D.S & R.M Staveley

Proposed Camping Pods
Standen Hey, Pendleton
FRA & Drainage Strategy

D5000-R-01

August 2026

PSA Design Ltd
Consulting Engineers
The Old Bank House
6 Berry Lane
Longridge
Preston PR3 3JA

Tel. 01772 786066
Fax. 01772 786265

www.psadesign.co.uk
mail@psadesign.co.uk

Document Control Sheet

Proposed Camping Pods - Standen Hey, Pendleton

FRA & Drainage Strategy

Job	Date	Issue	Copy
D5000	Aug 2026	Original	

Originator…… G Sanderson ……..

Checker…….. D Wallbank ……..……...

Approver…… G Sanderson ……..……...

© PSA Design Ltd. All rights reserved.

No part of this report may be copied or reproduced by any means without prior written permission from PSA Design. If you have received this report in error, please destroy all copies in your possession or control and notify PSA Design.
This report has been prepared for the exclusive use of the commissioning party and unless otherwise agreed in writing by PSA Design, no other party may use, make use of or rely on contents of the report. No liability is accepted by PSA Design for any use of this report, other than for the purposes for which it was originally prepared and provided.

Opinions and information provided in the report are on the basis of PSA Design using due skill, care and diligence in the preparation of the same and no explicit warranty is provided as to their accuracy. It should be noted that and it is expressly stated that no independent verification of any of the documents or information supplied to PSA Design has been made.

Contents

1.0 Introduction

2.0 Flood Risk Assessment

3.0 Drainage Strategy

3.1 Existing Drainage Situation
3.2 Proposed Surface Water Management Strategy
3.3 Proposed Foul Drainage System
3.4 Maintenance of Proposed SuDS Systems

4.0 Conclusion

Appendices

A Existing & Proposed Site Plans

B Outline Drainage Strategy

C SW Drainage Hydraulic Calculations

D Management and Maintenance regime

1. Introduction

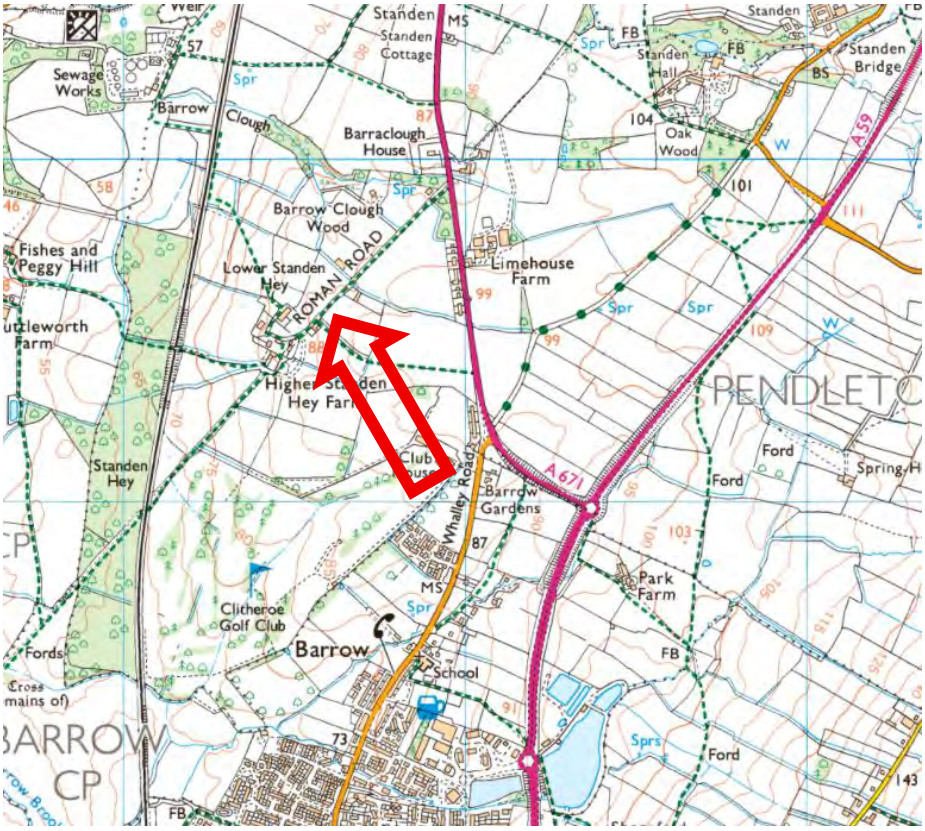
1.1. PSA Design Ltd have been commissioned to provide a Flood Risk Assessment (FRA) and Drainage Strategy to support a full planning application on land adjacent to Standen Hey Bungalow, Pendleton.

1.2. The application comprises the construction of 5no. short-term holiday let pods, facilities store, parking and access.

1.3. The location of the site is shown below and in more detail on the location plan included within **Appendix A**.

The site is located at: Land to the North-East of Standen Hey Bungalow
Whalley Road,
Pendleton,
BB7 1PP

NGR : 373610E, 439545N



1.4. This document sets out the issues relating to flood risk and seeks to outline the principles of the SuDS strategy for the proposed development. Once the scheme is approved, the principles have been agreed with both the Council Drainage Engineer, LLFA and Water Authority, if necessary, they will be subject to detailed design and formal approvals.

Existing Site

1.5. The application site is part of a field to the northeast of Standen Hey Bungalow and southwest of Long Acre. The field is currently used for grazing sheep and taking a grass crop off in summer. The field has defined boundaries. To the northwest is a hedge with trees adjacent to the private road, to the northeast is a beech hedge along the garden boundary of Long Acre. The eastern boundary and the southwest boundary are defined by hedges with trees.

1.6. The site of the proposed holiday lets is a roughly square in shape, approximately 0.36ha in area. Topographically the site generally falls from the southeast to northwest. There are no existing structures in the field.

1.7. An existing watercourse runs along the eastern boundary of the site. The watercourse is within land under control of the applicant.

1.8. Access to the site is from the north via a private road running off Whalley Road.

1.9. The existing site can be seen in context on the aerial extract below and on the Architects plans included in **Appendix A**.



Proposed Development

1.10. The proposal seeks permission to construct five holiday lets on the site with ancillary storage facilities, access and parking. Each unit can accommodate a maximum of two people and has a double bed with an open-plan kitchen, living, dining area and a separate shower room. Each pod is provided with an area of decking and a hot tub. Two of the units are provided with a sauna. Parking is provided for each pod towards the centre of the site with a joint access and turning area. A storage building will be provided to store maintenance equipment, refuse bins, cycle storage and a display of goods to purchase.

1.11. Each pod will measure 9.0m x 3.3m with a height to the ridge of 2.9m. They will be constructed out of timber. The decking area will have a similar footprint to the pods and be constructed out of timber or paving. The pods will be sat upon and surrounded by an open graded aggregate, similar to the associated parking bay. Screening between the units will be provided by informal landscaping. The site will be separated from the rest of the field by a post and wire fence.

1.12. The proposed new building will be used for storage purposes in association with the wider business operation. The building is of a simple, functional design and its scale and siting have

been carefully considered to ensure that it sits comfortably within the site and does not result in an overdevelopment of the plot.

1.13. The Architects existing and proposed layouts are included as **Appendix A**.

2. Flood Risk Assessment

2.1. The National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) set out Government policy aims on development and flood risk for England. The aim is to ensure flood risk is taken into account at all stages of the planning process, to avoid inappropriate developments in areas at risk of flooding, and to direct development away from areas of highest risk.

2.2. Flood mapping (extract below) from the EA website clearly indicates that the site is located within Flood Zone 1 and is therefore at very low risk of flooding. Accordingly, with reference to Table 2 from PPG, the proposed development would fall into the "more vulnerable" category and, in accordance with Table 3, the site proposals within Flood Zone 1 would be deemed "appropriate".

