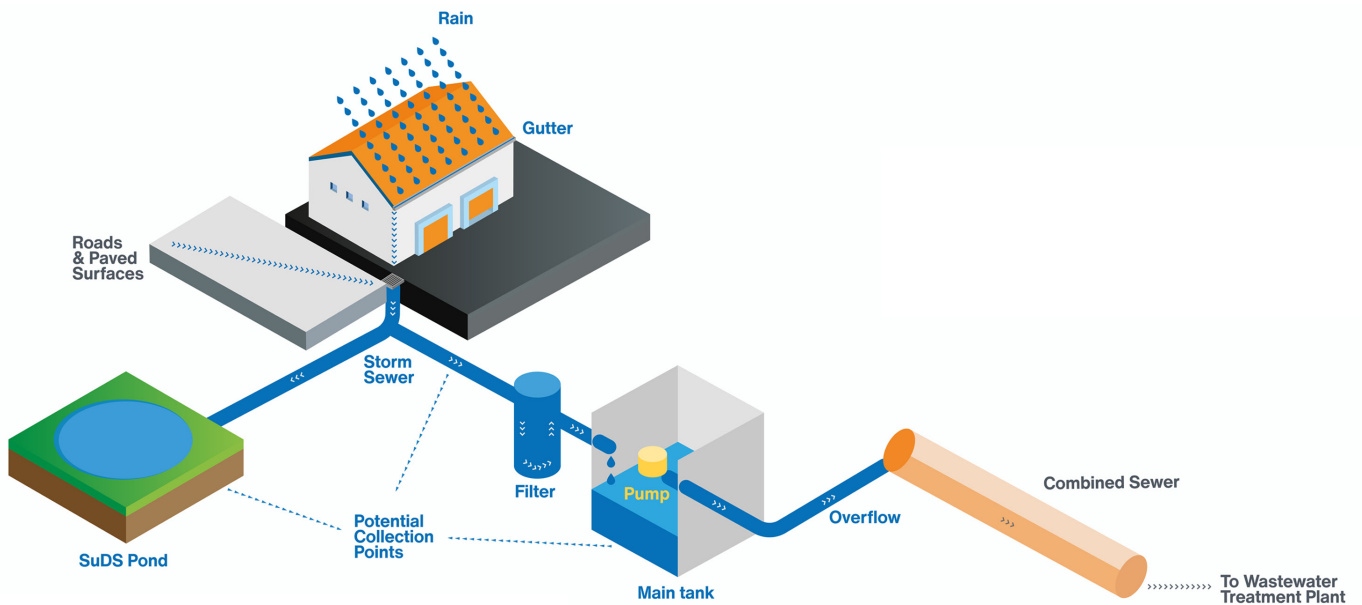


# Transitioning Surface Water Collection to Surface Water Reuse Systems

## Annex D. Historical Rainfall Assessment

Cuthbertson A., Wade R., Black A., Duffy A., Hendry S., Leask F., Ralph E., Sezen E., Varghese A., Ward K.



### POTENTIAL REUSES



### WIDER BENEFITS





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# D1. Dundee rainfall duration/intensity/frequency/seasonality patterns and trends

As background to the study of surface water runoff generation in Dundee and the potential for storage and reuse, an investigation was undertaken to explore patterns and relationships within observed rainfall data series from local rain gauges. Dundee is served with rain gauges at Mylnfield (JHI Invergowrie, from January 1997) and at Baluniefield (SEPA, from October 2008). (see Figure D1.1). To explore changes in behaviour, this analysis therefore focuses just on the longer record, from Mylnfield.

All data are available at a 15-minute interval only, using rain gauges with a bucket capacity equivalent to 0.2 mm (i.e. minimum rainfall data increment). Rolling totals were calculated for the following durations D: 1, 3, 6, 12, 24, 48 hours.

Independent events were extracted from the series of rolling totals by allowing only the highest total precipitation value P in any period D as a moving window through the continuous series. From the extracted data, thresholds T were then set equivalent to approximately 25 events per year (x 28 years = c. 700 events from each series) – an intentionally low threshold, given the focus on runoff diversion and the interest in using diverted volumes as a resource. The samples of events were then stratified by multiples of T so that patterns within the occurrence of rainfall events could be examined by reference to magnitude.

Three types of plot have been generated:

- Julian day by year with differentiation by event magnitude across all six durations D – this allows patterns in seasonality to be observed (Julian day is day number within each year, starting with Jan 1st = Day 1, Feb 1st = Day 32 ... Dec 31st = 365, or 366 in a leap year)
- Annual event frequencies, differentiated by D-hour event magnitudes as multiples of T (presented just for 1 hour and 24 hours)
- Histograms showing the seasonal distribution of rainfall events by magnitude for durations of 1 and 24 hours.

