



ALBERNI-CLAYOQUOT REGIONAL DISTRICT

ALBERNI VALLEY LANDFILL LANDFILL GAS GENERATION REPORT

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1. EXECUTIVE SUMMARY

The Alberni Valley Landfill (AVL) is approaching the point where it will be required by the Province to either install a methane gas collection and processing plant system or remove methane gas producing materials from the solid waste stream. This report provides an approximated time frame for the Board to consider, and possible alternatives to defer and/or eliminate, the need for a landfill gas collection system with the introduction of Bans on materials accepted at the landfill.

A gas collection design may be required in 2018. If Bans are implemented gas collection system may not be required for the duration of the landfill life.

The report has the following recommendations.

1. The Board reviews the need for gas collection versus Bans at the AVL.
2. The Board support the review of Ban alternatives with the PMAC and implement Bans in a sequential manner to maintain compliance with MOE regulations on methane gas.
3. Progressive bans on materials can delay major capital expenditures and continue to meet MOE requirements for methane gas management until beyond the year 2050.

A Landfill Gas Collection System is not recommended for the following reasons:

1. The gradual implementation of Bans will remove the need for a methane gas collection system for at least half of the remaining landfill life.
2. A LFG system will require the expenditure of \$13,870,000 (including capital, operations/maintenance, and closure costs) in funds.
3. If there are significant population changes from those projected, the Ban system should provide the flexibility to absorb these changes without the installation of a gas collection system.
4. Landfill gas collection systems will have to operate for a twenty to thirty period after the landfill is closed with steadily decreasing volumes of gas being collected during that period.

If the Board decides to implement Bans to reduce methane gas production, a review of the waste stream entering the landfill should be done to prioritize materials to be banned.



2. INTRODUCTION

The Alberni-Clayoquot Regional District (ACRD) operates the Alberni Valley Landfill (AVL) under the British Columbia Waste Management Act Operational Certificate Number MR-00524, issued June 29, 2004. The operational certificate provides the conditions for which the AVL is authorized to manage recyclable material and waste from the ACRD. The known areas disposing of waste at the AVL include the City of Port Alberni, ACRD Electoral Areas within the Alberni Valley and Bamfield and First Nations communities Tseshah, Hupacasath, Huu-ay-aht and Uchucklesaht.

The AVL has operated as a landfill since the early 1970's. It is located approximately 5 km west of Port Alberni. The landfill accepts various forms of solid waste including municipal solid waste, residential and commercial demolition materials (including roofing and gyproc), compost and stumps, and limited quantities of asbestos and contaminated soils. The landfill also accepts recyclables that are subsequently transferred from the landfill by Suncoast Waste Services for recycling.

Currently, the ACRD is attempting to obtain tenure of the southern portion of the landfill from the crown. Once this is achieved the landfill can be continued to be used for 50 to 80 years.

The City of Port Alberni and Beaver Creek Electoral Area now have curbside recycling programs and recycling depots are located in the City of Port Alberni and at the AVL.

There is currently no formal organics waste diversion program within the ACRD or City of Port Alberni. Backyard composting of organic waste is encouraged through distribution of backyard composters and educational material on the ACRD website.

The AVL accepts yard waste compost free of charge. The compost is stored onsite and subsequently removed by an outside contractor. The 2007 SWMP recommends several organic waste diversion programs such as establishing a yard waste depot within the City of Port Alberni, setting up a yard waste composting facility at the AVL or an alternate location, and completing a composting feasibility study. None of these programs have been implemented yet.

3. HISTORY OF LANDFILL GAS MANAGEMENT (LFG) REPORTS

To comply with the regulatory requirements a number of LFG assessments have been done including:

R.D. Cameron – “*ALBERNI VALLEY LANDFILL- REPORT ON LANDFILL GAS*” assessed the landfill in the early 2008 and projected that LFG collection would not be required until 2023 under the regulations in place at that time.