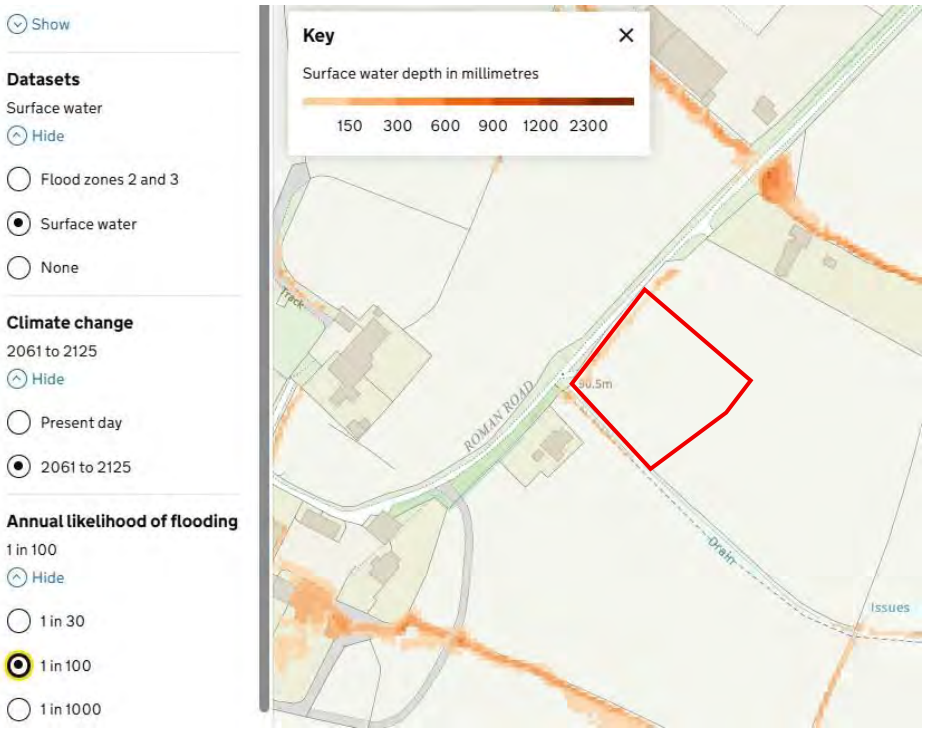


There will therefore be no requirement for a Sequential Test or Exception Test to be carried out for this development.

2.3. Notwithstanding the above, aside from fluvial and coastal flood risk, NPPF sets out that risk of flooding from ALL sources should be considered. This is discussed in more detail below.

Surface Water Flood Risk

2.4. Reference to online surface water flood risk mapping shows there is surface water flood risk in the area. Extracts are included below.



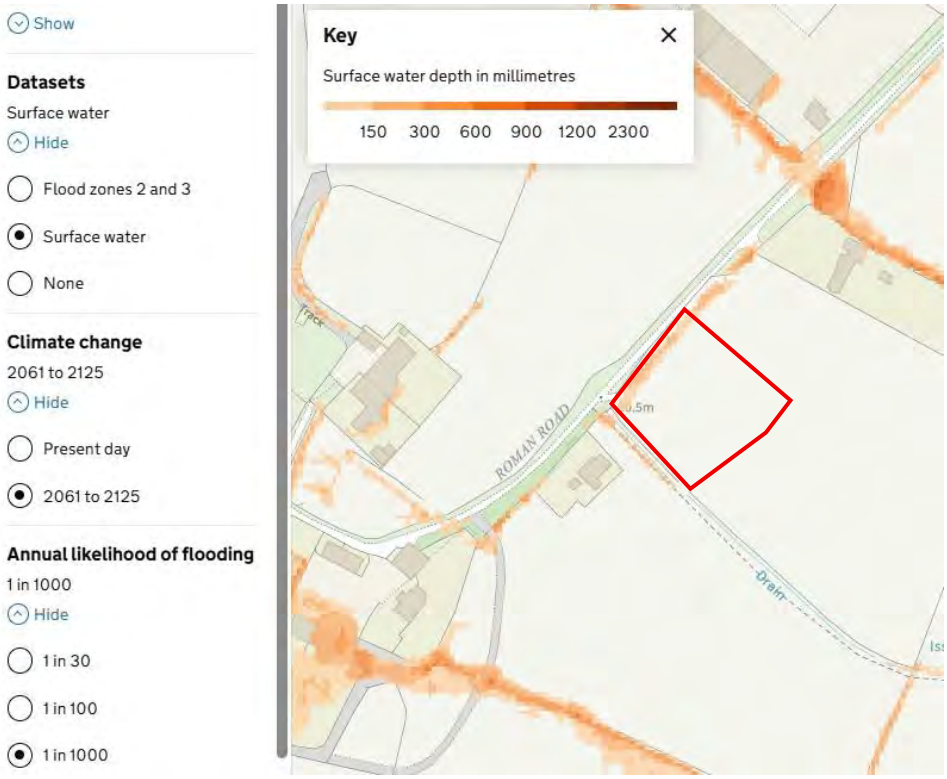
Map showing 1 in 100yr SW Flood Risk (including climate change)

2.5. With reference to the proposed plans (**Appendix A**) it can clearly be seen that during the 1 in 100yr (design flood) event, the proposed works are unaffected. The area shown at risk of flooding is confined to the north boundary of the site, northerly of any proposed buildings.

2.6. Flood depths are shown to be 150mm or less. To put this into context, the topo survey shows levels in the affected area at circa 90.70m AOD. The pods will be set a minimum of 150mm

above existing ground levels. "Pod 5" is the lowest laying pod which will be set a minimum of 91.2mAOD.

2.7. The 1 in 1000yr surface water flood map has also been reviewed with extract below.



2.8. The 1 in 1000yr map paints a similar picture with flooding confined to the north of the site. A key point of note is that the existing (and proposed) level in the northwest corner of the site is circa 90.5mAOD, continuing to fall the northwest away from the site. Thus, realistically flood depths on the site would never accumulate to any significant depth prior to naturally overspilling away from the site.

2.9. The site is therefore considered to be at **very low** risk of flooding from surface water.

2.10. The risk of flooding directly related to the increase in surface water run-off is discussed in further detail below in Section 3.

2.11. **Other sources of flood risk**

Reference has been made to online resources to assess flood risk from reservoirs and groundwater. Neither are considered to applicable to this area.

It is therefore concluded, in terms of flood risk, the site is appropriate for development and will be suitably safe from flood risk during its lifetime.

3. Drainage Strategy

3.1. **Existing Drainage Situation**

3.1.1. The existing site is greenfield. The nearest United Utilities sewer is located some 400m (as the crow files) from the site along Whalley Road.

3.1.2. It has been noted in section 1 above an existing watercourse runs along the eastern boundary of the site.

3.2. **Proposed Surface Water Management Strategy**

3.2.1. With respect to dealing with surface water, National Planning Policy Framework (NPPF), requires that, for the range of annual flow rate probabilities, up to and including the 1% annual probability (1 in 100-year event) the developed rate of run-off from a proposed site should be no greater than the undeveloped rate of run-off for the same event. Even when the site is brownfield, the site should be treated as greenfield.

3.2.2. It is also important to account for climate change (CC) when making assessment of surface water run-off. As the development site is located within the Ribble Management Catchment area, reference to the peak rainfall allowance map sets out the allowances below:

Scenario	Event	Central Allowance	Upper End Allowance
3.3% annual exceedance rainfall event	2050s	25%	35%
	2070s	30%	40%
1% annual exceedance rainfall event	2050s	25%	40%
	2070s	35%	50%

Catchment Peak Rainfall Allowances - Use '2050s' for development with a lifetime up 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

3.2.3. Therefore, CC should be taken into account by increasing the proposed rainfall intensity by 40% when assessing against the 3.3% (1 in 30) storm event and 50% when assessing against the 1% (1 in 100) storm event.

