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Client: Milestone Civils Ltd.

Surface Water Management Strategy
for the Proposed Development at Valley
Drive, Gravesend, Kent, DA12 5UE

November 2022

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Client: Mr R Stamp

Surface Water Management Strategy for the
Proposed Development at Valley Drive,
Gravesend, Kent, DA12 5UE

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1 Scope of Appraisal

Herrington Consulting has been commissioned by Milestone Civils Ltd to prepare a Surface Water Management Strategy (SWMS) for the proposed development at **Valley Drive, Gravesend, Kent, DA12 5UE.**

New development has the potential to increase the risk of flooding to neighbouring sites and properties through increased surface water runoff and as such, an assessment of the proposed site drainage can help to accurately quantify the runoff rates, flow pathways and the potential for infiltration at the site. This assessment considers the practicality of incorporating Sustainable Drainage Systems (SuDS) into the scheme design, with the aim of reducing the risk of flooding by actively managing surface water runoff.

This report has been prepared to supplement a full planning application and has been prepared in accordance with the requirements of both national and local planning policy. To ensure that due account is taken of industry best practice, reference has also been made to, CIRIA Report C753 'The SuDS Manual' and any relevant local planning policy guidance. The surface water management strategy included within this report is not intended to constitute a detailed drainage design.

2 Background Information

2.1 Site Location and Existing Use

The site is located at OS coordinates 566195, 170525 off Valley Drive, Gravesend in Kent and covers an area of approximately 0.58 hectares. The location of the site in relation to the surrounding area is shown in Figure 2.1.



Figure 2.1 – Location map (contains Ordnance Survey data © Crown copyright and database right 2022).

The site currently comprises a single residential dwelling with associated hardstanding, and a large undeveloped field.

2.2 Site Geology and Topography

Reference to the British Geological Survey (BGS) data identifies that the geology at the site comprises Thanet Sand Formation bedrock, with no overlaying superficial deposits.

Reference to a site-specific topographic survey indicates that land levels at the site vary between 70.91m – 74.04m Above Ordnance Datum Newlyn (AODN), with a gradual fall towards the West.

2.3 Proposed Development

The development proposals comprise the conversion of an existing house to 10no. flats including side and rear extension and loft conversion, the conversion of the rear annex building to 2no. dwelling houses including proposed new dormers, the construction of a new apartment building to form 11no. new apartments, the construction of 8no. semi-detached and 1no. detached houses and associated development. Figure 2.2 (below) shows the proposed development, and further drawings are included in Appendix A.1 of this report.

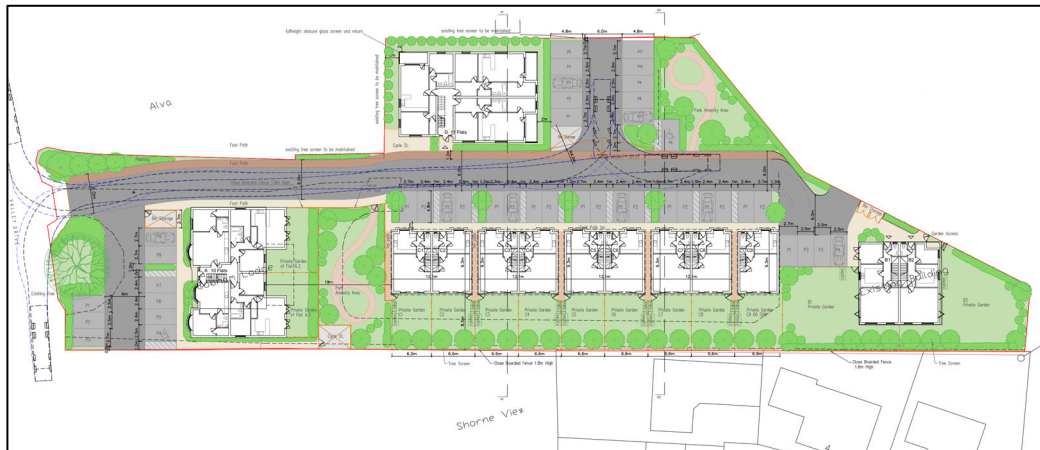


Figure 2.2 – Proposed development plan.

2.4 Planning Policy and Context

The general requirement for all new development is to ensure that the runoff from the development is managed sustainably and that the drainage solution does not increase the risk of flooding at the site, or within the surrounding area. In the case of brownfield sites, drainage proposals are typically measured against the existing performance of the site, although it is preferable (where practicable) to provide runoff characteristics that are similar to greenfield behaviour.

The Non-statutory Technical Standards for SuDS (NTSS) specify criteria to ensure sustainable drainage is included within development classified as 'major development' as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010. It is, however, recognised that SuDS should be designed to ensure that the maintenance and operation requirements are economically proportionate.

The proposed development is for the construction of over 10 residential units. As a result, the proposals are classified as 'major' development and therefore, the NTSS will apply. Reference to the NTSS has therefore been made throughout the following sections of this report to ensure the principles of sustainable drainage are considered.

2.5 Climate Change

The global climate is constantly changing, but it is widely recognised that we are now entering a period of accelerating change. Over the last few decades there have been numerous studies into the impact of potential future changes in the climate and there is now an increasing body of scientific evidence which supports the fact that the global climate is changing as a result of human activity. Past, present, and future emissions of greenhouse gases are expected to cause significant global climate change during this century.

The nature of climate change at a regional level will vary: for the UK, projections of future climate change indicate that more frequent short-duration, high-intensity rainfall, and more frequent periods of long-duration rainfall (of the type responsible for the recent UK flooding) could be expected.

These effects will tend to increase the size of flood zones associated with rivers, and the amount of flooding experienced from other inland sources. Consequently, the following section of this report takes into consideration the impacts of climate change and references the most contemporary guidance which is applicable to the development site.

Planning Horizon

To ensure that any recommended mitigation measures are sustainable and effective throughout the lifetime of the development, it is necessary to base the appraisal on climate change predictions which are commensurate with the planning horizon for the proposed development. The NPPF and supporting Planning Practice Guidance Suite (August 2021) state that residential development should be considered for a minimum of 100 years, but that the lifetime of a non-residential development depends on the characteristics of the development. The development that is the subject of this assessment is classified as residential, and therefore a design life of 100 years has been assumed.

