,779	575	19	3,779
3,641	554	19	3,641
3,541	538	18	3,541
3,473	528	18	3,473
3,434	522	18	3,434
3,420	520	18	3,420
3,427	521	18	3,427
3,455	525	18	3,455
3,499	532	18	3,499
3,557	541	18	3,557
3,628	552	19	3,628
3,711	564	19	3,711
3,802	578	19	3,802
3,911	595	20	3,911
4,035	614	21	4,035
4,173	635	21	4,173
4,323	657	22	4,323
4,485	682	23	4,485
4,658	708	24	4,658
4,840	736	25	4,840
5,031	765	26	5,031
5,231	796	27	5,231
5,439	827	28	5,439
5,653	860	29	5,653
5,874	893	30	5,874
6,102	928	31	6,102
6,335	963	32	6,335
6,574	1,000	34	6,574

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
97	194	0	0
89	178	0	0
82	163	0	0
76	153	0	0
72	144	0	0
68	136	0	0
64	129	0	0
61	122	0	0
58	117	0	0
56	113	0	0
55	110	0	0
54	107	0	0
53	106	0	0
53	106	0	0
53	106	0	0
53	107	0	0
54	108	0	0
55	110	0	0
56	112	0	0
57	115	0	0
59	118	0	0
61	121	0	0
62	125	0	0
65	129	0	0
67	134	0	0
69	139	0	0
72	144	0	0
75	150	0	0
78	156	0	0
81	162	0	0
84	168	0	0
87	175	0	0
91	182	0	0
94	189	0	0
98	196	0	0
102	203	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180
36	146	182
37	147	184
37	149	186
2	9	12
2	9	12
2	10	12
4	16	20
4	16	21
4	17	21
4	17	21
4	17	21
4	17	21
5	19	23
5	20	26
6	22	28
6	24	30
6	25	31
7	27	33
7	28	35
7	30	37
8	31	39
8	32	40
8	34	42
9	35	44
9	37	46
10	39	49
10	41	51
11	43	54
11	45	56
12	47	59
12	49	61
13	51	64
13	53	66
14	55	69
14	57	72
15	59	74
15	62	77
16	64	80
16	66	82
17	68	85

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
180
2,147
3,933
5,556
6,857
6,271
5,748
5,289
4,963
4,672
4,413
4,183
3,980
3,802
3,667
3,568
3,502
3,465
3,453
3,463
3,492
3,537
3,598
3,671
3,754
3,849
3,960
4,086
4,226
4,379
4,544
4,719
4,904
5,098
5,300
5,510
5,727
5,951
6,181
6,417
6,659

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
210,316	566	124
212,672	572	125
215,052	578	126
314,435	846	215
317,333	854	217
320,204	861	219
323,027	869	221
325,817	876	223
328,333	883	224
328,100	883	224
327,875	882	224
327,660	881	224
327,453	881	224
327,267	880	224
327,087	880	224
326,910	879	224
326,745	879	224
326,590	879	224
326,441	878	224
326,297	878	224
326,153	877	224
325,878	877	224
325,601	876	224
325,322	875	224
325,042	874	224
324,761	874	224
324,478	873	224
324,194	872	224
323,909	871	224
323,622	871	224
323,333	870	224
323,044	869	224
322,752	868	224
322,460	867	224
322,165	867	224
321,870	866	224
321,573	865	224

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
689	4	2015
697	5	2016
705	6	2017
1,061	7	2018
1,071	8	2019
1,080	9	2020
1,090	10	2021
1,099	11	2022
1,107	12	2023
1,107	13	2024
1,106	14	2025
1,106	15	2026
1,105	16	2027
1,105	17	2028
1,104	18	2029
1,104	19	2030
1,103	20	2031
1,103	21	2032
1,102	22	2033
1,102	23	2034
1,102	24	2035
1,101	25	2036
1,100	26	2037
1,099	27	2038
1,099	28	2039
1,098	29	2040
1,097	30	2041
1,096	31	2042
1,096	32	2043
1,095	33	2044
1,094	34	2045
1,093	35	2046
1,092	36	2047
1,092	37	2048
1,091	38	2049
1,090	39	2050
1,089	40	2051