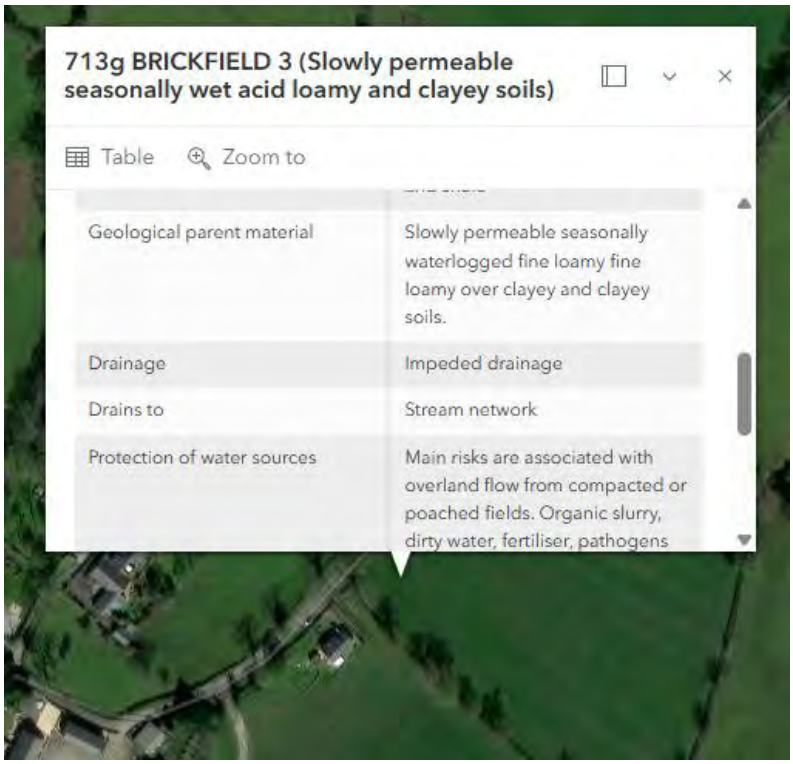
3.2.4. Given the nature of the proposed development an urban creep allowance is not deemed necessary as any further development on site would require a separate application. There will be no additional need for further impermeable area in any event as will be set out further down within this report.

Hierarchical Approach – Soakaways

3.2.5. Taking cognisance of the above (and in accordance with the hierarchical approach), the preferred surface water solution is to discharge to ground via soakaways. Even when there are alternative sewer connections or watercourses available, infiltration must still be utilised unless it is proved unfeasible.

3.2.6. Reference to the British Geological Survey (BGS) website, local borehole logs indicate “boulder clay”. This is reflected on review of the BGS mapping which shows the superficial deposits in the location being “Till, Devensian-Diamicton”.

3.2.7. Reference to “Soilscapes Mapping” backs up the above indicating the ground conditions have “impeded drainage”. See extract below.



3.2.8. It is therefore concluded that drainage via infiltration would not be viable at this site. However, surface level drainage in the topsoil layers (replicating existing) would likely be appropriate.

Hierarchical Approach – Watercourse

3.2.9. The second solution in the hierarchical approach would be discharge to a watercourse. It has already been established that a watercourse runs along the west boundary of the site and is topographically lower.

Hierarchical Approach – Surface Water Sewer / Combined Sewer

3.2.10. UU mapping shows the local area benefits from no adopted sewer systems.

Outline Strategy

3.2.11. PSA Drawing D5000-01 shows the outline drainage strategy for the site. The drawing is included as **Appendix B**. This would be as follows:

1. The proposed tarmac access road and turning circle would be drained to a filter drain running alongside the access. The access would be laid with falls in the drain. The access track would naturally follow the topography of the land which falls to the north.

2. Outfall from the filter drain would run into a shallow (500mm deep) open swale running southwest towards the watercourse.
3. A flow control chamber will be installed immediately prior to the outfall into the watercourse restricted peak run-off rates to 2l/s.
4. Parking bays, pods and storage shed will be sat on open graded aggregate with no formal drainage mimicking existing rainfall run-off.
5. The pods and storage shed have no formal rainwater pipes and surface water would fall directly to ground.
6. The general topography of the land will not be altered, maintaining gentle falls towards the watercourse.

3.2.12. To restrict surface water run-off from the proposed development it will be necessary to provide adequate attenuation storage on site. In this instance storage would be available with the open graded filter drain material and open swale. The proposed surface water system should be designed to accommodate a 1 in 100-year storm event uplifted to include a 50% allowance for climatic. The system has been modelled in Causeway FLOW and the results included as **Appendix C**. The model demonstrates no flooding during the 1 in 100yr + 50%CC event whilst maintaining run-off rates to less that 2l/s.

3.2.13. The solution presents and provides SuDS drainage techniques that will ensure that water quality criteria are suitably addressed via the use of filter drains and swales.

3.2.14. The above strategy will also ensure that interception run-off requirements are also achieved.

3.2.15. In the event of system blockage or if the system becomes inundated, overland flood flow pathways would follow the natural topography of the land and drain directly into the existing watercourse. The pods, raised a minimum of 150mm above ground level, would unaffected.

3.2.16. It is therefore concluded that a suitable and compliant SuDS drainage solution can be provided on the site that meets with current legislation.

3.3. Proposed Foul Drainage System

3.3.1. Due to the lack of alternative foul drainage options in the vicinity of the site, it is proposed to utilise a sewage treatment plant solution with outfall to watercourse.

3.3.2. The proposed foul drainage solution is illustrated on PSA Design drawing D5000-01. Drawing included in **Appendix C**. The treatment plant outfall would utilise the same connection as the surface water outfall set out above, linking in downstream of the flow control chamber.

3.3.3. Proposed foul loadings have been assessed as follows based on British Waters "Flows and Loads - 4". Given all three properties will utilise the existing watercourse outfall all three have been combined to assess total loading.

Based on 5 "serviced" static caravan type holiday lets with a peak occupancy if 2 persons/pod:
Population Equivalent = 5 x 2P = 10P
Serviced Caravan Type Static Holiday Let – 150 l/p/d
10 x 150l/p/day = 1500 litres or 1.5m^3

3.3.4. A Marsh Ensign 10 Sewage Treatment Plants (from Marsh Industries) has been specified and sized appropriately. The treatment plants are suitable for a population of 10 persons.

3.3.5. The total loading of 1.5m^3 falls well below the 5m^3 allowance as set out in the EA's "General Binding Rules" for discharges to watercourse and should therefore not require a specific permit.

3.3.6. The proposed hot tubs should <u>not</u> contain any chlorinated water or similar chemicals. Oxygen based water sanitation or similar should be used. This is to protect the integrity of the sewage treatment plant.

3.4. **Maintenance of Proposed Drainage Systems**

3.4.1. It is important during any development process to consider the long-term maintenance of the proposed drainage system. The proposed drainage will be maintained by the site owners who will also be duty bound to ensure continuous compliance with the EA's general binding rules (i.e. maintenance and upkeep of the treatment plant). If necessary, a management and maintenance plan can be secured through condition.

3.4.2. A typical management and maintenance regime for the various SW SuDS elements of the scheme is included for reference as **Appendix D.** The treatment plant would be maintained in accordance with the manufacturer's guidelines.

4. Conclusion

4.1. It has been demonstrated that the proposed development would be deemed appropriate in terms of flood risk. Pod floor levels will be raised a minimum of 150mm above ground level with a minimum flood level of 91.2mAOD.