BC Hydro – evaluated the potential for LFG collection and commercial value. They did not proceed with developing an LFG collection system based on their evaluation, as the volume generated would not provide sufficient economic benefit to pay for the infrastructure required.

In December 2008, the Province enacted a new regulation, requiring landfills that produce more than 1000 tonnes of methane gas a year to design a gas collection system.

Each year since 2010 annual reports to Ministry of Environment 2010-2013 have included a gas assessment. The methane gas levels have been near but less than the 1000 tonnes per year for this period.

4. LANDFILL GAS LEGISLATION, REGULATIONS & GUIDELINES

The Ministry of Environment has, since 2008, progressively developed regulations and guidelines for the management of gas produced within landfills. Some of these documents are listed below:

- *BC Landfill Gas Management Regulation*, Dec 2008
- *Landfill Gas Generation Assessment Procedures Guidelines*, March 2009
- *Technologies and Best Management Practices for Reducing GHG Emissions from Landfill Guidelines*, June 2011

5. 2nd EDITION OF LANDFILL CRITERIA FOR MUNICIPAL SOLID WASTE

In June 2016, the BC Ministry of Environment published updated landfill design criteria. The assessment and design criteria for assessing methane gas remain similar to the previous regulations.

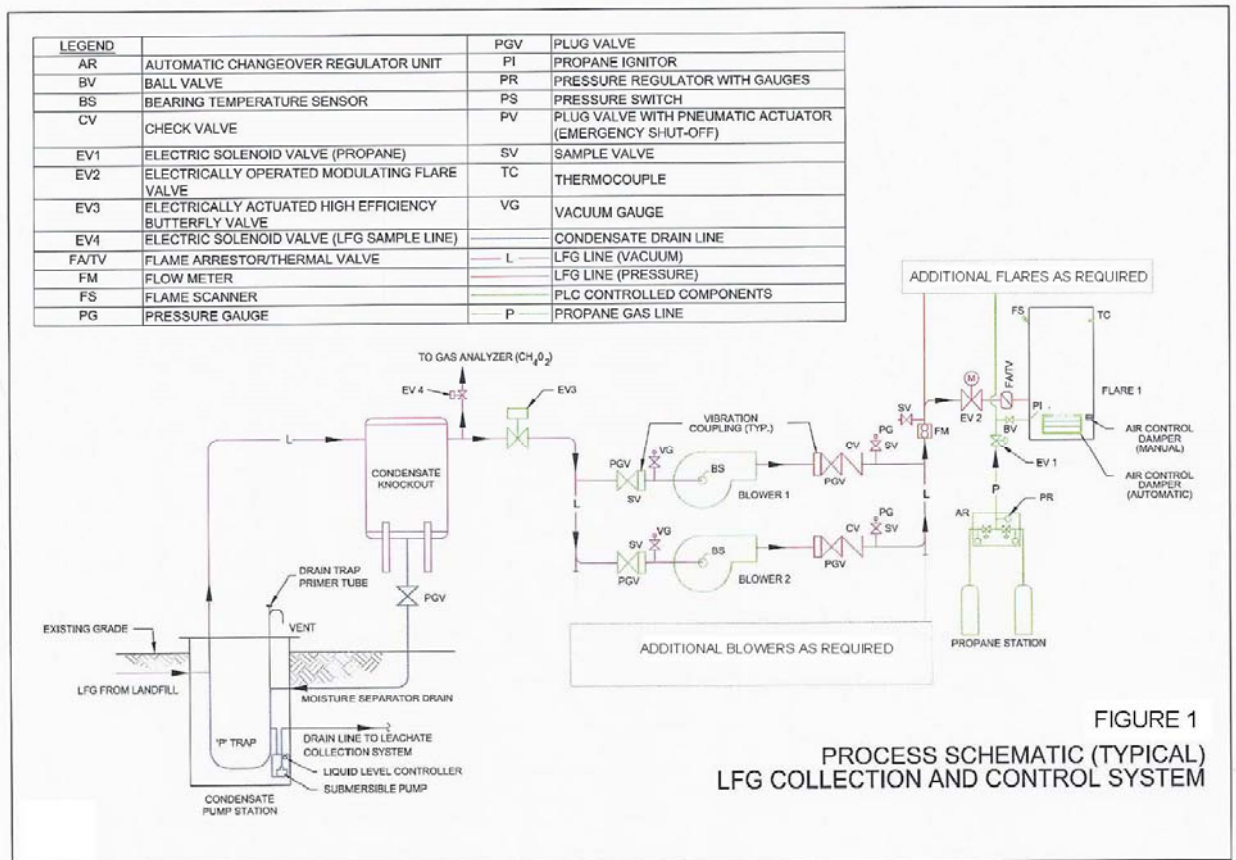


6. LANDFILL GAS COLLECTION

A LFG collection system is generally composed of the following:

1. Vertical extraction wells and horizontal collection trenches
2. Collection piping
3. LFG extraction plant (include condensate traps, blowers, and storage capacity)
4. LFG method for either using the gas collected or flaring it off.

A typical landfill control system is shown system is shown in Figure 1, below. The collection system can be either vertical wells at 40 to 120 metre c-c or horizontal trenches at 12 metres c-c, or a combination of both.



7. SOLID WASTE QUANTIFICATION AND LANDFILL CAPACITY

Since the 2007 Solid Waste Management Plan (SWMP) was prepared, several programs have been implemented to reduce the amount of solid waste entering the landfill. Some of these programs include a composting program and curbside recycling program.

