



Sustainable Drainage System Strategy

Site Address

Dun Elms
Nelsons Lane
Hurst
Wokingham
RG10 0RR

Client

WS Planning & Architecture

Report Reference

SWDS - 2025 - 000034

Prepared By

STM Environmental Consultants Ltd

Date

10/04/2026



**CONSULTING ENVIRONMENTAL
ENGINEERS AND SCIENTISTS**

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1 Document Control

	Sustainable Drainage System Strategy	
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2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone

3 Disclaimer

This report and any information or advice which it contains, is provided by STM Environmental Consultants Ltd (STM) and is solely for use by WS Planning & Architecture (Client).

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4 Executive Summary

BACKGROUND			
Location	Dun Elms, Nelsons Lane, Hurst, Wokingham, RG10 0RR Grid reference: 480758, 172693		
Site Area	4610 m ²		
Proposed Development	Change of use of land for the stationing of mobile homes to form 5 no. additional Gypsy and Traveller pitches, the erection of 3 no. day rooms and 1 no. building to form a stable following demolition of the existing stables, and associated changes in site layout and hard and soft landscaping.		
Current Site and Surrounding Uses	The site currently comprises a caravan park with hard standing and scalplings. It is located within a mainly agricultural area to the south of Hurst.		
Topography	The topographic survey indicates that the site slopes slightly from east to west, ranging from 38.86mAOD to 39.4mAOD.		
Hydrology	A number of unnamed, partially culverted channels and drains were identified in the vicinity of the site, all of which appear to be tributaries of the River Loddon, with the closest being located 210m east and 295m west of the site.		
Geology	BGS information indicates that there are no superficial deposits underlying the site, while the bedrock is classified as belonging to the London Clay.		
Source Protection Zone	The site is partially located within SPZ 3.		
Hydrogeology	BGS information indicates that the site is situated upon an Unproductive bedrock aquifer.		
Permeability	BGS information indicates that the bedrock is classified as highly variable.		
Infiltration Potential	BGS information indicates that there are opportunities for bespoke infiltration SuDS. Infiltration testing failed in TP01. In TP03, the infiltration rate was 1.23x10 ⁻⁶ m/s (0.0063 m/hr), which can be classified as a 'Moderate' rate of infiltration. Within the shallow pits TP02 and TP04, the infiltration rate ranged between 2.71x10 ⁻⁶ m/s (0.0097 m/hr) and 1.23x10 ⁻⁶ m/s (0.0044 m/hr), which can also be classified as 'Moderate'.		
Fluvial Flood Risk	Low – the proposed lies within EA Flood Zone 1, whilst flood zone 2 and 3 extents are witnessed across the blue line boundary.		
Surface Water Flood Risk	Low – Small sections along the front boundary of the site are indicated to be at 'High' risk of flooding during the 2040-2060 climate change scenario, while an area to the rear of the site is indicated to be at 'Low' risk. The rest of the site remains dry, however. Depths of up to 0.3m may be witnessed on site.		
Groundwater Flood Risk	Low - the BGS mapping does not indicate the potential for groundwater to occur on site. However, groundwater is likely to be less than 3mbgl for at least part of the year.		
Existing and Proposed Site Layout	Ground Cover	Existing (m²)	Proposed (m²) (Without SuDS)
	Buildings	319	915
	Driveways/Patio	1487	3695
	Gardens/ Soft landscaping	2804	0
	Total Impermeable Area	1806	4610

Changes in Impermeable	Without SuDS, the proposed development would increase the impermeable area of the site by 2804m ² and therefore increase the post-development runoff rate and volume.
PROPOSED SUDS	
<u>SuDS Target Requirement</u>	The proposal should aim to achieve the greenfield runoff rate all storm events. Due to size of the development proposal, maintain Qbar discharge rate for all storm events is not possible. The post development discharge rate during the 1% AEP plus CC event is 4.9 l/s during the critical storm scenario.
<u>Drainage Hierarchy</u>	The proposed development will partially discharge to ground and to the existing ditch to the northwest of the site.
<u>Storage Required to meet Planning Requirement</u>	The development is estimated to require 277m ³ of attenuation storage in order to meet the greenfield runoff rate.
<u>SuDS Strategy</u>	The proposal will mimic the natural drainage conditions as much as possible. The proposal will introduce porous tarmac, rain gardens and a series of bioretention areas will provide 405m³ of attenuation. The proposal will allow for partial infiltration across the site but all alternative permeable areas will be supported with underdrainage channels to convey stormwaters along the SuDS management chain. The use of porous tarmac across the site will form a large permeable aggregate sub-base that covers almost all of the development site. Excess stormwater will be diverted via a perforated pipe within the bioretention strips at the rear western corner of the blue-line boundary, from where it will discharge to a small ditch to the northwest of the site.
Foul Drainage	Due to site constraints, the discharge of foul effluent to ground or a watercourse is not feasible. Foul drainage will therefore be managed via a sealed cesspit system. A total storage capacity of approximately 240 m³ is proposed, equivalent to around 53 days' storage based on anticipated foul flows. The system will comprise four proprietary GRP cesspools (50–70 m³ each), designed to provide a fully watertight solution for off-mains wastewater storage. The tanks will be installed within a concrete surround to prevent flotation and will be fitted with high-level alarms. The system will be subject to a routine maintenance and emptying regime, with monthly emptying proposed to ensure sufficient operational capacity is maintained at all times.
Conclusion	With the proposed SuDS mitigation measures which have been introduced into the scheme, we believe that the proposed development will reduce local flood risk and therefore be in compliance with the LLFA's current planning policy and the NPPF.

5 Introduction

STM Environmental Consultants Limited have been appointed by WS Planning & Architecture to undertake a Sustainable Drainage System (SuDS) Strategy for a proposed development at Dun Elms, Nelsons Lane, Hurst, Wokingham, RG10 0RR.

5.1 Proposed Development

The SuDS report is required to support a planning application (Reference: 243193) for “Full application for the proposed change of use of land for the stationing of mobile homes to form 5 no. additional Gypsy and Traveller pitches, the erection of 3 no. day rooms and 1 no. building to form a stable following demolition of the existing stables, and associated changes in site layout and hard and soft landscaping.”

The planning condition states as follows:

5. Prior to the commencement of development, full details of the drainage system for the site have been submitted to and approved in writing by the LPA. The details shall include:
 1. Calculations indicating the existing runoff rate from the site.
 2. BRE 365 test results demonstrating whether infiltration is achievable or not.
 3. Use of SuDS following the SuDS hierarchy, preferably infiltration.
 4. Full calculations demonstrating the performance of soakaways or capacity of attenuation features to cater for 1 in 100-year flood event with a 40% allowance for climate change and runoff controlled at existing rates, or preferably better.
 5. If connection to an existing surface water sewer is proposed, we need to understand why other methods of the SuDS hierarchy cannot be implemented and see confirmation from the utilities supplier that their system has got capacity and the connection is acceptable.
 5. Details of a scheme to dispose of foul water from the site.
 6. Groundwater monitoring confirming seasonal high groundwater levels in the area.
 7. A drainage strategy plan indicating the location and sizing of SuDS features, with the base of any SuDS features located at least 1m above the seasonal high water table level.
 8. Details demonstrating how any SuDS for this development would be managed throughout the lifespan of the development and who will be responsible for maintenance.

The approved scheme shall be implemented prior to the first occupation of the development and shall be maintained in the approved form for as long as the development remains on the site.

Copies of the development plans are presented in [Appendix 1](#). The development is considered to be a non-minor development.

This report has been updated in response to the comments received from WBC. The comments are available in [Appendix 1.1](#).

A summary of the alterations and links detailed below.

1. Resolve the Foul Water conflict: If the ground failed the Vp test, applicant cannot use the "Discharge to Ground" detail shown in the Tricel manual.

The revised proposal collects all waste water within cesspools with regular monitoring, maintenance and empty task outlined and assigned. [See section 10](#).

2. Submit the Site Layout: Provide the Site Layout As Proposed (Drawing 501 Rev G) mentioned in Appendix 1 as a clear, scaled drainage strategy.

See [Appendix 7](#).

3. Provide Winter Data: Supplement Section 13.3.5 with winter groundwater readings to prove the 1m separation rule is met.

See [section 6.7.4](#).

5.2 Report Aims and Objectives

This report sets out the proposed drainage strategy that will be employed in the designs to meet the requirements of the planning condition and the National Planning Policy Framework.

5.3 Legislative and Policy Context

5.3.1 Legislative Context

Section H3 of the Building Regulations 2010 requires that adequate provision is made for rainwater to be carried from the building roofs and paved areas, and be preferentially discharged to soakaways or some other adequate infiltration system. Where that is not reasonably practicable, a watercourse; or sewer can be used.

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

5.3.2 Policy Context

The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England. The policies set out in this framework apply to the preparation of local and neighbourhood plans and to decisions on planning applications.

The latest version of the NPPF can be view online [here](#). The below text it extracted from the online document from paragraphs 170 – 186.

Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where

development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.

Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.

All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

-  Applying the sequential test and then, if necessary, the exception test as set out below;
-  Safeguarding land from development that is required, or likely to be required, for current or future flood management;
-  Using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques as part of an integrated approach to flood risk management); and
-  Where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.

A sequential risk-based approach should also be taken to individual applications in areas known to be at risk now or in future from any form of flooding, by following the steps set out below.

Within this context the aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed

development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test.

The sequential test should be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk).

Applications for some minor development and changes of use ⁽⁶²⁾ should also not be subject to the sequential test, nor the exception test set out below, but should still meet the requirements for site-specific flood risk assessments set out in footnote ⁽⁶³⁾.

Having applied the sequential test, if it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.

The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test it should be demonstrated that:

-  a) the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
-  b) the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Both elements of the exception test should be satisfied for development to be allocated or permitted.

Where planning applications come forward on sites allocated in the development plan through the sequential test, applicants need not apply the sequential test again. However, the exception test may need to be reapplied if relevant aspects of the proposal had not been considered when the test was applied at the plan-making stage, or if more recent information about existing or potential flood risk should be taken into account.

Paragraph 181 of the National Planning Policy Framework (NPPF) states that:

When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment (See Note 1)
Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

-  within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location
-  the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
-  it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
-  any residual risk can be safely managed; and
-  safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Paragraph 182 states that:

Applications which could affect drainage on or around the site should incorporate sustainable drainage systems to control flow rates and reduce volumes of runoff, and which are proportionate to the nature and scale of the proposal. These should provide multifunctional benefits wherever possible, through facilitating improvements in water

quality and biodiversity, as well as benefits for amenity. Sustainable drainage systems provided as part of proposals for major development should:

-  a) take account of advice from the Lead Local Flood Authority;
-  b) have appropriate proposed minimum operational standards; and
-  c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development.

A major development is defined as:

-  a residential development: 10 dwellings or more or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known
-  a non-residential development: provision of a building or buildings where the total floor space to be created is 1000 square metres or more or where the floor area is not yet known, a site area of 1 hectare or more.

Footnote 62 - This includes householder development, small non-residential extensions (with a footprint of less than 250m²) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

Footnote 63 - A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

5.4 Wokingham Borough Council

CP1 – Sustainable development

Planning permission will be granted for development proposals that:

- 1) Maintain or enhance the high quality of the environment;
- 2) Minimise the emission of pollutants into the wider environment;
- 3) Limit any adverse effects on water quality (including ground water);
- 4) Ensure the provision of adequate drainage;
- 5) Minimise the consumption and use of resources and provide for recycling;
- 6) Incorporate facilities for recycling of water and waste to help reduce per capita water consumption;
- 7) Avoid areas of best and most versatile agricultural land;
- 8) Avoid areas where pollution (including noise) may impact upon the amenity of future occupiers;
- 9) Avoid increasing (and where possible reduce) risks of or from all forms of flooding (including from groundwater);
- 10) Provide attractive, functional, accessible, safe, secure and adaptable schemes;
- 11) Demonstrate how they support opportunities for reducing the need to travel, particularly by private car in line with CP6; and
- 12) Contribute towards the goal of reaching zero-carbon developments as soon as possible by:
 - a) Including appropriate on-site renewable energy features; and
 - b) Minimising energy and water consumption by measures including the use of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form.

6 Site Characteristics

6.1 Location and Area

The site is centred at national grid reference 480758, 172693 and has an area of 4610 m².

It falls within the jurisdiction of Wokingham Borough Council in terms of the planning consultation process on flood risk and surface water management. The LLFA is also Wokingham Council.

Figure 1 provides the site location map and aerial imagery.

6.2 Current Site and Surrounding Uses

The site currently comprises a caravan park with hard standing and scalplings. It is located within a mainly agricultural area to the south of Hurst.

6.3 Site Topography

The mapping provided in [Appendix 2](#) shows the 1m LiDAR DTM (2022) ground elevations within the site. A topographical survey is also available in Appendix 2.

The topographic survey indicates that the site slopes slightly from east to west, ranging from 38.86mAOD to 39.4mAOD. The site is indicated to slope up from the rear towards the front boundary of the site, which forms the highest point, and the adjacent roadway (Nelson Lane). The surrounding area slopes from north to south.

Within the wider blue line boundary, the LIDAR mapping indicates that the elevations slope generally towards the northwestern corner. A small ditch is indicated to run adjacent to the rear of the blue line boundary, from where the elevations continue to slope towards the north.

The LIDAR mapping indicates a slightly higher ground level overall, with an average level of approximately 39.12mAOD.

Figure 1: Site location map and aerial photo



6.4 Geological and Hydrogeological Summary

The site is indicated to be situated on a bedrock of London Clay and which is indicated to have potential for bespoke infiltration methods.

The site is surrounded by drainage ditches, these are located along the blueline boundary on all sides apart from the western hedgerow.

The unnamed drainage ditches do not have constant flow.

The drainage ditch that are located to the northern boundary follow the existing natural topography and overland flow routes flows away and off site to the north west.

The drainage ditches within the site and surrounding area flow towards and form Kayersbridge Brook.

6.5 Nearby Surface Water Bodies

A number of unnamed, partially culverted channels and drains were identified in the vicinity of the site, the closest named feature being Kayersbridge Brook. all of which appear to be tributaries of the River Loddon, with the closest “main river” being located 210m east and 295m west of the site.

There are on field drainage ditches located within along the eastern and western boundaries of the blue line boundary.

6.6 On Site Trees – Root Protection Areas

The trees within the site have been surveyed and are all outlined the proposed development plan available in [Appendix 1](#).

6.7 Site Investigation Summary

The ground investigation works were carried out between 01/09/2025 and 03/09/2025.

2no. boreholes were drilled to a maximum depth of 6mbgl to determine the underlying geological conditions and groundwater table depth. Groundwater monitoring wells were installed.

4no. trial pits were excavated to a maximum depth of 1.5mbgl for the purpose of undertaking infiltration testing in general accordance with the BRE 365 DG methodology.

2no. trial pits were hand excavated to a maximum depth of 0.7mbgl for the purpose of undertaking field drainage testing in general accordance with the BS 5977.



Figure 2: Ground Investigation Map

1no. groundwater monitoring visit was undertaken during the winter months (Oct – Mar) on the 13th of October 2025.

Pictures, results tables and graphs of the site investigation and walk over are available in [Appendix 2.2](#).

6.7.1 Geological Findings

The geology encountered within the trial pits consisted of Made Ground (dark brown, dark grey sandy SILT) to a maximum depth of 0.5m (within TP04). This was underlain by dark brown, orange sandy SILT. In TP03, light brown, orange, slightly sandy Clay was encountered to a depth of 1.5mbgl.

6.7.2 Infiltration Testing

Infiltration testing in general accordance with the methodology outlined in BRE Digest 365 was conducted in TP01 – TP04.

The trial pits were rapidly filled with water from a 1.2m² water bowser and left to drain. The water level was continuously monitored using a water level logger and manual measurements.

Table 1: Infiltration testing results

TP	Dimension L & W / ø (m)	Depth (m)	Infiltration Rate (m/hr)	Infiltration Rate (m/s)	Classification
TP01	1.6 x 0.5	1.5	-	-	Failed
TP02 (Shallow)	0.5 x 0.5	0.5	0.004	1.23E-06	Moderate
TP03	1.6 x 0.5	1.5	0.006	1.75E-06	Moderate
TP04 (Shallow)	0.5 x 0.5	0.5	0.009	2.71E-06	Moderate

Infiltration testing failed in TP01. In TP03, the infiltration rate was 1.23x10⁻⁶ m/s (0.0063 m/hr), which can be classified as a 'Moderate' rate of infiltration.

Within the shallow pits TP02 and TP04, the infiltration rate ranged between 2.71x10⁻⁶ m/s (0.0097 m/hr) and 1.23x10⁻⁶ m/s (0.0044 m/hr), which can also be classified as 'Moderate'.

6.7.3 Field Drainage

2no. trial pits were excavated to a depth of 0.6m for the purpose of field drainage testing near to BH01.

At the base of the trial pit, 2no. 300mm x 300mm trial holes were filled with water and allowed to drain. The field drainage testing failed, as the water level within the pits failed to drain below 50% within 6-hours; as such the result Vp values was greater than 100.

6.7.4 Groundwater

Groundwater encountered at 4.5mbgl in BH01 and 3.1mbgl in BH02 during the investigation.

Groundwater levels were monitored on two separate occasions following the installations of the wells during the winter months.

Site Name:		Dun Elms, Nelsons Lane, Hurst, Wokingham, RG10 0RR				
Date	Borehole Reference	Ground Water Strike	Water Level	Well Depth	Comments	Weather
dd/mm/yy	BH#	m bgl	m bgl	{mbgl}		
01/09/2025	BH01	4.5	4.8	5.5	Borehole Drilled	Clear - Blue Skys
13/10/2025	BH01		4.8	5.2	Silting of BH	
06/03/2026	BH01		3.0	5.2		
01/09/2025	BH02	-	3.1	4.2	Borehole Drilled	Clear - Blue Skys
13/10/2025	BH02	-	3.5	4.2		
06/03/2026	BH02	-	-	-	Borehole could not be located.	

During the final monitoring round, completed in March 2026, BH02 was not able to be located.

Nevertheless, the groundwater encountered within BH01 indicated a groundwater depth of 3.0mbgl, showing an expected rise in the groundwater levels during the winter period. However, it provides good confidence that a 1m freeboard is ensured for SuDS systems to be installed across the site, especially when utilising shallow surface SuDS features (permeable paving / Bioretention areas).

7 Flood Risk

7.1 Summary

The overall flood risk to the site is considered to be low. The site within the redline boundary is generally at 'Low' risk of surface water flooding and very low risk of fluvial flooding.

The south west boundary, which forms a hedge row along the Nelsons Lane, indicated to be at 'High' risk of witness surface water ponding during the present day and climate change precipitation events.

The redline boundary to the south west is partially within Flood Zone 2. The flood zone 2 extent only partially impacts the site, no climate change flood extents are available.

7.1.1 Pluvial – Precipitation Events

The redline boundary to the south west is partially within Flood Zone 2. The flood zone 2 extent only partially impacts the site, no climate change flood extents impact the site.

7.1.2 Pluvial – Precipitation Events

Redline Boundary

The surface water flood extent overlaps slightly with the front boundary of the site, which is therefore indicated to be at 'High' risk of flooding. This appears to be due to a depressed strip of land parallel to the boundary (forming an unmapped drainage ditch), which lies between the site and the adjacent roadway (Nelsons Lane). Flood depths of up to 0.3m may be witnessed in this area; however, it is considered unlikely that this will significantly impact the site itself.

The access into the site forms a culverted section of this drainage ditch.



Figure 3: Access and drainage ditch along Nelson Lane

A small extent at the rear of the site, which includes part of the proposed stables, is indicated to be at 'Low' risk of flooding to a depth of less than 0.2m. The rest of the site remains dry.

Blueline Boundary

Surface water flooding within the blue line boundary during the extreme events covers a large proportion of the greenfield.



Figure 4: Surface Water Flooding Risk Overview

The existing stormwater flow route within the blueline boundary follows the natural land drainage over land flow routes; the gradual sloping nature of the site towards to the north/ north west of the site.

7.1.3 Groundwater

The site is not indicated to be susceptible to groundwater flooding. However, the groundwater table is indicated to be less than 3mbgl. Groundwater was encountered during the SI at 3.1mbgl (1st of September 2025). The flood risk maps area available in [Appendix 3](#).

7.2 Existing Surface Water Drainage Features

A utility search was undertaken which identified Thames Water as the local sewage undertaker. The drainage plans, which are presented in [Appendix 5](#), do not contain any information on surface or foul water drainage in the vicinity of the site.

8 Hydrological Run-off Assessment

To minimise the impact of the new development on local flood risk, the NPPF requires that the water drainage arrangements for any development site are that the volumes and peak flow rates leaving the site post-development are improved upon those of the existing conditions. The following run-off assessment predicts the Greenfield, pre- and post-development run-off rates and provides the required SuDS necessary for complying with the relevant planning policies.

8.1 Existing and Proposed Ground Cover

Table 2: Breakdown of Ground Cover in the Proposed Development

Ground Cover	Existing Development Area		Proposed Development Area		Difference (m ²)
	m ²	%	m ²	%	
Buildings	319	6.9	915	19.8	596
Hard Standing	1487	32.3	3695	80.2	2208
Soft landscaping	2804	60.8	0	0.0	-2804
Total	4610	100	4610	100	

Table 3: Summary of Permeable and Impermeable Areas

	Impermeable Area		Permeable Area		Total Area
	m ²	%	m ²	%	m ²
Existing Site	1806	39.2	2804	60.8	4610
Proposed Site	4610	100.0	0	0.0	4610
Difference	2804	60.8	-2804	-60.8	

The proposed development increases the impermeable area of the site by 61% to 4610m². As such this will have a negative impact on the runoff rate without the introduction of SuDS.

When considering the introduction of hard standing, the proposal has significant opportunity to reduce the total increase in impermeable area through the application of alternative surfaces.

8.2 Peak Flow Control

With regard to peak flow control, the non-statutory technical standards for sustainable drainage systems state that:

-  S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

8.3 Volume Control Requirements

With regard to volume control, the non-statutory technical standards for sustainable drainage systems state that:

-  S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.
-  S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

8.4 Run-off and Storage Calculations

The FEH method was applied to calculate the Greenfield, pre- and post-development run-off rates and target storage volumes including allowances for climate change. The full calculations and results are presented in [Appendix 4](#). The table below gives a summary of the results:

-  **Maximum discharge flow rate:** 2.5 (l/s)
-  **Outflow orifice diameter:** 44 (mm)
-  **Storage base length:** 48 (m)
-  **Storage base width:** 24 (m)
-  **Storage base area:** 1160 (m²)
-  **Storage total volume:** 474 (m³)
-  **Storage total water volume:** 427 (m³)

Table 4: Greenfield and Pre / Post Development Discharge Rates

	FEH Greenfield (l/s)	FEH Pre - Development (l/s)	Modelled Post Development (l/s)
Qbar	2.20	2.90	-
1 in 1 or 1 in 2	2.20	2.50	2.00
1 in 30	5.90	6.80	3.30
1 in 100	7.80	9.10	4.70
1 in 100 + CC			5.20

The storage volume required to meet the greenfield runoff rate was calculated to be approximately 284m³.

9 SuDS

9.1 SuDS Hierarchy

The SuDS Hierarchy sets out the preferred method of selecting which Sustainable Drainage System should be used.

-  rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation);
-  rainwater infiltration to ground at or close to source;
-  rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);

-  rainwater discharge direct to a watercourse (unless not appropriate);
-  controlled rainwater discharge to a surface water sewer or drain;
-  controlled rainwater discharge to a combined sewer;

The table outlined on the page below summarises the available SuDS, their potential suitability and the benefits.

9.2 Drainage Hierarchy Discussion

9.2.1 Rainwater Harvesting

The development has good potential to provide rainwater harvesting; As such this is recommended in the form of rainwater butts and tanks.

9.2.2 Alternative Roofing – Green, brown and Blue

Based on the proposed roof design, which include Pitched roofs, the use of alternative roofing is not deemed to be suitable.

9.2.3 Infiltration To Ground

Infiltration failed in TP01, but was successful in TP02-TP04. However, a relatively slow rate of infiltration was observed in the trial pits.

Typically, to achieve an acceptable infiltration rate that ensures half drainage times of less than 24 hours, the rates need to be 0.01m/hr or greater.

Ground waters were monitored over the winter period and were indicated to be at a height of 3.0mbgl during the March 2026 monitoring visit. Therefore a 1m freeboard is achieved assuming SuDS are not installed below 2.0mbgl.

Given the site and surrounding area, within a greenfield landscape; dominated by agricultural land uses in the form of grazing, livestock fields and arable land uses, the site should provide a focus on the use of blue green SuDS features to mimic the natural landscape as much as possible. Utilising blue green SuDS within the site and will help contribute to national standards, promoting biodiversity, water quality and achieve a

more sustainable design. Given the variable and relative low infiltration rates, any proposed system should

The site is located in SPZ 3. As such, pollution controls will be considered.

9.2.4 Permeable Surfaces and Filter Drains

Approximately 51% of the development will consist of outdoor space, and patios which could be designed to be permeable. Infiltration is partially suitable.

9.3 Appraisal of Potential SuDS Options

9.3.1 SuDS Options

Table 5: SuDS Appraisal; Feasibility of various SuDS and the potential uses on site.

Key	H	M	L	Y	?	N	N/A							
Details	High Impact	Medium	Low Impact	Yes	Maybe	No	Not Applicable							
Main Category	SuDS Features	Total Suspended Solids Removal	Heavy Metals Removal	Nutrient Removal	Bacteria Removal	Dissolved Pollutants	Runoff Volume Reduction	Flow Rate Control / Events			Site Potential	Included	Discussion / Details	Potential Storage Provided
								1-2 Years	10 - 30 Years	100 Years				
Source Control Measure	Green / Brown Roof	NA	NA	NA	NA	H	H	H	H	L	N	N	Poorly compatible with proposed;	0
	Rain Water harvesting	M	L	L	L	NA	M	M	H	L	Y	Y	Rainwater Butts	-
Infiltration Methods	Infiltration trench	H	H	H	M	H	H	H	H	L	Y	N	Conveyance route to rear;	0
	Permeable Pavement	H	H	H	H	H	H	H	H	H	Y	Y	Good potential	210
	Infiltration basin	H	H	H	M	H	H	H	H	H	Y	N	Limited Space	0
	Soakaway	H	H	H	M	H	H	H	H	L	Y	N	Slow Infiltration Rates	0
Filtration	Filtration Surface sand	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0
	Sub-surface sand filter	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0
	Perimeter sand filter	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0
	Bioretention/filter strips	H	H	H	M	H	L	H	H	L	Y	Y	Good Potential along Rear Boundary	196
	Filter trench	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0
Channels Features (Open)	Open channels Conveyance	H	M	M	M	H	M	H	H	H	Y	N	Limited Space	0
	Enhanced dry swale	H	H	H	M	H	M	H	H	H	Y	N	Limited Space	0
	Enhanced wet swale	H	H	M	H	H	L	H	H	H	Y	N	Limited Space	0
Wet SuDS	Wetland Shallow wetland	H	M	H	M	H	L	H	M	L	N	N	Poorly compatible with Proposed	0
	Extended detention wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space/Poorly compatible with Proposed	0
	Pond / wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space/Poorly compatible with Proposed	0
	Pocket wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space/Poorly compatible with Proposed	0
	Submerged gravel wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space/Poorly compatible with Proposed	0
	Wetland channel	H	M	H	M	H	L	H	M	L	N	N	Limited Space/Poorly compatible with Proposed	0
Retention	Retention pond	H	M	M	M	H	L	H	H	H	N	N	Limited Space/Poorly Compatible with Proposed	0
Detention	Detention basin	M	M	L	L	L	L	H	H	H	N	N	Limited Space/Poorly Compatible with Proposed	0
Tank Storage	Sub-surface storage (Tank)	L	L	L	L	L	L	H	H	H	Y	N	Good potential, least sustainable.	0
														406

9.4 SuDS Strategy

9.4.1 SuDS Options

The site is situated within a rural landscape, with the site being surrounded by small country lanes, farms, and greenfields. As such, the proposal will aim to introduce a blue green SuDS design to mimic the natural drainage conditions of the site as much as possible.

The proposal will introduce alternative permeable surfaces across suitable areas of the site, which will work in combination with flow through structures in the form of rain gardens, filtration trenches and bio-retention

The paddock within the blue line boundary will be landscape to provide shallow stormwater detention basis. The and system will provide 405m³ of attenuation and will mimic the natural drainage conditions of the site

The bespoke system will utilise infiltration SuDS where possible; however given the relative low rates of infiltration this cannot be relied upon to ensure suitable half drain times.

Excess stormwater will discharge into the drainage ditches that surround the site; The maximum discharge witnessed post development is 5.2 l/s during all storm events.

Table 6: Proposed SuDS

Location	Proposed Area (m ²)	SuDS Option	Estimated Storage Provided (m ³)
Ground Cover across compound	2030	300mm Sub-base	183
Conveyance routes / Compound to Bio-Retention	94	400mm Permeable Sub-base / Perforated pipe.	10
Rain Garden / Bio Retention Areas	1089	400mm Sub-base	224
Total			416

The drainage layout, model sections and model results are available in [Appendix 7](#)

The descriptions of the proposed SuDS and how they interact with the different features is outlined below.

9.4.2 Rainwater Butt

All buildings will have rainwater harvesting butts (200 litre) will be fitted to the downpipes to allow for rainwater re-use around the site.

Once at capacity the excess will discharge into the rain gardens or permeable paving.

9.4.3 Porous Tarmac – Ultra porous

Porous Tarmac is an alternative hardstanding surface which is fully and permeable and is SuDS complainant. It is designed to allow rainfall to percolate immediately through the surface near to where the raindrop lands – so surface ponding is completely eradicated without the need for an additional channel drainage system.

The construction will consist of 50mm thick 10mm porous asphalt, with a 80mm underlying bedding layer of Open Grade Course 20mm course; UTILIFLOW porous a 300mm sub-base consisting of a graded aggregate (MOT Type 3 fines removed) with a porosity of 0.30. This 450mm construction depth will provide CBR value of <5% which will be designed for cars and light vans. This construction over 2030m² will provide approximately 182m³ of interception, attenuation, and treatment storage and will allow for partial infiltration.

The area will be supported with drainage channels (under drains) and infiltration trenches which will ensure suitable conveyance routes are provided around the site.

9.4.4 Rain Garden and Bio-retention SuDS Features

Due to the relatively small change in surface elevations across the site, and the variable infiltration rates on the site, a bespoke partial infiltration SuDS system it to be introduced which will contribute towards the SuDS approach in assuring amenity, bio-diversity and water quality are achieved across the site.

Rain gardens and bio-retention features are largely the same, however bio-retention features are typically more engineered, larger and provide additional benefits.

Rain Gardens

Small rain gardens will be introduced around the compound. They will be strategically located to accept stormwater runoff directly from proposed rooftops (or rainwater butts). The rain gardens will form relatively small areas within close proximity so rooftop runoff can discharge directly onto the surface.

A rain garden is a shallow area of ground which receives run-off from roofs and other hard surfaces. A rain garden is planted with plants that can stand waterlogging for up to 48 hours at a time, but would typically drain completely within 12 - 24 hours.

A range of different plants can be included within the garden, as more drought-tolerant plants will be suitable towards the edges. During a storm water fills the depression and then drains.

A sequence of perforated pipes will be laid within the gravel sub-base that will convey surface waters into the rain garden. To ensure half drainage times are always met, an overflow drainage channel will be formed to connect the surface water into the hedgerow to the west and into the surrounding field.

Bio-Retention Areas

The fence line surrounding the travellers site will support an engineered bio-retention system that will provide water quality, form a large attenuation structure that acts as a conveyance and a filtration medium.

The bioretention structure, will house a 225mm diameter perforated underdrainage pipe; that will run along the entire boundary. It will be covered in a filtration sock, and packaged within a pea gravel surround that will 500mm x 500mm.

The bio-retention structures will be formed from a large gravel sub-base, formed from a permeable gravel aggregate, that will have a depth of 400mm across its length; in total the bioretention area will cover 560m but will be divided at intervals up too allow for field access; The underdrainage will ensure conveyance and connection are

maintained, inspection chambers will be situated at regular intervals to ensure access is provided for maintenance and monitoring.

A filtration fleece will be lain above the permeable sub-base to prevent fines migrating into the aggregate and underdrainage channel.

The filtration medium of the structure will be variable in depth, depending on its upstream or downstream position, will be 0.5 – 0.8m in depth. It will consist of mix of sand, loam, and organic matter that filters and treats runoff, the surface will be covered in mulch layer, which protects the soil and aids pollutant treatment.

The surface layer will be formed from suitable vegetation and planting (trees, shrubs etc) and decorative stone. It will also form a shallow depression which will provide further attenuation during the most extreme storm events.

If any flooding or blockages were caused within the system, the overflow would be directed into the paddock area and would follow the natural overland flow routes.

9.4.5 Detention Basin

The surrounding field, with existing shallow falls towards the northwest corner, forms a natural detention basin before discharge into the existing drainage ditch.

No additional works are required to form the detention basin and no modification will be required as the SuDS measures implement upstream ensure there is an overall reduction in the surface water runoff rate.

9.4.6 Surface Water Discharge Points

The proposal will discharge the excess storm water into the surrounding field via filtration and a protected flow control. The proposal aims to discharge the excess flows overland to provide further reduction in the sites runoff rate by increase the travel distance for stormwater reaching the drainage ditch.

9.5 Water Quality Assessment

The Simple Index Approach to water quality tool was used to ensure suitable water quality treatment has been provided within the proposed SuDS measures.

9.5.1 Treatment of Run-off

Treatment of roof water runoff will be provided through the provision of the permeable paving, rainwater tank filtration unit to intercept gross solids and sediment, guidance will be provided to the developer on appropriate maintenance.

9.5.2 Exceedance Flows

The elevation review of the LIDAR 1m DTM Mapping indicates that in the event of exceedance on the site upon completion, overland flows will flow towards the rear of the site, ensuring that safe access and egress can be maintained during such an event.

9.6 Maintenance and Adoption of SuDS

All SuDS features will be properly installed by competent persons. They will be maintained regularly to ensure that their design capacity and attenuation characteristics provide the required storage volume.

Landscaping and adjacent areas will be designed such that they do not cause soil, mulch and other materials to be washed onto the permeable surfaces and into drains causing clogging.

Owners of the properties/persons responsible for maintenance of SuDS components will be provided with operation and maintenance manuals which will include information such as:

-  the location of SuDS components;
-  an explanation of design intent and objective of the SuDS;
-  the requirements for regular and occasional inspection and maintenance;
-  visual indicators that may trigger maintenance.

Regular maintenance of SuDS components is relatively straightforward with the main tasks consisting of:

-  Regular visual inspections – checking inlets are not blocked and verifying that clogging has not occurred;
-  Litter and debris removal;
-  Grass cutting;
-  Preventive sweeping;
-  Weeding and invasive plant control;
-  Oil and stain removal.

Occasional maintenance activities to ensure the long-term performance of the SuDS features include:

-  Sediment removal
-  Vegetation and plant replacement

These simple measures will ensure that the storage capacity of the system is maintained and that the need for reconstruction and replacement of components is minimised.

Further details on SuDS maintenance measures that will be employed at the site can be found in [Appendix 8](#).

10 Foul Drainage

10.1 Constraints

The site is situated in a location that is not serviced by the public sewer network.

The site is not directly serviced by the foul sewer network, when reviewing the general guidance for new connection into the public network, the typical allowance of 30m per unit is applied.