Total CVWMC LF GHGs - 40 years **182,673** **tonnes CO_2e**

Total TS GHGs - 40 years **39,370** **tonnes CO_2e**

Table F8: GHG assessment of Option 3(a) - Sustane located in Comox Valley

Year		Bio-diesel GHG: Bio-diesel Combustion GHG		Electricity Generation and Offsets - Sustane: Metal - ferrous	Metal - Non-Ferrous	Plastics	Net Sustane Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC: Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		0.12 tonnes CO_2e per tonne throughput	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes	tonnes	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	3,503	3,503	1,734	5,260	1,941	-5,433	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	3,543	3,543	1,754	5,319	1,963	-5,493	1,903,852	1,427,889	1,413,610	490,242	47,596	442,646	295	943
6	2023	3,582	3,582	1,773	5,379	1,985	-5,555	1,726,738	1,295,054	1,282,103	444,635	43,168	401,467	268	855
7	2024	6,098	6,098	3,019	9,156	3,379	-9,456	1,568,311	1,176,234	1,164,471	403,840	39,208	364,632	243	777
8	2025	6,116	6,116	3,027	9,183	3,389	-9,483	1,441,445	1,081,084	1,070,273	371,172	36,036	335,136	224	714
9	2026	6,116	6,116	3,027	9,183	3,389	-9,483	1,333,075	999,806	989,808	343,267	33,327	309,940	207	660
10	2027	6,116	6,116	3,027	9,183	3,389	-9,483	1,243,625	932,719	923,391	320,233	31,091	289,143	193	616
11	2028	6,116	6,116	3,027	9,183	3,389	-9,483	1,170,967	878,225	869,443	301,524	29,274	272,250	182	580
12	2029	6,116	6,116	3,027	9,183	3,389	-9,483	1,113,256	834,942	826,593	286,664	27,831	258,832	173	551
13	2030	6,116	6,116	3,027	9,183	3,389	-9,483	1,068,824	801,618	793,602	275,222	26,721	248,502	166	529
14	2031	6,116	6,116	3,027	9,183	3,389	-9,483	1,036,116	777,087	769,316	266,800	25,903	240,897	161	513
15	2032	6,116	6,116	3,027	9,183	3,389	-9,483	1,013,762	760,322	752,719	261,044	25,344	235,700	157	502
16	2033	6,116	6,116	3,027	9,183	3,389	-9,483	1,000,558	750,419	742,915	257,644	25,014	232,630	155	496
17	2034	6,116	6,116	3,027	9,183	3,389	-9,483	995,454	746,591	739,125	256,329	24,886	231,443	154	493
18	2035	6,116	6,116	3,027	9,183	3,389	-9,483	997,272	747,954	740,474	256,798	24,932	231,866	155	494
19	2036	6,116	6,116	3,027	9,183	3,389	-9,483	1,005,157	753,867	746,329	258,828	25,129	233,699	156	498
20	2037	6,116	6,116	3,027	9,183	3,389	-9,483	1,018,439	763,829	756,191	262,248	25,461	236,787	158	504
21	2038	6,116	6,116	3,027	9,183	3,389	-9,483	1,036,364	777,273	769,500	266,864	25,909	240,955	161	513
22	2039	6,116	6,116	3,027	9,183	3,389	-9,483	1,058,292	793,719	785,782	272,510	26,457	246,053	164	524
23	2040	6,116	6,116	3,027	9,183	3,389	-9,483	1,083,680	812,760	804,632	279,048	27,092	251,956	168	537
24	2041	6,116	6,116	3,027	9,183	3,389	-9,483	1,112,085	834,063	825,723	286,362	27,802	258,560	172	551
25	2042	6,116	6,116	3,027	9,183	3,389	-9,483	1,143,126	857,344	848,771	294,355	28,578	265,777	177	566
26	2043	6,116	6,116	3,027	9,183	3,389	-9,483	1,179,018	884,263	875,421	303,597	29,475	274,122	183	584
27	2044	6,116	6,116	3,027	9,183	3,389	-9,483	1,219,326	914,495	905,350	313,976	30,483	283,493	189	604
28	2045	6,116	6,116	3,027	9,183	3,389	-9,483	1,263,663	947,747	938,270	325,393	31,592	293,802	196	626
29	2046	6,116	6,116	3,027	9,183	3,389	-9,483	1,311,681	983,761	973,923	337,758	32,792	304,966	203	650
30	2047	6,116	6,116	3,027	9,183	3,389	-9,483	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
31	2048	6,116	6,116	3,027	9,183	3,389	-9,483	1,417,554	1,063,166	1,052,534	365,020	35,439	329,581	220	702
32	2049	6,116	6,116	3,027	9,183	3,389	-9,483	1,474,884	1,106,163	1,095,101	379,783	36,872	342,911	229	730
33	2050	6,116	6,116	3,027	9,183	3,389	-9,483	1,534,839	1,151,129	1,139,618	395,221	38,371	356,850	238	760
34	2051	6,116	6,116	3,027	9,183	3,389	-9,483	1,597,221	1,197,916	1,185,936	411,284	39,931	371,354	248	791
35	2052	6,116	6,116	3,027	9,183	3,389	-9,483	1,661,855	1,246,391	1,233,927	427,928	41,546	386,381	258	823
36	2053	6,116	6,116	3,027	9,183	3,389	-9,483	1,728,583	1,296,437	1,283,473	445,110	43,215	401,895	268	856
37	2054	6,116	6,116	3,027	9,183	3,389	-9,483	1,797,265	1,347,949	1,334,469	462,796	44,932	417,864	279	890
38	2055	6,116	6,116	3,027	9,183	3,389	-9,483	1,867,777	1,400,833	1,386,824	480,953	46,694	434,258	290	925
39	2056	6,116	6,116	3,027	9,183	3,389	-9,483	1,940,008	1,455,006	1,440,456	499,552	48,500	451,052	301	961
40	2057	6,116	6,116	3,027	9,183	3,389	-9,483	2,013,858	1,510,394	1,495,290	518,568	50,346	468,222	312	997