These plots are shown in the Figures D1.2 – D1.9 below. [Note: 2025 rainfall values are included in these plots but refer to the year up to 26 August 2025 only].

Linear regression analysis was undertaken to attempt to characterise any trends in annual event frequencies, with 2024 used as the end year in all cases (i.e. last complete year). The seasonal distribution of rainfall events shows a concentration on the months May-October for 1-hour durations (i.e. Figure D1.2), and less seasonal variation at 24 hours duration with July, August and October showing the highest frequencies (i.e. Figure D1.6).

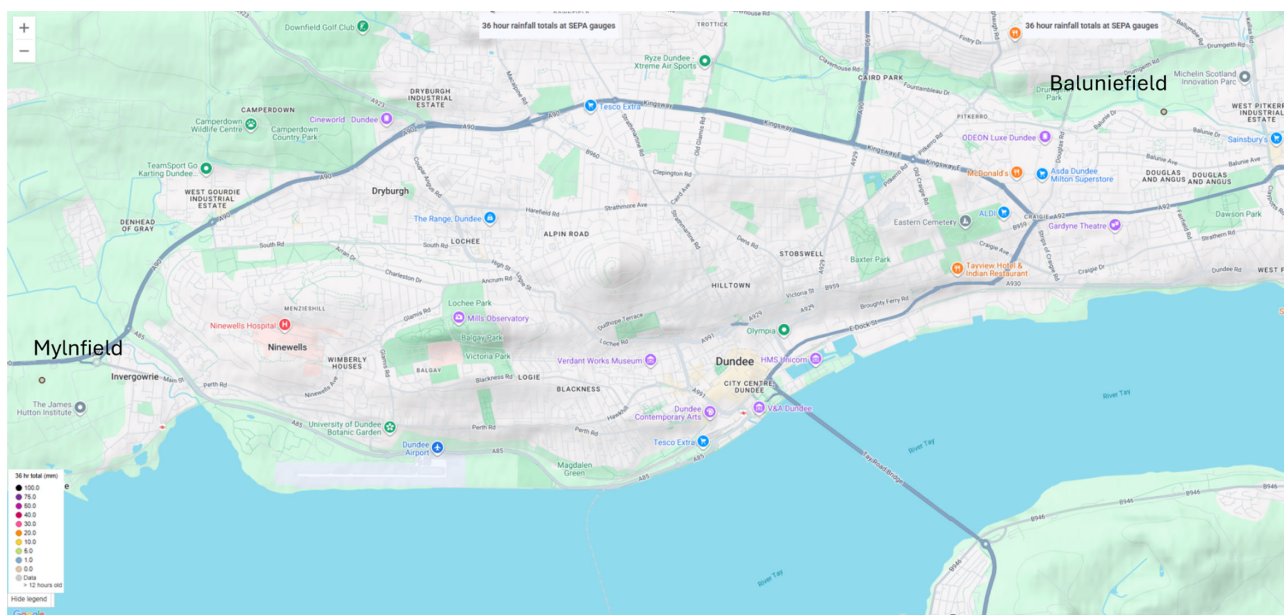


Figure D1.1: Location of rain gauges Mylnfield and Baluniefield in Dundee area [adapted from [Scottish Rainfall Data – provided by Scottish Environment Protection Agency \(SEPA\)](#)].

The key point from all these plots is that year-to-year variations in event frequency, magnitude and seasonality appear to be stronger than any underlying trends.

For the rainfall-runoff analysis undertaken in the surface water reuse scenarios (Annex E), 2003 and 2015 were selected as rainfall records representing particularly “dry” and “wet”.