There are no identifiable foul assets within 500m of the site. As such the proposal will require an alternative solution.

Therefore, the proposal will be required to install a suitable system to discharge the sewage and effluent into a surface water body, into the ground or into a cesspit.

Due to the site location and environmental characteristics the discharge to ground or a watercourse are not permitted by the general binding rules.

The sites infiltration potential within the limited area where a drainage field could be located was indicated to be poor (i.e Vp greater than 100).

The adjacent field is almost entirely covered by Flood Zone 2 and 3 preventing the use of drainage fields or drainage mounds.

The surrounding watercourses (field drainage ditches) run dry during part of the year as such no foul effluent discharge is permitted via the general binding rules.

Due to the extensive restrictions the use of cesspits is considered to be the best solution.

10.2 Discharge Calculator

The proposed development site will form a total of 10no. pitches upon completion.

The occupancy of each pitch is considered to be on average 2.4 person per pitch, for the use of the calculations this each pitch will be considered to house 3no. of people on a daily basis to assess the daily volumes of waste water.

For the purpose of this assessment the total daily volumes of discharge have assumed constant occupation of all plots to ensure the correct tank sizing is applied.

10.3 Design Load and Requirements

The design population, with an assumed capacity 3no. people per unit (10no. units) has a total potential occupancy of 30 people.

Each cesspit is sized to serve a maximum of 6 - 9 persons. In accordance with Approved Document H, the minimum storage volume is calculated as 18,000 litres for the first two users plus 6,800 litres per additional user.

C1 = 3 pitches = 9 people

C2 = 2 pitches = 6 people

C3 = 3 pitches = 9 people

C4 = 2 pitches = 6 people

C1 / C3 — 3 pitches

- Users = **9**
- Daily flow = **$9 \times 150 = 1,350$ L/day**
- Minimum cesspit volume = **$18,000 + (7 \times 6,800)$**
- **= 65,600 litres**
- **= 65.6 m³**
- **Proposed Tank size = 70m³**

C2 / C4 — 2 pitches

- Users = 6
- Daily flow = $6 \times 150 = 900 \text{ L/day}$
- Minimum cesspit volume = $18,000 + (4 \times 6,800)$
- = **45,200 litres**
- = **45.2 m³**
- **Proposed Tank size = 50m³**

This increase allows for additional freeboard and will aid in reduced frequency of emptying.

The total volume provided on site will be 240m³ providing a 53 days' worth of waste storage before emptying is required.

10.4 Proposed Foul Drainage Summary

All foul water waste from the site will discharge into Cesspools which will be contained

The Marsh 50000/70000 Litre Cesspool (also known as a cesspit) is the ultimate solution for safe, high-volume, off-mains wastewater storage. Manufactured from robust GRP, this 70,000L tank is engineered to provide a completely watertight, reliable container for raw sewage, grey water, and other approved non-mains effluent.

With a heavy-duty shell suitable for all ground conditions, the HSC70000 model ensures long-term integrity and comes backed by Marsh Industries' exceptional 25-year structural guarantee.

Key Features and Specifications (Bulleted List)

- **Capacity:** 50,000 / 70,000 Litres
- **Construction Material:** High-Quality GRP (Glass Reinforced Plastic)
- **Durability:** Heavy-Duty shell as standard, suitable for all ground conditions.

- **Standards:** Designed and manufactured to **BS4994 / BSEN976** and **CE Marked**.
- **Warranty:** 25-Year Structural Guarantee; 50-Year Design Life.
- **Handling:** Features integral lifting eyes for simple on-site placement.
- **Installation:** Unique 'keying-in' lip for effective anchoring with concrete surround due to groundwater.
- **Function:** Covered, watertight tank for **storage only**—it has no outlet and provides no biological treatment.
- **Alarms :** High-Level Alarm (recommended) and Chemical/Silage Liners.

The proposed units will be located a minimum of 7m away from any habitable unit and have been positioned outside of the designated Flood Zone 2 and 3 extent.

The tanks will be encased in a concrete surround following the manufactures guidance.

The tanks are easily accessible by the access track, and will routinely monitored, and maintained and emptied by:

A Better Service Ltd

The Homestead Park Lane, Charvil, Reading
Berkshire
RG10 9TR

Email: info@abetterserviceuk.co.uk

11 Conclusion and Recommendations

With the proposed SuDS mitigation measures in place, it is considered that the proposed development will reduce local flood risk and enhance the local environment and will therefore be in compliance with the LLFA's current planning policy and the NPPF.

12 References

1. Communities and Local Government - National Planning Policy Framework NPPF, 2019.
2. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
3. Core Strategy, Wokingham Borough Council, 2010.

13 Appendices

13.1 Appendix 1 – Development Plans & Photos

See next page.

NOTES

Written dimensions only are to be used from this drawing.
If any doubt exist the contractor must ask for clarification.
On no account must the contractor scale off this drawing.

Contractors and sub contractors must check and agree all dimensions before preparing workshop drawings or commencing work on site.

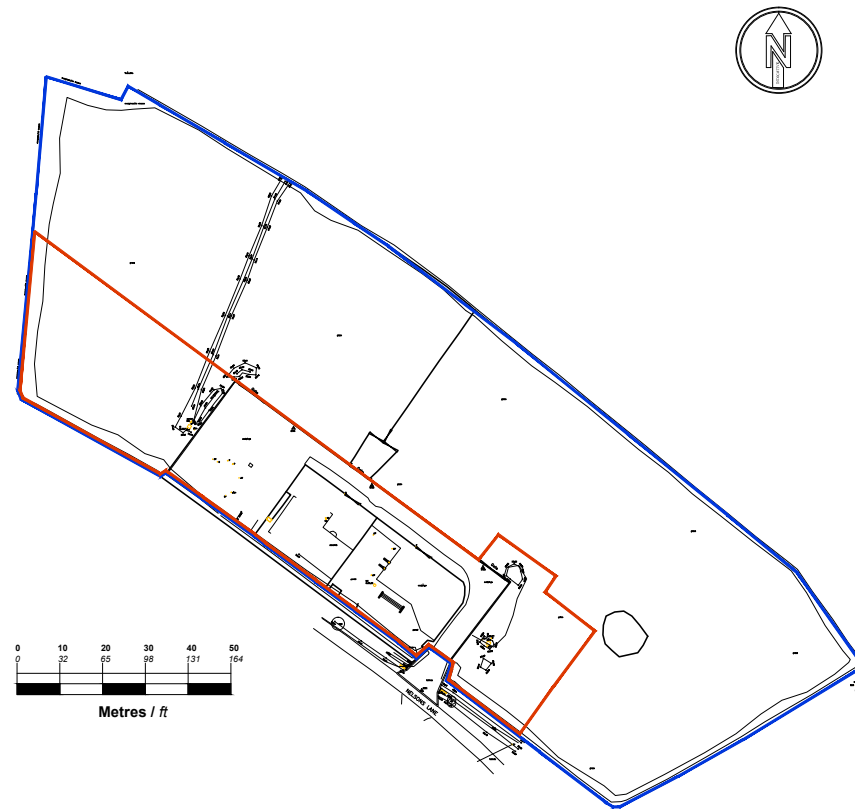
Contractors are responsible for informing ripars of any discrepancy discovered on this drawing or between this drawing and any other related documents issued in respect of the work.

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All work must be carried out in accordance with the current Building Regulations, Codes of Practice and British Standards. If any doubt exists the contractor must ask for clarification.

The Construction Design and Management Regulations 2015. It is the responsibility of the client to instruct the appointed contractor to identify any special hazards in the carrying out of the construction works and prepare a Health & Safety Plan and submit the relevant information to the Health & Safety Executive if necessary.

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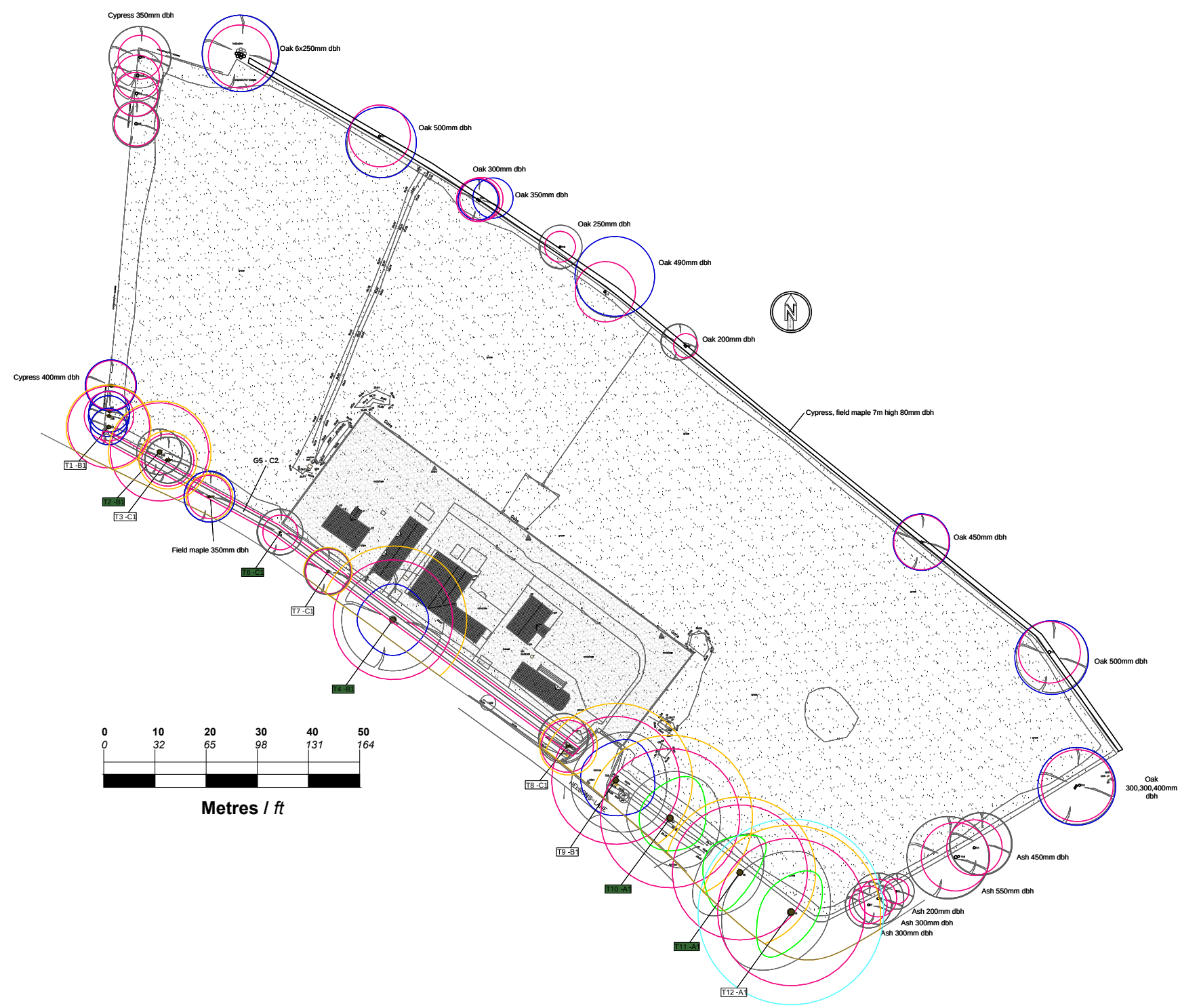


A Amended To Client Requirements 01-05-2024

Contract Proposed Alterations At Dunn Elms, Nelsons Lane, Reading, RG10 0RR		mpas	
Client		Martin Peacock Architectural Services Limited	
Drawing Location Plan		Old Reading Room Main Street, Stanforth Settlement North Yorkshire YO24 9PE. Tel: 07765 224 261	
Drawn Scale Date	MDP 1:1250 @A3 04-03-2024	2024-11	400 A

Key

- Existing Landscaping (Trees)
- Existing Landscaping (Low Level Planting / Hedge)
- Existing Road / Track Surface
- Existing Caravan Pitch
- Application Boundary



13.2 Appendix 1.1 – Drainage Comments from WBC

PDF to follow this page.

Date: 6 January 2026
Application: 253144



**WOKINGHAM
BOROUGH COUNCIL**

WBC Drainage

Development Management &
Compliance

P.O. Box 157

Shute End, Wokingham

Berkshire, RG40 1BN

Tel: (0118) 974 6000

Minicom No: (0118) 974 6991

Dear WBC Drainage,

Discharge of condition Consultation

Application Number: 253144

Applicant: Mr Andrew Loveridge

Site Address: Dun Elms, Nelsons Lane, Hurst, Wokingham, RG10 0RE

Parish: St. Nicholas Hurst

Grid Reference: Easting - 480761, Northing - 172680

Type of Development:

Proposal: Application for submission of details to comply with the following condition of planning consent 243193 dated 11/04/2025. Condition 5. Drainage System. 6. Landscaping. 7. Biodiversity Enhancements. 8. Horse manure storage. BNG Condition.

Case Officer: Kieran Neumann

Development Management has received the above application, and we require your comments on the proposal using the recommended memorandum below. The documents associated with this are available to view in NEC DM using the application number 253144. Alternatively, public documents are available to view on the Council's planning application search page: [Wokingham Borough Council Online Planning](#).

Please index your response into NEC DM against the application. If you are recommending conditions, you should give a reason with reference to relevant policies. A list of standard conditions can be requested from the case officer.

Your observations are required in respect of this application by **27 January 2026**.

Yours sincerely,
Development Management & Compliance

MEMORANDUM

From:	NT		
Service	WBC Drainage	App No:	253144
Address:	Dun Elms, Nelsons Lane, Hurst, Wokingham, RG10 0RE.		
Proposal:	Application for submission of details to comply with the following condition of planning consent 243193 dated 11/04/2025. Condition 5. Drainage System. 6. Landscaping. 7. Biodiversity Enhancements. 8. Horse manure storage. BNG Condition.		
Type of Development:			
Site Visit Made:	No		

Summary Of Recommendations

- ☐ No comment
- ☐ No objection
- ☐ No objection subject to conditions (and reasons) **stated below**
- ☒ Request further information before determination as **stated below**
- ☐ Objection due to the reason(s) **stated below**

Comments On Proposal

LLFA received Application for submission of details to comply with the following condition of planning consent 243193 dated 11/04/2025. Condition 5. Drainage System. 6. Landscaping. 7. Biodiversity Enhancements. 8. Horse manure storage. BNG Condition on 6th January 2026.

As a LLFA technical findings from the provided Sustainable Drainage System Strategy (Ref: SWDS-2025-000034). While the report provides a professional conceptual framework, it is not currently in a position to discharge the planning conditions. Based on a detailed review of Appendix 1 and Appendix 6, below assessment of how these documents address the planning conditions. While they provide significant technical detail, they still do not fully satisfy the LLFA's requirements for formal discharge, primarily due to missing data and internal contradictions. Below is formal consolidated response regarding the status of the planning conditions:

Runoff Rates and Hydraulic Performance (Discharged) - The report identifies a post-development discharge rate of approximately 4.7 to 5.2 l/s (using a 44mm orifice) for the 1 in 100-year + 40% CC event. While this appears to be a reduction from the calculated pre-development rate of 9.1 l/s.

Infiltration and SuDS Hierarchy (Discharged) - Appendix 1 contains section 13.3.2 "Infiltration Testing Graphs" and 13.3.3 "Infiltration Data and Results – TP04". BRE 365 testing was conducted, showing "moderate" rates in three pits and failure in one. While the strategy correctly adopts a "partial infiltration" approach (permeable paving and rain gardens), the full raw test sheets and pit

location plans (referenced as Appendix 2.2) must be included in the formal planning submission to validate the design rates used.

Management and Maintenance (Discharged)- Appendix 6 provides the full Tricel Service & Maintenance Manual, and Appendix 1 confirms that WS Planning & Architecture will instruct a maintenance company for scheduled works. This satisfies the "how" and "who" of the maintenance condition.

Groundwater Levels (Not Discharged) - This is the most significant barrier to approval. The condition requires confirmation of seasonal high groundwater levels. The report relies on a single monitoring event in October 2025. Appendix 1 lists Section 13.3.5 Groundwater Monitoring. A single autumn reading cannot establish the peak winter water table. Without seasonal monitoring (typically Nov–Mar), you cannot demonstrate compliance with the mandatory 1.0m clearance between the base of SuDS features and the groundwater table. In the London Clay/Head deposits characteristic of this area, a rising winter water table could flood the attenuation storage, rendering the SuDS ineffective.

Foul Drainage Strategy (Not Discharged) - Appendix 6 includes the Tricel Maxus Service & Maintenance Manual and technical specifications for the treatment plant. Appendix 1 (Section 13.10.1) highlights "General Binding Rules not Met" in red text. There is a fundamental inconsistency in the proposal. The report suggests a package treatment plant with effluent discharged partly to ground via an infiltration system, yet the same report notes that percolation testing for foul water failed ($V_p > 100$). Applicant cannot propose infiltration for foul effluent where the ground has been proven unsuitable. You must provide a single, viable foul route—either a justified discharge to a watercourse (requiring an Environment Agency Permit) or a revised infiltration design supported by further testing at the specific discharge location.

LLFA Recommendation

Appendices 1 and 6 provide the How (specifications and manuals) but not the Where or When (final site plan and winter groundwater data). To discharge the conditions, you must:

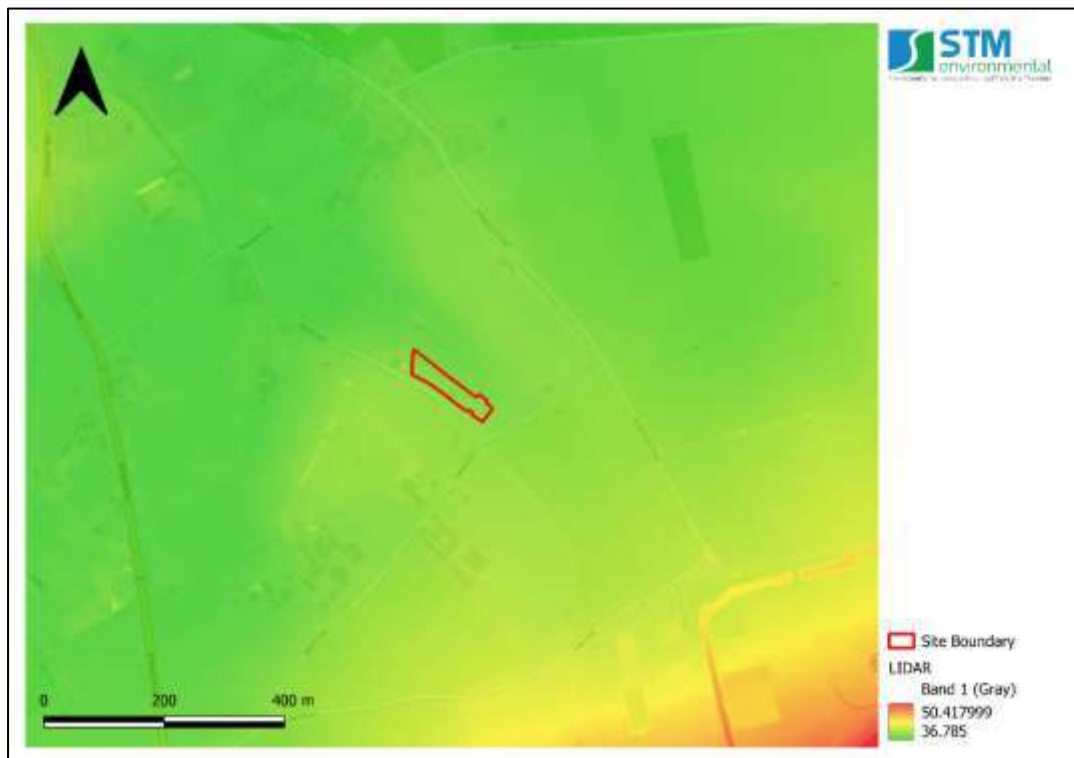
1. Resolve the Foul Water conflict: If the ground failed the V_p test, applicant cannot use the "Discharge to Ground" detail shown in the Tricel manual.
2. Submit the Site Layout: Provide the Site Layout As Proposed (Drawing 501 Rev G) mentioned in Appendix 1 as a clear, scaled drainage strategy.
3. Provide Winter Data: Supplement Section 13.3.5 with winter groundwater readings to prove the 1m separation rule is met.

Conditions & Reasons (if required)

Date:	07/01/2026	Signed:	NT
--------------	------------	----------------	----

13.3 Appendix 2.1– Site Topography and Drainage Characteristics

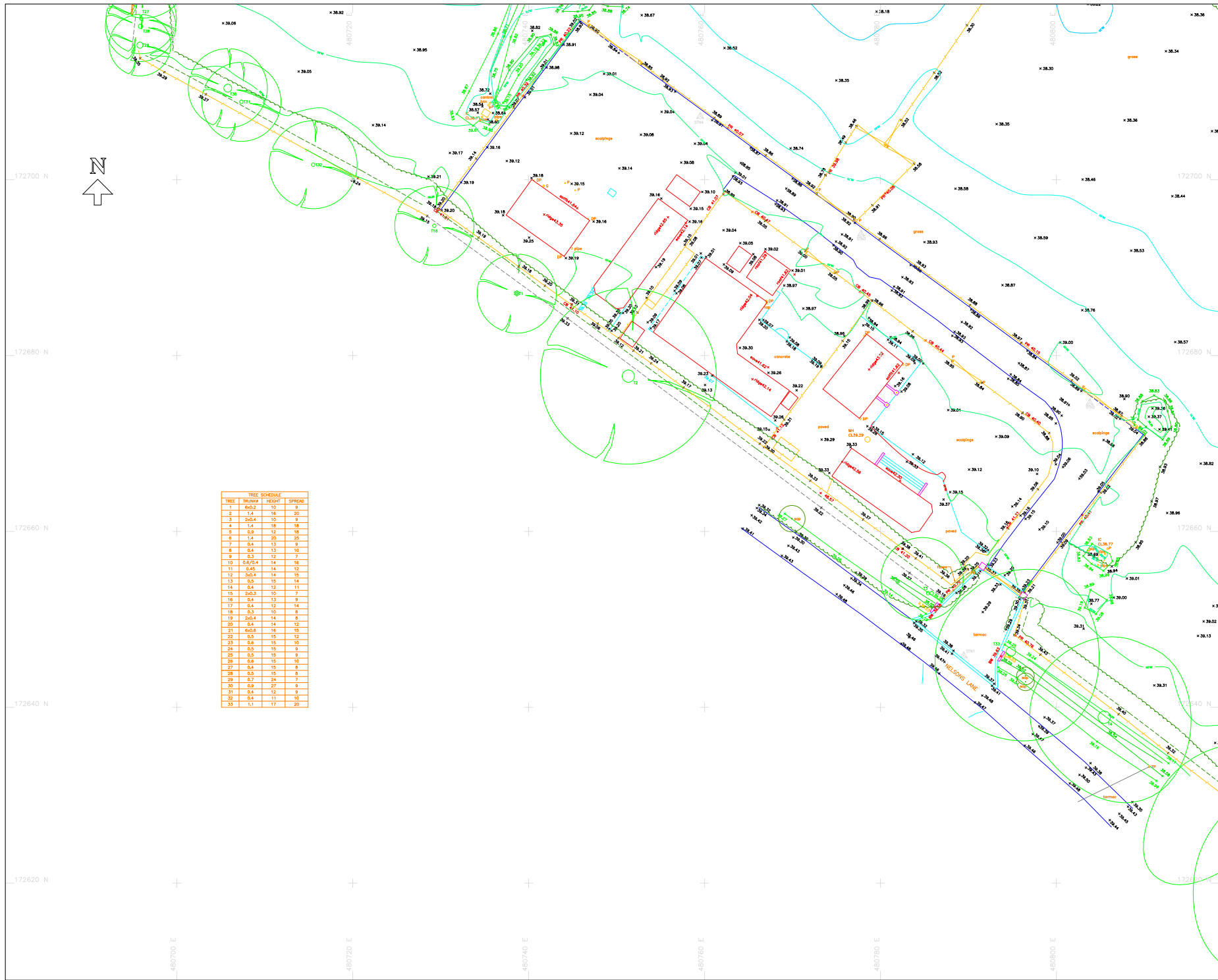
13.3.1 LIDAR Mapping showing Site Topography - (Source: LiDAR DTM 2022)





13.3.2 Topographic Survey Map

See next page.



TREE SCHEDULE			
TREE	THINNESS	HEIGHT	SPREAD
1	60x2	10	9
2	1.4	16	20
3	20x4	10	9
4	1.4	18	18
5	0.9	12	16
6	1.4	20	25
7	0.4	13	9
8	0.4	13	10
9	0.5	12	7
10	0.9/0.4	14	16
11	0.45	14	12
12	30x4	14	15
13	0.5	15	14
14	0.4	12	11
15	20x3	10	7
16	0.4	13	9
17	0.4	12	14
18	0.3	10	8
19	20x4	14	8
20	0.4	14	12
21	60x6	16	15
22	0.5	15	12
23	0.6	15	10
24	0.5	15	9
25	0.5	15	9
26	0.6	15	10
27	0.4	15	8
28	0.5	15	8
29	0.7	24	7
30	0.9	27	9
31	0.4	12	9
32	0.4	11	10
33	1.1	17	20

LEGEND

FEATURE STYLES		FEATURE ABBREVIATIONS	
SURVEY CONTROL		AV	Air Valve
FENCE		BS	Blue Stop
HEDGE		BT	British Telecom
FWS		BW	Brick Wall
SWS		CB	Conc Bollard
WATER		CL	Cover Level
POWER LINE (OVERHEAD)		CTO	cable TV outlet
TELECOM LINE (OVERHEAD)		EB	Electric Box
ELECTRIC MAIN		EC	Electric Cover
GAS MAIN		EP	Electricity Pole
EMBANKMENT		FL	Floor Level
FENCE TYPES		FM	Fire Hydrant
BWR Barbed Wire		G	Gully
CB Close Board		GM	Gas Meter
CI Corrugated Iron		GV	Gas Valve
CL Chain Link		I	Invert Level
CPL Conc Panel		IC	Inspection Chamber
CP Chestnut Paving		KLS	Keep Left Sign
CW Chicken Wire		KD	Kerb Offset
IW Interwoven		LB	Letter Box
IR Iron Rolling		LP	Lamp Post
OB Openboard		MWR	Metal Post
PR Post and rail		MP	Metal Post
PW Post and Wire		MB	Metal Bollard
		P	Point
		PI	Petrol Interceptor
		RG	Road Gully
		RNB	Road Name Board
		RC	Road Sign
		RS	Retaining Wall
		SA	Sidewalk
		SC	Stoopway
		SV	Sluice Valve
		TP	Telegraph Pole
		TB	Telephone Box
		TJ	Tel-Junction
		TL	Traffic Light
		V	Valve
		VP	Vent Pipe
		WL	Water Level
		WM	Water Meter
		WO	Water Outlet
		WV	Water Valve

DATUM
GRID - ORDNANCE SURVEY NATIONAL GRID (OSTN15)
LEVELS - ORDNANCE SURVEY (OSGM15)
SCALE FACTOR REMOVED

SURVEY CONTROL			
SDN	1	1	1
1	480780.489	172648.870	159.383
2	480665.791	172647.431	158.911
3	480772.750	172663.814	158.922
4	480794.491	172707.205	158.844

NOTES

Drainage and service covers that were buried, obscured or not visible at the time of the survey cannot be shown. Sewer connections between manholes are assumed to be straight and only shown where above ground are shown. All critical dimensions and connections should be checked and verified prior to starting work.
Tree canopy measured values are written as maximum spreads.
Tree species/condition to be verified by arboricultural.
Offsite tree positions/sizes are approximate.
Surveyed physical features may not necessarily represent the legal boundary and should be checked with support of the Land Registry Title.
Some areas overgrown at time of survey
Dashed/grey features are indicative of a feature not accessible at time of survey



