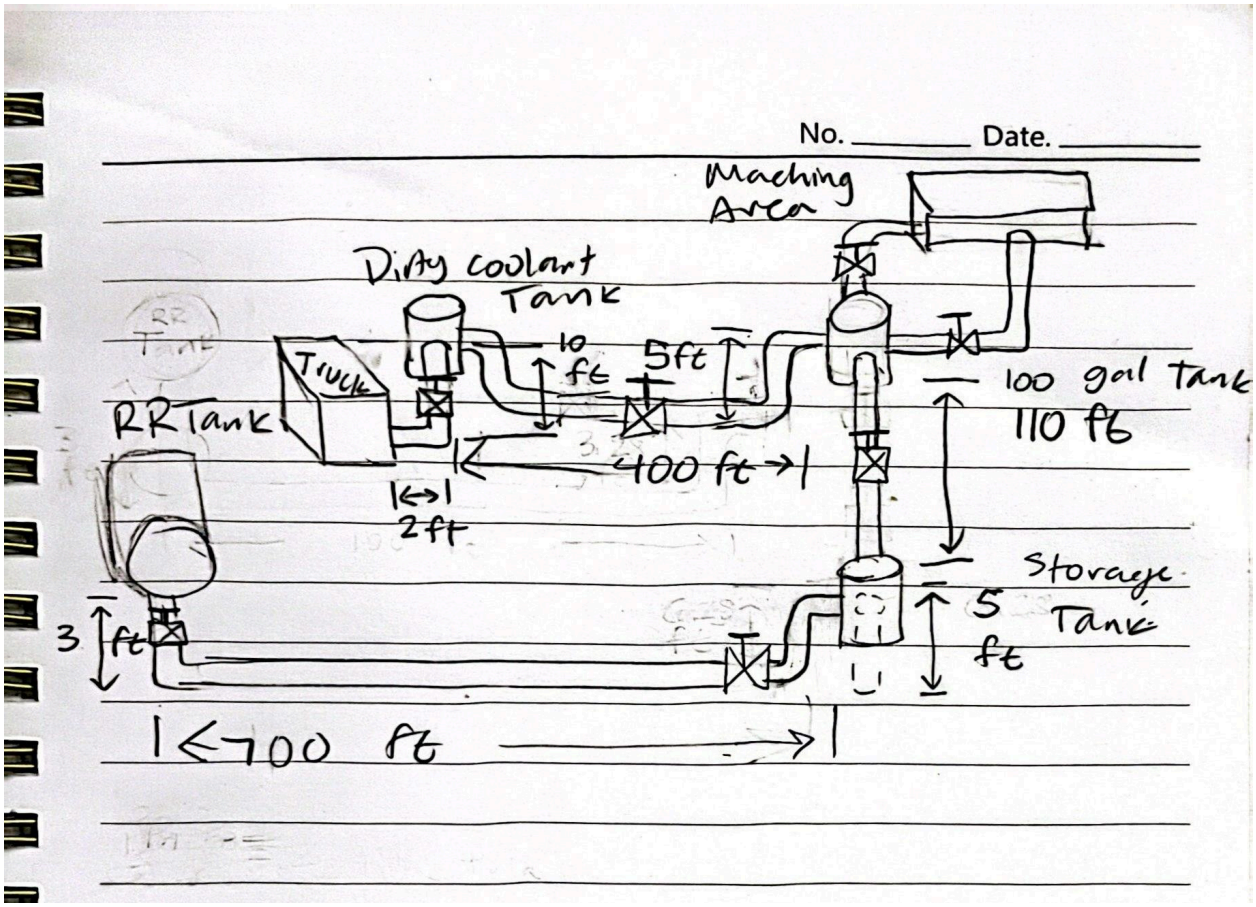
(Each number corresponds to the task number on the assignment)

1.



2.

