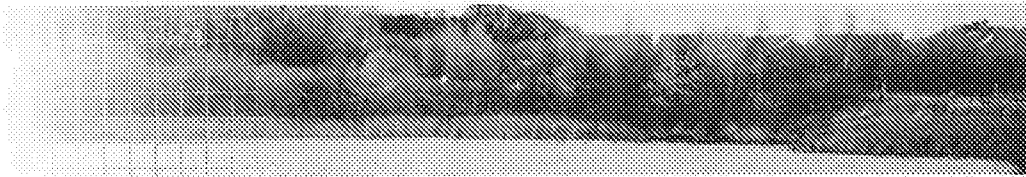


UK Sustainable Drainage Guidance & Tools



HR Wallingford
Working with water



[Home](#) [Irish SuDS](#) [Tools](#) [Information](#)

[Drainage Tools](#) [Other Industry Tools](#)

[Greenfield](#)

☒ [Runoff](#)

[estimation](#)

[Stormwater](#)

☒ [Storage](#)

[analysis](#)

[RWH tank](#)

☒ [Sizing](#)

[for 1](#)

[property](#)

[RWH tank](#)

☒ [Sizing](#)

[for multiple](#)

[properties](#)

[Site](#)

☒ [Evaluation](#)

[for SuDS](#)

☒ [SuDS cost](#)

[calculator](#)

[Joint](#)

☒ [Probability](#)

[analysis](#)

☒ [Infiltration](#)

[design](#)

[Water](#)

☒ [Quality](#)

[SuDS](#)

[calculator](#)

Rainwater Harvesting Tank Sizing

-for Individual Residential Properties

Site name: Felpham Road

Site location: Felpham

House reference: 114

Roof type: Standard pitch ▼

No. of bedrooms: 2 ▼

Default values

Editable values

No. of occupants

1.74

3

Standard deviation of occupants

0.73

3

Roof area (m²)

Not available

69

Daily consumption per person (l/p/d)

40

Average annual rainfall depth (mm)

Not available

40

No. of rainfall events per year

150

Depression storage loss (mm)

0.5

Runoff coefficient

0.9

Filter coefficient

0.9

Design rainfall depth (mm)

60

Calculate

Report

Reset

Ratio Y/D: 0.04

Tank size (m³): 2.9

Compliance (%): 100

Help Information

Rainwater Harvesting Tank Sizing for Individual Residential Properties

This tool, developed by [HR Wallingford](#), aims to assist in the sizing of rainwater harvesting tank for an individual house. The ratio of annual Yield/Demand (hereafter referred to as Y/D) is used to evaluate the viability of the rainwater harvesting tank for effective stormwater management. The 'Yield' is estimated by multiplying the annual effective rainfall depth by the contributing roof area, while 'Demand' is estimated by multiplying the house occupancy by the per capita daily consumption of non-potable water.

In the case of Y/D not exceeding 0.9 (which indicates there is normally empty space in the tank for storing rainfall runoff), the tank storage size and its likelihood of compliance are calculated by the "[Kellagher and Gerolin Methodology](#)". If Y/D exceeds 0.9, the rainwater harvesting system is considered to be suitable for non-potable water supply only, and the tank size is calculated based on the standard approach where the volume required is the lesser of 5% of the annual Yield (Y) or 5% of the annual Demand (D).

[Back to Top](#)

Site name

Please name the site being evaluated. The site name will be recorded in the generated report.

[Back to Top](#)

Site location

Please give an appropriate location for the site. The site location will be recorded in the generated report.

[Back to Top](#)

House reference

Please assign a unique house identification reference to the property for which the rainwater harvesting tank size is to be calculated. This ID will be recorded in the generated report.

[Back to Top](#)

Roof type

Roof types vary, but it is assumed that there are two basic types which have a key influence on runoff yield in relation to rainwater harvesting. The 'Standard Pitch' option represents roofs with high runoff proportions and would include sheet metal roofs, slate, concrete tiles, etc. The 'Green Roof' option is a catch-all for high interception, low runoff proportion roofs.

[Back to Top](#)

No. of bedrooms

Users can select a value from 1 to 5.

[Back to Top](#)

Roof area (m^2)

The roof area is the connected area draining to the rainwater harvesting tank. The plan area should be used. It should be noted that there is no default value available for this entry i.e. it must be entered by the user.

[Back to Top](#)

No. of occupants/Standard deviation of occupants

Since actual occupancy of any particular house type varies in time, the mean occupancy rates for houses with a certain number of bedrooms are applied for calculating the tank size. The Standard Deviation of Occupants indicates the variance of the occupants (ie the variability of the possible number of occupants), which the tank compliance calculation uses as an input. The tool assumes the mean and standard deviation of occupants as shown in the table below. However the option exists of over-riding these assumptions by stating an occupancy level ranging from 0.5 to 8 and a user calculated standard deviation level. It should be noted that if a user defined value for the mean is given, then the standard deviation value should also be provided.

