

DATE: September 5, 2019

FILE: 5360-50

TO: Chair and Directors
Comox Strathcona Waste Management Board

Supported by Russell Dyson
Chief Administrative Officer

FROM: Russell Dyson
Chief Administrative Officer

R. Dyson

**RE: Campbell River Waste Management Centre – Landfill Gas Management
Regulation Warning Letter**

Purpose

To provide the Comox Strathcona Waste Management (CSWM) Board (Board) with the recommended plan and timeline to complete the closure of the Campbell River Waste Management Centre (CRWMC) providing implications of proceeding related to the Landfill Gas Management Regulation (the Regulation) and Ministry of Environment and Climate Change Strategy (the Ministry).

Recommendation from the Chief Administrative Officer:

THAT the Comox Strathcona Waste Management Board support the planned closure approach described as Option 3 in the September 5, 2019 staff report, and direct staff to continue to follow the 2017 Design, Operations and Closure Plan for the Campbell River Waste Management Centre to meet Landfill Gas Management Regulation in 2023.

AND FURTHER THAT the Comox Strathcona Waste Management Board offset the estimated emissions resulting from Option 3 vs Option 1 by supporting the purchase of 48,300 metric tonnes of verified carbon offsets at an estimated cost of \$3.25, totalling approximately \$160,000.

AND FURTHER THAT the Comox Strathcona Waste Management Board send a letter to the Ministry of Environment and Climate Change Strategy to confirm our intent to meet the Landfill Gas Management Regulation as outlined in the 2017 Design, Operations and Closure Plan for Campbell River.

AND FINALLY THAT the 2020-2024 Financial Planning ensures that the necessary funding is available within the budget to undertake the closure works to proceed as per Option 3.

Executive Summary

At the June Board meeting the CRWMC warning letter associated with the Regulation was considered. Board direction was to investigate the non-compliant status and provide possible alternatives for consideration at the September 2019 Board meeting.

Our consultant GHG Limited, was engaged to support the analysis of three options available including the immediate closure of the landfill, a phased closure approach and closure consistent with the planned timeline within the design, operations and closure Plan 2017 (DOCP), closure at capacity. The CSWM service is committed to meeting the landfill gas (LFG) regulations and closing the CRWMC. Our

commitment to borrow and the planned expenditures in the financial plan shows that the CSWM service is willing to comply with the LFG regulations.

The three options are as follows:

Option 1 - Immediate Closure

- Estimated that 81,700 m³ of airspace would go unfilled at the CRWMC with an estimated value of the lost airspace at approximately \$5 million;
- Cost burden of approximately \$11,000,000 to be incurred in 2019-2021;
- Compliant with the Regulation an estimated 24 months earlier than Option 2 phased closure, or Option 3 planned closure;
- LFG collection and destruction would begin in Q4 2021, estimated to be 75 per cent efficient; and
- Leachate generation would virtually cease in 2021 due to impermeable cover on landfill.

Option 2 - Phased Closure

- Consumes all available airspace at the CRWMC;
- Phased implementation results in additional contractor mobilizations, additional tender events, and potentially multiple contractors, increasing costs to close the CRWMC by an estimated \$900,000;
- An additional 1,150 tonnes of LFG is estimated to be captured and destroyed with a phased closure compared to the planned closure, with LFG collection beginning in Q4 2021;
- Leachate generation would decrease in 2021 by 44 per cent, and virtually cease in Q4 2023;
- Partially compliant with the Regulation 12 months earlier than Option 3, planned closure; and
- Warranty period on LFG flare could be exposed to a more complex situation that adds risk and could lead to additional costs.

Option 3 - Planned Closure (2017 DOCP)

- Consumes all available airspace at the CRWMC;
- An additional 2,300 tonnes of LFG (48,300 t CO₂e) is estimated to be released under the planned closure compared to the immediate closure approach, with LFG collection beginning in Q4 2022;
- Cost burden of approximately \$11M to be incurred primarily in 2022-2023;
- Leachate generation would virtually cease in Q4 2023;
- Compliant with the LFG Management Regulation in Q4 2023.

The intent of the Landfill Gas Regulation is to prevent the release of methane to the atmosphere, for safety and for protection of the environment. By purchasing verified carbon offsets for the emissions resulting from the selection of Option 3, some mitigation of the impacts to the atmosphere from the non-compliance status will be achieved.

Prepared by:

S. Willie

Sarah Willie, EIT
Solid Waste Analyst

Concurrence:

A. McGifford

Andrew McGifford, CPA, CGA
Senior Manager of CSWM
Services

Concurrence:

Marc Rutten, P.Eng.
General Manager of
Engineering Services

Background

The Regulation established province-wide criteria for landfill gas capture from municipal solid waste landfills in 2008. The main focus of the regulation is the reduction of greenhouse gasses from landfills, as well as identifying opportunities to increase landfill gas recovery.

Landfill gas works have not been installed to date and staff informed the Board at the June 20, 2019 Board meeting that a warning letter related to the Regulation at the CRWMC was received from the Ministry on March 22, 2019. The warning letter specifies that because we have not installed landfill gas management facilities at the CRWMC we are out of compliance with the Regulation. The CSWM service has been out of compliance since February 2017, and we will remain out of compliance until the landfill gas collection system commences construction, currently scheduled for 2022 within the 2017 DOCP.

Background information and a detailed timeline of events was included within the June staff report, and an updated timeline is appended as Appendix A within this report.

June 13, 2019 staff report to the Board:

[Campbell River Waste Management Centre – Landfill Gas Management Regulation Warning Letter](#)

The recommendation within the June 20, 2019 Board report was:

THAT the implications of remaining non-compliant with the Landfill Gas Management Regulation at the Campbell River Waste Management Centre be further investigated by staff to address the non-compliant status and provide possible alternatives for the Board's consideration in September 2019.

Subsequent to the June Board meeting staff have held regular conference calls with the Ministry staff and immediately engaged GHD to complete an options analysis on three paths forward for coming into compliance with the Regulation. The complete letter report on the financial, technical, environmental and operational analysis by GHD on the options presented above is included as Appendix B.

The CSWM service has been diligent in constructing new infrastructure that meets current environmental requirements, including gas collection and flaring, with a new engineered lined cell and leachate treatment facility at the Comox Valley Waste Management Centre (CVWMC). As we move forward, we continue to address historical landfill closures in a timely manner within the financial constraints that the service faces due to changing environmental regulations.

Staff reviewed a draft report from GHD on the above options with Ministry staff from the authorization department in a call on September 3, 2019 and GHD finalized their report based on feedback received.

Options

The Board has the following options to consider:

Option 1 – Close the landfill immediately

Immediate actions would be taken to close the CRWMC landfill and meet the Regulation, including regrading of the landfill slopes, installation of geomembrane final cover, and installation and commissioning of the LFG collection system at the Site. LFG collection and full compliance would begin at the end of 2021.

This option would result in transfer of all waste to the CVWMC in Q3 2020, and consume an additional 81,700 m³ of airspace at the CVWMC valued at approximately \$5,000,000.

Closing the landfill immediately would have the most impact on the capital expenditure budget for the CSWM service between 2019 and 2023, with an estimated spend of \$13.2 million in 2021 at both CVWMC and CRWMC.

