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Don Hamilton, BA
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101 Martin Street
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Dear Mr. Hamilton:

Project No: 60190320

Regarding: Updated Campbell Mountain Landfill Life Cycle Cost Assessment

In November 2010, AECOM submitted a proposal to estimate the "true costs" of landfilling in the Regional District of Okanagan Similkameen (RDOS). The Campbell Mountain Landfill was proposed to be the focus of the assessment. The work was initiated in December 2010. As a cost model had already been established for the Campbell Mountain Landfill (the Landfill) it was decided to update the model created by CH2M HILL in 2006. AECOM obtained the cost model files in May 2011 and subsequently updated the cost model based on current information available for the landfill. A brief overview of the model, the work undertaken to update the model and the results is provided below. Appendix A attached includes additional detail to support the summary letter including guidance for updating the model in the future.

The Campbell Mountain Landfill's land lease contract was re-negotiated with the City on Penticton in 2005. In order to renew the contract the City of Penticton required that the RDOS perform a life cycle cost assessment for the Campbell Mountain Landfill. The first assessment was carried out by CH2M HILL and the results were presented in May 2006. The renewed lease also required an Environmental Impairment Fund to be established and budgeted to contain $6,300,000 by the end of the landfill life.

The RDOS introduced city curbside recycling in 1998 and the amount of waste disposed has since decreased significantly. When the first cost assessment was performed in 2006 the diversion rate for the region serviced by the Campbell Mountain Landfill was estimated at 29%. The RDOS Solid Waste Management Plan (SWMP), dated June 2011, indicates that the current diversion rate for the entire regional district is 51%. The diversion rate is currently slightly higher (54%) in the region serviced by the Campbell Mountain Landfill. One reason for the higher diversion rate could be that the service area includes Penticton, the largest community in the district, where recycling facilities and services are more accessible than in rural areas. In the SWMP, the diversion potential is estimated to be 73% once the organics are diverted from the solid waste stream. Assuming that the potential diversion rate

is reached by 2016 (as suggested in the SWMP) the estimated lifespan of the Campbell Mountain Landfill will extend significantly. Assuming that the diversion rate reaches 73% in 2016 and stays constant, the Campbell Mountain Landfill's current phase (Phase 1) will last until 2043. As discussed with RDOS staff, the 2011 cost assessment is based upon the assumption that the landfill will be closing once the present phase is filled to capacity.

The 2011 life cycle cost assessment is based on the model created for the 2006 assessment and has been modified based on current information about the site, the budget, the solid waste stream and potential costs. The cost assessment includes all costs of landfilling at the Campbell Mountain Landfill. Key costing inputs are summarized below:

- Environmental Impairment Fund. As per the previous recommendation, the Environmental Impairment Fund is budgeted to contain $6,300,000 by closure in 2043. This fund was established to cover the costs of managing unforeseen environmental risks associated with the landfill.
- Capital Reserve Fund. The Capital Reserve Fund is budgeted to cover development of the initial portion (landfill infrastructure and initial waste cell development) of a new Regional Sanitary Landfill. The balance at the end of 2043 is set to $0.
- Closure Fund. The Closure Fund is set to allow for 25 years of post-closure monitoring and maintenance at $50,000 per year (2010$).
- Landfill gas system installation, operation and maintenance. The capital and operating cost for installation of landfill gas management system has been calculated and included in the model. The system is assumed to be installed in two stages: Stage 1 in the summer of 2013 and Stage 2 in the summer of 2028. The annual operations and maintenance cost for the new landfill gas management system is estimated to be $39,000 (2010$). The capital cost for the entire system is estimated to be approximately $1,500,000 (2010$). Estimations are based on information provided in *Cost Estimation for Implementing GHG Emission Reduction Projects at Landfills in British Columbia* (Golder 2008).
- Material for final closure. The cost to construct final cover for Phase 1 (115,000 m^2) is estimated to be $40 per m^2. The cost for final cover is included in the total closure cost.
- Transfer station. Under the future solid waste management system, it may be necessary to develop a transfer station in the vicinity of Penticton depending upon where the replacement landfill is located. The potential transfer station development cost has been incorporated in one of two modeling scenarios. The second modelling scenario assumes that no transfer station is required.