SURVEYED BY
ATLAS GEOMATICS LTD
land & engineering surveyors

14 Park Close
Sonning Common
Oxfordshire
RG4 9RY

T: 07900 243622

e: office@atlasgeomatics.co.uk
www.atlasgeomatics.co.uk

CLIENT

ET PLANNING

SITE

DUNN ELMS
NELSONS LANE
READING
RG10 0RR

TITLE

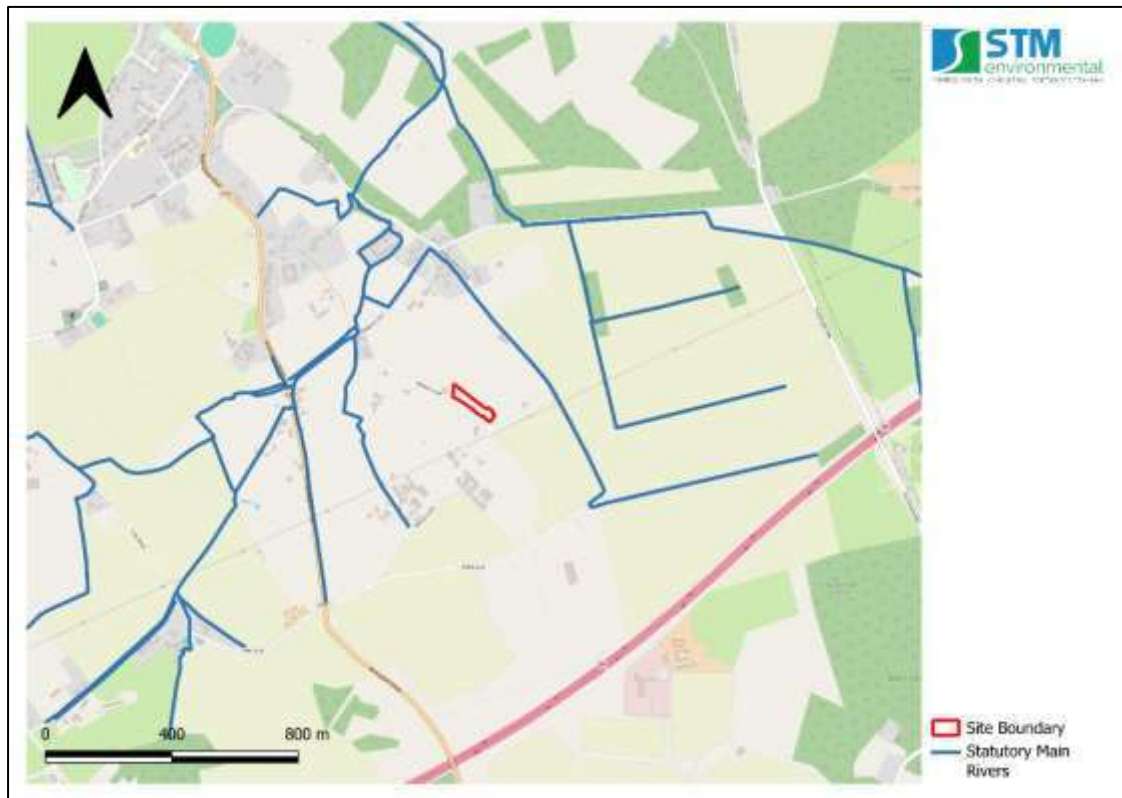
SITE SURVEY

AS EXISTING

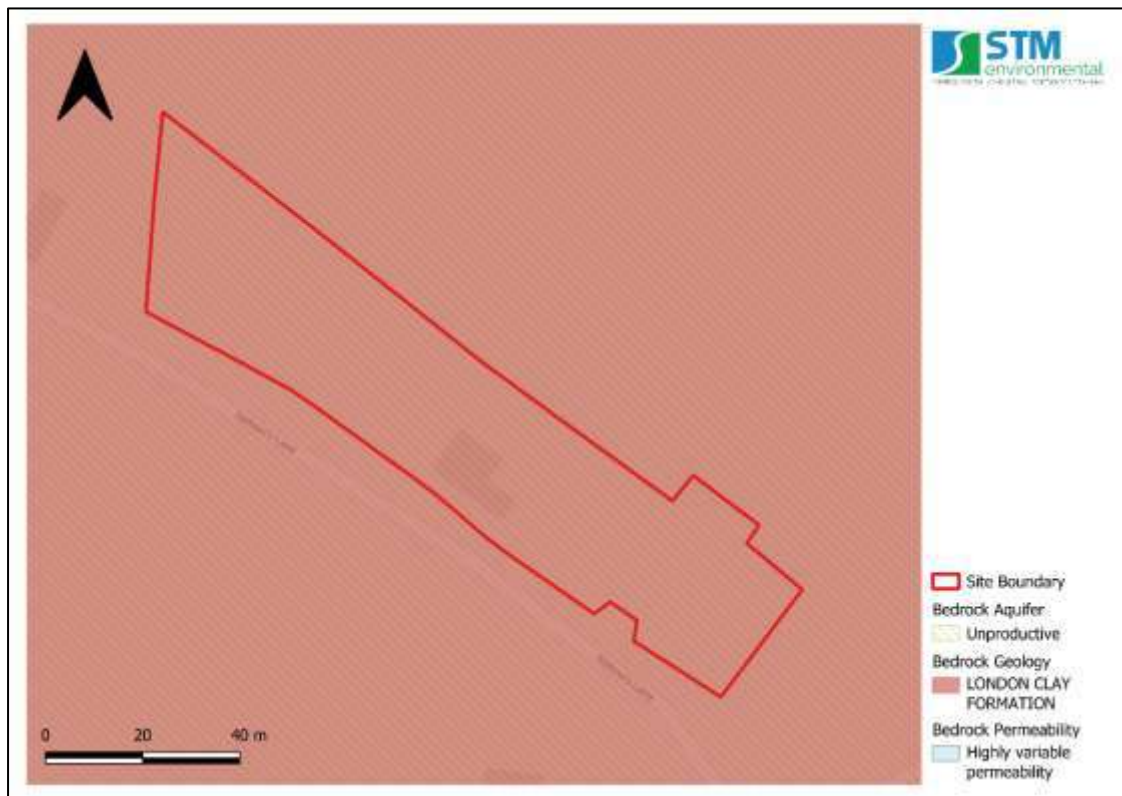
SCALE 1/200 (A1) DATE FEBRUARY 2024

DRAWING No. T02 JOB No. 2402521

13.3.3 Hydrology Map



13.3.4 Bedrock Geology, Hydrogeology & Permeability (Source: BGS, 2016)



13.3.5 Infiltration Drainage Potential (Source: BGS, 2016)



13.3.6 Groundwater Table Depth (Source: BGS 2016)



13.4 Appendix 2.2– Site Investigation

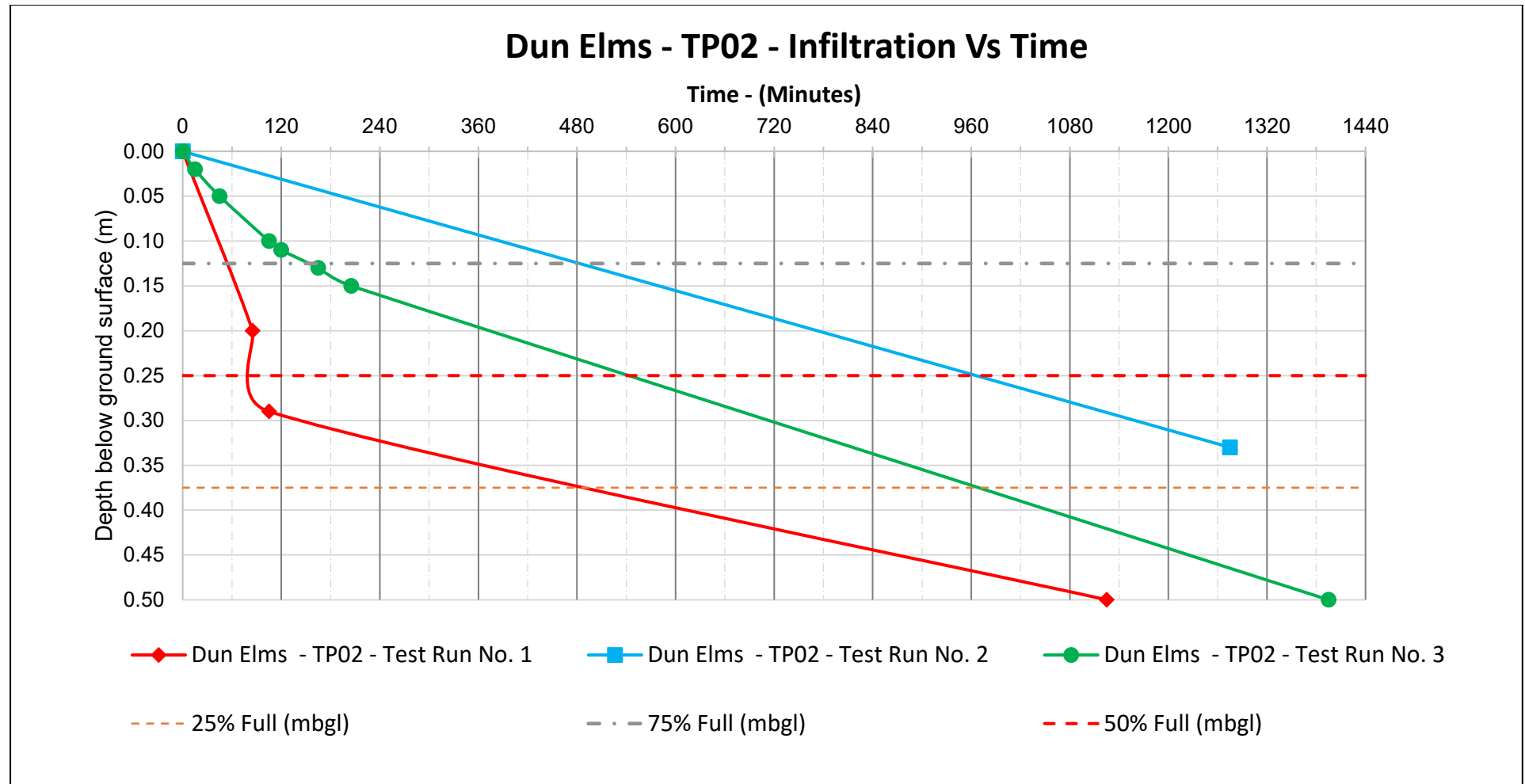
13.4.1 Site Investigation Photos



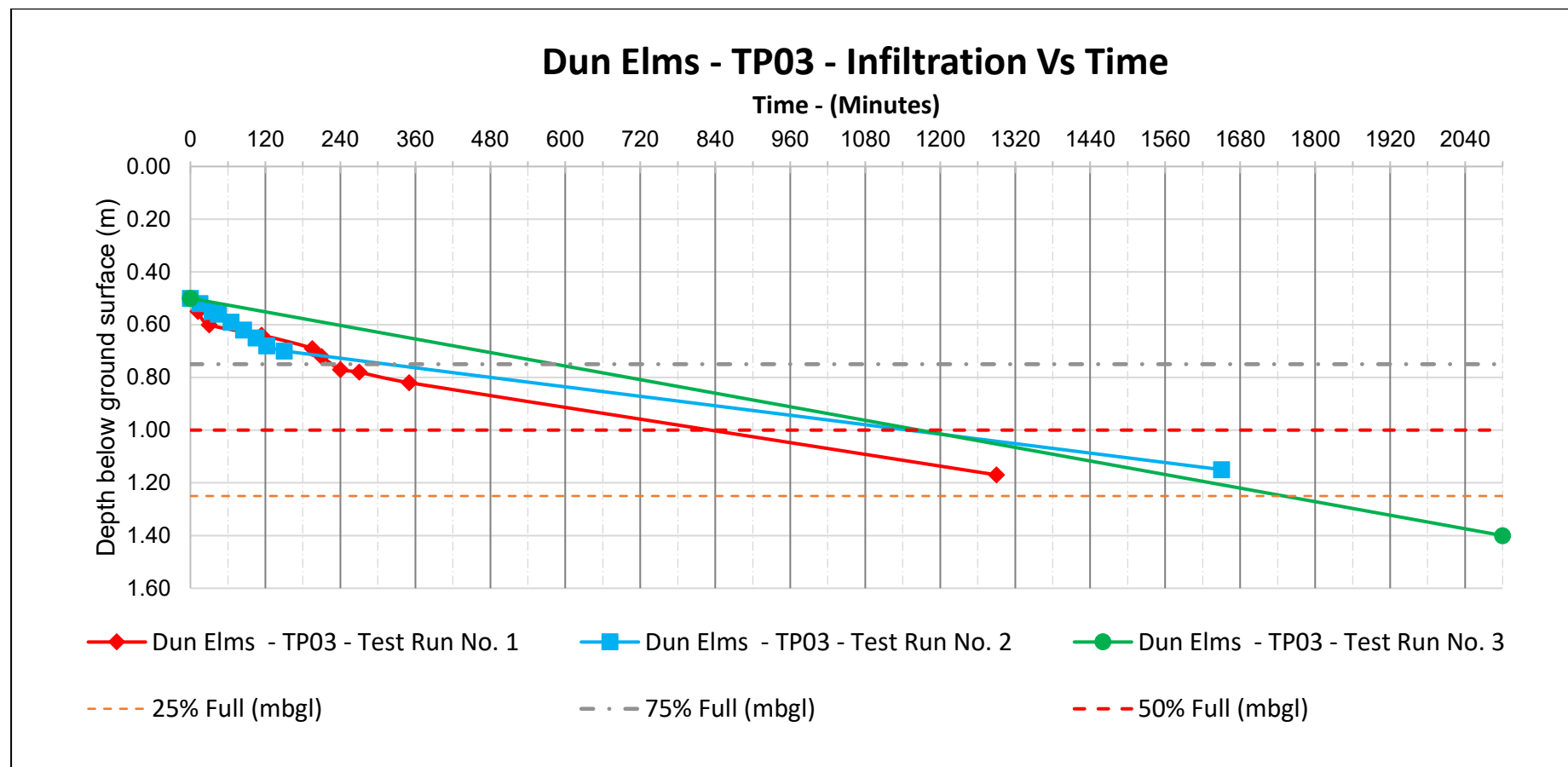




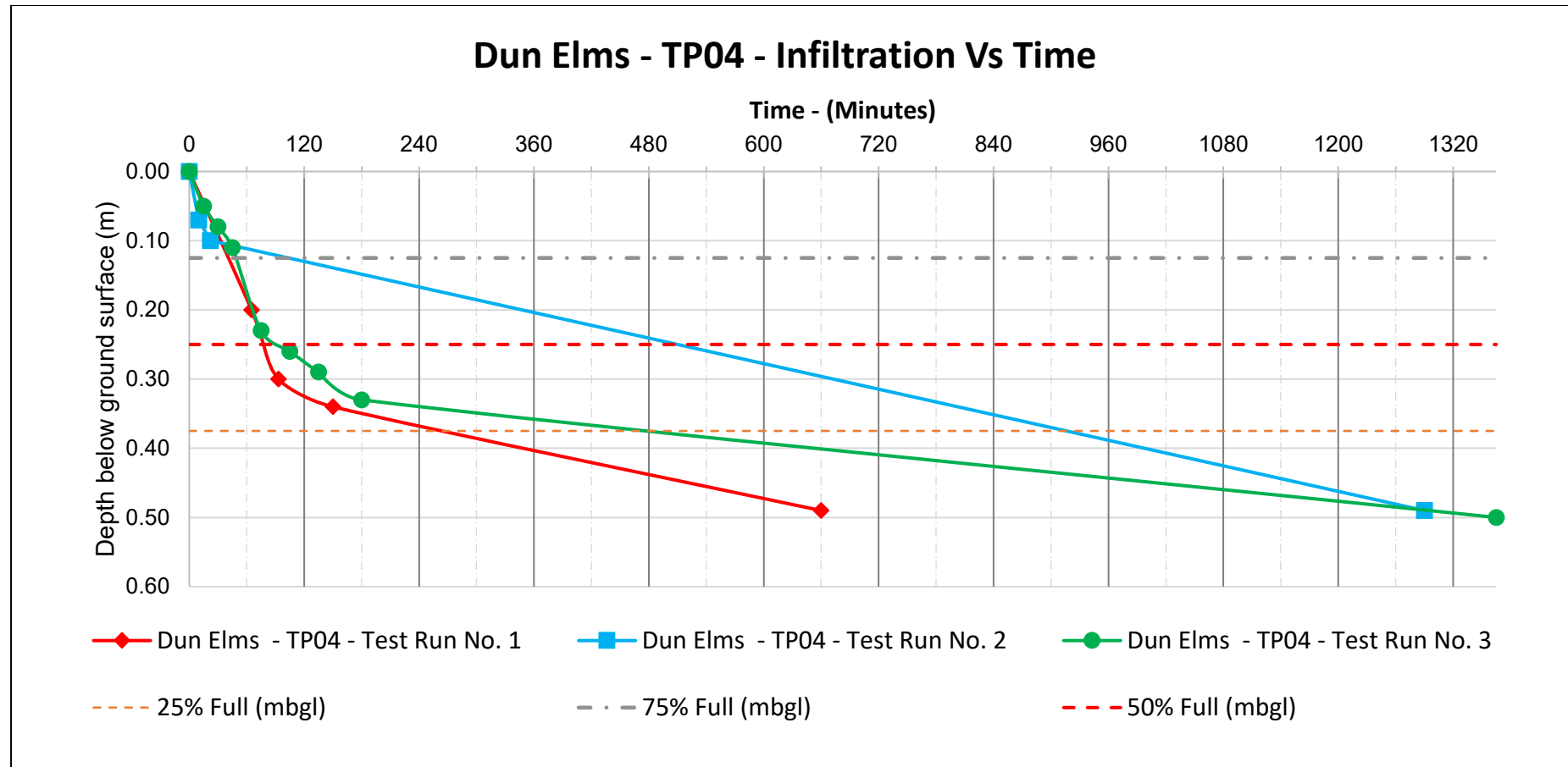
13.4.4 TP02 (Shallow) - Graph



13.4.6 TP03 (Standard) - Graph



13.4.8 TP04 (Shallow) - Graph



[illegible]

13.4.10 Soakaway Test Location Map



13.4.11 Groundwater Monitoring

Site Name:		Dun Elms, Nelsons Lane, Hurst, Wokingham, RG10 0RR				
Date	Borehole Reference	Ground Water Strike	Water Level	Well Depth	Comments	Weather
dd/mm/yy	BH#	m bgl	m bgl	{mbgl}		
01/09/2025	BH01	4.5	4.8	5.5	Borehole Drilled	Clear - Blue Skys
13/10/2025	BH01		4.8	5.2	Silting of BH	
06/03/2026	BH01		3.0	5.2		
01/09/2025	BH02	-	3.1	4.2	Borehole Drilled	Clear - Blue Skys
13/10/2025	BH02	-	3.5	4.2		
06/03/2026	BH02	-	-	-	Borehole could not be located.	

13.5 Appendix 3 – Flood Risk Mapping

13.5.1 Flood Map for Planning (EA)

See next page.

Flood map for planning

Your reference
Unspecified

Location (easting/northing)
480783/172703

Created
23 October 2025 10:34

Your selected location is in flood zone 3, an area with a high probability of flooding.

This means:

- you must complete a flood risk assessment for development in this area
- you should follow the Environment Agency's standing advice for carrying out a flood risk assessment (see <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence which sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2025 AC0000807064. <https://flood-map-for-planning.service.gov.uk/os-terms>



Flood map for planning

Your reference

Unspecified

Location (easting/northing)

480783/172703

Scale

1:2,500

Created

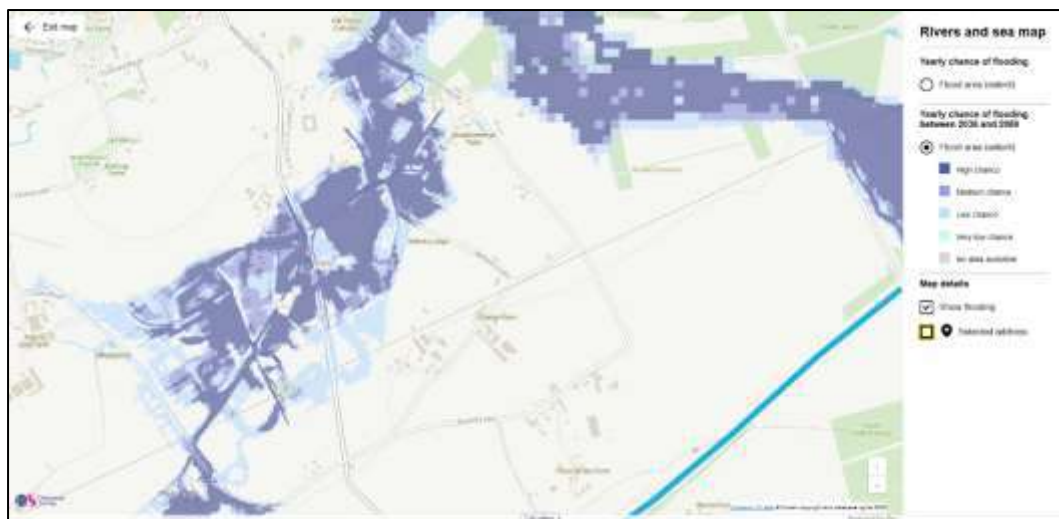
23 Oct 2025 10:34

-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area



0 20 40 60m

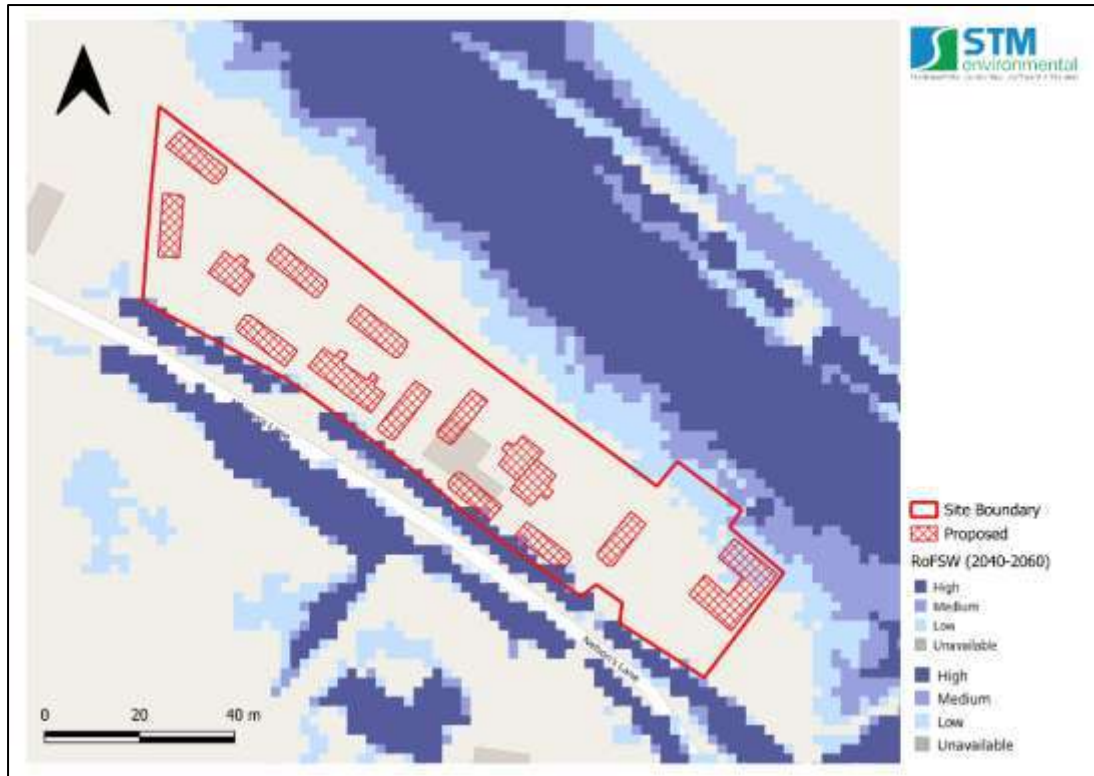
13.5.2 Long Term Fluvial Flood Risk Map (EA)



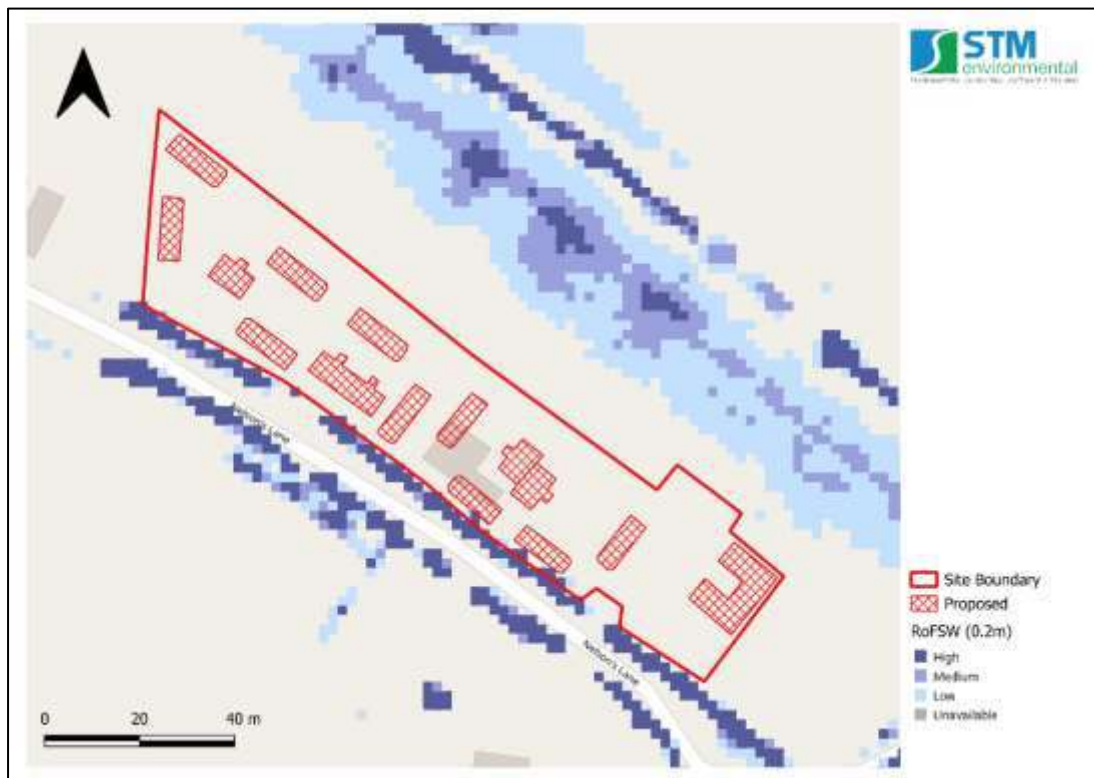
13.5.3 Long Term Pluvial Flood Risk Map (EA)



13.5.4 Risk of Flooding from Surface Water (2040-2060) (EA, 2025)



13.5.5 Risk of Flooding from Surface Water (2040-2060), 0.2m (EA, 2025)



13.5.6 Groundwater flooding susceptibility (Source: BGS, 2016).

N/A.

13.6 Appendix 4 – Runoff Rate and Storage Calculations

13.6.1 UK SuDS

See next page.

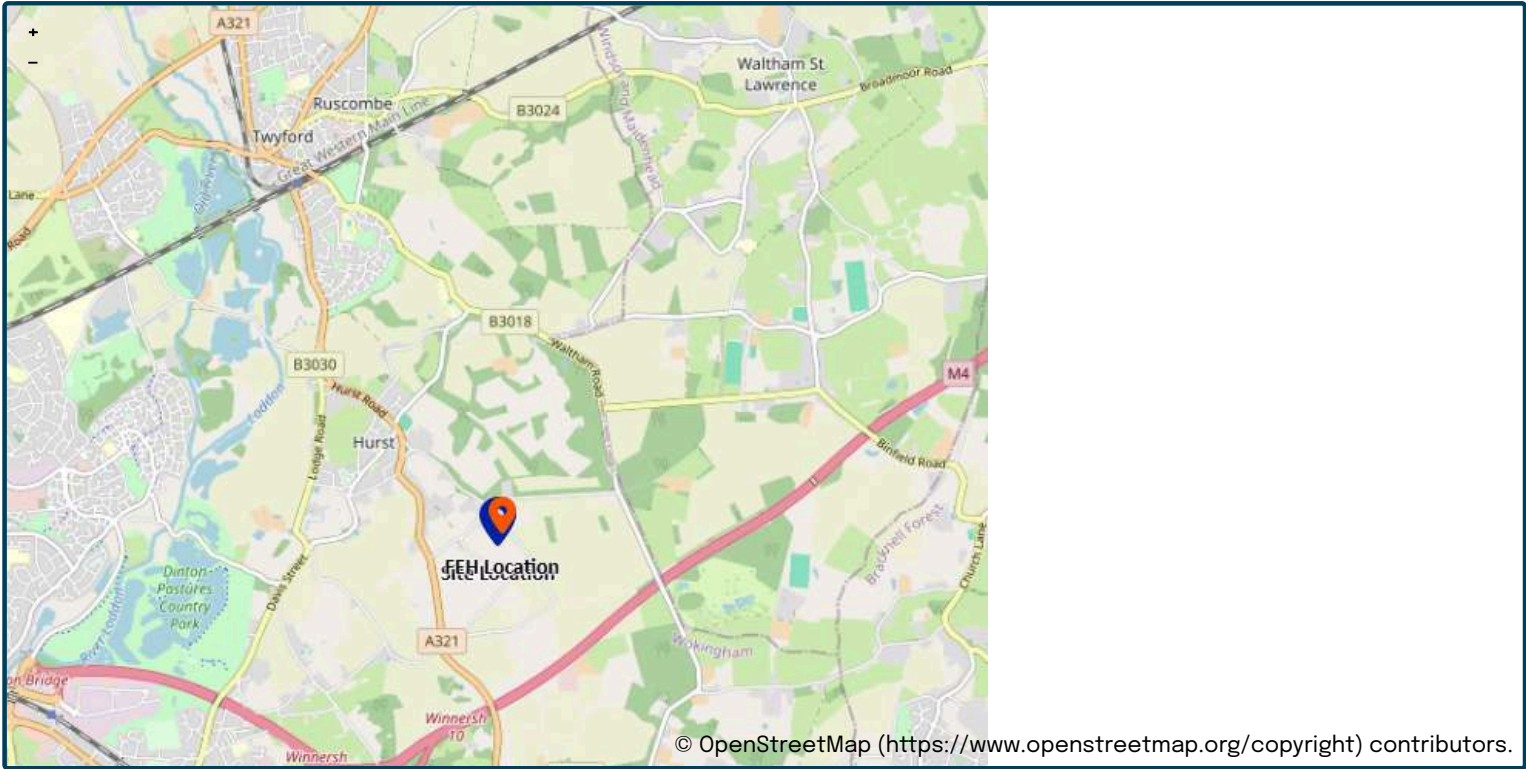
This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is recommended that the total storage volume for the site is distributed across the site using multiple SuDS and that hydraulic modelling software is used to undertake and finalise the detailed design of the drainage system.

Project details

Date	02/10/2025
Calculated by	Yonas Makoni
Reference	SWDS - 2025 - 000034
Model version	2.1.2

Location

Site name	Dun Elms
Site location	Wokingham



Site easting (British National Grid)	480730
Site northing (British National Grid)	172694

Site areas

⚠ There are problems with this field.

Total site area (ha)	0.461	ha
----------------------	------------------	----

Roof area

Total roof area (ha)	0.0915	ha
Contributing roof area (ha)	0.0915	ha
Non-contributing roof area (ha)	0	ha

Paved area

Total paved area (ha)	0.3695	ha
Contributing paved area (ha)	0.3695	ha
Non-contributing paved area (ha)	0	ha

Grass / vegetated area

Total grass / vegetated area (ha)	0	ha
Contributing grass / vegetated area (ha)	0	ha
Non-contributing grass / vegetated area (ha)	0	ha

Total area

Total contributing area (ha)	0.461	ha
------------------------------	------------------	----

Contributing areas with urban creep allowance

Urban creep allowance factor	+0% (no creep)
------------------------------	---------------------------

Storage design parameters

Storage base shape	Rectangular / square	
Storage base length to width ratio	2:1	
Storage design depth (m)	0.4	m
Storage side slope (1 in x)	1 in 1	
Storage voids ratio (%)	90% (e.g. geocellular crate systems)	
Storage volume design return period (years)	1:100 years	

Discharge flow rate from the site

Method

Type of site

Previously developed

Specify the method

FEH statistical + relaxation

FEH statistical

My value

SAAR (mm)

652mm

BFIHOST

0.171

QMed (l/s)

2.19l/s

QMed-QBar conversion

1.136

Total area for greenfield runoff calculation (ha)

0.461ha

QBar (l/s)

2.49l/s

Hydrological region

6

Return period (years)

Qbar (1:2.3 years)

Growth curve factor

1

Flow rate (FEH statistical) (l/s)

2.49l/s

Relaxation factor

1x

Map/default value

652

1.136

0.461

6

44

Final discharge rate

Runoff calculation method

FEH statistical + relaxation

Design flow rate (l/s)

2.49l/s

Blockage risk

Specify the method

Flow rate

Minimum discharge flow rate to prevent blockage

1l/s

My value

Design orifice diameter (mm)

44mm

Flow rate of orifice (l/s)

2.49l/s

Calculated value

44

Rainfall and runoff

Rainfall input type

FEH22 CSV file

FEH_Point_Rainfall_FEH22_AM_480758_172693.csv

Distance from FEH location to site (km)

0km

Climate change allowance factor

140%

Model results

- **Maximum discharge flow rate:** 2.5 (l/s)
- **Outflow orifice diameter:** 44 (mm)
- **Storage base length:** 48 (m)
- **Storage base width:** 24 (m)
- **Storage base area:** 1160 (m²)
- **Storage total volume:** 474 (m³)
- **Storage total water volume:** 427 (m³)
- **Storm return periods run:** 1, 2, 10, 30, 100, 200 (years)
- **Storm durations run:** 15, 30, 60, 120, 180, 240, 360, 540, 720, 900, 1080, 1440, 1800, 2160, 2880, 3600, 4320, 5040, 5760 (minutes)

Return Period (years)	Critical Duration (minutes)	Peak Flow Rate (l/s)	Max Depth (m)	Max water volume (m ³)	Max storage volume (m ³)
1	1440	1.3	0.12	129	143
2	1080	1.4	0.15	156	173
10	900	1.9	0.25	267	297
30	720	2.2	0.32	339	377
<u>100</u>	<u>720</u>	<u>2.5</u>	<u>0.40</u>	<u>427</u>	<u>474</u>
200	720	2.7	0.45	489	543

Please note runoff estimation and storage volume estimation are subject to uncertainty. Storage volume results are therefore reported to the nearest 1 m³ value, unless storage volumes are less than 10 m³, in which case, storage volumes are provided to 1 decimal place.

Disclaimer

This report was produced using the surface water storage volume design tool (2.1.2) developed by HR Wallingford and available at [uksuds.com](https://www.uksuds.com) (<https://www.uksuds.com/>). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at [uksuds.com/terms-conditions](https://www.uksuds.com/terms-conditions) (<https://www.uksuds.com/terms-conditions>). The outputs from this tool have been used to estimate surface water storage volumes for the whole site based on a limiting discharge rate from the site. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

HR Wallingford are not responsible for any rainfall data shared that is subject to licensing terms imposed by UK Centre for Ecology & Hydrology's Flood Estimation Handbook web service (<https://fehweb.ceh.ac.uk/Home/Terms> (<https://fehweb.ceh.ac.uk/Home/Terms>)).

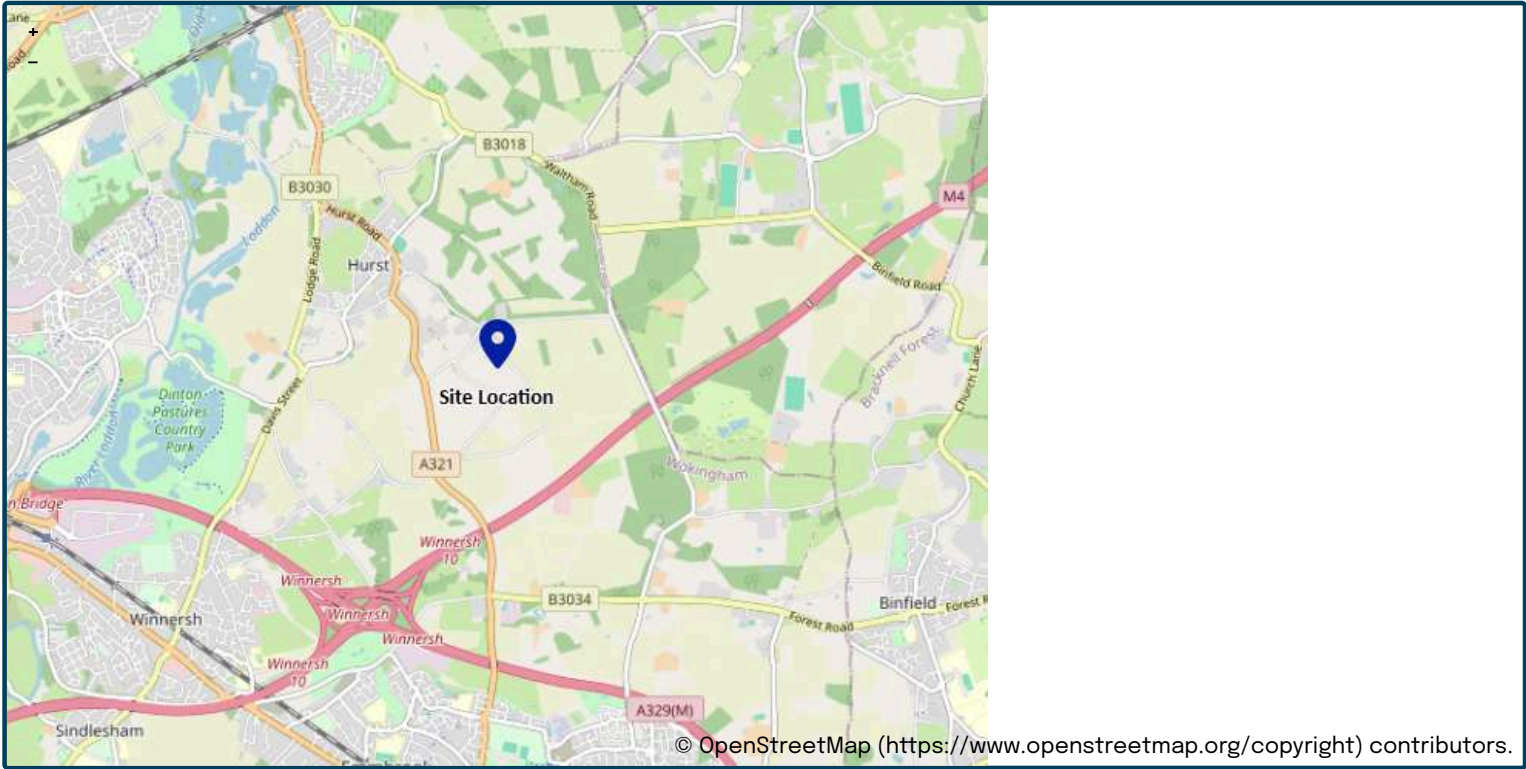
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Project details

Date	25/09/2025
Calculated by	Yonas Makoni
Reference	SWDS - 2025 - 000034
Model version	2.1.2

Location

Site name	Dun Elms
Site location	Wokingham



Site easting (British National Grid)	480759
Site northing (British National Grid)	172696

Site details

Total site area (ha)	0.4610	ha
----------------------	--------	----

Greenfield runoff

Method

Method	FEH statistical
--------	-----------------

FEH statistical

	<u>My value</u>		<u>Map value</u>
SAAR (mm)	652	mm	652
BFIHOST	0.171		
QMed-QBar conversion	1.136		1.136
QMed (l/s)	2.19	l/s	
QBar (FEH statistical) (l/s)	2.49	l/s	

Growth curve factors

	<u>My value</u>		<u>Map value</u>
Hydrological region	6		6
1 year growth factor	0.85		
2 year growth factor	0.88		
10 year growth factor	1.62		
30 year growth factor	2.3		
100 year growth factor	3.19		
200 year growth factor	3.74		

Results

Method	FEH statistical	
Flow rate 1 year (l/s)	2.1	l/s
Flow rate 2 year (l/s)	2.2	l/s
Flow rate 10 years (l/s)	4.0	l/s
Flow rate 30 years (l/s)	5.7	l/s
Flow rate 100 years (l/s)	7.9	l/s
Flow rate 200 years (l/s)	9.3	l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent ‘zero’ figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

This report was produced using the Greenfield runoff rate estimation tool (2.1.2) developed by HR Wallingford and available at uksuds.com (<https://www.uksubs.com/>). The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at uksuds.com/terms-conditions (<https://www.uksubs.com/terms-conditions>). The outputs from this tool have been used to estimate Greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, Centre for Ecology and Hydrology, Wallingford Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

13.7 Appendix 5 – Drainage Asset Search

See next page.