Option 2 – Phased closure of the landfill

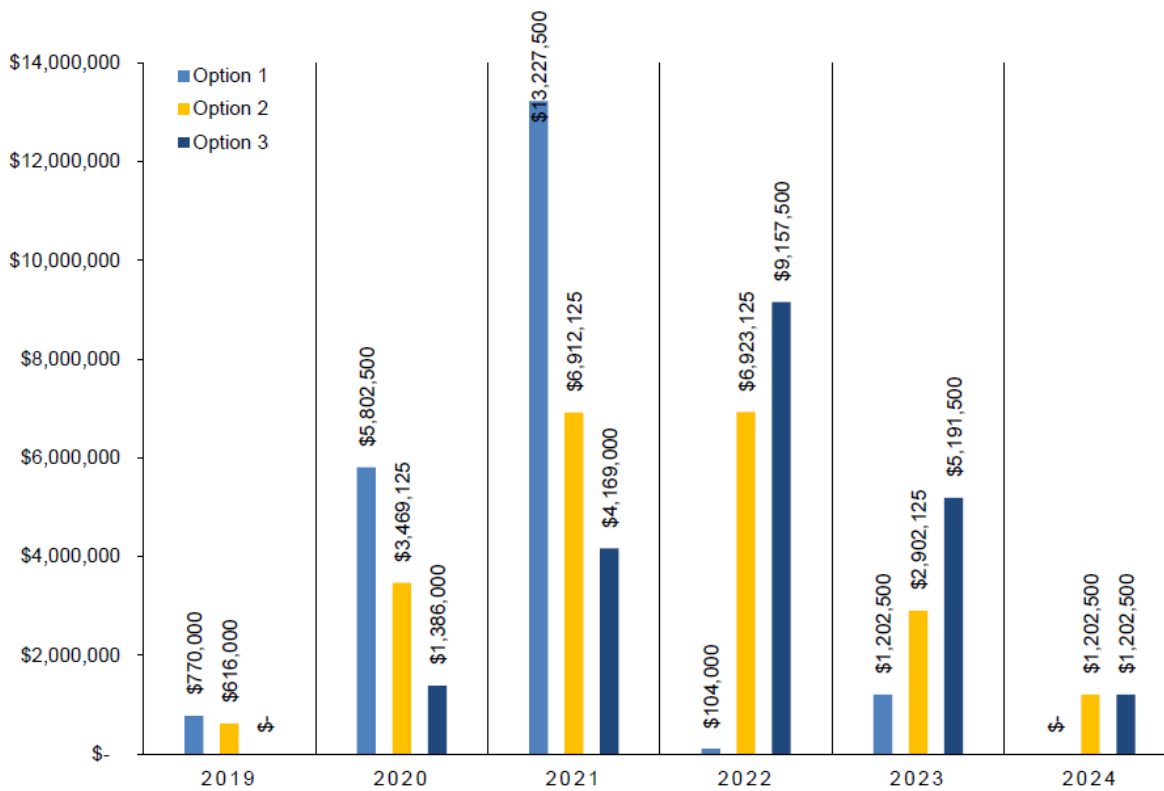
Immediate actions would be taken to commence a phased closure of the landfill at the CRWMC to achieve partial compliance earlier than currently planned, while still fully utilizing the available airspace at the CRWMC. The works would be completed in phases, with a partial closure in areas already filled to capacity resulting in some collection of LFG by the end of 2021, and an estimated reduction in landfill gas of 1,150 tonnes compared to planned closure. Final closure, full collection of LFG and compliance would occur at the end of 2023.

This option would incur additional expense due to not completing all works at the same time, it is estimated to cost an additional \$900,000 more than immediate closure or planned closure. Overall capital expenditures for CRWMC closure, and Cell 1 and 2 works at CVWMC would be spread out more evenly, with peak expenses in 2022 and 2023 of \$6.9 million dollars estimated for each year.

Option 3 – Continue with the closure schedule provided in the 2017 Design, Operations and Closure Plan

As per the planned closure strategy in the 2017 DOCP, LFG works would be installed after the CRWMC reached capacity in one single project. Final closure and full collection of LFG would occur at the same time as under the phased closure scenario, at the end of 2023. An additional 2,300 tonnes of landfill gas is estimated to be released compared to immediate closure of the landfill.

This option would incur similar total capital expenditures to immediate closure, but would result in delaying peak spending to 2022.



Based on discussions with representatives with the compliance and authorizations branch of the Ministry, Comox Valley Regional District (CVRD) staff are recommending to proceed with Option 3 – planned closure of the landfill ensuring we complete all closure plans as we fully utilize the CRWMC airspace.

The considerations for recommending Option 3 are:

- A phased closure approach would not move up our ability to reach compliance;
- Landfill capacity is fully utilized (maximizes revenue and delays redirection of waste);
- Expenditures are spread over five years (highest spending year is 2022 with \$9.1 million);
- Full compliance with the LFG Regulation would be delayed until the fourth quarter of 2023, subsequent to the closure of the landfill; and
- Minimal disruption to operations and site users.

We will remain out of compliance until landfill gas collection is installed and fully implemented.

If directed, staff will offset the estimated emissions resulting selection of Option 3, vs Option 1 by supporting the purchase of 48,300 metric tonnes of verified carbon offsets. Staff will review a variety of carbon offset options currently available in the marketplace, with a preference for landfill gas projects. All offsets considered will be verified as recommended by the “Becoming Carbon Neutral: Guidebook for BC Local Governments”.

Financial Factors

In November 2014, the Board adopted a loan authorization bylaw which authorizes the borrowing of \$45.3M for capital projects in the CSWM service. The CRWMC capital closure costs were included within the borrowing bylaw and the estimated CRWMC capital closure costs were \$13.1M. The bylaw provides the funding required to undertake all three options considered. The recommended approach is estimated at \$11M. There has been no borrowing associated with the CRWMC capital closure costs to date.

In May 2019 the CVRD purchased carbon offsets from the Spartanburg County Landfill Gas Project, South Carolina at a cost of \$2.25 USD/metric tonne of CO₂e. At an estimated cost of \$3.00 to \$3.50 CAD/MT, 48,300 MT of carbon offsets would cost approximately \$144,900-169,050 CAD to purchase.

The 2020-2024 Financial Plan would need to reflect the Board direction and if the planned approach is supported by the board, the Financial Plan may require amendments to reflect the changes in the capital expenditures based on timelines for the landfill reaching capacity.

Legal Factors

Failure to comply with the requirements under the Regulation is an offence under the *Environmental Management Act* (EMA). Section 120(3) of EMA states as follows:

120(3) A person who contravenes any of the following commits an offence and is liable on conviction to a fine not exceeding \$1,000,000 or imprisonment for not more than 6 months, or both:(e) section 76.2 [management of greenhouse gases at waste management facilities]

The Ministry has the ability to initiate action and impose an administrative penalty against the CVRD if we fail to comply with the warning letter. The Administrative Penalties Regulation (EMA) (B.C. Reg. 133/2014) (APR) was brought into force in 2014. Section 27(1) of the APR states as follows:

27(1) A person who contravenes section 4(1) or (5), 5(3), 7(1) or (2), 8(3) or (4)(b), 9(1), 11(3) or 15(1) of the Landfill Gas Management Regulation is liable to an administrative penalty not exceeding \$40,000.

