Island Aquifer

In the island aquifer problem, IGW was compared to an analytical solution of the steady state drawdown due to groundwater pumping in a homogeneous aquifer. The drawdown is calculated for a cylindrical island with a constant abstraction rate in a well in the center of the island. Constant recharge is added on top of the aquifer (Figure 1).

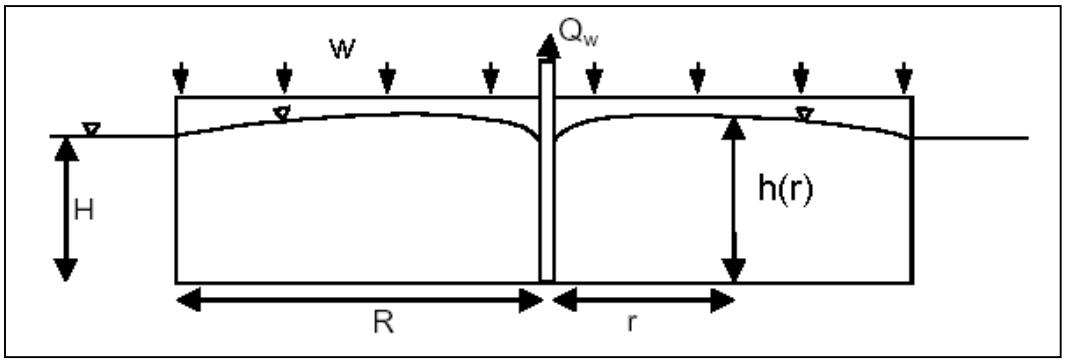

Figure.1-The island aquifer problem

Analytical Solution

The steady-state solution of the hydraulic head, h, as a function of the radial distance from the well, r, is given by:

$$h(r) = \sqrt{H^2 - \frac{Q_w}{\pi k}\ln\frac{R}{r} + \frac{w}{2k}(R^2 - r^2)} \qquad 0 < r \le R \qquad (1)$$

Where:

H	is the initial saturated thickness [L]
R	is the radius of the island [L]
Q_w	is the constant flow rate abstracted from the well [L^3/T]
k	is the hydraulic conductivity [L/T]
w	is the recharge [L/T]

IGW Numerical Solution

IGW is applied to solve the flow problem given the following assumptions:

Physical parameters:

Q_w = 3000 m^3/day
H = 20 m Constant head boundary
S_y = 0.1 Specific yield
k = 50 m/day Hydraulic conductivity

w = 0.1 m/day recharge
R = 323 m Island radius
Aquifer top elevation 50 m
Aquifer bottom elevation 0 m

Numerical Parameters:

The IGW model consists of

Number of cells in x direction	200
Number of cells in y direction	150
Δx = 5m Grid spacing in x direction	
Δy = 5m Grid spacing in y direction	

A layout of IGW model is illustrated in Figure 2.

