36.59 A nozzle produces a $200\frac{ft}{s}$ stream of water with $500gpm$ that drives the wheel of an impulse turbine. The water jet strikes the turbine wheel at a radial distance of $3ft$. What is the maximum power produced by the turbine?

A. $0.4hp$

B. $79hp$

C. $8400hp$

D. $36,000hp$

The maximum power produced by an Impulse Turbine occurs when the fluid exits in a straight line with no deflection, such that the angle $\alpha = 180°$. The equation for max power becomes the formula below.

$$\dot{W}_{max} = \frac{Q\gamma v_1^2}{2g}$$

Convert the volume flow rate to $\frac{ft^3}{s}$.

$$Q = 500\frac{gal}{min}\left(\frac{1ft^3}{7.48gal}\right)\left(\frac{1min}{60s}\right) = 1.11\frac{ft^3}{s}$$

Evaluate the max power. Convert units to hp.

$$\dot{W}_{max} = \frac{\left(1.11\frac{ft^3}{s}\right)\left(62.4\frac{lb_f}{ft^3}\right)\left(200\frac{ft}{s}\right)^2}{2\left(32.2\frac{ft}{s^2}\right)} = 43,179\frac{ft\cdot lb_f}{s}\left(\frac{1hp}{550\frac{ft\cdot lb_f}{s}}\right) = 78.5hp$$

Answer B