The warning letter indicates that the compliance determination for the inspection was assessed as Level 2-Category C. An escalation of this determination and consequences would require that the CVRD showed “little or no demonstrated willingness or capacity to meet regulatory requirement” and/or a “wilful violation of ministry regulatory requirement”.

In following our design, operation and closure plan to achieve compliance, and in committing the funds and resources necessary to meet the closure plan, the Ministry should have an understanding that the CVRD is demonstrating a willingness to meet our regulatory requirements. It is not likely that the Ministry staff will be able to provide written approval of our design, operation and closure plan, as it does not meet the Landfill Gas Regulation as prescribed.

Intergovernmental Factors

The advisory management committee has reviewed a draft of the report from GHD and their input was sought on the three options presented.

Interdepartmental Involvement

Engineering Services is leading this work with support from Financial Services. The CSWM service will work with the onsite contractor Barry and Vale Contracting Ltd. should a change to their operations or contract terms be necessary.

Citizen/Public Relations

Communication to the public is not necessary at this time, but should construction activities or changes to operations require that the public be engaged a communications plan will be developed to support the changes.

Attachments: Appendix A – CRWMC Closure Option Analysis Report from GHD
Appendix B – Detailed Timeline of Events



This document is in draft form. A final version of this document may differ from this draft. As such, the contents of this draft document shall not be relied upon. GHD disclaims any responsibility or liability arising from decisions made based on this draft document.

September 5, 2019

Reference No. 056484

Mr. Andrew McGifford, CPA, CGA
Senior Manager Comox Strathcona Waste Management Services
Comox Valley Regional District
600 Comox Road
Courtenay, BC V9N 3P6

Dear Mr. McGifford

**Re: Closure Option Analysis
Campbell River Waste Management Centre
Comox Valley Regional District**

GHD Limited (GHD) has prepared this Closure Option Analysis (Analysis) for the Comox Valley Regional District (CVRD), a function of the Comox Strathcona Waste Management (CSWM) service. This Analysis was developed to provide regulatory compliance support to the CVRD for the Campbell River Waste Management Centre (Site).

1. Background

The Landfill Gas Management Facilities Design Plan (SCS Engineers, 2013) for the Site was initially submitted to the BC Ministry of Environment (MOE) in February 2013. Section 8 (3) of the Landfill Gas Management Regulation (LFG Regulation), requires that landfill gas management facilities and practices must be installed and implemented no later than four years after the landfill gas management facilities design plan is submitted. Therefore, the deadline to complete the construction of the landfill gas (LFG) collection system at the Site was February 2017.

In the fall of 2016, GHD was retained by the CVRD to complete an updated Design, Operations, and Closure Plan (2017 DOCP) for the landfill at the Site. A key objective of the 2017 DOCP was to provide a design and corresponding operating plan to optimize the use of remaining airspace at the landfill and to bring the landfill to closure. The 2017 DOCP included the Updated Landfill Gas Management Facilities Design Plan (GHD, 2017), which provided improvements to the 2013 design in terms of simplification, LFG collection efficiency and cost. The gas collection efficiency and lower costs are achieved by installing the gas collection wells at the time of placing the geomembrane final cover system over the landfill. The 2017 DOCP was presented to the authorizations division of the BC Ministry of Environment and Climate Change Strategy (ENV) in June 2017, with final submission made in March 2, 2018. The 2017 DOCP indicated that the final contours for the landfill will be reached in early 2023, the LFG collection system will be constructed in 2022–2023 and the landfill at the Site will be closed in 2023.

On March 21, 2019, ENV's compliance division issued a warning letter to the CVRD noting that the LFG collection system had not been constructed at the Site by the February 2017 deadline.



On a June 10, 2019 conference call between ENV, the CVRD, and GHD, ENV indicated that the only way to reach compliance with the LFG Regulation was to construct the LFG collection system at the Site.

The purpose of this Analysis is to re-evaluate the schedule for the installation of the LFG collection system, geomembrane final cover system, and closing the landfill at the Site. This Analysis identifies three feasible options for carrying out the closure of the landfill. The Analysis uses comparative criteria to evaluate the advantages and disadvantages of the closure options taking into consideration technical, environmental, financial, and practical aspects.

2. Closure Options

Closure of the landfill at the Site includes regrading of the landfill slopes, installation of geomembrane final cover, and installation and commissioning of the LFG collection system at the Site. The three closure options evaluated in this Analysis are as follows:

- Option 1 – Close the landfill immediately
- Option 2 – Phased closure of the landfill
- Option 3 – Continue with the closure schedule provided in the 2017 DOCP

The three closure options are described further in the subsections below. Figure 1 illustrates the schedule for each closure option.

Option 1 – Close the landfill immediately

Under Option 1, immediate actions will be taken to close the landfill at the Site under a fast tracked timeline with compressed construction period to meet the requirement of the LFG regulation. Under this option, final closure of the Site can be achieved by the third quarter of 2021.

Approximately 80,000 cubic meters (m³) of landfill capacity at the CRWMC will be unused, which has a value to the CSWM service of approximately \$5 million. The \$5 million approximate value was calculated as follows:

- 80,000 m³ of airspace unused
- Approximate apparent waste density of 0.6 tonnes/m³
- Assumed value of waste disposal at \$100 per tonne
- 80,000 m³ x 0.6 tonnes/m³ x \$100 = \$4.8 million

Under Option 1, waste would be redirected to the Comox Valley Waste Management Centre (CVWMC) beginning in the third quarter of 2020. Immediate closure of the CRWMC would impact the fill rate and timing of capital works at the CVWMC.



Option 2 – Phased closure of the landfill

Under Option 2, immediate actions will be taken to commence a phased closure of the landfill at the Site to achieve compliance, while still fully utilizing the available airspace at the CRWMC.

The closure works would be completed in three phases to allow for the filling operations continue, but will achieve partial LFG collection earlier than planned in the 2017 DOCP scheduled closure. The initial phase includes the design, tender, and construction of the perimeter LFG header for the LFG collection system, surface water management works, and regrading of the lower slopes of the landfill.

The second phase involves the installation of the geomembrane final cover and LFG collection wells on the lower slopes, and the construction and commissioning of the LFG flare station. Partial LFG collection could begin as early as the end of 2021.

The final phase of closure activities would include final grading, the installation of the geomembrane final cover and installation of the LFG collection wells on the upper slopes of the landfill. Final closure of the Site could be completed by the fourth quarter of 2023.

Under Option 2, early diversion of waste to the CVWMC would not be required.

Figure 2 provides a reference illustration for Option 2. Note that the purpose of this figure is to indicate the approximate location(s) of the closure works and not to present a final design. Figure 3 presents the topographic conditions at the Site as of October 2018 to illustrate where the current landfill topographic contours are at relative to the proposed final contours.

Option 3 – Continue with the closure schedule provided in the 2017 DOCP

Under Option 3, the planned closure strategy provided in the 2017 DOCP would be followed, and closure construction and LFG collection infrastructure work would commence simultaneous with the landfill reaching capacity. LFG collection at the lower slopes of the landfill would commence in the fourth quarter of 2022 and full LFG collection would occur commence in 2023.

The timeline to close the landfill at the Site for Option 3 is a traditional time frame for a project of this size.

Carbon credits will be purchased to account for the LFG available for collection at the Site prior to constructing the LFG collection system.

Under Option 3, early diversion of waste to the CVWMC would not be required.



