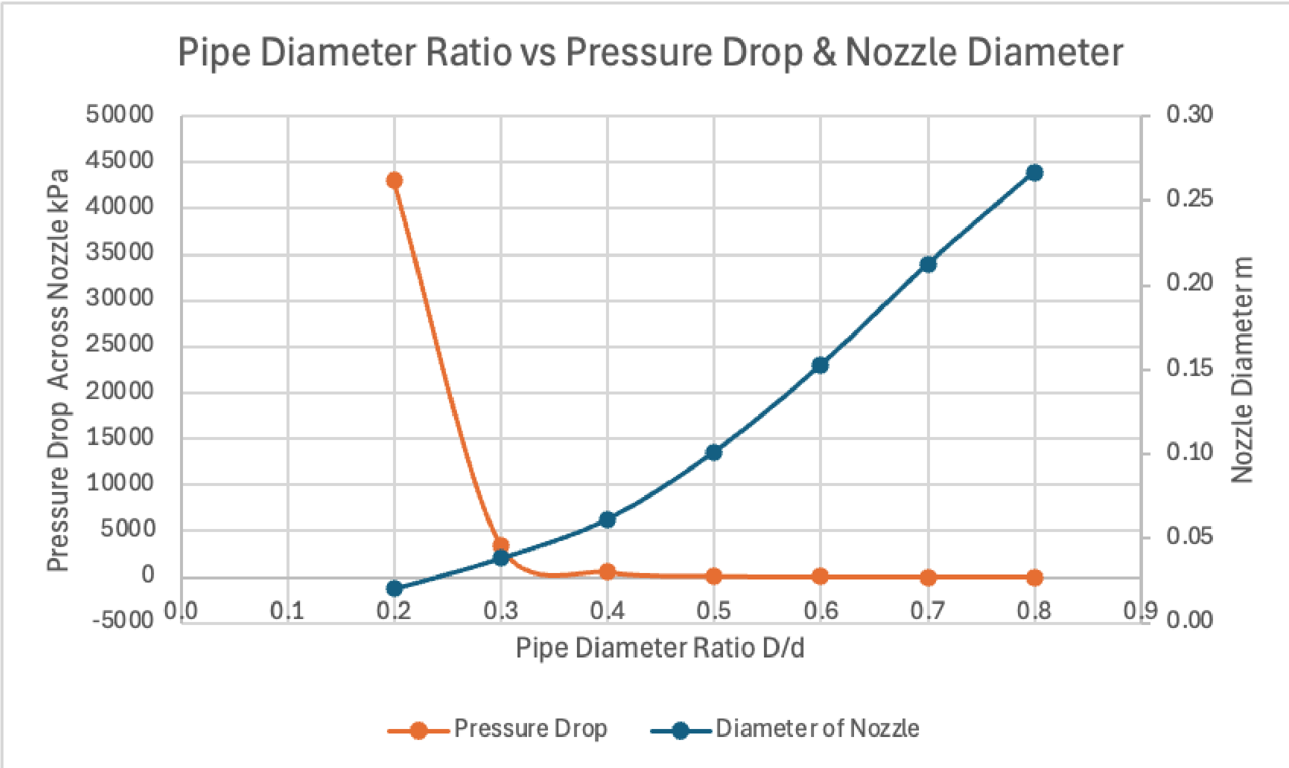


Pipe Diameter Ratio vs Pressure Drop & Nozzle Diameter
Pressure Drop Across Nozzle kPa
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
-5000
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Pipe Diameter Ratio D/d
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Nozzle Diameter m
Pressure Drop
Diameter of Nozzle

Figure 3

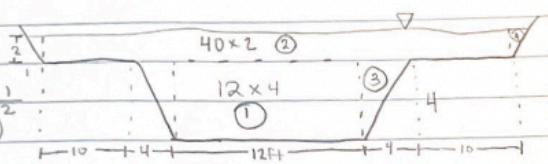
c)

$$P_{ower} = \frac{Q\gamma h_L}{\eta} \Rightarrow \frac{(0.0959\ \frac{m^3}{s})(9.81\ \frac{kN}{m^3})(1.21\ \frac{kN}{m^2})}{0.6} = 1.897\ kW$$

$$\% = \frac{1.897\ kW}{1242.6\ kW} = 0.00153 \times 100$$

$= 0.153\%$ increase in pump power

c) Slope = 0.00015



$$Q = \frac{1}{n} A R^{\frac{2}{3}} S^{\frac{1}{2}}$$

$\eta = 0.05$ for light brush ~~tbl 14.1~~

$$Q = \frac{1}{0.05}(146 ft^2)(3.05 ft)^{\frac{2}{3}}(0.00015)^{\frac{1}{2}}$$

$$Q = 75.2\ \frac{ft^3}{s}$$

$$R = \frac{A}{Wp} \Rightarrow \frac{146 ft^2}{47.82 ft} = 3.05 ft$$

$$\%\ Pumped = \frac{Q_{pumped}}{Q_{channel}}$$

$$= \frac{3.387\ \frac{ft^3}{s}}{75.2\ \frac{ft^3}{s}} = 0.045 \times 100 = 4.5\%$$ pumped flow

