SUB-APPENDIX D6-B

Ridge Landfill HELP Model

Appendix D6-B

(Submitted by Dillon Consulting)

Ridge Landfill HELP Model

The HELP Model was used to estimate the leachate generation through Ridge Landfill final cover. From HELP weather database, weather data from Windsor meteorological station was used. 25% surface slope and 25 m slope length was used in the models. The main input data included final cover layers information (*Table 1*), and evapotranspiration and weather information (*Table 2*). Based on the available information, 7 m deep municipal waste and 0.3 m drainage layer were included in the simulations. The simulation period is 20 years.

Five scenarios were simulated:

Scenario 1 – An operating landfill with a 1.35 m thick clay cover with a relatively elevated hydraulic conductivity of 1.7×10^{-5} cm/s.

Scenario 2 – An operating landfill with a 0.85 m thick clay cover with a relatively elevated hydraulic conductivity of 1.7×10^{-5} cm/s.

Scenario 3 – A closed landfill with a 0.85 m thick clay cover with a hydraulic conductivity of 1×10^{-6} cm/s.

Scenario 4 – A closed landfill with a 1.35 m thick clay cover with a hydraulic conductivity of 1×10^{-6} cm/s.

Scenario 5 – A closed landfill with a 0.3 m intermediate cover with k = $1.0E^{-5}$ cm/s and 0.55 m final cover with $1.0E^{-6}$ cm/s (equivalent hydraulic conductivity of 1.47×10^{-6}).

A summary of the output results is presented in *Table 3*.

Table 1: Final Cover Layers Input Parameters

Layer Name	Type	Description	Thickness (cm)	Hydraulic Conductivity (cm/s)
Top Soil	VPL*	Fine Sandy Loam	15	5.2×10^{-4}
Cover Soil	BSL*	Clay	Varies	Varies

* VPL: Vertical Percolation Layer, BSL: Barrier Soil Liner

Table 2: Evapotranspiration and Weather Data

Input Parameter	Value	Reference
Vegetation Class	Fair stand of grass	
Evaporation Zone Depth	0.15 m	The depth will be equal to the depth of the topsoil after run.
Maximum leaf area index	2	Based on HELP Manual for a fair stand of grass.
Q1 humidity	74	https://www.timeanddate.com/weather/canada/windsor/climate (average of 1985-2015)
Q2 humidity	66	https://www.timeanddate.com/weather/canada/windsor/climate (average of 1985-2015)
Q3 humidity	71	https://www.timeanddate.com/weather/canada/windsor/climate (average of 1985-2015)
Q4 humidity	74	https://www.timeanddate.com/weather/canada/windsor/climate (average of 1985-2015)

Table 3: Models Output

Scenario	Final Cover Hydraulic Conductivity (cm/s)	Final Cover Thickness (m)	Annual Average Precipitation (in mm/year)	Runoff in mm/year (%)	Evapotranspiration in mm/year (%)	Leachate Generation (mm/year)
1	1.7×10^{-5}	1.35	930	143 (15%)	527 (57%)	260 (28%)
2	1.7×10^{-5}	0.85	930	143 (15%)	527 (57%)	261 (28%)
3	1.0×10^{-6}	0.85	929.6	204.8 (22.0%)	586.9 (63.1%)	137.6 (14.8%)
4	1.0×10^{-6}	1.35	929.6	206.6 (22.2%)	587.5 (63.2%)	135.2 (14.5%)
5	1.47×10^{-6}*	0.85	929.6	187.3 (20.1%)	573.9 (61.7%)	168.2 (18.1 %)

* Equivalent hydraulic conductivity of 0.3 m intermediate cover with k = 1.0E-5 cm/s and 0.55 m final cover with 1.0E-6 cm/s.

The interim cover scenarios (Scenario 1 and Scenario 2), have a similar leachate generation rate of approximately 260 mm/year for both simulated thicknesses. The final cover scenarios (Scenario 3 and Scenario 4) also have similar predicted leachate generation rates of ~136 mm/year. The hybrid scenario has a slightly higher leachate generation rate of 168 mm/year.

Recommendation

The leachate generation recommended to be used in the landfill design is 150 mm/year. This value is consistent with the generic landfills of O.Reg. 232/98 and reflects the precision of the simulation method.