Landfill Closure
An Innovative Geosynthetic Barrier System

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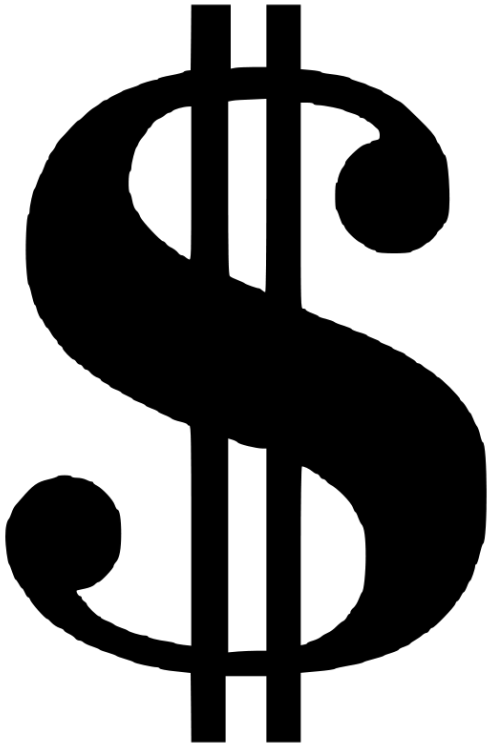
Why Do We Close Landfills?

- It's the law
- To minimize post closure environmental liability
- To minimize post closure financial liability

Is the Lowest Capital Cost the Wise Choice for Closure?

- Long term post closure costs are frequently not considered in cost analysis

- Long term financial and environmental liabilities may not be fully understood



Alberta Final Cover Requirements (Standard Regulatory Cover - soil)

"(ii) a final cover system consisting of three layers constructed in the following order from bottom to top:

a. 0.60 metres barrier layer with a maximum hydraulic conductivity of

1×10^{-7} metres per second;

b. subsoil; and

c. 0.20 metres of topsoil.

Landfill Capping Options for Closure

1. Standard Regulatory Cover
2. Compacted Clay Cover (with frost protection)
3. Geosynthetic Cover (Geomembrane and/or Geosynthetic Clay Liner)
4. Water Balance (Store and Release) Cover
5. Infiltration Cover

Standard Regulatory Cover - Compacted Clay

Standard Regulatory Cover - Compacted Clay

Pros	Cons
Low capital cost if suitable clay soils are present on site.	Highly susceptible to wetting/drying and freeze/thaw cycles.
Permit approvals/registrations straight forward.	Several order of magnitude increase in permeability years after construction.
Specialized contractors not required.	Typically more permeable than bottom liner systems (i.e. landfill will accumulate water and may require leachate collection and treatment in perpetuity).
	Ongoing leachate treatment or disposal costs could be very significant.

Geosynthetic Barrier Cover

Geosynthetic Barrier Cover

Pros	Cons
Readily obtainable and can be shipped anywhere.	Capital costs are typically higher than standard regulatory covers.
High level of quality control during manufacturing	Thin layers that must be installed with care by specialized ~~sub~~contractors.
Not significantly affected by wetting/drying and freeze/thaw cycles.	Require gas control and venting if waste is gas generating.
Very low infiltration rates. Can potentially eliminate ongoing leachate generation resulting in reduced treatment and disposal costs.	Require drainage control above geomembrane.

Case Study of a Geosynthetic Barrier Cover

- Located in a wet environment
  - Annual rainfall over 2000 mm
  - 24 hour rainfall events of 100 mm
  - Non freezing conditions most of the year
  - No local source of clay borrow
- Leachate currently treated with process effluent
  - No incremental cost while operating
- Client was promised a low cost water balance cover by a consultant
  - Is it appropriate?