3. Technical and Practical Considerations

Comparative criteria were used to conduct the Analysis. The criteria were used to identify and analyze the technical and practical considerations and to compare the advantages and disadvantages of each option. The criteria used in the analysis includes:

- Capacity
- Landfill Gas
- Effect on Public
- Effect on the Environment
- Landfill Operations
- Design/Construction Considerations
- Expenditures
- Regional Waste Management

The above criteria are defined in the subsections below. Table 1 provides the comparative analysis for each of the closure options.

Capacity

Capacity considers the airspace capacity at the landfill at the Site consumed and/or remaining under each closure option. Consequences of lost capacity includes lost revenue from tipping fees and advancing the requirement for developing new landfill capacity within the CVRD.

Landfill Gas

The Landfill Gas criteria reviews timing for commencing collection of LFG and achieving the 75% LFG collection efficiency target.

Effect on the Public

This criteria considers how closing the landfill at the Site will impact the residents of Campbell River and commercial haulers/industry in Campbell River. This criteria considers the timing for when waste will be diverted to the CVWMC.

Effect on the Environment

This criteria evaluates environmental impacts to the receiving environment, including groundwater/surface water and the atmosphere. The criteria considers when leachate generation will cease at the CRWMC as well as a comparison of volumes of LFG (as carbon dioxide equivalent [CO₂e]) collected.



Landfill Operations

This criteria evaluates how Site operations will be affected including fillings rates, waste diversion to the CVWMC, and landfilling in concurrence with closure construction activities.

Campbell River Waste Management Centre Design/Construction Considerations

This criteria evaluates how each closure option will affect the timing of the detailed design and required construction activities as the landfill development proceeds for the closure of the landfill and construction of a new cell at the CVWMC.

Expenditures

This criteria analyzes the present value of the work that will be undertaken as well as the schedule for expenditures. Further details regarding this criteria are provided in Section 4.

4. Financial Considerations

4.1 Expenditures

The CVRD's expenditures and schedule of expenditures will vary based on the closure option chosen before moving forward. The upcoming projects that will be affected by the closure of the landfill at the Site are the construction of Cell 2 at the CVWMC and the closure of Cell 1 at the CVWMC.

GHD understands the following budgets have been carried by the CVRD for the closure of the landfill at the CRWMC and the development of CVWMC landfill cells in the next 5 years:

- Design/construction for closure of the CRWMC landfill: \$11 million (GHD, 2017)
- Design/construction of Cell 2 at the CVWMC: \$8.8 million (AECOM, 2017)
- Design/construction of partial closure of Cell 1 at the CVWMC: \$1.3 million (AECOM, 2017)

Additionally, the CVRD plans to purchase carbon credits under Option 3 for the years prior to the completion of the LFG collection system.

In 2018, the CVRD was able to purchase carbon credits at a rate of \$2.25 US dollars per metric tonne of CO₂e. Table 2 below summarizes the estimated carbon credit cost per year. The attached Table 3 details the calculations for each year's carbon credit cost taking into account the Site's LFG generation rate, portion of the landfill footprint that LFG can be collected, and assumed collection efficiency.



Table 2 Estimated Carbon Credit Costs (Option 3 only) 2019 - 2023

Year	Carbon Credit Cost
2019	\$33,129
2020	\$33,379
2021	\$33,628
2022	\$33,876
2023*	\$8,525
Notes:	
*Partial LFG collection achieved by the first quarter of 2023	
Table in 2019 Canadian dollars	
Exchange rate of 0.75 CAD/USD assumed	

4.2 Cash Flow Analysis

A cash flow analysis was completed to understand the timeline of expenditures and present value for each closure option.

Each construction project's budget was broken down between the design, tender, and construction/construction oversight costs. Based on GHD's industry experience, it was estimated 7% of the total project budget would be allocated to design, 0.5% to the tendering, and the remaining 92.5% to the construction/construction oversight.

The carbon credit costs were only included in Option 3's cash flow analysis.

The following rates were used for the cash flow analysis:

- Inflation rate of 2.71% (10 year average of non-residential construction index, CANSIM Table 18-10-0135-01)
- Long term borrowing rate of 2.79% (Municipal Finance Authority of BC as of July 29, 2019)

The design/construction budget was estimated to increase by ten percent (10%) if the landfill at the Site was closed through the phased approach.



The results of the cash flow analysis are shown in the attached Tables 4 and 5. Figure 4 below illustrates the timeline of expenditures for each closure option as estimated in the cash flow analysis:

Figure 4 Timeline of Expenditures

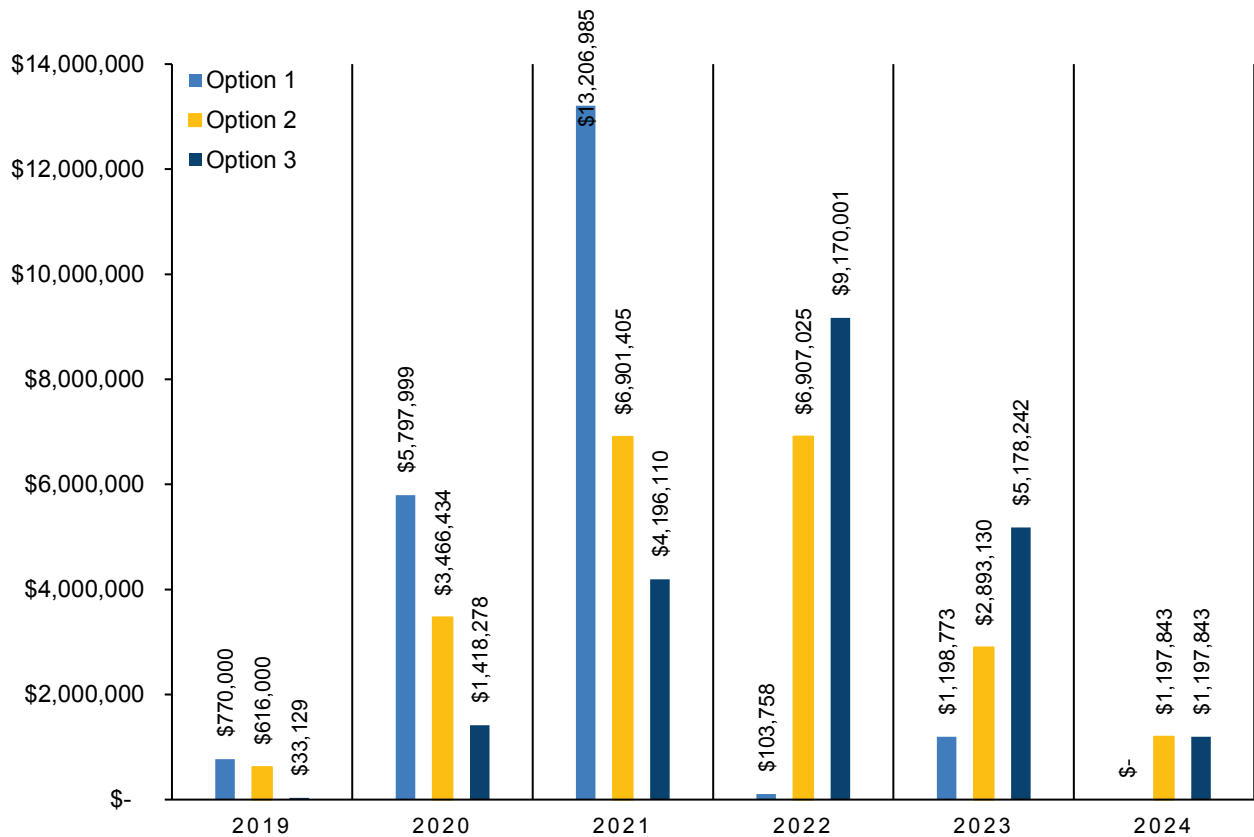


Figure 4 illustrates the timeline of expenditures over the next 5 years for each closure option. From review of Figure 4, Option 1's expenditures are weighted heavily within 2020 and 2021, with a spending peak of \$13 million in 2021. Option 2's expenditures are spread out, with the peak in 2021 and 2022. Option 3's expenditures are delayed, with the largest expenditure of \$9 million in 2022.