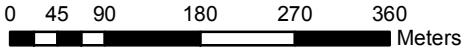
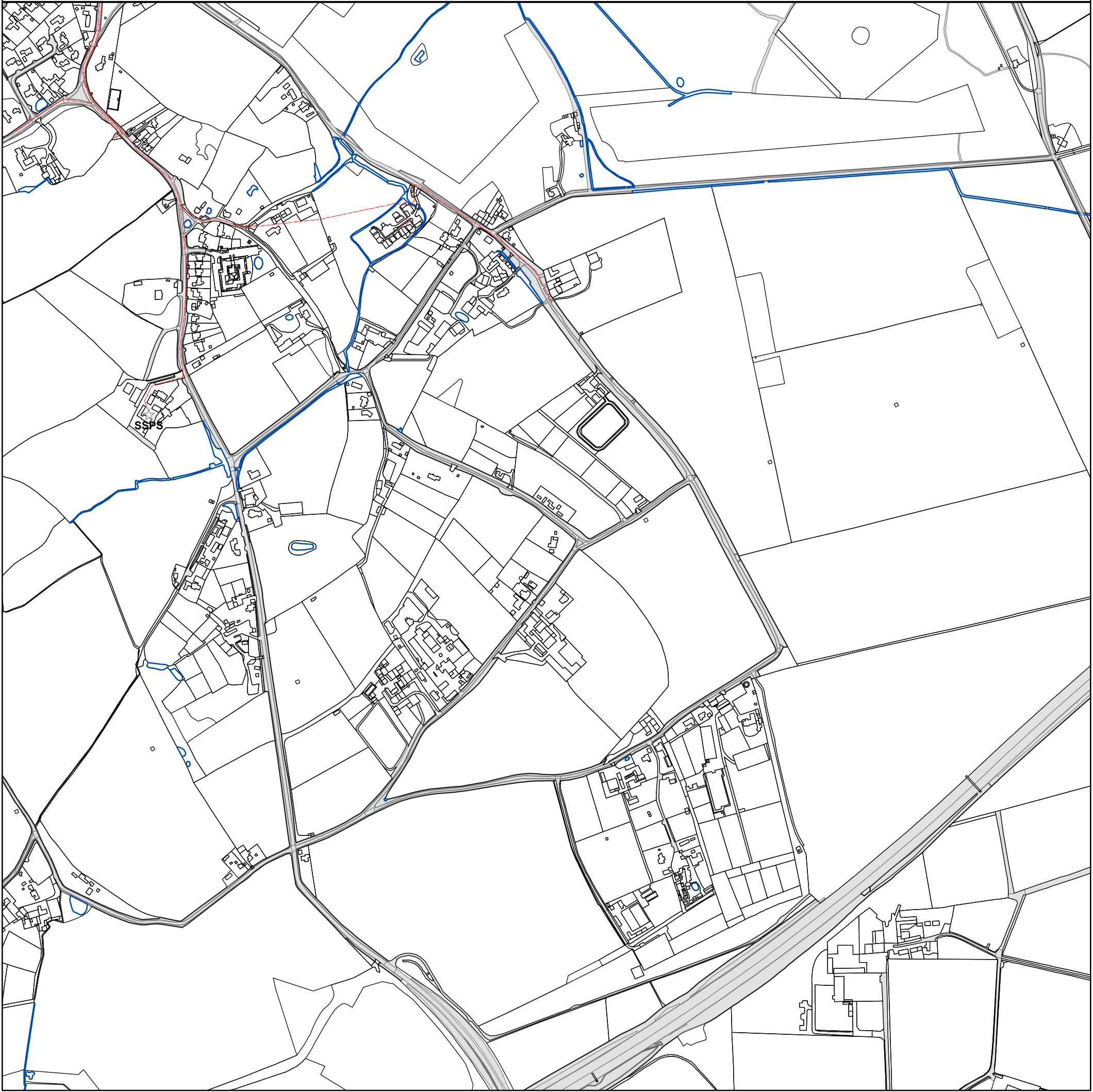


The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 480803,172654
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2024) with the Sanction of the controller of H.M. Stationery Office, License no. AC0000849556 Crown Copyright Reserved.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
n/a	n/a	n/a
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified before any works are undertaken. Crown copyright Reserved

Scale: 1:7161
Width: 2000m
Printed By: SEswara1
Print Date: 29/08/2025
Map Centre: 480755,172605
Grid Reference: SU8072NE

Comments:

ALS/ALS Standard/2025_5215613

NB: Level quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates no Survey information is available.

REFERENCE	COVER LEVEL	INVERT LEVEL
9502	39.08	36.99
9403	38.89	36.17
9303	38.76	34.4
8301	39.1	37.27
5202	37.04	34.18
0202	38.7	35.09
0901	38.45	37.3
0001	39.69	36.88
0902	39.31	37.16
1201	37.74	35.94
5204	37.17	35.08
6101	37.79	35.59
0204		
6102	38.01	35.81
9402	39.3	36.38
9401	39.35	36.63
931A		
211C		
221A		
091A		

REFERENCE	COVER LEVEL	INVERT LEVEL
9501	39.12	36.65
7301	39.26	37.73
8401	39.09	36.79
0301	38.73	34.6
7101	38.31	36.43
0201	38.86	35.15
0102	39.05	36.04
0101	39.39	36.46
1202		
5203	37.12	34.25
6201	37.49	35.39
1101	37.63	36.23
0203		
6103	38.34	36.09
7001		
9302	37.66	33.29
521A		
211B		
211A		



Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

	Foul Sewer: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.
	Surface Water Sewer: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.
	Combined Sewer: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.
	Storm Sewer
	Sludge Sewer
	Foul Trunk Sewer
	Surface Trunk Sewer
	Combined Trunk Sewer
	Foul Rising Main
	Surface Water Rising Main
	Combined Rising Main
	Vacuum
	Thames Water Proposed
	Vent Pipe
	Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

	Sewer
	Culverted Watercourse
	Proposed
	Decommissioned Sewer
	Content of this drainage network is currently unknown
	Ownership of this drainage network is currently unknown

Notes:

- 1) All levels associated with the plans are to Ordnance Datum Newlyn.
- 2) All measurements on the plan are metric.
- 3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the direction of flow.
- 4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

	Air Valve		Meter
	Dam Chase		Vent
	Fitting		

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

	Ancillary		Drop Pipe
	Control Valve		Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol. Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

	Inlet		Outfall
	Undefined End		

Other Symbols

Symbols used on maps which do not fall under other general categories.

	Change of Characteristic Indicator		Public / Private Pumping Station
	Invert Level		Summit

Areas

Lines denoting areas of underground surveys, etc.

	Agreement
	Chamber
	Operational Site

Ducts or Crossings

	Casement	Ducts may contain high voltage cables. Please check with Thames Water.
	Conduit Bridge	
	Subway	
	Tunnel	

5) 'na' or '0' on a manhole indicates that data is unavailable.

6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology, please contact Property Searches on 0800 009 4540.



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 480803, 172654.
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map (2024) with the Sanction of the controller of H.M. Stationery Office, License no. AC0000849556 Crown Copyright Reserved.



Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

- 4"** **Distribution Main:** The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.
- 16"** **Trunk Main:** A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.
- 3" SUPPLY** **Supply Main:** A supply main indicates that the water main is used as a supply for a single property or group of properties.
- 3" FIRE** **Fire Main:** Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.
- 3" METERED** **Metered Pipe:** A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.
- Transmission Tunnel:** A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.
- Proposed Main:** A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

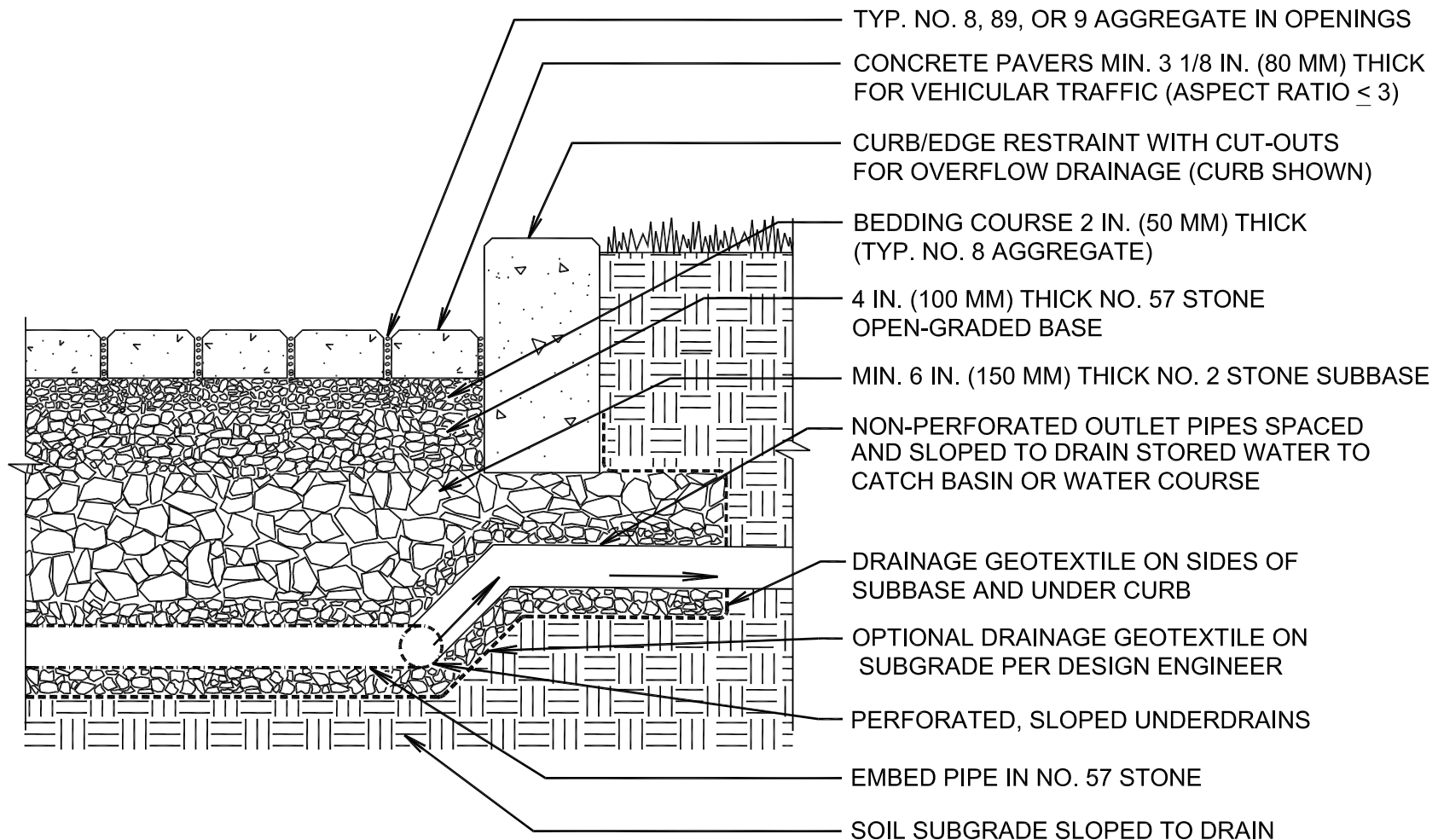
- Data Logger
- Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

- Other Water Company Main:** Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.
- Private Main:** Indicates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

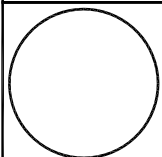
13.8 Appendix 6 – Details of Proposed SuDS

13.8.1 Permeable Paving



NOTES:

1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN PEDESTRIAN AND RESIDENTIAL APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN. CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.
3. NO. 2 STONE MAY BE SUBSTITUTED WITH NO.3 OR NO.4 STONE.
4. SELECT GEOTEXTILE PER AASHTO M 288.



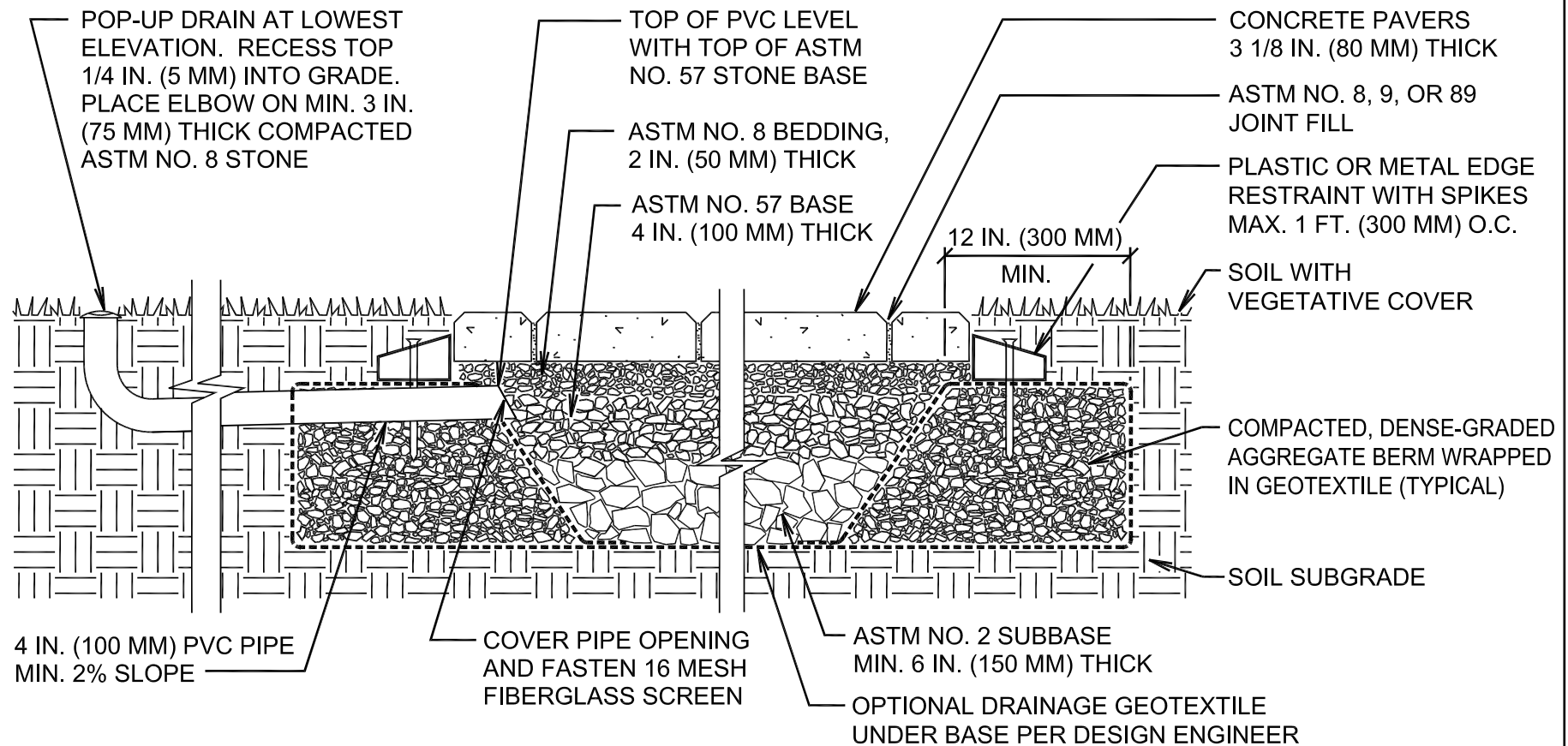
PERMEABLE PAVEMENT WITH PARTIAL INFILTRATION TO SOIL SUBGRADE

DRAWING NO.

ICPI-69

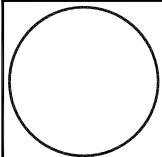
SCALE

NO SCALE



NOTES:

1. DESIGN, MATERIAL, AND CONSTRUCTION GUIDELINES TO FOLLOW ICPI GUIDE SPECIFICATIONS
2. DAYLIGHT DRAIN PIPE TO DRAINAGE SWALE. USE POP-UP DRAIN IN YARD (AS SHOWN) OR CONNECT TO STORM SEWER.
3. APPLY WATERPROOF MEMBRANE VERTICALLY AGAINST HOUSE FOUNDATION PRIOR TO PLACING SUBBASE AND BASE.
4. ALL SOIL SUBGRADES SHALL SLOPE TOWARD STREET.
5. SUBGRADE SOIL MAXIMUM CROSS SLOPE IS 0.5%. MAXIMUM LONGITUDINAL SLOPE IS 2% TOWARD STREET.
6. USE SOIL BERMS FOR LONGITUDINAL SOIL SUBGRADE SLOPES EXCEEDING 2% TOWARD STREET.
7. 5% MAXIMUM SURFACE SLOPE.
8. THICKER SUBBASE AND/OR ADDITIONAL DRAIN PIPES MAY BE REQUIRED IF DRIVEWAY RECEIVES RUNOFF FROM ADJACENT IMPERVIOUS SURFACES OR ROOFS.
9. NO. 2 STONE MAY BE SUBSTITUTED WITH NO. 3 OR NO. 4 STONE.
10. SELECT GEOTEXTILE PER AASHTO M 288.



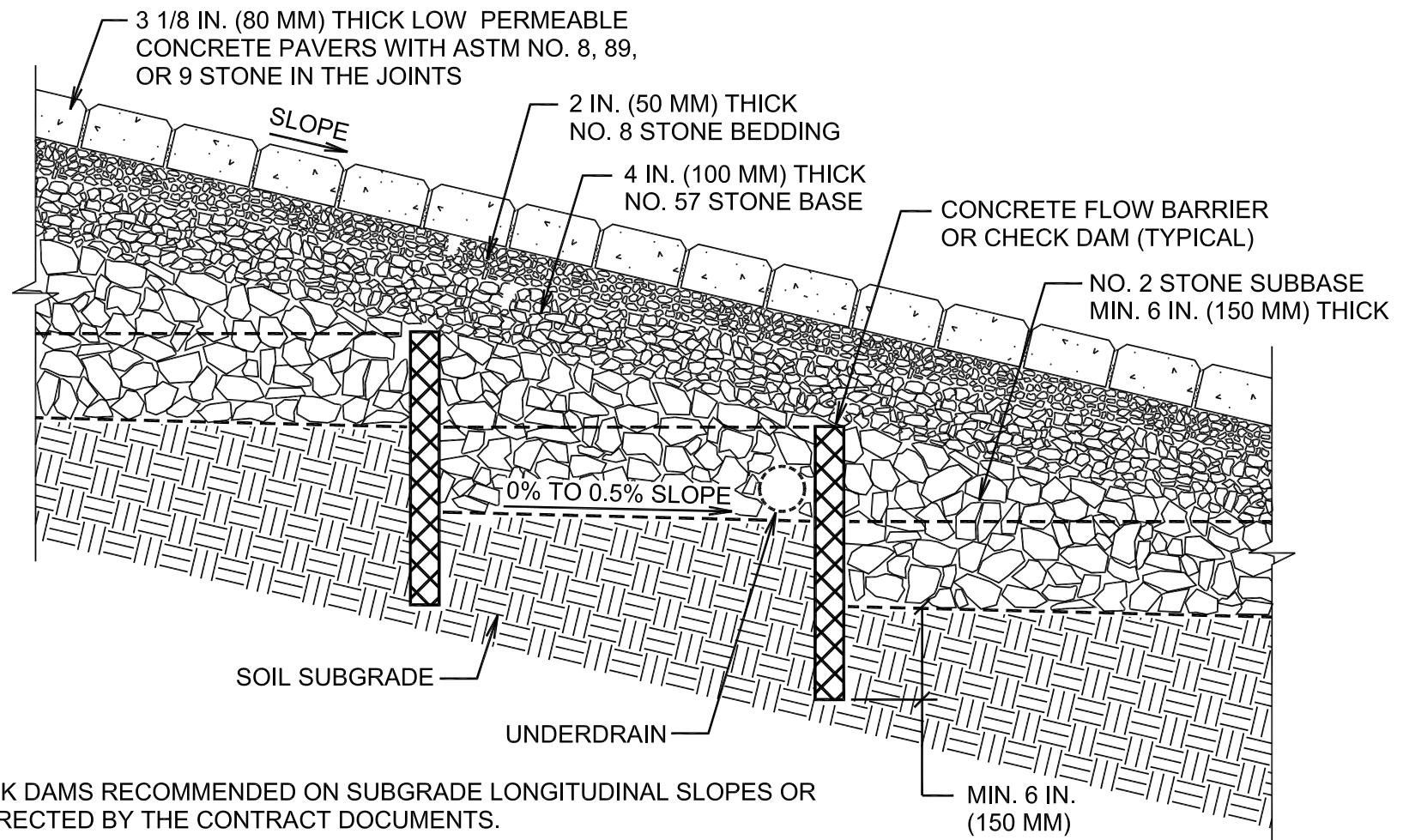
PERMEABLE INTERLOCKING CONCRETE PAVEMENT DRIVEWAY WITH AGGREGATE BERMS

DRAWING NO.

ICPI-79

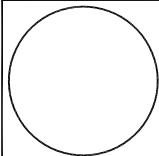
SCALE

NO SCALE



NOTES:

1. CHECK DAMS RECOMMENDED ON SUBGRADE LONGITUDINAL SLOPES OR AS DIRECTED BY THE CONTRACT DOCUMENTS.
2. ENGINEER TO DESIGN SYSTEM TO ACHIEVE STORAGE, DRAW-DOWN, STRUCTURAL, AND FREEZE-THAW REQUIREMENTS.
3. FOR FACILITIES WITH AN IMPERMEABLE LINER: MINIMUM SUBGRADE SLOPE SHALL BE 2% TO DRAIN DRY.
4. DISTANCE BETWEEN CHECK DAMS IS DETERMINED BY LIMITING WATER TO ONLY FILL THE SUBBASE IN EACH CELL. REFER TO THE CONTRACT DOCUMENTS FOR SPACING.
5. CHECK DAMS SHALL ONLY EXTEND TO BOTTOM OF THE NO. 57 STONE BASE PER LONGITUDINAL SLOPE DETAIL ON THIS SHEET.
6. 6 IN. (150 MM) IS REQUIRED BELOW CHECK DAMS SECTIONS WITH A 15 IN. (375 MM) TOTAL DEPTH. SHOULD BE LEVEL WITH CONCRETE PAVER FIELD.
7. CHECK DAMS: 4,000 PSI (28 MPA) CONCRETE OR PER CONTRACT DOCUMENTS.



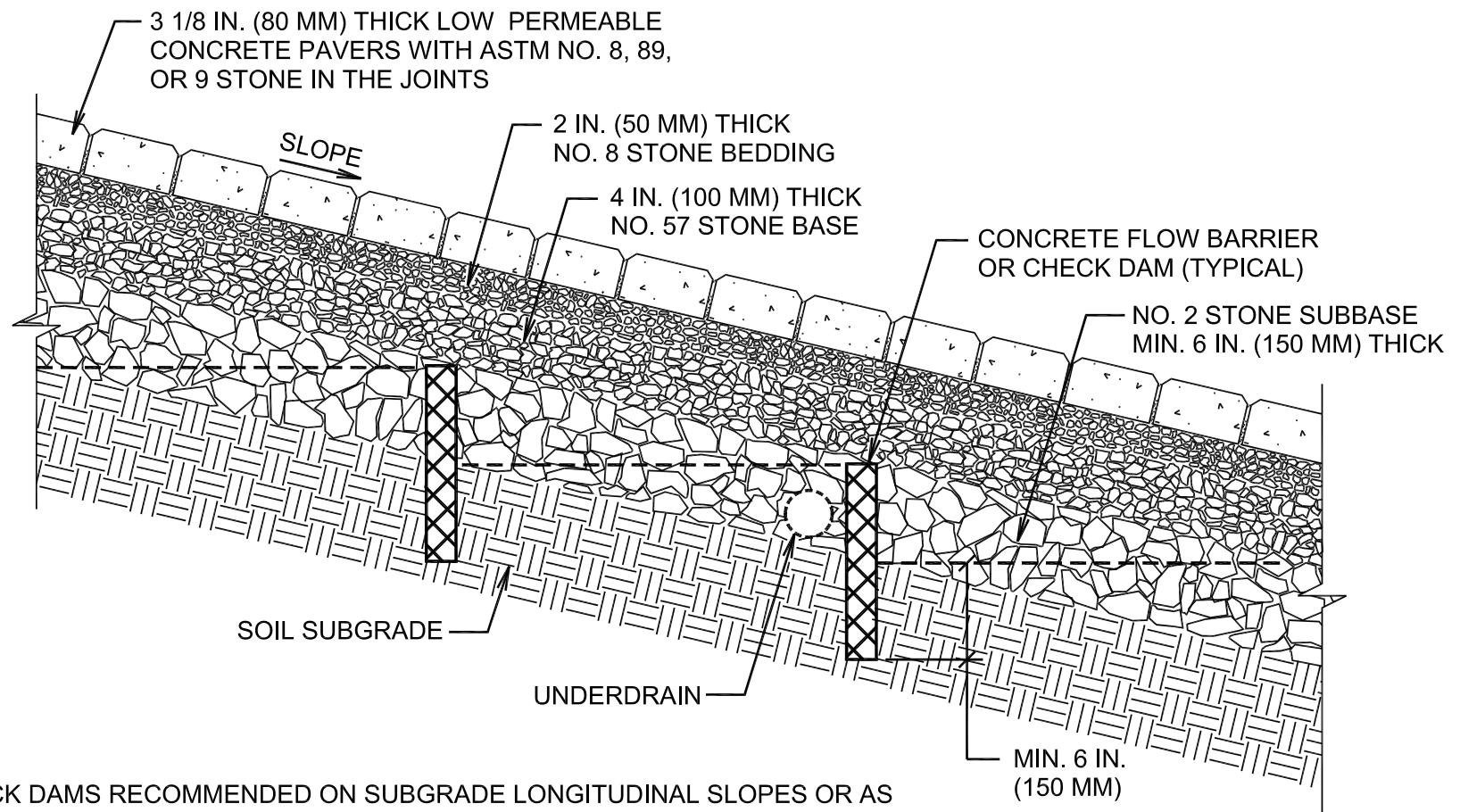
PERMEABLE PAVEMENT WITH TERRACED SUBGRADE

DRAWING NO.

ICPI-82

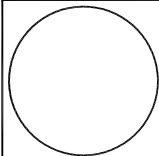
SCALE

NO SCALE



NOTES:

1. CHECK DAMS RECOMMENDED ON SUBGRADE LONGITUDINAL SLOPES OR AS DIRECTED BY THE CONTRACT DOCUMENTS.
2. ENGINEER TO DESIGN SYSTEM TO ACHIEVE STORAGE, DRAW-DOWN, STRUCTURAL, AND FREEZE-THAW REQUIREMENTS.
3. FOR FACILITIES WITH AN IMPERMEABLE LINER: MINIMUM SUBGRADE SLOPE SHALL BE 2% TO DRAIN DRY.
4. DISTANCE BETWEEN CHECK DAMS IS DETERMINED BY LIMITING WATER TO ONLY FILL THE SUBBASE IN EACH CELL. REFER TO THE CONTRACT DOCUMENTS FOR SPACING.
5. CHECK DAMS SHALL ONLY EXTEND TO BOTTOM OF THE NO. 57 STONE BASE PER LONGITUDINAL SLOPE DETAIL ON THIS SHEET.
6. 6 IN. (150 MM) IS REQUIRED BELOW CHECK DAMS SECTIONS WITH A 15 IN. (375 MM) TOTAL DEPTH. SHOULD BE LEVEL WITH CONCRETE PAVER FIELD.
7. CHECK DAMS: 4,000 PSI (28 MPA) CONCRETE OR PER CONTRACT DOCUMENTS.



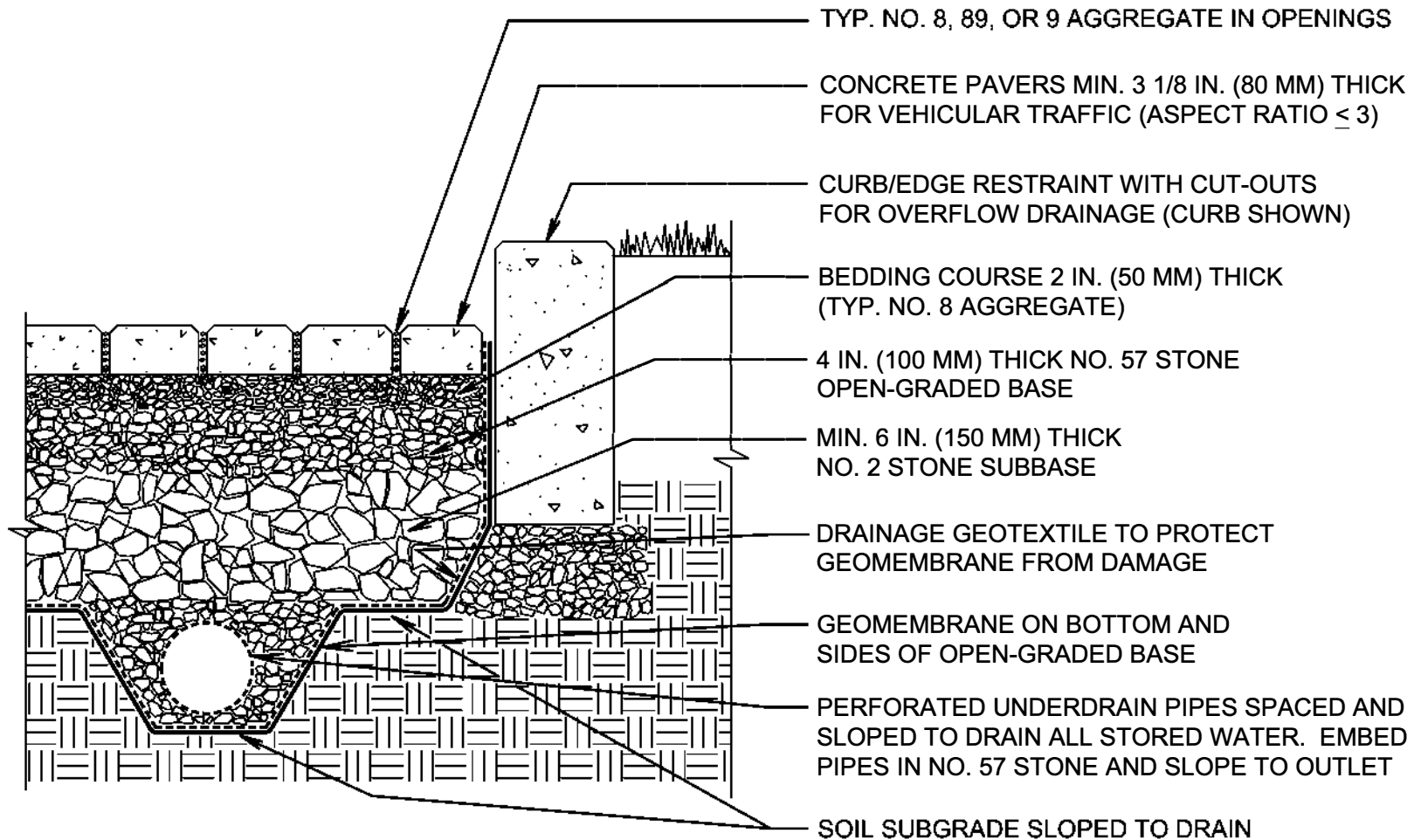
PERMEABLE PAVEMENT ON SLOPED SUBGRADE

DRAWING NO.

ICPI-81

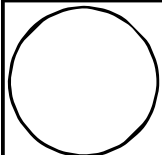
SCALE

NO SCALE



NOTES:

1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN RESIDENTIAL APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN. NO. 3 OR NO. 4 STONE IS ACCEPTABLE. CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.
3. PERFORATED PIPES MAY BE RAISED FOR WATER STORAGE FROM LARGE RAIN EVENTS WITH OUTLET(S) AT LINER BOTTOM TO DRAIN SMALL RAIN EVENTS.
4. SELECT GEOTEXTILE PER AASHTO M 288.



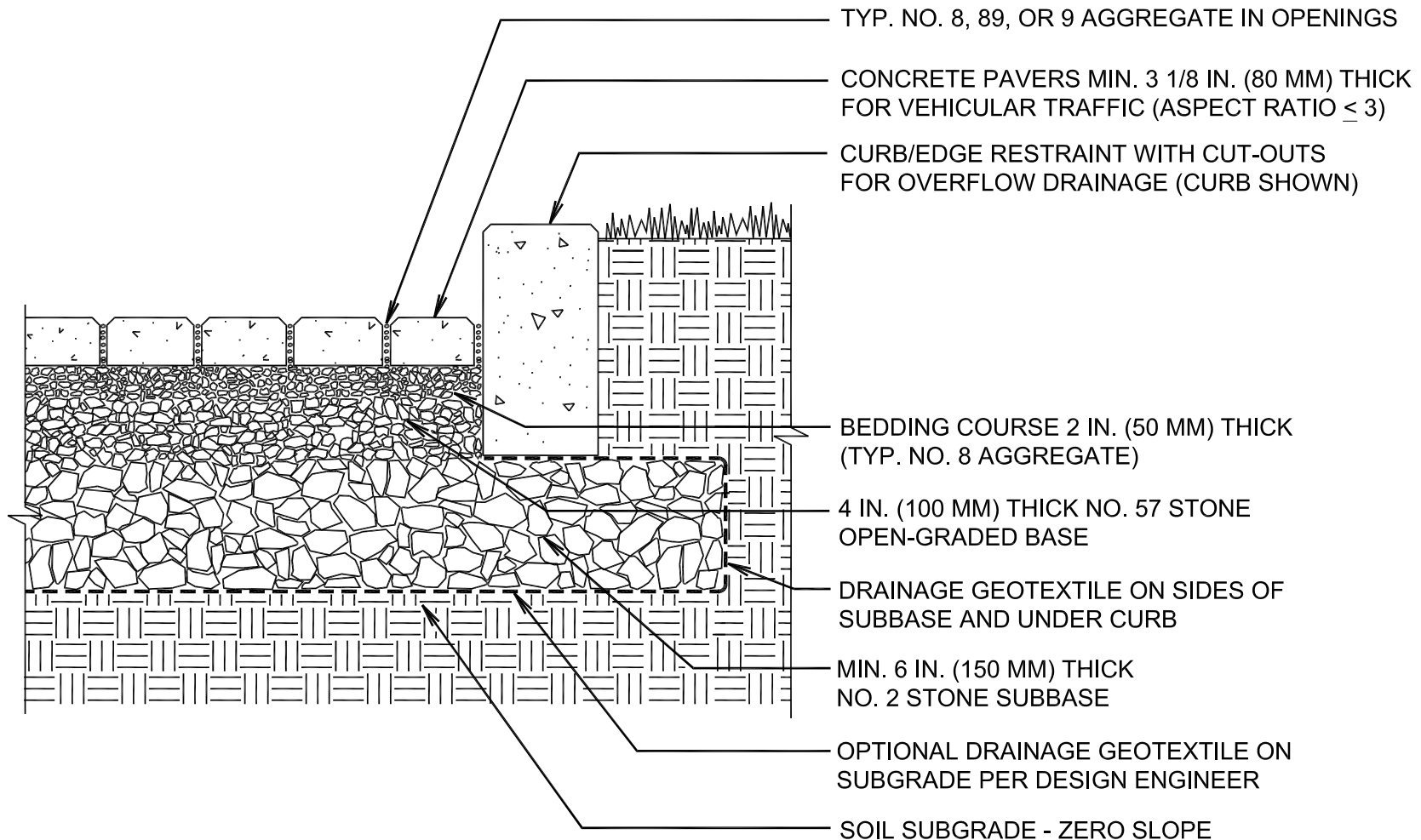
PERMEABLE PAVEMENT WITH NO
INFILTRATION TO SOIL SUBGRADE

DRAWING NO.

ICPI-70

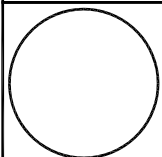
SCALE

NO SCALE



NOTES:

1. 2 3/8 IN. (60 MM) THICK PAVERS MAY BE USED IN PEDESTRIAN AND RESIDENTIAL APPLICATIONS.
2. NO. 2 STONE SUBBASE THICKNESS VARIES WITH DESIGN. CONSULT ICPI PERMEABLE INTERLOCKING CONCRETE PAVEMENT MANUAL.
3. NO. 2 STONE MAY BE SUBSTITUTED WITH NO. 3 OR NO. 4 STONE.
4. SELECT GEOTEXTILE PER AASHTO M 288.



PERMEABLE PAVEMENT WITH FULL INFILTRATION TO SOIL SUBGRADE

DRAWING NO.

ICPI-68

SCALE

NO SCALE

Rural Stormwater Solutions

MANAGING STORMWATER RUNOFF FOR RURAL LANDOWNERS

Bioinfiltration Swales



Figure 1. A fully planted bioinfiltration swale¹

Introduction

In rural areas, you may not have city services like storm drains that conveniently carry stormwater away, but there are still many ways to solve drainage issues. This fact sheet describes one of the ways you can manage drainage issues on your property. By removing standing water in your yard, preventing erosion, dealing with minor flooding, and redirecting water away from your building foundations, you will be protecting your investment and water quality in nearby lakes, streams, and marine waters.