Throughout 2016, the AVL accepted waste and charged tipping fees according to ACRD Bylaw No. R1027. The weight of solid waste entering the landfill in 2016 is summarized in Table 1 below.

Table 1: Measured Weight of Solid Waste Entering the AVL in 2016

| Item | Weight (tonnes) |
|-------------------------------|-----------------|
| Residential Mixed Solid Waste | 8,989 |
| Commercial Mixed Solid Waste | 6,081 |
| Tires (# of tires) | 213 |
| Compost | 64 |
| Outgoing Steel | 368 |
| Incoming Cover Material | 726 |
| Asbestos | 271 |
| Land Clearing | 22 |
| Roofing | 1,017 |
| Gyproc | 250 |
| Mixed Construction Demolition | 2,608 |
| Contaminated Soil | 938 |
| Animal Carcasses | 1 |
| Service Road Cleanup | 7 |

The Multi-Material British Columbia (MMBC) recycling program was implemented in 2014. Under this province wide program, recyclable materials are collected and separated (cans, glass, newspaper, cardboard, plastic and steel) and stockpiled at the AV Landfill transfer station. The recyclable materials are subsequently removed by a commercial recycling company funded by the MMBC program. Asbestos from large building demolitions is buried in a designated area. Asbestos from small renovation projects is buried in the daily landfill area. Compost material is stockpiled onsite and removed by a private composting company. With minor variations these figures reflect the waste being placed in the landfill over the last 5 years.



The amount of material landfilled during 2016 was approximately 20,248 tonnes, bringing the total estimated quantity of solid waste at the AV Landfill to approximately 761,483 tonnes.

The waste composition has been separated into three categories to assess its potential for generating methane gas. The categories are:

1. Relatively inert
2. Moderately decomposable
3. Decomposable

As no solid waste categorization studies have been completed, the solid waste composition was based on a combination of scale records and the *British Columbia's Solid Waste Flow Report, 2006 Summary Report* prepared for MoE by BC Stats in February 2010. We have also made an allowance for new MMBC program, where applicable.