Potential Changes in Climate

Recognising that the impact of climate change will vary across the UK, the allowances were updated in May 2022 to show the anticipated changes to peak rainfall across a series of management catchments. The proposed development site is located in the **Medway Management Catchment**, as defined by the 'Peak Rainfall Allowance' maps, hosted by the Department for Environment, Food and Rural Affairs. Guidance provided by the EA states that this mapping should be used for site-scale applications (e.g. drainage design), in small catchments (less than 5km²), or urbanised drainage catchments. For large rural catchments, the peak river flow allowances should be used.

The development site lies within an urbanised drainage catchment and therefore, the Peak Rainfall Allowances for the Medway Management Catchment should be applied.

For each Management Catchment, a range of climate change allowances are provided for two time epochs and for each epoch, there are two climate change allowances defined. These represent different levels of statistical confidence in the possible scenarios on which they are calculated. The two levels are as follows:

- Central: based on the 50th percentile
- Upper End: based on the 90th percentile

The EA has provided guidance regarding the application of the climate change allowances and how they should be applied in the planning process. The range of allowances for the Management Catchment in which the development site is located are shown in Table 2.1 below.

Management Catchment Name	Annual exceedance probability	Allowance Category	2050s	2070s
Medway	3.3 %	Central	20%	20%
		Upper End	35%	35%
	1 %	Central	20%	20%
		Upper End	45%	40%

Table 2.1 – Recommended peak rainfall intensity allowances for each epoch for the Medway Management Catchment.

For a development with a design life of 100 years the Upper End climate change allowance is recommended to assess whether:

- there is no increase in flood risk elsewhere, and;
- the development will be safe from surface water flooding.

From Table 2.1 above, it can be seen that the recommended climate change allowance for this site is a 45% increase in peak rainfall. Therefore, this increase has been applied to the hydraulic drainage model constructed to inform the surface water management strategy. Where this allowance has been applied the abbreviation “+45%cc” has been used.

3 Existing Drainage

3.1 Existing Surface Water Drainage

As a result of the permeable geology, it is likely that the existing site drains informally into the ground via an existing soakaway.

Brownfield runoff rates have been calculated below. These hydrological calculations have been undertaken using the Modified Rational Method, and synthetic rainfall data derived using the variables obtained from the Flood Estimation Handbook (FEH). The existing impermeable area at the site is 0.236 ha.

Return Period (years)	Peak runoff from the existing site (l/s)
1	46.8
30	126.6
100	164.6

Table 3.1 – Summary of peak runoff rates for the existing site.

Southern Water has provided sewer mapping as part of their asset location data for the site and surrounding area. An extract of this mapping is provided in Figure 3.1 below and shows the location of public sewers in close proximity to the site.

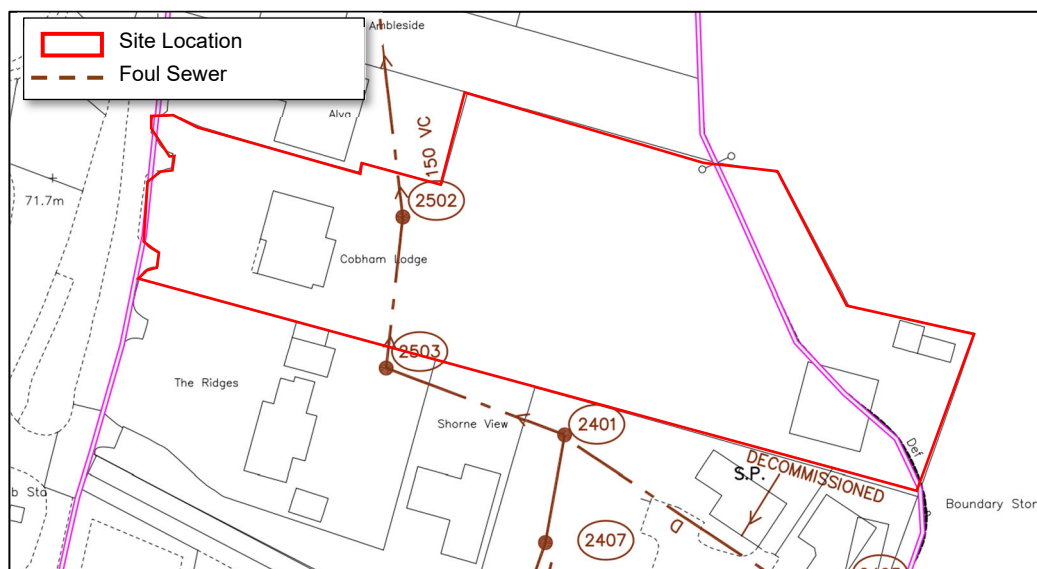


Figure 3.1 – Extract from Southern Water asset location mapping for the area around Valley Drive.

From Figure 3.1 (above) it is evident that the sewers in this area are typically foul water networks. It is acknowledged that a foul sewer crosses the site, however, no buildings are proposed in this area.

4 Sustainable Drainage Assessment

4.1 Site Characteristics

The important characteristics of the site that have the potential to influence the surface water drainage strategy are summarised in Table 4.1 below.

Site Characteristic	Development Site	
Total area of site	~0.58 ha	
Current site condition	Developed (Brownfield)	
Greenfield runoff rates (based on the FEH methodology)	1:1yr = 0.20 l/s Qbar = 0.24 l/s 1:30yr = 0.56 l/s 1:100yr = 0.77 l/s	
Infiltration	0.1 m/hr (based on infiltration testing undertaken at the site. See Appendix A.6).	
Current surface water discharge method	Drains into existing soakaway.	
Is there a watercourse nearby?	No	
Impermeable area	Existing ~ 2,360 m ²	Proposed ~ 3,130 m ²

Table 4.1 – Site characteristics affecting rainfall runoff.

Based on the table above, it is evident that the development proposals will increase the total impermeable area across the site. As a result, the rate at which the surface water runoff is discharged from the site is likely to increase. Consequently, measures will need to be put in place to ensure that the impact of this additional surface water runoff is appropriately managed.

4.2 Opportunities to Discharge Surface Water Runoff

Part H of the Building Regulations summarises a hierarchy of options for discharging surface water runoff from developments. The preferred option is to **infiltrate** water into the ground, as this deals with the water at source and serves to replenish groundwater. If this option is not viable, the next option of preference is for the runoff to be discharged into a **watercourse**. Only if neither of these options are possible, the water should be conducted into the **public sewer** system.