This fact sheet provides general concepts about when bioinfiltration swales might help manage stormwater, including general design, construction, and maintenance guidelines. Consult with your local planning office after reading this document. Depending on the amount of stormwater flow, the design of a bioinfiltration swale and the construction may require professional expertise, such as a licensed engineer. In addition, an individual homeowner should not attempt to manage large-flow situations independently.

There are many considerations when determining how to best manage stormwater in a specific location. To assist you in making the best decision for your needs, please refer to the fact sheets on [Understanding Your Site Conditions](#) and [Options for Managing Surface Water Drainage](#).

What is a bioinfiltration swale?

A bioinfiltration swale is a stormwater conveyance system that moves water from one place to another while allowing for infiltration and treatment. The swale consists of an excavated channel for stormwater with a gentle downgradient slope. There is vegetation planted on the channel bottom and sides. Bioinfiltration swales are an excellent alternative to standard ditches or traditional piped stormwater conveyance systems because they are designed to move water to locations that can handle excess stormwater while simultaneously treating and infiltrating the water as it moves through the swale.

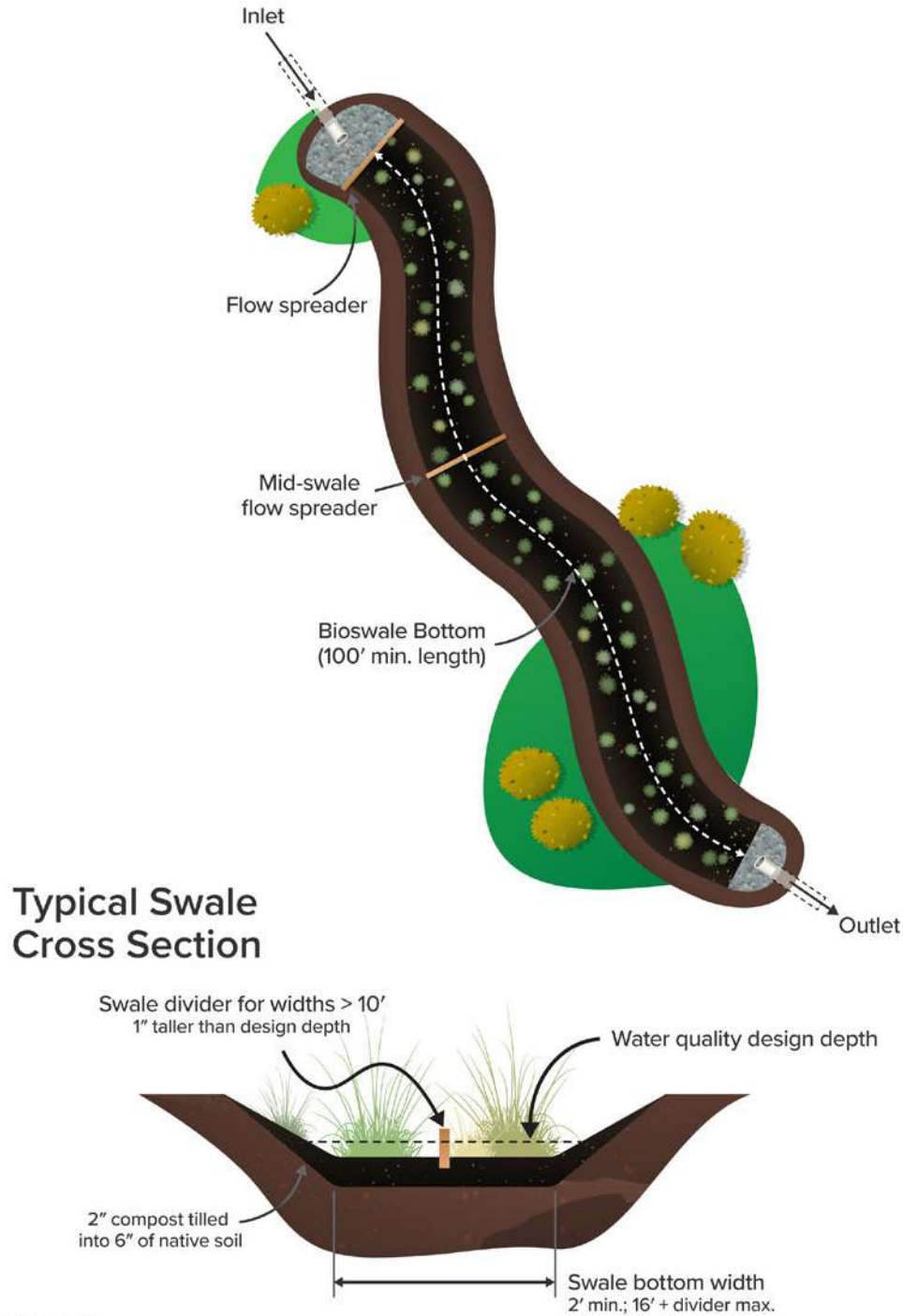


Illustration by Andrew Mack, Washington State University

■ **Figure 2. Anatomy of a bioinfiltration swale²**



Figure 3. Juvenile coho salmon are impacted by high pollutant loads in the first flush of stormwater after a dry spell. Credit: D. McNamara

How do bioinfiltration swales improve water quality?

The primary way a bioinfiltration swale improves water quality is by reducing sediment in the flowing water. Sedimentation is a water quality issue because it fills in and smothers the gravel habitat that salmon and a host of other aquatic organisms depend on.

Sediment and associated particulate pollutants, such as heavy metals suspended in stormwater, are trapped by vegetation in the swale as the water slowly flows down the gentle slope. Therefore, a minimum vegetation cover of 70 percent is recommended³ to treat stormwater adequately.

The soil used in bioinfiltration swales is usually amended to increase the organic matter and promote stormwater infiltration into the bottom of the channel. Amending the soil with compost helps promote infiltration of the "first flush" (see sidebar) of runoff, increasing pollutant removal⁴. Typically, compost is tilled into a depth of about six inches to ensure that it does not get washed out.

Bioinfiltration swales do not effectively remove dissolved pollutants such as nitrogen or metals. Therefore, other methods are recommended to treat dissolved pollutants upstream or downstream of the bioinfiltration swale.

How are bioinfiltration swales different from bioretention systems and drainage ditches?

Bioinfiltration swales are different from bioretention systems. Bioinfiltration swales are conveyance systems where most stormwater flows along the length of the system on a gradient from a high point to a low point.

Bioretention systems do **not** convey water across the landscape; they capture water, filter it, and retain it, allowing it to soak into the ground. A rain garden is an example of a bioretention system.

Drainage ditches are designed to **move** large volumes of water, usually quickly, to remove it from the area; thus, they are not designed to **treat** water quality. Table 1 compares bioinfiltration swales to other methods.

What is "first flush"?

After a long summer of dry weather, the first rainstorm is usually welcomed, but that rain runoff also delivers a summer's worth of pollution buildup to nearby streams and water bodies. During a dry spell, our roads, highways, sidewalks, driveways, and other hard surfaces accumulate sediment, heavy metals, oils, pesticides, fertilizers, and pollutants from various sources on the landscape. The first rain transports this unnoticed material into ditches, storm drains, and nearby water bodies. This is sometimes referred to as "first flush." For *each* storm event, there is also the "first flush," which is when enough rain has fallen and begins running off across paved areas and the landscape.

Table 1. Comparing infiltration methods

Features	Bioinfiltration Swale	Bioretention System / Rain Garden	Drainage Ditch
Designed for	Moving water slowly from one area to another, treating and infiltrating it along the way, thereby improving water quality and reducing some flooding.	Stopping water, treating, and infiltrating it onsite, thereby improving water quality and reducing flooding.	Moving water quickly from one area to another, reducing flooding.
How it works	Flat bottomed channel sloping at a slight gradient to slow water as it is conveyed. Dense plantings also slow water and sediment, to allow treatment while still moving water to a more desirable location. Effective for trapping sediment and associated pollution.	Flat bottom retains water and allows it to soak into the ground through a special soil mix designed to filter out pollutants.	U- or V-shaped bottom with varying downhill slope conveys large volumes of water from the area. Little to no water quality treatment.
General shape	Linear channel with gentle downhill gradient and gently sloping sides.	Any shape, but usually round or kidney-shaped to fit landscape. Flat bottom area for infiltration, gently sloping sides.	Linear with gentle downhill gradient. Sides are typically a 1:1 or 2:1 (H:V) slope.
Soils	Often amended with compost.	Special "Bioretention Soil Mix" (usually 60% sand, 40% compost), placed about 18" deep.	Native soils. No amendment.
Vegetation	Yes. 70% coverage minimum; hardy grass-like plants in treatment area.	Yes. Plants at the bottom and sides of the rain garden must be able to thrive in wet and dry conditions.	No. Not planted.
Mulch	No.	Yes. Up to 4" of arborists' woodchips or other mulch.	No.
Maintenance	Mowing. Leaf and sediment removal as needed.	Weed, remove sediment, clean inflow and overflow, and mulch as needed.	Removal of plants and sediment as needed.

Converting a drainage ditch to a bioinfiltration swale

The advantages of bioinfiltration swales are that they improve water quality and reduce the amount of stormwater by providing some infiltration. However, modifying a drainage ditch to a bioinfiltration swale can pose challenges: since drainage ditches are designed to move large volumes of water, they may be too steep or sized wrong to convey water as slowly as needed for a bioretention swale⁴. Therefore, it is recommended that only small drainage ditches are converted to bioinfiltration swales, with possible modifications to reduce the grade if necessary to slow conveyance.

Advantages and disadvantages of bioinfiltration swales

Advantages of bioinfiltration swales include:

- ▶ Reducing sediment and associated particulate pollutants.
- ▶ Conveying water and providing flood storage, potentially reducing downstream flooding.⁵
- ▶ Contributing to groundwater recharge when the existing soils below the bottom of a bioinfiltration swale consist of high-infiltration soils.⁶

The limitations of bioinfiltration swales include:

- ▶ They can be complex to size correctly and design; a professional is often required.
- ▶ If too much sediment accumulates in the swale, water cannot flow through the soil/plant interface, limiting the swale's ability to remove stormwater pollutants.⁷
- ▶ They are prone to be taken over by invasive plants if not planted or maintained correctly.
- ▶ They may be ineffective in removing pollution if improperly designed.

Bioinfiltration swales are not effective:

- ▶ For treating stormwater with high pollutant loads or high sediment loads.⁶
- ▶ Where soils are saturated for extended periods, because many plants will not survive if in wet conditions continuously, although some design and plant-selection adjustments can address this.⁵
- ▶ In arid regions, unless irrigation is provided as needed, since high plant density is critical to ensure particulate trapping—although some plant-selection choices can mitigate for this.
- ▶ If located downstream of runoff sources carrying pollutants that might kill vegetation in the bioinfiltration swale.

Design considerations

Bioinfiltration swales are somewhat complex to design. They must be able to transport stormwater continuously. In addition, bioinfiltration swales are designed to convey the most prominent peak flows and ensure that the "water quality design flow" is treated.⁸

The "water quality design flow" is the basis for calculating the dimensions of a bioinfiltration swale. This flow rate is at or below which 91% of the total runoff volume, will be treated⁴. Once the water quality design flow is determined, the bioinfiltration swale's bottom width and length can be calculated. A licensed civil/water resources engineer should make these design calculations.

The bottom width and length of the bioinfiltration swale define the "bioinfiltration swale area" (the area below the water quality design depth is known as the "swale treatment area"); this should be between 10 to 20 percent of the contributing area⁶ feeding stormwater to the system.

Typical dimensions

The size of a bioinfiltration swale is dependent on the size of the contributing area and site constraints, but the typical dimensions of a bioinfiltration swale⁸ are:

- ▶ **Minimum** bottom width 2 ft
- ▶ **Minimum** longitudinal slope 0.25 percent. (1 to 2 percent preferred)
- ▶ **Maximum** longitudinal slope 6 percent
- ▶ If the longitudinal slope exceeds 6 percent, check dams with vertical drops that do not exceed 12 inches are needed. In addition, the spacing between check dams should ensure that the slope does not exceed 6 percent between drop sections.⁴

Specific design and planting requirements pertain to the bioinfiltration swale area. For example, the side slopes of the bioinfiltration swale should be 3H:1V but cannot exceed 2H:1V.

Special circumstances

Flat terrain

When the terrain is flat, a typical bioinfiltration swale with a slope less than 0.25 percent will not meet the goals of water quality treatment; some essential refinements to the design are therefore needed. Two refinements that enable bioinfiltration swales to be installed in flat terrain are adding underdrains or designing them as wet bioinfiltration swales. These two refinements are broadly described below.

When an underdrain is needed

An underdrain is necessary to ensure that water in a bioinfiltration swale with a gentle slope will flow through the plant-soil interface to achieve some level of water quality treatment. A perforated pipe encased in drain rock is installed approximately one foot below the bioinfiltration swale bottom and 4-6 inches above the native soils below. Ensuring that water can flow freely to the underdrain pipe is critical.

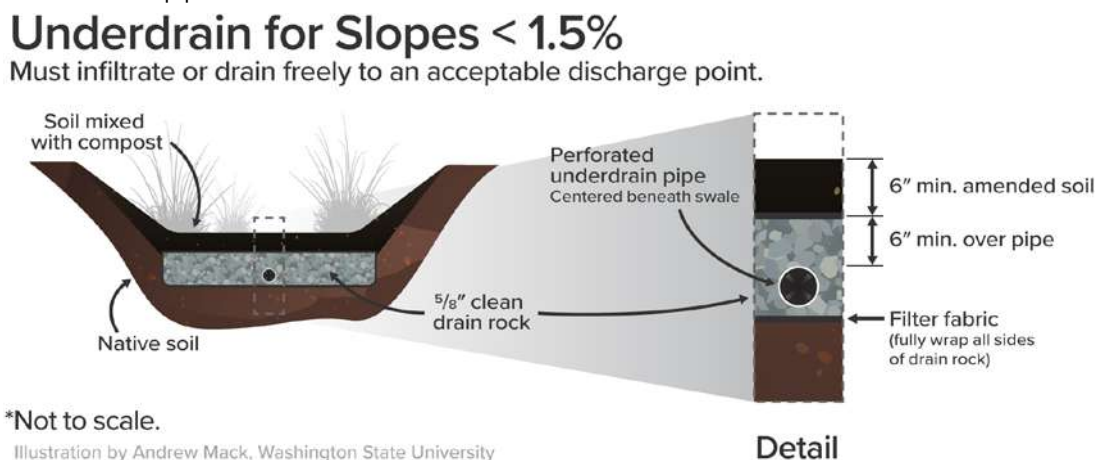


Figure 4. The details of a bioinfiltration swale with an underdrain²

Wet bioinfiltration swales are appropriate when drainage is needed in flat terrain, and the water table is close to the ground surface resulting in wet or saturated soils. This condition can also occur when there are compacted till soils or clayey soils. Therefore, plants must be chosen that can survive these specific soil conditions.

High Flows

If design flow velocity exceeds 4 cubic ft/sec, use a turf reinforcement mat.⁸ High design flow velocities are expected when the bioinfiltration swale has a steep gradient. It is critical to provide erosion control after construction¹⁰ and ensure that vegetation is well established in the newly constructed swale before runoff is allowed to flow into the bioinfiltration swale. It is also essential that weed sources are not introduced in the newly exposed soils of a bioinfiltration swale; existing weed roots should be thoroughly removed from the subsoil.

What to plant

Grass-like plants should be established across the whole worksite. If using seeds, apply in spring or fall by hydroseeding or broadcast application.⁴

The treatment area needs plants that provide a dense cover to limit erosion.⁴ A minimum of 70 percent planting coverage should be the goal of any bioinfiltration swale planting design. The plants must withstand (remain upright) the forces exerted on them by the design water quality event.⁴ The plants should be chosen to withstand the soil conditions within the bioinfiltration swale in terms of pH, compaction, soil moisture, or lack of moisture.⁵

Newly planted bioinfiltration swales must be protected from runoff until the plants are well established.⁴

King County approved two seed mixes for the treatment area for use in typical bioinfiltration swales; those mixes are detailed in Chapter 6 of the 2021 King County Surface Water Design Manual.⁴ Plant recommendations for a wet bioinfiltration swale are also provided in that document. Please consult with a landscape or erosion control specialist for regions outside of western Washington for recommended plant mixes, fertilizer, and mulch.

For areas of the swale above the treatment zone, standard lawn mixes or landscape plantings can be used. Plants that can bind the bank soils to prevent erosion are critical in bioinfiltration swales that are likely to see high flows. A list of suitable ground covers and grasses for the regions above the treatment area zone can be found in Chapter 6 of the 2021 King County Surface Water Design Manual.⁴

Maintaining your swale

Periodic inspections and maintenance of bioinfiltration swales are critical for ensuring their proper functioning. The following is recommended for a well-functioning swale:

- ▶ Inspect swale twice a year at a minimum.¹¹
- ▶ Remove deposited sediments and trash periodically.³
- ▶ Mow grass in the areas of the bioinfiltration swale above the water quality treatment zone monthly during the growing season—grass clippings from mowing should be removed and disposed of or composted.⁴
- ▶ Irrigate and prune plants.³ A temporary irrigation system may be needed to ensure plants survive, especially if installed in the dry season.
- ▶ Remove leaf litter so it does not clog the system. Remove any volunteer trees/shrubs.
- ▶ Ensure there is no standing water after a storm event.
- ▶ Regrade swale if standing water persists¹² or if channelization or erosion has occurred.⁴ If regrading is needed annually, there may be a more significant, more systemic issue with the bioinfiltration swale that might need to be addressed.
- ▶ Remove accumulated sediments up-grade of check dams (if any)¹¹ and from the head of the swale.⁴

In the first two years after planting, frequently check for excessively tall or nuisance vegetation during the growing season. After the first two years, check annually. Monitor plant health and identify causes for plant stress.¹¹

Resources

For more information, visit Rural Stormwater Solutions (<https://ruralstormwater.wsu.edu/resources/>).

References

For links to these references, visit Rural Stormwater Solutions (<https://ruralstormwater.wsu.edu/references/>).

1. Guzzardo Partnership. Bioswale @First.
2. Washington Department of Ecology. *2019 Stormwater Management Manual for Western Washington*.
3. CalRecycle. *Biostrips and Bioswales*.
4. King County, Washington. *King County Surface Water Design Manual 2021*.
5. Clemson Cooperative Extension. *An Introduction to Bioswales*.
6. Capital Regional District. *Bioswales*.
7. Rebecca A Purvis, Ryan J Winston, William F Hunt, Brian Lipscomb, Karthik Narayanaswamy, Andrew McDaniel, Matthew S Lauffer, and Susan Libes. *Evaluating The Hydrologic Benefits of a Bioswale in Brunswick County, North Carolina (NC), USA*. *Water*, 11(6):1291, 2019.
8. CalTrans (California DOT). *Biofiltration Swale Design Guidance, 2012*.
9. Chesapeake Bay Foundation. *Infiltration trench maintenance*.
10. Oregon Department of Environmental Quality. *Construction Stormwater Best Management Practices Manual, 2021*.
11. King County, Washington. *King County Drainage Maintenance Standards for Commercial and Multifamily Drainage Facilities, 2008*.
12. City of Bothell. *Bioswales*.

How to cite this fact sheet

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WASHINGTON STATE UNIVERSITY
EXTENSION



DEPARTMENT OF
ECOLOGY
State of Washington



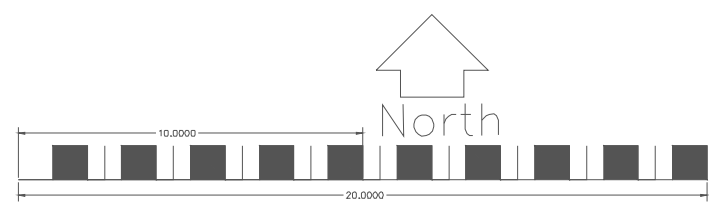
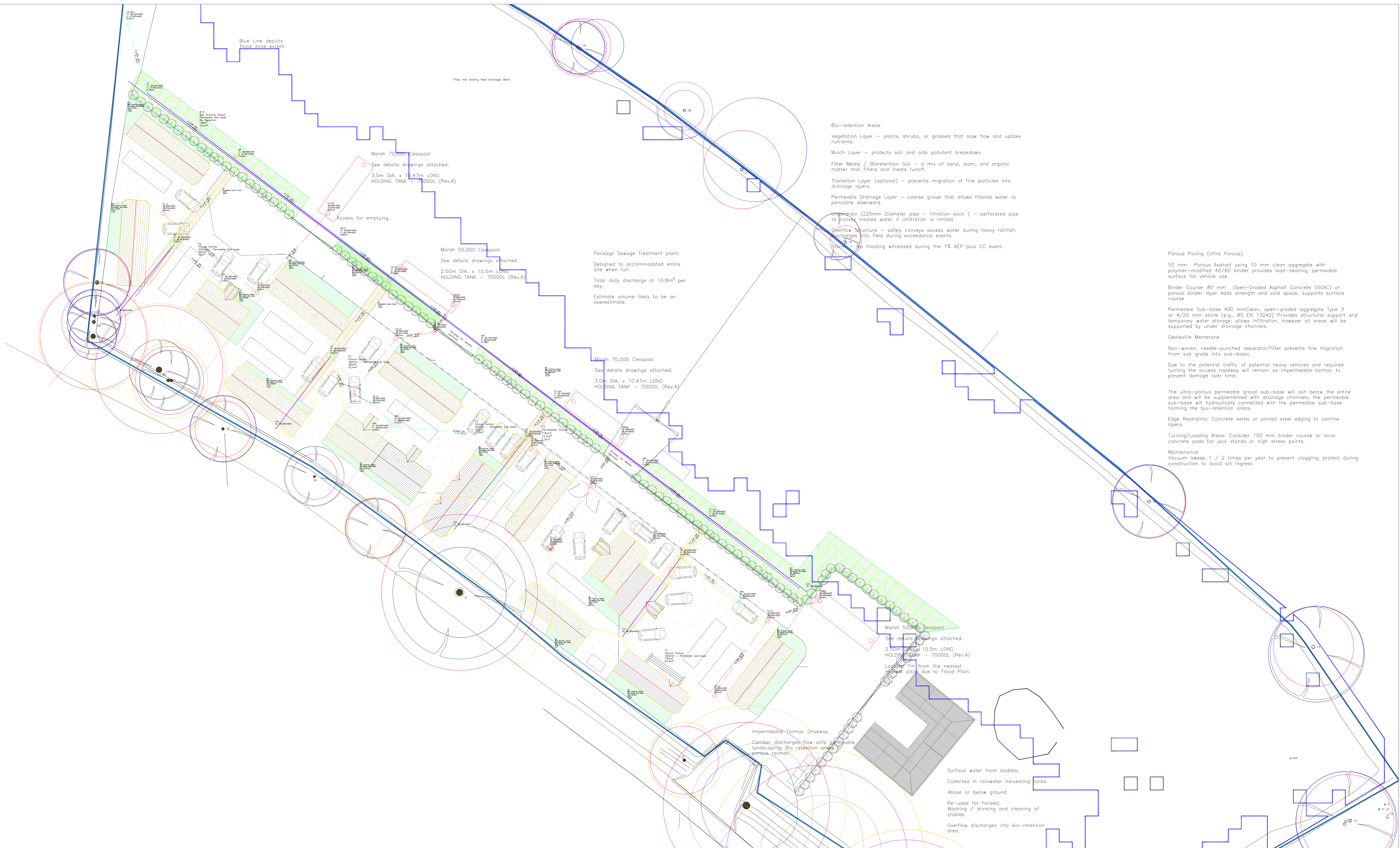
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April 2022. Rural Property Surface Water Management Tools and Training: WQNEP-2020-WaStUn-00063

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13.9 Appendix 7 - Drainage Modelling

13.9.1 Drainage Layout



Map Legend

	Surface Water Manhole		Swale / Ditch
	Foul Water Manhole		Floodable Area (Detention Basin)
	Flow Control Chamber		Gravel Filtration Trench
	Rainwater Down Pipe		SuDS Bio-Retention Area / Rain Garden
	Modeled Storage Structure		Soft Landscaping / Amenity Space
	Cesspool		Porous Tarmac
			Tarmac (Impermeable)

Project ID:
SWDS - 2025 - 00034
Date:April 2026

Site:
Dun Elms, Nelsons Lane Hurst Wokingham, RG10 0RR

Title;
Drainage Management Plan (Surface Water and Foul)

STM Environmental Consultants Ltd

Issue :No.2.0
By :Matthew Ashdown

13.9.2 Drainage Results

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	0.75
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	0.550
Time of Entry (mins)	15.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Adoptable Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	499	1350	749	1500	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

STM Links SW Link Type

Template	Freeform Carrier	Barrels	1	Follow Ground	x
Shape	Circular	Auto Increment (mm)	75		

Available Diameters (mm)

100 | 150

Circular Link Type

Template	Freeform Carrier	Barrels	1	Follow Ground	x
Shape	Circular	Auto Increment (mm)	75		

Available Diameters (mm)

100 | 150

(Trench) Link Type

Template	Freeform Carrier	Barrels	1	Auto Increment (mm)	75
Shape	Rectangular	Height (mm)	599	Follow Ground	x

Available Diameters (mm)

100

(Trench) Link Type

Template	Freeform Carrier	Barrels	1	Auto Increment (mm)	75
Shape	Rectangular	Height (mm)	543	Follow Ground	x

Available Diameters (mm)

100

(Trench) Link Type

Template	Freeform Carrier	Barrels	1	Auto Increment (mm)	75
Shape	Rectangular	Height (mm)	800	Follow Ground	x

Available Diameters (mm)

100

(Trench) Link Type

Template	Freeform Carrier	Barrels	1	Auto Increment (mm)	75
Shape	Rectangular	Height (mm)	837	Follow Ground	x

Available Diameters (mm)

100

Circular Link Type

Template	Freeform Carrier	Barrels	1	Follow Ground	x
Shape	Circular	Auto Increment (mm)	75		

Available Diameters (mm)

100 | 150

Circular Link Type

Template	Freeform Carrier	Barrels	1	Follow Ground	x
Shape	Circular	Auto Increment (mm)	75		

Available Diameters (mm)

100 | 150

Circular Link Type

Template	Freeform Carrier	Barrels	1	Follow Ground	x
Shape	Circular	Auto Increment (mm)	75		

Available Diameters (mm)

100 | 150

Circular Link Type

Template	Freeform Carrier	Barrels	1	Follow Ground	x
Shape	Circular	Auto Increment (mm)	75		

Available Diameters (mm)

100 | 150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
F4a			39.300	450	480698.071	172719.956	0.704	38.596
F3a	0.006		39.300	600	480722.577	172702.495	0.667	38.633
F2a	0.006		39.200	600	480750.024	172687.040	0.410	38.790
F1a	0.048		39.350	600	480775.945	172670.577	0.467	38.883
F3_Out			39.000	1200	480740.378	172725.946	0.780	38.220
F3	0.026	15.00	39.300	1200	480731.069	172713.733	0.800	38.500
13_OUT			38.150	1200	480707.973	172769.800	0.247	37.903
D1			38.300	600	480702.834	172754.165	0.350	37.950
BR			38.900	1200	480716.924	172743.990	0.909	37.991
F4	0.016	15.00	39.300	1200	480706.964	172730.863	0.837	38.463
10			39.000	1200	480732.573	172731.909	0.845	38.155
7			39.100	1200	480754.222	172715.370	0.758	38.342
F2_Out			39.100	600	480765.465	172706.831	0.674	38.426
F2	0.016	15.00	39.200	600	480761.042	172700.955	0.543	38.657
4			39.200	600	480779.042	172696.519	0.585	38.615
F1_Out			39.300	450	480789.304	172688.670	0.599	38.701
F1	0.014	15.00	39.200	600	480784.878	172682.732	0.450	38.750
1			39.300		480804.262	172677.515	0.129	39.171
2	0.005	15.00	39.300	450	480714.042	172725.060	0.700	38.600
3		15.00	39.300	600	480740.176	172703.587	0.650	38.650
5		15.00	39.300	600	480740.922	172703.017	0.500	38.800
6		15.00	39.300	450	480793.976	172675.998	0.450	38.850

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)
1.000	6	F1	11.319	0.600	38.850	38.750	0.100	113.2	150	15.20	28.9
F1_Link	F1	F1_Out	7.406	0.600	38.750	38.701	0.049	150.0	150	15.35	28.7
1.002	F1_Out	4	12.920	0.600	38.701	38.615	0.086	150.0	150	15.61	28.4
1.003	4	F2_Out	17.049	0.600	38.615	38.501	0.114	150.0	150	15.96	28.0
2.000	5	F2	20.225	0.600	38.800	38.657	0.143	141.4	150	15.40	28.7
F2_Link	F2	F2_Out	7.355	0.600	38.657	38.570	0.087	84.5	150	15.51	28.5
1.004	F2_Out	7	14.118	0.600	38.426	38.342	0.084	168.1	225	16.20	27.8
1.005	7	F3_Out	17.421	0.600	38.342	38.226	0.116	150.0	225	16.47	27.5
3.000	3	F3	13.634	0.600	38.650	38.500	0.150	90.9	150	15.22	28.9
F3_Link	F3	F3_Out	15.356	0.600	38.500	38.295	0.205	74.9	150	15.44	28.6
1.006	F3_Out	10	9.822	0.600	38.220	38.155	0.065	150.0	225	16.62	27.3
1.007	10	BR	19.770	0.600	38.155	38.023	0.132	150.0	225	16.93	27.0
4.000	2	F4	9.153	0.600	38.600	38.463	0.137	66.8	150	15.12	29.0
F4_Link	F4	BR	16.478	0.600	38.463	38.354	0.109	151.2	150	15.46	28.6
1.008	BR	D1	17.380	0.600	37.991	37.950	0.041	423.9	300	17.31	26.7
1.009	D1	13_OUT	16.458	0.600	37.950	37.903	0.047	350.2	150	17.83	26.2

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)
1.000	0.944	16.7	6.9	0.300	0.300	0.088	0.0	67	0.899
F1_Link	0.818	14.5	9.3	0.300	0.449	0.119	0.0	88	0.868
1.002	0.818	14.5	12.5	0.449	0.435	0.162	0.0	108	0.918
1.003	0.818	14.5	12.3	0.435	0.449	0.162	0.0	106	0.916
2.000	0.843	14.9	3.4	0.350	0.393	0.043	0.0	48	0.681
F2_Link	1.094	19.3	4.6	0.393	0.380	0.059	0.0	50	0.896
1.004	1.005	40.0	18.0	0.449	0.533	0.239	0.0	106	0.980
1.005	1.065	42.3	17.8	0.533	0.549	0.239	0.0	102	1.019
3.000	1.054	18.6	3.8	0.500	0.650	0.049	0.0	46	0.830
F3_Link	1.163	20.5	5.8	0.650	0.555	0.075	0.0	55	1.004
1.006	1.065	42.3	23.3	0.555	0.620	0.314	0.0	119	1.090
1.007	1.065	42.3	24.5	0.620	0.652	0.334	0.0	123	1.102
4.000	1.232	21.8	4.4	0.550	0.687	0.056	0.0	45	0.964
F4_Link	0.815	14.4	5.5	0.687	0.396	0.072	0.0	65	0.763
1.008	0.757	53.5	29.3	0.609	0.050	0.405	0.0	158	0.774
1.009	0.531	9.4	28.7	0.200	0.097	0.405	0.0	150	0.541

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)
1.000	11.319	113.2	150	STM_Links_SW	39.300	38.850	0.300	39.200	38.750	0.300
F1_Link	7.406	150.0	150	STM_Links_SW	39.200	38.750	0.300	39.300	38.701	0.449
1.002	12.920	150.0	150	STM_Links_SW	39.300	38.701	0.449	39.200	38.615	0.435
1.003	17.049	150.0	150	STM_Links_SW	39.200	38.615	0.435	39.100	38.501	0.449
2.000	20.225	141.4	150	STM_Links_SW	39.300	38.800	0.350	39.200	38.657	0.393
F2_Link	7.355	84.5	150	STM_Links_SW	39.200	38.657	0.393	39.100	38.570	0.380
1.004	14.118	168.1	225	STM_Links_SW	39.100	38.426	0.449	39.100	38.342	0.533
1.005	17.421	150.0	225	STM_Links_SW	39.100	38.342	0.533	39.000	38.226	0.549
3.000	13.634	90.9	150	STM_Links_SW	39.300	38.650	0.500	39.300	38.500	0.650
F3_Link	15.356	74.9	150	STM_Links_SW	39.300	38.500	0.650	39.000	38.295	0.555
1.006	9.822	150.0	225	STM_Links_SW	39.000	38.220	0.555	39.000	38.155	0.620

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	6	450	Manhole	Adoptable	F1	600	Manhole	Adoptable
F1_Link	F1	600	Manhole	Adoptable	F1_Out	450	Manhole	Adoptable
1.002	F1_Out	450	Manhole	Adoptable	4	600	Manhole	Adoptable
1.003	4	600	Manhole	Adoptable	F2_Out	600	Manhole	Adoptable
2.000	5	600	Manhole	Adoptable	F2	600	Manhole	Adoptable
F2_Link	F2	600	Manhole	Adoptable	F2_Out	600	Manhole	Adoptable
1.004	F2_Out	600	Manhole	Adoptable	7	1200	Manhole	Adoptable
1.005	7	1200	Manhole	Adoptable	F3_Out	1200	Manhole	Adoptable
3.000	3	600	Manhole	Adoptable	F3	1200	Manhole	Adoptable
F3_Link	F3	1200	Manhole	Adoptable	F3_Out	1200	Manhole	Adoptable
1.006	F3_Out	1200	Manhole	Adoptable	10	1200	Manhole	Adoptable

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)
1.007	19.770	150.0	225	STM_Links_SW	39.000	38.155	0.620	38.900	38.023	0.652
4.000	9.153	66.8	150	STM_Links_SW	39.300	38.600	0.550	39.300	38.463	0.687
F4_Link	16.478	151.2	150	STM_Links_SW	39.300	38.463	0.687	38.900	38.354	0.396
1.008	17.380	423.9	300	STM_Links_SW	38.900	37.991	0.609	38.300	37.950	0.050
1.009	16.458	350.2	150	STM_Links_SW	38.300	37.950	0.200	38.150	37.903	0.097