8. FUTURE SOLID WASTE PROJECTIONS

A high and low range of population projections have been provided to us by the ACRD Planning Department, in the planning department. These are plotted in Figure 2, below. We have also included a line showing the projected landfill growth based on our experience at the landfill over the last five years. This allows for an annual growth of 0.3%. While there will likely be a population increase in future years, it is anticipated that the reduction of solid waste material being delivered to the landfill will offset this, if not decrease it. Therefore, an annual filling rate of 18,400 (the average filling rate from the last three years) and an annual 0.3% increase in weight delivered to the AVL is used as a basis for future projections of annual tonnages. The implementation of Multi Material BC is in its third year of operation. The MMBC program has had a noticeable impact on the waste stream entering the AVL. It could take several years until the full impact is understood, however, it is expected that there will be an overall decrease in the waste being placed in the landfill, with manufacturers and commercial producers looking toward more environmentally friendly packaging.

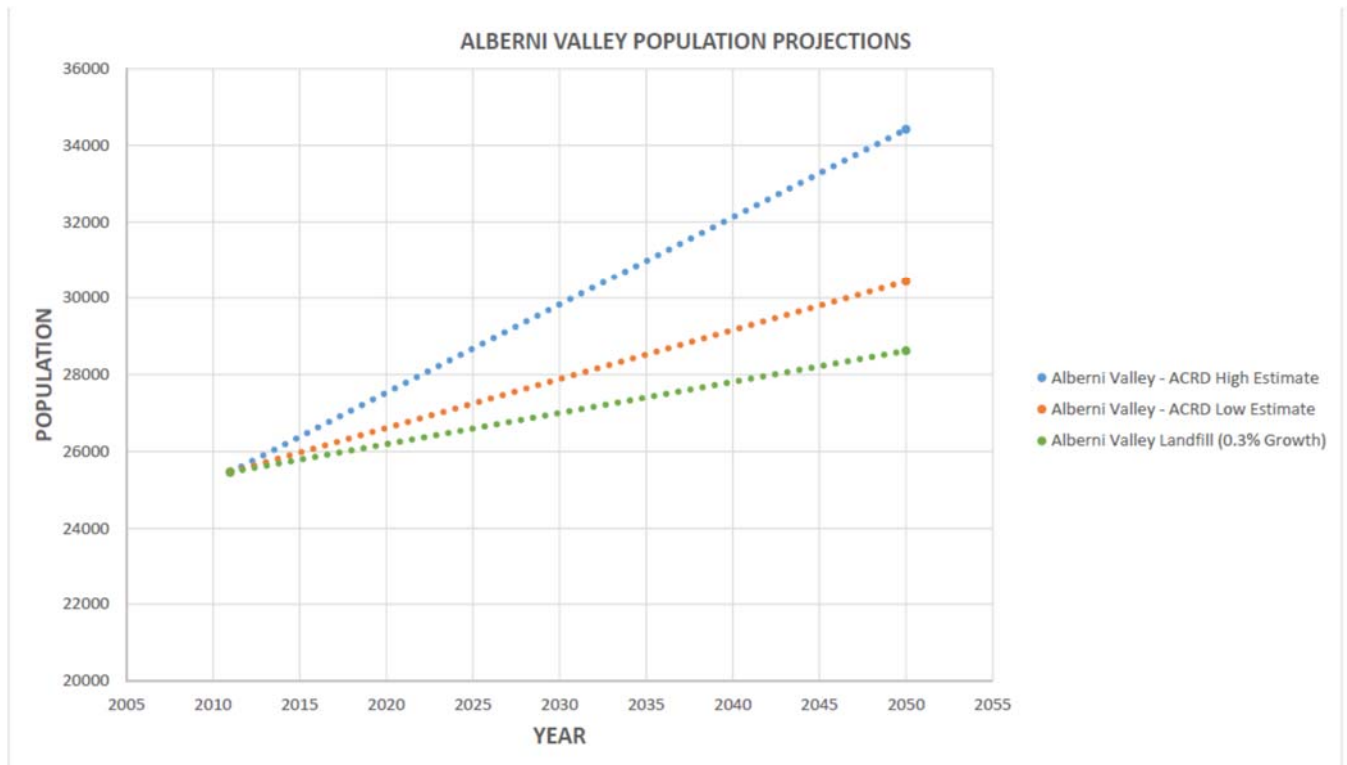


FIGURE 2



9. LANDFILL GAS GENERATION MODEL

The Province has developed a model for estimating gas generation at the landfill. It is based on the Scholl Canyon model which uses a first order kinetic equation to evaluate LFG production and emission rates.