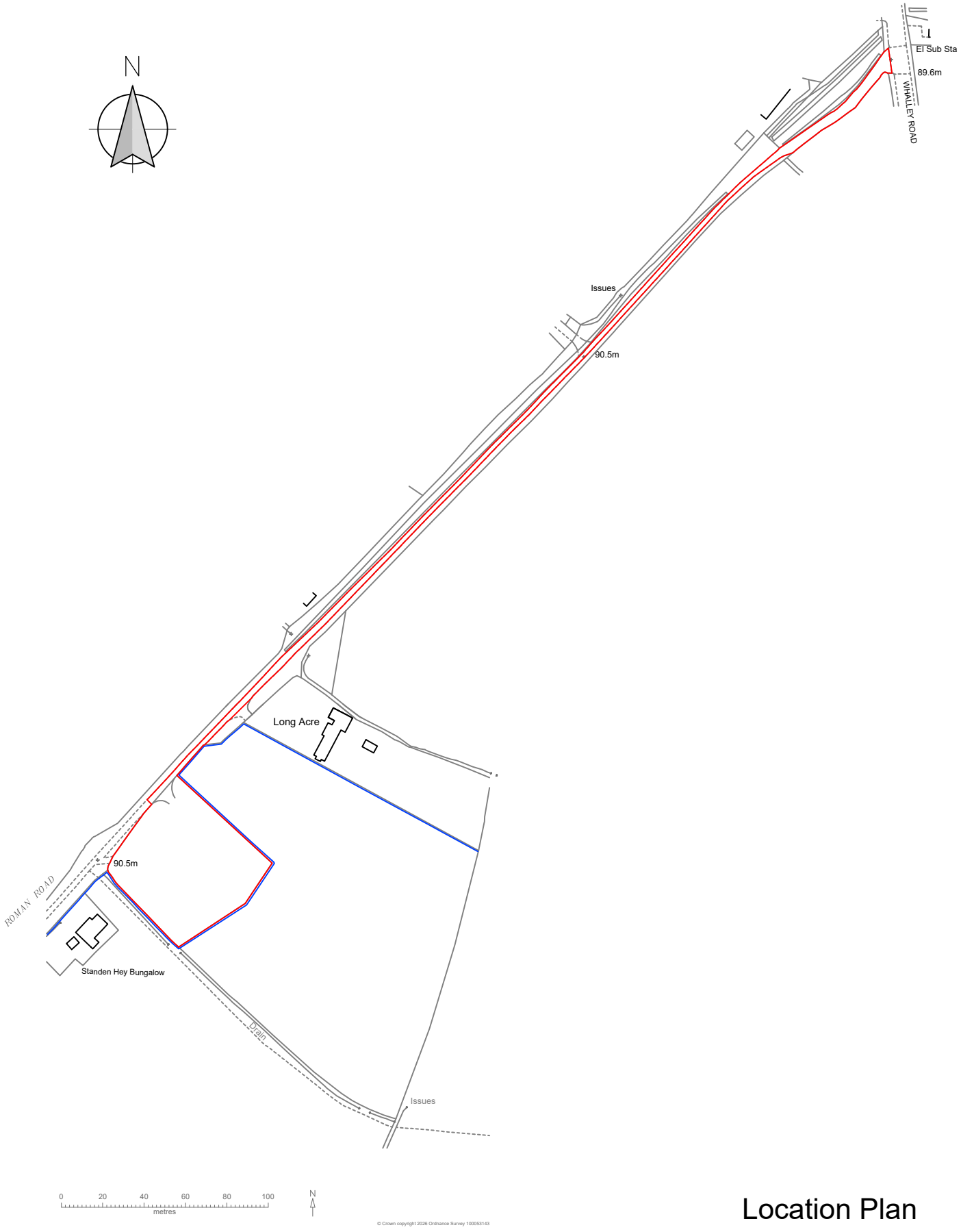
4.2. Section 3 has set has set out the principles of draining surface water from the site in a sustainable manner and presented an appropriate SuDS solution that would meet with the necessary requirements.

4.3. Foul drainage will be dealt with via a suitably sized sewage treatment plant with outfall direct to watercourse. The total foul loadings from the proposed development fall well within the EA's general binding rules limit and therefore a site-specific discharge permit would not be required.

4.4. Accordingly, there should be no flood risk or drainage reasons why the proposals should not be granted planning consent.