The total present value of the capital expenditures for the 3 construction projects for each closure option in 2019 dollars was calculated to be:

- Option 1 – \$21,077,515
- Option 2 – \$21,981,837
- Option 3 – \$21,193,604



5. Closure Options Analysis

From review of Table 1, the takeaways for the technical and practical comparative criteria are:

- Option 1 is the only option that results in unused airspace (approximately 80,000 m³); whereas Options 2 and 3 consume all available airspace.
- In Option 1, the target of 75% collection efficiency is anticipated for the end of 2021; whereas for Options 2 and 3, the target is achieved two years later by the end of 2023.
- Option 2 provides for collection of LFG earlier than Option 3 with a collection efficiency of 37.5% achieved by early (Q1) 2022 due to the phased closure and interim collection. However the operation of the LFG collection system under partial closure can result in increased fire risk due to the inflow of oxygen into the landfill surface. This risk can be minimized through increased gas probe monitoring.
- Under Option 1 increased operational activity will occur earlier at the CVWMC. None of the options identified will affect individual household deliveries of waste to the CRWMC. Due to space constraints at the plateau of the landfill, larger trucks will be unable to reach the top of the landfill at the Site and will be required to deliver waste to CVWMC by Q4 2021 for Option 1, and two years later (Q4 2023) for Options 2 and 3.
- Option 1 involves collection of the largest volume of LFG with 24,150 tonnes CO₂e greater than Option 2 and 48,300 tonnes CO₂e greater than Option 3). Option 3 involves collection of the smallest volume of LFG relative to Options 1 and 2 due to the timing of construction of LFG collection works.
- Leachate generation at the Site is essentially eliminated earliest with Option 1, partially reduced prior to being eliminated for Option 2, and is eliminated the latest under Option 3.
- Options 1 and 3 involve single tender processes and using a single general contractor, resulting in a simplified procurement and warranty process. The difference between construction considerations for Options 1 and 3 is related to final design contours; under Option 1 the landfill will be closed with a flat plateau whereas under Option 3 the landfill is closed at final design contours.
- Option 2 involves phased closure, involving three separate contracts to complete construction of the closure works over a five-year period; Phasing closure through multiple contracts results in increased complexity in the execution of tendering, construction and warranty periods for each contract. Contract risks arise due to construction of new closure works during the warranty period of the previous works installed.

The following subsections summarize the advantages and disadvantages for each closure option based on the analyses noted above and carried out in this letter.



5.1 Option 1 – Immediate Closure

The advantages for Option 1 are:

- Earliest full compliance with LFG Regulation (fourth quarter of 2021)
- Earliest elimination of leachate generation (third quarter of 2021)
- Expenditures similar to Option 3 and \$900,000 less than Option 2

The disadvantages for Option 1 are:

- Landfill capacity loss of ~81,700 m³ (approximate value \$5 million)
- Shortest expenditure schedule (highest spending year is 2021 with \$13.2 million)

5.2 Option 2 – Phased Closure

The advantages for Option 2 are:

- Landfill capacity is fully utilized (maximizes revenue and delays redirection of waste)
- Expenditures are spread over 5 years (highest spending year is 2022 with \$6.9 million)
- Partial compliance with LFG Regulation by the first quarter of 2022
- Leachate generation partially reduced by the fourth quarter of 2021

The disadvantages for Option 2 are:

- Expenditures estimated to be \$900,000 greater than Option 1 and \$800,000 greater than Option 3
- Three separate contracts to complete the work over a five year period
- Full compliance with the LFG Regulation delayed until the fourth quarter of 2023
- Leachate generation not eliminated until the fourth quarter of 2023

5.3 Option 3 – Planned Closure

The advantages for Option 3 are:

- Landfill capacity is fully utilized (maximized revenue and delays redirection of waste)
- Total expenditures similar to Option 1 and \$800,000 less than Option 2
- Expenditures are spread over the next 5 years (highest spending year is 2022 with \$9.2 million)
- Carbon credits purchased to account for the difference in available LFG collection versus LFG not collected



The disadvantages for Option 2 are:

- Full compliance with the LFG Regulation is delayed until the fourth quarter of 2023
- Elimination of leachate generation by the fourth quarter of 2023 (no interim reduction as in Option 2)

5.4 Summary

Figure 5 below provides a visual summary of the closure option analysis.

Figure 5 Summary Table

Criteria	Option 1	Option 2	Option 3
Capacity			
Landfill gas			
Effect on the public			
Effect on the environment			
Landfill operations			
Campbell River landfill design/construction considerations			
Present value			
Legend Superior Inferior			

From review of the figure above, Option 3 scores the highest in this Analysis:

- Option 1: 4 superior, 0 middle, 3 inferior
- Option 2: 1 superior, 5 middle, 1 inferior
- **Option 3: 4 superior, 2 middle, 1 inferior**



Should you have any questions regarding this analysis, please do not hesitate to contact the undersigned.

Sincerely,

GHD

Michaela Dyck, G.I.T.

Gregory D. Ferraro, P.Eng.

MND/cs/06

Encl.

cc: Sarah Willie (Comox Valley Regional District)

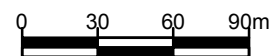


LEGEND:

- 180.0 — FINAL CONTOUR (2m INTERVAL)
- — FINAL CONTOUR (1m INTERVAL)
- — LEGAL BOUNDARY
- - - - SITE BOUNDARY
- - - - APPROXIMATE LIMIT OF WASTE
- x - CHAIN LINK FENCE
- x — ELECTRIC FENCE
- — LIMIT OF EXISTING FINAL COVER
- ▨ GRAVEL ROADWAY
- ▨ ASPHALT ROADWAY
- ▨ RIP RAP DITCH
- ▨ TURF REINFORCEMENT MAT
- - - - CULVERT □ SURFACE WATER PIPE
- M.H. MANHOLE

PHASED CLOSURE WORKS LEGEND:

- LFG COLLECTION HEADER
- - - - DRAINAGE DITCH
- ▨ UPPER SLOPE
- ▨ LOWER SLOPE
- FLARE STATION



SOURCE:
 EXISTING TOPOGRAPHICAL SURVEY COMPLETED OCTOBER 20, 2016 BY MCELHANNEY LAND SURVEYED LTD.
 APPROXIMATE LIMIT OF WASTE PER MCELHANNEY CONSULTING SERVICES LTD., DRAWING LIMIT OF EXISTING WASTE, DATED MAY 30, 2013.

