

Project	La Loma neighbourhood water supply	Date	16 Oct 2026
Element	Rising main T-2	Author	Eng. Ana Pérez

1 · Purpose and scope

This report presents the head loss analysis of the rising main T-2 of the La Loma neighbourhood water supply, for a design discharge of 50.0 L/s, using the Hazen-Williams equation under steady pressure flow. The discharge is taken from the design demand of the population study; the diameter and reach length were input by the Author, and the Hazen-Williams coefficient corresponds to a typical value for PVC / HDPE. Details are given in the input data.

2 · Input data

Parameter	Symbol	Value	Unit	Source
Design discharge	Q	50.0	L/s	Design demand (population study)
Internal diameter	D	200	mm	Input by the Author
Length of the reach	L	500.0	m	Input by the Author
Hazen-Williams coefficient	C	130	—	Typical value for PVC / HDPE
Allowable head loss	h_{allow}	10.00	m H ₂ O	Input by the Author

Fittings in the reach (minor losses):

Fitting	K	Quantity	K × quantity
Standard 90° elbow	0.90	2	1.80
Globe valve, fully open	10.00	1	10.00
Other fitting	0.50	1	0.50
Sum of coefficients, ΣK			12.30

3 · Assumptions and acceptance criteria

- Steady flow of water under pressure in a circular pipe flowing full, with constant internal diameter and material along the reach.
- Hazen-Williams equation, empirical, valid for water at ordinary temperatures in turbulent flow; the coefficient C is taken as constant along the reach.
- Minor losses at the fittings proportional to the velocity head: $h_m = \Sigma K \cdot V^2 / 2g$.
- Practical criteria adopted: mean velocity between 0.60 and 3.00 m/s (minimum to prevent deposition; maximum to limit water hammer, noise and wear); total head loss $\leq$ allowable head loss $h_{\text{allow}} = 10.00$ m H₂O.
- Acceleration due to gravity $g = 9.81$ m/s².

4 · Methodology

Continuity and friction head loss by the Hazen-Williams equation (SI):

$$A = \frac{\pi D^2}{4} \quad V = \frac{Q}{A}$$

$$h_f = \frac{10.67 L Q^{1.852}}{C^{1.852} D^{4.87}}$$

Minor losses, total head loss and unit head loss:

$$h_m = \sum K \frac{V^2}{2g} \quad h_{\text{total}} = h_f + h_m \quad J = \frac{h_{\text{total}}}{L}$$

5 · Calculations

With the inputs expressed in SI: $Q = 50.0 \text{ L/s} = 0.0500 \text{ m}^3/\text{s}$; $D = 200 \text{ mm} = 0.200 \text{ m}$.

Substituting the inputs into the expressions above:

$$\text{With } D = 0.200 \text{ m: } V = \frac{4 \cdot 0.0500}{\pi \cdot (0.200)^2} = \mathbf{1.59 \text{ m/s.}}$$

$$h_f = \frac{10.67 \cdot 500.0 \cdot (0.0500)^{1.852}}{130^{1.852} \cdot (0.200)^{4.87}} = \mathbf{6.41 \text{ m}}$$

$$h_m = 12.30 \cdot \frac{1.59^2}{2 \cdot 9.81} = \mathbf{1.59 \text{ m}}; \quad h_{\text{total}} = 6.41 + 1.59 = \mathbf{7.99 \text{ m}}; \quad J = 7.99 / 500.0 = \mathbf{1.60 \%}.$$

6 · Results

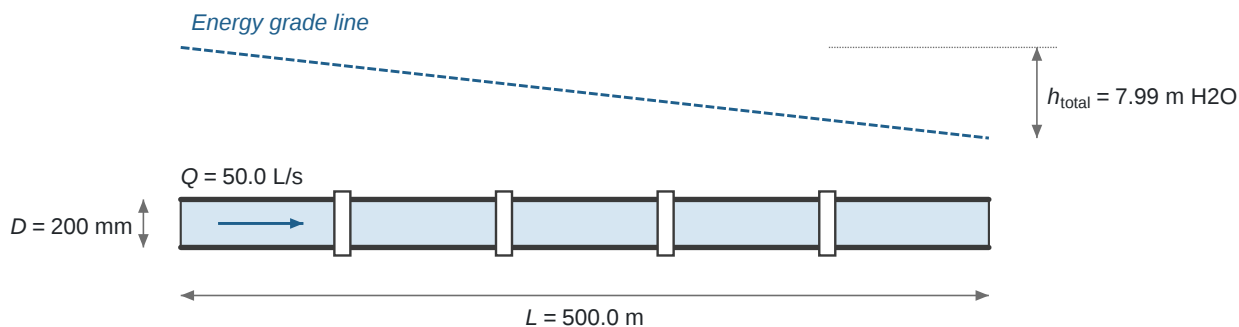
Quantity	Value	Quantity	Value
Total head loss, h_{total}	7.99 m H2O	Minor losses, h_m	1.59 m H2O
Mean velocity, V	1.59 m/s	Unit head loss, J	1.60 %
Friction loss, h_f	6.41 m H2O	Share of minor losses, h_m/h_{total}	19.9 %

7 · Design checks

Criterion	Limit	Calculated value	Result
Minimum velocity (deposition)	$\geq 0.60 \text{ m/s}$	1.59 m/s	✓ SATISFIED
Maximum velocity (water hammer and wear)	$\leq 3.00 \text{ m/s}$	1.59 m/s	✓ SATISFIED
Allowable total head loss	$\leq 10.00 \text{ m H2O}$	7.99 m H2O	✓ SATISFIED

At the design discharge, the pipe operates at a mean velocity of 1.59 m/s. This value is above the minimum velocity of 0.60 m/s, which guards against deposition, and below the maximum velocity of 3.00 m/s, which limits water hammer and wear. Both velocity criteria are therefore satisfied. The total head loss of 7.99 m H2O is the sum of a friction loss of 6.41 m H2O and minor losses of 1.59 m H2O. The minor losses arise from the loss coefficients K of the fittings, which are proportional to the velocity head, and they represent 19.9 % of the total. Expressed as total loss per unit length, the unit head loss over the reach is 1.60 %. The total loss remains within the allowable head loss of 10.00 m H2O, so the allowable total head loss criterion is also satisfied.

8 · Pipeline sketch



Sketch not to scale.

9 · Conclusion

For the design discharge and the internal diameter considered, the rising main T-2 produces a total head loss of 7.99 m H₂O, with a mean velocity of 1.59 m/s. All the adopted design criteria are satisfied, covering the minimum and maximum velocity and the allowable total head loss. The pipe is therefore hydraulically adequate for this operating condition under the adopted assumptions. The calculation applies to steady pressure flow of water and uses the Hazen-Williams equation to evaluate the friction loss.

10 · References

- Saldarriaga, J. (2007). *Hidráulica de tuberías: abastecimiento de agua, redes, riegos*. Alfaomega. — Typical values of the C coefficient and of the absolute roughness, and velocity criteria for pipelines.
- Williams, G. S., and Hazen, A. (1920). *Hydraulic Tables* (3rd ed.). John Wiley & Sons. — Hazen-Williams equation.
- Crane Co. (1988). *Flow of Fluids Through Valves, Fittings, and Pipe* (Technical Paper No. 410). — Loss coefficients K of the fittings.

Calculations, checks and report drafting carried out with HidraSoftware Calculators, based on the data and criteria defined by the Author, under whose professional responsibility this document is issued.