**Agent:**

Sedum Cottage, Owen Street, Pennar,
Pembroke Dock, Pembs, SA72 6SL
Tel: **07826 705493**
E-mail: mail@sureline.org.uk

**Date & Revision No:** 27th July 2023 v1.0

**Applicants:** Mr Owen Jones

**Project:** Cow housing and covered feeding shed

**Site address:** Pant-y-Grwyndy, near Cardigan, SA43 3NP

# Preliminary surface water drainage proposal

## Basic Requirement

From January 2019 all new developments in Wales that involve construction of a new house, or with a construction area of 100 m² or more, are required to incorporate Sustainable Drainage Systems (SuDS) for disposal of surface water in accordance with the Statutory SuDS standards published by the Welsh Ministers. The SuDS scheme must be approved by the Local Authority acting in its SuDS Approving Body (SAB) role before construction work begins. 6 key criteria must be met by the scheme, including:

1) Destination of surface water run-off
2) Hydraulic control of surface water run-off
3) Water quality
4) Amenity
5) Biodiversity and
6) Design with a view towards construction, operation, maintenance and structural integrity.

## Description

The current proposal involves the construction of a new cow housing and covered feeding building with a footprint of 2,630 m² and a profiled sheet steel roof.

## Proposal

This document proposes an initial indicative design for a SuDS system, based on a generic mid-range infiltration figure of $5 \times 10^{-5}$ m/s pending on-site testing.

Calculations have been carried out for the proposed building on the basis of the surface water drainage system discharging to two rubble-filled soakaways, assuming 30% free volume and generic infiltration characteristics as above.

## Caveat

The proposed scheme is provisional and will be reviewed on receipt of site-specific infiltration test data, prior to submission of a formal SuDS scheme. If the infiltration characteristics are better or worse, the soakaway sizes may be reduced or enlarged accordingly. If ground conditions are not suitable for a soakaway, alternative SuDS components (such as swales) may need to be substituted.

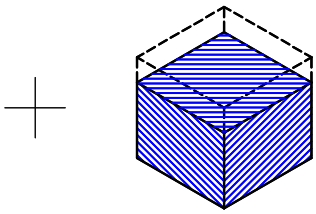
# Soakaway sizing methodology

When it rains, water runs quickly off hard, impermeable surfaces such as slate or zinc roofs, tarmac or block paving. Run-off from one site can become part of a flash flood on another; especially if cumulative with other run-off. The goal of sustainable surface water design is to manage surface water responsibly on site as much as possible; avoiding pollution and run-off elsewhere.

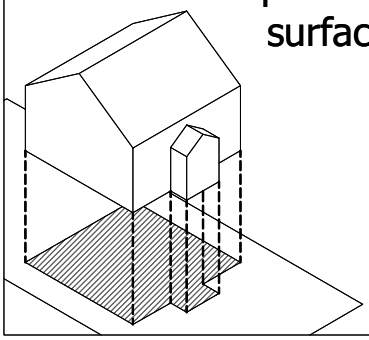
Water will often be channelled into a soakaway quicker than it can soak into the ground, leading to water building up inside the soakaway. A soakaway should be sized to cope with this build-up from a range of rainstorms without over-flowing; from short heavy downpours to lengthy but less intense rainfalls. The size needed will vary from site to site, depending on the total area of hard surfacing that is drained into it, the type of water storage and the permeability of the ground.

To find the size needed we estimate the difference between the inflow and outflow for a range of storm durations from 5 minutes to 1 day based on 1-in-100-year storms, plus an allowance for the effects of climate change.

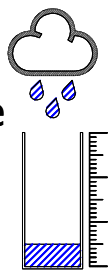
## INFLOW

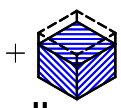


area of impermeable surfaces...



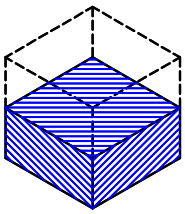
...multiplied by predicted extreme storm rainfall...