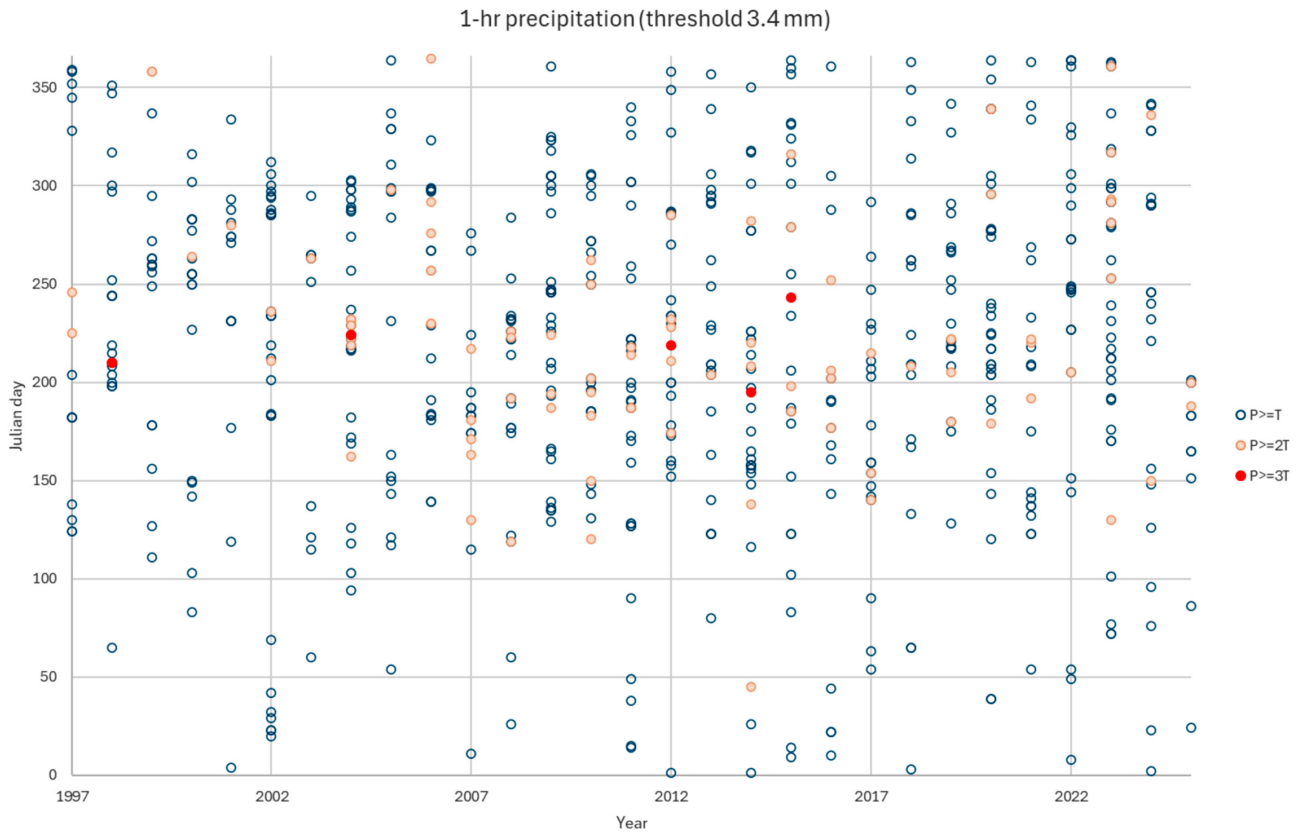


Figure D1.2: Plot illustrating historic variation in rainfall event magnitude, frequency and seasonality [data from MyInfield (JHI Invergowrie) 1997 – 2025] for D = 1 hr event duration and rainfall threshold T = 3.4 mm.

