~~[illegible]~~
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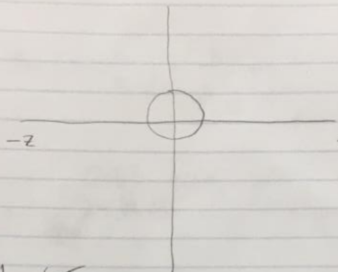
1)



$$\Phi_{av} = \frac{1}{2}\left(\Phi_2 + \Phi_1\right) = \tfrac{1}{2}(2880 + 1620) = 2250$$

$$\Phi_1 = \frac{1}{2} k \, \phi_1^2 = \tfrac{1}{2}(10)(24)^2 = 2880$$

$$\Phi_2 = \frac{1}{2} k \, \phi_2^2 = \tfrac{1}{2}(10)(18)^2 = 1620$$

$$\phi_{avg} = \sqrt{\frac{2\Phi_{avg}}{k}} = \sqrt{\frac{(2250)2}{10}} = 15\sqrt{2} = 21.2$$

$$\phi_0 = 22.7 \Rightarrow \Phi_0 = \tfrac{1}{2} k \, \phi_0^2 = 2576.45$$

$$\Omega = -Q_{x0}\left(z - \frac{R^2}{z}\right) + \frac{Q}{2\pi}\ln z + \Phi_0$$

$$Q_{x0} = \frac{\Phi_1 - \Phi_2}{2L} = \frac{2880 - 1620}{-2(1000)} = -0.63$$

* Assume the lake doesn't affect the far field conditions

at $z = L$

$$\Phi_1 = Q_{x0}\left(L - \frac{R^2}{L}\right) + \frac{Q}{2\pi}\ln\frac{L}{R} + \Phi_0$$

$$2880 = (0.63)\left(1000 - \frac{100^2}{1000}\right) + \frac{Q}{2\pi}\ln\frac{1000}{100} + 2576.45$$

$$Q = -873.6$$

2)

$$\Omega = -Q_{x0}\left(z - \frac{R^2}{z}\right) + \frac{Q}{2\pi}\ln\left[\frac{z - z_w}{z - \frac{Rz}{z_w}}\ \frac{R}{|z|}\right] + \Phi_0$$

a) $Q_{x0} = 0.63$ from part one

$\Phi_0 = 2576.45$ from part one

$R = 100$

at $z = -L$

$re(\Omega) = \Phi_1$

$$Q = \frac{\left(\Phi_1 - \Phi_0 + Q_{x0}\left(-L - \frac{R^2}{-L}\right)\right) 2\pi}{re\left(\ln\left[\frac{-L - z_w}{-L + \frac{RL}{z_w}}\ \frac{R}{|L|}\right]\right)}$$

For $z_w = \frac{L}{2}$, downstream

$Q = 228.47$

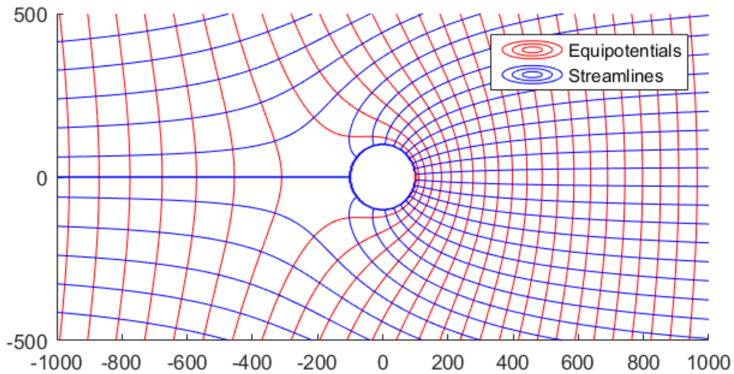
For $z_w = \frac{-L}{2}$ upstream

$Q = 203.11$

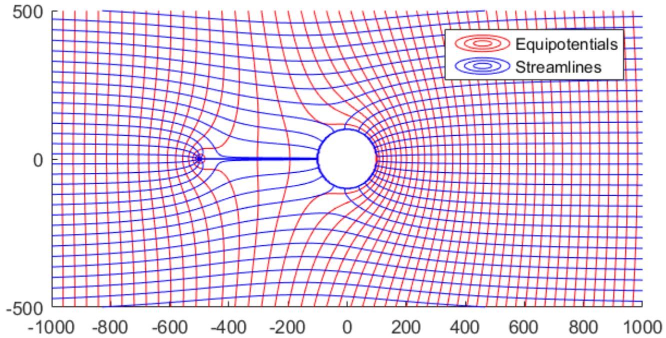
3) Less pumping is required when the well is located upgradient of the lake. More pumping is required when the well si downstream of the lake because the downstream well pulls more from the lake. The upstream well captures less water from the lake because the gradient from the well to the lake is less in the upstream case than the downstream case. The flownet for the upstream well placment resembles the flownet for the lake without the well more than the downstream well placment's flownet.