All sizes of the required material in the System (Step 2)			
Type	Size	Material	Quantity
Schedule-40 Elbow	1-⅞”	Steel	10
Schedule-40 Valve	1-⅞”	Steel	7
Schedule-40 Fitting	1-⅞”	Steel	12

3.

Losses

Chosen pipe size: 2in Sch. 40 steel

$$\frac{D}{\varepsilon} = \frac{2.067\ in \cdot \frac{1ft}{12in}}{5.0\times10^{-6} ft} = 34{,}450 \qquad Q = 41.6\ gal/min$$

$$R_e = \frac{VD}{\nu}$$

$$(0.94)(1.94\ slugs/ft) = 1.8236\ \frac{slug}{ft} = \rho_{sol.}$$

$$(0.94)(62.4\ \frac{\#}{ft^3}) = 58.656\ \frac{\#}{ft^3} = \gamma_{sol.}$$

D_{H_2O} @ 80°F

$$D = (1.5)(9.15\times10^{-6}\ \frac{ft^2}{s}) = 1.372\times10^{-5}\ \frac{ft^2}{s}$$

$$41.7\ \frac{gal}{min} \cdot \frac{1\ min}{60\ s} \cdot \frac{231\ in^3}{1\ gal} = 160\ \frac{in^3}{s} \cdot \left(\frac{1ft}{12in}\right)^3 = 0.0929\ \frac{ft^3}{s}$$

$$\frac{Q_A}{A_A} = V_A$$

$$\frac{0.0929\ \frac{ft^3}{s}}{0.0233\ ft^2} = 3.987\ \frac{ft}{s} = V$$

$$R_e = \frac{(.1723ft)(3.987\ \frac{ft}{s})}{1.372\times10^{-5}\ \frac{ft^2}{s}} = 50{,}069.98$$

$$f = \frac{0.25}{\left[\log\left(\frac{1}{3.7\,D/\varepsilon} + \frac{5.74}{R_e{}^{0.9}}\right)\right]^2}$$

$f = 0.01587$

$f_t = 0.01587$

Assuming Long Radius Elbows

Losses:

$$K = 20 \cdot f_t$$
$$= 10 \cdot 20 \cdot 0.01587$$
$$= 3.174$$

$K = 8 \cdot f_t$

$= 7 \cdot 8 \cdot 0.01587$

$= 0.88872$

$K = 1.0$

$K_{total} = (5)(1.0) = 5$

$K = 0.5$

$K_{total} = (6)(0.5)$

$= 3$

$$h_{L\ Pipe} = f \cdot \left(\frac{L}{D}\right)\frac{V^2}{2g}$$

$$= (0.01587)\left(\frac{1235\ ft}{0.1723\ ft}\right)\left(\frac{\left(3.897\ \frac{ft}{s}\right)^2}{2 \cdot 32.2\ \frac{ft}{s^2}}\right)$$