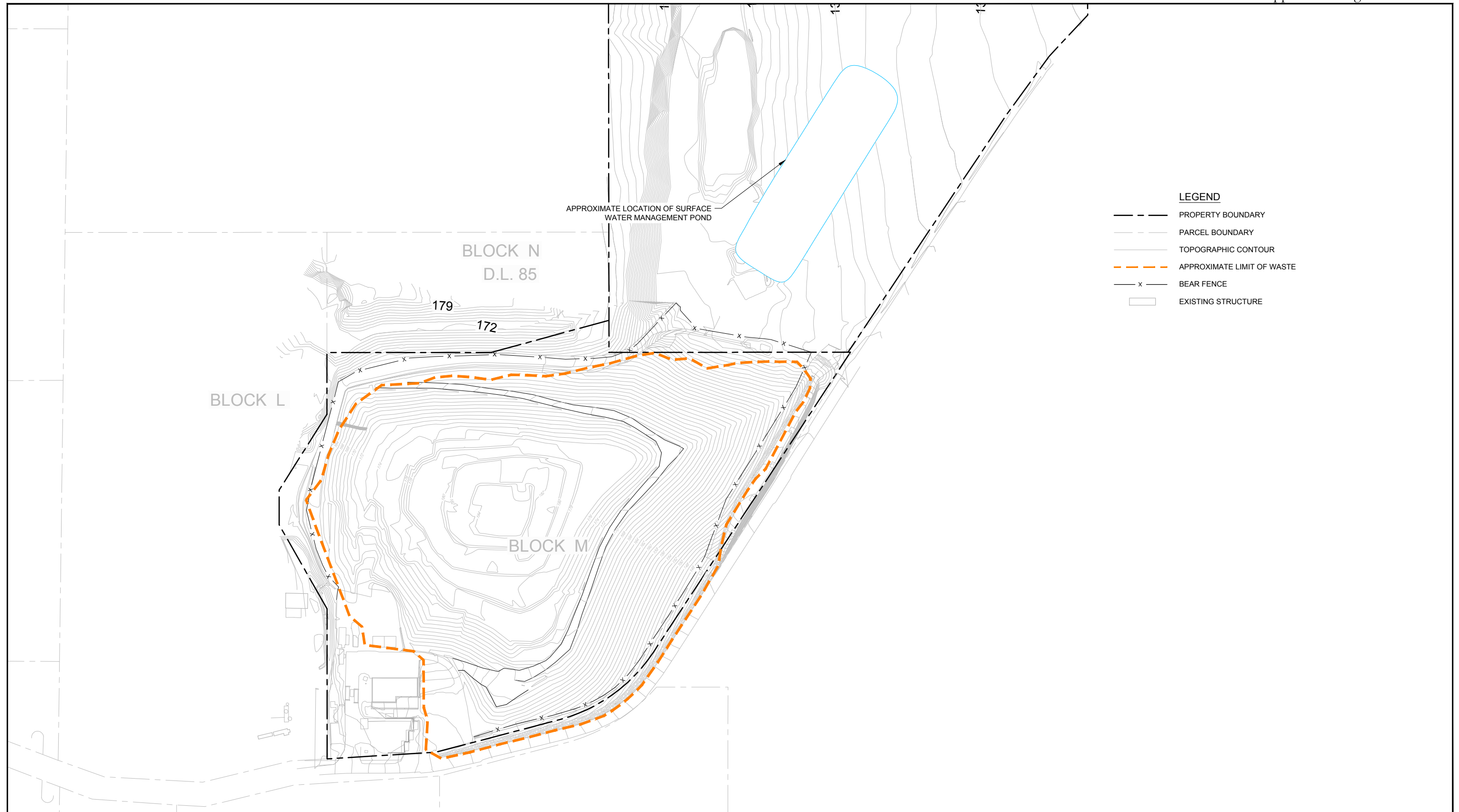


CAMPBELL RIVER WASTE MANAGEMENT CENTRE
 CLOSURE OPTION ANALYSIS

2019-2023 PHASED CLOSURE WORKS

56484-17
 Se 5, 2019

figure 2



LEGEND

- PROPERTY BOUNDARY
- - - PARCEL BOUNDARY
- TOPOGRAPHIC CONTOUR
- - - APPROXIMATE LIMIT OF WASTE
- x - BEAR FENCE
- EXISTING STRUCTURE

BLOCK L

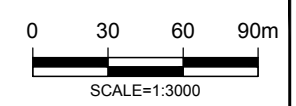
BLOCK N
D.L. 85

BLOCK M

APPROXIMATE LOCATION OF SURFACE
WATER MANAGEMENT POND

179

172



NOTE: McIVOR LAKE AND COLD CREEK TRIBUTARY LOCATIONS ARE APPROXIMATE.
SOURCE: TOPOGRAPHICAL INFORMATION BASED SURVEY BY McELHANNEY ASSOCIATES DATED OCTOBER 24, 2018.
WELL LOCATIONS BASED ON SURVEY DATA PROVIDED BY TETRA TECH EBA.
LIMIT OF WASTE FROM SCS ENGINEERS, PHASE I CLOSURE PLAN, JUNE 6, 2013.



CAMPBELL RIVER WASTE MANAGEMENT CENTRE
CLOSURE OPTION ANALYSIS

OCTOBER 2018 CONDITIONS
CLOSURE FEASIBILITY ANALYSIS

56484-17
Aug 7, 2019

figure 3

Table 1
Rationale Summary
Closure Option Analysis
Campbell River Waste Management Centre
Comox Valley Regional District