Total Technology GHGs - 40 years **-338,882** **tonnes CO_2e**

Table F8: GHG assessment of Option 3(a) - Sustane located in Comox Valley

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,200	943	32	6,200
5,623	855	29	5,623
5,107	777	26	5,107
4,694	714	24	4,694
4,341	660	22	4,341
4,050	616	21	4,050
3,813	580	20	3,813
3,625	551	19	3,625
3,481	529	18	3,481
3,374	513	17	3,374
3,301	502	17	3,301
3,258	496	17	3,258
3,242	493	17	3,242
3,248	494	17	3,248
3,273	498	17	3,273
3,317	504	17	3,317
3,375	513	17	3,375
3,446	524	18	3,446
3,529	537	18	3,529
3,622	551	19	3,622
3,723	566	19	3,723
3,840	584	20	3,840
3,971	604	20	3,971
4,115	626	21	4,115
4,272	650	22	4,272
4,439	675	23	4,439
4,616	702	24	4,616
4,803	730	25	4,803
4,998	760	26	4,998
5,202	791	27	5,202
5,412	823	28	5,412
5,629	856	29	5,629
5,853	890	30	5,853
6,083	925	31	6,083
6,318	961	32	6,318
6,558	997	34	6,558

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
96	192	0	0
87	174	0	0
79	158	0	0
73	145	0	0
67	134	0	0
63	125	0	0
59	118	0	0
56	112	0	0
54	108	0	0
52	104	0	0
51	102	0	0
50	101	0	0
50	100	0	0
50	101	0	0
51	101	0	0
51	103	0	0
52	104	0	0
53	107	0	0
55	109	0	0
56	112	0	0
58	115	0	0
59	119	0	0
61	123	0	0
64	127	0	0
66	132	0	0
69	137	0	0
71	143	0	0
74	149	0	0
77	155	0	0
80	161	0	0
84	167	0	0
87	174	0	0
91	181	0	0
94	188	0	0
98	196	0	0
101	203	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180
36	146	182
37	147	184
37	149	186
1	5	6
1	5	6
1	5	6
2	9	11
2	10	12
3	12	15
3	14	17
4	15	19
4	17	21
5	19	23
5	20	26
6	22	28
6	24	30
6	25	31
7	27	33
7	28	35
7	30	37
8	31	39
8	32	40
8	34	42
9	35	44
9	37	46
10	39	49
10	41	51
11	43	54
11	45	56
12	47	59
12	49	61
13	51	64
13	53	66
14	55	69
14	57	72
15	59	74
15	62	77
16	64	80
16	66	82
17	68	85

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
180
2,147
3,933
5,556
6,851
6,206
5,630
5,118
4,707
4,356
4,067
3,833
3,647
3,504
3,400
3,329
3,288
3,273
3,281
3,309
3,354
3,414
3,487
3,571
3,665
3,769
3,888
4,022
4,169
4,328
4,498
4,678
4,867
5,065
5,270
5,484
5,704
5,930
6,162
6,400
6,643

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
51,651	139	95
51,935	140	95
52,210	140	96
52,469	141	96
52,720	142	97
52,964	142	97
53,197	143	98
53,422	144	98
53,637	144	98
53,844	145	99
54,031	145	99
54,211	146	99
54,387	146	100
54,552	147	100
54,707	147	100
54,856	148	101
55,000	148	101
55,144	148	101
55,419	149	102
55,697	150	102
55,975	151	103
56,255	151	103
56,536	152	104
56,819	153	104
57,103	154	105
57,388	154	105
57,675	155	106
57,964	156	106
58,254	157	107
58,545	157	107
58,838	158	108
59,132	159	108
59,427	160	109
59,725	161	109

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
0	4	2015
0	5	2016
0	6	2017
234	7	2018
235	8	2019
236	9	2020
237	10	2021
238	11	2022
240	12	2023
241	13	2024
242	14	2025
243	15	2026
244	16	2027
244	17	2028
245	18	2029
246	19	2030
247	20	2031
247	21	2032
248	22	2033
249	23	2034
249	24	2035
251	25	2036
252	26	2037
253	27	2038
254	28	2039
256	29	2040
257	30	2041
258	31	2042
260	32	2043
261	33	2044
262	34	2045
264	35	2046
265	36	2047
266	37	2048
267	38	2049
269	39	2050
270	40	2051

