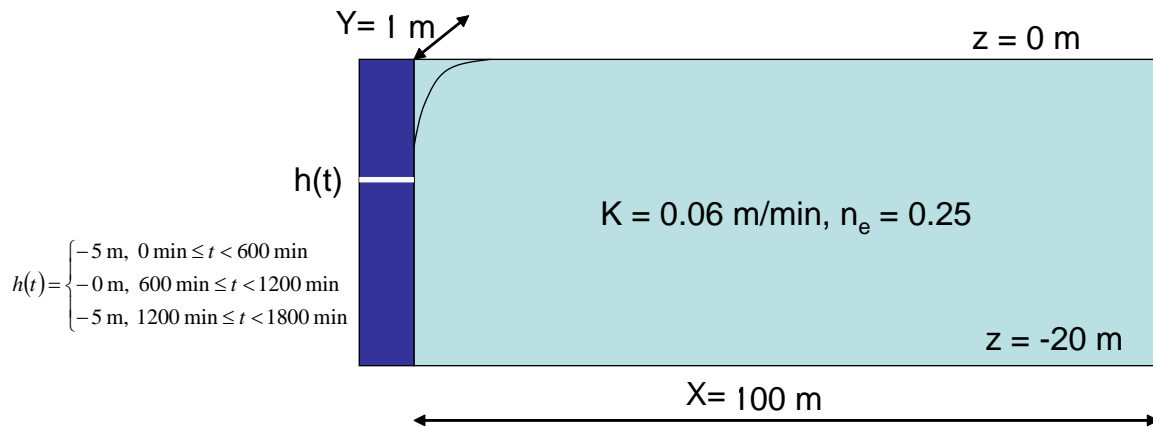mflab tutorial: simulation of transient flows in an unconfined aquifer induced by water level fluctuations in the adjacent surface water body

Task 1

- Set up a two-layer model to simulate transient flows in an unconfined aquifer (initial hydraulic head =0) subject to water level fluctuations in the adjacent surface water body as shown in the diagram below.
- Use mflab to construct the model and conduct analysis.

$$h(t)=\begin{cases}-5\,\mathrm{m}, & 0\,\mathrm{min}\le t<600\,\mathrm{min}\\ -0\,\mathrm{m}, & 600\,\mathrm{min}\le t<1200\,\mathrm{min}\\ -5\,\mathrm{m}, & 1200\,\mathrm{min}\le t<1800\,\mathrm{min}\end{cases}$$

Y= 1 m

z = 0 m

h(t)

K = 0.06 m/min, n_e = 0.25

z = -20 m

X= 100 m

Hints:
  (1) Enable LPF package (excel file→NAM tab→BCF). Use mf_adapt to create geometry object **gr**, horizontal hydraulic conductivity (HY), vertical hydraulic conductivity (VCONT), primary storage coefficient (SF1), second storage coefficient (SF2), IBOUND and initial hydraulic head (STRTHD).
      Useful functions: **gridObj**, **gr.const**
  (2) Make sure the time and length units are respectively set as min and m (ITMUNI and LENUNI in MFLOW tab of excel file).
  (3) Enable CHD package (excel file→NAM tab→CHD) to simulate **time-variant specified–head function**. Specify three stress periods at (.xls->PER tab). Give reasonable time steps (e.g., NSTP=100). Make sure all the stress periods are transient (i.e., Transient=1).Use **bcnZone** function in **mf_adapt.m** to create the CHD object.
      Useful functions: **bcnZone**
  (4) Enable output control package (excel file→NAM tab→OC). Carefully choose output time steps for each stress periods (.xls->PER tab, INCODE IHDDFL IBUDFL ICBCFL). 10 outputs in each stress periods would be sufficient (i.e., if NSTP=100, then these values can be 10).
  (5) Write analyze script in mf_analyze.m. Understands data structure of head object and budget object.
      Useful functions: **readDat**, **readBud, strcmp**

Task 2

How to simulate the case shown in the following diagram?

1 m

z = 0 m

h(t)

K = 0.06 m/min, n_e = 0.25

z = -20 m

$$h(t) = \begin{cases} -5\,\text{m}, & 0\,\text{min} \le t < 600\,\text{min} \\ -0\,\text{m}, & 600\,\text{min} \le t < 1200\,\text{min} \\ -5\,\text{m}, & 1200\,\text{min} \le t < 1800\,\text{min} \end{cases}$$

100 m