Criteria	Option 1 <i>Immediate Closure</i>	Option 2 <i>Phased Closure</i>	Option 3 <i>Planned Closure (2017 DOCP)</i>
Capacity	- Leaves approximately 81,700 m ³ of airspace capacity unused	- Consumes all available airspace	- Consumes all available airspace
Campbell River Waste Management Centre (CRWMC) Expenditures	- Expenditures commence in Q4 2019, complete by Q3 2021	- Expenditures commence Q4 2019, complete by Q4 2023	- Expenditures commence Q3 2020, complete by Q4 2023
Comox Valley Waste Management Centre (CVWMC) Expenditures	- Cell 2 expenditures commence Q4 2019, complete by Q3 2021 - Cell 1 expenditures commence Q1 2022, complete by Q4 2023	- Cell 2 expenditures commence Q1 2020, complete by Q2 2022 - Cell 1 expenditures commence Q1 2023, complete by Q4 2024 - Same expenditure schedule as Option 3	- Cell 2 expenditures commence Q1 2020, complete by Q2 2022 - Cell 1 expenditures commence Q1 2023, complete by Q4 2024 - Same expenditure schedule as Option 2
Landfill Gas	- 75% collection efficiency target achieved by Q4 2021	- 37.5% collection efficiency achieved by Q1 2022 - 75% collection efficiency target achieved by Q4 2023	- 75% collection efficiency target achieved by Q4 2023
Effect on the Public	- No effect on individual household deliveries of waste to the CRWMC - Larger trucks must deliver waste to the CVWMC commencing in Q1 2021	- No effect on individual household deliveries of waste to the CRWMC - Larger trucks must deliver waste to the CVWMC commencing in 2023	- No effect on individual household deliveries of waste to the CRWMC - Larger trucks must deliver waste to the CVWMC commencing in 2023
Effect on the Environment	- Reduces leachate generation from 87,950 m ³ /yr to 10 m ³ /yr starting in Q3 2021 - LFG collection commences in Q3 2021 - Collect 1,150 tonnes of LFG (24,150 tonnes CO ₂ e) more than Option 2 - Collect 2,300 tonnes of LFG (48,300 tonnes CO ₂ e) more than Option 3	- Reduces leachate generation from 87,950 m ³ to 49,260 m ³ /yr starting in Q4 2021 - Reduces leachate generation from 49,260 m ³ /yr to 10 m ³ /yr in Q4 2023 - Collection of LFG commences in Q4 2021 - Collect 1,150 tonnes of LFG (24,150 tonnes CO ₂ e) less than Option 1 - Collect 1,150 tonnes of LFG (24,150 tonnes CO ₂ e) more than Option 3	- Reduction of leachate generation from 87,950 m ³ /yr to 10 m ³ /yr in Q4 2023 - Collection of LFG commences in Q4 2022 - Collect 2,300 tonnes of LFG (48,300 tonnes CO ₂ e) less than Option 1 - Collect 1,150 tonnes of LFG (24,150 tonnes CO ₂ e) less than Option 2
Landfill Operations	- Fill rate increase of 28,000 m ³ /yr at CVWMC by Q1 2020 - Fill rate increase of 56,000 m ³ /yr at CVWMC 2.5 years earlier than Options 2 and 3 (Q3 2020)	- Fill rate increase of 28,000 m ³ /yr at CVWMC by Q1 2020 - Fill rate increase to 56,000 m ³ /yr at CVWMC 2.5 years later than Option 1 (Q1 2023) - Landfilling at the top of the landfill concurrent with lower slope closure activities - Airspace consumption rates at CRWMC will decrease as waste diversion to the CVWMC increases	- Fill rate increase of 28,000 m ³ /yr at CVWMC by Q1 2020 - Fill rate increase to 56,000 m ³ /yr at CVWMC 2.5 years later than Option 1 (Q1 2023) - Landfill operations will proceed as planned in the 2017 DOCP. Airspace consumption rates at CRWMC will decrease as waste diversion to the CVWMC increases
Campbell River Landfill Design/Construction Considerations	- Landfill closed with flat plateau (< 10%), below design contours - Landfill closed with single tender process and single general contractor - Simplified warranty period for LFG collection and flare system	- Landfill closed with full capacity utilized achieving design contours (same as Option 3) - Phased implementation results in additional contractor mobilizations, additional tender events, and potentially multiple contractors. - More complex warranty period for LFG collection and flare system	- Landfill closed with full capacity utilized achieving design contours (similar to Option 2) - Single tender process with single general contractor (similar to Option 1) - Simplified warranty period for LFG collection and flare system (similar to Option 1)

Table 3

**Carbon Credit Cost Estimate
Closure Option Analysis
Campbell River Waste Management Centre
Comox Valley Regional District**

Year	Modelled Landfill Gas Generation Rate⁽¹⁾ Tonnes CO₂e	Portion of Landfill that LFG can be collected from (footprint that has reached final contours/total footprint)	Assumed Collection Efficiency of LFG collection System in Areas Installed	Annual Potential LFG Collection Tonnes CO₂e	Cost of Carbon Credits
2019	32,009	46%	75%	11,043	\$ 33,129
2020	32,250	46%	75%	11,126	\$ 33,379
2021	32,491	46%	75%	11,209	\$ 33,628
2022	32,730	46%	75%	11,292	\$ 33,876
2023*	32,948	46%	75%	2,842	\$ 8,525

Notes:

⁽¹⁾Supplemental Landfill Gas Generation Assessment (GHD, 2019)

*Portion of 2023, January to March. LFG collection on lower slopes will be achieved by Q1 2023

CO₂e - carbon dioxide equivalent

Table 4

**Inputs to Cash Flow Analysis
Closure Option Analysis
Campbell River Waste Management Centre
Comox Valley Regional District**

Capital Costs

Item	Description	Design	Tender	Construction and Const. QA/QC	Total
1a	Campbell River Closure Design and Construction (1 Construction Event)	\$770,000	\$55,000	\$10,175,000	\$11,000,000
1b	Campbell River Closure Design and Construction (Phased Over 5 years) ⁽¹⁾	\$847,000	\$110,000	\$11,192,500	\$12,149,500
2	Comox Valley Cell 2 Design and Construction ⁽²⁾	\$616,000	\$44,000	\$8,140,000	\$8,800,000
3	Comox Valley Cell 1 Closure Design and Construction ⁽³⁾	\$91,000	\$13,000	\$1,202,500	\$1,300,000

Rates

Inflation Rate - 10 year average of non-residential construction index ⁽⁴⁾	2.71%
Long-term (30 years) borrowing rate ⁽⁵⁾	2.79%

Carbon Credit Costs

Carbon credit cost	\$2.25 \$US/tonne
\$US to \$CDN exchange rate	0.75 \$US/\$CDN
Carbon credit cost	\$3.00 \$CDN/tonne

Notes:

Const. - Construction

QA/QC - quality assurance/quality control

⁽¹⁾Assumed 10% increase for phased closure based on GHD's industry experience.

⁽²⁾Total sourced from *Comox Valley Waste Management Centre Master Plan* (AECOM, 2017)

⁽³⁾Total sourced from *Comox Valley Waste Management Centre Master Plan* (AECOM, 2017).

⁽⁴⁾Construction cost inflation rate applied to forecast construction costs, calculated based on 10 year average annual increase in Vancouver non-residential building construction index (CANSIM Table 18-10-0135-01) (latest index Q1 2019).

⁽⁵⁾Long-term borrowing rate sourced from Municipal Finance Authority of BC as of July 29, 2019.

Table 5
Cash Flow Analysis
Closure Option Analysis
Campbell River Waste Management Centre
Comox Valley Regional District

Closure Option #	Option Description	2019	2020	2021	2022	2023	2024	Total	
1	Immediate Closure	Campbell River Closure Design and Construction	\$ 770,000	\$ 5,142,500	\$ 5,087,500			\$ 11,000,000	
		Comox Valley Cell 2 Design and Construction		\$ 660,000	\$ 8,140,000			\$ 8,800,000	
		Comox Valley Cell 1 Closure Design and Construction				\$ 104,000	\$ 1,202,500		\$ 1,306,500
		Sub-Total	\$ 770,000	\$ 5,802,500	\$ 13,227,500	\$ 104,000	\$ 1,202,500	\$ -	
		Future Value	\$ 770,000	\$ 5,959,763	\$ 13,954,215	\$ 112,687	\$ 1,338,260	\$ -	
		Present Value	\$ 770,000	\$ 5,797,999	\$ 13,206,985	\$ 103,758	\$ 1,198,773	\$ -	
	Total Present Value	\$ 21,077,515							
2	Phased Closure	Campbell River Closure Design and Construction	\$ 616,000	\$ 2,853,125	\$ 2,798,125	\$ 2,853,125	\$ 2,798,125		\$ 11,918,500
		Comox Valley Cell 2 Design and Construction		\$ 616,000	\$ 4,114,000	\$ 4,070,000			\$ 8,800,000
		Comox Valley Cell 1 Closure Design and Construction					\$ 104,000	\$ 1,202,500	\$ 1,306,500
		Sub-Total	\$ 616,000	\$ 3,469,125	\$ 6,912,125	\$ 6,923,125	\$ 2,902,125	\$ 1,202,500	
		Future Value	\$ 616,000	\$ 3,563,147	\$ 7,291,875	\$ 7,501,423	\$ 3,229,769	\$ 1,374,530	
		Present Value	\$ 616,000	\$ 3,466,434	\$ 6,901,405	\$ 6,907,025	\$ 2,893,130	\$ 1,197,843	
	Total Present Value	\$ 21,981,837							
	Difference from Option #1	\$ 904,322							
3	Planned Closure	Campbell River Closure Design and Construction		\$ 770,000	\$ 55,000	\$ 5,087,500	\$ 5,087,500		\$ 11,000,000
		Carbon Credits	\$ 33,129	\$ 33,379	\$ 33,628	\$ 33,876	\$ 2,842		\$ 136,854
		Comox Valley Cell 2 Design and Construction		\$ 616,000	\$ 4,114,000	\$ 4,070,000			\$ 8,800,000
		Comox Valley Cell 1 Closure Design and Construction					\$ 104,000	\$ 1,202,500	\$ 1,306,500
		Sub-Total	\$ 33,129	\$ 1,419,379	\$ 4,202,628	\$ 9,191,376	\$ 5,194,342	\$ 1,202,500	
		Future Value	\$ 33,129	\$ 1,457,848	\$ 4,433,520	\$ 9,959,144	\$ 5,780,772	\$ 1,374,530	
	Present Value	\$ 33,129	\$ 1,418,278	\$ 4,196,110	\$ 9,170,001	\$ 5,178,242	\$ 1,197,843		
	Total Present Value	\$ 21,193,604							
	Difference from Option #1	\$ 116,089							