The Scholl Canyon formula is as follows:

$$Q_T = \sum_{t=1, n} 2 L_o k M_t e^{-kt}$$

Where:

Q_T = total LFG emissions (50 percent CH₄ and 50 percent CO₂ by volume)

K = LFG generation constant (year⁻¹)

L_o = methane general potential (m³ CH₄/tonne of waste)

M = mass of waste (tonnes) placed in year t

T = time in years



10. LANDFILL GAS PROJECTIONS

Using the Scholl Canyon model for assessing current and future landfill gas production, with Bans and without, we have determined the methane gas production until 2070. There are a number of materials which impact methane gas production. We have selected some of the more prominent ones to evaluate their impact on extending the landfill life without constructing a LFG collection system. The following cases were reviewed to determine the impact of reducing methane gas production by implementing bans.

1. No Bans
 - a. If no Bans are implemented it is possible that a LFG collection system would have to be designed in 2018. Construction of the LFG system would have to be completed within 4 years after a one year design period.
 - b. Residential –Wood-Paper-Bans ban would include the removal of residential non-food waste from the waste stream. It is estimated that this can defer the planning construction of a LFG system until between 2020 and 2025. The variability is based on possible differences in the waste stream resulting from recycling and the MMBC program.
2. Construction/Demolition - Wood & Paper Ban
 - a. Construction and demolition waste has a 70 to 80% wood composition by weight. The removal of this type of waste would defer the need of a LFG system until between 2020 and 2025.
3. Residential - Wood - Paper, & C/D Waste Bans.
 - a. This combines two of the above and would defer LFG planning until 2023 and 2027.
4. Organics Bans
 - a. ICI Bans
 - i. A ban on ICI waste materials could defer a LFG collection system until 2093.
 - b. City of Port Alberni Food & Yard Waste Bans
 - i. A LFG system can be deferred until 2033 if food waste is collected with a 50% recovery rate. Currently yard and garden waste is

accepted at the landfill but not incorporated into the fill. An outside contractor removes it from the landfill site. Therefore, there will be no methane gas reduction as it is not generating gas from yard waste at this time.

c. Alberni Valley Food & Yard Waste

- i. This estimate includes all contributors to the Alberni Valley Landfill including the City. It is based on a 50% removal of food wastes from the waste stream. The LFG system could be deferred until 2052.

d. ICI Ban

- i. This Ban includes all Industrial, Commercial and Institutional sources contributing to the AVL waste stream. It is assumed that there will be a 90% diversion of organic materials from these types of sources. The removal of this type of waste would remove the requirement for a LFG system for the duration of the site.

5. Ban of Wood, Construction / Demolition, & Organics Waste

- a. Bans on all of the above materials will enable the landfill to reach its full capacity without requiring a LFG collection system.

If no bans are implemented it is possible that the AVL will require a plan for a landfill gas collection system by 2018 -2019. The LFG system would have to be constructed in the four years following development of a plan. By initiating a gradual banning of materials acceptable at landfill this date can be pushed forward and permanently deferred.

11. LFG COST

The capital costs provided, herein, are based on generally accepted design criteria for landfill gas collection systems. Construction of a gas collection system will be done in three stages as the filling process continues over the next 70 years.

In addition to the capital cost there will be ongoing Operation & Maintenance costs and the cost for continuing operation during the landfill closure period.