The following opportunities for managing the surface water runoff discharged from the development site are listed in order of preference:

Water Re-Use – Water re-use systems should ideally be considered to reduce the reliance on the demand for potable water. However, such systems can rarely manage 100% of the surface water runoff discharged from a development, as this requires the yield from the building and hardstanding area to balance perfectly with the demand from the proposed development. Consequently, whilst rainwater recycling systems can be considered for inclusion within the scheme, an alternative solution for attenuating storm water will still be required.

Infiltration – The soil and underlying geology at this location has been analysed using the BGS mapping. The geology of the site is made up of Thanet Sand formation bedrock, with no overlying superficial deposits. Although this stratum is generally considered to be permeable, infiltration testing has been undertaken to calculate the available infiltration rate. The results of the infiltration testing (see Appendix A.6) indicate an infiltration rate of 0.2-0.1 m/hr. Consequently, discharging surface water runoff to the ground via infiltration is considered to be viable for the site.

Discharge to Watercourses – There are no watercourses located within close proximity to the site, which show onward connectivity to a main river, the sea, or any other large surface water body. As a result, there is no opportunity to discharge surface water runoff from the development to an existing watercourse.

Discharge to Public Sewer System – No public surface water sewers have been identified within the local area, and a more suitable solution for discharging surface water from the proposed development is available. Discharging surface water from the development into the public sewer system is therefore not considered to be a viable solution.

4.3 Constraints and Further Considerations

The key constraints that are relevant to this development are listed below:

- There is limited open space to incorporate SuDS that require very large areas of land such as wetlands and large infiltration basins.
- Due to the gradient across the site, it may be necessary to incorporate check dams within the sub-base of any permeable paving system.
- Any infiltration features which result in a concentrated discharge of surface water runoff to the ground, such as soakaways, should not normally be located within 5.0 metres of any existing, or proposed (adjacent) buildings.
- A minimum of a 1.0 metre unsaturated zone shall be maintained between the base of any infiltration SuDS and the maximum seasonal water table.

4.4

Proposed Surface Water Management Strategy

The drainage strategy set out below discusses each of the different elements of the proposed scheme, along with the results from a numerical drainage model constructed for the site, which can be used to demonstrate how the overall objectives can be achieved. This does not represent a detailed surface water drainage design; it is simply an assessment to demonstrate that the objectives and requirements of the NPPF and NTSS can be met at the planning stage.

Rainwater Harvesting System

To reduce the developments reliance on potable water supplies for external use a rainwater harvesting system is proposed. The system proposes to utilise the rainwater coming from the roof of the proposed buildings and filtrating it before being stored within an underground tank. It is recognised that the rainwater harvesting system will need to overflow into the soakaway, to ensure that in the event the system is full prior to the onset of the design rainfall event, water can be discharged away from the properties without increasing the risk of flooding. Consequently, further SuDS have been proposed.

Permeable Surfacing

Runoff from the hardstanding areas across the site, in addition to overflow from the rainwater harvesting system, will be directed via underground pipes into a layer of open graded subbase material, located beneath permeable surface. The sub-base will store surface water runoff whilst infiltrating into the ground through a permeable geotextile liner. The permeable surfacing system will contain an overflow pipe which will direct water from the top of the paving system directly into a soakaway which is discussed below. A summary of the Causeway Flow+ analysis for permeable surfacing is shown in Table 4.2 below.

Parameter	Value (1:100yr+45%cc event)
SuDS	Permeable Surfacing
Total area draining to permeable surfacing, including overflow from other SuDS and a 10% allowance for urban creep	3,440 m ²
Area of permeable surfacing	~1606 m ²
Infiltration	Permitted (0.1 m/h)
Sub-base depth	350 mm
Critical storm duration	180 minutes
Overflow device	Pipe Connects directly to the soakaway

Table 4.2 – Summary of permeable surfacing SuDS.

Crate Storage Soakaway

Surface water runoff stored within the permeable surfacing system will be discharged into a crate soakaway system located within the amenity area to the northeast of the site. The system will allow for additional storage before infiltrating into the underlying sand. Calculations have been undertaken to determine the depth and volume of the crates system required, and the results are summarised in Table 4.3 below.

Parameter	Value (1:100yr+45%cc event)
SuDS	Crate Storage Soakaway
Total area draining to soakaway, including overflow from other SuDS and a 10% allowance for urban creep	3,440 m ²
Area of Crate Storage Soakaway	~ 46 m ²
Infiltration	Permitted (0.1 m/h)
Depth	2m
Critical storm duration	180 minutes

Table 4.3 – Summary of Crate Storage Soakaway SuDS.

It is evident that, with the inclusion of the proposed SuDS, there is the potential to accommodate all the surface water runoff from the site up to, and including, the design rainfall event.

4.5 Indicative Drainage Layout Plan

Figure 4.1 below is an indicative drainage layout plan delineating how the proposed SuDS can be incorporated into the scheme proposals.

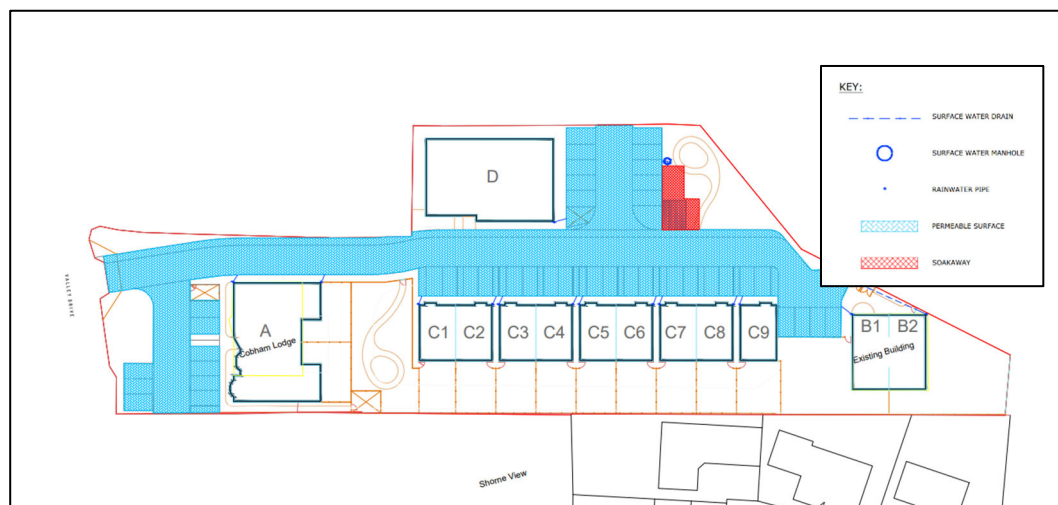


Figure 4.1 – Indicative drainage layout plan showing the proposed location of SuDS.

