1 Methods

We calculate the rates of change for the storage in the cover layer [S_{cl}], the storage in the waste layer [S_{wb}] and the drainage layer [S_{dr}]:

$$\frac{dS_{cl}}{dt} = J_{rf}(t) - L_{cl}(t) - E(t) \tag{1}$$

$$\frac{dS_{wb}}{dt} = (1 - \beta(t))L_{cl}(t) - L_{wd}(t) \tag{2}$$

$$\frac{dS_{dr}}{dt} = \beta(t)L_{cl}(t) + L_{wd}(t) - Q_{dr}(t) = 0 \tag{3}$$

where $J(t)$ is the rainfall rate, $E(t)$ is the evaporation rate and the L-terms are the leaching rates from the different layers calculated with the equations given below. Rainfall and potential evapo-transpiration are obtained from meteorological datasets and are the driving boundary conditions for this problem.

Because a pump maintains a constant level in the drainage system, the storage in the drainage system is constant (i.e. the rate of change is equal to zero). This implies that the leachate production rate from the drainage system is $Q_{dr} = \beta(t)L_{cl} + L_{wd}(t)$.

$$L_{cl} = a\left(\frac{S_{cl} - S_{cl_{min}}}{S_{cl_{max}} - S_{cl_{min}}}\right)^{b_{cl}} \tag{4}$$

where a is the saturated hydraulic conductivity of the cover layer [m/day], $S_{cl_{max}}$ is a maximum achievable storage in the cover layer, $S_{cl_{min}}$ is the minimum storage in the cover layer where water will still freely drain and b_{cl} is a dimensionless empirical parameter.

$$L_{wb} = a\left(\frac{S_{wb} - S_{wb_{min}}}{S_{wb_{max}} - S_{wb_{min}}}\right)^{b_{wb}} \tag{5}$$

$$E(t) = pEv(t)\ C_f\ f_{red} \tag{6}$$

where pEv is the potential evaporation [m/day], C_f is crop factor and f_{red} is a reduction factor reducing evapotranspiration under dry soil conditions:

$$f_{red} = \begin{cases} 0 & S_{cl} < S_{Ev_{min}} \\ \frac{S_{cl} - S_{Ev_{min}}}{S_{Ev_{max}} - S_{Ev_{min}}} & S_{Ev_{min}} \leq S_{cl} \leq S_{Ev_{max}} \\ 1 & S_{cl} > S_{Ev_{max}} \end{cases} \tag{7}$$

$\beta(t)$ is a term that allows a certain fraction of water leaching from the cover layer to directly enter the drainage layer. This can be function of time:

$$\beta = \beta_0\ \left(\frac{S_{cl} - S_{cl_{min}}}{S_{cl_{max}} - S_{cl_{min}}}\right) \tag{8}$$

Some data you can use:

Table 1: Some characteristics of Cell VP-06 of the Wieringermeer landfill

	Cell VP-06
base area $[m^2]$	28355
top area $[m^2]$	9100
slope width $[m]$	38
waste body height $[m]$	12
cover layer height $[m]$	1.5
waste (wet weight $[kg]$)	281083000
in operation	1992-1998