Total CVWMC LF GHGs - 40 years **177,983** **tonnes CO_2e**

Total TS GHGs - 40 years **8,530** **tonnes CO_2e**

Table F9: GHG assessment of Option 3(b) - Sustane located in Campbell River

Bio-diesel GHG				Electricity Generation and Offsets - Sustane			Net Sustane Emissions	Methane Captured, Destroyed, Oxidized and Emitted - CVWMC							
Year		Bio-diesel Combustion GHG		Metal - ferrous	Metal - Non-Ferrous	Plastics		Methane Volume	Methane Collected	Methane Destroyed	Methane not Collected & Destroyed	Methane Oxidized	Total Methane Emitted	Tonnes Methane Emitted	Tonnes Methane Destroyed
		0.12 tonnes CO_2e per tonne throughput	Total GHG CO_2e	3% of Throughput CO_2e Offset	1.8% of throughput CO2e Offset	7% of Throughout CO_2e Offset	Combustion - Electricity Offset	From LandGem	75% Collection Efficiency	99% of Collected Methane	Total - Destroyed	10% of Methane not Collected	Total - Destroyed - Oxidized	0.000667 Tonnes/m^3	0.000667 Tonnes/m^3
		tonnes CO_2	tonnes CO_2e	tonnes	tonnes	tonnes	tonnes	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	m^3/year	tonnes CH_4	tonnes CH_4
0	2017	0	0	0	0	0	0								
1	2018	0	0	0	0	0	0	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	0	0	0	0	0	0	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	0	0	0	0	0	0	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	3,513	3,513	1,739	5,275	1,947	-5,448	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	3,553	3,553	1,759	5,334	1,969	-5,509	1,903,852	1,427,889	1,413,610	490,242	47,596	442,646	295	943
6	2023	3,592	3,592	1,778	5,394	1,991	-5,571	1,726,738	1,295,054	1,282,103	444,635	43,168	401,467	268	855
7	2024	6,116	6,116	3,027	9,182	3,389	-9,483	1,568,311	1,176,234	1,164,471	403,840	39,208	364,632	243	777
8	2025	6,116	6,116	3,027	9,182	3,389	-9,483	1,441,445	1,081,084	1,070,273	371,172	36,036	335,136	224	714
9	2026	6,116	6,116	3,027	9,182	3,389	-9,483	1,333,075	999,806	989,808	343,267	33,327	309,940	207	660
10	2027	6,116	6,116	3,027	9,182	3,389	-9,483	1,243,625	932,719	923,391	320,233	31,091	289,143	193	616
11	2028	6,116	6,116	3,027	9,182	3,389	-9,483	1,170,967	878,225	869,443	301,524	29,274	272,250	182	580
12	2029	6,116	6,116	3,027	9,182	3,389	-9,483	1,113,256	834,942	826,593	286,664	27,831	258,832	173	551
13	2030	6,116	6,116	3,027	9,182	3,389	-9,483	1,068,824	801,618	793,602	275,222	26,721	248,502	166	529
14	2031	6,116	6,116	3,027	9,182	3,389	-9,483	1,036,116	777,087	769,316	266,800	25,903	240,897	161	513
15	2032	6,116	6,116	3,027	9,182	3,389	-9,483	1,013,762	760,322	752,719	261,044	25,344	235,700	157	502
16	2033	6,116	6,116	3,027	9,182	3,389	-9,483	1,000,558	750,419	742,915	257,644	25,014	232,630	155	496
17	2034	6,116	6,116	3,027	9,182	3,389	-9,483	995,454	746,591	739,125	256,329	24,886	231,443	154	493
18	2035	6,116	6,116	3,027	9,182	3,389	-9,483	997,272	747,954	740,474	256,798	24,932	231,866	155	494
19	2036	6,116	6,116	3,027	9,182	3,389	-9,483	1,005,157	753,867	746,329	258,828	25,129	233,699	156	498
20	2037	6,116	6,116	3,027	9,182	3,389	-9,483	1,018,439	763,829	756,191	262,248	25,461	236,787	158	504
21	2038	6,116	6,116	3,027	9,182	3,389	-9,483	1,036,364	777,273	769,500	266,864	25,909	240,955	161	513
22	2039	6,116	6,116	3,027	9,182	3,389	-9,483	1,058,292	793,719	785,782	272,510	26,457	246,053	164	524
23	2040	6,116	6,116	3,027	9,182	3,389	-9,483	1,083,680	812,760	804,632	279,048	27,092	251,956	168	537
24	2041	6,116	6,116	3,027	9,182	3,389	-9,483	1,112,085	834,063	825,723	286,362	27,802	258,560	172	551
25	2042	6,116	6,116	3,027	9,182	3,389	-9,483	1,143,126	857,344	848,771	294,355	28,578	265,777	177	566
26	2043	6,116	6,116	3,027	9,182	3,389	-9,483	1,179,018	884,263	875,421	303,597	29,475	274,122	183	584
27	2044	6,116	6,116	3,027	9,182	3,389	-9,483	1,219,326	914,495	905,350	313,976	30,483	283,493	189	604
28	2045	6,116	6,116	3,027	9,182	3,389	-9,483	1,263,663	947,747	938,270	325,393	31,592	293,802	196	626
29	2046	6,116	6,116	3,027	9,182	3,389	-9,483	1,311,681	983,761	973,923	337,758	32,792	304,966	203	650
30	2047	6,116	6,116	3,027	9,182	3,389	-9,483	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
31	2048	6,116	6,116	3,027	9,182	3,389	-9,483	1,417,554	1,063,166	1,052,534	365,020	35,439	329,581	220	702
32	2049	6,116	6,116	3,027	9,182	3,389	-9,483	1,474,884	1,106,163	1,095,101	379,783	36,872	342,911	229	730
33	2050	6,116	6,116	3,027	9,182	3,389	-9,483	1,534,839	1,151,129	1,139,618	395,221	38,371	356,850	238	760
34	2051	6,116	6,116	3,027	9,182	3,389	-9,483	1,597,221	1,197,916	1,185,936	411,284	39,931	371,354	248	791
35	2052	6,116	6,116	3,027	9,182	3,389	-9,483	1,661,855	1,246,391	1,233,927	427,928	41,546	386,381	258	823
36	2053	6,116	6,116	3,027	9,182	3,389	-9,483	1,728,583	1,296,437	1,283,473	445,110	43,215	401,895	268	856
37	2054	6,116	6,116	3,027	9,182	3,389	-9,483	1,797,265	1,347,949	1,334,469	462,796	44,932	417,864	279	890
38	2055	6,116	6,116	3,027	9,182	3,389	-9,483	1,867,777	1,400,833	1,386,824	480,953	46,694	434,258	290	925
39	2056	6,116	6,116	3,027	9,182	3,389	-9,483	1,940,008	1,455,006	1,440,456	499,552	48,500	451,052	301	961
40	2057	6,116	6,116	3,027	9,182	3,389	-9,483	2,013,858	1,510,394	1,495,290	518,568	50,346	468,222	312	997