Appendix A

Architects Plans

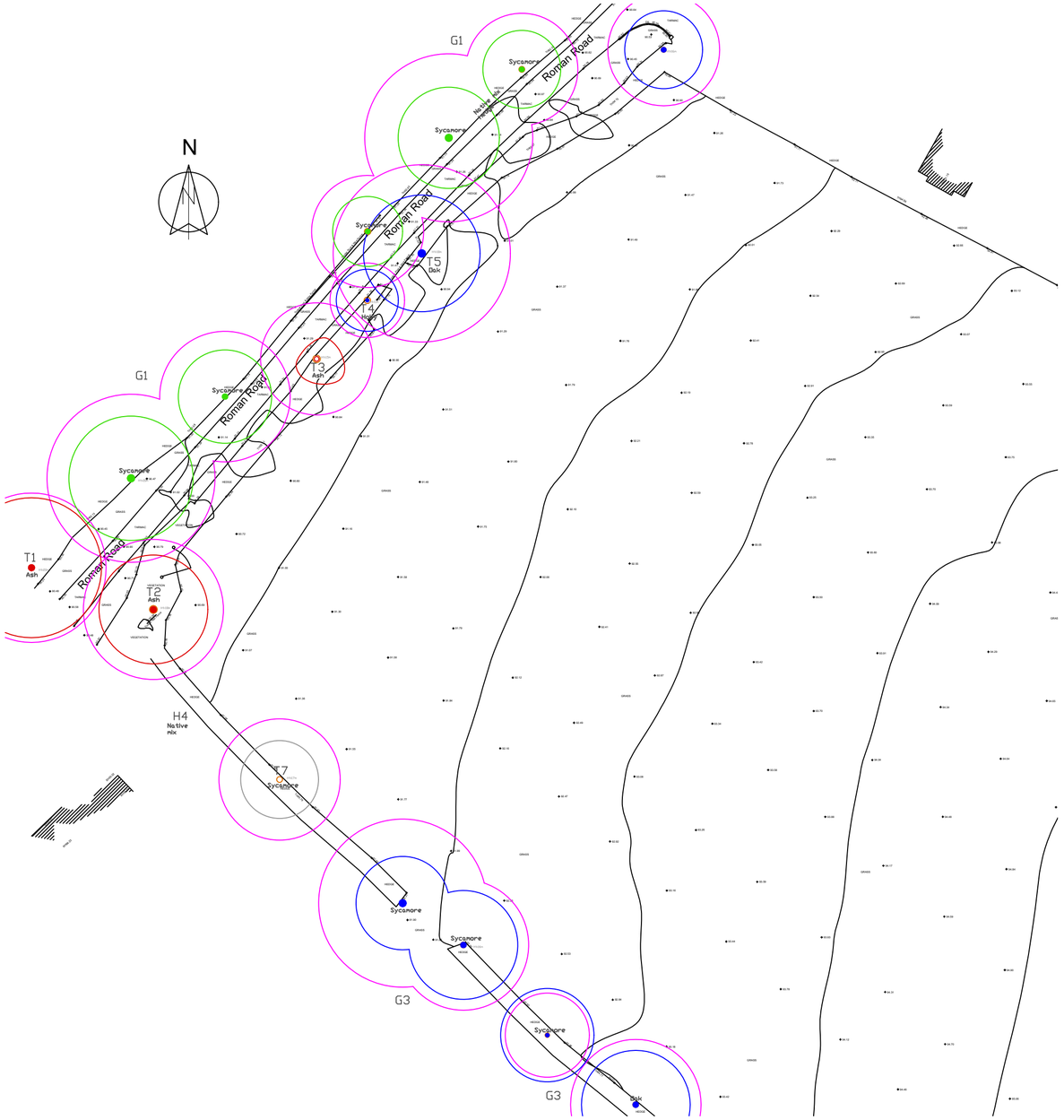


© Crown copyright 2026 Ordnance Survey 100053143

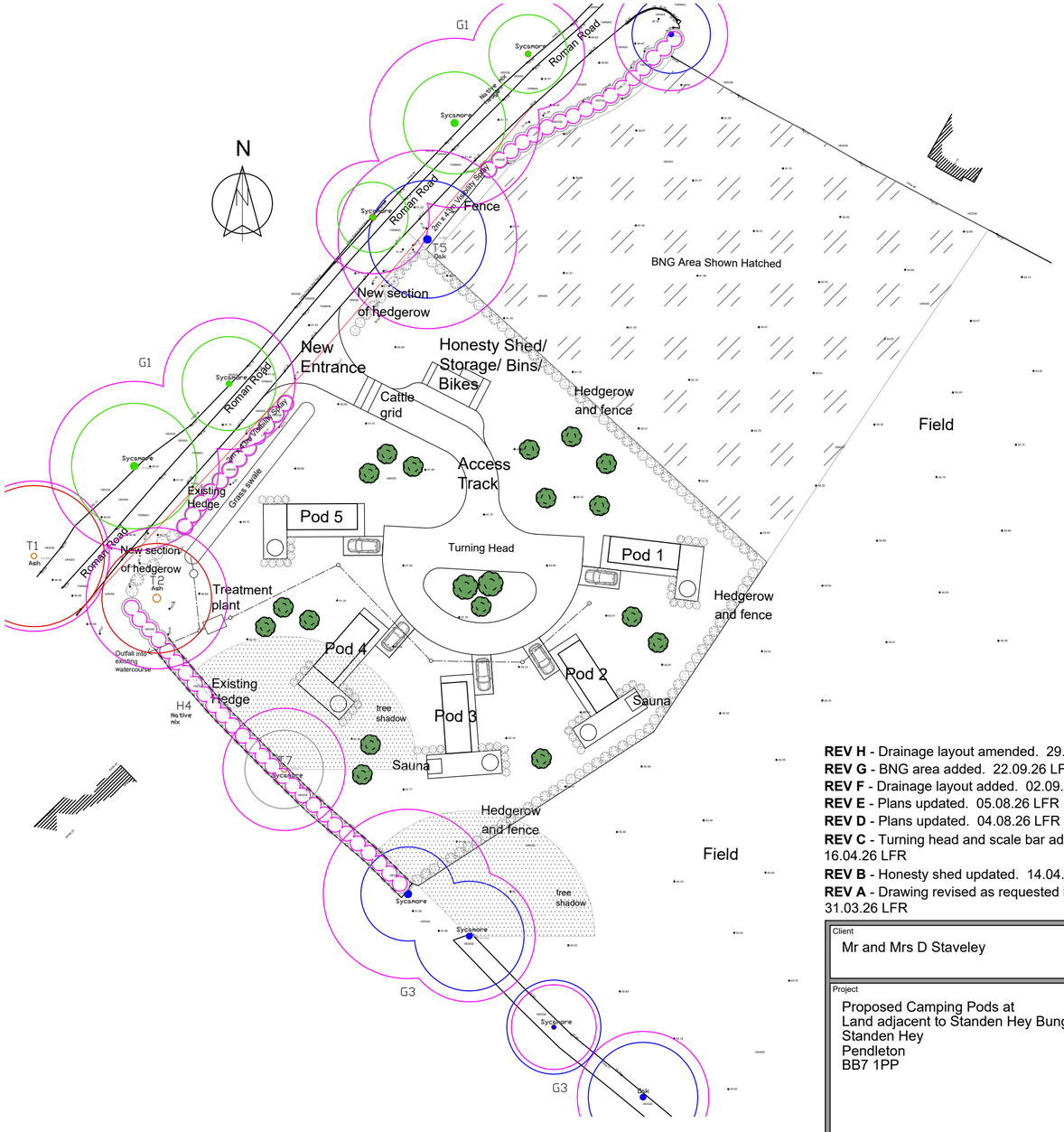
Location Plan
1:2500 @ A4

183 - LP

This drawing is to be read in conjunction with all relevant Surveyors, consultants' and specialists' drawings and specifications. All dimensions and levels are to be checked on site. This drawing is subject to copyright. All work carried out before Planning and Building Permission has been granted is at the contractor/clients risk. The Surveyor is to be notified of any discrepancies.



Existing Site Plan



Proposed Site Plan

REV H - Drainage layout amended. 29.09.26 LFR
REV G - BNG area added. 22.09.26 LFR
REV F - Drainage layout added. 02.09.26 LFR
REV E - Plans updated. 05.08.26 LFR
REV D - Plans updated. 04.08.26 LFR
REV C - Turning head and scale bar added. 16.04.26 LFR
REV B - Honesty shed updated. 14.04.26 LFR
REV A - Drawing revised as requested by client. 31.03.26 LFR

Client
Mr and Mrs D Staveley

Project
Proposed Camping Pods at
Land adjacent to Standen Hey Bungalow
Standen Hey
Pendleton
BB7 1PP

Drawing Title
Existing and Proposed Site Plans

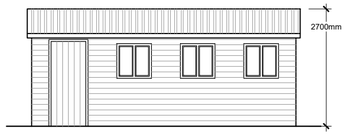
Scale	Date	Drawn
1:500 @ A2	Mar 2026	LFR

READ DESIGN LTD

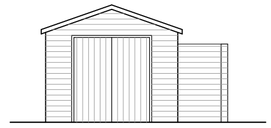
183 - 01 H

This drawing is to be read in conjunction with all relevant Surveyors, consultants' and specialists' drawings and specifications. All dimensions and levels are to be checked on site. This drawing is subject to copyright. All work carried out before Planning and Building Permission has been granted is at the contractor/clients risk. The Surveyor is to be notified of any discrepancies.

Honesty Shed/ Storage/ Bins



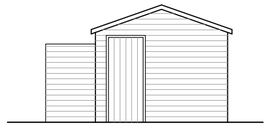
Front SW Elevation



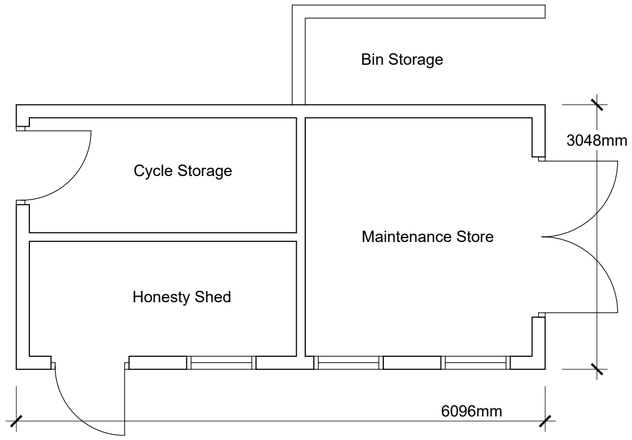
Side SE Elevation



Rear NE Elevation

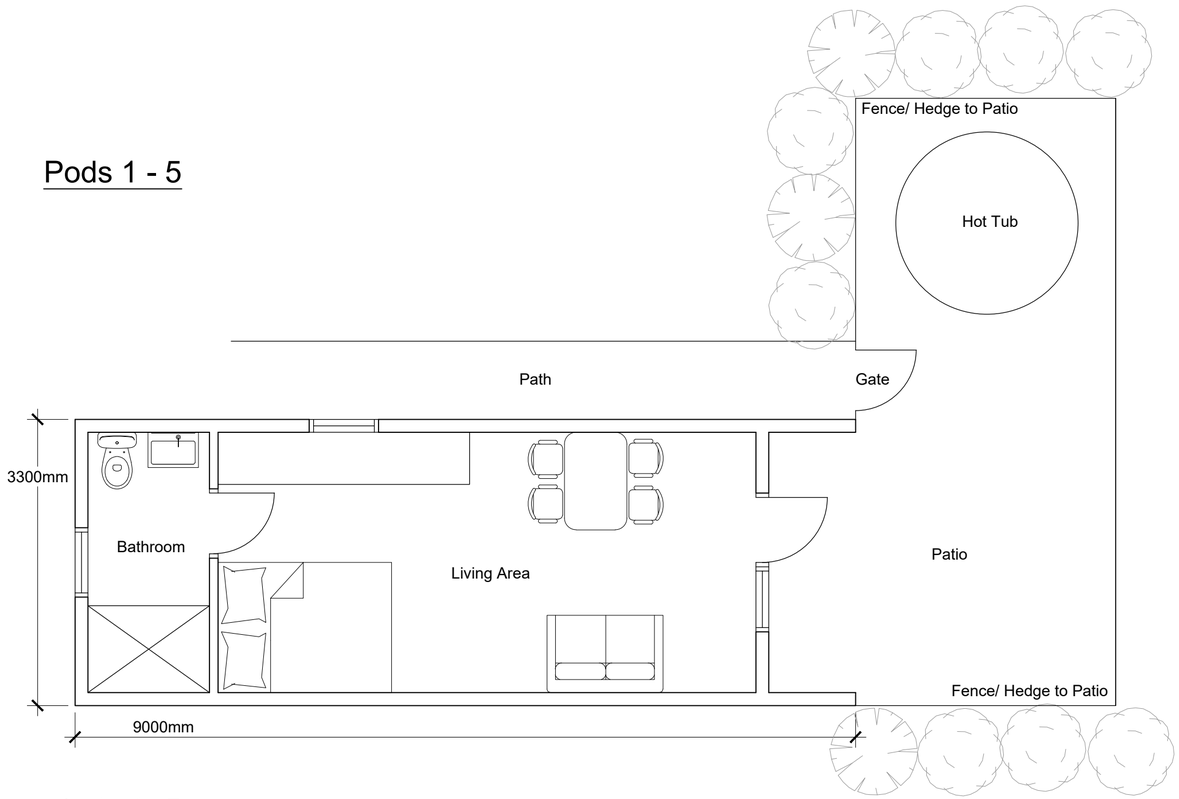


Side NW Elevation

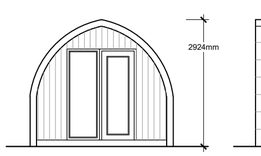


Honesty Shed/ Storage/ Bins
Proposed Floor Plan
1:50

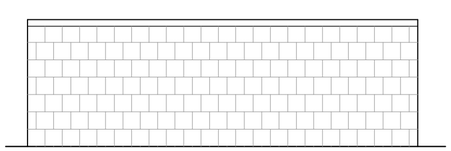
Pods 1 - 5



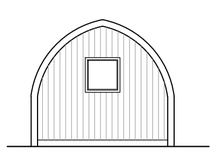
Pods 1 -5
Indicative Proposed Floor Plan
1:50



