Analysis of three-dimensional groundwater flow toward a radial collector well in a finite-extent unconfined aquifer-second review

The authors have addressed most of my comments. In my original review, I mentioned that the stream function presented for the case of section 3.1 does not exist. The answer of the authors to my objection is unsatisfactory. I understand from the problem description that the well is placed along $z = 0.5, 9.5 \le x \le 10.5, y = 1$, while the for domain has width $W_y = 20$. This implies that the flow is three-dimensional. Although the authors present the flow net for y=1 and claim that the flow in $y = 0$ is two-dimensional, this does not imply that the stream function exists. The presence of non-zero second order derivatives prevents the stream function, as presented by the authors, from being single-valued.

As a second comment, I remain of the opinion that the the paper would much benefit from a more thorough validation, especially in view of my preceding statement. The comparison with Hunt's solution is given, but holds only for a very limited case.

Summary

In my view, the use of the stream function in example 3.1 is in error. If I misunderstood their example as being three-dimensional, whereas in reality is two-dimensional, then the authors have to make this much more clear than in the present form of the paper. If the problem is indeed three-dimensional, then the use of the stream function must be removed from the paper. The reader may easily verify the truth of my statement by considering the case of a point sink at the origin in three-dimensional space. The discharge potential for that case has the form

$$\Phi = -\frac{Q}{4\pi}\frac{1}{r} \tag{1}$$

where

$$r^2 = x_1^2 + x_2^2 + x_3^2 \tag{2}$$

where $x_i, i = 1, 2, 3$, are the Cartesian coordinates. Set $x_2 = 0$. Then

$$\Phi = \frac{Q}{4\pi}\frac{1}{\sqrt{x_1^2 + x_3^2}} \tag{3}$$

Introduce complex variables $z = x_1 + \mathrm{i}y_1, \bar{z}, x_1 - \mathrm{i}y_1$, so that(3) becomes

$$\Phi = -\frac{Q}{4\pi}\frac{1}{\sqrt{z\bar{z}}} \tag{4}$$

This function is not holomorphic, and thus the stream function does not exist for this case.