Total Technology GHGs - 40 years **-338,954** **tonnes CO_2e**

Table F9: GHG assessment of Option 3(b) - Sustane located in Campbell River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,200	943	32	6,200
5,623	855	29	5,623
5,107	777	26	5,107
4,694	714	24	4,694
4,341	660	22	4,341
4,050	616	21	4,050
3,813	580	20	3,813
3,625	551	19	3,625
3,481	529	18	3,481
3,374	513	17	3,374
3,301	502	17	3,301
3,258	496	17	3,258
3,242	493	17	3,242
3,248	494	17	3,248
3,273	498	17	3,273
3,317	504	17	3,317
3,375	513	17	3,375
3,446	524	18	3,446
3,529	537	18	3,529
3,622	551	19	3,622
3,723	566	19	3,723
3,840	584	20	3,840
3,971	604	20	3,971
4,115	626	21	4,115
4,272	650	22	4,272
4,439	675	23	4,439
4,616	702	24	4,616
4,803	730	25	4,803
4,998	760	26	4,998
5,202	791	27	5,202
5,412	823	28	5,412
5,629	856	29	5,629
5,853	890	30	5,853
6,083	925	31	6,083
6,318	961	32	6,318
6,558	997	34	6,558

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
96	192	0	0
87	174	0	0
79	158	0	0
73	145	0	0
67	134	0	0
63	125	0	0
59	118	0	0
56	112	0	0
54	108	0	0
52	104	0	0
51	102	0	0
50	101	0	0
50	100	0	0
50	101	0	0
51	101	0	0
51	103	0	0
52	104	0	0
53	107	0	0
55	109	0	0
56	112	0	0
58	115	0	0
59	119	0	0
61	123	0	0
64	127	0	0
66	132	0	0
69	137	0	0
71	143	0	0
74	149	0	0
77	155	0	0
80	161	0	0
84	167	0	0
87	174	0	0
91	181	0	0
94	188	0	0
98	196	0	0
101	203	0	0

Landfill Operations - CVWMC LF			
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations	CVWMC LF Emissions
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment	LFG - Electricity Offset + Operations
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180	180
36	146	182	2,147
37	147	184	3,933
37	149	186	5,556
1	5	6	6,851
1	5	6	6,206
1	5	6	5,629
2	8	10	5,118
2	10	12	4,707
3	12	15	4,356
3	14	17	4,067
4	15	19	3,833
4	17	21	3,647
5	19	23	3,504
5	20	26	3,400
6	22	28	3,329
6	24	30	3,288
6	25	31	3,273
7	27	33	3,281
7	28	35	3,309
7	30	37	3,354
8	31	39	3,414
8	32	40	3,487
8	34	42	3,571
9	35	44	3,665
9	37	46	3,769
10	39	49	3,888
10	41	51	4,022
11	43	54	4,169
11	45	56	4,328
12	47	59	4,498
12	49	61	4,678
13	51	64	4,867
13	53	66	5,065
14	55	69	5,270
14	57	72	5,484
15	59	74	5,704
15	62	77	5,930
16	64	80	6,162
16	66	82	6,400
17	68	85	6,643

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
77,937	210	129
78,810	212	130
79,692	214	132
84,010	226	130
83,726	225	129
83,451	224	129
83,193	224	128
82,942	223	128
82,697	222	127
82,464	222	127
82,239	221	126
82,024	221	126
81,817	220	126
81,631	220	125
81,451	219	125
81,274	219	125
81,109	218	124
80,954	218	124
80,805	217	124
80,661	217	123
80,518	217	123
80,242	216	123
79,965	215	122
79,686	214	122
79,406	214	121
79,125	213	121
78,843	212	120
78,558	211	120
78,273	211	119
77,986	210	118
77,698	209	118
77,408	208	117
77,117	207	117
76,824	207	116
76,530	206	116
76,234	205	115
75,937	204	115