The model is divided into three components; revenue, cost and reserve / impairment funds. Refuse disposal fees and other disposal fees (e.g., scrap metal disposal fees) make up the majority of the revenue component. The revenue from disposal fees is in direct correlation with the amount of waste disposed at the Landfill.

The cost component is divided into several categories: administration, operations and maintenance (O&M), capital projects (such as equipment purchase and signage), the potential transfer station capital project, the new landfill capital project, closure projects (including the LFG system), other projects (such as environmental monitoring initiatives and consultants services), transfers to the three reserves as well as potential debt repayment.

There are three funds that make up the funds component of the model, the Environmental Impairment Fund, the Closure Fund and the Capital Reserve Fund. Money is transferred to these funds on an annual basis to ensure sufficient means for closure and capital projects. In the model, the tipping fee is adjusted to cover all of the cost components (e.g., administration, O&M, capital projects) over the operating period.

The results of the cost modelling are presented in Table 1 below. The break-even tipping fee for the Landfill, assuming there is no need for construction of a transfer station, is approximately $82/tonne. The primary reason for the increase in the break-even disposal fee from the model results of 2006 is the projected reduced disposal rate in the region. The model also includes installation and operations of a new landfill gas collection system, not included in the 2006-model.

Table 1. Waste Disposal Cost and Break-even Tipping Fees for CMLF Closure in 2043 at the End of Phase 1

	Break-even Tipping Fee (2010$)
New scenario without transfer station	$ 82.00
New scenario with transfer station	$ 89.37

The tipping fee at Campbell Mountain Landfill is currently $55.00 for refuse. The disposal cost of other waste material varies between $0 and $200 per tonne. The assessment suggests that the average tipping fee has to increase by approximately $27/tonne (2010$) to cover the costs over the evaluation period. The current tipping fees at landfills in close proximity to the Campbell Mountain are presented in Table 2 below.

Table 2. Current tipping fees at landfills in close proximity of the Campbell Mountain landfill

Landfill location	Current Tipping Fee
Kelowna	$ 55.00[1]
Summerland	$ 55.00
Oliver	$ 55.00
Osoyoos	$ 65.00
North Okanagan Regional District landfills	$ 85.00

[1] *Kelowna is in the process of increasing their tipping fees.*

Table 2 shows current tipping fees at other nearby landfills. As shown in the table, an increase to approximately $80/tonne would be similar to tipping fees in the North Okanagan Regional District but much higher than other tipping fees in the surrounding area.

In order to implement full cost recovery for the Campbell Mountain Landfill, the RDOS should consider an increase recovering $80/tonne either by increasing tipping fees or through a combination of increased tipping fees and higher taxation. This could be done using a phased approach over several years. The life cycle cost analysis should be updated at least every five years to ensure that tipping fee adjustments are made on an on-going basis.

If you have any questions or concerns, please contact us.

Sincerely,
AECOM Canada Ltd.

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Appendix A

Model Revisions and User Guide

Appendix A Model Revisions and User Guide

Introduction

In November 2010, AECOM submitted a proposal to estimate the "true costs" of landfilling in the Regional District of Okanagan Similkameen (RDOS). The Campbell Mountain Landfill (the Landfill) was proposed to be the focus of the assessment. The work was initiated in December 2010. As a cost model had already been established for the Campbell Mountain Landfill it was decided to update the model created by CH2M HILL in 2006. AECOM obtained the cost model files in May 2011 and subsequently updated the cost model based on current information available for the landfill.

This appendix to the summary letter report provides additional detail on updates to the cost model and guidance for updating the model in the future.

Changes and Assumptions

The model created in 2005 has been modified to correspond to the current situation and available information for the Campbell Mountain Landfill. The various changes and updates to the model have been divided into categories and are presented below.