A full-scale copy of this layout is located in Appendix A.4 of this report.

4.6 Management and Maintenance

For any surface water drainage system to operate as originally designed, it is necessary to ensure that it is adequately maintained throughout its lifetime. Therefore, over the lifetime of a development there is a possibility that the performance of the system could be reduced, or could fail if it is not correctly maintained. This is even more important when SuDS form a part of the surface water management system, as these require a more onerous maintenance regime than a typical piped network.

The key requirements of any management regime are routine inspection and maintenance. When the development is taken forward to the detailed design stage, an 'owner's manual' will need to be prepared. This should include:

- A description of the drainage scheme.
- A location plan showing all of the SuDS features and equipment, such as flow control devices etc.
- Maintenance requirements for each element, including any manufacturer specific requirements.
- An explanation of the consequences of not carrying out the specified maintenance.
- Details of who will be responsible for the ongoing maintenance of the drainage system.

For the SuDS recommended by this assessment, the most obvious maintenance tasks will be the regular brushing and cleaning of the permeable surfacing and the de-silting of the soakaway. The tables appended to this report provide details on the typical maintenance requirements for each of the proposed SuDS. It is acknowledged that inspections and maintenance procedures are likely to be required at a higher frequency during the first few years following construction as each of the systems becomes established.

For developments such as this that rely to some extent on the ongoing inspection and maintenance of SuDS, it will be necessary to ensure that measures are in place to maintain the system for the lifetime of the development.

As a result of all of the SuDS being communal, it is likely that the management company responsible for maintaining the rest of the site will be tasked with the inspection and maintenance of these features. In addition, the regular inspection and desilting of the soakaway and manholes will need to be carried out.

Further details of the maintenance and management strategy should be confirmed following the completion of a detailed drainage design for the development.

4.7 Sensitivity Testing and Residual Risk

When considering residual risk, it is necessary to consider the impact of a flood event that exceeds the design event, or the implications if the proposed drainage system was to become blocked.

Inspection of the topography across the site suggests that if the permeable paving became overwhelmed following an extreme rainfall event, water could exit the drainage system and would flow towards the north of the site and away from the proposed buildings.

To minimise the risk of the uncontrolled discharge of floodwater from the permeable surfacing system, an overflow pipe can be incorporated into the design of this drainage feature, discharging directly into the soakaway.

Notwithstanding this, it is recognised that the drainage proposals will incorporate a significant volume of additional storage for storm water, which is not currently provided on the existing site. As a result, when compared to the existing site, it is likely that the volume of water discharged from the site during an extreme rainfall will be reduced, thus minimising the potential impact of flooding to the surrounding area.

Based on the analysis above it is therefore concluded that the proposed drainage system outlined within this strategy will not result in an increased risk of flooding to properties at the site or within the surrounding area.

6 Conclusions and Recommendations

The overarching objective of this report is to appraise the proposals for the development at Valley Drive, Gravesend to ensure that the risk of surface water flooding offsite will not increase as a result of the development proposals. This report has therefore been prepared to provide a sustainable solution for managing the surface water runoff discharged from the development site, in accordance with the NPPF, the NTSS and local planning policy.

It is concluded that the most viable solution for managing all of the surface water runoff discharged from the proposed development will be via infiltration into the ground.

In order to infiltrate surface water runoff into the ground, SuDS have been proposed to provide storage, treatment and water re-use facilities. The proposed SuDS include rainwater harvesting, permeable surfacing and a soakaway. These SuDS will be used to store water onsite and maximise the water which can be adsorbed by vegetation or infiltrated into the ground. The proposed SuDS discharge all of the surface water runoff from the site into the underlying soil during the design rainfall event. This is considered to be in accordance with the NTSS..

Details of the typical maintenance and management requirements for each element of the drainage system have been provided to ensure that the proposed drainage solution can be maintained and will continue to operate over the lifetime of the development. It is, however, recommended that an “owner’s manual” containing additional product specific maintenance requirements is produced as part of the detailed design for the site.

In conclusion, it is evident a sustainable solution for managing the surface water runoff discharged from the proposed development at Valley Drive, Gravesend is available. Consequently, the proposals will meet the requirements of the NPPF, the NTSS and local planning policy.

7 Appendices

Appendix A.1 – Drawings

Appendix A.2 – Southern Water Asset Location Data

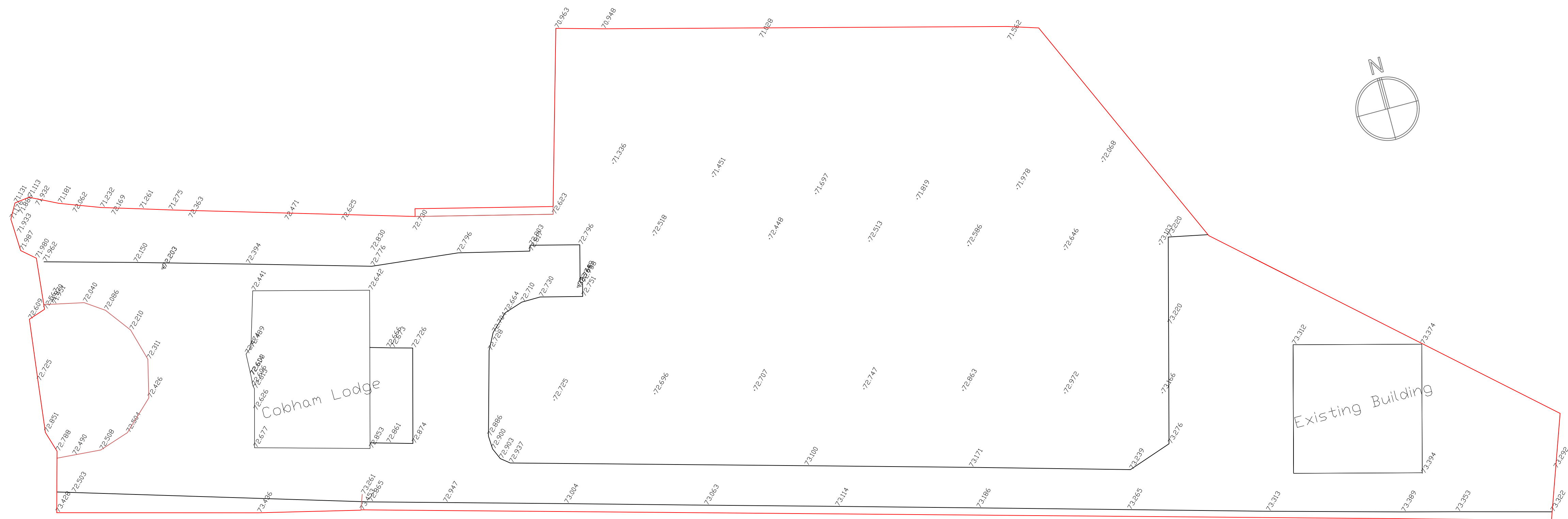
Appendix A.3 – Indicative Drainage Layout Plan