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
338	4	2015
342	5	2016
346	6	2017
356	7	2018
354	8	2019
353	9	2020
352	10	2021
351	11	2022
350	12	2023
349	13	2024
348	14	2025
347	15	2026
346	16	2027
345	17	2028
344	18	2029
343	19	2030
342	20	2031
342	21	2032
341	22	2033
340	23	2034
340	24	2035
338	25	2036
337	26	2037
336	27	2038
335	28	2039
333	29	2040
332	30	2041
331	31	2042
330	32	2043
328	33	2044
327	34	2045
326	35	2046
324	36	2047
323	37	2048
322	38	2049
320	39	2050
319	40	2051

Total CVWMC LF GHGs - 40 years **177,981** **tonnes CO_2e**

Total TS GHGs - 40 years **12,529** **tonnes CO_2e**

Table F10: GHG assessment of Option 3(c) - Sustane located in Gold River

Year		Bio-diesel GHG: Bio-diesel Combustion GHG – 0.12 tonnes CO_2e per tonne throughput (tonnes CO_2)	Bio-diesel GHG: Total GHG CO_2e (tonnes CO_2e)	Electricity Generation and Offsets - Sustane: Metal - ferrous – 3% of Throughput CO_2e Offset (tonnes)	Electricity Generation and Offsets - Sustane: Metal - Non-Ferrous – 1.8% of throughput CO2e Offset (tonnes)	Electricity Generation and Offsets - Sustane: Plastics – 7% of Throughput CO_2e Offset (tonnes)	Net Sustane Emissions: Combustion - Electricity Offset (tonnes)
0	2017	0	0	0	0	0	0
1	2018	0	0	0	0	0	0
2	2019	0	0	0	0	0	0
3	2020	0	0	0	0	0	0
4	2021	3,513	3,513	1,739	5,275	1,947	-5,448
5	2022	3,553	3,553	1,759	5,334	1,969	-5,509
6	2023	3,592	3,592	1,778	5,394	1,991	-5,571
7	2024	6,116	6,116	3,027	9,182	3,389	-9,483
8	2025	6,116	6,116	3,027	9,182	3,389	-9,483
9	2026	6,116	6,116	3,027	9,182	3,389	-9,483
10	2027	6,116	6,116	3,027	9,182	3,389	-9,483
11	2028	6,116	6,116	3,027	9,182	3,389	-9,483
12	2029	6,116	6,116	3,027	9,182	3,389	-9,483
13	2030	6,116	6,116	3,027	9,182	3,389	-9,483
14	2031	6,116	6,116	3,027	9,182	3,389	-9,483
15	2032	6,116	6,116	3,027	9,182	3,389	-9,483
16	2033	6,116	6,116	3,027	9,182	3,389	-9,483
17	2034	6,116	6,116	3,027	9,182	3,389	-9,483
18	2035	6,116	6,116	3,027	9,182	3,389	-9,483
19	2036	6,116	6,116	3,027	9,182	3,389	-9,483
20	2037	6,116	6,116	3,027	9,182	3,389	-9,483
21	2038	6,116	6,116	3,027	9,182	3,389	-9,483
22	2039	6,116	6,116	3,027	9,182	3,389	-9,483
23	2040	6,116	6,116	3,027	9,182	3,389	-9,483
24	2041	6,116	6,116	3,027	9,182	3,389	-9,483
25	2042	6,116	6,116	3,027	9,182	3,389	-9,483
26	2043	6,116	6,116	3,027	9,182	3,389	-9,483
27	2044	6,116	6,116	3,027	9,182	3,389	-9,483
28	2045	6,116	6,116	3,027	9,182	3,389	-9,483
29	2046	6,116	6,116	3,027	9,182	3,389	-9,483
30	2047	6,116	6,116	3,027	9,182	3,389	-9,483
31	2048	6,116	6,116	3,027	9,182	3,389	-9,483
32	2049	6,116	6,116	3,027	9,182	3,389	-9,483
33	2050	6,116	6,116	3,027	9,182	3,389	-9,483
34	2051	6,116	6,116	3,027	9,182	3,389	-9,483
35	2052	6,116	6,116	3,027	9,182	3,389	-9,483
36	2053	6,116	6,116	3,027	9,182	3,389	-9,483
37	2054	6,116	6,116	3,027	9,182	3,389	-9,483
38	2055	6,116	6,116	3,027	9,182	3,389	-9,483
39	2056	6,116	6,116	3,027	9,182	3,389	-9,483
40	2057	6,116	6,116	3,027	9,182	3,389	-9,483

