To support Wyevale Nurseries in understanding how their current rainwater harvesting system will perform with their planned increase in reservoir storage capacity and to inform needs for modifying their glasshouse and horticultural polytunnel structures to improve system performance and reduce groundwater (and mains water) use.

Business profile

Location	Kings Acre, Hereford
Main irrigated production system	Hardy ornamental nursery stock, pot plants,
Dominant system within polytunnels and greenhouses	Nursery stock
Existing RWH system	Yes

Helping to improve decision-making regarding RWH reliability

Using data collected from Wyevale Nurseries (Table 1), the RWH tool was set up and used to simulate daily irrigation demand taking into account the business location, production systems, protected area (polytunnel and greenhouse) characteristics and the existing rainwater harvesting system. The tool uses a daily time-step water balance model to estimate how much rainfall runoff can be usefully collected and stored, and then what proportion of seasonal irrigation demand can be met from rainwater runoff.

Table 1 Key input data for RWH tool.

Key component	**Description**
1. Rainwater harvesting configuration and hydrology	
Rainwater harvesting area (ha)	2.3 (15% of irrigated area)
Runoff efficiency (%)	90
Rainfall threshold for runoff production (mm)	1
Start and end dates for rainwater collection (months)	January-December
2. Plant water requirements and irrigation demand	
Type	Nursey stock
Irrigated area (ha)	15
Effective cropping area (%)	100
Timing of irrigation demand (months)	January-December (peak demand in May to July)
Evapotranspiration (ET) adjustment (%)	90% (reflecting balance of glasshouse, polytunnel and open beds)
Irrigation drainage/runoff fraction (%)	30
Emergency irrigation supply from RWH storage (hours)	48
3. Storage capacity	
RWH storage capacity (m^3)	3000 and 23000

Using the RWH tool to assess annual irrigation demand and rainwater harvested from polytunnels

Figure 1 shows the annual model output for current RWH at Wyevale, including the volume of rainwater that could be usefully collected [**black line**], the gross irrigation water

demand (including drainage / runoff losses) [**red line**], and the volume of harvested rainwater used to meet irrigation demand [**blue shaded area**]. The simulated gross irrigation demand is around 100-130,000 m^3/yr of which 90-120,000 m^3/yr is met from alternative water sources (mostly groundwater). The site has little potential to utilitse more rainwater from the current collection area with the existing reservoir storage capacity (red line). Figure 2 shows that a proportion of the harvested rainfall overflows [**medium blue**], especially between November and January.

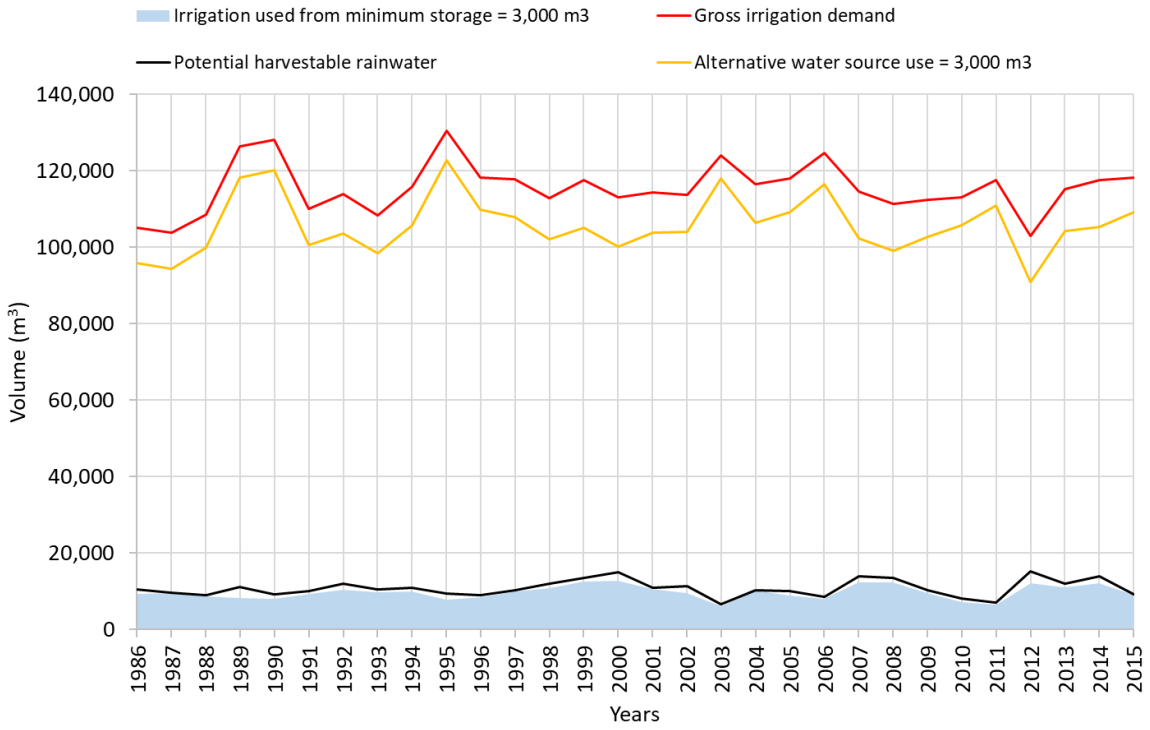


Figure 1 Annual RWH summary analysis for Wyevale, Kings Acre (current).