Figures:

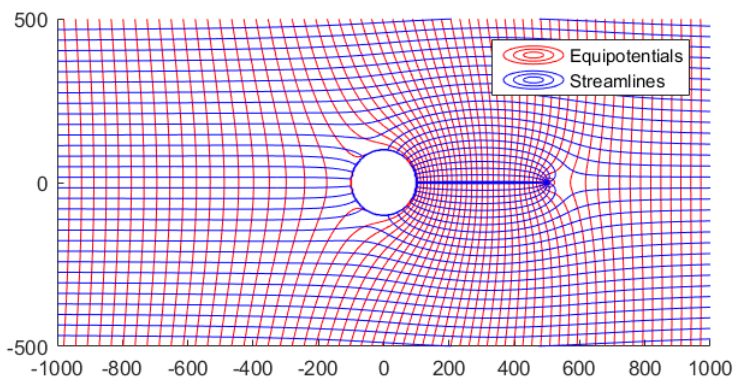
Lake raised above aquifer average



Well placed upstream:



Well placed downstream:



Code:

Runfile1:

```
Qx0  = 0.63;
Phi0= 2576.45;
rl= 100;
Phi1  = 2880
l = 1000

Q= (Phi1 - Phi0 -Qx0*(l - rl*rl/l) )*2* pi/log(l/rl)

ContourMe_flow_net(-1000,1000,500,-500,500,500,@(z)omega_total1(z,Q,Qx0,
Phi0, rl),30);
```

Omega_total1:

```
function [ Omega ] = omega_total1( z, Q,Qx0, Phi0, rl)
%OMEGA_TOTAL Summary of this function goes here
%   Detailed explanation goes here
rsq=(z)*conj(z);
if rsq>rl^2
    Omega = omega_uniformflow_lake( Qx0, z, rl) + omega_well( z, 0 , rl,
Q) +Phi0;
else
    Omega = Phi0;

end
end
```

omega_uniforflow_lake:

```
function [ Omega ] = omega_uniformflow_lake( Qx0, z, rl )
%OMEGA_UNIFORMFLOW_LAKE Summary of this function goes here
%   Detailed explanation goes here

Omega = -Qx0*(z-rl*rl/z);
end
```

omega_well:

```
function [ Omega ] = Omega_well(z,z0,rw,Q)
rsq=(z-z0)*conj(z-z0);
if rsq>rw^2
    Omega=Q/(2*pi)*log(z-z0);
else
    Omega = 0;
```

```
end
```

Runfile2:

```
Qx0  = 0.63;
Phi0= 2576.45;
rl= 100;


Phi1=2880;
l=1000;
zw =-l/2;

Q=2*pi* (Phi1 - Phi0 + Qx0*(-l+rl*rl/l))/real(log((rl/(-l*conj(-l)))*(-l-
zw)/(-l-rl*-1/conj(zw))))

ContourMe_flow_net(-1000,1000,500,-
500,500,500,@(z)omega_total2(z,zw,Q,Qx0, Phi0, rl),30);
```

Omega_total2:

```
function [ Omega ] = omega_total2( z, zw, Q,Qx0, Phi0, rl)
rsq=(z)*conj(z);
if rsq>rl^2
    Omega  = omega_uniformflow_lake(Qx0, z,rl) +
omega_well_near_lake(z,zw,rl,Q) + Phi0;
else
       Omega = Phi0;

end
end
```

omega_well_near_lake:

```
function [ Omega ] = omega_well_near_lake( z,z0,rl,Q )
%OMEGA_WELL_NEAR_LAKE Summary of this function goes here
%   Detailed explanation goes here
Omega=Q/(2*pi)*log((rl/(z*conj(z)))*(z-z0)/(z-rl*z/conj(z0)));

end
```