Methane Captured, Destroyed, Oxidized and Emitted - CVWMC

Year		Methane Volume – From LandGem (m^3/year)	Methane Collected – 75% Collection Efficiency (m^3/year)	Methane Destroyed – 99% of Collected Methane (m^3/year)	Methane not Collected & Destroyed – Total - Destroyed (m^3/year)	Methane Oxidized – 10% of Methane not Collected (m^3/year)	Total Methane Emitted – Total - Destroyed - Oxidized (m^3/year)	Tonnes Methane Emitted – 0.000667 Tonnes/m^3 (tonnes CH_4)	Tonnes Methane Destroyed – 0.000667 Tonnes/m^3 (tonnes CH_4)
0	2017								
1	2018	603,415	452,561	448,036	155,379	15,085	140,294	94	299
2	2019	1,151,150	863,363	854,729	296,421	28,779	267,642	179	570
3	2020	1,648,886	1,236,665	1,224,298	424,588	41,222	383,366	256	817
4	2021	2,101,822	1,576,367	1,560,603	541,219	52,546	488,674	326	1,041
5	2022	1,903,852	1,427,889	1,413,610	490,242	47,596	442,646	295	943
6	2023	1,726,738	1,295,054	1,282,103	444,635	43,168	401,467	268	855
7	2024	1,568,311	1,176,234	1,164,471	403,840	39,208	364,632	243	777
8	2025	1,441,445	1,081,084	1,070,273	371,172	36,036	335,136	224	714
9	2026	1,333,075	999,806	989,808	343,267	33,327	309,940	207	660
10	2027	1,243,625	932,719	923,391	320,233	31,091	289,143	193	616
11	2028	1,170,967	878,225	869,443	301,524	29,274	272,250	182	580
12	2029	1,113,256	834,942	826,593	286,664	27,831	258,832	173	551
13	2030	1,068,824	801,618	793,602	275,222	26,721	248,502	166	529
14	2031	1,036,116	777,087	769,316	266,800	25,903	240,897	161	513
15	2032	1,013,762	760,322	752,719	261,044	25,344	235,700	157	502
16	2033	1,000,558	750,419	742,915	257,644	25,014	232,630	155	496
17	2034	995,454	746,591	739,125	256,329	24,886	231,443	154	493
18	2035	997,272	747,954	740,474	256,798	24,932	231,866	155	494
19	2036	1,005,157	753,867	746,329	258,828	25,129	233,699	156	498
20	2037	1,018,439	763,829	756,191	262,248	25,461	236,787	158	504
21	2038	1,036,364	777,273	769,500	266,864	25,909	240,955	161	513
22	2039	1,058,292	793,719	785,782	272,510	26,457	246,053	164	524
23	2040	1,083,680	812,760	804,632	279,048	27,092	251,956	168	537
24	2041	1,112,085	834,063	825,723	286,362	27,802	258,560	172	551
25	2042	1,143,126	857,344	848,771	294,355	28,578	265,777	177	566
26	2043	1,179,018	884,263	875,421	303,597	29,475	274,122	183	584
27	2044	1,219,326	914,495	905,350	313,976	30,483	283,493	189	604
28	2045	1,263,663	947,747	938,270	325,393	31,592	293,802	196	626
29	2046	1,311,681	983,761	973,923	337,758	32,792	304,966	203	650
30	2047	1,363,071	1,022,303	1,012,080	350,991	34,077	316,914	211	675
31	2048	1,417,554	1,063,166	1,052,534	365,020	35,439	329,581	220	702
32	2049	1,474,884	1,106,163	1,095,101	379,783	36,872	342,911	229	730
33	2050	1,534,839	1,151,129	1,139,618	395,221	38,371	356,850	238	760
34	2051	1,597,221	1,197,916	1,185,936	411,284	39,931	371,354	248	791
35	2052	1,661,855	1,246,391	1,233,927	427,928	41,546	386,381	258	823
36	2053	1,728,583	1,296,437	1,283,473	445,110	43,215	401,895	268	856
37	2054	1,797,265	1,347,949	1,334,469	462,796	44,932	417,864	279	890
38	2055	1,867,777	1,400,833	1,386,824	480,953	46,694	434,258	290	925
39	2056	1,940,008	1,455,006	1,440,456	499,552	48,500	451,052	301	961
40	2057	2,013,858	1,510,394	1,495,290	518,568	50,346	468,222	312	997

Total Technology GHGs - 40 years -338,954 tonnes CO_2e

Table F10: GHG assessment of Option 3(c) - Sustane located in Gold River

LFG GHG Emissions Summary - CVWMC			
CO_2e Methane Emitted	CO_2 from Methane Destruction	CO_2 from Oxidized Methane	Total GHG Emissions from LFG
21 x Tonnes Emmitted	1 Tonne for Every Tonne Destroyed	1 Tonne for Every Tonne Oxidized	Sum of GHG Emissions
tonnes CO_2e	tonnes CO_2	tonnes CO_2	tonnes CO_2e
1,965	299	10	1,965
3,749	570	19	3,749
5,370	817	27	5,370
6,845	1,041	35	6,845
6,200	943	32	6,200
5,623	855	29	5,623
5,107	777	26	5,107
4,694	714	24	4,694
4,341	660	22	4,341
4,050	616	21	4,050
3,813	580	20	3,813
3,625	551	19	3,625
3,481	529	18	3,481
3,374	513	17	3,374
3,301	502	17	3,301
3,258	496	17	3,258
3,242	493	17	3,242
3,248	494	17	3,248
3,273	498	17	3,273
3,317	504	17	3,317
3,375	513	17	3,375
3,446	524	18	3,446
3,529	537	18	3,529
3,622	551	19	3,622
3,723	566	19	3,723
3,840	584	20	3,840
3,971	604	20	3,971
4,115	626	21	4,115
4,272	650	22	4,272
4,439	675	23	4,439
4,616	702	24	4,616
4,803	730	25	4,803
4,998	760	26	4,998
5,202	791	27	5,202
5,412	823	28	5,412
5,629	856	29	5,629
5,853	890	30	5,853
6,083	925	31	6,083
6,318	961	32	6,318
6,558	997	34	6,558