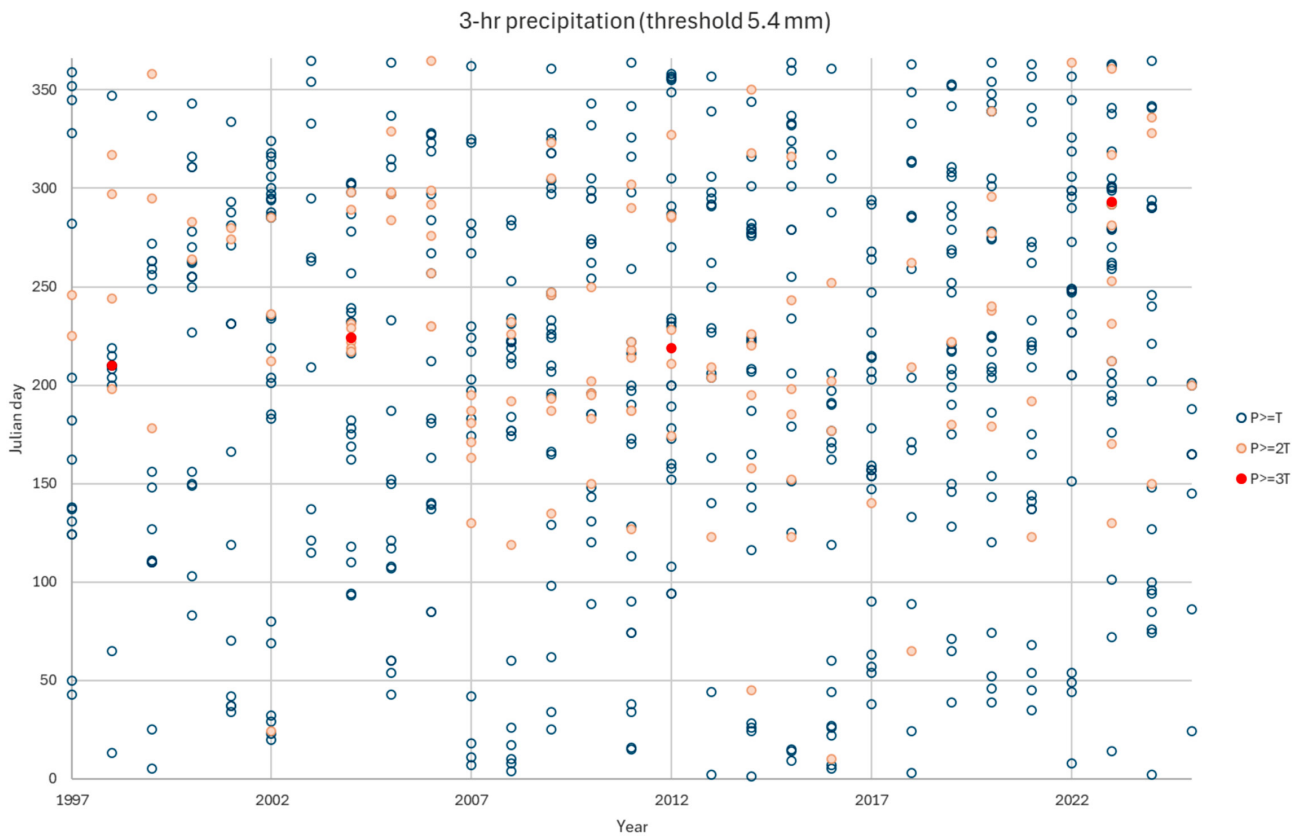


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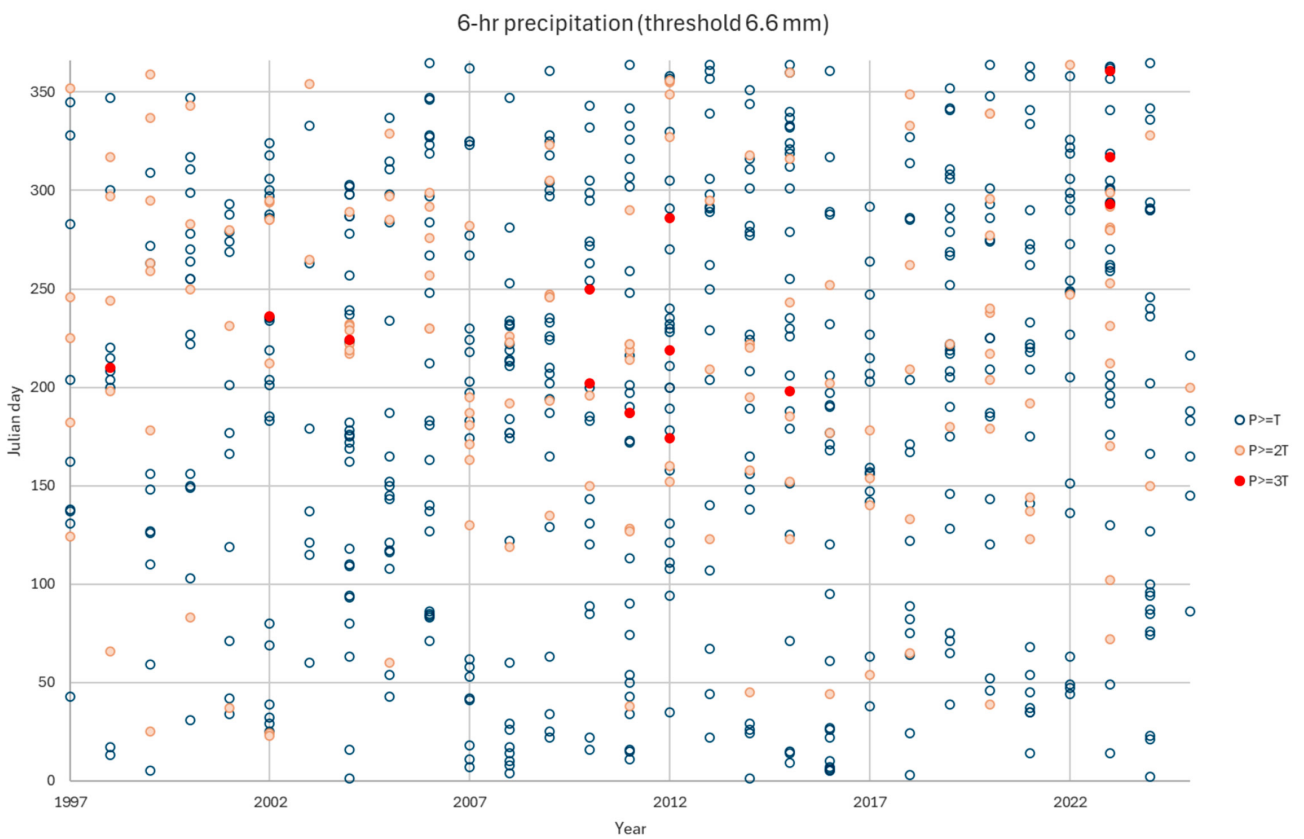


Figure D1.4: Plot illustrating historic variation in rainfall event magnitude, frequency and seasonality [data from MyInfield (JHI Invergowrie) 1997 – 2025] for D = 6 hr event duration and rainfall threshold T = 6.6 mm.