Appendix B

The following provided timeline addresses how the CSWM Service addressed the *Landfill Gas Management Regulation* (effective January 1, 2009) at the CRWMC site leading up to the warning letter.

- December 2010 – Landfill Gas Generation Assessment prepared by Conestoga-Rovers & Associates is finalized.
- March 2012 – CVRD issues RFP for the closure design, closure plan and updated operations plan for the CRWMC.
- Contract awarded to SCS Engineers to complete the closure design, closure plan and updated operations plan.
- December 2012 – 2012 Solid Waste Management Plan prepared by AECOM is finalized.
- February 2013 – Landfill Gas Management Facilities Design Plan prepared by SCS Engineers is finalized.
- March 2013 – CVRD receives the Ministry’s approval on SCS Engineers’ proposed closure design plan including construction of the MSE wall and subsequent phased closure. The Ministry acknowledges the MSE wall will likely add approximately 5 years of site life.
- April 2013 – Landfill Gas Management Facilities Design Plan prepared by SCS Engineers is considered accepted.
- May 23, 2013 – MoE approves the 2012 Solid Waste Management Plan.
- Summer 2013 – Construction of Phase 1 closure for CRWMC commences, including construction of the MSE wall. SCS Engineers provides construction oversight.
- February 2014 – Updated DOCP prepared by SCS Engineers is finalized.
- Spring 2015 – Phase 1 closure at CRWMC completed.
- June 2015 – Per board direction a meeting is held with the Minister of Environment to discuss regulations and the cost to implement the 2012 CSWM SWMP and related costs to implement the plan associated with implementing provincial regulations.
- October 14, 2015 – Letter sent to the Ministry authorizations staff to provide an update on the CSWM 2012 SWMP implementation, asking for support to undertake the complete closure and final cover of the Campbell River landfill as a single project in 2021 as opposed to current plans for the partial landfill closure in 2016 and the full closure in 2019.
- December 22, 2015 – The Ministry responded to the letter to support the Tahsis and Zeballos landfills delayed closures by approximately 10 years. Also, the CRWMC could impact compliance with the landfill’s operational certificate, the associated SWMP and other obligations under the *Environmental Management Act* if closure and final cover of the CRWMC landfill as a single project in 2021 as opposed to current plans for the partial landfill closure in 2016 and the full closure in 2019.
- November 2016 – The Board provided direction to adjust the major project implementation schedule to more evenly distribute the cost to taxpayers over the five year period of the 2017 to 2021 – [staff report](#).
- Early 2017 – GHD began work on the updating the 2017 DOCP and maximizing the remaining airspace at the CRWMC, based on Board direction.
- November 15, 2017 – GHD finalized CRWMC 2017 DOCP.
- January 18, 2018 – CSWM staff then reviewed and provided the 2017 DOCP to the Board ([CRWMC 2017 DOCP staff report](#) and [GHD presentation](#)) and the Board approved for submission at the January 18, 2018, Board meeting.
- March 2, 2018 – Submission of 2017 DOCP with an application for a minor amendment to Operational Certificate 2401 to adopt the DOCP, update authorized works and update boundaries of the Site. An Updated LFG Management Facilities Design Plan is included in the 2017 DOCP submission.

- May 1, 2018 – Updated LFG Management Facilities Design Plan is considered “accepted” as per Section 18 of the LFG Regulation.
- October 29, 2018 – Conference call pre-application meeting between the Ministry, the CVRD and GHD for the 2017 DOCP.
- November 27, 2018 – Conference call meeting between the Ministry, the CVRD and GHD to review the LFG substitution application process.
- December 2, 2018 – The Ministry conducts inspection at CRWMC with regards to the Hazardous Waste Regulation and the Site’s Operational Certificate.
- January 22, 2019 – The Ministry conducts inspection on the CRWMC with regards to the Landfill Gas Management Regulation.
- March 19, 2019 – Submission of application for LFG substitution including 2017 LFG Generation Assessment Report.
- March 21, 2019 – The Ministry issues warning letter regarding the results of its January 22, 2019 inspection (Appendix B).
- March 22, 27, and 29, 2019 – Newspaper ads ran in the Campbell River Mirror for an open house inform the public of the LFG substitution application and to educate the public on the overall closure strategy for the landfill at the Site.
- March 25 to April 1, 2019 – Radio ads ran 3x per day to advertise the open house on 99.7 2DayFM and 97.3 The Eagle.
- April 2, 2019 – The CVRD hosted the open house to inform the public of the LFG substitution application and to educate the public on the overall closure strategy for the landfill at the Site.
- April 2, 2019 – Bulletin posted at the Site entrance for the LFG substitution application as required by Section 20(2) (a) of the Landfill Gas Management Regulation.
- April 3, 2019 and April 5, 2019 – Newspaper notices ran in the Campbell River Mirror for the LFG substitution application as required by Section 20(2) (c) of the Landfill Gas Management Regulation.
- April 2, 2019 to May 5, 2019 – Public consultation period as required by Section 20(2) of the Landfill Gas Management Regulation.
- April 18, 2019 – CVRD submits response letter to the Ministry’s March 21, 2019, warning letter. The response letter indicates that the CVRD is following the timeline provided in the 2017 DOCP as the corrective action plan (Appendix C).
- May 29, 2019 – Public Consultation Summary report is submitted to the Ministry.
- May 30, 2019 – The Ministry, the CVRD and GHD participate in a pre-application conference call for the LFG substitution application. The Ministry advises they will not make a decision regarding the LFG substitution application.
- June 20, 2019 – CVRD staff report to the Board on the warning letter received, and that possible alternatives for consideration will be provided in September 2019.
- August 2019 – GHD provides a Draft Closure Option Analysis letter report to CVRD for consideration and discussion with the Technical Advisory Committee and Ministry staff.