Cover Details

- Gas venting layer
  - Geosynthetic DrainTube layer, lateral pipe network with vents
- Barrier layer
  - Composite geosynthetic cover consisting of a geomembrane over a GCL
- Drainage layer
  - Geosynthetic DrainTube layer with rip-rap lined channels
- Vegetation layer
  - Manufactured topsoil layer (sand and biosolids)

Gas Venting Layer – trenching and drain rock

Gas Venting Layer – vent piping

Gas Venting Layer – before DrainTube

Gas Venting Layer –DrainTube installation

Barrier Layer – GCL over DrainTube

Barrier Layer – GCL

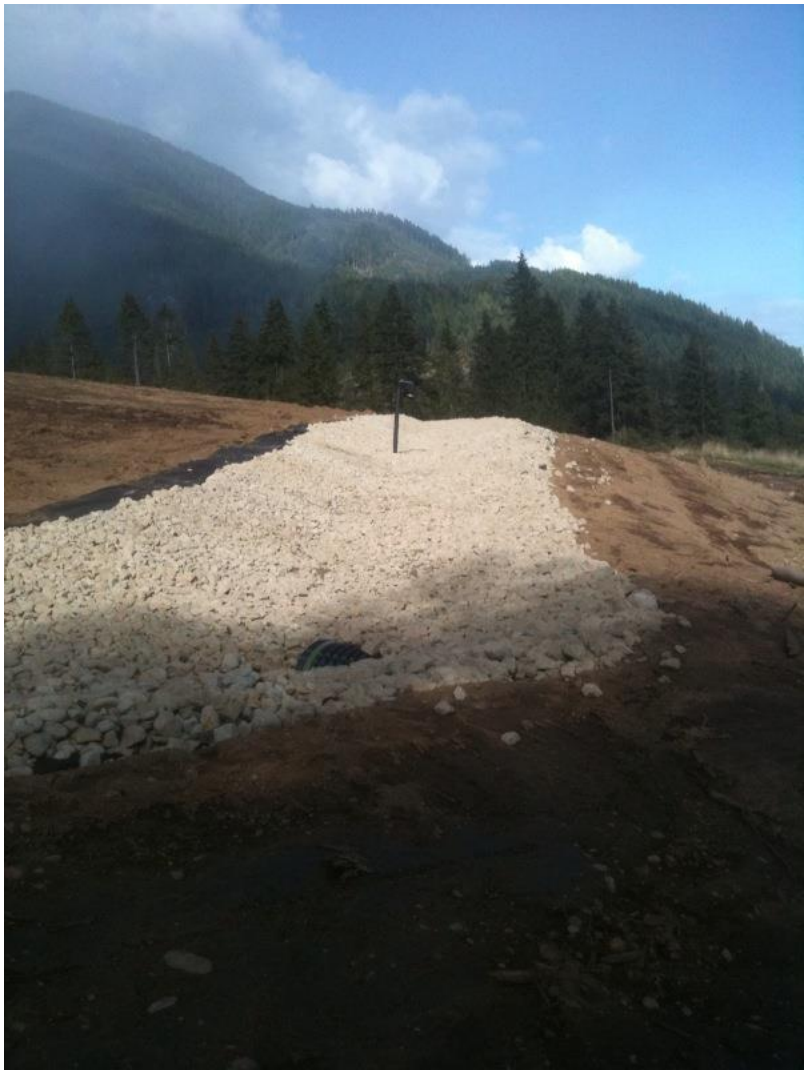
Barrier Layer – Geomembrane over GCL

Barrier Layer – Completed geomembrane

Completed Geosynthetics

Drainage Layer – DrainTube and ditching

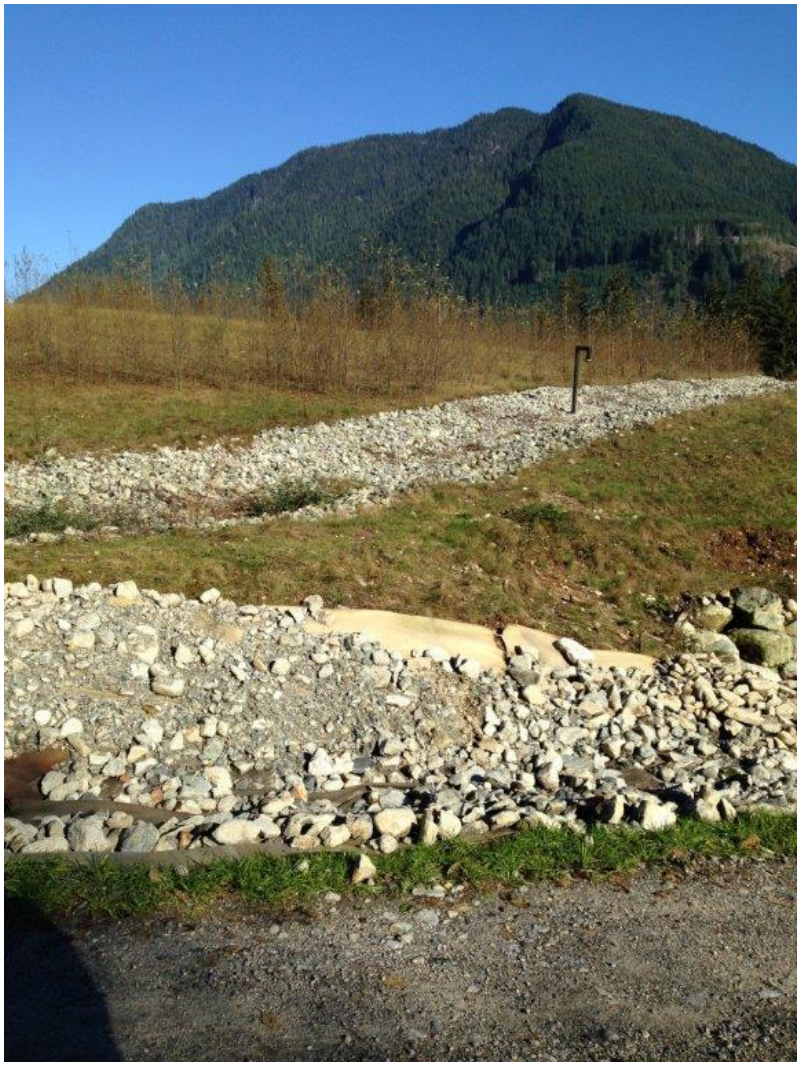
Drainage Layer – Surface water ditching



Vegetation Layer – Subsoil and topsoil

Vegetation Layer – Fall after planting

Vegetation Layer – Four years after planting



Costs / Benefits of DrainTube Geocomposite

Thickness of geonet (a)	Transmisivity (1)	Rf_{creep}	$Rf_{Int.}$	Cost (2)	DRAINTUBE equivalent (3)	Transmissivity (4)	Rf_{creep}	$Rf_{Int.}$	Cost (2)	Performance Ratio (5)	Cost ratio	Averall ratio
220	$2{,}5.10^{-4}$ m^2/s	1.30	1.20	5.05 $	606 ST 0.5 D20	$2{,}5.10^{-4}$ m^2/s	1.00	1.00	4.83 $	156%	96%	163%