$= 26.82\ ft$

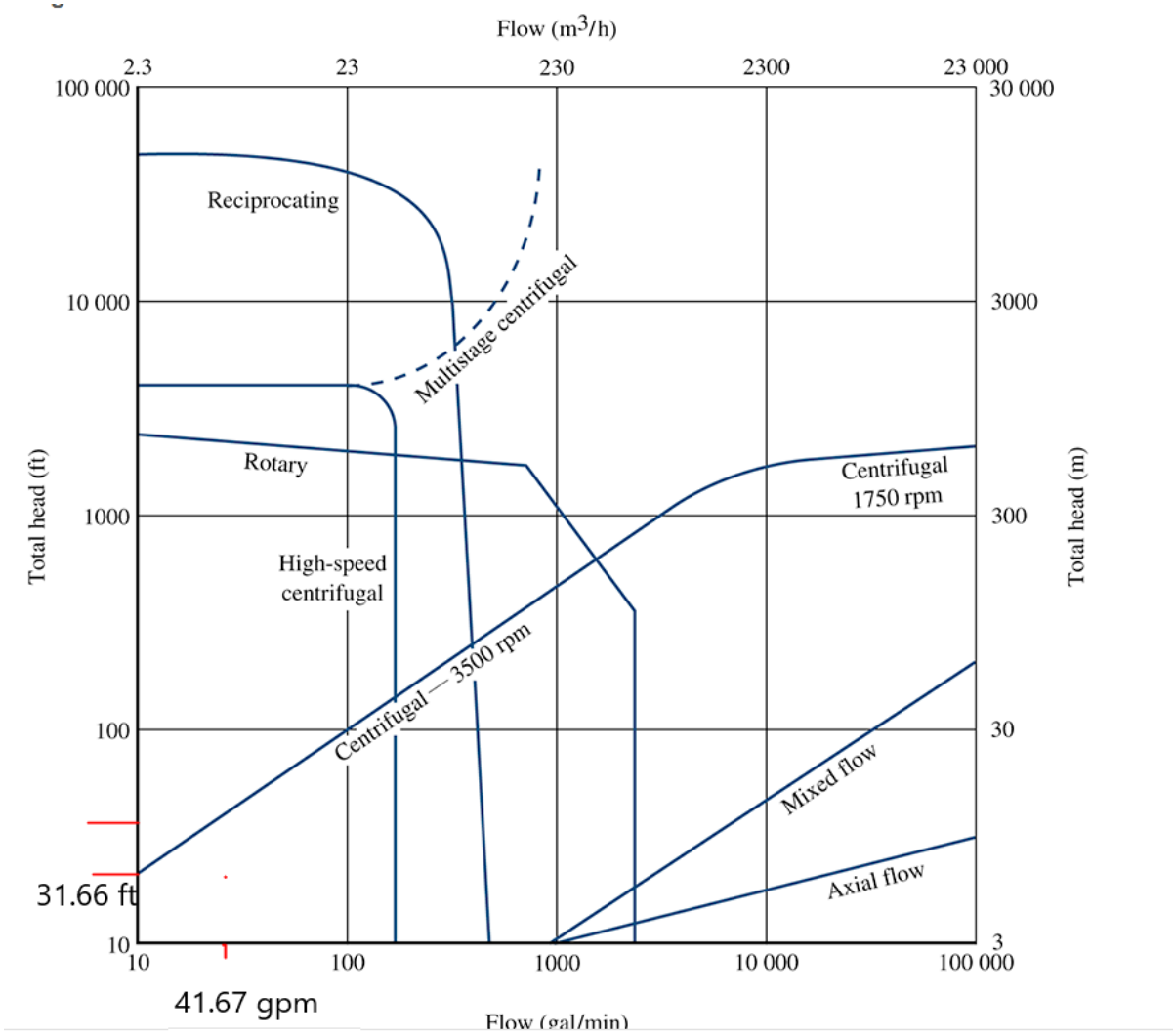
$$h_{L\ Fittings} = \left(0.88872 + 5 + 3 + 3.174\right)\left(\frac{\left(3.897\ \frac{ft}{s}\right)^2}{2 \cdot 32.2\ \frac{ft}{s^2}}\right)$$