Waste and Population Projection

- Starting 2009 the waste generation rate is 1.14 tonnes/year/capita. The waste generation rate has been calculated based on waste data for 2009 (AECOM 2011).
- Between 2009 and 2016 the waste diversion is 54%. The diversion rate has been calculated from waste data for 2009 (AECOM 2011).
- The waste diversion is 73% from 2017 to landfill closure, this based on projections made in Regional District of Okanagan-Similkameen Solid Waste Management Plan (AECOM 2011).
- The waste density, set by CH2MHILL, of 0.9 tonnes/m^3 is fairly high, however settlement was not considered and the density was therefore left at 0.9 tonnes/m^3.
- CH2MHILL assumed a population growth in Penticton of 2%, this after discussion with the client. Stats Canada Census data suggests a 1% growth between 2001 and 2006 and the growth rate used in the model was therefore adjusted to 1.5%.

Starting Budget

The financial data used in the 2005 model was based on the RDOS 2005-2008 budget for the Campbell Mountain Landfill. In 2005 the Campbell Mountain Landfill had its own budget. The current budget considers the costs and revenues for the Campbell Mountain and the Okanagan Falls Landfills together. The budget figures used in the model for the Campbell Mountain Landfill were determined by calculating the percentage of the total budget for the two landfills that was allocated to Campbell Mountain Landfill for the 2005-2008 budget. Based on this calculation the 2011 budget was separated as follows:

- Revenues: 58% of 2011 budget
- Expenditures: 83% of 2011 budget

Landfill reserves as of December 31, 2010 were provided by the client.

Landfill Life Time Expectancy

As a result of increased diversion rates the landfill lifetime has been prolonged. Based on discussions with RDOS staff, due to additional cost for importation of borrow material for Phase 2 (Golder 2005) it has been assumed that closure of the landfill will occur at the end of Phase 1 in 2043.

Borrow Material

Golder (2005) estimated a 54,000 m^3 deficiency of borrow material for Phase 1 closure. Based on the 4:1 waste-cover ratio used in the model, there is sufficient borrow material for operational cover (i.e. daily / intermediate cover). There would be approximately 13,000 m^3 of material remaining at the time of closure. Given the relatively small amount of material remaining at the time of closure and based on the uncertainty with estimating cover soil use over the period, it was assumed that all of the materials required for closure would be imported. The cost of final closure has been updated to reflect this. A new Excel tab has been created for calculations of borrow material.

Landfill Gas Management System

The capital and operating cost for installation of landfill gas management system has been calculated based on *Cost Models Found in Cost Estimation Model for Implementing GHG Emission Reduction Projects at Landfills in British Columbia* (Golder 2008). The system is assumed to be installed in two stages: Stage 1 in the summer of 2013 and Stage 2 in the summer of 2028. The operations and maintenance cost is calculated based on a dry climate scenario (annual precipitation under 650 mm). A new Excel tab has been created for these calculations. The capital cost has been worked into the closure cost and the O&M cost has been worked into the overall O&M cost.

Operating and Maintenance Costs

In the 2005 model the operating and maintenance (O&M) costs were projected to increase in direct relation to the population growth. As the diversion rate is expected to increase over the next few years the disposal rate no longer follows the trend of population growth. The O&M costs have therefore been updated to change in direct relation to disposal rates rather that fluctuation in service population. If the amount of waste disposed in year 2 is 1% more than the waste disposed in year 1, the O&M costs for year 2 are 1% higher than in year 1.

Inflation

Waste disposal cost and tipping fees are given in 2010-CAN$, whereas the cost and revenues given in *Cash Flow* are adjusted with inflation. When comparing break-even tipping fees to numbers from 2002 the assumed 3% inflation has to be taken into account. The break-even tipping fees for the three options presented in *Life Cycle Cost Assessment Final Report Campbell Mountain Landfill* (CH2MHILL 2006) have been adjusted to 2010-CAN$ and are presented in Table A1 below.

Table A1. Break-even Tipping Fees for Scenarios Created in 2005 (CH2MHILL) Adjusted to 2010$ Based on 3% Inflation Rate

		2002$	2010$
Without transfer station	Scenario 0	$46.36	$58.72
	Scenario1	$61.03	$77.31
	Scenario 2	$90.29	$114.38
With transfer station	Scenario 0	$50.34	$63.77
	Scenario1	$66.85	$84.68
	Scenario 2	$99.48	$126.02

Model Setup

The cost assessment model consists of 14 Excel spreadsheet worksheets. Each of the worksheets is identified with a letter. These spreadsheets are listed, described and explained below. Worksheets (A) and (B) are actively used when modelling. Worksheets (C) and (D) present charts of the yearend balances of the Closure and Capital Reserve Funds. The other worksheets contain data and projections used in the model.