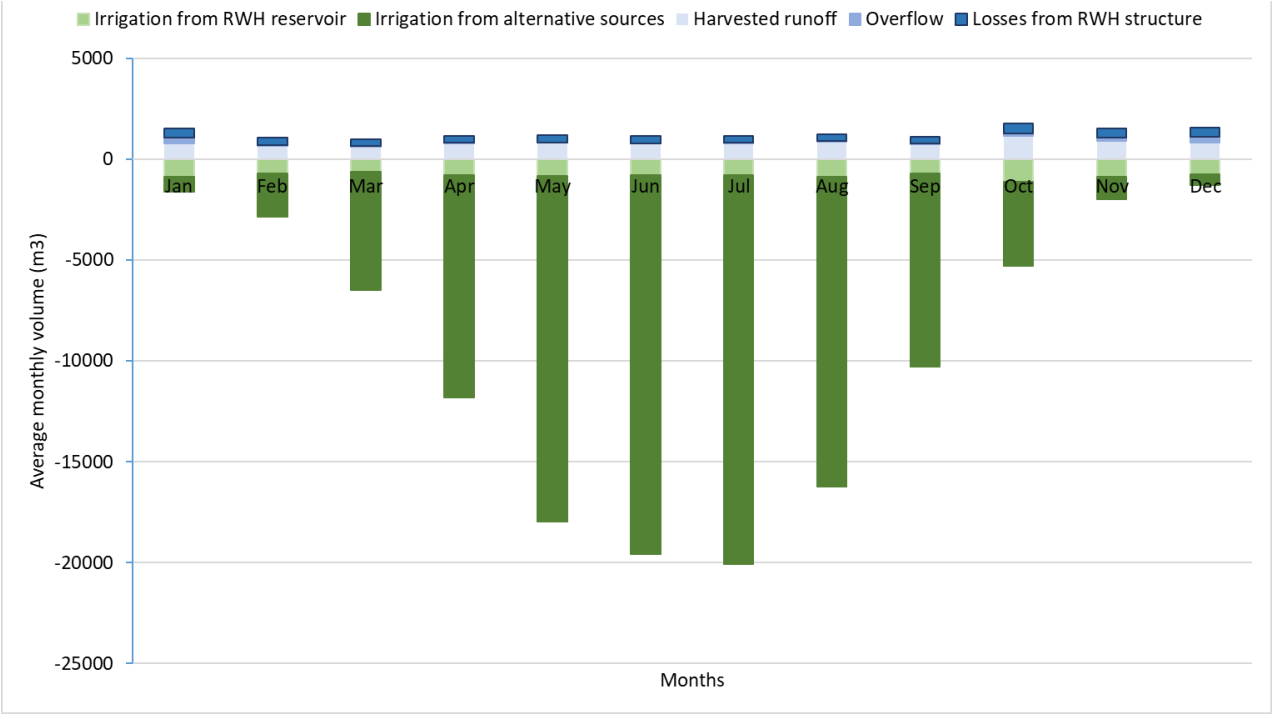


Figure 2 Monthly average water balance using RWH tool (current)

RWH performance metrics

Two RWH performance metrics were calculated. An irrigation deficit is assumed to be any proportion of demand not met by the available water supply from harvested rainwater. The water saving efficiency is the percentage of the total amount of irrigation water demanded that is supplied from the RWH system. Figure 2 and Figure 3 show the two metrics for the current and future storage capacities.