$= 2.844\ ft$

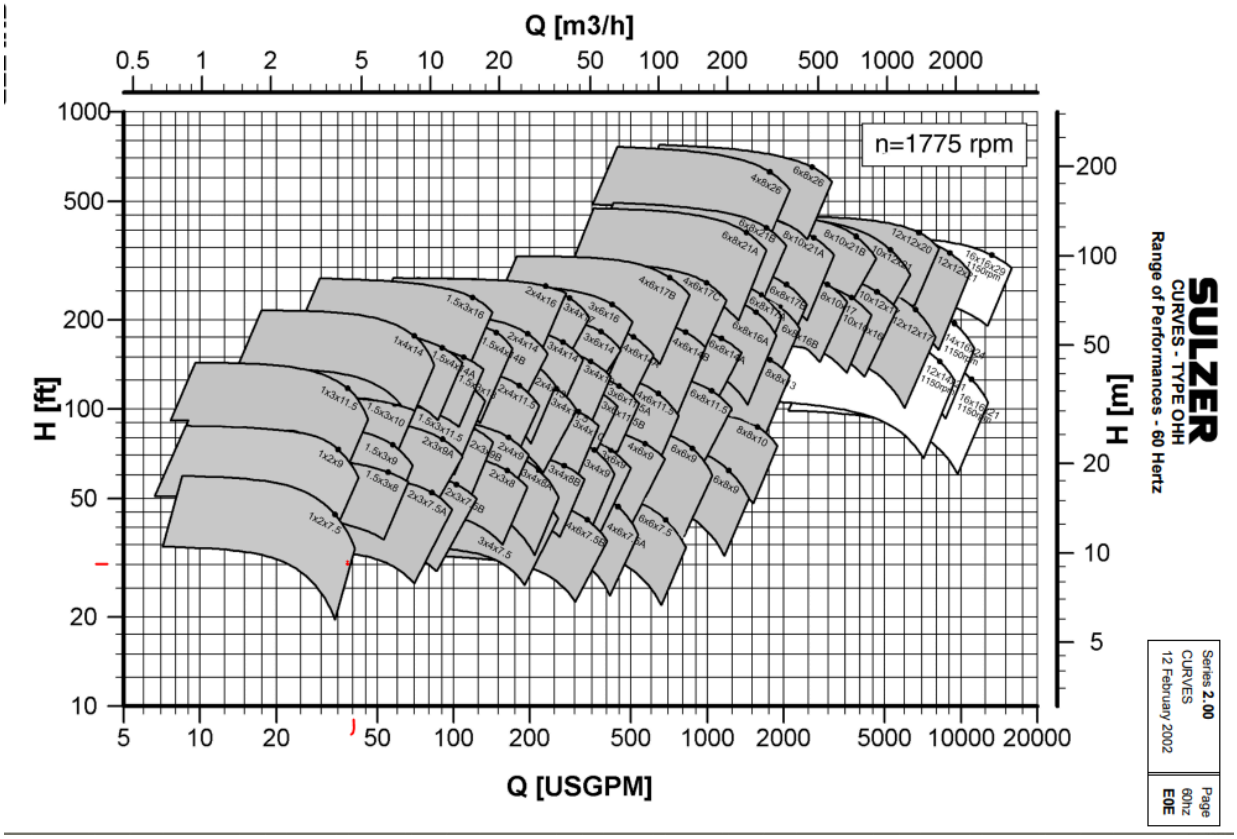
$h_{total} = 29.664\ ft$

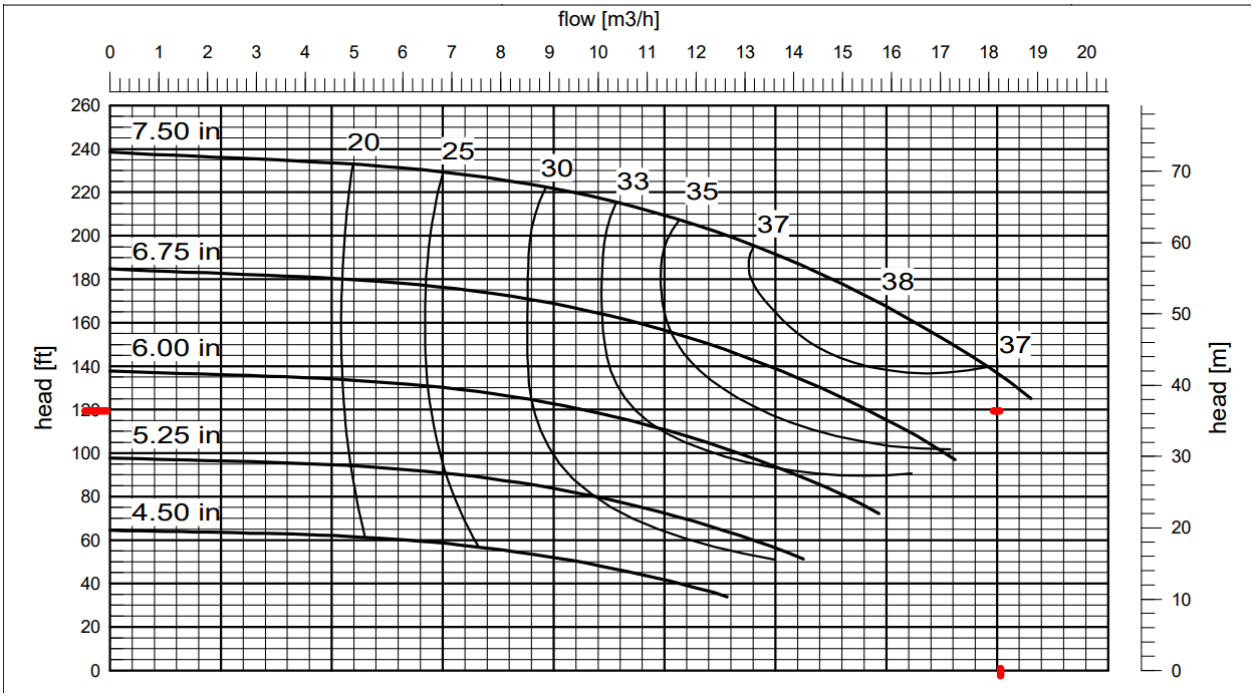
4. → Change in elevation from point A to point B is 2 feet
→ Pump head is 31.664 feet
→ Flow rate is 41.67 gallons per minute

5. Because we need to control the flow rate which the positive displacement does not allow.

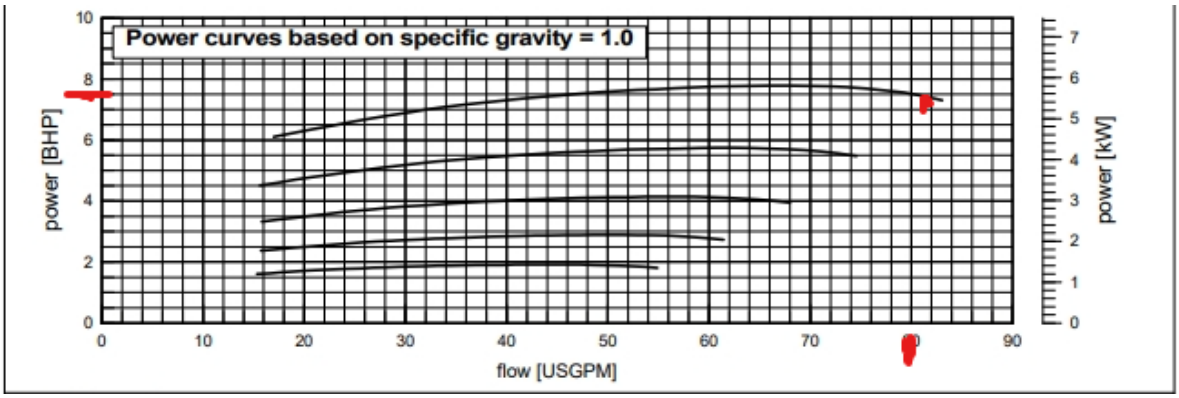


6. The size pump we chose was 1x2x7.5 which runs at 3500 rpm and 60 hertz (page 368), the point of operation is specified on the graph in red. (Our pump runs at 1775 rpm)





7. Based on the power curve we determined that 8.25 BHP is necessary to power the pump properly.



8.

9.

All sizes of the required material in the System			
Type	Size	Classification	Quantity
Schedule-40 Elbow	1-⅞”	Steel/ 90° Elbow	10
Schedule-40 Valve	1-⅞”	Steel/ Gate Valve	7
Schedule-40 Fitting	1-⅞”	Steel	12
Sulzer Pump	1x2x7.5-1	1775 RPM	1