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.007	10	1200	Manhole	Adoptable	BR	1200	Manhole	Adoptable
4.000	2	450	Manhole	Adoptable	F4	1200	Manhole	Adoptable
F4_Link	F4	1200	Manhole	Adoptable	BR	1200	Manhole	Adoptable
1.008	BR	1200	Manhole	Adoptable	D1	600	Manhole	Adoptable
1.009	D1	600	Manhole	Adoptable	13_OUT	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F4a	480698.071	172719.956	39.300	0.704	450				
F3a	480722.577	172702.495	39.300	0.667	600				
F2a	480750.024	172687.040	39.200	0.410	600				
F1a	480775.945	172670.577	39.350	0.467	600				
F3_Out	480740.378	172725.946	39.000	0.780	1200		1 F3_Link 2 1.005	38.295 38.226	150 225
F3	480731.069	172713.733	39.300	0.800	1200		0 1.006 1 3.000	38.220 38.500	225 150
13_OUT	480707.973	172769.800	38.150	0.247	1200		0 F3_Link 1 1.009	38.500 37.903	150 150
D1	480702.834	172754.165	38.300	0.350	600		0 1.008 1 1.009	37.950 37.950	300 150
BR	480716.924	172743.990	38.900	0.909	1200		1 F4_Link 2 1.007	38.354 38.023	150 225
F4	480706.964	172730.863	39.300	0.837	1200		0 1.008 1 4.000	37.991 38.463	300 150
10	480732.573	172731.909	39.000	0.845	1200		0 F4_Link 1 1.006	38.463 38.155	150 225
7	480754.222	172715.370	39.100	0.758	1200		0 1.007 1 1.004	38.155 38.342	225 225
							0 1.005	38.342	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
F2_Out	480765.465	172706.831	39.100	0.674	600		1 F2_Link 2 1.003	38.570 38.501	150 150
F2	480761.042	172700.955	39.200	0.543	600		0 1.004 1 2.000	38.426 38.657	225 150
4	480779.042	172696.519	39.200	0.585	600		0 1.002 1 F2_Link	38.615 38.615	150 150
F1_Out	480789.304	172688.670	39.300	0.599	450		0 1.003 1 F1_Link	38.615 38.701	150 150
F1	480784.878	172682.732	39.200	0.450	600		0 1.002 1 1.000	38.701 38.750	150 150
1	480804.262	172677.515	39.300	0.129			0 F1_Link	38.750	150
2	480714.042	172725.060	39.300	0.700	450		0 4.000	38.600	150
3	480740.176	172703.587	39.300	0.650	600		0 3.000	38.650	150
5	480740.922	172703.017	39.300	0.500	600		0 2.000	38.800	150
6	480793.976	172675.998	39.300	0.450	450		0 1.000	38.850	150

Simulation Settings

Rainfall Methodology	FEH-22	Drain Down Time (mins)	1440	30 year (l/s)	5.0
Rainfall Events	Singular	Additional Storage (m³/ha)	0.0	100 year (l/s)	5.0
Summer CV	0.750	Starting Level (m)		Check Discharge Volume	✓
Analysis Speed	Fast	Check Discharge Rate(s)	✓	100 year +40% 360 minute (m³)	230
Skip Steady State	x	2 year (l/s)	5.0		

Storm Durations

60 | 360

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

Pre-development Discharge Rate

Site Makeup	Greenfield	SPR	0.47	Betterment (%)	0
Greenfield Method	IH124	Region	6	QBar	2.2
Positively Drained Area (ha)	0.500	Growth Factor 2 year	0.88	Q 2 year (l/s)	1.9
SAAR (mm)	646	Growth Factor 30 year	2.40	Q 30 year (l/s)	5.3
Soil Index	4	Growth Factor 100 year	3.19	Q 100 year (l/s)	7.0

Pre-development Discharge Volume

Site Makeup	Greenfield	SPR	0.47	Storm Duration (mins)	360
Greenfield Method	FSR/FEH	CWI	97.185	Betterment (%)	0
Positively Drained Area (ha)	0.500	Return Period (years)	100	PR	0.476
Soil Index	4	Climate Change (%)	40	Runoff Volume (m³)	230

Node BR Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	2.0		
Invert Level (m)	37.991	Diameter (m)	0.031		

Node F1 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	4.0		
Invert Level (m)	38.750	Diameter (m)	0.052		

Node F2 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	4.0		
Invert Level (m)	38.657	Diameter (m)	0.052		

Node F3 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	3.0		
Invert Level (m)	38.500	Diameter (m)	0.045		

Node F4 Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	2.0		
Invert Level (m)	38.463	Diameter (m)	0.037		

Node BR Bioretention Area Storage Structure

Underdrain Link Type	Circular	Base Inf Coefficient (m/hr)	0.00100
Underdrain Diameter (mm)	225	Side Inf Coefficient (m/hr)	0.00100
Underdrain Velocity	Colebrook-White	Safety Factor	1.0
Underdrain ks (mm) / n	0.150	Porosity	0.30
Underdrain Length (m)	100.000	Invert Level (m)	38.600
Underdrain Slope (1:X)	150.0	Time to half empty (mins)	328
Underdrain Height above base (m)	0.000	Main Channel Length (m)	100.000
Underdrain DS Node	D1	Main Channel Slope (1:X)	175.0
Filter Conductivity (m/hr)	0.10000	Main Channel n	1.000
Filter Depth (m)	0.600		

Inlet Connects
Node To
1 Storage

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	0.200	550.0	0.201	0.0

Node F1 Out Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00100	Porosity	0.30	Link	F1_Link
Side Inf Coefficient (m/hr)	0.00100	Invert Level (m)	38.701	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	5	Diameter (mm)	150

Node F2 Out Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00100	Porosity	0.30	Link	F2_Link
Side Inf Coefficient (m/hr)	0.00100	Invert Level (m)	38.570	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	216	Diameter (mm)	150

Node F3_Out Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.30	Link	F3_Link
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	38.295	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	664	Diameter (mm)	300

Node BR Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Link	F4_Link
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	38.354	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	480	Diameter (mm)	150

Node F1 Porous Paving Storage Structure

Underdrain Link Type	Circular	Base Inf Coefficient (m/hr)	0.00100
Underdrain Diameter (mm)	150	Side Inf Coefficient (m/hr)	0.00100
Underdrain Velocity	Colebrook-White	Safety Factor	1.5
Underdrain ks (mm) / n	15.000	Porosity	0.30
Underdrain Length (m)	20.000	Invert Level (m)	38.750
Underdrain Slope (1:X)	150.0	Time to half empty (mins)	172
Underdrain Height above base (m)	0.000		

Inlets

F1a

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	750.0	750.0	0.300	750.0	779.1	0.301	0.0	779.1

Node F2 Porous Paving Storage Structure

Underdrain Link Type	Circular	Base Inf Coefficient (m/hr)	0.00100
Underdrain Diameter (mm)	150	Side Inf Coefficient (m/hr)	0.00100
Underdrain Velocity	Colebrook-White	Safety Factor	1.5
Underdrain ks (mm) / n	15.000	Porosity	0.30
Underdrain Length (m)	20.000	Invert Level (m)	38.657
Underdrain Slope (1:X)	150.0	Time to half empty (mins)	96
Underdrain Height above base (m)	0.000		

Inlets

F2a

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	360.0	360.0	0.300	360.0	380.2	0.301	0.0	380.2

Node F3 Porous Paving Storage Structure

Underdrain Link Type	Circular	Base Inf Coefficient (m/hr)	0.00100
Underdrain Diameter (mm)	150	Side Inf Coefficient (m/hr)	0.00100
Underdrain Velocity	Colebrook-White	Safety Factor	1.5
Underdrain ks (mm) / n	15.000	Porosity	0.30
Underdrain Length (m)	20.000	Invert Level (m)	38.500
Underdrain Slope (1:X)	150.0	Time to half empty (mins)	432
Underdrain Height above base (m)	0.000		

Inlets

F3a

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	420.0	420.0	0.300	420.0	441.8	0.301	0.0	441.8

Node F4 Porous Paving Storage Structure

Underdrain Link Type	Circular	Underdrain Height above base (m)	0.000
Underdrain Diameter (mm)	150	Base Inf Coefficient (m/hr)	0.00100
Underdrain Velocity	Colebrook-White	Side Inf Coefficient (m/hr)	0.00100
Underdrain ks (mm) / n	15.000	Safety Factor	1.5
Underdrain Length (m)	20.000	Porosity	0.30
Underdrain Slope (1:X)	150.0	Invert Level (m)	38.463

Node F4 Porous Paving Storage Structure

Time to half empty (mins) 568

Inlets

F4a

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	500.0	500.0	0.300	500.0	523.8	0.301	0.0	523.8

Approval Settings

Node Size	✓	Minimum Backdrop Height (m)	0.200	Return Period (years)	30
Node Losses	✓	Maximum Backdrop Height (m)	1.500	Time to Half Empty	✓
Link Size	✓	Full Bore Velocity	✓	Return Period (years)	30
Minimum Diameter (mm)	100	Minimum Full Bore Velocity (m/s)	0.750	Discharge Rates	✓
Link Length	✓	Maximum Full Bore Velocity (m/s)	3.000	2 year (l/s)	2.2
Maximum Length (m)	100.000	Proportional Velocity	✓	30 year (l/s)	6.0
Coordinates	✓	Return Period (years)	100	100 year (l/s)	8.0
Accuracy (m)	1.000	Minimum Proportional Velocity (m/s)	0.500	Discharge Volume	✓
Crossings	✓	Maximum Proportional Velocity (m/s)	3.000	100 year 360 minute (m ³)	300
Cover Depth	✓	Surcharged Depth	✓	First Flush	✓
Minimum Cover Depth (m)	0.550	Return Period (years)	30	Return Period (years)	30
Maximum Cover Depth (m)	3.000	Maximum Surcharged Depth (m)	0.100	First Flush Depth (mm)	5
Backdrops	✓	Flooding	✓		

Approval Results

The network has been designed using IDF rainfall
It contains 22 nodes (1 outfall) and 16 links
The total impermeable area is 0.464 ha
5 online controls have been defined
8 structures have been defined, providing 122m³ of storage below the flood risk level
Infiltration based on BRE 365 has been applied at 6 of the structures
Simulations have been completed using FEH-22 summer storms from 15 to 1440 minute duration

10 manholes are smaller than that required by the library

	Node	Required Dia (mm)	Actual Dia (mm)
x	D1	1200	600
x	F2_Out	1200	600
x	F2	1200	600
x	4	1200	600
x	F1_Out	1200	450
x	F1	1200	600
x	2	1200	450
x	3	1200	600
x	5	1200	600
x	6	1200	450
✓	F3_Out	1200	1200
✓	F3	1200	1200
✓	13_OUT	1200	1200
✓	BR	1200	1200
✓	F4	1200	1200
✓	10	1200	1200
✓	7	1200	1200

8 connections have combined exit and entry losses less than the recommended total

	Node	US Link	DS Link	US Exit Loss	DS Entry Loss	Angle (degrees)	Recommended Node Losses
x	F3_Out	F3_Link	1.006	0.250	0.250	90	0.900
x	F3	3.000	F3_Link	0.250	0.250	79	0.900
x	D1	1.008	1.009	0.250	0.250	72	0.900
x	BR	F4_Link	1.008	0.250	0.250	91	1.200
x	F4	4.000	F4_Link	0.250	0.250	88	0.900
x	F2_Out	F2_Link	1.004	0.250	0.250	90	0.900
x	F1_Out	F1_Link	1.002	0.250	0.250	89	0.900

	Node	US Link	DS Link	US Exit Loss	DS Entry Loss	Angle (degrees)	Recommended Node Losses
✗	F1	1.000	F1_Link	0.250	0.250	90	1.200
✓	F3_Out	1.005	1.006	0.250	0.250	0	0.150
✓	BR	1.007	1.008	0.250	0.250	2	0.150
✓	10	1.006	1.007	0.250	0.250	0	0.150
✓	7	1.004	1.005	0.250	0.250	0	0.150
✓	F2_Out	1.003	1.004	0.250	0.250	0	0.150
✓	F2	2.000	F2_Link	0.250	0.250	59	0.500
✓	4	1.002	1.003	0.250	0.250	0	0.150

No circular links have diameters < 100mm

	US Node	DS Node	Link	Dia (mm)
✓	6	F1	1.000	150
✓	F1	F1_Out	F1_Link	150
✓	F1_Out	4	1.002	150
✓	4	F2_Out	1.003	150
✓	5	F2	2.000	150
✓	F2	F2_Out	F2_Link	150
✓	F2_Out	7	1.004	225
✓	7	F3_Out	1.005	225
✓	3	F3	3.000	150
✓	F3	F3_Out	F3_Link	150
✓	F3_Out	10	1.006	225
✓	10	BR	1.007	225
✓	2	F4	4.000	150
✓	F4	BR	F4_Link	150
✓	BR	D1	1.008	300
✓	D1	13_OUT	1.009	150

No links have lengths > 100.000m

	US Node	DS Node	Link	Length (m)
✓	6	F1	1.000	11.319
✓	F1	F1_Out	F1_Link	7.406
✓	F1_Out	4	1.002	12.920
✓	4	F2_Out	1.003	17.049
✓	5	F2	2.000	20.225
✓	F2	F2_Out	F2_Link	7.355
✓	F2_Out	7	1.004	14.118
✓	7	F3_Out	1.005	17.421
✓	3	F3	3.000	13.634
✓	F3	F3_Out	F3_Link	15.356
✓	F3_Out	10	1.006	9.822
✓	10	BR	1.007	19.770
✓	2	F4	4.000	9.153
✓	F4	BR	F4_Link	16.478
✓	BR	D1	1.008	17.380
✓	D1	13_OUT	1.009	16.458

No links have lengths that differ from their coordinated length by more than 1.000m

	US Node	DS Node	Link	Length (m)	Coordinate Length (m)
✓	6	F1	1.000	11.319	11.319
✓	F1	F1_Out	F1_Link	7.406	7.406
✓	F1_Out	4	1.002	12.920	12.920
✓	4	F2_Out	1.003	17.049	17.049
✓	5	F2	2.000	20.225	20.225
✓	F2	F2_Out	F2_Link	7.355	7.355
✓	F2_Out	7	1.004	14.118	14.118
✓	7	F3_Out	1.005	17.421	17.421
✓	3	F3	3.000	13.634	13.634
✓	F3	F3_Out	F3_Link	15.356	15.356
✓	F3_Out	10	1.006	9.822	9.822
✓	10	BR	1.007	19.770	19.770
✓	2	F4	4.000	9.153	9.153

	US Node	DS Node	Link	Length (m)	Coordinate Length (m)
✓	F4	BR	F4_Link	16.478	16.478
✓	BR	D1	1.008	17.380	17.380
✓	D1	13_OUT	1.009	16.458	16.458

5 links cross one or more other links

	US Node	DS Node	Link	Network	Link	Easting (m)	Northing (m)
x	4	F2_Out	1.003	FW	3.001	480774.830	172699.718
x	7	F3_Out	1.005	FW	6.002	480748.553	172719.701
x	3	F3	3.000	FW	6.000	480735.258	172709.066
x	10	BR	1.007	FW	1.001	480729.400	172734.358
x	F4	BR	F4_Link	FW	1.000	480708.522	172732.917

12 links have cover depth outside the range 0.550-3.000m

	US Node	DS Node	Link	Minimum Depth (m)	Maximum Depth (m)
x	6	F1	1.000	0.300	0.300
x	F1	F1_Out	F1_Link	0.300	0.449
x	F1_Out	4	1.002	0.435	0.449
x	4	F2_Out	1.003	0.435	0.449
x	5	F2	2.000	0.350	0.393
x	F2	F2_Out	F2_Link	0.380	0.393
x	F2_Out	7	1.004	0.449	0.533
x	7	F3_Out	1.005	0.533	0.549
x	3	F3	3.000	0.500	0.650
x	F4	BR	F4_Link	0.396	0.687
x	BR	D1	1.008	0.050	0.609
x	D1	13_OUT	1.009	0.097	0.200
✓	F3	F3_Out	F3_Link	0.555	0.650
✓	F3_Out	10	1.006	0.555	0.620
✓	10	BR	1.007	0.620	0.652
✓	2	F4	4.000	0.550	0.687

2 nodes have backdrops outside the range 0.200-1.500m

	Node	US Link	DS Link	Backdrop (m)
x	F2_Out	F2_Link	1.004	0.069
x	F3_Out	1.005	1.006	0.006
✓	F1	1.000	F1_Link	0.000
✓	F1_Out	F1_Link	1.002	0.000
✓	4	1.002	1.003	0.000
✓	F2_Out	1.003	1.004	0.000
✓	F2	2.000	F2_Link	0.000
✓	7	1.004	1.005	0.000
✓	F3	3.000	F3_Link	0.000
✓	F3_Out	F3_Link	1.006	0.000
✓	10	1.006	1.007	0.000
✓	BR	1.007	1.008	-0.043
✓	F4	4.000	F4_Link	0.000
✓	BR	F4_Link	1.008	0.213
✓	D1	1.008	1.009	0.000

1 link has full bore velocity outside the range 0.750-3.000m/s

	US Node	DS Node	Link	Velocity (m/s)
x	D1	13_OUT	1.009	0.531
✓	6	F1	1.000	0.944
✓	F1	F1_Out	F1_Link	0.818
✓	F1_Out	4	1.002	0.818
✓	4	F2_Out	1.003	0.818
✓	5	F2	2.000	0.843
✓	F2	F2_Out	F2_Link	1.094
✓	F2_Out	7	1.004	1.005
✓	7	F3_Out	1.005	1.065

US Node	DS Node	Link	Velocity (m/s)
✓ 3	F3	3.000	1.054
✓ F3	F3_Out	F3_Link	1.163
✓ F3_Out	10	1.006	1.065
✓ 10	BR	1.007	1.065
✓ 2	F4	4.000	1.232
✓ F4	BR	F4_Link	0.815
✓ BR	D1	1.008	0.757

6 links have peak proportional velocity outside the range 0.500-3.000m/s during the 100 year return period

US Node	DS Node	Link	Velocity (m/s)	Event
x 6	F1	1.000	0.071	100 year +40% CC 240 minute summer
x 3	F3	3.000	0.093	100 year +40% CC 180 minute summer
x F3	F3_Out	F3_Link	0.427	100 year +40% CC 360 minute summer
x 2	F4	4.000	0.180	100 year +40% CC 30 minute summer
x F4	BR	F4_Link	0.403	100 year +40% CC 180 minute summer
x BR	D1	1.008	0.307	100 year +40% CC 15 minute summer
✓ F1	F1_Out	F1_Link	0.607	100 year +40% CC 30 minute summer
✓ F1_Out	4	1.002	0.614	100 year +40% CC 15 minute summer
✓ 4	F2_Out	1.003	0.969	100 year +40% CC 30 minute summer
✓ 5	F2	2.000	0.000	
✓ F2	F2_Out	F2_Link	0.577	100 year +40% CC 60 minute summer
✓ F2_Out	7	1.004	0.724	100 year +40% CC 15 minute summer
✓ 7	F3_Out	1.005	0.828	100 year +40% CC 15 minute summer
✓ F3_Out	10	1.006	0.710	100 year +40% CC 15 minute summer
✓ 10	BR	1.007	0.573	100 year +40% CC 30 minute summer
✓ D1	13_OUT	1.009	0.599	100 year +40% CC 240 minute summer

4 links have a surcharged depth greater than 0.100m during the 30 year return period

US Node	DS Node	Link	Surcharged Depth (m)	Event
x F2_Out	7	1.004	0.105	30 year 360 minute summer
x 7	F3_Out	1.005	0.188	30 year 360 minute summer
x F3_Out	10	1.006	0.309	30 year 360 minute summer
x 10	BR	1.007	0.373	30 year 360 minute summer
✓ 6	F1	1.000	0.000	
✓ F1_Out	4	1.002	0.000	
✓ 4	F2_Out	1.003	0.038	30 year 30 minute summer
✓ 5	F2	2.000	0.000	
✓ 3	F3	3.000	0.000	
✓ 2	F4	4.000	0.001	30 year 480 minute summer
✓ D1	13_OUT	1.009	0.000	

No nodes flood during the 30 year return period

Node	Flood (m³)
✓ F4a	0.0000
✓ F3a	0.0000
✓ F2a	0.0000
✓ F1a	0.0000
✓ F3_Out	0.0000
✓ F3	0.0000
✓ 13_OUT	0.0000
✓ D1	0.0000
✓ BR	0.0000
✓ F4	0.0000
✓ 10	0.0000
✓ 7	0.0000
✓ F2_Out	0.0000
✓ F2	0.0000
✓ 4	0.0000
✓ F1_Out	0.0000
✓ F1	0.0000
✓ 1	0.0000
✓ 2	0.0000

	Node	Flood (m³)
✓	3	0.0000
✓	5	0.0000
✓	6	0.0000

No infiltrating structures failed to half empty in 1440 minutes during the 30 year return period

	DS Node	Structure	Time to Half Empty (mins)
✓	F3	Porous Paving	432
✓	BR	Bioretention Area	328
✓	F4	Porous Paving	568
✓	F2_Out	Link Surround	216
✓	F2	Porous Paving	96
✓	F1_Out	Link Surround	5
✓	F1	Porous Paving	172

No outfalls have a discharge rate greater than 2.2l/s during the 2 year return period

	US Node	DS Node	Link	Discharge Rate (l/s)	Event
✓	D1	13_OUT	1.009	2.2	2 year 360 minute summer

No outfalls have a discharge rate greater than 6.0l/s during the 30 year return period

	US Node	DS Node	Link	Discharge Rate (l/s)	Event
✓	D1	13_OUT	1.009	3.6	30 year 360 minute summer

No outfalls have a discharge rate greater than 8.0l/s during the 100 year return period

	US Node	DS Node	Link	Discharge Rate (l/s)	Event
✓	D1	13_OUT	1.009	5.2	100 year +40% CC 240 minute summer

No outfalls have a discharge volume greater than 300m³ during the 100 year 360 minute storm

	US Node	DS Node	Link	Discharge Volume (m³)	Event
✓	D1	13_OUT	1.009	264.3	100 year +40% CC 360 minute summer

1 outfall has a positive discharge during the 30 year return period (first 5mm)

	US Node	DS Node	Link	Discharge Rate (l/s)	Event
x	D1	13_OUT	1.009	1.4	30 year (first 5mm) 15 minute summer

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	102.910	29.120	30 year 360 minute summer	35.754	9.201
2 year 30 minute summer	65.861	18.636	30 year 480 minute summer	27.433	7.250
2 year 60 minute summer	43.585	11.518	30 year 600 minute summer	21.965	6.008
2 year 120 minute summer	31.790	8.401	30 year 720 minute summer	19.197	5.145
2 year 180 minute summer	25.877	6.659	30 year 960 minute summer	15.265	4.020
2 year 240 minute summer	20.982	5.545	30 year 1440 minute summer	10.597	2.840
2 year 360 minute summer	16.243	4.180	30 year (first 5mm) 15 minute summer	98.135	20.000
2 year 480 minute summer	12.772	3.375	30 year (first 5mm) 30 minute summer	43.078	10.000
2 year 600 minute summer	10.402	2.845	30 year (first 5mm) 60 minute summer	24.177	5.000
2 year 720 minute summer	9.211	2.469	30 year (first 5mm) 120 minute summer	11.763	2.500
2 year 960 minute summer	7.468	1.966	30 year (first 5mm) 180 minute summer	8.025	1.667
2 year 1440 minute summer	5.329	1.428	30 year (first 5mm) 240 minute summer	6.263	1.250
30 year 15 minute summer	301.443	85.298	30 year (first 5mm) 360 minute summer	4.343	0.833
30 year 30 minute summer	196.912	55.719	30 year (first 5mm) 480 minute summer	3.393	0.625
30 year 60 minute summer	131.444	34.737	30 year (first 5mm) 600 minute summer	2.656	0.500
30 year 120 minute summer	81.225	21.465	30 year (first 5mm) 720 minute summer	2.330	0.417
30 year 180 minute summer	61.752	15.891	30 year (first 5mm) 960 minute summer	1.810	0.312
30 year 240 minute summer	48.173	12.731	30 year (first 5mm) 1440 minute summer	1.227	0.208

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
100 year +40% CC 15 minute summer	544.479	154.069	100 year +40% CC 360 minute summer	62.547	16.095
100 year +40% CC 30 minute summer	358.130	101.338	100 year +40% CC 480 minute summer	47.883	12.654
100 year +40% CC 60 minute summer	240.249	63.491	100 year +40% CC 600 minute summer	38.276	10.469
100 year +40% CC 120 minute summer	144.785	38.262	100 year +40% CC 720 minute summer	33.405	8.953
100 year +40% CC 180 minute summer	109.099	28.075	100 year +40% CC 960 minute summer	26.487	6.975
100 year +40% CC 240 minute summer	84.709	22.386	100 year +40% CC 1440 minute summer	18.279	4.899

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.86%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	F4a	448	38.644	0.048	0.2	0.0000	0.0000	OK
360 minute summer	F3a	344	38.652	0.019	0.2	0.0000	0.0000	OK
30 minute summer	F2a	29	38.791	0.001	0.3	0.0000	0.0000	OK
30 minute summer	F1a	23	38.887	0.003	3.0	0.0000	0.0000	OK
360 minute summer	F3_Out	312	38.649	0.429	5.3	0.7524	0.0000	SURCHARGED
360 minute summer	F3	336	38.652	0.152	3.6	10.2443	0.0000	SURCHARGED
360 minute summer	13_OUT	328	37.945	0.042	2.2	0.0000	0.0000	OK
360 minute summer	D1	328	38.001	0.051	2.2	0.0144	0.0000	OK
360 minute summer	BR	312	38.648	0.657	5.7	13.0477	0.0000	FLOOD RISK
360 minute summer	BR Filter Layer	328	38.005	0.005	0.6	0.8513	0.0000	OK
480 minute summer	F4	440	38.644	0.181	4.7	16.5097	0.0000	SURCHARGED
360 minute summer	10	312	38.649	0.494	5.3	0.5588	0.0000	SURCHARGED
360 minute summer	1.007:50%	312	38.649	0.560	5.8	0.0000	0.0000	SURCHARGED
360 minute summer	7	312	38.650	0.308	5.0	0.3481	0.0000	SURCHARGED
360 minute summer	F2_Out	304	38.650	0.224	4.4	0.0659	0.0000	OK
360 minute summer	1.004:50%	304	38.650	0.266	5.0	0.0000	0.0000	SURCHARGED
180 minute summer	F2	116	38.746	0.089	3.0	4.4267	0.0000	OK
30 minute summer	4	26	38.674	0.059	4.6	0.0168	0.0000	OK
120 minute summer	F1_Out	72	38.741	0.040	2.3	0.0084	0.0000	OK
30 minute summer	1.002:50%	25	38.718	0.060	4.6	0.0000	0.0000	OK
240 minute summer	F1	160	38.885	0.135	6.1	14.1893	0.0000	OK
120 minute summer	F1_Link:50%	72	38.767	0.042	2.3	0.0020	0.0000	OK
15 minute summer	1	1	39.171	0.000	0.0	0.0000	0.0000	OK
480 minute summer	2	448	38.644	0.044	0.1	0.0070	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)
480 minute summer	F4a	Porous Paving	F4	-0.4	-0.036	-0.047		
360 minute summer	F3a	Porous Paving	F3	-0.3	-0.029	-0.033		
30 minute summer	F2a	Porous Paving	F2	0.0	0.000	0.000		
30 minute summer	F1a	Porous Paving	F1	0.0	0.003	0.000		
360 minute summer	F3_Out	1.006	10	5.3	0.412	0.124	0.3906	
360 minute summer	F3	F3_Link	F3_Out	-0.8	0.406	-0.040	0.2702	
360 minute summer	F3	Infiltration		0.1				
360 minute summer	D1	1.009	13_OUT	2.2	0.470	0.231	0.0761	79.4
360 minute summer	BR	1.008	D1	1.6	0.290	0.030	0.1084	
360 minute summer	BR	Filtration		0.6				
360 minute summer	BR Filter Layer	Underdrain		0.0	0.000	0.000	0.0322	
360 minute summer	BR Filter Layer	Infiltration		0.0				
480 minute summer	F4	F4_Link	BR	0.9	0.387	0.065	0.2901	
480 minute summer	F4	Infiltration		0.1				
360 minute summer	10	1.007	1.007:50%	5.3	0.350	0.124	0.3931	
360 minute summer	10	1.007	BR	5.7	0.316	0.136	0.3931	
360 minute summer	7	1.005	F3_Out	5.0	0.438	0.117	0.6929	
360 minute summer	F2_Out	1.004	1.004:50%	4.4	0.477	0.110	0.2806	
360 minute summer	F2_Out	Infiltration		0.0				
360 minute summer	F2_Out	1.004	7	5.0	0.507	0.124	0.2807	
180 minute summer	F2	F2_Link	F2_Out	1.4	0.549	0.072	0.0370	
180 minute summer	F2	Infiltration		0.0				
30 minute summer	4	1.003	F2_Out	4.5	0.716	0.315	0.1598	
120 minute summer	F1_Out	1.002	1.002:50%	2.3	0.520	0.157	0.0330	
120 minute summer	F1_Out	Infiltration		0.0				
120 minute summer	F1_Out	1.002	4	4.5	0.712	0.310	0.0407	
240 minute summer	F1	F1_Link	F1_Link:50%	1.8	0.516	0.122	0.0133	
240 minute summer	F1	Infiltration		0.1				
240 minute summer	F1	F1_Link	F1_Out	2.2	0.581	0.151	0.0139	
15 minute summer	1	Bioretention Area	BR	0.0	0.000	0.000		
480 minute summer	2	4.000	4.000:50%	0.1	0.129	0.006	0.0421	

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.86%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	4.000:50%	448	38.643	0.112	1.7	0.0000	0.0000	OK
360 minute summer	3	336	38.652	0.002	0.0	0.0006	0.0000	OK
360 minute summer	3.000:50%	344	38.652	0.077	1.5	0.0000	0.0000	OK
15 minute summer	5	1	38.800	0.000	0.0	0.0000	0.0000	OK
15 minute summer	2.000:50%	14	38.773	0.044	2.6	0.0948	0.0000	OK
240 minute summer	6	164	38.885	0.035	0.0	0.0056	0.0000	OK
240 minute summer	1.000:50%	160	38.885	0.085	3.6	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)
480 minute summer	2	4.000	F4	3.8	0.616	0.175	0.0725	
360 minute summer	3	3.000	3.000:50%	0.0	0.001	0.000	0.0312	
360 minute summer	3	3.000	F3	2.8	0.502	0.149	0.0911	
15 minute summer	5	2.000	2.000:50%	0.0	0.000	0.000	0.0221	
15 minute summer	5	2.000	F2	2.6	0.964	0.177	0.0452	
240 minute summer	6	1.000	1.000:50%	0.0	-0.009	-0.002	0.0380	
240 minute summer	6	1.000	F1	3.6	0.660	0.216	0.0764	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.79%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	F4a	488	38.751	0.155	0.4	0.0000	0.0000	OK
240 minute summer	F3a	240	38.763	0.130	0.7	0.0000	0.0000	OK
120 minute summer	F2a	92	38.841	0.050	0.8	0.0000	0.0000	OK
180 minute summer	F1a	144	38.986	0.103	5.3	0.0000	0.0000	OK
360 minute summer	F3_Out	360	38.754	0.534	9.7	1.0150	0.0000	FLOOD RISK
360 minute summer	F3	360	38.763	0.263	5.1	24.4443	0.0000	SURCHARGED
360 minute summer	13_OUT	368	37.957	0.054	3.6	0.0000	0.0000	OK
360 minute summer	D1	368	38.017	0.067	3.6	0.0188	0.0000	OK
360 minute summer	BR	360	38.752	0.761	10.9	39.0031	0.0000	FLOOD RISK
360 minute summer	BR Filter Layer	368	38.013	0.013	1.9	2.1683	0.0000	OK
480 minute summer	F4	480	38.751	0.288	4.4	32.8275	0.0000	SURCHARGED
360 minute summer	10	360	38.753	0.598	9.6	0.6765	0.0000	FLOOD RISK
360 minute summer	1.007:50%	360	38.753	0.664	11.0	0.0000	0.0000	SURCHARGED
360 minute summer	7	352	38.755	0.413	9.2	0.4670	0.0000	SURCHARGED
360 minute summer	F2_Out	352	38.756	0.330	8.0	0.1073	0.0000	SURCHARGED
360 minute summer	1.004:50%	352	38.755	0.371	9.3	0.0000	0.0000	SURCHARGED
120 minute summer	F2	92	38.839	0.182	8.2	12.0156	0.0000	SURCHARGED
30 minute summer	4	27	38.803	0.188	11.9	0.0533	0.0000	SURCHARGED
30 minute summer	F1_Out	27	38.844	0.143	4.6	0.0266	0.0000	OK
30 minute summer	1.002:50%	27	38.839	0.181	12.0	0.0000	0.0000	SURCHARGED
180 minute summer	F1	144	38.983	0.233	11.2	36.4811	0.0000	FLOOD RISK
30 minute summer	F1_Link:50%	27	38.846	0.120	4.5	0.0029	0.0000	OK
15 minute summer	1	1	39.171	0.000	0.0	0.0000	0.0000	OK
480 minute summer	2	480	38.751	0.151	0.3	0.0240	0.0000	SURCHARGED
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute summer	F4a	Porous Paving	F4	-0.9	-0.066	-0.122		
240 minute summer	F3a	Porous Paving	F3	-1.1	-0.076	-0.143		
120 minute summer	F2a	Porous Paving	F2	-0.8	-0.063	-0.097		
180 minute summer	F1a	Porous Paving	F1	-0.9	-0.063	-0.114		
360 minute summer	F3_Out	1.006	10	9.6	0.425	0.227	0.3906	
360 minute summer	F3	F3_Link	F3_Out	0.7	0.415	0.036	0.2703	
360 minute summer	F3	Infiltration		0.1				
360 minute summer	D1	1.009	13_OUT	3.6	0.541	0.381	0.1091	172.7
360 minute summer	BR	1.008	D1	1.7	0.290	0.032	0.1428	
360 minute summer	BR	Filtration		1.9				
360 minute summer	BR Filter Layer	Underdrain		0.0	0.000	0.000	0.1323	
360 minute summer	BR Filter Layer	Infiltration		0.0				
480 minute summer	F4	F4_Link	BR	1.0	0.397	0.070	0.2901	
480 minute summer	F4	Infiltration		0.1				
360 minute summer	10	1.007	1.007:50%	9.6	0.372	0.226	0.3931	
360 minute summer	10	1.007	BR	10.9	0.278	0.258	0.3931	
360 minute summer	7	1.005	F3_Out	9.2	0.435	0.218	0.6929	
360 minute summer	F2_Out	1.004	1.004:50%	8.0	0.460	0.200	0.2807	
360 minute summer	F2_Out	Infiltration		0.0				
360 minute summer	F2_Out	1.004	7	9.2	0.496	0.231	0.2807	
120 minute summer	F2	F2_Link	F2_Out	2.1	0.561	0.106	0.0974	
120 minute summer	F2	Infiltration		0.1				
30 minute summer	4	1.003	F2_Out	11.8	0.870	0.819	0.3001	
30 minute summer	F1_Out	1.002	1.002:50%	5.0	0.586	0.346	0.1128	
30 minute summer	F1_Out	Infiltration		0.0				
30 minute summer	F1_Out	1.002	4	11.9	0.853	0.826	0.1137	
180 minute summer	F1	F1_Link	F1_Link:50%	2.5	0.562	0.170	0.0189	
180 minute summer	F1	Infiltration		0.1				
180 minute summer	F1	F1_Link	F1_Out	4.0	0.651	0.275	0.0230	
15 minute summer	1	Bioretention Area	BR	0.0	0.000	0.000		
480 minute summer	2	4.000	4.000:50%	0.3	0.137	0.013	0.0805	

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.79%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute summer	4.000:50%	480	38.751	0.219	3.2	0.0000	0.0000	SURCHARGED
360 minute summer	3	352	38.763	0.113	0.0	0.0319	0.0000	OK
360 minute summer	3.000:50%	352	38.763	0.188	3.4	0.0000	0.0000	SURCHARGED
120 minute summer	5	92	38.840	0.040	0.1	0.0112	0.0000	OK
120 minute summer	2.000:50%	92	38.839	0.111	6.0	0.5853	0.0000	OK
180 minute summer	6	140	38.984	0.134	0.1	0.0213	0.0000	OK
180 minute summer	1.000:50%	140	38.984	0.184	9.7	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
480 minute summer	2	4.000	F4	3.3	0.687	0.153	0.0806	
360 minute summer	3	3.000	3.000:50%	0.0	0.008	0.003	0.1085	
360 minute summer	3	3.000	F3	3.8	0.648	0.204	0.1200	
120 minute summer	5	2.000	2.000:50%	-0.1	-0.027	-0.007	0.0891	
120 minute summer	5	2.000	F2	5.5	0.653	0.369	0.1594	
180 minute summer	6	1.000	1.000:50%	-0.1	-0.016	-0.006	0.0968	
180 minute summer	6	1.000	F1	9.6	0.844	0.573	0.0996	