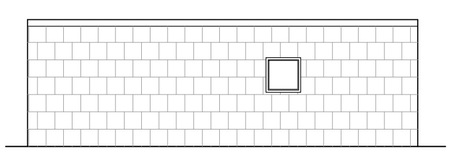
Front Elevation



Side Elevation



Rear Elevation



Side Elevation

REV B- Size of patios to pods reduced. 04.08.26 LFR

REV A - Honesty Shed/ Storage building amended. 16.04.26 LFR

Client
Mr and Mrs D Staveley

Project
Proposed Camping Pods at
Land adjacent to Standen Hey Bungalow
Standen Hey
Pendleton
BB7 1PP

Drawing Title
Proposed Plans and Elevations

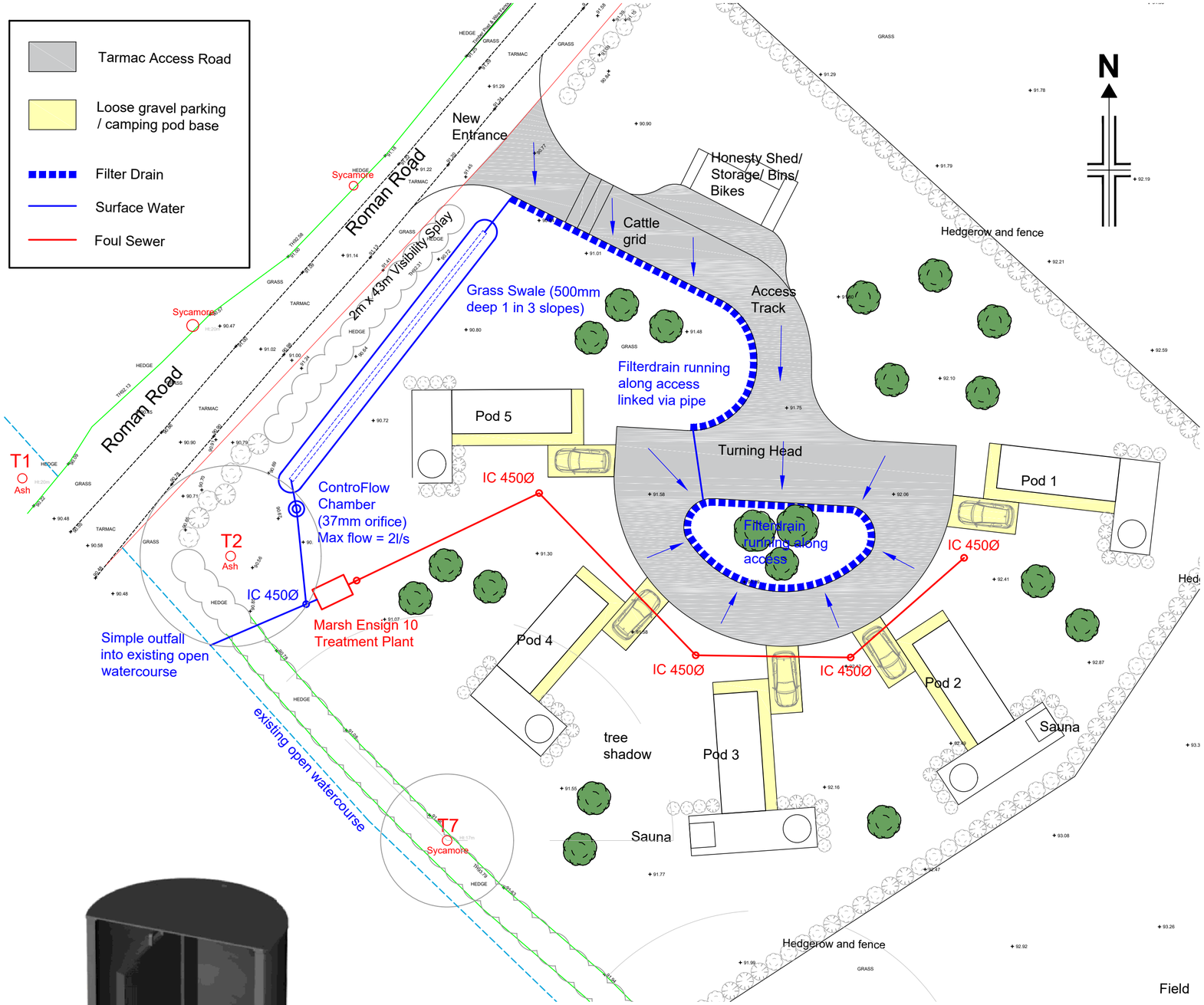
Scale	Date	Drawn
1:50/100 @ A2	April 2026	LFR

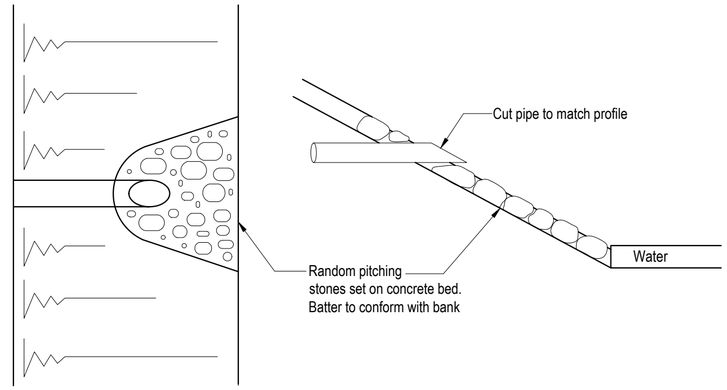
READ DESIGN LTD

183 - 02 B

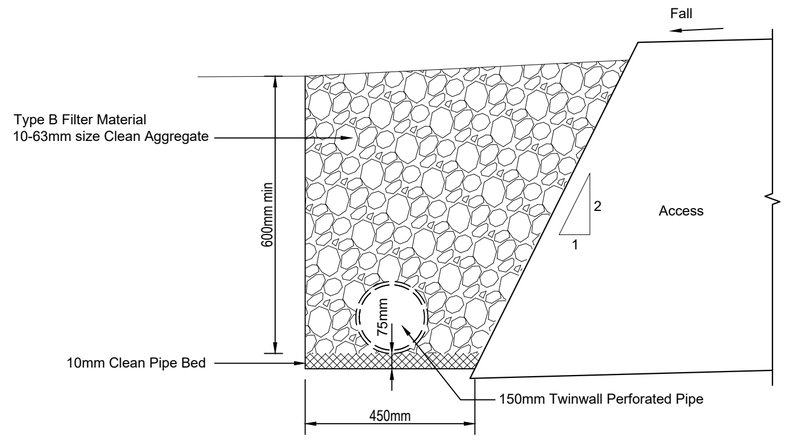
Appendix B

Outline Drainage Strategy

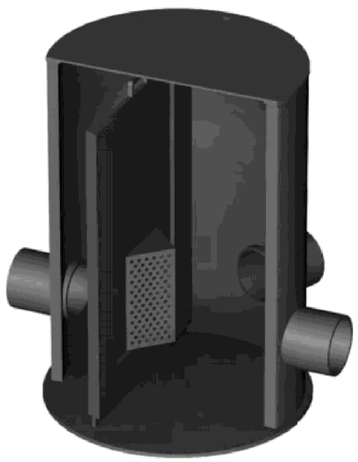




Typical Simple Outfall Detail



Filter Drain Detail



Controflow 500 Flow Control Chamber

REV	DATE	AMENDMENT DETAILS	DRAWN	CHECKED	APPROVED
P2	26/09/26	Outfall location adjusted to avoid tree root zone	GS	DLW	GS
P1	25/08/26	For Planning	GS	DLW	GS