Appendix A.4 – Surface Water Management Calculations

Appendix A.5 – Maintenance Schedules

Appendix A.6 – Infiltration test results

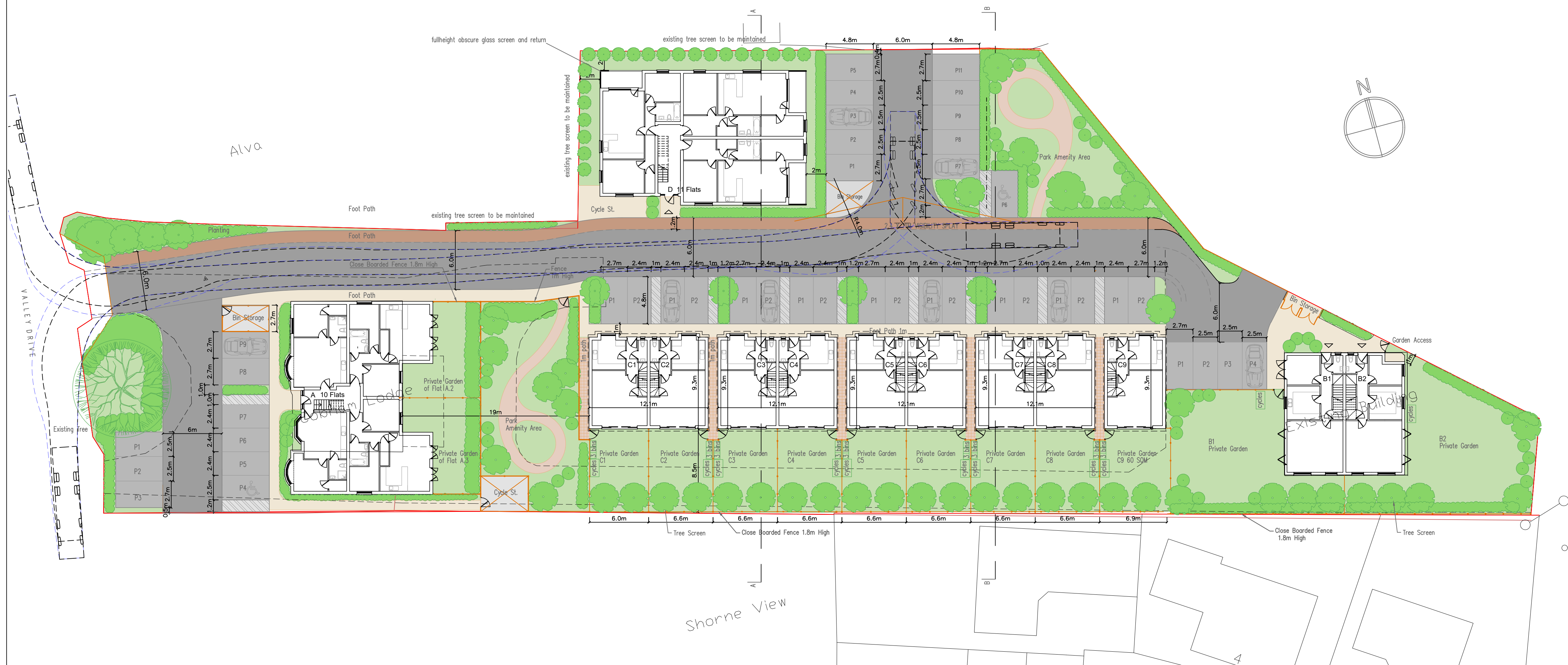
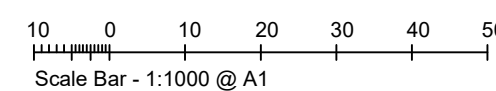
Appendix A.1 – Drawings



Existing Block Plan
Scale 1:250 @ A1



Proposed Location Plan
Scale 1:1000 @ A1



Proposed Block Plan
Scale 1:250 @ A1

Key

- 1800mm close boarded fence
- 1000mm fence
- Soft landscape - green areas
- Hard landscape - black paving
- Hard landscape - pervious black paving - parking areas
- Hard landscape - red tarmac - bicycle lane
- Hard landscape - floor path
- Hard landscape - paving slabs
- Park hard surfacing
- Existing pavement to be removed
- Existing tree
- Existing tree to be removed
- Proposed vegetation
- Disabled parking bay
- Clear access zone

PROJECT:

Cobham Lodge, Valley Drive
Gravesend, Kent, DA12 5UE

TITLE:

Existing and Proposed Block Plan

SCALE: 1:250 @ A1

DATE: June 22

Drawing No.

1458-02

REV.

Q



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Appendix A.2 – Southern Water Asset Location Data



Herrington Consulting Ltd
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Elham Valley
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Kent
CT4 6DQ

Your ref EG/2248
Our ref 353349
Date 20 September 2019
Contact searches@southernwater.co.uk
Tel 0845 272 0845
0330 303 0276
Fax 01634 844514

Attention: Herrington Consulting

Dear Customer

Re: Provision of public sewer and water main record extract

**Location: Cobham Lodge, Valley Drive, Gravesend, Kent,
DA12 5UE**

Thank you for your order regarding the provision of extracts of our sewer and/or water main records. Please find enclosed the extracts from Southern Water's records for the above location.

We confirm payment of your fee in the sum of £49.92 and enclose a VAT receipt for your records.

Customers should be aware that there are areas within our region in which there are neither sewers nor water mains. Similarly, whilst the enclosed extract may indicate the approximate location of our apparatus in the area of interest, it should not be relied upon as showing that further infrastructure does not exist and may subsequently be found following site investigation. Actual positions of the disclosed (and any undisclosed) infrastructure should therefore be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan. Accordingly it should not be considered to be a definitive document.