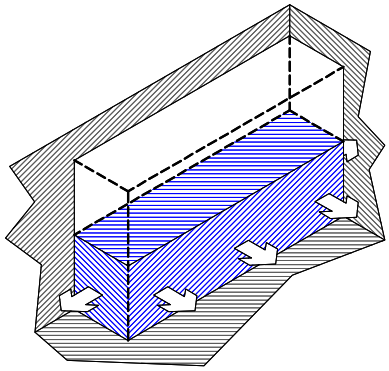


...plus allowance for climate change

## OUTFLOW



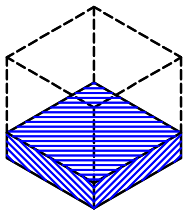
surface area of the soakaway (when $\frac{1}{2}$ full)...



...multiplied by the permeability of the ground...

...multiplied by how long the storm lasts

## STORAGE VOLUME REQUIRED



Calculations are run for various different storm lengths.

The volume required is the highest storage figure, "**S**", returned by any of the sets of calculations.


sureline DESIGN SERVICES LTD
Tel: 07826 705493
E-mail: mail@sureline.org.uk


Site: Pant-y-Grwyndy, Cardigan
Plot: Cow housing shed
Client: Mr Owen Jones

Drgs: Storage sizing methodology
File: Pant-y-Grwyndy
Scale: not to scale
Date: 25/07/23 Drn: MDH
Drg ref: 601 A

## CALCULATION OF STORAGE VOLUME REQUIRED

The volume of free space in the soakaway should be sufficient to temporarily buffer the amount of run-off flowing into it with the amount soaking into the ground.

**STORAGE 'S' is calculated as:**

$S = I_{CC} - O$

where:

| | | | |
|---|---|---|---|
| **S** | = | **STORAGE** | storage volume needed to temporarily balance inflow and outflow |
| **$I_{CC}$** | = | **INFLOW** | from the impermeable areas drained to the soakaway plus an allowance for impact of climate change |
| **O** | = | **OUTFLOW** | infiltrating into the soil during rainfall |

**Soakaway properties:**

| | | | |
|---|---|---|---|
| Length: | = | 100.0 | m |
| Width: | = | 1.8 | m |
| Depth: | = | 2.5 | m |
| % free volume: | = | 30% | |
| Storage volume available: | = | 131.25 | m³ |

| | |
|---|---|
| **Client:** | **Owen Jones** |
| **Site:** | **Pantygrwndy Farm** |
| **Plot:** | **Cubicle housing** |
| **Date:** | **25/07/23** |
| **Version:** | **v1.0** |

**OUTFLOW 'O' is calculated as:**

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

where:

| | | | | | | |
|---|---|---|---|---|---|---|
| **$a_{s50}$** | = | the **AREA** of the **SIDES** of the storage volume when filled to **50%** of its effective depth | **$a_{s50}$** = | 76.31 | m³ | *((2 x length + 2 x width) x (depth / 2) x % free volume)* |
| **f** | = | **INFILTRATION** rate that water soaks into the ground | **f** = | 5.0 | x 10-5 m/s | *(indicative figure pending percolation tests)* |
| **D** | = | **DURATION** of the storm in minutes (see "Storm Duration" column below) | | | | |

**INFLOW '$I_{CC}$' is calculated as:**

$I_{CC} = I + CCA$

where basic inflow '**I**' is calculated below and is modified with a Climate Change Allowance '**CCA**'.

Climate Change Allowance to be added = 30% *(from BRE digest 365, 2016 edition)*

$I = A \times R$

where:

| | | | |
|---|---|---|---|
| **A** | = | **AREA** | the area of impermeable surfaces drained to the soakaway |
| **R** | = | **RAINFALL** | the total rainfall in a design storm (based on "worst case" scenario of 1-in-100-year storms). |

**Drained area:**

| | | | | |
|---|---|---|---|---|
| Floor area of new barn | = | 2630 | m² | *(from plans)* |
| **M5-60** | = | 20 | mm | *(from BRE digest 365, 2016 edition)* |
| **'r'** | = | 0.27 | for the site | *(from BRE digest 365, 2016 edition)* |