Electricity Generation and Offsets - CVWMC LF			
Total Gas Collected	Potential Power	Energy Generation	BC Electricity Offset
From LandGEM	200 kW per 100 ft^3/min	Based on Operation 91% of the Year	BC Hydro Offset of 22 Tonnes CO_2e per GWh
ft^3/min	kW	GWh / year	tonnes CO_2e
0	0	0	0
30	61	0	0
58	116	0	0
83	166	0	0
106	212	0	0
96	192	0	0
87	174	0	0
79	158	0	0
73	145	0	0
67	134	0	0
63	125	0	0
59	118	0	0
56	112	0	0
54	108	0	0
52	104	0	0
51	102	0	0
50	101	0	0
50	100	0	0
50	101	0	0
51	101	0	0
51	103	0	0
52	104	0	0
53	107	0	0
55	109	0	0
56	112	0	0
58	115	0	0
59	119	0	0
61	123	0	0
64	127	0	0
66	132	0	0
69	137	0	0
71	143	0	0
74	149	0	0
77	155	0	0
80	161	0	0
84	167	0	0
87	174	0	0
91	181	0	0
94	188	0	0
98	196	0	0
101	203	0	0

Landfill Operations - CVWMC LF		
Buildings - Fuel and Electricity	Landfill Equipment	GHGs from Landfill Operations
0.001 Tonnes CO_2e per Tonne Waste	0.004 Tonnes CO_2e per Tonne Waste	Buildings and Equipment
tonnes CO_2e	tonnes CO_2e	tonnes CO_2e
36	144	180
36	146	182
37	147	184
37	149	186
1	5	6
1	5	6
1	5	6
2	8	10
2	10	12
3	12	15
3	14	17
4	15	19
4	17	21
5	19	23
5	20	26
6	22	28
6	24	30
6	25	31
7	27	33
7	28	35
7	30	37
8	31	39
8	32	40
8	34	42
9	35	44
9	37	46
10	39	49
10	41	51
11	43	54
11	45	56
12	47	59
12	49	61
13	51	64
13	53	66
14	55	69
14	57	72
15	59	74
15	62	77
16	64	80
16	66	82
17	68	85

CVWMC LF Emissions
LFG - Electricity Offset + Operations
tonnes CO_2e
180
2,147
3,933
5,556
6,851
6,206
5,629
5,118
4,707
4,356
4,067
3,833
3,647
3,504
3,400
3,329
3,288
3,273
3,281
3,309
3,354
3,414
3,487
3,571
3,665
3,769
3,888
4,022
4,169
4,328
4,498
4,678
4,867
5,065
5,270
5,484
5,704
5,930
6,162
6,400
6,643

Transfer Station Hauling and Operations		
Fuel Consumption	Waste Hauling	Transfer Station Operations
2.4 L/tonne	0.00269 Tonnes CO_2e / L	0.0044 Tonnes CO_2e / Tonne Waste
L	tonnes CO_2e	tonnes CO_2e
0	0	0
0	0	0
0	0	0
0	0	0
207,833	559	129
210,160	565	130
212,512	572	132
310,112	834	224
309,828	833	224
309,554	833	224
309,295	832	224
309,044	831	224
308,799	831	224
308,566	830	224
308,342	829	224
308,127	829	224
307,919	828	224
307,733	828	224
307,553	827	224
307,377	827	224
307,212	826	224
307,056	826	224
306,907	826	224
306,764	825	224
306,620	825	224
306,344	824	224
306,067	823	224
305,789	823	224
305,509	822	224
305,228	821	224
304,945	820	224
304,661	820	224
304,375	819	224
304,088	818	224
303,800	817	224
303,510	816	224
303,219	816	224
302,926	815	224
302,632	814	224
302,336	813	224
302,039	812	224

Net Transfer Station Emissions	Year	
Hauling + Operations		
tonnes CO_2e		
	0	2011
0	1	2012
0	2	2013
0	3	2014
688	4	2015
696	5	2016
703	6	2017
1,058	7	2018
1,058	8	2019
1,057	9	2020
1,056	10	2021
1,056	11	2022
1,055	12	2023
1,054	13	2024
1,054	14	2025
1,053	15	2026
1,053	16	2027
1,052	17	2028
1,052	18	2029
1,051	19	2030
1,051	20	2031
1,050	21	2032
1,050	22	2033
1,049	23	2034
1,049	24	2035
1,048	25	2036
1,048	26	2037
1,047	27	2038
1,046	28	2039
1,045	29	2040
1,045	30	2041
1,044	31	2042
1,043	32	2043
1,043	32	2043
1,041	34	2045
1,041	35	2046
1,040	36	2047
1,039	37	2048
1,038	38	2049
1,038	39	2050
1,037	40	2051

Total CVWMC LF GHGs - 40 years **177,981** **tonnes CO_2e**

Total TS GHGs - 40 years **37,725** **tonnes CO_2e**