Should you require any further assistance regarding this matter, please contact the LandSearch team.

Yours faithfully

LandSearch

VAT receipt

Ordered by:

Herrington Consulting Ltd
Elham Valley
Canterbury
Kent
CT4 6DQ

VAT registration number: 813 0378 56
Order reference: 353349
Your reference: EG/2248

Receipt for provision of an extract from the public sewer and/or water main records.

Location	Costs
Cobham Lodge Valley Drive Gravesend Kent DA12 5UE	£41.60
Net total	£41.60
VAT	£8.32
Total	£49.92
Paid	Paid in full

Thank you for your payment:

Received on: 19 September 2019

For enquiries regarding the information provided in this receipt, please contact the LandSearch team:

Tel: 0845 270 0212
0330 303 0276 (individual consumers)

Email: searches@southernwater.co.uk

Web: www.southernwater.co.uk

LandSearch
Southern Water Services
Southern House
Capstone Road
Chatham
Kent
ME5 7QA



SEWER RECORDS PAGE 1 OF 2



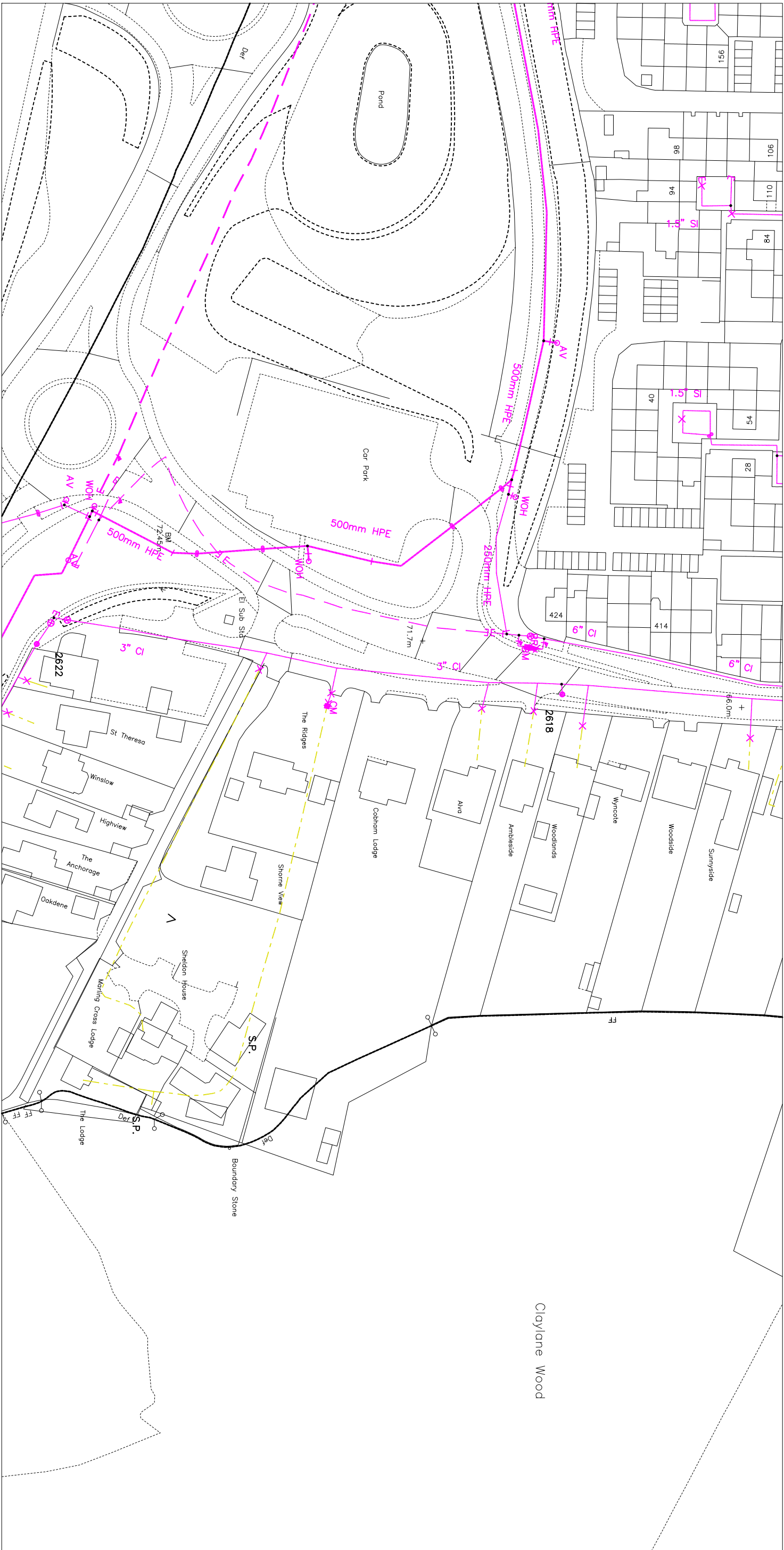
O.S. REF. TQ6670NW		Drawn by: ahmadr	The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. WARNING: BAC pipes are constructed of Bonded Asbestos Cement WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement
Scale: 1:1250			
Title: 353349_Cobham Lodge, Valley Dri	Date: 20/09/2019	Based upon Ordnance Survey Digital Data with the permission of the controller of H.M.S.O. Crown Copyright Reserved Licence No. WU 298530.	
N			