**MX-D** = Notation indicates a storm lasting for '**D**' minutes and with a return period of '**X**' years.
Rainfall for **M5-60** (60 minute storm with 5 year return period) is used as the basis for the calculation (taken as 20mm for all parts of UK).
**M5-D** is calculated for a range of storm durations (5 mins to 1 day) and adjusted for the site location (**M5-60** x factor **Z1**, based on ratio '**r**').
Total rainfall '**R**' (**M100-D**) is derived from calculated **M5-D**, multiplied by factor **Z2**. (see reference sheet for **Z1** and **Z2**)

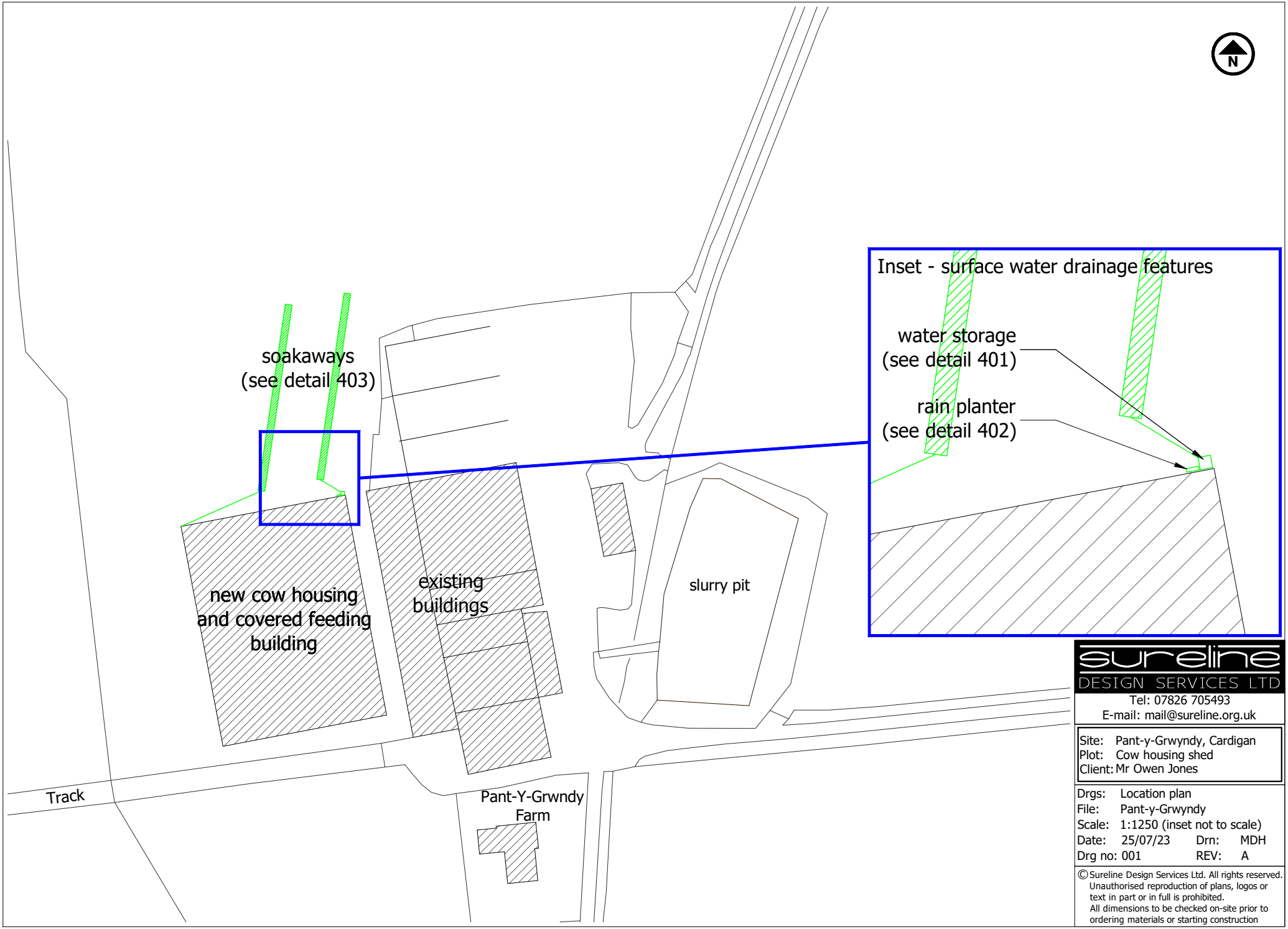
| | | *(RAINFALL CALCULATIONS)* | | | |
|---|---|---|---|---|---|
| **Storm duration** | | **Factor Z1 for 'r' of** | **M5-D min =** | **Factor Z2** | **M100-D min = R** |
| **D** | **D (min)** | **0.27** | **20mm x Z1** | **(Eng/Wal)** | **(mm)** |
| **5 minutes** | 5 | 0.33 | **6.6** | 1.91 | **12.6** |
| **10 minutes** | 10 | 0.48 | **9.6** | 1.91 | **18.3** |
| **¼ hour** | 15 | 0.58 | **11.6** | 1.95 | **22.6** |
| **½ hour** | 30 | 0.76 | **15.2** | 2.00 | **30.4** |
| **1 hour** | 60 | 1.00 | **20.0** | 2.00 | **40.0** |
| **2 hour** | 120 | 1.27 | **25.4** | 2.01 | **51.1** |
| **4 hour** | 240 | 1.64 | **32.8** | 1.97 | **64.6** |
| **6 hour** | 360 | 1.88 | **37.6** | 1.97 | **74.1** |
| **10 hour** | 600 | 2.24 | **44.8** | 1.94 | **86.9** |
| **24 hour** | 1440 | 3.10 | **62.0** | 1.90 | **117.8** |

