

Project	Los Álamos residential development — Storm drainage	Date	16 Oct 2026
Element	Catchment draining to sewer C-1	Author	Eng. Ana Pérez

1 · Purpose and scope

This report sets out the estimate of the peak discharge of the catchment draining to sewer C-1, within the Los Álamos residential development — Storm drainage project, obtained by the rational method for a return period of 25 years. The main-channel geometry comes from the project mapping at scale 1:5 000, the rainfall intensity from the IDF curves of the project's reference rain-gauge station, and the runoff coefficient from the project land-use plan, as detailed in the input-data section.

2 · Input data

Parameter	Symbol	Value	Unit	Source
Length of the main channel	L	900.0	m	Project mapping, scale 1:5 000
Elevation drop along the main channel	ΔH	30.00	m	Project mapping, scale 1:5 000
Return period	T_r	25	years	Input by the Author

Sub-areas of the catchment (runoff coefficient weighted by area):

Sub-area	C	Area (ha)	C × Area
Roofs	0.90	3.00	2.70
Roads and pavements	0.85	2.00	1.70
Green areas	0.25	7.00	1.75
Total and weighted C	0.5125	12.00	6.15

Source of the sub-areas: Project land-use plan.

IDF curve supplied by the Author (intensities in mm/h); shaded, the design return period:

Duration (min)	$T_r = 2$ years	$T_r = 5$ years	$T_r = 10$ years	$T_r = 25$ years
5	110.0	140.0	160.0	185.0
10	85.0	108.0	124.0	140.0
15	71.0	90.0	104.0	118.0
20	62.0	79.0	91.0	104.0
30	50.0	64.0	74.0	85.0
60	33.0	43.0	50.0	58.0

Source of the IDF curve: IDF curves of the project's reference rain-gauge station.

3 · Assumptions

- Rainfall of uniform intensity in space and time over the whole catchment, with a duration equal to the time of concentration, so that the whole catchment contributes to the peak discharge.
- Runoff coefficient constant during the storm, weighted by the area of each sub-area according to its cover.
- The return period of the peak discharge is that of the design rainfall.
- The rational method is applicable to the catchment under study.
- Time of concentration by the Kirpich formula, calibrated on small rural catchments with a defined channel and slopes of 3 % to 10 %.
- Intensity from the supplied IDF curve for a duration equal to the time of concentration, by logarithmic interpolation between tabulated durations, without extrapolation.

4 · Methodology

Peak discharge by the rational method (i in mm/h, A in m², Q in m³/s):

$$Q = \frac{C i A}{3\,600\,000}$$

Runoff coefficient weighted by sub-areas:

$$C = \frac{\sum(C_i A_i)}{\sum A_i}$$

Time of concentration by the Kirpich formula (L in m; S , mean slope of the main channel, in m/m; t_c in min):

$$S = \frac{\Delta H}{L} \quad t_c = 0.01947 L^{0.77} S^{-0.385}$$

Intensity for a duration equal to t_c , interpolated on a logarithmic scale between the tabulated durations t_1 and t_2 that bracket it:

$$\log i = \log i_1 + \frac{(\log t_c - \log t_1)(\log i_2 - \log i_1)}{\log t_2 - \log t_1}$$

5 · Calculations

Weighted runoff coefficient:

$$C = \frac{6.15}{12.00} = \mathbf{0.5125}$$

Time of concentration by Kirpich:

$$S = \frac{30.00}{900.0} = 0.0333 \quad t_c = 0.01947 \cdot 900.0^{0.77} \cdot 0.0333^{-0.385} = \mathbf{13.58 \text{ min}}$$

For $T_r = 25$ years and $t_c = 13.58$ min, between $t_1 = 10$ min ($i_1 = 140.0$ mm/h) and $t_2 = 15$ min ($i_2 = 118.0$ mm/h):

$$\log i = \log 140.0 + \frac{(\log 13.58 - \log 10) \cdot (\log 118.0 - \log 140.0)}{\log 15 - \log 10} \rightarrow i = \mathbf{123.1 \text{ mm/h}}$$

Peak discharge:

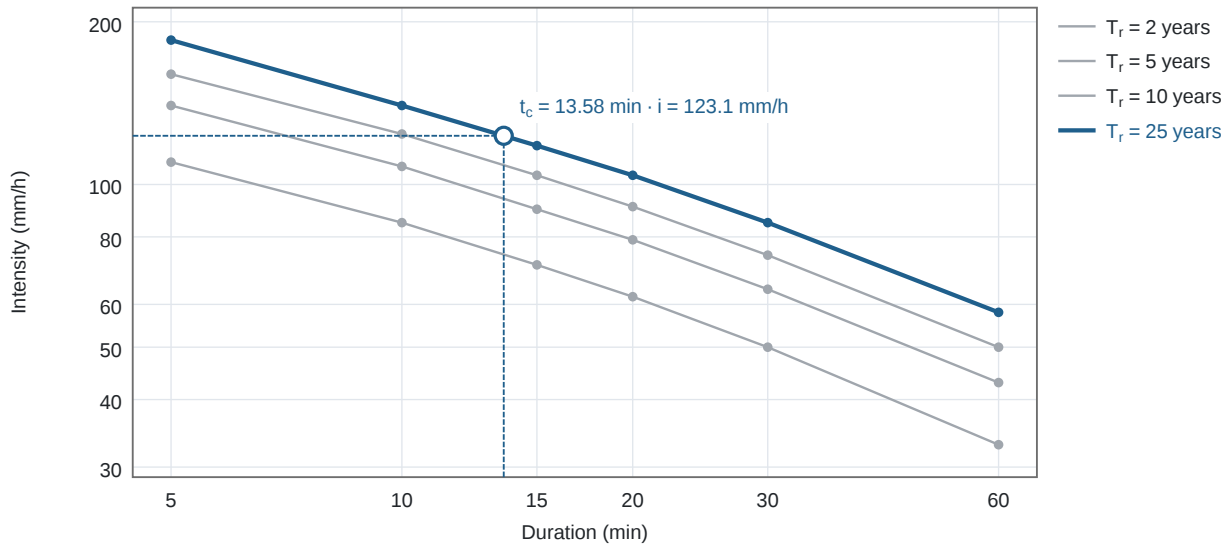
$$Q = \frac{0.5125 \cdot 123.1 \cdot 120\,000}{3\,600\,000} = \mathbf{2.10 \text{ m}^3/\text{s}}$$

6 · Results

Quantity	Value	Quantity	Value
Peak discharge, Q	2.10 m³/s	Catchment area, A	12.00 ha
Time of concentration, t _c	13.58 min	Return period, T _r	25 years
Design rainfall intensity, i	123.1 mm/h	Mean slope of the main channel, S	0.0333 m/m
Weighted runoff coefficient, C	0.5125		

The time of concentration, 13.58 min, was estimated with the Kirpich formula from the length and the elevation drop of the main channel. It represents the time needed for runoff from the hydraulically most remote point of the catchment to reach the outlet, and it therefore sets the duration of the design rainfall. For that duration and the 25-year return period, the IDF curve supplied by the Author gives a design rainfall intensity of 123.1 mm/h, interpolated between the tabulated durations of the curve. The runoff coefficient, weighted by the area of the sub-areas of the catchment, is 0.5125 and expresses the fraction of rainfall that becomes runoff. Multiplying the coefficient by the intensity and by the catchment area of 12.00 ha yields a peak discharge of 2.10 m³/s.

7 · Intensity-duration-frequency curve



Logarithmic scales. Dots: tabulated values; in blue, the curve of the design return period.

8 · Conclusion

For a return period of 25 years, the peak discharge of the catchment draining to sewer C-1 is estimated at 2.10 m³/s, supported by a time of concentration of 13.58 min and a design rainfall intensity of 123.1 mm/h. As an assumption adopted by the method, the return period of the discharge is taken to be the same as that of the design rainfall. The estimate results from the rational method under the adopted assumptions.

9 · References

- Chow, V. T., Maidment, D. R., and Mays, L. W. (1988). *Applied Hydrology*. McGraw-Hill. — Rational method, runoff coefficients and intensity-duration-frequency curves.
- Kirpich, Z. P. (1940). Time of concentration of small agricultural watersheds. *Civil Engineering*, 10(6), 362. — Time-of-concentration formula and its calibration domain.

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.