(A) Cash Flow Model. The cash flow model is main worksheet that tabulates from the other worksheets. Data is extracted from 11 other spreadsheets into the cash flow model. By adjusting certain parameters the assessments results change. Basic instructions for how to run the model are presented in the section *Running the Model* below.

(B) Parameters. Model parameters such as closure year, interest, inflation and size of new landfill can be found on worksheet (B), parameters. The budget for capital projects and other projects pre-closure are defined here. When running the model the annual transfer to Closure Reserve and the break-even tipping fee are calculated and the results displayed on the parameters spreadsheet.

(C) Chart of Closure Reserve. The Closure ReserveClosure Reserve chart presents the yearend balance and shows how the fund fluctuates over the years until closure in 2043. The “dips” in the graph represent the installation of the landfill gas management system assumed to take place in 2013 and 2028. The Closure Reserve is set to allow for 25 years of post-closure monitoring and maintenance at $50,000 per year (2010$).

(D) Chart of Capital Reserve. The Capital Reserve chart presents the yearend balance in the fund and shows how it increases until 2041 when the reserve is used for landfill property acquisition and access development initiation for the new landfill. The Capital Reserve is set to contain $0 at the time of closure.

(E) Budget Data. The budget data is based on the annual provisional five year financial plan set by the RDOS for the regional landfills, Campbell Mountain and Okanagan Falls Landfills. The plan has been compared to previous budgets where the two landfills were budgeted separately in order to allocate appropriate costs to the Campbell Mountain Landfill.

(F) Closure Costs. The closure costs include final cover estimated at a cost of $40.00 per m^2. The closure cost also includes the installation of a landfill gas management system as well as decommissioning of exciting infrastructure.

(G) New Site Development Costs. The cost of the new site development includes: pre-development, site development, infrastructure, phase 1 cell development, sedimentation pond, facultative lagoon, storm water detention pond and environmental controls. These costs are extracted from the Capital Reserve budget during 2041 and 2042.

(H) Transfer Station Capital Cost. Under the future solid waste management system it may be necessary to develop a transfer station in the vicinity of Penticton depending upon where the replacement landfill is located. The potential transfer station development cost has been incorporated into the model and can be turned on and off by multiplying the formula in the yellow cell (E37) by either 1 or 0.

(I) Population Data. The population data spreadsheet includes population data for Penticton and other areas serviced by the Campbell Mountain Landfill.

(J) Current Waste Generation. The waste generation for 2009 is based in data retrieved from the RDOS solid waste management plan (SWMP) (AECOM 2011). The data is used to calculate waste disposal rate, waste diversion rate and waste generation rate to be used in future waste projection.

(K) Waste Projection. The waste disposal projection until 2043 is calculated in spreadsheet (K). The rates established in spreadsheet (J) are used as well as the population data in spreadsheet (I). The population growth is taken into account as well as an increased diversion rate as projected in the RDOS SWMP (AECOM 2011).

(L) Landfill Gas Capital and Operation Cost. It has been assumed that a landfill gas management system will be installed at the Campbell Mountain Landfill. The system is assumed to be installed in two stages: Stage 1 in the summer of 2013 and Stage 2 in the summer of 2028. The installation cost as well as O&M costs have been estimated using *Cost Estimation Model for Implementing GHG Emission Reduction Projects at Landfills in BC* (Golder 2008). The total installation cost is estimated to be $1,500,000 (2010$) and the annual O&M cost to be $39,000 (2010$).

(M) Projected Operation and Management Costs. The annual change of the operation and management is directly related to changes in annual disposal . This has been taken into account in spreadsheet (M).

(N) Borrow Material Needed for Closure. The amount of borrow material needed to be imported to site for final cover is calculated in spreadsheet (N). Calculations are based on results in spreadsheet (K) and estimated available volumes of borrow material presented in Borrow Material Assessment Campbell Mountain Sanitary Landfill – Penticton, British Columbia (Golder 2005). The amount of material needed to be imported is very low in the grand scheme of things and has therefore been considered negligible. The cost for potential import has not been included in the model

Running the Model

Prior to running the model the user must decide upon the assumed year of closure and capping. Currently only dates prior to 2043 can be chosen. The closure year is typed into cell H13 in spreadsheet (B).