| *(INFLOW CALCULATIONS + CCA)* | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **A** | x | **R** | = | **I** | + | **CCA** | = | **$I_{CC}$** | | |
| **(m²)** | | **(mm)** | | **(m³)** | | **30%** | | **(m³)** | | |
| ( 2630 | x | 12.6 | ) = | 33.16 | + | 9.95 | = | 43.10 | | |
| " | x | 18.3 | ) = | 48.23 | + | 14.47 | = | 62.70 | | |
| " | x | 22.6 | ) = | 59.50 | + | 17.85 | = | 77.35 | | |
| " | x | 30.4 | ) = | 79.96 | + | 23.99 | = | 103.95 | | |
| " | x | 40.0 | ) = | 105.21 | + | 31.56 | = | 136.77 | | |
| " | x | 51.1 | ) = | 134.29 | + | 40.29 | = | 174.57 | | |
| " | x | 64.6 | ) = | 169.96 | + | 50.99 | = | 220.95 | | |
| " | x | 74.1 | ) = | 194.83 | + | 58.45 | = | 253.28 | | |
| " | x | 86.9 | ) = | 228.60 | + | 68.58 | = | 297.18 | | |
| " | x | 117.8 | ) = | 309.85 | + | 92.95 | = | 402.80 | | |

| *(OUTFLOW CALCULATIONS)* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **$a_{s50}$** | x | **f** | x | **D** | ) = | **O** | | | | | | |
| **(m³)** | | **(10-5 m/s)** | | **(mins)** | | **(m³)** | | | | | | |
| ( 76.3125 | x | 5.01 | x | 5 | ) = | 1.91 | | | | | | |
| ( " | x | " | x | 10 | ) = | 3.82 | | | | | | |
| ( " | x | " | x | 15 | ) = | 5.73 | | | | | | |
| ( " | x | " | x | 30 | ) = | 11.46 | | | | | | |
| ( " | x | " | x | 60 | ) = | 22.92 | | | | | | |
| ( " | x | " | x | 120 | ) = | 45.83 | | | | | | |
| ( " | x | " | x | 240 | ) = | 91.67 | | | | | | |
| ( " | x | " | x | 360 | ) = | 137.50 | | | | | | |
| ( " | x | " | x | 600 | ) = | 229.17 | | | | | | |
| ( " | x | " | x | 1440 | ) = | 550.00 | | | | | | |