SEWER RECORDS PAGE 2 OF 2

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0604X			UNK	UNK	CIRC
0605X			UNK	UNK	CIRC
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0607X			UNK	UNK	CIRC
0608X			UNK	UNK	CIRC
0609X			UNK	UNK	CIRC
0610X			UNK	UNK	CIRC
0611X			UNK	UNK	CIRC
0612X			UNK	UNK	CIRC
0613X			UNK	UNK	CIRC
0614X			UNK	UNK	CIRC
0614Y			UNK	UNK	CIRC
0615X			UNK	UNK	CIRC
0616X			UNK	UNK	CIRC
0617X			UNK	UNK	CIRC
0618X			UNK	UNK	CIRC
0619X			UNK	UNK	CIRC
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0621X			UNK	UNK	CIRC
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1503X			UNK	UNK	CIRC
1504X			UNK	UNK	CIRC
1609X	61.74	59.86	UNK	UNK	CIRC
1612X			UNK	UNK	CIRC
1613X			UNK	UNK	CIRC
1614X			UNK	UNK	CIRC
1615X			UNK	UNK	CIRC
1616X			UNK	UNK	CIRC
1617X			UNK	UNK	CIRC
1618X			UNK	UNK	CIRC
1619X			UNK	UNK	CIRC
1620X			UNK	UNK	CIRC
2401X	74.19	72.28	UNK	UNK	CIRC
2402X			UNK	UNK	CIRC
2403X	74.4	73.84	UNK	VC	CIRC
2404X			UNK	UNK	CIRC
2405X	75.57	72.64	UNK	VC	CIRC
2406X	75.69	72.67	UNK	VC	CIRC
2407X	72.475	72.475	UNK	VC	CIRC
2408X	75.63	73.31	UNK	VC	CIRC
2501X	69.8	68.42	UNK	VC	CIRC
2502X	72.73	71.46	UNK	VC	CIRC
2503X			UNK	UNK	CIRC
2603X			UNK	UNK	CIRC
2604X	67.12	65.45	UNK	VC	CIRC
9604X			UNK	UNK	CIRC
9615X			UNK	UNK	CIRC
9616X			UNK	UNK	CIRC
9617X			UNK	UNK	CIRC
9633X	60.95	59.54	UNK	UNK	CIRC
9634X	63.35		UNK	UNK	CIRC

[illegible]

Drawn by:	ahmadr
Title:	353349_Cobham Lodge, Valley Dri
Date:	20/09/2019
	



LEGEND - MAINS

- Distribution Main / Communication pipe
- Clockwise closing valve
- Trunk Main
- Raw water main
- Non potable
- Abandoned main
- Proposed Main
- Fire main
- Non SWS
- Sluice valve
- Closed valve
- Air valve
- Butterfly valve
- Pressure reducing valve
- Reflux valve
- Motorised valve

Washout

Washout hydrant

Meier

Capped end

Emptying plug

Stopcock

Leak Noise Correlator Survey Point

Anode

Telemetry cable

Access point / hatchbox

Break pressure tank

Change node

Pumping station

Booster station

Insertion Flow Meter Point

Water tower

Service reservoir

Water Supply Works

Bore hole / Well

Intake

Customer site

Swab insertion point

MATERIALS

- Alkaliene

AK
- Cast iron

CI
- Span (grey) iron

SI
- Concrete

CO
- Ductile iron

DI
- Bonded Asbestos Cement

BAC
- Glass reinforced plastic

GRP
- Glass reinforced epoxy

GRE
- (Unplastidised) Polyvinyl chloride

PVC
- Polyethylene

PE
- Steel

ST
- Concrete segments bolted

CSB
- Concrete segments unbolted

CSU
- Galvanised iron

GI
- Ductile sleeve

DS
- Concrete pre-stressed

CPS
- High performance polyethylene

HPE
- Unknown

??

170407
565946

566427

Drawn by:	ahmadr	O.S.Ref:	TQ6670NW
Scale:	1:1250	TITLE: 353349_Cobham Lodge, Valley Dri	
Date:	20/09/2019		

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd. accept no responsibility in the event of inaccuracy. The actual positions of pipes should be determined on site.

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Southern Water

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Appendix A.3 – Indicative Drainage Layout Plan

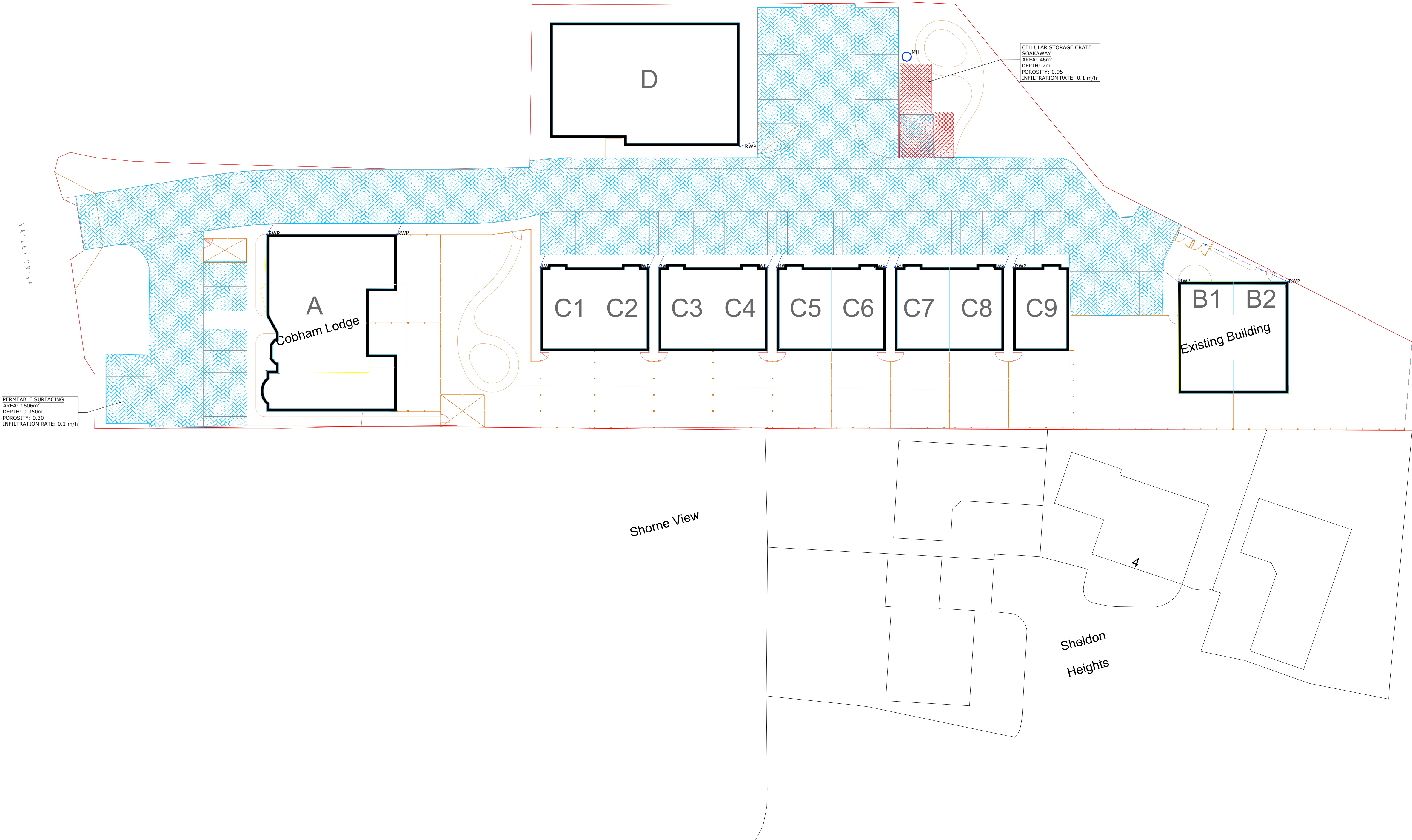
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GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
2. ALL WORK IS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, EUROPEAN NORMS, CODES OF PRACTICE AND BUILDING PRACTICE.
3. ALL DIMENSIONS ARE TO BE CHECKED BY THE CONTRACTOR PRIOR TO STARTING THE WORKS ON SITE. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.
4. INFILTRATION FEATURES WILL BE SUBJECT TO SITE SPECIFIC INFILTRATION TESTING AND TRIAL HOLES.
5. ALL DRAINAGE SYSTEMS WILL NEED TO BE INSTALLED AND DESIGNED FOR SUITABLE LOADING REQUIREMENTS.
6. THE CONTRACTOR SHALL OBTAIN PRIOR APPROVAL AND ALL NECESSARY LICENCES FROM THE THE HIGHWAY AUTHORITY AND/OR SEWERAGE UNDERTAKER BEFORE CARRYING OUT ANY WORKS.
7. THIS DRAWING WAS PRODUCED FOR USE IN CONJUNCTION WITH A PLANNING SUBMISSION AND SHOULD NOT BE USED FOR OTHER PURPOSES. A MORE DETAILED DESIGN INCLUDING PRODUCT SPECIFICATIONS WILL NEED TO BE PRODUCED PRIOR TO CONSTRUCTION.

