which yields

$$\boxed{y_2 = 2.59 \text{ m}}$$

The energy equation gives the energy loss, ΔE, as

$$\Delta E = y_1 + \frac{V_1^2}{2g} - y_2 - \frac{V_2^2}{2g} = 1 + \frac{7^2}{2(9.81)} - 2.59 - \frac{\left(\frac{21}{2\times2.59+2.59^2}\right)^2}{2(9.81)} = \boxed{0.748 \text{ m}}$$

3.44. From the given data: $m = 2$, $Q = 0.30$ m^3/s, $y = 15$ cm, and

$$\begin{aligned}
A &= my^2 = 2(0.15)^2 = 0.045 \text{ m}^2 \\
T &= 2my = 2(2)(0.15) = 0.6 \text{ m} \\
D &= \frac{A}{T} = \frac{0.045}{0.6} = 0.075 \text{ m} \\
V &= \frac{Q}{A} = \frac{0.30}{0.045} = 6.67 \text{ m/s} \\
\text{Fr} &= \frac{V}{\sqrt{gD}} = \frac{6.67}{\sqrt{(9.81)(0.075)}} = 7.78
\end{aligned}$$

Since $\boxed{\text{Fr} = 7.78} > 1$, the flow is supercritical.

The hydraulic jump equation is the same as for a trapezoidal channel with $b = 0$, hence

$$\begin{aligned}
\frac{my_1^3}{3} + \frac{Q^2}{gmy_1^2} &= \frac{my_2^3}{3} + \frac{Q^2}{gmy_2^2} \\
\frac{m(0.15)^3}{3} + \frac{(0.30)^2}{(9.81)(2)(0.15)^2} &= \frac{2y_2^3}{3} + \frac{(0.30)^2}{(9.81)(2)y_2^2} \\
0.219 &= 0.667y_2^3 + \frac{0.00459}{y_2^2}
\end{aligned}$$

which yields

$$y_2 = 0.679 \text{ m} \quad \text{or} \quad 0.145 \text{ m}$$

Since the downstream flow is subcritical, $\boxed{y_2 = 0.679 \text{ m}}$.

3.45. From given data: $Q = 10$ m^3/s, $b = 5.5$ m, $S_o = 0.0015$, $n = 0.038$, $y_2 = 2.2$ m.

(a) Using the direct-integration method,

$$\begin{aligned}
y_1 &= y_2 - \frac{S_o - \left(\frac{nQ\bar{P}^{2/3}}{\bar{A}^{5/3}}\right)^2}{1 - \frac{\bar{V}^2}{g\bar{y}}}(x_2 - x_1) \\
&= y_2 - \frac{S_o - \left(\frac{nQ(b+2\bar{y})^{2/3}}{(b\bar{y})^{5/3}}\right)^2}{1 - \frac{Q^2}{gb^2\bar{y}^3}}(x_2 - x_1) \\
&= 2.2 - \frac{0.0015 - \left(\frac{(0.038)(10)(5.5+2\bar{y})^{2/3}}{(5.5\bar{y})^{5/3}}\right)^2}{1 - \frac{10^2}{(9.81)(5.5)^2\bar{y}^3}}(100 - 0) \qquad (1)
\end{aligned}$$

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where

$$\bar{y} = \frac{y_1 + y_2}{2} = \frac{y_1 + 2.2}{2} \qquad (2)$$

Solving Equations 1 and 2 gives

$$\boxed{y_1 = 2.12 \text{ m}}$$

(b) Using the standard-step equation

$$\Delta L = \frac{\left[y + \frac{V^2}{2g}\right]_2^1}{\bar{S}_f - S_o} \qquad (3)$$

This equation is solved iteratively until $\Delta L = 100$ m, and the iterations are summarized in the following table:

y_2	A_2	P_2	R_2	V_2	S_2	y_1	A_1	P_1	R_1	V_1	S_1	$\bar{S}_f$	ΔL
2.2	12.1	9.4	1.29	0.826	0.00070	2.20	12.1	9.4	1.29	0.826	0.00070	0.00070	0
2.2	12.1	9.4	1.29	0.826	0.00070	2.10	11.6	9.2	1.26	0.866	0.00080	0.00075	129
2.2	12.1	9.4	1.29	0.826	0.00070	2.11	11.6	9.22	1.26	0.862	0.00079	0.00075	115
2.2	12.1	9.4	1.29	0.826	0.00070	2.12	11.7	9.24	1.26	0.857	0.00078	0.00074	100

Therefore $\boxed{y_1 = 2.12 \text{ m}}$.

Find the uniform flow depth, y_n, using the Manning equation

$$Q = \frac{1}{n} \frac{A^{5/3}}{P^{2/3}} \sqrt{S_o}$$

which can be written as

$$\begin{aligned} 10 &= \frac{1}{n} \frac{(5.5y_n)^{5/3}}{(5.5 + 2y_n)^{2/3}} \sqrt{S_o} \\ 10 &= \frac{1}{0.038} \frac{(5.5y_n)^{5/3}}{(5.5 + 2y_n)^{2/3}} \sqrt{0.0015} \end{aligned}$$

which gives

$$y_n = 1.719 \text{ m}$$

Plugging this value of y into the direct-step equation, Equation 3 gives

y_2	A_2	P_2	R_2	V_2	S_2	y_1	A_1	P_1	R_1	V_1	S_1	$\bar{S}_f$	ΔL
2.2	12.1	9.4	1.29	0.826	0.000704	1.719	9.455	8.94	1.00	1.06	0.00149	0.001	1230

Therefore $\boxed{\Delta L = 1230 \text{ m}}$.