| *(STORAGE REQUIRED)* | | | | |
|---|---|---|---|---|
| **$I_{CC}$** | - | **O** | = | **S** |
| **(m³)** | | **(m³)** | | **(m³)** |
| 43.10 | - | 1.91 | = | 41.19 |
| 62.70 | - | 3.82 | = | 58.88 |
| 77.35 | - | 5.73 | = | 71.62 |
| 103.95 | - | 11.46 | = | 92.49 |
| 136.77 | - | 22.92 | = | 113.86 |
| 174.57 | - | 45.83 | = | 128.74 |
| 220.95 | - | 91.67 | = | 129.28 |
| 253.28 | - | 137.50 | = | 115.78 |
| 297.18 | - | 229.17 | = | 68.02 |
| 402.80 | - | 550.00 | = | 0.00 |

| | | | |
|---|---|---|---|
| **Total storage volume available:** | **131.25** | **m³** | *(storage volume in soakaway – water butts disregarded)* |
| **Max. storage volume required:** | **129.28** | **m³** | *(highest figure from storage calculation column '**S**' – bottom right)* |



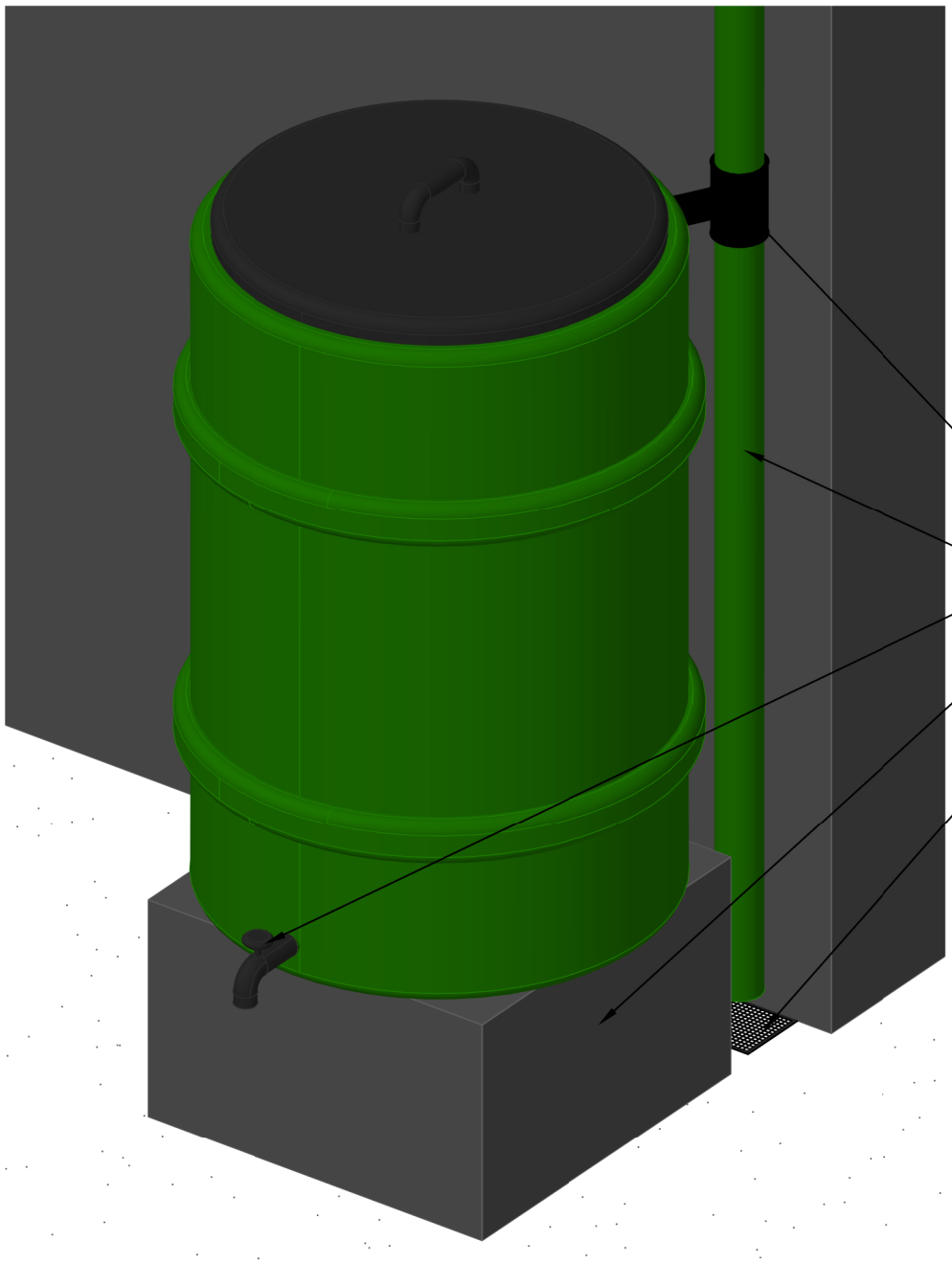

sureline
DESIGN SERVICES LTD
Tel: 07826 705493
E-mail: mail@sureline.org.uk

Site: Pant-y-Grwyndy, Cardigan
Plot: Cow housing shed
Client: Mr Owen Jones

Drgs: Location plan
File: Pant-y-Grwyndy