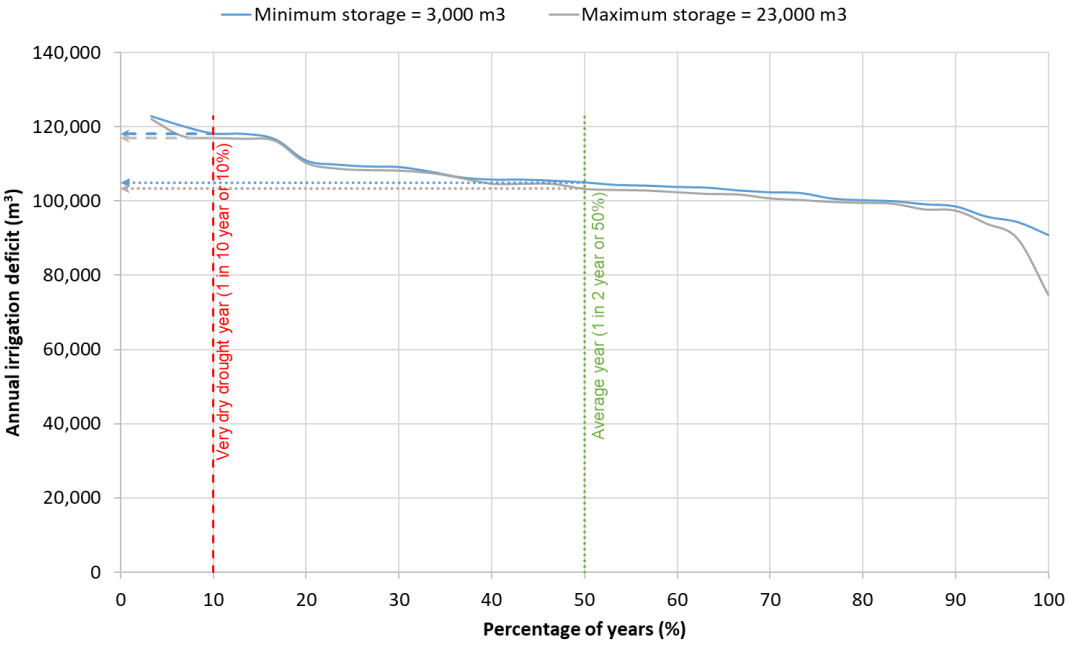


Figure 3 Irrigation deficit for current and future storage capacities

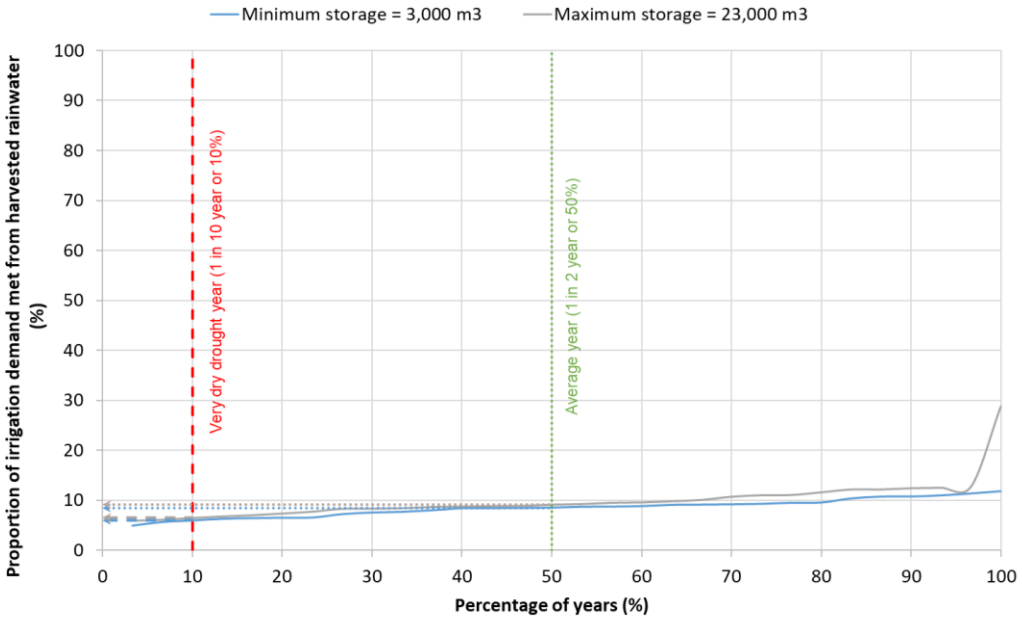


Figure 4 Water saving efficiency for current and future storage capacities

The figures suggest that, if the distribution of annual harvestable rainwater from RWH system follows the 30-year historical weather data, the planned increased reservoir capacity makes only small beneficial changes to both the RWH irrigation deficit (Fig. 3) and the percentage of the total amount of irrigation water demanded supplied from the RWH system (Fig 4).

Key implications for RWH at Wyevale

The current rainwater harvesting area appears to be insufficient to re-fill the planned increased reservoir size, with the simulated reservoir not re-filling to capacity in any of the 30 years simulated. This emphasises the need to plan the sizing of the new reservoir in conjunction with the RWH system in order to efficiently utilise the increased storage capacity, reduce reliance of groundwater and reduce risk from supply interruptions.

The tool suggests that the rainwater harvesting collection area needs to be approximately quadrupled (from 15% to 60% of the irrigated area) in order to refill the reservoir in most years (Figure 5 – upper row), although there will still be a need for around 70,000-80,000 m^3 of additional water supply in most years.

