Comment on ‘P. Xin et al., Advances in Water Resources 91 (2016) 1–10’

Zaadnoordijk, Willem J.

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Corresponding Author: Dr. Willem Jan Zaadnoordijk, Ph.D.

Corresponding Author's Institution:

First Author: Willem Jan Zaadnoordijk, Ph.D.

Order of Authors: Willem Jan Zaadnoordijk, Ph.D.

Comment on 'P. Xin et al./Advances in Water Resources 91 (2016) 1-10'

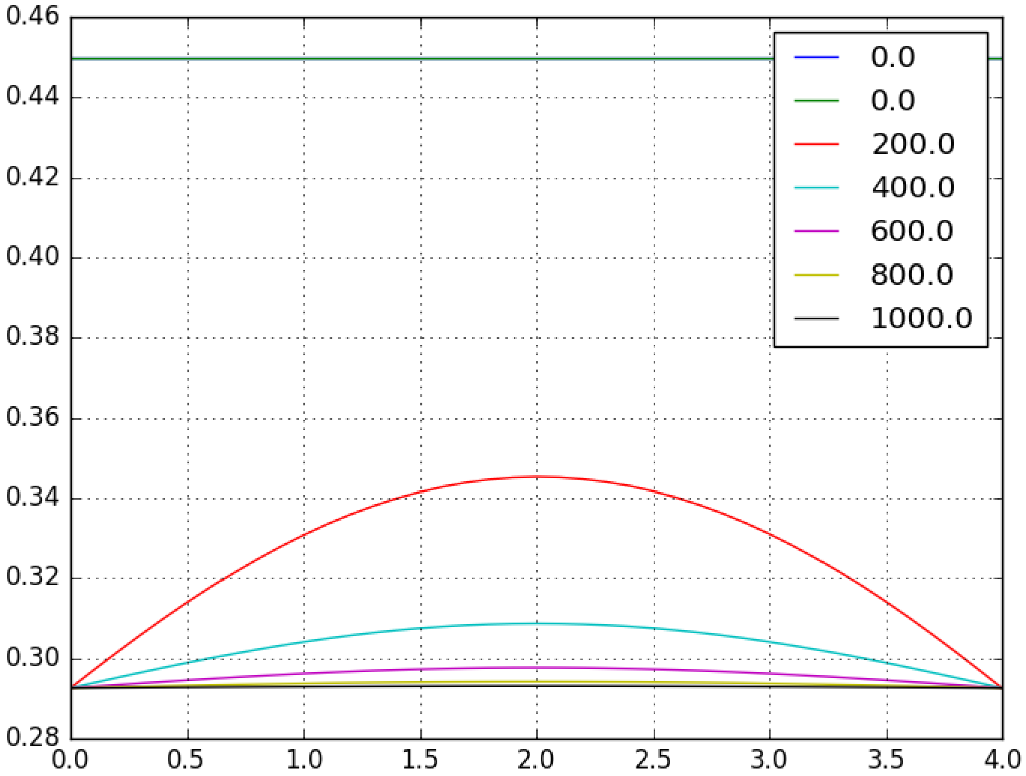
Willem J. Zaadnoordijk, KWR Watercycle Research Institute, Nieuwegein, the Netherlands (until 1 July 2016), TNO-Geological Survey of the Netherlands, Utrecht, the Netherlands (starting 1 July 2016); also at: Water Resources Section, Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, Netherlands

wjz_rdam@yahoo.co.uk

keywords: storage coefficient, specific yield, porosity

Xin et al. (2016) present an approximate analytical solution to a variable saturated formulation of a drainage problem. They compared their solution to a saturated flow-based model and found a large discrepancy. However, the discrepancy is due to the value of the storage coefficient used and not to the model formulation.

Xin et al. (2016) used the total porosity as the storage coefficient in the saturated flow-based model, while water table storage (often referred to as specific yield) usually is smaller (see a textbook such as Fitts, 2013). They present results from experiments in a sand flume and report a water release of 12% of the volume between the initial and final water table. Using this value of 0.12 as storage coefficient in a 1-dimensional calculation based on the Dupuit Forchheimer assumption gives a result (figure below) which is very similar to the outcome of the analytical solution presented by Xin et al. (2016) in their Figure 5a.



Note: Figure 5a of Xin et al. (2016) shows the initial groundwater table erroneously at 0.4 m instead of the correct value of 0.45 m.

