

# Homework 1, CEGE 4352 Groundwater Modeling, 2018

## Problem 1

A well will be placed near a river of infinite length; the head along the river is  $\phi_0$ . The head at a distance  $L$  from the river bank is measured at  $\phi_1$ . The hydraulic conductivity in the aquifer is  $k$ ; the aquifer is unconfined. The  $y$ -axis is along the river bank. The well will be placed at  $z = -d$ , its radius is  $r_w$  and its discharge is  $Q$ .

Note: submit narrative in pdf form electronically, submit Matlab® code, including run script. The report must include your plots obtained from Matlab®. Note: All analysis must be done in terms of complex variables. Create the contour plots using the contouring routine provided.

*Questions:*

1. Determine an expression for the rate of uniform flow  $Q_{x0}$ , using the flow case without well.
2. Present an expression for both the complex potential and the discharge function  $W$ .
3. Program both the complex potential and the discharge function for each individual item needed in your solution, including functions to convert heads to potentials and back.
4. Produce three flow nets by contouring the complex potential for the following three cases, where
  - $\phi_0 = 15$  m,  $\phi_1 = 18.5$  m.
  - $L = 1000$  m,  $d = 175$  m
  - $k = 10$  m/day.
  - $r_w = 0.2$  m

Contour the modulus of the discharge function for the three cases listed above. The discharge  $Q_{\max}$  is defined as  $\pi d Q_{x0}$  and  $Q = a Q_{\max}$ , where

- (a) Case 1:  $a = 0.6$
- (b) Case 2:  $a = 1$
- (c) Case 3:  $a = 1.5$