The default RWH tool only captures rainfall falling on the collection area and therefore is likely to under-estimate the total capture which is a mix of rainwater and irrigation drainage/runoff from the outdoor lined beds (20694 m²) and glasshouses (2400 m²). The right-hand column in Figure 5 shows the effect of including the irrigation drainage – it makes little difference to the reservoir levels (as most filling occurs in the winter when irrigation needs, and therefore, irrigation drainage/runoff, is low), but increases the water saving efficiency as more harvested water is able to utilised from the reservoir

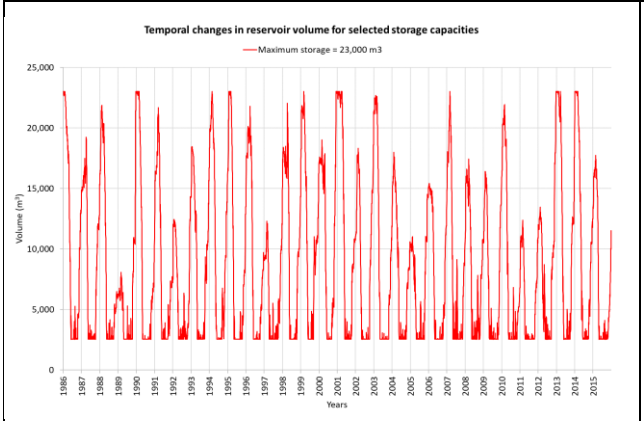
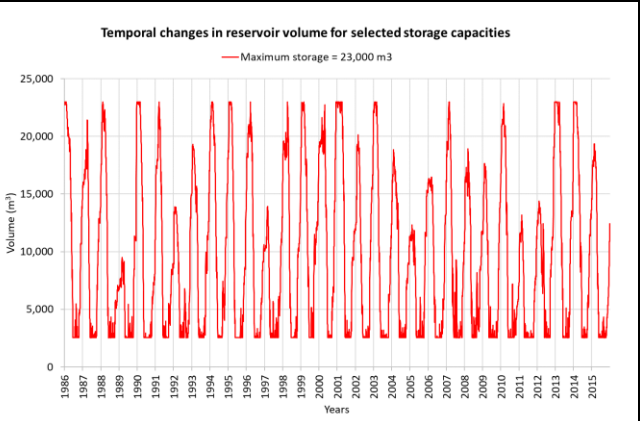
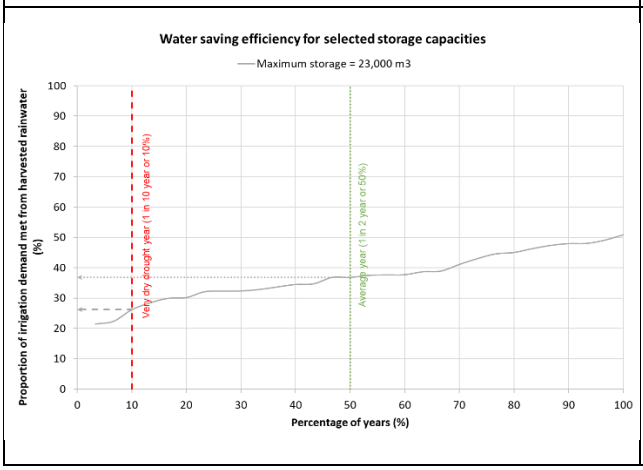
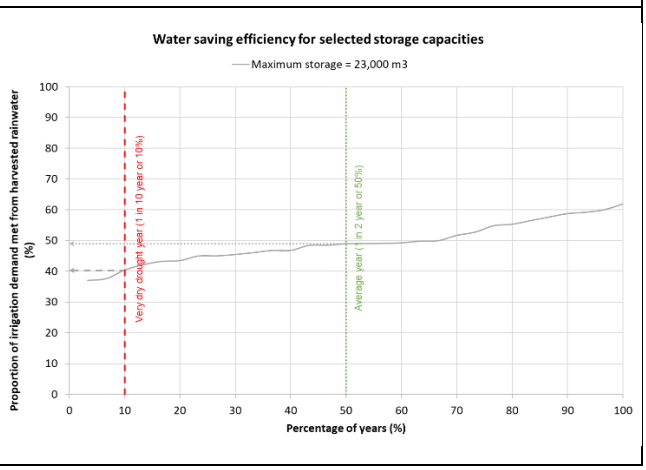
Harvesting rainwater only	Harvesting rainwater and irrigation drainage
	
	

Figure 5 The (upper row) reservoir volume and (lower row) the proportion of irrigation met from the RWH system when the collection area is quadrupled to 60% of the irrigated area.