References

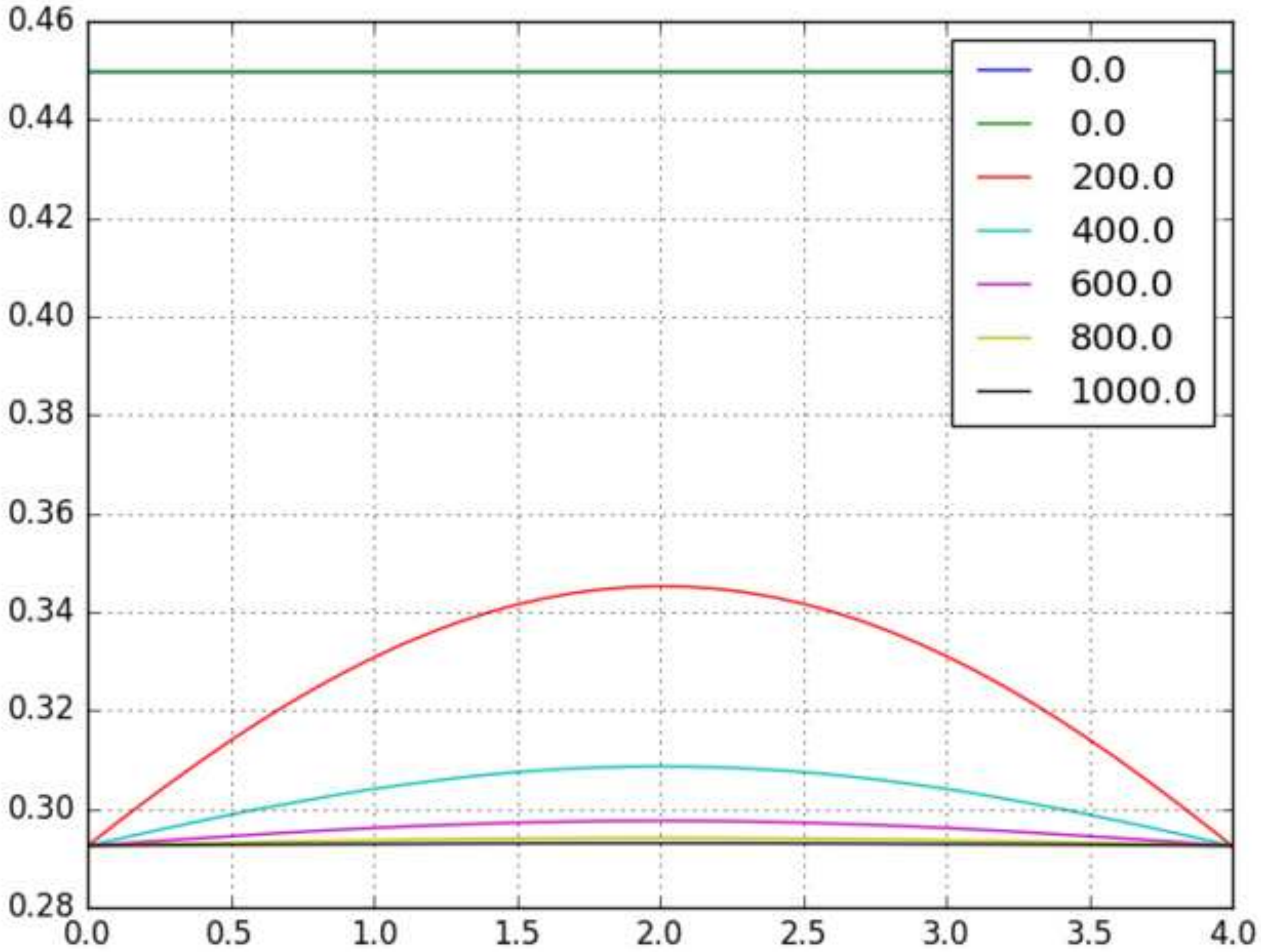
Charles R. Fitts (2013) Groundwater Science, second edition, Academic Press, Waltham MA, USA.

Pei Xin, Han-Cheng Dan, Tingzhang Zhou, Chunhui Lu, Jun Kong, Ling Li (2016) An analytical solution for predicting the transient seepage from a subsurface drainage system, Advances in Water Resources, , http://dx.doi.org/10.1016/j.advwatres.2016.03..006.

Appendix Python script used to produce figure

```
# explicit finite differences
# problem of Xin et al.,2016

import numpy as np

h0 = 0.45
k  = 3.8e-3 # m/s
S  = 0.12
hBnd = 0.2925

L  = 4.0
n  = 40
dx = L/n

dt = 0.1
tEnd = 1000.
nt = int(tEnd/dt)
tPlot = [0., 200., 400., 600., 800., 1000.]
iPlot = 1
nPlot = len(tPlot)

x = np.arange(0.0, L+dx, dx)
nx = len(x)
h = np.ones(nx)*h0          # initial heads

hTimeT = []
hTimeT.append( h.copy() )
tCurrent = 0.0
h[0]  = hBnd                # boundary head t>0
h[-1] = hBnd                # boundary head t>0
while iPlot<nPlot :
        hl = h[0:-2]
        hm = h[1:-1]
        hr = h[2:]
        ql = k*hm*(hl-hm)/dx
        qr = k*hr*(hr-hm)/dx
        dh = (ql+qr)*dt/S/dx
        hn = hm+dh
        h[1:-1] = hn
        tCurrent += dt
        if tCurrent >= tPlot[iPlot] :
                hTimeT.append(h.copy() )
                iPlot += 1

import matplotlib.pyplot as plt
plt.hold('on')
for i in range(nPlot) :
        plt.plot(x, hTimeT[i], label=str(tPlot[i]) )
plt.legend()
plt.grid(True)
plt.savefig('efd.png')
plt.show()
```

Figure


0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
0.28
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0.0
0.0
200.0
400.0
600.0
800.0
1000.0