The user determines the annual transfer to the Closure Reserve (H48, spreadsheet (B)) by adjusting the transfers so that the reserve is empty 25 years post closure. This is easily done by using the 'Goal Seek' function (MS Excel 2010):

1. Open spreadsheet (A)
2. Select the 'Data' tab on the Ribbon
3. Select 'What-if Analysis'
4. Select 'Goal Seek'
5. Select cell BS47 as 'Set Cell'. This is the cell representing the balance of the Closure Reserve at the end of the year 25 years post closure.
6. Set 'To value' to 0 (or preferred balance)
7. Select cell H48, spreadsheet (B) in 'By changing cell'. This is how the transfer to the Closure Reserve is adjusted.
8. Click ok
9. Click ok

The transfer to Closure Reserve is now set to cover the cost of post closure operations for 25 years past 2043 with an annual budget of $50,000 (2010$).

In order to set the Environmental Impairment Fund's final balance to a value chosen by the user, use 'Goal Seek'. Referring to the 'Goal Seek' instructions above set the:

1. 'set cell' to the fund's balance at closure (cell AO61, spreadsheet (A))
2. 'to value' to the chosen balance (e.g. $6,300,000)
3. 'by changing cell' to the *Transfer To Impairment Reserve* for 2011 (cell I34, spreadsheet (A))
4. Run the function by clicking ok twice

Adjust the Capital Reserve Fund's final balance using the 'Goal Seek' function the same way as for adjustment of the Environmental Impairment Fund, but choosing the Break-Even Tipping Fee (cell H59, Speadsheet (B)) as the 'Change Cell'.

Results

The final results of the cost modelling are presented in the table below. The main source of revenue for the Campbell Mountain Landfill is tipping fees. This means, as the diversion rate increases and the level of waste disposal decreases the lost revenue has to be compensated for in order to break-even. This is in the model done by increasing the tipping fees.

The results in Table A2 are established assuming the Closure Reserve balance covers the landfill cost 25 years post closure and that there is $6.3M available in the Environmental Impairment Reserve at the time of the Landfill closure.

Table A2. Waste Disposal Cost and Break-even Tipping Fees for CMLF Closure in 2043 at the End of Phase 1

	Break-even Tipping Fee (2010Can$)
New scenario without transfer station	$ 82.00
New scenario with transfer station	$ 89.37

The break-even tipping fees for the Campbell Mountain Landfill without and with construction of new transfer station are $82 and $89 respectively. The current tipping fee at the landfill is $55.

In order to cover for closure and future costs, annual savings are required. The annual amounts required to be transferred to the different funds are presented in Table A3 below.

Table A3. Annual Transfers to the Closure, Capital Reserve and Environmental Impairment Funds

	Annual Transfers	
	Without Transfer Station	**With Transfer Station**
Closure Fund (closure and LFG system)	$228,090	$228,090
Environmental Impairment Fund	$109,503	$109,503
Capital Reserve Fund[1]	Varying (new landfill) Average $1,152,892	Varying (new landfill and transfer station) Average $1,422,709

[1] *The transfer to the Capital Reserve changes by the year (higher transfer for the transfer station scenario). The estimated annual contribution need is found on row 32, spreadsheet (A).*

The transfers to the Closure and Environmental Impairment Funds are the same for the both scenarios. The prospect construction of a transfer station would be funded by the Capital Reserve Fund and the annual transfers to this fund are different between the scenarios. On average, $1,150,000 should be transferred annually to the Capital Reserve if no transfer station is planned to be built. If a transfer station is planned and additional $270,000 should be contributed annually.

References

AECOM, 2011:
Regional District of Okanagan-Similkameen Solid Waste Management Plan.

CH2MHILL, 2006:
Life Cycle Cost Assessment Final Report Campbell Mountain Landfill.

Golder, 2005:
Borrow Material Assessment Campbell Mountain Sanitary Landfill Penticton, British Columbia.

Golder, 2008:
Cost Estimation for Implementing GHG Emission Reduction Projects at Landfills in British Columbia.