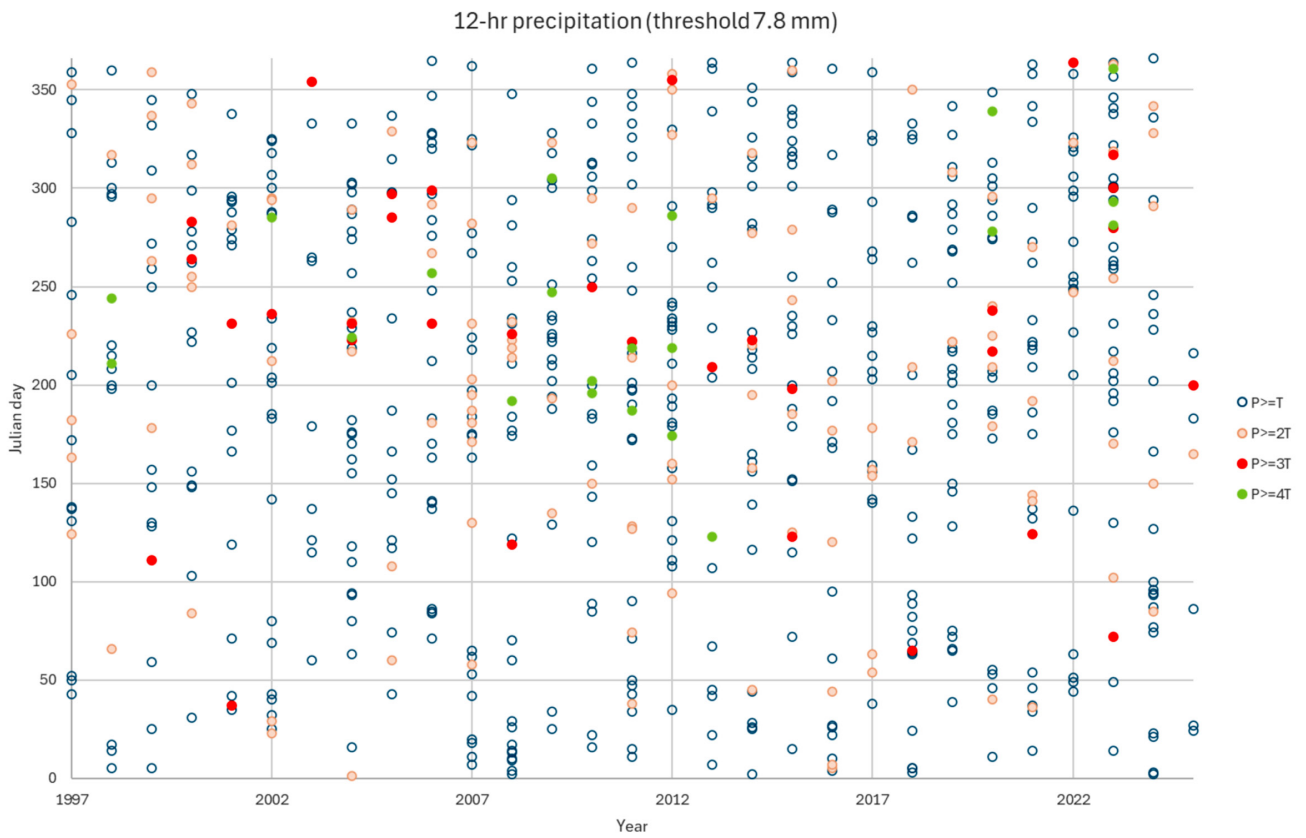


Figure D1.5: Plot illustrating historic variation in rainfall event magnitude, frequency and seasonality [data from Mylnfield (JHI Invergowrie) 1997 – 2025] for  $D = 12$  hr event duration and rainfall threshold  $T = 7.8$  mm.