Results for 30 year (first 5mm) Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	F4a	1	38.596	0.000	0.0	0.0000	0.0000	OK
15 minute summer	F3a	18	38.634	0.001	0.2	0.0000	0.0000	OK
15 minute summer	F2a	18	38.791	0.001	0.2	0.0000	0.0000	OK
15 minute summer	F1a	15	38.886	0.003	2.0	0.0000	0.0000	OK
15 minute summer	F3_Out	44	38.493	0.273	4.4	0.4014	0.0000	SURCHARGED
15 minute summer	F3	21	38.545	0.045	3.3	2.6490	0.0000	OK
15 minute summer	13_OUT	45	37.936	0.033	1.4	0.0000	0.0000	OK
15 minute summer	D1	45	37.990	0.040	1.4	0.0114	0.0000	OK
15 minute summer	BR	43	38.493	0.502	3.5	0.6287	0.0000	SURCHARGED
15 minute summer	BR Filter Layer	1	38.000	0.000	0.0	0.0000	0.0000	OK
15 minute summer	F4	21	38.499	0.036	3.1	2.4718	0.0000	OK
15 minute summer	10	44	38.493	0.338	4.5	0.3821	0.0000	SURCHARGED
15 minute summer	1.007:50%	44	38.493	0.404	4.7	0.0000	0.0000	SURCHARGED
15 minute summer	7	43	38.493	0.151	4.0	0.1707	0.0000	OK
15 minute summer	F2_Out	44	38.493	0.067	3.3	0.0189	0.0000	OK
15 minute summer	1.004:50%	44	38.493	0.109	4.0	0.0000	0.0000	OK
15 minute summer	F2	21	38.699	0.042	2.8	2.0794	0.0000	OK
15 minute summer	4	15	38.661	0.046	2.9	0.0131	0.0000	OK
15 minute summer	F1_Out	18	38.730	0.029	1.2	0.0059	0.0000	OK
15 minute summer	1.002:50%	15	38.705	0.047	2.9	0.0000	0.0000	OK
15 minute summer	F1	21	38.800	0.050	6.5	5.1929	0.0000	OK
15 minute summer	F1_Link:50%	17	38.755	0.029	1.2	0.0014	0.0000	OK
15 minute summer	1	1	39.171	0.000	0.0	0.0000	0.0000	OK
15 minute summer	2	12	38.610	0.010	0.2	0.0016	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	F4a	Porous Paving	F4	0.0	0.000	0.000		
15 minute summer	F3a	Porous Paving	F3	0.0	0.001	0.000		
15 minute summer	F2a	Porous Paving	F2	0.0	0.001	0.000		
15 minute summer	F1a	Porous Paving	F1	0.0	0.004	0.000		
15 minute summer	F3_Out	1.006	10	3.7	0.630	0.087	0.3906	
15 minute summer	F3	F3_Link	F3_Out	0.6	0.400	0.028	0.1437	
15 minute summer	F3	Infiltration		0.0				
15 minute summer	D1	1.009	13_OUT	1.4	0.412	0.146	0.0550	15.2
15 minute summer	BR	1.008	D1	1.4	0.281	0.026	0.0851	
15 minute summer	BR	Filtration		0.0				
15 minute summer	BR Filter Layer	Underdrain		0.0	0.000	0.000	0.0001	
15 minute summer	BR Filter Layer	Infiltration		0.0				
15 minute summer	F4	F4_Link	BR	0.3	0.288	0.022	0.1603	
15 minute summer	F4	Infiltration		0.0				
15 minute summer	10	1.007	1.007:50%	3.8	0.558	0.090	0.3931	
15 minute summer	10	1.007	BR	3.4	0.426	0.081	0.3931	
15 minute summer	7	1.005	F3_Out	4.0	0.647	0.095	0.5931	
15 minute summer	F2_Out	1.004	1.004:50%	3.3	0.555	0.082	0.1021	
15 minute summer	F2_Out	Infiltration		0.0				
15 minute summer	F2_Out	1.004	7	4.0	0.654	0.100	0.1672	
15 minute summer	F2	F2_Link	F2_Out	0.6	0.483	0.030	0.0087	
15 minute summer	F2	Infiltration		0.0				
15 minute summer	4	1.003	F2_Out	2.9	0.633	0.199	0.0775	
15 minute summer	F1_Out	1.002	1.002:50%	1.2	0.426	0.080	0.0226	
15 minute summer	F1_Out	Infiltration		0.0				
15 minute summer	F1_Out	1.002	4	2.9	0.623	0.201	0.0301	
15 minute summer	F1	F1_Link	F1_Link:50%	0.7	0.417	0.051	0.0073	
15 minute summer	F1	Infiltration		0.1				
15 minute summer	F1	F1_Link	F1_Out	1.2	0.487	0.080	0.0088	
15 minute summer	1	Bioretention Area	BR	0.0	0.000	0.000		
15 minute summer	2	4.000	4.000:50%	0.2	0.138	0.009	0.0126	

Results for 30 year (first 5mm) Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	4.000:50%	6	38.581	0.050	2.3	0.0000	0.0000	OK
15 minute summer	3	1	38.650	0.000	0.0	0.0000	0.0000	OK
15 minute summer	3.000:50%	6	38.617	0.042	2.0	0.0000	0.0000	OK
15 minute summer	5	1	38.800	0.000	0.0	0.0000	0.0000	OK
15 minute summer	2.000:50%	7	38.770	0.041	1.8	0.0822	0.0000	OK
15 minute summer	6	5	38.893	0.043	0.6	0.0069	0.0000	OK
15 minute summer	1.000:50%	5	38.893	0.093	4.0	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	2	4.000	F4	2.4	1.209	0.110	0.0121	
15 minute summer	3	3.000	3.000:50%	0.0	0.000	0.000	0.0136	
15 minute summer	3	3.000	F3	2.0	1.085	0.110	0.0215	
15 minute summer	5	2.000	2.000:50%	0.0	0.000	0.000	0.0200	
15 minute summer	5	2.000	F2	1.9	0.935	0.127	0.0311	
15 minute summer	6	1.000	1.000:50%	-0.6	-0.165	-0.038	0.0445	
15 minute summer	6	1.000	F1	4.2	1.226	0.255	0.0328	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 82.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	F4a	435	38.965	0.368	0.7	0.0000	0.0000	OK
360 minute summer	F3a	232	39.121	0.487	1.3	0.0000	0.0000	OK
120 minute summer	F2a	108	38.949	0.159	1.4	0.0000	0.0000	OK
360 minute summer	F1a	264	39.183	0.300	5.8	0.0000	0.0000	OK
240 minute summer	F3_Out	232	38.876	0.656	16.0	1.3226	0.0000	FLOOD RISK
360 minute summer	F3	232	39.121	0.621	9.1	38.9311	0.0000	FLOOD RISK
240 minute summer	13_OUT	248	37.968	0.065	5.2	0.0000	0.0000	OK
240 minute summer	D1	248	38.032	0.082	5.2	0.0232	0.0000	OK
240 minute summer	BR	232	38.871	0.880	18.8	52.5365	0.0000	FLOOD RISK
240 minute summer	BR Filter Layer	248	38.022	0.022	3.4	3.4743	0.0000	OK
600 minute summer	F4	435	38.964	0.501	5.8	45.9284	0.0000	SURCHARGED
240 minute summer	10	232	38.875	0.720	15.8	0.8141	0.0000	FLOOD RISK
240 minute summer	1.007:50%	228	38.873	0.784	18.8	0.0000	0.0000	SURCHARGED
240 minute summer	7	232	38.879	0.537	15.4	0.6070	0.0000	FLOOD RISK
240 minute summer	F2_Out	232	38.881	0.455	12.6	0.1780	0.0000	FLOOD RISK
240 minute summer	1.004:50%	224	38.879	0.495	15.5	0.0000	0.0000	SURCHARGED
120 minute summer	F2	106	38.948	0.291	12.4	23.9006	0.0000	FLOOD RISK
30 minute summer	4	27	39.021	0.406	17.2	0.1148	0.0000	FLOOD RISK
30 minute summer	F1_Out	27	39.099	0.398	5.5	0.1081	0.0000	FLOOD RISK
30 minute summer	1.002:50%	27	39.096	0.438	17.4	0.0000	0.0000	SURCHARGED
360 minute summer	F1	256	39.179	0.429	12.3	67.6844	0.0000	FLOOD RISK
30 minute summer	F1_Link:50%	27	39.101	0.376	5.7	0.0410	0.0000	SURCHARGED
15 minute summer	1	1	39.171	0.000	0.0	0.0000	0.0000	OK
600 minute summer	2	435	38.964	0.364	0.4	0.0579	0.0000	SURCHARGED
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	F4a	Porous Paving	F4	-1.4	-0.082	-0.186		
360 minute summer	F3a	Porous Paving	F3	-1.7	-0.098	-0.222		
120 minute summer	F2a	Porous Paving	F2	-1.6	-0.098	-0.207		
360 minute summer	F1a	Porous Paving	F1	-1.6	-0.088	-0.200		
240 minute summer	F3_Out	1.006	10	15.8	0.497	0.373	0.3906	
360 minute summer	F3	F3_Link	F3_Out	2.2	0.427	0.105	0.2703	
360 minute summer	F3	Infiltration		0.1				
240 minute summer	D1	1.009	13_OUT	5.2	0.599	0.550	0.1418	234.7
240 minute summer	BR	1.008	D1	1.8	0.290	0.034	0.1914	
240 minute summer	BR	Filtration		3.4				
240 minute summer	BR Filter Layer	Underdrain		0.0	0.000	0.000	0.2644	
240 minute summer	BR Filter Layer	Infiltration		0.1				
600 minute summer	F4	F4_Link	BR	1.0	0.395	0.067	0.2901	
600 minute summer	F4	Infiltration		0.1				
240 minute summer	10	1.007	1.007:50%	15.7	0.417	0.372	0.3931	
240 minute summer	10	1.007	BR	18.8	0.472	0.444	0.3931	
240 minute summer	7	1.005	F3_Out	15.3	0.517	0.362	0.6929	
240 minute summer	F2_Out	1.004	1.004:50%	12.6	0.510	0.314	0.2807	
240 minute summer	F2_Out	Infiltration		0.0				
240 minute summer	F2_Out	1.004	7	15.4	0.555	0.385	0.2807	
120 minute summer	F2	F2_Link	F2_Out	2.2	0.571	0.116	0.1295	
120 minute summer	F2	Infiltration		0.1				
30 minute summer	4	1.003	F2_Out	17.1	0.969	1.181	0.3001	
30 minute summer	F1_Out	1.002	1.002:50%	6.3	0.447	0.435	0.1137	
30 minute summer	F1_Out	Infiltration		0.0				
30 minute summer	F1_Out	1.002	4	17.2	0.977	1.190	0.1137	
360 minute summer	F1	F1_Link	F1_Link:50%	3.1	0.525	0.215	0.0642	
360 minute summer	F1	Infiltration		0.1				
360 minute summer	F1	F1_Link	F1_Out	4.2	0.649	0.287	0.0652	
15 minute summer	1	Bioretention Area	BR	0.0	0.000	0.000		
600 minute summer	2	4.000	4.000:50%	0.4	0.137	0.017	0.0806	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 82.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
600 minute summer	4.000:50%	435	38.964	0.432	4.4	0.0000	0.0000	SURCHARGED
360 minute summer	3	232	39.122	0.472	0.3	0.1334	0.0000	FLOOD RISK
360 minute summer	3.000:50%	232	39.122	0.547	6.0	0.0000	0.0000	SURCHARGED
120 minute summer	5	106	38.949	0.149	0.2	0.0421	0.0000	OK
120 minute summer	2.000:50%	106	38.948	0.220	10.6	2.3131	0.0000	SURCHARGED
30 minute summer	6	27	39.184	0.334	0.8	0.0530	0.0000	FLOOD RISK
30 minute summer	1.000:50%	27	39.184	0.384	29.7	0.0000	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
600 minute summer	2	4.000	F4	4.3	0.692	0.199	0.0806	
360 minute summer	3	3.000	3.000:50%	-0.3	-0.017	-0.016	0.1200	
360 minute summer	3	3.000	F3	5.9	0.733	0.314	0.1200	
120 minute summer	5	2.000	2.000:50%	-0.2	-0.028	-0.010	0.1779	
120 minute summer	5	2.000	F2	8.5	0.729	0.572	0.1780	
30 minute summer	6	1.000	1.000:50%	-0.8	-0.169	-0.050	0.0996	
30 minute summer	6	1.000	F1	29.2	1.661	1.753	0.0996	

13.9.3 Drainage Sections

13.10 Appendix 8 – SuDS Maintenance Manual

All maintenance activities will be the responsibility of WS Planning & Architecture. They will appoint a management company to undertake the general maintenance duties within the site and will join service agreements with the suppliers and manufactures of the SuDS/Pumps when required.

The information presented below is taken from the CIRIA SuDS Manual (Report c753) and [SuDS](#). Further details on installation and maintenance can be found detailed below and online.

13.10.1 Pervious Pavements

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations - pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.	WS Planning & Architecture will be responsible for setting up the management company.
Occasional maintenance	Stabilise and mow contributing areas.	As required.	
	Removal of weeds or manage using weed killer applied directly into the weeds rather than spraying.	As required - once per year on less frequently used pavements.	
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.	
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and lost material.	As required.	WS Planning & Architecture will be responsible for setting up the management company.
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging).	
Monitoring	Initial Inspection.	Monthly for three months after installation.	
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action.	Three-monthly, 48h after large storms in first six months.	
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.	
	Monitor Inspection chambers.	Annually.	

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy). Therefore, if litter management is already required at the site, this should have marginal cost implications.

13.10.2 Rain Garden Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in inlet and outlet components	Quarterly; As required.	WS Planning & Architecture will be responsible for setting up the management company.
	Inspection & Cleaning of gutters and any filters on downpipes feeding into rain gardens as required.	Quarterly; As required.	
	Remove, replace and maintain vegetation as required; Ensuring cuttings are removed to prevent debris build up; Weeding of flower bed to maintain the desired vegetation, density and biodiversity - Vegetation management	Monthly inspections Summer; As required Quarterly during Winter month; Or as required.	
Remedial actions	Replace dead or overgrown vegetation as required.	As required.	
	Replacement of clogged geotextile (will require reconstruction of raingarden).	As required.	
Monitoring	Inspect silt traps / discharge points and note rate of sediment accumulation and ensure no erosion pathways forming.	Monthly in the first year and then annually.	
	Check raingardens are emptying as required following a storm event occurring.	After storms; When possible.	

Maintenance will be carried out manually. All monitoring and maintenance will be carried out by the appointed estate management company that undertakes the general landscaping maintenance.

13.10.3 SuDS Rain Water Butt Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in inlet and outlet components;	Quarterly; As required. Increase freq. to Monthly during Autumn;	WS Planning & Architecture will be responsible for setting up the management company.
	Inspection & Cleaning of gutters and any filters on downpipes feeding into the Rain Water Butts.	Quarterly; Increase freq. to Monthly during Autumn;	
Remedial actions	Cleaning of the water butt. Fully drain the water butt and clear out debris and enable access; Scrub out the inside of the butt or tank with a coarse brush, if accessible, using a proprietary cleaning product such as Just Water Butt Cleaner or garden disinfectant; Rinse with clean water; Cleaning of Gutters; Clean or fit a new filter;	Annually; Or as required.	
Remedial actions	Use water/empty water butts - to clean, water plants (inside & out); Empty water Butt more frequently during the winter, to allow for storage during storms and to keep the water fresh;	Once every two weeks; as required	

Maintenance will be carried out manually. All monitoring and maintenance will be carried out by the appointed estate management company that undertakes the general landscaping maintenance.

13.10.4 Surface Water Pump Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspection of pumping chamber for sediment and debris in inlet and outlet components; Inspection of pumping chamber for sediment and debris in inlet and outlet components; Grounds & Housekeeping: a clean and tidy pump station is a healthy pump station. Grass, trees and shrubs should be maintained for ease of access and to maintain a proper operating buffer from vegetation.	Monthly	WS Planning & Architecture will be responsible for setting up the management company.
Regular maintenance	A typical service schedule will be included but is not limited to the following; Pump down sump on hand operation. Clean and check float level equipment. Check and adjust impeller/wear plate on pumps. Check oil bath lubrication if applicable. Check operation and wear of control panels/starters, including housing. Examine non-return and gate valves [if mounted in separate valve chamber and/or if accessible at time of service without undertaking a confined space entry]. Check pipework for leaks/wear/damage and report. Test run pumps and monitor performance leave running if possible and report if pumps not running and/or to correct characteristic. Replace or use parts/consumables necessary to bring station online, but only if within authorised limit. If necessary, report any defects/faults diagnosed. Our quotation for remedial repairs will automatically follow. Check motors and rotating elements of pumps for higher-than-normal temperature. Visually inspect pumps and motors for coating failure and oxidation and reapply protective coatings/paint as necessary. Inspection of electrical wiring and pumping station controllers Electrical Cables: Cables should be kept organized and tied-off in secure locations where available. Seals should be monitored to make sure they are in-tact. Contacts: Both the starter contacts and the alternator contacts should be inspected to make sure connections are good. Breakers: A failure to maintain the breakers can allow a simple surge to wipe out your controls or pumps.	Annual or bi-annual service.	WS Planning & Architecture will instruct the pump supplier to or suitable maintenance company to undertake scheduled monitoring.
Remedial Actions	Replacement of parts, seals, wires, fuses; Lubricating moving parts; Pump replacement; Replace worn parts and ensure good operation of pumps through general maintenance; Grease / Lubricate / Replacing seals as required.	As required	WS Planning & Architecture will instruct the pump supplier to or suitable maintenance company to undertake scheduled monitoring / repair works as required.

All maintenance and monitoring works will be scheduled and will follow the manufactures guidance and will be carried out by a qualified professional as required.

13.11 Appendix 9 – Foul Drainage

13.11.1 General Binding Rules

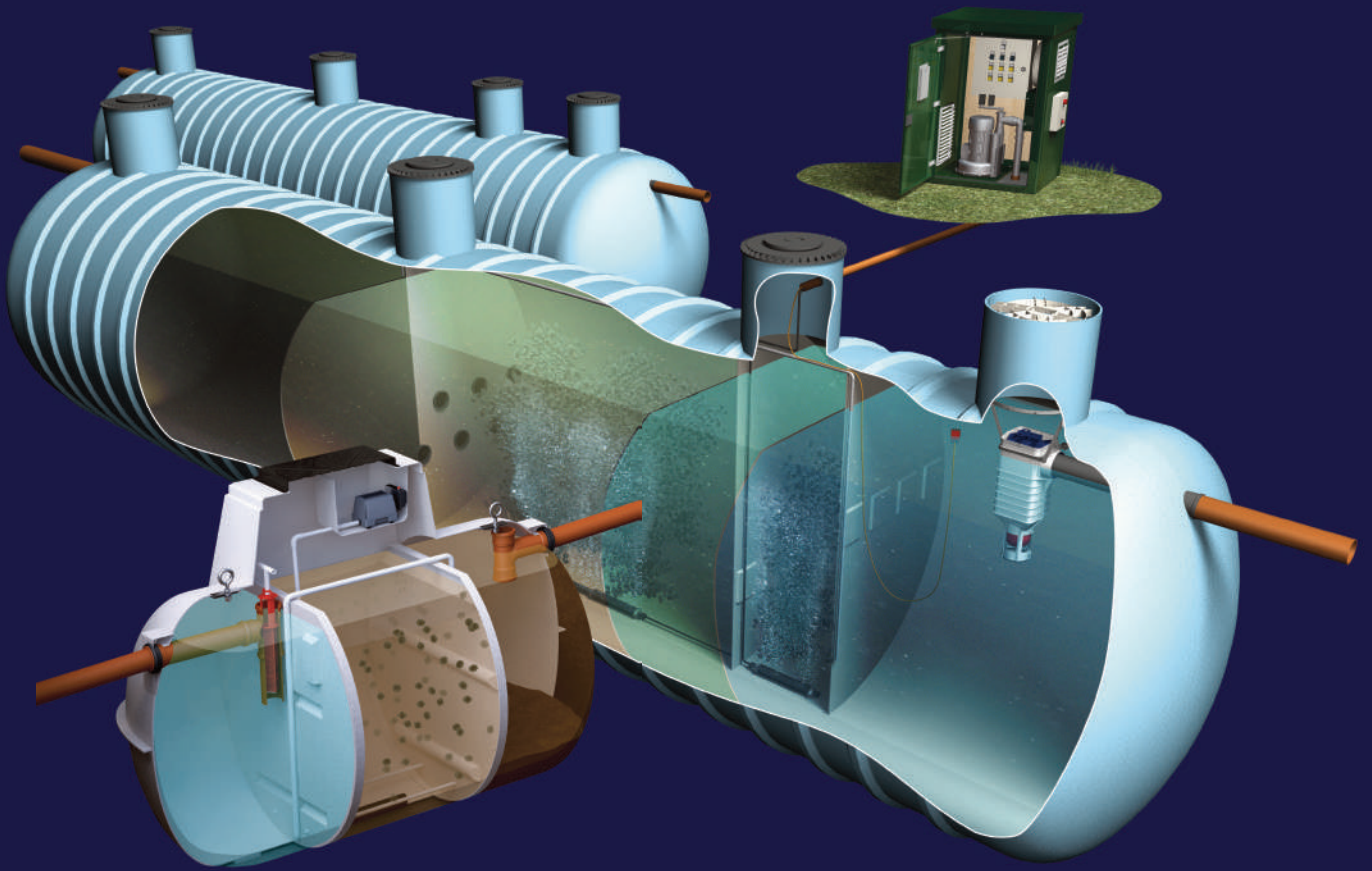
	Discharge to Ground Only
	Discharge to Surface Water
	Discharge to Ground or Surface Water
Red Text	General Binding Rules not Met. Permit Application Required

#	Discharge to Surface Water	Discharge to ground	General binding rule	Info	Criteria Meet?
1		x	The discharge must be 2 cubic metres or less per day in volume.	10.8m ³ Value is calculated of fully occupied; Unlikely to accurate volume	No
2	x		The sewage must only be domestic.	Yes	Yes
3	x		The discharge must be 5 cubic metres or less per day in volume.	10.8m ³	No
4	x	x	The discharge must not cause pollution of surface water or ground water.	Sewage Treatment plan	Yes
5		x	The sewage must receive treatment from a septic tank and infiltration system (drainage field) or a sewage treatment plant and infiltration system.	N/A	Yes
6	x		The sewage must receive treatment from a sewage treatment plant.	Yes - Package Treatment Plant	Yes
7		x	The discharge must not be within a groundwater Source Protection Zone 1 or within 50 metres from any well, spring or borehole that is used to supply water for domestic or food production purposes.	No wells or BH within identified within 50m. Closest Well is 90m south of redline boundary.	Yes
8	x		For discharges in tidal waters, the discharge outlet must be below the mean spring low water mark.	N/A	N/A
9	x	x	All works and equipment used for the treatment of sewage effluent and its discharge must comply with the relevant design and manufacturing standards i.e. the British Standard that was in force at the time of the installation, and guidance issued by the appropriate authority on the capacity and installation of the equipment.	Yes	Yes
10	x	x	The system must be installed and operated in accordance with the manufacturer's specification.	Yes	Yes
11	x	x	Maintenance must be undertaken by someone who is competent.	Yes	Yes
12	x	x	Waste sludge from the system must be safely disposed of by an authorised person.	Yes	Yes
13	x	x	If a property is sold, the operator must give the new operator a written notice stating that a small sewage discharge is being carried out, and giving a description of the waste water system and its maintenance requirements.		Yes
14	x	x	The operator must ensure the system is appropriately decommissioned where it ceases to be in operation so that there is no risk of pollutants or polluting matter entering groundwater, inland fresh waters or coastal waters.		Yes

For a new discharge, which is one that was started on or after 1 January 2015, the following general binding rules also apply:					
#	Discharge to Surface Water	Discharge to ground	General binding rule	Info	Criteria Meet?
15	x	x	New discharges must not be within 30 metres of a public foul sewer.	No public sewers available within the 500m of the site.	Yes
16	x	x	For new discharges, the operator must ensure that the necessary planning and building control approvals for the treatment system are in place.	Yes	In planning currently;
17	x		New discharges must not be in or within: 500 metres of a Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site, biological Site of Special Scientific Interest (SSSI), freshwater pearl mussel population, designated bathing water, or protected shellfish water; 200 metres of an aquatic local nature reserve; 50 metres of a chalk river or aquatic local wildlife site.	None identified within 200m of the site. SSSI Impact Risk Zones - for LPAs to determine likely impacts on terrestrial SSSIs and when to consult Natural England (See Link)	Yes Consultation with Natural England maybe required; LPA to decide.
18		x	New discharges must not be in, or within 50 metres of, a Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar site, or biological Site of Special Scientific Interest (SSSI), and must not be in an Ancient Woodland.	None identified within 50m of the site.	Yes;
19	x		New discharges must be made to a watercourse that normally has flow throughout the year.	The drainage ditch does not have flow all year round.	No; General Binding Rules do not apply. Permit with the EA is required.
20	x		For new discharges, any partial drainage field must be installed within 10 metres of the bank side of the watercourse.	Possible - drainage field would be located within Flood Zone 2 and 3;	Yes
21	x		New discharges must not be made to an enclosed lake or pond.	N/A	Yes
For a new discharge that started on or after 2 October 2023, the following two general binding rules also apply					
#	Discharge to Surface Water	Discharge to ground	General binding rule	Info	Criteria Meet?
22	x	x	A new discharge shall not use the same outlet as any other discharge if the combined volume of those discharges would exceed the volumetric general binding rules thresholds for groundwater or surface water.	Yes	Yes
23	x	x	A new discharge shall not be made to a discharge point within 50 metres of any other exempt groundwater activity or water discharge activity.	N/A	Yes

Package sewage treatment plants

Installation and operation manual



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Based in Northamptonshire and with extended facilities in Bridgwater, Somerset, Marsh Industries is a leading manufacturer of sewage treatment plant, off-mains drainage products and rainwater harvesting systems for both UK and overseas markets.

Marsh supplies sewage treatment plant and off-mains drainage products for domestic, commercial and industrial applications as well as offering engineering design and technical support.

With one of the largest merchant distributor networks available in Europe, clients ask for Marsh products and services because they know the company delivers from a solid foundation of knowledge, customer support, product quality and proven performance.

Architects, specifiers and installers within the construction sectors seek alliances and partnership with Marsh because its core products and services bring further added value to their own brands.

COVID-19 NOTICE

Start up information for sewage treatment plants after prolonged periods of inactivity

When returning to or reopening your place of business, please follow the instructions below to enable a smooth start-up and to minimise the risk of pollution when restarting your sewage treatment plant.

Firstly, make sure the area is secure and cordoned off to prevent people or animals on site from falling into the sewage treatment plant. Where possible a qualified British Water accredited engineer should be employed to carry out these procedures. This process should be undertaken by two people while observing HM Government Social Distancing (Covid-19). PPE must be worn and handwashing/sanitizing must be carried out.

When first opening the tank chambers please ensure the area is well ventilated and engineers are wearing protective face masks. Sewer gases can accumulate in sewage treatment plants, particularly Hydrogen Sulphide, which can be very dangerous even at low levels. (Sewer gas is a complex mixture of toxic and nontoxic gases produced by the decomposition of organic household or industrial components of sewage.)

- ✓ When your treatment plant is turned on, make sure the compressor/air blower is operational.
- ✓ Inspect the air filters on the top of the compressor and remove any debris impeding the flow of air.
- ✓ Check whether air is reaching the treatment zone of your sewage treatment plant. This can be done by checking for a mild jacuzzi effect in the middle chamber of the plant.
- ✓ Make sure the media (golf ball sized pieces of plastic) are freely circulating in the aeration chamber within the treatment plant. These must not be accumulating at one side of the chamber or the other.
- ✓ Ensure that the treatment plant is vented locally and that air is allowed unhindered access to the plant with no air admittance valves located on the vent.
- ✓ Be aware that when restarting your plant after prolonged periods of inactivity, smell and odour may be generated in the initial weeks while the biomass - 'good bacteria' - starts to grow again on the media (Activated carbon vents are available for purchase from Marsh Industries if this is an issue).
- ✓ Existing recirculation pipes from the final chamber to the primary chamber assist and speed up the sewage treatment process, however a temporary submersible pump with a flow of less than 10 litres a minute can be fitted into the final humus chamber to further enhance the process. The pump must be 1m below the waterline and should discharge to the primary chamber with the hose being under the waterline to minimise the agitation of solids. The pump can be operated for 20mins in every hour for 6 hours per day for the first 4 days of start up. After this period, the pump should be removed, cleaned and stored.

If you have concerns about restarting your sewage treatment plant, please contact the Marsh HQ on 01933 654582.

Note: Marsh Industries accepts no liability for any damage or loss, including consequential loss caused by the failure of any drainage equipment or any failure caused by gross solids or fats entering the sewage treatment plant.

It is the responsibility of the installer/contractor to undertake installation of the sewage treatment plant as per the manufacturer instructions.

Marsh Industries believe that the information printed in this manual is accurate, and published for information only. No warranties, express or implied, are contained therein, nor does any legal liability attach to Marsh Industries for any reason whatsoever. The company's policy is one of continuous product improvement and we reserve the right to make alterations to our range and specification without prior notice.

1 Pre-installation checklist

Prior to installation please check or take note of the following:

- ✓ Ensure that the information contained in this manual is adhered to at all times.
- ✓ When the sewage treatment plant arrives on site it is recommended to fully inspect for damage (ie, fractures to the shell or ribs, delamination, scratches or abrasions deeper than 1.5mm, stress cracks or star crazing). If any damage is seen or suspected please notify Marsh Industries immediately as problems cannot be rectified easily after installation.
- ✓ It is the responsibility of the installer/contractor to undertake installation of the sewage treatment plant as per Marsh Industries' instructions.
- ✓ All electrical work must be undertaken by fully qualified personnel under the guidance of The Health & Safety at Work Act.
- ✓ Ensure the plant is properly ventilated.
- ✓ The end-user of the plant is responsible for the operation and maintenance of the system and its discharge either direct to a watercourse or through a percolation area.
- ✓ It is important that the product is operated under the conditions for which it is designed. Any variation in these conditions could prevent the unit from performing to its full potential and the effluent discharge may not meet required standards.
- ✓ Maintain the system in accordance with this handbook.
- ✓ Any service contract offered by Marsh is mechanical only and does not include desludging (emptying of the system). The end-user must desludge the system in accordance with the guidelines provided in this handbook.
- ✓ Drainage fields, drains and desludging of the plant remains the responsibility of the end-user. Any damage to the installation due to the influx of surface water or the backing up of drainage fields or drains is not covered by service agreements.
- ✓ Contact Marsh Industries if you have any technical queries regarding the installation, maintenance or servicing of the system.

To maintain optimum system performance the end-user must be aware of certain precautions, including the following:

- ✗ Do not open the plant cover without firstly isolating the mains power.
- ✗ Do not alter in any way, any part of the system or internal parts supplied with the system.
- ✗ The design loading of the plant should not be exceeded.
- ✗ High volume discharges such as those from swimming pools and Jacuzzi's must never enter the system.
- ✗ Surface water must not enter the system.
- ✗ Heavy duty toilet paper, sanitary towels or incontinence pads must not enter the sewage treatment plant. This could cause severe blockages and can adversely affect organic biomass growth.
- ✗ If the plant is installed in a care home or medical facility, spent medication must not enter the sewage treatment plant as this can adversely affect organic biomass growth.
- ✗ Do not allow large quantities of chemicals to enter the system including:
 - *Water softener regenerate*
 - *Disinfectants or high concentrate bleaches*
 - *Strong acids and alkalis*
 - *Oil or grease*
 - *Pesticides*
 - *Photographic chemicals*

2 Site location (For guidance only)

Minimum distances for locating sewage treatment plant is set out below. These are minimum distances only – the unit should be located as far away as is practically possible. However, when locating the plant, consideration should be given to allow adequate access for a desludging tanker.

	Any dwelling	Watercourse or stream	Spring or well	Lake/moat	Site boundary	Road	Slope, break or cuts
Plant	7m	10m	50m	50m	3m	4m	4m
Percolation area	15m	10m	50m	50m	3m	4m	4m

3 Tank installation

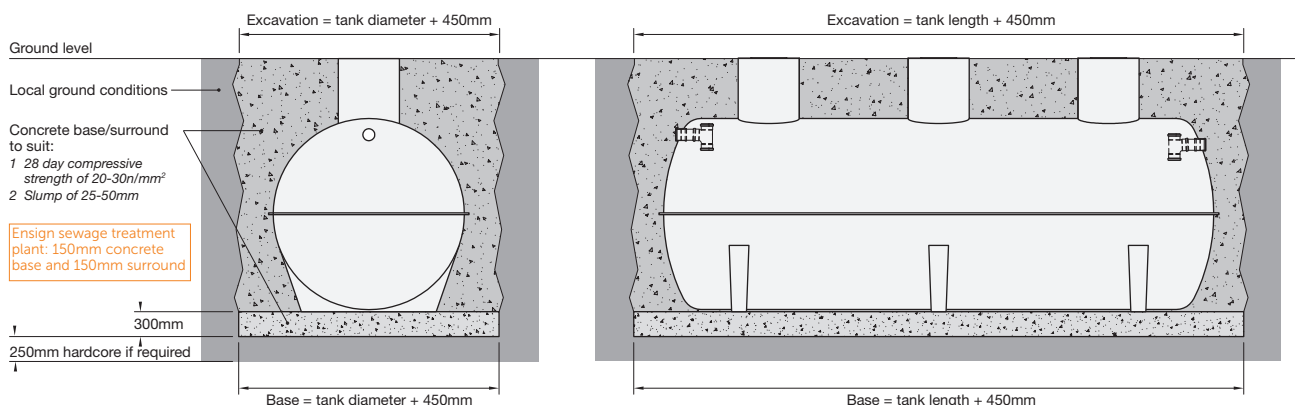
Site inspection

- Ensure site location ground is flat, even and free from rocks.
- If the plant is to be installed in a high traffic area, a qualified civil engineer should design a separate load bearing slab and reinforced base of hard core with metal grid support and concrete.