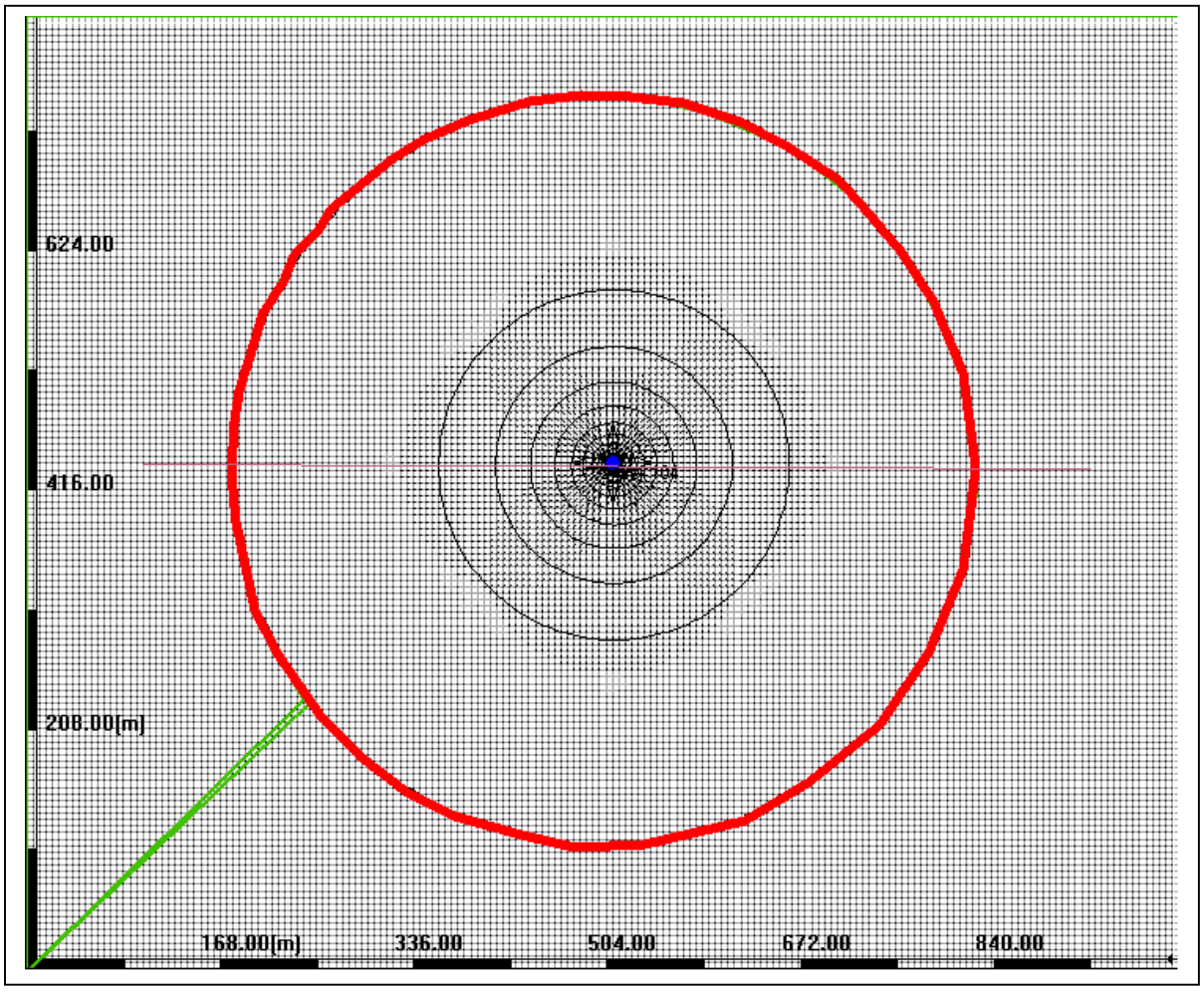

Figure 2. IGW model layout for island aquifer problem.

The pumping well is located in the center of the island point (507.5,438.5).

Analytical solution versus IGW

Comparison between the analytical solution and IGW is presented below for two cases. The first case occurs before pumping when only recharge is added to the island aquifer and the second occurs after pumping. Both cases are in steady state condition (See figure 3 and 4).