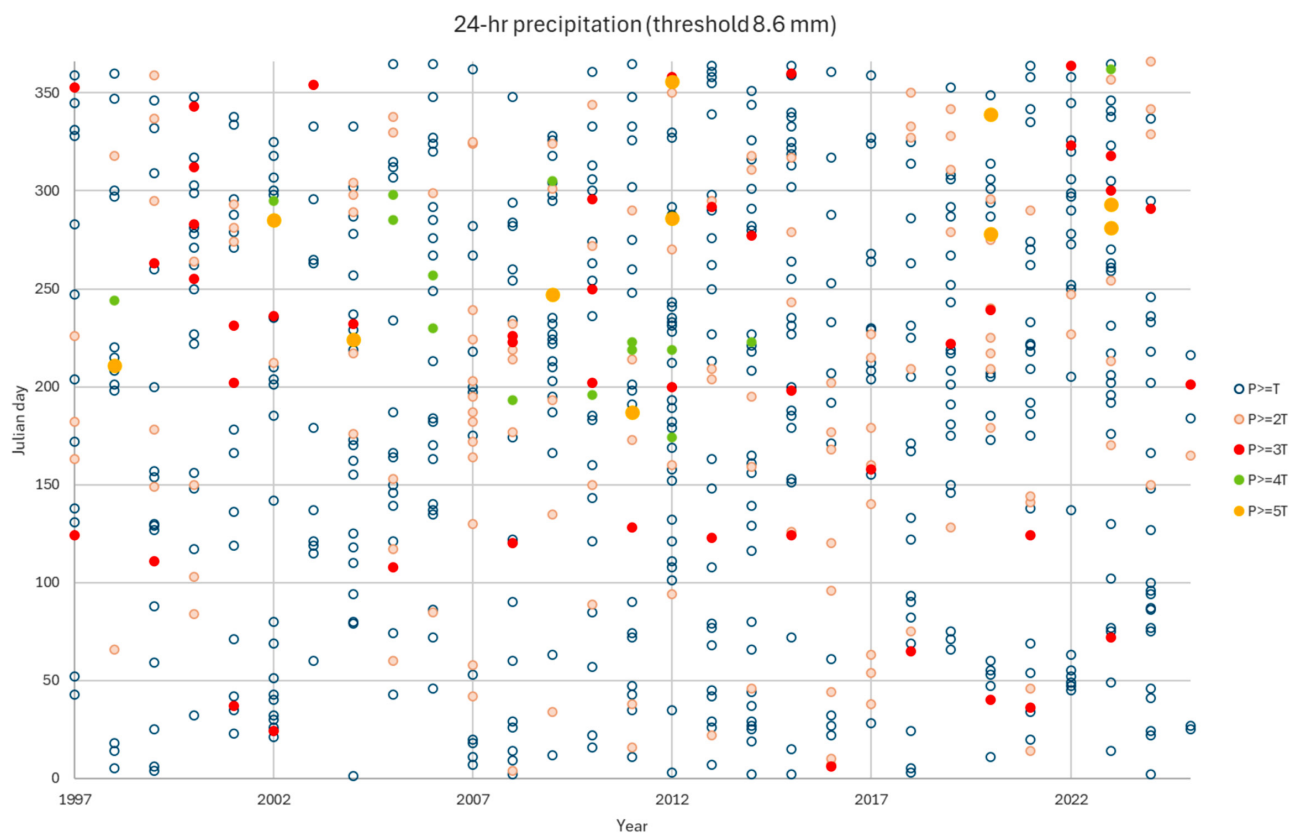


Figure D1.6: Plot illustrating historic variation in rainfall event magnitude, frequency and seasonality [data from Mylnfield (JHI Invergowrie) 1997 – 2025] for  $D = 24$  hr event duration and rainfall threshold  $T = 8.6$  mm.