No. of Bedrooms	No. of Occupants per house	Standard deviation of occupants per house
1	1.39	0.56
2	1.74	0.73
3	2.35	1.02
4	3.02	1.17

5	3.66	1.32
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[Back to Top](#)

Daily consumption per person (l/p/d)

This is an estimated overall domestic non-potable water consumption rate per day on the basis of regular daily use throughout the year. The default consumption rate consists of 21 litres per person for toilet flushing, 19 litres per person for washing machines and 0 litres per person for other regular uses, which are based on [Waterwise information \(2010\)](#). The tool allows users to over-ride the value.

[Back to Top](#)

Average annual rainfall depth (mm)

This represents the annual average rainfall depth. This can be estimated for a site using the Stormwater Storage Tool which has a map layer which provides this information, or it can be obtained from FSR or FEH mapping. It should be noted that there is no default value available for this entry ie it must be entered by the user.

At present, it is assumed that climate change will not have a significant influence on total annual depth of rainfall. The methodology presumes that there is not a great deal of difference in rainfall depth between the seasons. This latter assumption is predicted to change to wetter winters and drier summers. This means that the method will become more conservative in dealing with summer storms and a greater chance of failure in winter. However the value of controlling stormwater volume is highest in summer (summer flooding and water quality in rivers) so this trend is seen as being acceptable for using this procedure.

It should be understood that all rainfall is important for assessing Yield, while one extreme event is used for the design event for stormwater management.

[Back to Top](#)

No. of rainfall events per year

This is an estimated value, This is an estimated value, indicating how many rainfall events generally occur per year. It is used for estimating total annual depression storage losses. It is advised that the range should be between 100 and 200 events, and is a function of the location of the site.

[Back to Top](#)

Depression storage loss (mm)

)

This represents the initial wetting loss for each rainfall event. The default value is determined by the Roof Type. For a Standard Pitch roof, it is 0.5 mm, whilst for a Green Roof, it is 3.0 mm. The valid user-defined values range from 0.1 mm to 1.0 mm for a Standard Pitch roof,

and from 1.0 mm to 10 mm for a Green Roof or Flat Roof.

As total yield is based on net runoff and as there are a minimum of around 150 events a year across much of UK, 'depression storage' losses (ie rainfall depths before runoff commences) will amount to quite a large total rainfall depth over the year ie. 75mm reduction in the net rainfall from standard pitched roofs if 0.5mm depression storage is assumed. Caution should be taken in using high depression storage values for surfaces like green roofs as seasonal runoff characteristics will be linked to both antecedent conditions and evapotranspiration characteristics.

[Back to Top](#)

Runoff coefficient

This represents the percentage of rainfall loss including infiltration, evapotranspiration, splash etc. The default value is determined by Roof Type. For Standard Pitch, the default is set at 0.9 whilst for a Green or Flat Roof, it is 0.7. The valid range for user-defined entries is from 0.5 to 1.0.

General guidance on roof runoff for rainwater harvesting is provided by BS8515 ([link](#)). Users should be cautious when evaluating systems for roofs with high losses, particularly green roofs, as the individual design of the roof will have a significant influence on the hydraulic behaviour. Although the facility to assess green roofs has been provided, the runoff assumptions are unlikely to be representative of the real system behaviour. A time series based model would be needed to carry out this detailed analysis to take account of variations in evapotranspiration.

It should also be noted that a simplification made in this tool is that the Runoff Proportion Coefficient for the Annual Rainfall Depth and for the Design Rainfall Depth are the same. However, in reality they are likely to be different.

[Back to Top](#)

Filter coefficient

This represents the percentage of the rainfall lost in the filter device within the rainwater harvesting system. The valid range for user-defined entries is from 0.75 to 1.0.

The suppliers of the rainwater harvesting system should advise on the performance of the filter, both for ordinary events as well as high intensity rainfall.

It should be noted that a simplification made in this tool is that the Filter Coefficient for the Annual Rainfall Depth and for the Design Rainfall Depth are the same. However, in reality they are likely to be different.

[Back to Top](#)

Design rainfall depth (mm)

This is the design storm rainfall event depth that requires control by the rainwater harvesting tank. The default value is based on the present day 1:100yr 6hr event. This is a value of

around 60mm for much of the UK.

[Back to Top](#)

Ratio Y/D

This represents the ratio of Yield (roof runoff volume having taken account of any losses) over Demand (total consumption volume by occupants in the property). When it is no more than 0.9 the tank can be used for both stormwater control and water supply. Otherwise, it is considered feasible only for non-potable water supply and not for stormwater management.

[Back to Top](#)

Tank size (m^3)

This is the storage volume calculated using the "Kellagher and Gerolin Methodology" using all the input data above when Y/D is no more than 0.9; otherwise the sizing for non-potable water supply only is based on that the volume required is the lesser of 5% of the annual Yield (Y) or 5% of the annual Demand (D).

[Back to Top](#)

Compliance

This is the estimated probability that a property of the type specified will comply with storing the roof runoff from the design event; ie that spillage will not occur from the rainwater harvesting tank. The probability will be less than 100% unless the number of occupants is known and fixed.

[Back to Top](#)

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