Scale: 1:1250 (inset not to scale)
Date: 25/07/23 Drn: MDH
Drg no: 001 REV: A

# Water butt detail

Water harvesting and storage meets the following criteria of the SUDS standards:
S1 - Run-off collected on site for use (Priority level 1).
S2 - Providing additional storage capacity to help prevent run-off discharging from site.
S6 - Providing a low-tech, low maintenance, cost-effective drainage system.




Notes:

- The detail shows a water butt to illustrate relevant features. Water storage on site may take a different form but with similar features such as a storage tank, IBC (Intermediate Bulk Container) etc.
- The storage volume of water containers is not included in the calculations as extreme weather events are more probable during the winter months when rainfall volumes are generally higher and it is likely that there will be little or no spare storage capacity in the container.

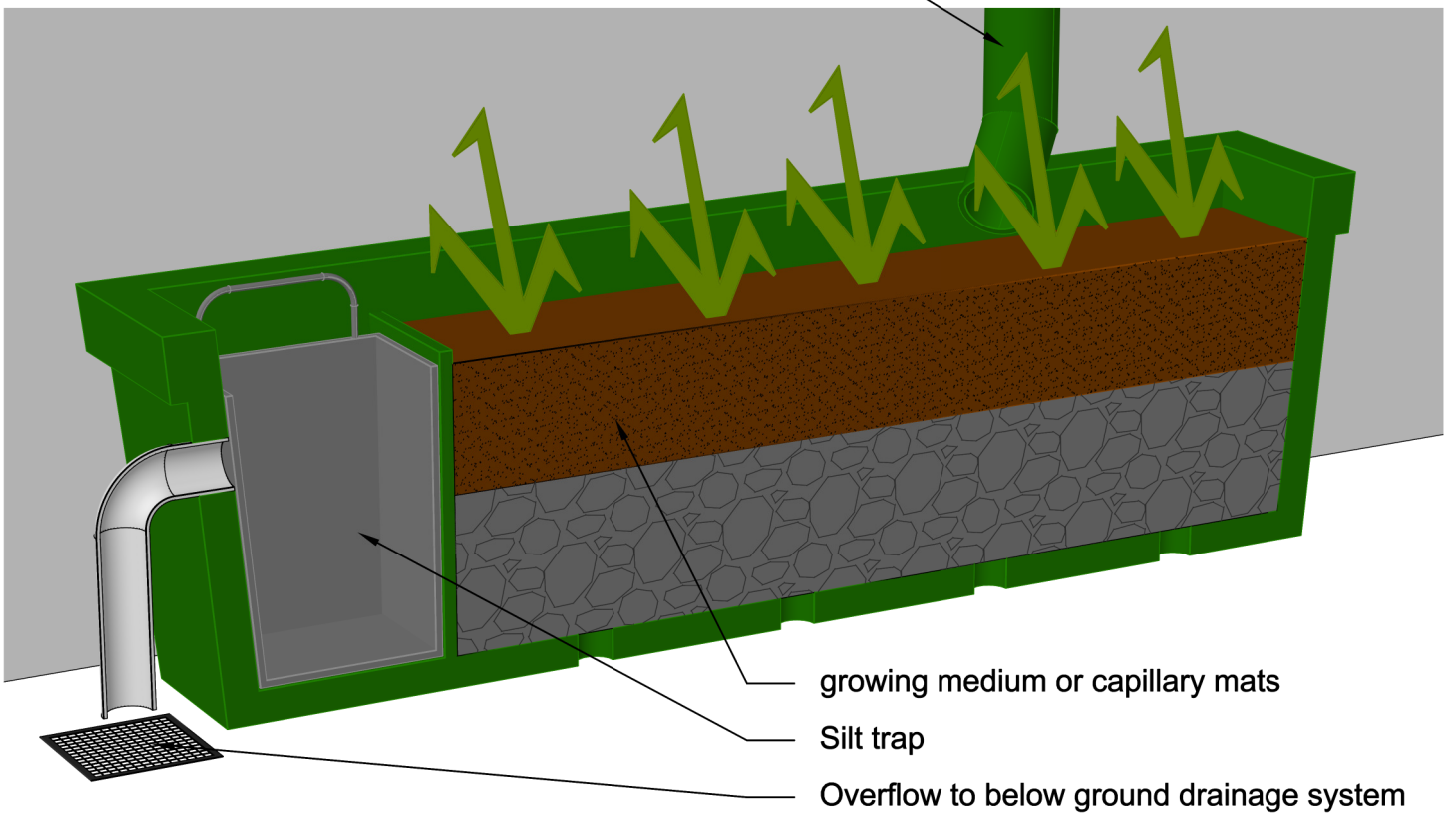
sureline
DESIGN SERVICES LTD
Tel: 07826 705493
E-mail: mail@sureline.org.uk