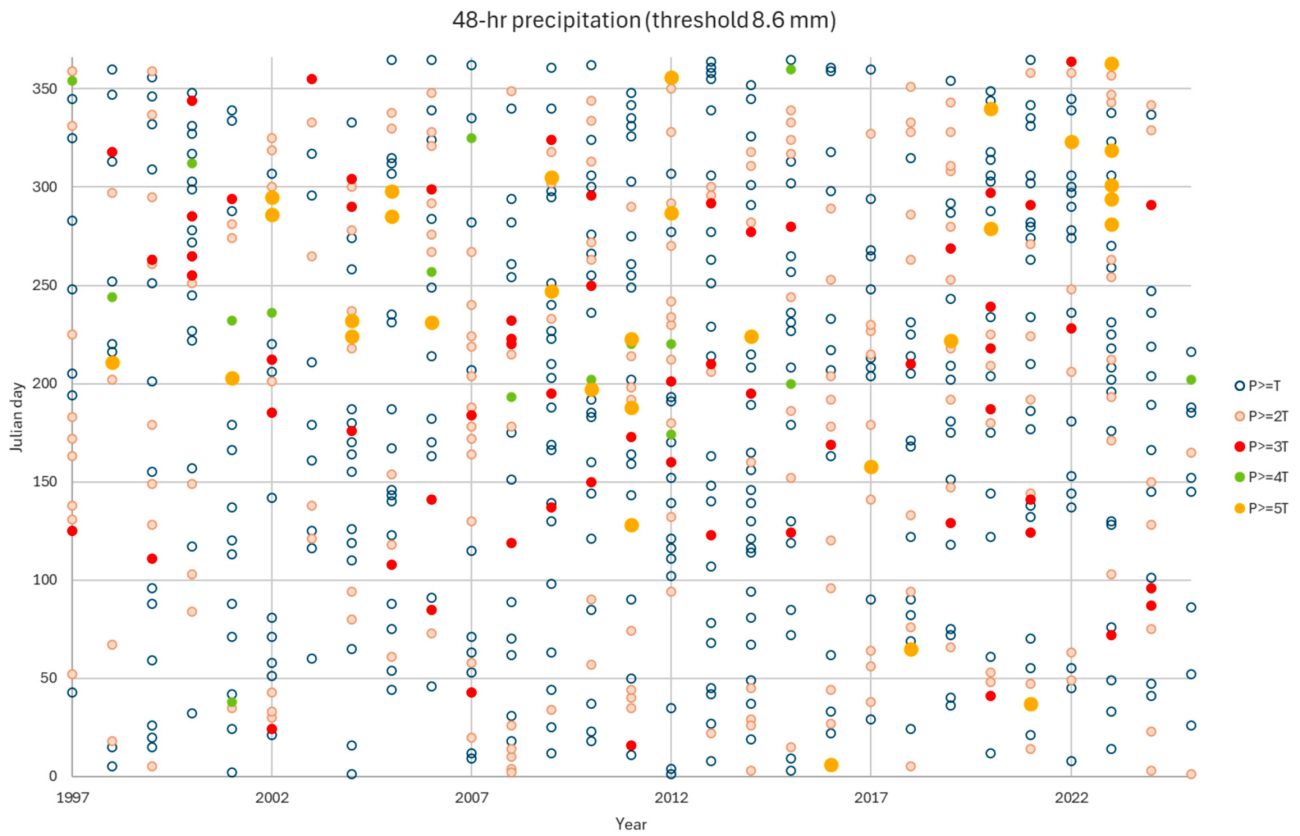


Figure D1.7: Plot illustrating historic variation in rainfall event magnitude, frequency and seasonality [data from MyInfield (JHI Invergowrie) 1997 – 2025] for D = 48 hr event duration and rainfall threshold T = 8.6 mm.

