SOAKAWAY DESIGN

Date:	26/10/2017
Issue:	O
Project:	New Road, Staincross, Barnsley
Client:	
Brief:	Design a soakaway to receive stormwater from 71.4 m^2 impermeable surface for a site at New Road, Staincross, Barnsley.

Summary of Soakaway

The Table below provides a summary of the required parameters of the soakaway. A calculation summary is provided in Appendix A.

Impermeable Area:	71.4 m^2
Length	3.3 m
Width:	1.0m
Depth:	2.5 m
Inflow Pipe Depth:	1.0 m
Effective Depth:	1.5 m (based on the difference between the depth, and the inflow pipe depth)
Free Volume:	30 per cent (based on an average value for granular fill)
Time taken to Discharge from Full to Half-Empty (T_{F-HE})	2.19 hours (approx. 2 hours, 11 minutes)

Appendix A: Calculation Summary

Calculations based on guidance and procedure contained within 'BRE Digest 365: Soakaway Design'.

Design Basis

Table 1 provides the input parameters used for the design basis.

Table 1: Input Parameters

Input Parameter	***Value (Unit)***
Rainfall Ratio[1] *(r)*	*0.37*
Impermeable Area	*71.4 m^2*
Width	*1.0 m*
Depth:	*2.5 m*
Inflow Pipe Depth:	*1.0 m*
Effective Depth	*1.5 m*
Free Volume	*30 per cent*

'Design Basis' Equation:

$$I - O = S$$

Where:

I: Inflow from Impermeable Area to Soakaway (m^3);

O: Outflow from Soakaway infiltrating Surrounding Soil (m^3); and,

S: Required Storage in the Soakaway (m^3).

Inflow from Impermeable Area to Soakaway

'BRE Digest 365: Soakaway Design' notes that a design storm should have a 10-year return period.

Table 2 provides the 10 year storm rainfalls for a range of storm durations.

Table 2: 10-Year Storm Rainfall for a range of Storm Durations

Storm Duration (min)	***M10-D (mm)***
10	*12.5*
15	*15.3*
30	*19.7*
60	*24.8*
120	*30.2*
240	*36.0*
360	*40.0*
600	*44.9*

'Inflow to Soakaway' Equation:

$$I = A \times R$$

Where:

I: Inflow from Impermeable Area to Soakaway (m^3);

A: Impermeable area (m^2); and,

R: 10-Year Storm Rainfall (m).

Based on Table 2, Table 3 provides the inflows from the impermeable area for a range of storm durations.

[1] Based on Figure 1 (Ratio of 60 minute to 2 Day Rainfalls of 5 Year Return Period) from BRE Digest 365: Soakaway Design.

Table 3: Inflows from the Impermeable Area

Storm Duration (min)	***I (m^3)***
10	*0.9*
15	*1.1*
30	*1.4*
60	*1.8*
120	*2.2*
240	*2.6*
360	*2.9*
600	*3.2*

Outflow from Soakaway Infiltrating Surrounding Soil

'Outflow from Soakaway' Equation:

$$O = a_{s50} \times f \times D$$

Where:

O: Outflow from Soakaway infiltrating Surrounding Soil (m^3);

a_{s50}: Internal surface area of soakaway to 50 per cent effective depth (excluding base area) (m^2);

f: Infiltration rate (m/s); and,

D: Storm duration (s).

Infiltration Rate (Calculated):

$f = V_{p75-25} / (a_{p50} \times t_{p75-25})$

Where:

V_{p75-25}: Effective storage volume in trial pit between 75 per cent and 25 per cent effective depth (m^3);

a_{p50}: Internal surface area of trail pit to 50 per cent effective depth (including base area) (m^2); and,

t_{p75-25}: Time for water level to fall from 75 per cent to 25 per cent effective depth (s).

Infiltration tests undertaken. Two tests undertaken. Data provided via telephone 25/10/2017 (see Appendix B). Data for worst case used. Based on this data:

$f = 0.42 / (3.59 \times 8013) = 1.46 \times 10^{-5}$ m/s.

Required Storage in the Soakaway

'Required Storage' Equation:

$$S = L \times W \times E \times F$$

Where:

S: Required Storage in the Soakaway (m^3);

L: Length of soakaway (m);

W: Width of soakaway (m);

E: Effective depth of soakaway (m);

F: Free volume.

Based on these parameters, Table 4 provides the required length of the soakaway for a range of storm durations.

Table 4: Required Length of Soakaway for a range of Storm Durations

Storm Duration (min)	***L (m)***
10	*1.9*
15	*2.3*
30	*2.8*
60	*3.2*
120	*3.3*
240	*2.9*
360	*2.6*
600	*2.0*

Based on Table 4, the required length of the soakaway is 3.3 m.

To confirm the parameters of the soakaway are appropriate, 'BRE Digest 365: Soakaway Design' notes that the soakaway should discharge from full to half full volume with 24 hours.

Based on the parameters of the soakaway, the calculated time to empty from full to half full storage volume is approx. 2 hours, 11 minutes. This is within the required time.

Appendix B: Data provided to Calculate Infiltration Rate

Data Provided by Telephone (25/10/2017)

Hole Size: 2400 mm × 1000 mm

Hole Depth: 750 mm

400 mm water added at 9:37

Top 25 per cent (100 mm) dropped by 10:09

Middle 50 per cent (200 mm) dropped by 12:23

Empty by 14:35

400 mm water added at 10:05

Top 25 per cent (100 mm) dropped by 10:34

Middle 50 per cent (200 mm) dropped by 13:00

Empty by 15:32