Site: Pant-y-Grwyndy, Cardigan
Job: Cow housing shed
Client: Mr Owen Jones

Drgs: Water storage detail
File: Pant-y-Grwyndy
Scale: not to scale
Date: 25/07/23 Drn: MDH
Drg no: 401

# Rain planter detail

Rain planters meet the following criteria of the SUDS standards:
S2 - Providing additional storage capacity to help prevent run-off discharging from site.
S3 - Trapping sediments and pollutants as a basic water quality treament.
S4 - Providing amenity benefits.
S5 - Maximising bio-diversity benefits.
S6 - Providing a low-tech, low maintenance, cost-effective drainage system.




Notes:

- Rain planters allow the creation of small but important zones that can help treat and slow run-off whilst also providing attractive planting and habitat for wildlife.
- Planting should be carefully selected as not all plants will be well-suited to conditions that can range from intensely wet to very dry conditions; the Royal Horticultural Society's website has a section offering guidance on suitable planting for rain gardens - see www.rhs.org.uk

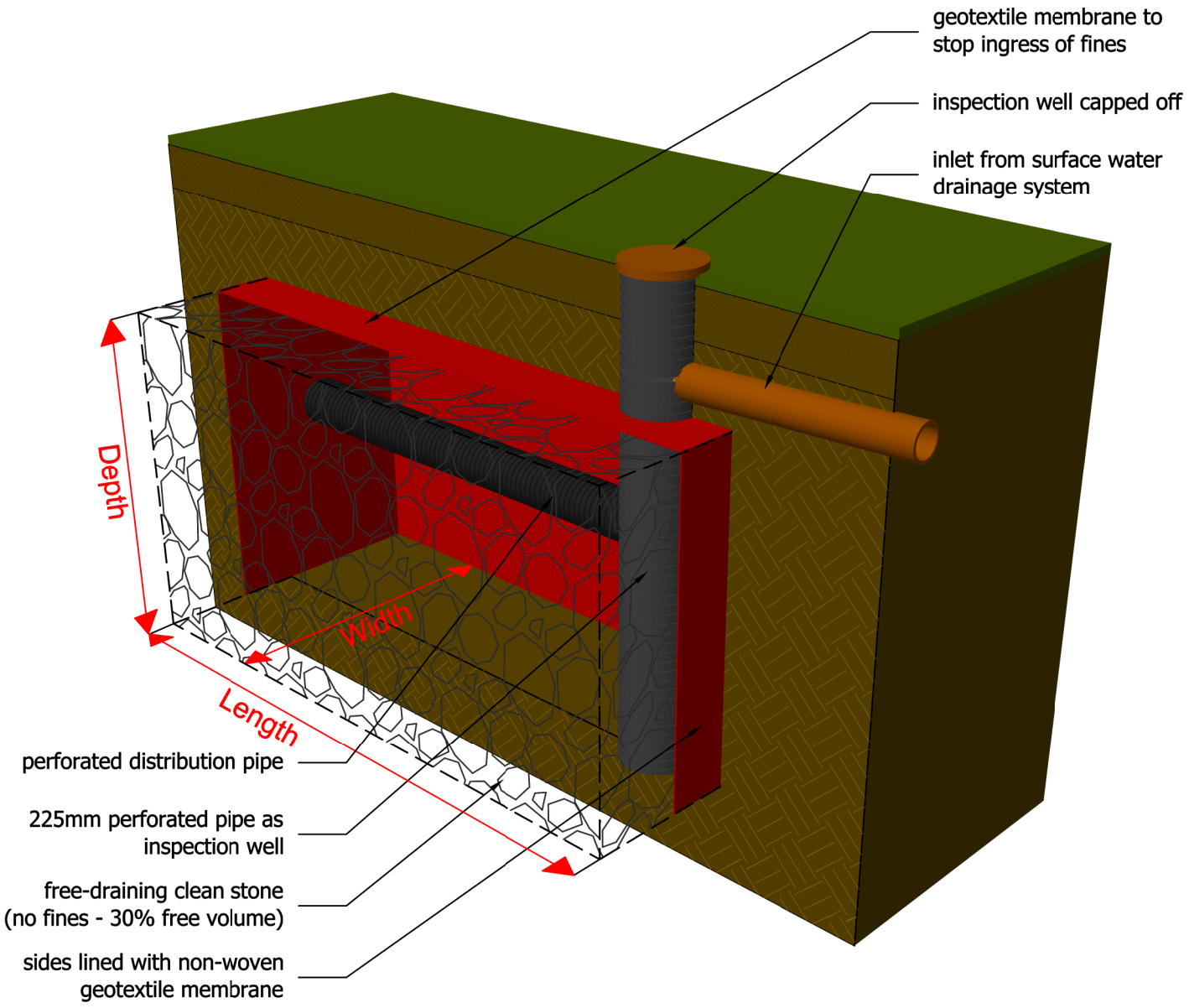
sureline DESIGN SERVICES LTD
Tel: 07826 705493
E-mail: mail@sureline.org.uk

Site: Pant-y-Grwyndy, Cardigan
Job: Cow housing shed
Client: Mr Owen Jones

Drgs: Rain planter detail
File: Pant-y-Grwyndy
Scale: not to scale
Date: 25/07/23 Drn: MDH