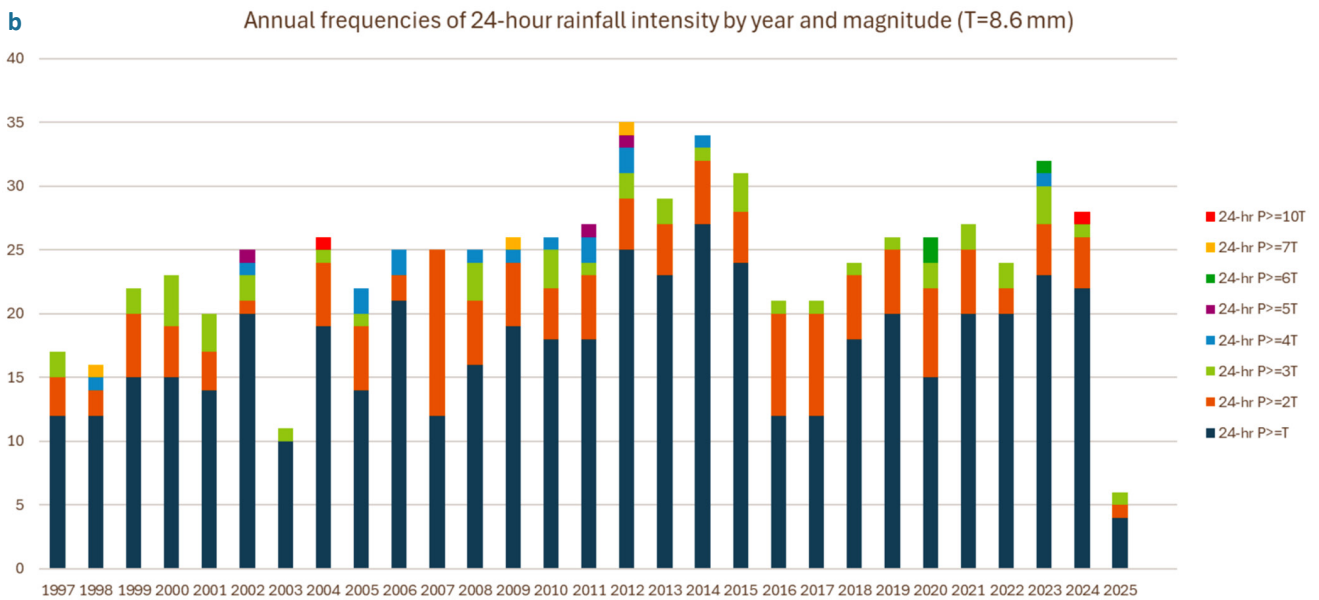
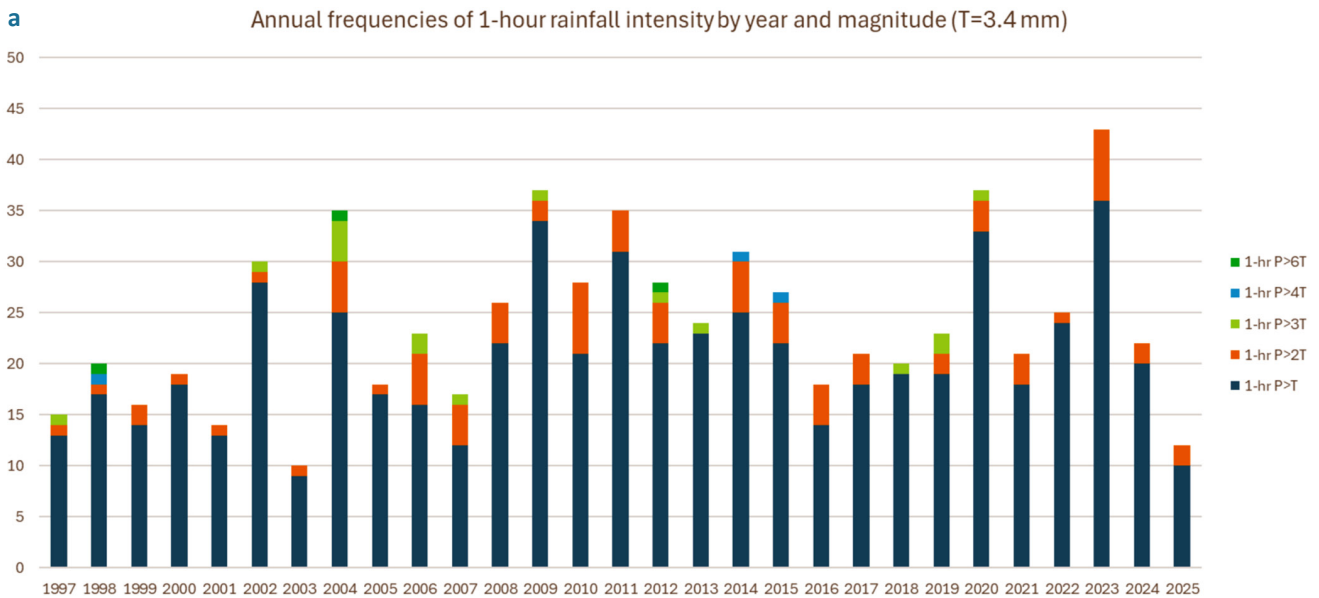


Figure D1.8: Annual event frequency histograms differentiated by D-hr rainfall event magnitudes P (presented as multiples of threshold T) for (a) D = 1 hr; T = 3.4 mm, and (b) D = 24 hrs; T = 8.6 mm

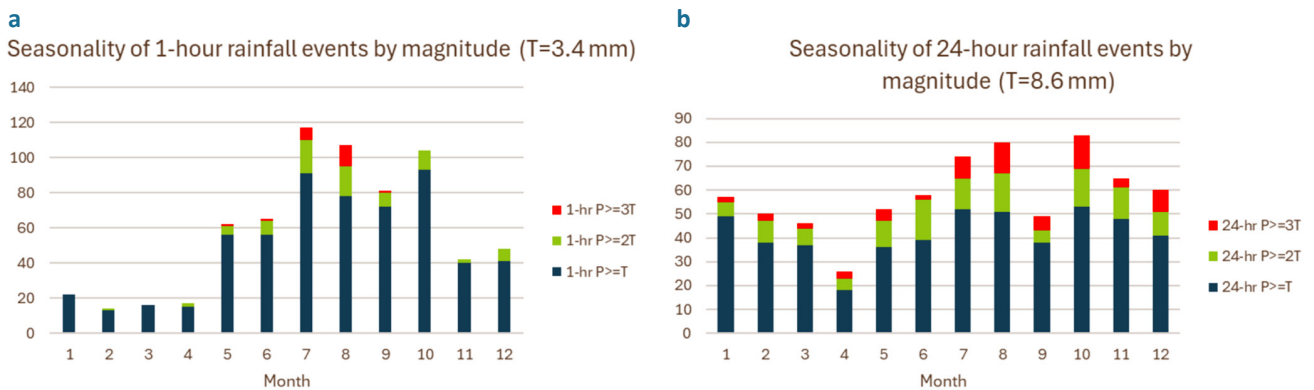


Figure D1.9: Histograms showing the seasonal distributions of D-hr rainfall event P (presented as multiples of threshold T) for (a) D = 1 hr; T = 3.4 mm, and (b) D = 24 hrs; T = 8.6 mm.



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