D.S & R.M Staveley

Standen Hey, Pendleton

Outline Drainage Strategy

Drwg No. **D5000-01** Rev. **P2**

Scale **1:250** Sheet Size **A2**

Date **24 September 2026**

Drawn **GS** Checked **DW** Approved **GS**

PSA DESIGN
PSA Design Ltd
The Old Bank House, 6 Berry Lane,
Longridge, Preston, PR3 3JA
Tel. 01772 786066
www.psadesign.co.uk
mail@psadesign.co.uk

P:\Jobs\Development\D5000 - Standen Hey, Pendleton - FRA\CAD\Drawings\D5000-01 - Outline Drainage.dwg

Appendix C

SW Hydraulic Calculations

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
Rainfall Events	Singular	Skip Steady State	x
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	19.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.250	Starting Level (m)	
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	40	0	0
100	50	0	0

Flow v18.0 Copyright © 1988-2026 Causeway Technologies Ltd

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	19.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.250	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Depth (m)	Invert Level (m)
FD1a	0.016	4.00	91.800		0.600	91.200
FD1b			91.700		0.600	91.100
FD2a	0.029	4.00	91.700	1200	0.600	91.100
FD2b			91.300		0.600	90.700
Control			90.800		0.700	90.100
Outfall			90.700	1200	0.700	90.000

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
FilterDrain 1	FD1a	FD1b	33.000	0.600	91.200	91.100	0.100	330.0	150	5.00	41.0
FilterDrain 2	FD2a	FD2b	33.000	0.600	91.100	90.700	0.400	82.5	150	4.50	42.6
Swale	FD2b	Control	32.000	0.320	90.700	90.100	0.600	53.3	150	10.35	30.2
Outfall	Control	Outfall	1.000	0.600	90.100	90.000	0.100	10.0	150	10.35	30.2

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
FilterDrain 1	0.548	9.7	1.8	0.450	0.450	0.016	0.0	44	0.418
FilterDrain 2	1.107	19.6	3.4	0.450	0.450	0.029	0.0	42	0.829
Swale	0.091	13.0	2.4	0.450	0.550	0.029	0.0	62	0.056
Outfall	3.204	56.6	2.4	0.550	0.550	0.029	0.0	21	1.584

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
FilterDrain 1	33.000	330.0	150	Circular	91.800	91.200	0.450	91.700	91.100	0.450
FilterDrain 2	33.000	82.5	150	Circular	91.700	91.100	0.450	91.300	90.700	0.450
Swale	32.000	53.3	150	Swale	91.300	90.700	0.450	90.800	90.100	0.550
Outfall	1.000	10.0	150	150	90.800	90.100	0.550	90.700	90.000	0.550

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
FilterDrain 1	FD1a		Junction		FD1b		Junction	
FilterDrain 2	FD2a	1200	Manhole	PCC	FD2b		Junction	
Swale	FD2b		Junction		Control		Junction	
Outfall	Control		Junction		Outfall	1200	Manhole	PCC

Flow v18.0 Copyright © 1988-2026 Causeway Technologies Ltd

Manhole Schedule

Node	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
FD1a	91.800	0.600		0	FilterDrain 1	91.200	150
FD1b	91.700	0.600		1	FilterDrain 1	91.100	150
FD2a	91.700	0.600	1200	0	FilterDrain 2	91.100	150
FD2b	91.300	0.600		1	FilterDrain 2	90.700	150
				0	Swale	90.700	150
Control	90.800	0.700		1	Swale	90.100	150
				0	Outfall	90.100	150
Outfall	90.700	0.700	1200	1	Outfall	90.000	150

Node Control Online Orifice Control

Flap Valve	x	Design Depth (m)	0.400	Discharge Coefficient	0.650
Replaces Downstream Link	x	Design Flow (l/s)	2.0		
Invert Level (m)	90.100	Diameter (m)	0.037		

Node FD1b Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0
Side Inf Coefficient (m/hr)	0.00000	Link	FilterDrain 1
Safety Factor	2.0	Surround Shape	(Trench)
Porosity	0.32	Diameter (mm)	600
Invert Level (m)	91.100		

Node FD2b Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	3
Side Inf Coefficient (m/hr)	0.00000	Link	FilterDrain 2
Safety Factor	2.0	Surround Shape	(Trench)
Porosity	0.32	Diameter (mm)	600
Invert Level (m)	90.700		

Flow v18.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	FD1a	10	91.292	0.092	6.6	0.0490	0.0000	OK
15 minute winter	FD1b	10	91.174	0.074	6.6	0.0000	0.0000	OK
15 minute summer	FD2a	10	91.185	0.085	12.0	0.1774	0.0000	OK
15 minute winter	FD2b	12	90.853	0.153	12.0	0.1494	0.0000	SURCHARGED
120 minute winter	Control	92	90.410	0.310	4.4	0.0000	0.0000	SURCHARGED
120 minute winter	Outfall	94	90.018	0.018	1.7	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	FD1a	FilterDrain 1	FD1b	6.6	0.658	0.681	0.3306	2.6
15 minute summer	FD2a	FilterDrain 2	FD2b	12.0	1.031	0.612	0.4383	
15 minute winter	FD2b	Swale	Control	10.5	0.087	0.808	4.5735	
120 minute winter	Control	Outfall	Outfall	1.7	1.353	0.029	0.0012	13.0

Flow v18.0 Copyright © 1988-2026 Causeway Technologies Ltd

Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	FD1a	10	91.316	0.116	9.1	0.0616	0.0000	OK
15 minute winter	FD1b	10	91.188	0.088	9.1	0.0000	0.0000	OK
15 minute summer	FD2a	10	91.206	0.106	16.6	0.2215	0.0000	OK
15 minute winter	FD2b	12	90.881	0.181	16.6	0.2176	0.0000	SURCHARGED
120 minute winter	Control	96	90.513	0.413	6.2	0.0000	0.0000	FLOOD RISK
120 minute winter	Outfall	96	90.019	0.019	1.9	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	FD1a	FilterDrain 1	FD1b	9.1	0.714	0.938	0.4173	3.9
15 minute summer	FD2a	FilterDrain 2	FD2b	16.6	1.095	0.847	0.5091	
15 minute winter	FD2b	Swale	Control	15.8	0.097	1.215	6.5855	
120 minute winter	Control	Outfall	Outfall	1.9	1.410	0.034	0.0014	18.3

Flow v18.0 Copyright © 1988-2026 Causeway Technologies Ltd

Appendix D

Management and maintenance regime

SuDS Maintenance

This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints.

The recommended operations and frequencies are typical and should be more frequent initially to ensure that there are no unforeseen issues with the operation. They should then adjusted to suit the site requirements.

The surface water network has been designed to accommodate the 1 in 100-year storm rainfall event plus an allowance for climate change particular to the requirements of the site. It may be that the exceedance flows above the 1 in 30-year storm rainfall event are stored within the site partially above ground, on non-habitable external landscaping, parking or other space. As the flows are generally being attenuated on site and within SuDS features, there will be a period after storm events where the network is still partially or fully surcharged and is draining down. Where this surcharging is still present after 48hrs, appropriate action should be taken as noted in this section.

Components

The typical SuDS components are highlighted below. This is not an exhaustive list and reference should be made to the SuDS Manual (Ciria C753) for any items not listed.

- Pipes
- Drainage Channels and Gullies
- Permeable Pavements
- Soakaways & Infiltration Trenches
- Attenuation / Infiltration Basins
- Attenuation Storage Tanks
- Oil Separators

A suitable maintenance strategy should be adopted to ensure the drainage network is cleaned regularly and the routine maintenance and cleansing regime should be documented.

It is assumed that the maintenance of the drainage network will be the responsibility of an on-site facilities management team.