Movement of the sewage treatment plant

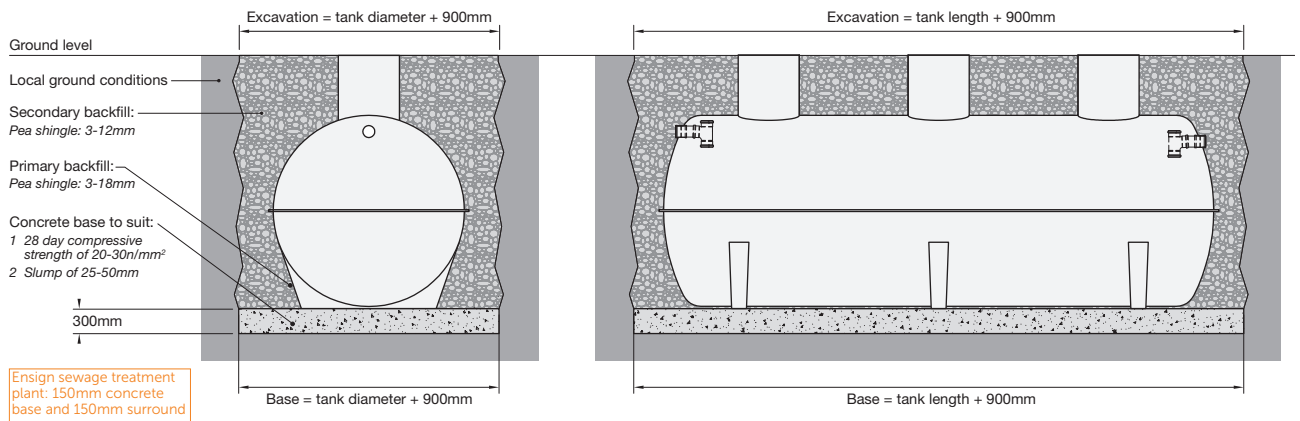
- The weight of the tank is not evenly distributed along its length, so time needs to be taken to ensure the straps are distributed to prevent movement or slippage.
- Use only web straps to lift the tank - do not allow chains, cables or wire ropes to make contact with the tank.
- **Note: Lifting eyes (rated to 350kgs) used during the manufacture of Ensign units can be used for on-site handling**
- A lifting beam is to be used for tanks over 8m long.
- The tank must be fully lifted off the ground for clear movement – do not drag the tank along the ground.
- The unit needs to be chocked to prevent movement or rolling when sitting on the ground.

Concrete base and surround (Recommended)



- Essential for wet sites where the water table can rise above the base of the system (Installation in a wet site may be precluded by site considerations in relation to effluent disposal).
- Groundwater must be controlled and prevented during the installation, even when the tank has been strapped or anchored. Failure to do so will damage the shell and invalidate all warranties.
- The excavation must be kept as dry as possible. Excess water should be evacuated using a site pump/sump, hole/suction hose arrangement. Dewatering should be continued for as long as necessary or at least until the concrete base has set.
- Ensure the excavation is safe with sloped surrounds and shuttering to safeguard the installation.
- The grade and thickness of the concrete base should be designed to suit site conditions - a minimum thickness of 300mm (Ensign sewage treatment plant: 150mm concrete base) and for high water table/wet sites a 250mm hardcore sub-base should be laid, compacted and levelled.
- *The choice of concrete is the responsibility of the installer and should be chosen to suit local ground conditions. In normal conditions with non-aggressive soils, a concrete with a 28 day compressive strength of 20 to 30N/mm² with a 25 to 50mm slump – this must adhere to the relevant BS EN standards. If in doubt seek specialist advice prior to installation.*
- *When pouring concrete around the sewage treatment plant, please ensure the maximum pressure of 15kN/m² around the plant is not exceeded. The concrete should never be poured directly on to the tank.*
- *Do not use vibrating poker.*
- Lower the sewage treatment plant onto the concrete base ensuring the tank is level at all laterals.
- Connect up the pipework - the system is plumbed for 160mm UPVC pipe (Ensign sewage treatment plant up to 16pe: 110mm UPVC pipe). A short length of pipe with flexible joints should be used immediately before and after the sewage treatment plant to allow for movement between the tank and the pipe work.
- The excavation should be backfilled with concrete of minimum 225mm pour width to approximately 300mm below the ground level (full surround to top of tank, around turrets and inlet/outlet points).
- In a multiple tank arrangement, there must be a minimum of 500mm distance between the tanks. This 500mm void must be filled with concrete during the pouring.
- Evenly fill each chamber of the tank with clean water to a depth of 700mm. Continually check the pipework levels and connections visually.
- Backfill evenly around the tank with concrete ensuring no voids are present, especially around the bottom of the tank shell and ribs.
- Continue filling the tank chambers with water whilst evenly backfilling and pouring concrete around the tank ensuring that the water level is no more than 300mm above the concrete level.
- Ensure all turrets and access covers are sealed to prevent concrete entering the plant. Use framework around the turrets to prevent distortion and damage to the tank.
- We recommend that normally the depth from ground level to inlet invert of the sewage treatment plant should be no more than 1.5m. This could change due to groundwater conditions. Deeper inverts with heavier duty shells and ribs are available from Marsh Industries.

Granular surround (For free draining sites)



Primary backfill

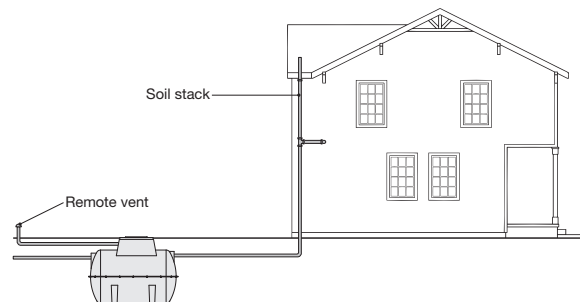
- Primary granular backfill is pea shingle between 3-18mm in size. It should be washed, have no sharp edges and contain no boulders. In winter, check to ensure there are no clumps of ice in the materials as this can create voids causing long term damage.
- Tanks must be installed with primary backfill only within the region immediately surrounding the tanks - the pour width should be 450mm. During the pour, check to make sure that no voids are created and that the pour is evenly distributed.
- The pour should be evenly to the top of the turrets and access points. Care needs to be taken to avoid distortion.

Secondary backfill

- Secondary backfill is pea shingle between 3-12mm or coarse sand. This once again is judged to be clean, free flowing with no voids whilst pouring.
- If crushed stone is used as the secondary backfill, ensure that it is at least 450mm from the tank walls and dome ends.
- Be careful as dug material needs to be carefully selected and sifted to ensure no roots, clay or boulders are present.
- Take care when compacting the backfill material not to distort the turrets or access chambers.

Ventilation

- It is important that a specific air venting point is provided by the installer to allow the system to freely vent and disperse gas, and also ensure air supply to the compressor if this is integral to the tank.
- For all sewage treatment plants it is recommended that a remote vent stack should be installed. This should be connected into the (marked) vent position on the tank using the 110mm grommet supplied, and terminate at a suitable distance and height from any surrounding dwellings to allow dispersal of air from the system. Consideration should be given to the prevailing wind and any local site geography that may inhibit air dispersion or allow any odours to return towards the dwellings.
- Marsh recommend external compressors (in housing supplied) to ensure a constant supply of clean, dry air. If the compressor is supplied integral to the unit (in 'basin' under manway lid) it is recommended to fit a vent local to the tank to improve air supply and quality.
- If in any doubt as to the installation of an appropriate vent, please contact Marsh Industries.



4 Electrical guidelines

NOTE: If the plant is not due to be commissioned for at least two weeks it is advisable to remove the compressor.

- Connection must be performed by a suitably qualified and experienced electrical contractor.
- The electrical requirement of the unit will be either Single Phase or Three Phase. Please check the specification that has been supplied to you about your system.
- The compressor is either linear or side channel and will come with wiring instructions.
- A GRP kiosk or above ground housing may be supplied/required dependent on the size of the plant. Please check your system specification in advance so that you are able to prepare the site for your kiosk.

Standard gravity system with air blower (Conforms to European Standards)

- A 230V, 16amp waterproof plug and socket connector will be supplied with the unit, one for each compressor required. Please check your system specification about the quantity and type of compressor(s). On larger units, connection details can be bespoke, please check prior to installation.

It is the end-user's responsibility for the provision of:

- A single run of 1.5mm (or greater dependent on distance/voltage drop considerations) 3 core SWA cable from the end-user's distribution cabinet to the tank unit socket, or to the pre-wired distribution box fitted inside the GRP kiosk. The cable armour must be properly bonded to the main earth at the premises
- Cable protection via 10amp MCB/RCD or RCBO, rated 230V AC and tripping current 30mA.
- The unit will come with power failure alarm as standard. Other alarms are available, depending on your application, please check the specification supplied to you about your alarm options.
- The air pump/compressors and electric power must never be switched off. It is imperative they run 24 hours a day, every day, to ensure a constant supply of oxygen to the bacteria in the biozone.

Alarm options

Various alarm systems are available to suit different standards and system specifications. Please contact Marsh Industries for full details.

5 Service checklist and maintenance

The plant must be switched off and isolated before checking the electrical components and supply.

General

- Check to ensure the levels in the tank are even across all chambers.
- Regularly check to see if the primary chamber requires desludging (See section 7).

Compressor

- Check to ensure all compressors are working and air hose connections are secure.
- Annually clean the filter on the top of the compressor.
- Annually check the diaphragms and replace if required.
- Check the loss of pressure alarm on compressors.
- If the compressors are housed, either in a kiosk or housing, check to ensure ventilation is adequate.

Media (Within aeration chamber)

- Ensure media is moving around the aeration chamber freely by the diffuser/diffusers.
- Visually check to ensure adequate bio-mass growth on the media surface area.

Polylok Filter (Tertiary filtration)

- If a Polylok Filter is fitted to the plant at the outlet end (normally only on plants over 50PE) carefully lift the filter out of the casket and wash down before returning it back into the casket securely. This should be done normally once a month.
- A high level alarm should be fitted to alert the site owner of when the filter needs cleaning.

High level alarm

- If a high level alarm is fitted, check to ensure the high level alarm float switch is secure and working by lifting of the float switch by approximately 200mm.

Structural

- Check to ensure the baffles are not damaged.
- Check that all manhole cover and frames are secure and all locking nuts are in place.

Electrical

- Check supply current and amps.
- Check wiring condition and IP plugs.

6 Drainage fields

For development proposals in sewered areas it is usually a legal requirement to connect to the public sewer, either by gravity or pumping, as the sewage is conveyed to a municipal sewage treatment works. However, if it can be demonstrated that the proposed sewage disposal system offers a more sustainable solution to the overall water management of the site, then the regulators will consider the installation of a 'private' system.

For any such proposal you should:

- Check with your regulating body to confirm current status with regard to Registration/Consent, quality and volume limits, etc.
- Take account of the requirements of Building Regulations and discuss with the local planning authority at an early stage - well before any planning application is made.

Drainage fields

- If you have access to a suitable area of land, discharge from your septic tank or treatment plant to a properly designed and sized drainage field is the best environmental option as the treated effluent recharges groundwater, nutrients are retained in the soil, and nutrient loads on surface waters are reduced.
- The most common form of drainage field is a subsurface percolation area comprising perforated infiltration pipes laid in shingle filled trenches – normally within 1m of ground level to allow the micro-organisms in the soil to break down the organic matter, and at least 1.2m above the winter water table.
- The drainage field has two principal purposes:
 - To allow percolation of partially treated/treated effluent to ground at a controlled rate.
 - To allow further treatment of partially treated effluent before it reaches the groundwater level.

- Before you can dispose of effluent via a drainage field you first need to assess whether such a route is appropriate, ie, you have a good depth of well-drained, well-aerated soil away from watercourses, wells/boreholes, dwellings, and avoiding sloping sites and areas prone to waterlogging.

Trial hole and percolation test method (See figure 1)

- To calculate the exact area of land required for effective disposal an 'assessment' is required, usually by performing a percolation/water table test as outlined in BS6297 (Code of Practice for the Design and Installation of Drainage Fields for use in Wastewater Treatment) and the latest version of Building Regulations: H2.
- A trial hole should be dug to determine the position of the standing groundwater table a minimum of 1m² in area and 2m deep, or a minimum of 1.5m below the invert of the proposed drainage field pipework.
- The groundwater table should not rise to within 1m of the invert level of the proposed effluent distribution pipes. If the test is carried out in summer, the likely winter groundwater levels should be considered.
- A percolation test should then be carried out to assess the further suitability of the proposed area. A hole 300mm square should be excavated to a depth 300mm below the proposed invert level of the effluent distribution pipe. Where deep drains are necessary the hole should conform to this shape at the bottom, but may be enlarged above the 300mm level to enable safe excavation to be carried out.
- Fill the 300mm square section of the hole to a depth of at least 300mm with water and allow it to seep away overnight.
- Next day, refill the test section with water to a depth of at least 300mm and observe the time, in seconds, for the water to seep away from 75% full to 25% full level (ie, a depth of 150mm). Divide this time by 150. The answer gives the average time in seconds (Vp) required for the water to drop 1mm.
- The test should be carried out at least three times with at least two trial holes and the average figure from the tests should be taken. The test should not be carried out during abnormal weather conditions such as heavy rain, severe frost or drought.

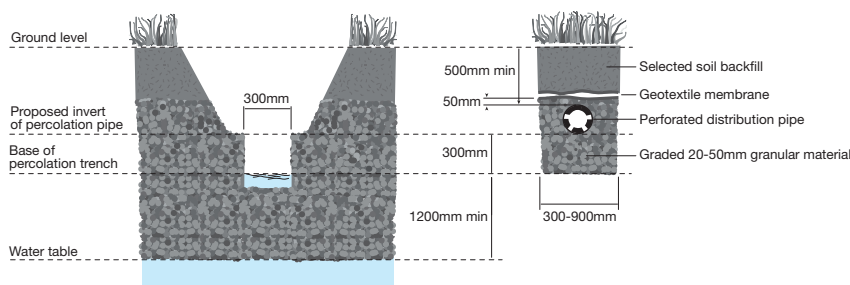


Figure 1 - Percolation/water table test

- Drainage field disposal should only be used when percolation tests indicate average values of Vp of between 12 and 100. This minimum value ensures that untreated effluent cannot percolate too rapidly into groundwater. Where Vp is outside these limits effective treatment is unlikely to take place in a drainage field.

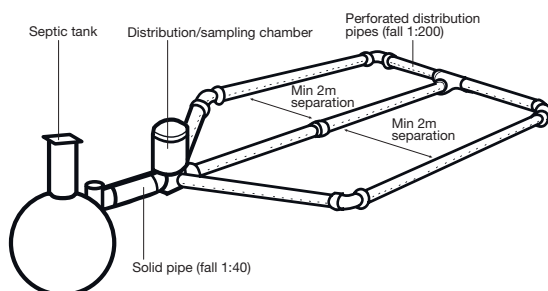


Figure 2 - Typical drainage field construction

Drainage field construction (See figures 1 and 2)

- Drainage fields should be designed and constructed to ensure aerobic contact between the liquid effluent and the subsoil using perforated pipe laid in trenches.
- Pipes should be laid on a 300mm layer of clean shingle or broken stone (graded between 20mm and 50mm) at a minimum depth of 500mm and a uniform gradient not steeper than 1:200.
- Trenches should be filled to a level 50mm above the pipe and covered with a layer of geotextile to prevent the entry of silt. The remainder of the trench can be filled with soil.
- Trenches should be from 300mm to 900mm wide with areas of undisturbed ground 2m wide being maintained between parallel trenches.
- An inspection chamber should be installed between the septic tank and the drainage field.
- Drainage fields should be set out as a continuous loop fed from the inspection chamber.
- To calculate the floor area of the drainage field (A_t in m^2), the following formulas should be used:
 - For septic tanks: $A_t = p \times V_p \times 0.25$
 - For treatment plant: $A_t = p \times V_p \times 0.20$

Where p is the number of persons served by the tank and V_p is the percolation value (secs/mm) obtained.

7 Desludging

The sewage treatment plant will require desludging and maintenance as follows:

- 6PE-35PE – Annually or as required
- 40PE-100PE – Six monthly or as required
- 100PE-300PE – As advised

The desludging of the plant is the responsibility of the site owner. Desludging should be carried out according to the size of the plant and dependent on usage.

It is the site owner's responsibility to provide access for the vacuum tanker, to desludge the plant. Vehicles should never drive over the system. Keep at least 4 metres away from the covers on the plant.

NOTE: If effluent samples are to be taken they should be taken from the sample chamber or, alternatively, from the discharge pipe. Sampling should only be taken by approved test centres.

Desludging procedure

- Desludging should normally be carried out by a vacuum sludge tanker.
- Licensed tankers are available commercially and the service is also provided by some local authorities.
- The sludge should be disposed of in accordance with local authority instructions or in a manner which will not cause pollution.
- The tank should be desludged before the onset of winter if conditions do not allow a tanker on site.
- The sludge in the primary chamber (s) should not be removed completely, but approximately 75mm should be kept in the bottom of the tank to re-seed the new sludge, which will be formed when the tank is put into use again.

The depth of sludge can be checked using the following technique:

- Use a pole that can touch the bottom of the tank and wrap the bottom 1.4m with a white rag.
- Lower the pole to the bottom of the tank and hold for several minutes to allow the sludge layer to penetrate the rag.
- Remove the pole and note the sludge line, which will be darker than the colouration caused by the liquid waste.

(Typically a dark sludge line approximately 2/3rd from the bottom of the pole means you should desludge).

- On every alternative desludge, dead humus/scum should be skimmed from the final settlement tank(s). Ensure the tee pieces in all chambers are clear.

- Care must be taken not to damage the treatment plant with the hose of the vacuum tanker.

Please note:

- The sewage treatment plant should be clearly marked and vacuum tanker should never come closer than the depth of the excavation for the system unless the appropriate precautions have been taken. Never drive over the sewage treatment plant.
- Desludging should never be carried out alone due to potential dangers.
- The access cover should never be left off while the unit is unattended.
- The continued performance of the plant will depend on regular maintenance and cleaning. It is the end-user's responsibility to desludge the unit and keep the vents clear.

Further safety precautions

- Naked flames should not be used in vicinity of the tank due to the danger of explosion.
- Never enter a tank unless a safety line is attached to the person entering the tank and a second person is above ground to help if the entrant is overcome by gasses or foul air. Personnel entering the tank must have suitable breathing equipment and be fully trained in man entry techniques.
- As safety and security is of vital importance in sewage treatment systems, the following aspects are critical:
 - *Protective clothing/gloves/breathing apparatus, should be worn at all times.*
 - *Always remove contaminated clothing and protective equipment after working with sewage treatment Systems.*
 - *Wash hands and face prior to eating, drinking or smoking.*
 - *Adequate first aid boxes should be present.*
 - *When working with machinery/electrical equipment, proximity of water should be noted. All tools and electrical equipment should be kept dry.*
 - *A second person should be present when carrying out non-routine maintenance.*
- Disused or abandoned tanks should be demolished, filled in or sealed so that accidental entry is impossible.

8 Warranty information

Marsh Industries offers an initial 12-month warranty on every plant installed provided that it is installed, commissioned (if required) and maintained in accordance with the manufacturer's instructions and also provided that the unit has not been subject to damage or abuse. This warranty covers all of the GRP components and any other additional installed components against malfunction.

Marsh Industries

Marsh Industries delivers world-class water/wastewater treatment products and solutions to the domestic, commercial and agricultural sectors from its UK manufacturing plants in Kettering and Bridgwater.

The company is recognised as a collaborative and trusted partner to its customers, with a reputation for providing quality products that really do add value:

- *Sewage treatment plants 4-500+ PE*
- *Pump stations 234-20,000+ litres*
- *Septic tanks and cesspools 2800-20,000+ litres*
- *Septic conversion units 4-60+ PE*
- *Grease traps 234-20,000+ litres*
- *Trash/debris barriers*
- *Agri-silage tanks up to 100,000 litres*
- *Stormwater attenuation up to 130,000 litres*
- *Rainwater harvesting systems 1500-20,000+ litres*
- *Oil separators, wash-down separators and silt traps*

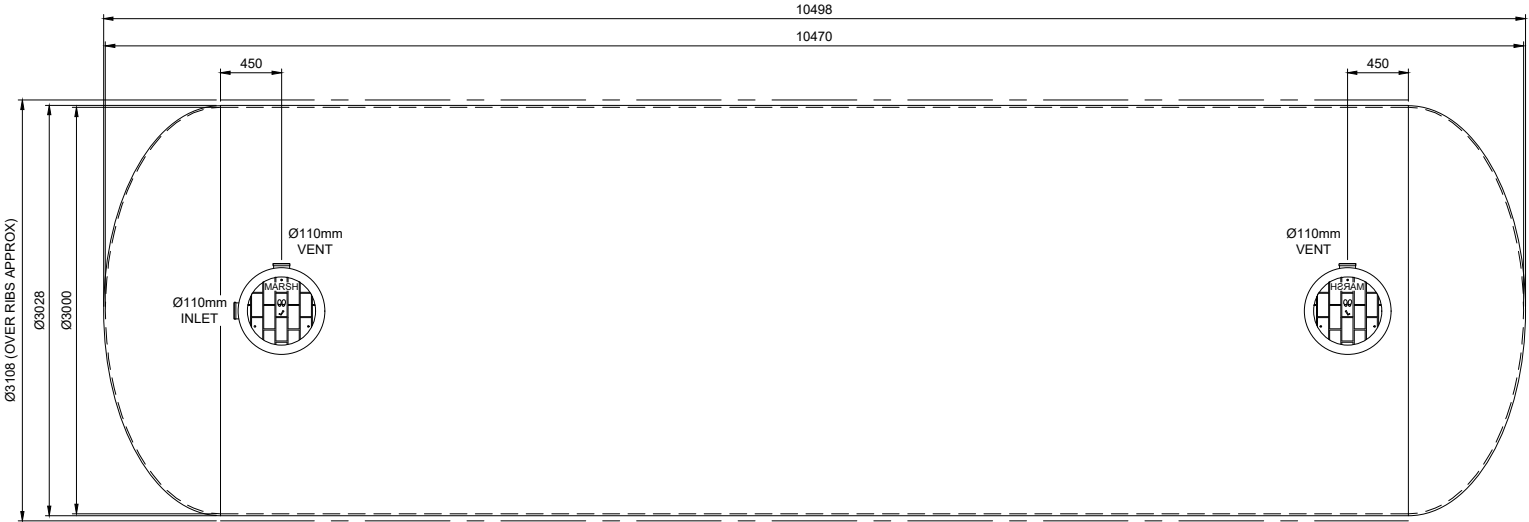
All products are fully type-tested and certified to ensure compliance with relevant environmental permitting programmes and building regulations.

In addition, the company's state-of-the art computer software, GAIA, can generate precise, bespoke commercial sewage treatment plants and pump chamber systems to the finest specification.

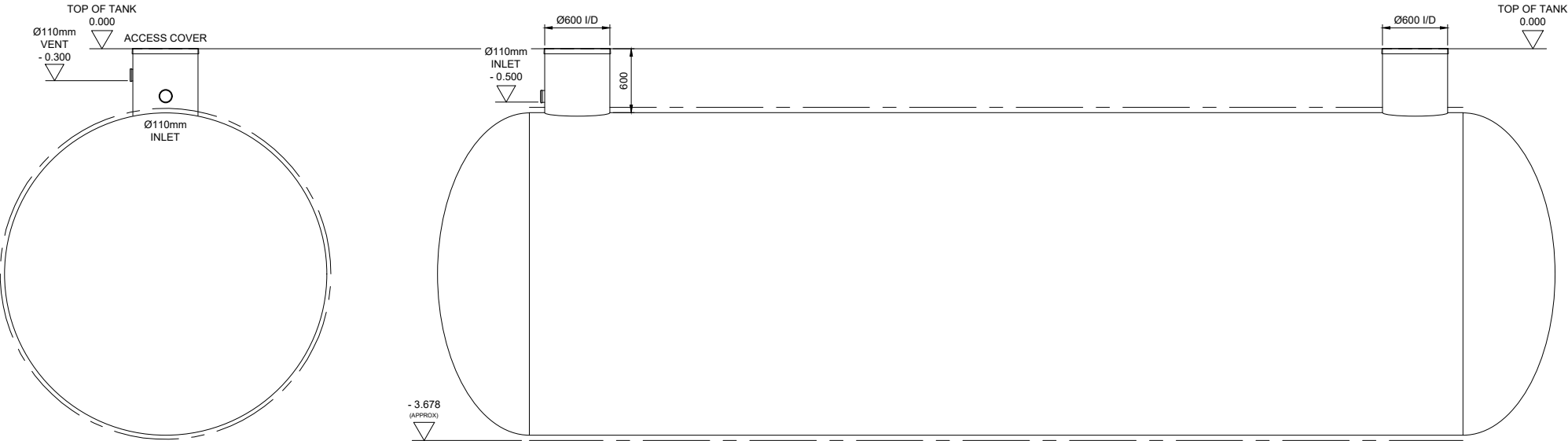
sales@marshindustries.co.uk
+44 (0)1933 654582
www.marshindustries.co.uk



GENERAL NOTE:
All tanks are subject to a 2.5% tolerance on all dimensions. Any internals (if shown) are for guidance only, and may vary due to individual specifications. Rib centres may vary during manufacture.



PLAN

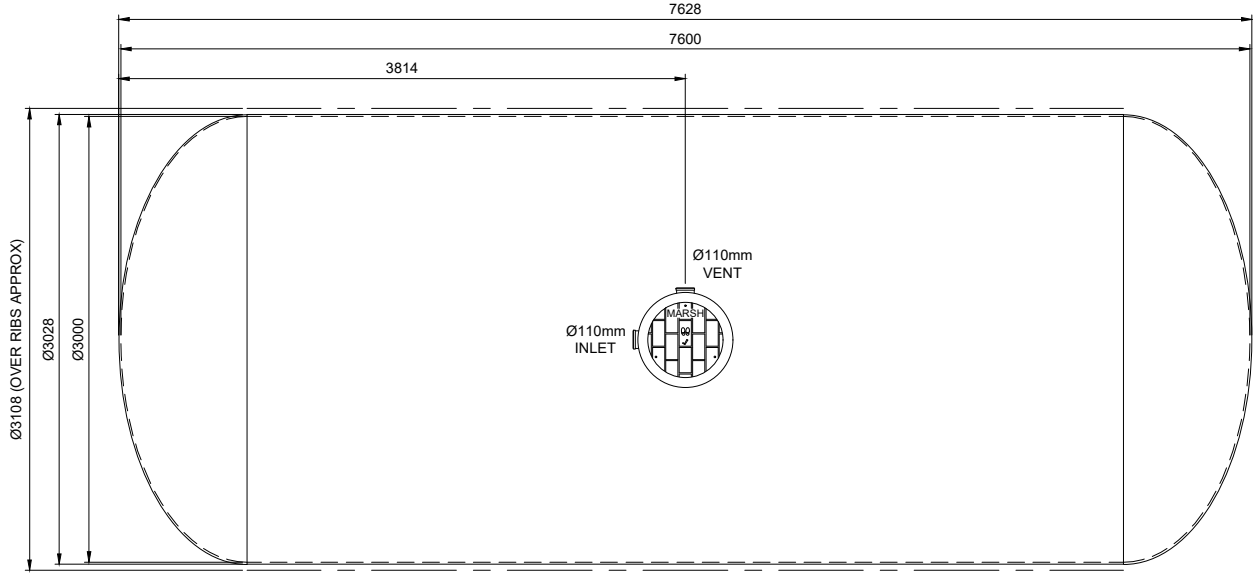


VIEW ON INLET

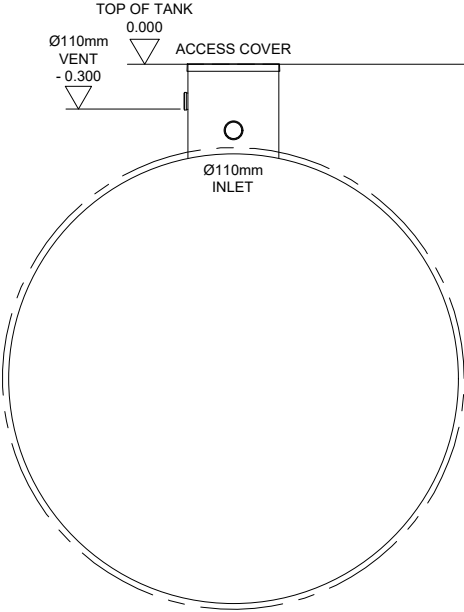
SIDE ELEVATION

REV	DESCRIPTION	DATE	SIG	REV	DESCRIPTION	DATE	SIG	CLIENT	TITLE	DRG	REV
				A	For Approval.	03.11.16	P.L.		MARSH HOLDING TANK Ø3.0m x 10.47m LONG TANK 70,000 ltr CAPACITY		A
								THIS DRAWING IS THE PROPERTY OF MARSH INDUSTRIES LTD. AND MUST NOT BE REPRODUCED OR CIRCULATED FOR ANY PURPOSE WHATSOEVER WITHOUT FIRST OBTAINING WRITTEN CONSENT FROM THE MARSH INDUSTRIES LTD.			
								UNITS 9-13 ADDINGTON PARK IND. EST., LITTLE ADDINGTON, KETTERING, NORTHAMPTONSHIRE, NN14 4AS.			
								MARSH INDUSTRIES > Leaders in off-mains drainage			
								3 RD ANGLE PROJECTION			
								DO NOT SCALE IF IN DOUBT ASK			
								SCALE N.T.S. 03.11.2016			
								CHKD APPD			
								DATE			

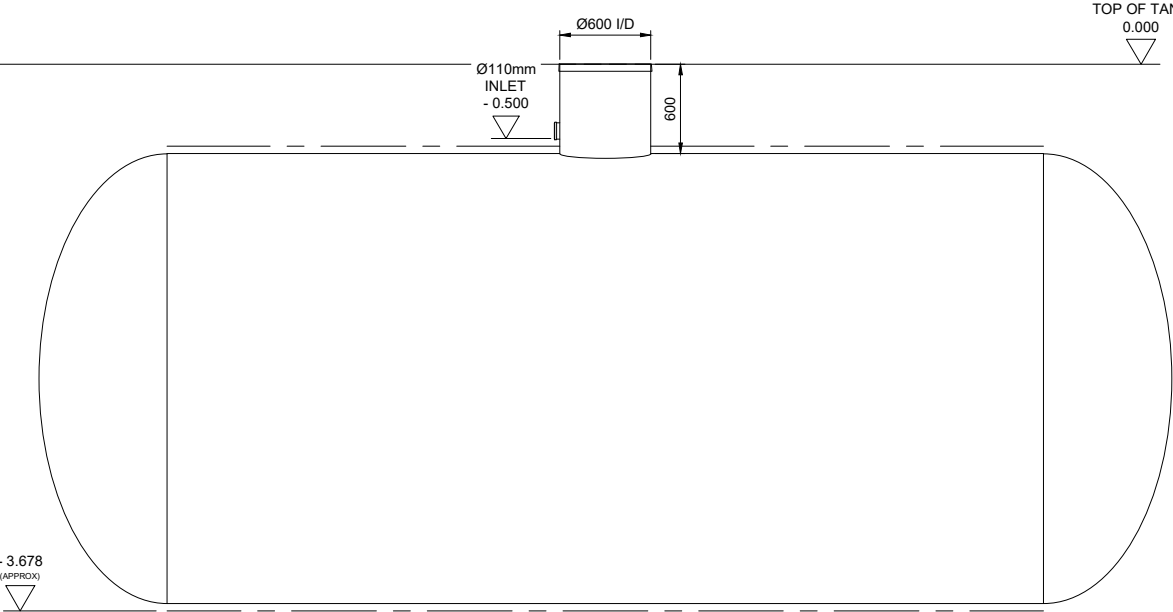
GENERAL NOTE:
All tanks are subject to a 2.5% tolerance on all dimensions. Any internals (if shown) are for guidance only, and may vary due to individual specifications. Rib centres may vary during manufacture.



PLAN



VIEW ON INLET



SIDE ELEVATION

REV	DESCRIPTION	DATE	SIG	REV	DESCRIPTION	DATE	SIG	CLIENT	TITLE	DRG	REV
				A	For Approval.	03.11.16	P.L		MARSH HOLDING TANK Ø3.0m x 7.60m LONG TANK 50,000 ltr CAPACITY		A
								UNITS 9-13 ADDINGTON PARK IND. EST., LITTLE ADDINGTON, KETTERING, NORTHAMPTONSHIRE, NN14 4AS.			
								MARSH INDUSTRIES > Leaders in off-mains drainage			

Matthew Ashdown

From: Michael Harrison <michael.harrison@marshindustries.co.uk>
Sent: 10 April 2026 13:20
To: Matthew Ashdown
Cc: Contracts; Marsh Sales
Subject: Marsh Industries Cesspool Quote
Attachments: 2.5m DIA. x 10.50m LONG HOLDING TANK - 50000L (Rev.A).pdf; 2.5m DIA. x 14.50m LONG HOLDING TANK - 70000L (Rev.A).pdf; 3.0m DIA. x 7.60m LONG HOLDING TANK - 50000L (Rev.A).pdf; 3.0m DIA. x 10.47m LONG HOLDING TANK - 70000L (Rev.A).pdf

Hi Matt

Further to your conversation with my colleague Jodie.

Please find pricing below for 50,000l and 70,000l Cesspools in 2.5m and 3m diameter options. All options have been priced with turret extensions to achieve a 1.2m inlet invert.

70,000l Cesspool - 2.5m Diameter - 1.2m Inlet	
Marsh Product Code:	70000l Cesspool
Product description:	70000l Cesspool 2.5m Diameter 1.2m Inlet
Length [mm]:	14522
Width [mm]:	2500
Height [mm]:	3872
Inlet invert [mm]:	1200
Inlet Connection [mm]:	160 (tbc)
Outlet invert [mm]:	NA
Outlet Connection [mm]:	NA
Cover Type (2 Turrets):	Pedestrian
Nett Price including delivery, but not offloading:	£ 10,115.00

70,000l Cesspool - 3m Diameter - 1.2m Inlet	
Marsh Product Code:	70000l Cesspool 3m Dia
Product description:	70000l Cesspool 3m Diameter 1.2m Inlet
Length [mm]:	10470
Width [mm]:	3000
Height [mm]:	4378
Inlet invert [mm]:	1200
Inlet Connection [mm]:	160 (tbc)
Outlet invert [mm]:	NA
Outlet Connection [mm]:	NA
Cover Type (2 Turrets):	Pedestrian
Nett Price including delivery, but not offloading:	£ 10,799.00

50,000l Cesspool - 2.5m Diameter - 1.2m Inlet	
Marsh Product Code:	50000l Cesspool
Product description:	50000l Cesspool 2.5m Diameter 1.2m Inlet
Length [mm]:	10500
Width [mm]:	2500
Height [mm]:	3872
Inlet invert [mm]:	1200
Inlet Connection [mm]:	110
Outlet invert [mm]:	NA

50,000l Cesspool - 3m Diameter - 1.2m Inlet	
Marsh Product Code:	50000l Cesspool 3m Diameter 1.2m Inlet
Product description:	50000l Cesspool 3m Diameter 1.2m Inlet
Length [mm]:	7600
Width [mm]:	3000
Height [mm]:	4378
Inlet invert [mm]:	1200
Inlet Connection [mm]:	110
Outlet invert [mm]:	NA

Outlet Connection [mm]:	NA
Cover Type:	Pedestrian
Nett Price including delivery, but not offloading:	£ 7,378.00

Outlet Connection [mm]:	NA
Cover Type:	Pedestrian
Nett Price including delivery, but not offloading:	£ 7,720.00

The tanks will come with the following guarantees/warranties –

- 25 Year Structural Guarantee

Lead time is 3 weeks from drawing approval

Delivery is included (but not offload).

Prices exclude VAT and are valid for 30 days.

Drawings attached (showing standard 500mm inlets)

Regards

Michael

Michael Harrison

Business Development Director

M 07384 464517 | 01933 654582

michael.harrison@marshindustries.co.uk

www.marshindustries.co.uk



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