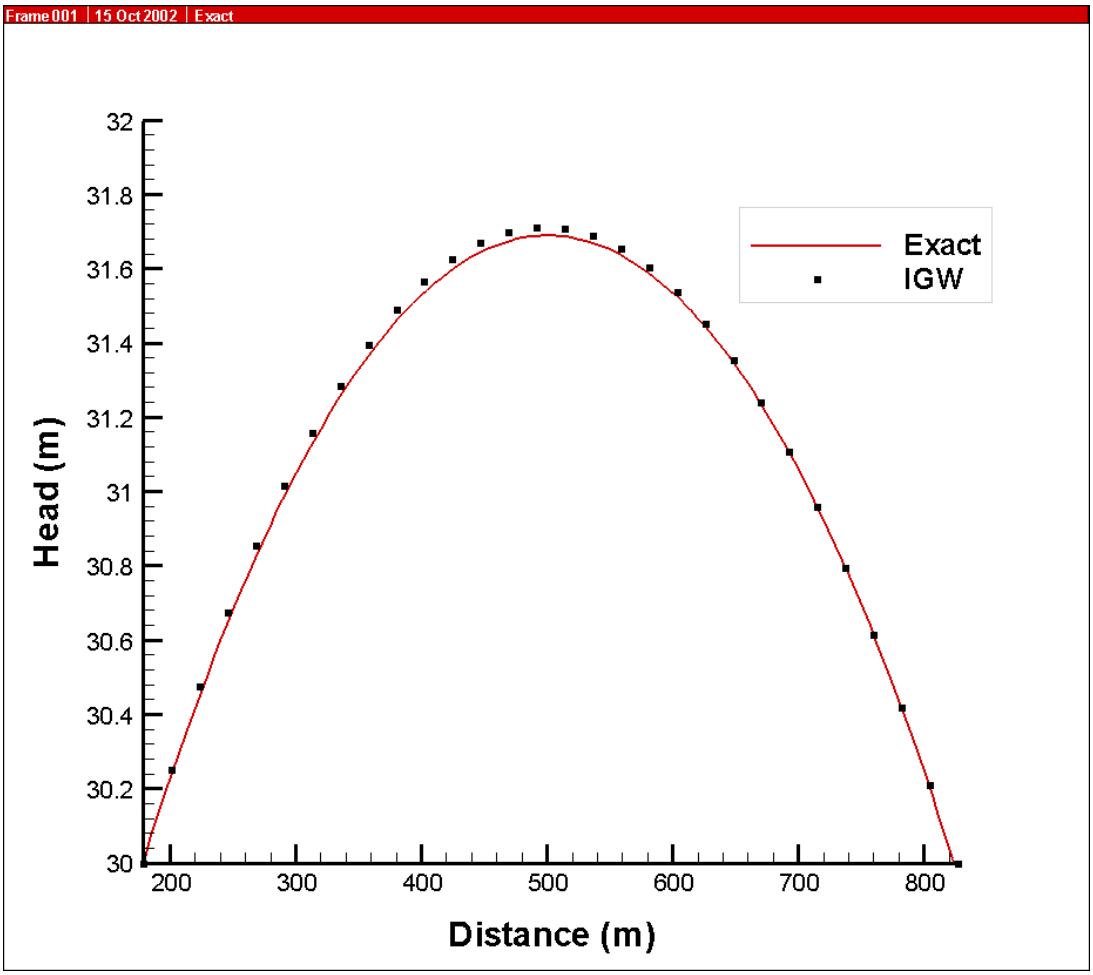

Figure3. The island aquifer analytical solution compared to IGW before pumping (recharge only).

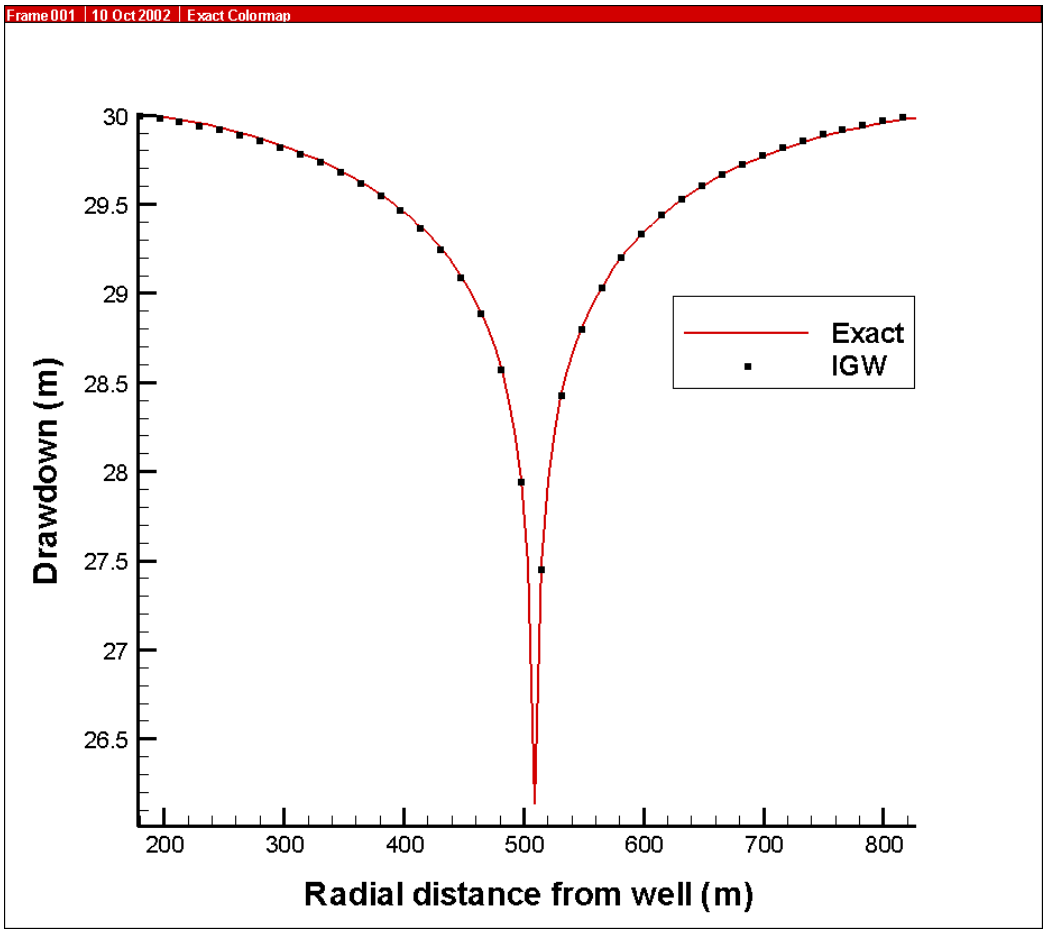

Figure4. The island aquifer analytical solution compared to IGW after pumping.

The numerical solution is graphically indistinguishable from the exact solution.