$A_1 = 12 \times 4 = 48 ft^2$

$A_2 = 40 \times 2 = 80 ft^2$

$2\ A_3 = \frac{1}{2}(4)(4) = 8 ft \cdot 2 = 16 ft^2$

$2\ A_4 = \frac{1}{2}(1)(2) = 1 ft \cdot 2 = 2 ft^2$

$A_t = 48 + 80 + 16 + 2 = 146 ft^2$

$W_p = 2.24 + 10 + 5.67 + 12 + 5.67 + 10 + 2.24$

$= 47.82 ft$

$\sqrt{(4)^2+(4)^2} = 5.67 ft$ $\quad \sqrt{(1)^2+(2)^2} = 2.24 ft$

WP

A_1: DNC 12

A_3: DNC 5.67 (2)

5 A_4: $\sqrt{(1) + (1)} = 1.41$

4 0 : $\sqrt{(}$

A_2:

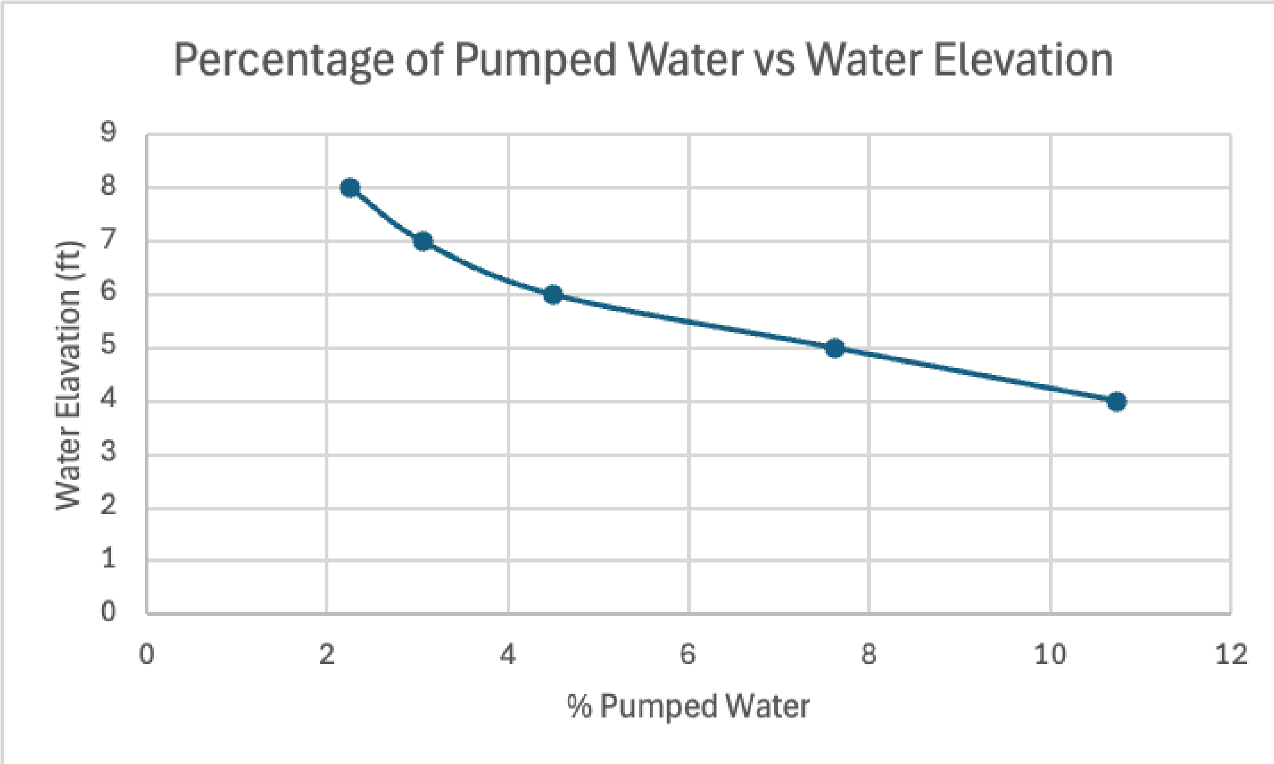


Figure 4

Materials:

- Water at 60F
- 8-in schedule 40 steel pipe
- 60% efficient pump
- Open channel with natural light brush
- Q2: Flow nozzle instrument

Summary & Analysis:

a) The figure 1 shows, as the pipe diameter decreases, the pump power requirement increases significantly, especially for smaller diameters. This relationship is due to increased frictional losses in smaller pipes, which demand more power to maintain a specific flow rate. A pipe diameter in the range of 0.2 m to 0.25 m appears to be the best choice because it minimizes the pump power requirement without excessively increasing the diameter; therefore, the pipe diameter I chose for this system was a good choice.

b) Referring back to figure 3, the pressure drop access the nozzle (orange line) trend makes sense because a smaller nozzle diameter (relative to the pipe) causes a large restriction in flow, leading to a high velocity and high-pressure drop across the nozzle due to the Venturi effect. As the nozzle diameter becomes closer to the pipe diameter, the restriction decreases, and so does the pressure drop. The graph provides a logical relationship between the diameter ratio, pressure drop, and nozzle diameter. It demonstrates how nozzle restrictions impact pressure drop in a way that aligns with theoretical expectations. The trends in both pressure drop and nozzle diameter are as expected, so the graph appears to make sense.

c) After analyzing figure 4, the trend shows a negative relationship; as the percentage of pumped water increases, the water elevation decreases. The graph suggests that as more water is pumped, the water level in the channel or reservoir decreases. This trend is logical if we consider that increasing the percentage of water being pumped out would reduce the volume of water available in the system, thereby lowering the water elevation. The graph aligns with expected principles; more pumping leads to lower water elevation in a consistent relationship.