Drg no: 402

# Soakaway detail; rubble fill

Soakaways meet the following criteria of the SUDS standards:
S1 - Infiltration of run-off to ground (Priority level 2).
S2 - Providing storage capacity to prevent run-off discharging from site.
S3 - Trapping sediments and pollutants as a basic water quality treament.
S6 - Providing a low-tech, low maintenance, cost-effective drainage system.




| Soakaway dimensions (x2): | |
|---|---|
| Length: | 50.00m |
| Width: | 1.80m |
| Depth: | 2.50m |

Notes:

- Soakaways not to be constructed within 5 metres of a building, within 2.5 metres of a boundary, in unstable land or in ground where the water table reaches the bottom of the pit at any time of year.
- Soakaways should also not be constructed near any drainage field, drainage mound of other soakaway so that the overall soakage capacity of the ground is exceeded and the effectiveness impaired.
- Soakaways should not be constructed where the presence of contamination in the run-off could result in pollution of groundwater source or resource.


sureline DESIGN SERVICES LTD
Tel: 07826 705493
E-mail: mail@sureline.org.uk


Site: Pant-y-Grwyndy, Cardigan
Job: Cow housing shed
Client: Mr Owen Jones

Drgs: Soakaway detail - stone fill
File: Standard details
Scale: not to scale
Date: 25/07/23 Drn: MDH
Drg no: 403