A copy of the final construction drainage layout should be provided in the final Operations and Maintenance Manual.

It is recommended that the drainage system is inspected as a minimum twice a year, with the system also being inspected after any major storm event.

Significant sediment deposition is likely in areas used for storage, so a post clean-up operation may be required including the removal of litter, vegetation, sewerage debris and larger objects.

Long-term management practices include monthly sweeping of external paved areas. The sweeping program will remove sand and contaminants directly from paved surfaces before they become mobilised during storm events and transported to the drainage system.

During the winter months, drainage features such as gullies and channels should be cleared of ice, snow, debris or litter

Sediment/material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the filter drains and the upstream/downstream chambers.

Pipes

Pipes are proprietary products and the materials can vary across the site and as such where used the manufacture's recommendations should be followed.

Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.

Access for maintenance is provided through access chambers and manholes.

Regular inspection and maintenance is important to identify areas which may have been obstructed and may not be draining correctly thus exposing the development to a greater level of flood risk.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection should be provided as post construction CCTV survey.	N/A
Regular maintenance\ inspection	Inspect for evidence of poor operation via water level in chambers. If required, take remedial action.	3-monthly, 48 hours after large storms.
	Check and remove large vegetation growth near pipe runs.	Monthly or as required
Remedial Action	Rod through poorly performing runs as initial remediation.	As required.
	If continued poor performance jet and CCTV survey poorly performing runs.	As required.
	Seek advice as to remediation techniques suitable for the type of performance issue and location.	As required If above does not improve performance.

Drainage Channels and Gullies

Channels and gullies should be inspected and cleaned in accordance with the manufacturer's details. Channel units can be cleaned through the use of a high-pressure hose; this can be fed into the channel system through access units strategically placed along the channel run. The throat section of channel units should be kept clear at all times to ensure uninterrupted flow of surface water into the drainage channel and any debris within the throat should be removed.

Locking bolts should be replaced and sufficiently tightened, taking care that the bolt heads do not stand above the top surface of the cover or grate. If covers are allowed to move within their frame, this may cause damage to the frame or seating.

Sediment\material removal should be undertaken in consultation with the environmental regulator to confirm appropriate protocols; especially where run-off is taken from potentially contaminated areas such as the car park channels.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection including channel outlet boxes.	Half yearly and after large storms.
Regular maintenance\ inspection	Litter and debris removal	Monthly or as required.
	Check and remove large vegetation growth near channel runs.	Monthly or as required
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	3-monthly, 48 hours after large storms.
Remedial Action	Inspect access/outlet boxes and rod through poorly performing channels and outlets as initial remediation.	As required.

Permeable Pavements

Permeable pavements contain proprietary products and as such where used the manufacturer's recommendations should be followed.

The permeable pavements are intended to be water quality and attenuation storage features. These features are intended to be dry except during rainfall events.

The surface has been designed to contain gaps where rain can flow through the upper construction layers in to the voided stone which makes up the subbase. Where these features are intended to be used as infiltration devices or soakaways any capping also needs to be permeable to permit the flows to the formation.

Access for maintenance is provided by inspection/access pipes, although access will be limited as this is a surface feature only.

Regular inspection and maintenance is important for the effective operation of the pervious pavement.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Initial Inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth. If required, take remedial action. Inspect silt accumulation rates and establish appropriate brushing frequencies. Silt can also be caused by adjacent landscaping areas which should be reprofiled to provide a flat area or berm adjacent to the paving.	3-monthly, 48 hours after large storms.
Regular maintenance\ inspection	Brushing and Vacuuming	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required and as per landscape architect's specification.
	Removal of weeds	As required.
Remedial Action	Remediate any landscaping which, through vegetation maintenance or soil slip, has been	As required.

Maintenance Schedule	Required Action	Frequency
	raised to within 50 mm of the level of the paving.	
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required.
	Rehabilitation of surface and upper sub-structure. This could include replacement of the jointing and bedding material. The upper geotextiles layer may also need replacing if clogged and Terram 1000 has a life span of 25 years.	As required (if infiltration performance is reduced as a result of significant clogging).

Soakaways & Infiltration Trenches

Infiltration systems will require regular maintenance to ensure continuing operation to design performance standard. Different designs will have different operation and maintenance requirements.

Soakaways and infiltration trenches should include monitoring points where water level can be observed and measured. This can either be via an inspection well or inspection cover (where attenuation storage is a void). For larger installations the access should provide a clear view of the infiltration surface, for small filled soakaways a 500mm perforated pipe would be appropriate.

Silt traps should be installed immediately upstream of every inlet into a soakaway / infiltration system.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inspection pipes for blockages, and clear if required. If faults persist rodding may be required.	Monthly for three months after installation
	Inspect silt traps and note rate of sediment accumulation	Monthly for 3 months and then annually or as required.
Regular maintenance\ inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and filter chambers.	Annually (or as required after heavy rainfall events)
Remedial Actions	Repair/rehabilitation of inlets/outlets.	As required.
	Rehabilitation of surface and upper sub-structure. This could include replacement of the bedding material. The upper geotextiles layer may also need replacing if clogged and Terram 1000 has a life span of 25 years.	As required (if infiltration performance is reduced as a result of significant clogging).

Attenuation / Infiltration Basins

Regular inspection and maintenance is important for the effective operation of infiltration and attenuation basins.

Adequate access should be provided to allow appropriate equipment & vehicles to maintain the basin.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets, outlets and overflows for blockages and clear if required. If faults persist rodding may be required.	Monthly for three months after installation
	Inspect silt traps and note rate of sediment accumulation	Monthly for 3 months and then annually or as required.
	Inspect infiltration surfaces for compaction and ponding	Monthly for 3 months and then annually
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre-treatment structures and filter chambers.	Annually (or as required after heavy rainfall events)
	Cut grass for landscaped areas and access routes	Monthly during growing season or as required
	Cut grass (meadow grass in and around the basin	Half yearly : spring (before nesting season) and autumn
	Reseed areas of poor growth, prune and trim trees and remove cuttings	As required
Remedial Actions	Repair/rehabilitation of inlets/outlets.	As required.
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required

Attenuation Tanks

Regular inspection and maintenance is important for the effective operation of infiltration and attenuation basins. Attenuation tanks contain proprietary products and as such where used the manufacturer's recommendations should be followed

Access points should be established to allow for visual inspection and jetting as appropriate.

Silt traps must be installed prior to all inlets.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets, outlets and overflows for blockages and clear if required. If faults persist rodding may be required.	Monthly for three months after installation then annually
	Survey inside of tank for sediment build up and remove if necessary	After 1 year and then every 5 years or as required
Remedial Actions	Repair/rehabilitation of inlets/outlets.	As required.
Regular Maintenance	Inspect and identify any areas that are not operation correctly and if necessary take remedial action	Monthly for three months after installation then annually
	Remove debris from catchment surface (where it may cause risk to performance)	As required
	Remove sediment from pre-treatment structures & silt traps	Annually or as required

Oil Separators

Proprietary treatment systems will require routine maintenance to ensure continuing operation to design performance standards. Because of the wide range of different designs and performance, all manufacturers should provide detailed specifications and frequencies for the required maintenance activities.

During the first few months after installation, units should be visually inspected after rainfall events and the amount of deposition measured to give the operator an idea of the expected rate of sediment and oil deposition. After this initial period, systems should be inspected every 6 months to verify the appropriate level of maintenance. During these inspections, the floating debris and floating oils should

normally be removed. His may be done using a van mounted system without the need for a large tanker. Silt should be removed if it reached 75% of the capacity of the sump. In most situations, the units should be fully cleaned out at least annually. Should there be a significant spill of oil then the system should be cleaned immediately.

Removal of oil, silt and other pollutants must be in accordance with the appropriate waste management legislation.

A typical operation and maintenance regime is set out in the table below for a proprietary system.

Maintenance Schedule	**Required Action**	**Frequency**
Regular Maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	6 monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following a significant spill
Remedial Actions	Replace malfunctioning parts or structures	As required.
Monitoring	Inspect for evidence of poor operation	6 monthly
	Inspect filter media and establish appropriate replacement frequencies	6 monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first 6 months of operation and then every 6 months