The costs breakdown as follow:

| | |
|------------------------------|---------------|
| Capital Cost | \$ 5,500,000 |
| Operation & Maintenance Cost | \$ 5,600,000 |
| Landfill Closure Cost | \$ 750,000 |
| Total Estimated Cost | \$ 13,870,000 |

As Bans are introduced they will reduce the quantity of waste being charged for and consequently the revenue generated from the landfill.

The following table provides an approximation on what the loss of revenue for the Bans indicated above.

| | |
|--|------------|
| Residential – Wood-Paper Ban | -\$73,600 |
| Construction & Demolition Ban | -\$48,000 |
| Residential & C/D Combined Ban | -\$121,600 |
| Organics Ban | |
| City of Port Alberni Food & Yard Waste | -\$71,800 |
| Alberni Valley Food & Yard Waste | -\$114,700 |
| ICI Ban | -\$295,000 |

12. CONCLUSIONS

1. In accordance with the provincial regulations and guidelines, a gas collection and utilization or combustion system for the control of methane gas is not needed at this landfill at the present time. Under current landfill criteria, planning and design stage for such a system would not be needed until at least the year 2018.
2. A LFG collection system could be deferred past 2050 and possibly for the duration of the landfill life, with the implementation of Bans on materials accepted at the landfill. The review of waste materials to be banned from the AVL should be comprehensive and include the entire waste stream entering the AVL and their impact on methane gas production.
3. The financial impact of Bans on the cost of operating the landfill is not expected to be proportionate to the reduction of waste being delivered to it and may in fact require the raising of tipping rates to offset the loss in revenue brought about by handling less waste.
4. There will be a significant capital cost for the construction of a gas collection system, together with significant ongoing cost to extend the system as the landfill grows vertically and horizontally.



13. ACTION PLAN

1. The ACRD board approve the concept to implement Bans to remove the need to construct a LFG collection facility at the AVL.
2. The PMAC review Bans at the AVL and make recommendations on the sequential development of Bans.
3. The board review and develop bylaws to enforce the proposed Bans in 2017.

14. RECOMMENDATIONS

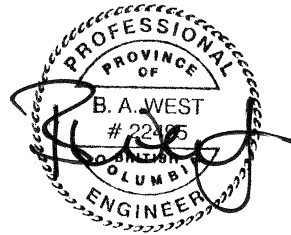
1. The Board review the need for gas collection versus Bans at the AVL.
 - a. Progressive bans on materials can delay major capital expenditures and continue to meet MOE requirements for methane gas management until beyond the year 2050 and can extend to the end of the landfill life.
2. The Board support the Action Plan to implement Bans at the AVL.
3. A Landfill Gas Collection System is not recommended for the following reasons:
 - a. The gradual implementation of Bans will remove the need for a methane gas collection system for at least half of the remaining landfill life.
 - b. It will require the expenditure of significant capital funds.
 - c. There will be an ongoing expenditure for operation and maintenance of the LFG system.
 - d. There will be ongoing capital expenditures for collection of the gas as the landfill expands vertically and horizontally.
 - e. If there are significant population changes from those projected, the Ban system should provide the flexibility to absorb these changes without the installation of a gas collection system.
 - f. Landfill gas collection systems will have to operate for a twenty to thirty period after the landfill is closed with steadily decreasing volumes of gas being collected during that period.
4. If the Board decides to implement Bans to reduce methane gas production, a review of the waste stream entering the landfill should be done to prioritize materials to be banned.

15. LIMITATIONS

This document was prepared by McGill & Associates Engineering Ltd. for the Alberni-Clayoquot Regional District. Its material, recommendations and conclusions represent the best material available to McGill & Associates Engineering Ltd. at the time of the report preparation. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. McGill & Associates Engineering Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Yours truly,

for McGill & Associates Engineering Ltd.



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Reviewed by Brad West, P.Eng

AJM/wm