250	$5{,}0.10^{-4}$ m^2/s	1.30	1.20	5.61 $	606 ST 0.5 D25	$5{,}0.10^{-4}$ m^2/s	1.00	1.00	4.96 $	156%	88%	176%
275	$7{,}0.10^{-4}$ m^2/s	1.30	1.20	5.91 $	606 ST 1 D20	$5{,}0.10^{-5}$ m^2/s	1.00	1.00	5.11 $	111%	86%	129%
330	$9{,}0.10^{-4}$ m^2/s	1.30	1.20	6.60 $	606 ST 1 D25	$1{,}0.10^{-3}$ m^2/s	1.00	1.00	5.37 $	173%	81%	213%
300 T (b)	$5{,}0.10^{-3}$ m^2/s	1.30	1.10	8.17 $	606 ST 4 D25	$4{,}0.10^{-3}$ m^2/s	1.00	1.00	7.78 $	114%	95%	120%

(a) : T means Triaxial, otherwise biaxial

(1) : as per tech data sheet, under 10 000 psf, i=0.1, 15 min between steel plates (1 000 psf confined (b))

(2) : in $ per sqm, installed, typical location with a 6 oz on both side

(3) : DRAINTUBE 606 is composed by 2 6 oz fabrics

(4) : 10 000 psf, i=0.1, 100 hours, confined

Rf creep : Reduction factor due to creep

Rf Intru : Reduction factor due to intrusion

(5) : Performance = (Trans DT/Rfc/Rfi) / (Trans Net/Rfc/Rfi)

Project Successes

- **Approximately 30% of the landfill has been closed with this capping technique to date.**
- **Client reports substantially reduced levels of leachate within the closed section of the landfill.**
- **Client reports quantity of leachate being transferred to the effluent treatment system has reduced by approximately 50% from previous levels and further reductions are expected.**

Any Questions?

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