KEY:

- — — — — SURFACE WATER DRAIN
- NH SURFACE WATER MANHOLE
- RWP RAINWATER PIPE
- PERMEABLE SURFACE
- SOAKAWAY



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Rev	Description	Author	Checked	Date
P1	Revised issue	BW	EC	07/11/22
P0	First issue	BW	EC	31/10/22

CLIENT
MILESTONE CIVIL ENGINEERING

PROJECT
VALLEY DRIVE, GRAVESEND

SCALE	PROJ REF	ORIGINATOR	CHECKED BY
1:250	2248	BW	EC

HC DWG REF.
2248_DWG_r1

DWG TITLE
INDICATIVE SURFACE WATER DRAINAGE LAYOUT

DWG No.
HC-2248-501

10 m SCALE 1 : 250 @ A1 0 10 m

Appendix A.4 – Surface Water Management Calculations

Design Settings

Rainfall Methodology	FEH-13	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	45	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	x
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	200.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Proposed 1	0.313	4.00	10.000	1200	-0.056	-0.010	0.800
Proposed 2	0.000		10.000	1200	10.015	-0.015	1.200

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	Proposed 1	Proposed 2	10.071	0.600	9.200	8.800	0.400	25.2	300	4.05	181.4

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	3.146	222.3	297.6	0.500	0.900	0.313	0.0	300	3.186

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	10.071	25.2	300	Circular	10.000	9.200	0.500	10.000	8.800	0.900

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Proposed 1	1200	Manhole	Adoptable	Proposed 2	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Proposed 1	-0.056	-0.010	10.000	0.800	1200				
						0	1.000	9.200	300
Proposed 2	10.015	-0.015	10.000	1.200	1200		1	1.000	8.800
									300

Simulation Settings

Rainfall Methodology	FEH-13	Drain Down Time (mins)	10080	30 year (l/s)	1.0
Summer CV	1.000	Additional Storage (m³/ha)	0.0	100 year (l/s)	1.3
Winter CV	1.000	Check Discharge Rate(s)	✓	Check Discharge Volume	x
Analysis Speed	Detailed	2 year (l/s)	0.4		
Skip Steady State	x	10 year (l/s)	0.7		

Storm Durations

15	60	180	360	600	960	2880
30	120	240	480	720	1440	10080

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
2	45	0	0
30	0	0	0
30	45	0	0
100	0	0	0
100	45	10	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	2.40
Greenfield Method	FEH	Growth Factor 100 year	3.19
Positively Drained Area (ha)	1.000	Betterment (%)	0
SAAR (mm)	606	QMed	0.4
Host	1	QBar	0.4
BFIHost	0.889	Q 2 year (l/s)	0.4
Region	7	Q 10 year (l/s)	0.7
QBar/QMed conversion factor	1.136	Q 30 year (l/s)	1.0
Growth Factor 2 year	0.88	Q 100 year (l/s)	1.3
Growth Factor 10 year	1.62		

Node Proposed 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.10000	Invert Level (m)	9.550	Slope (1:X)	1000.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	96	Depth (m)	0.350
Safety Factor	2.0	Width (m)	160.600	Inf Depth (m)	
Porosity	0.30	Length (m)	10.000		

Node Proposed 2 Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	7.000	Depth (m)	2.000
Side Inf Coefficient (m/hr)	0.10000	Time to half empty (mins)	1796	Inf Depth (m)	
Safety Factor	2.0	Pit Width (m)	4.600	Number Required	1
Porosity	0.95	Pit Length (m)	10.000		

Results for 2 year Critical Storm Duration. Lowest mass balance: 91.11%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Proposed 1	10	9.323	0.123	62.1	0.1387	0.0000	OK
2880 minute summer	Proposed 2	1920	8.788	-0.012	2.8	78.1386	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
15 minute summer	Proposed 1	1.000	Proposed 2	62.1	2.498	0.279	0.2505	
15 minute summer	Proposed 1	Infiltration		0.0				
2880 minute summer	Proposed 2	Infiltration		0.7				

Results for 2 year +45% CC Critical Storm Duration. Lowest mass balance: 91.11%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	Proposed 1	570	9.559	0.359	9.3	2.2053	0.0000	SURCHARGED
600 minute summer	Proposed 2	375	9.564	0.764	12.9	88.2861	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
960 minute summer	Proposed 1	1.000	Proposed 2	9.3	1.527	0.042	0.7092	
960 minute summer	Proposed 1	Infiltration		3.9				
600 minute summer	Proposed 2	Infiltration		0.8				

Results for 30 year Critical Storm Duration. Lowest mass balance: 91.11%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	Proposed 1	148	9.586	0.386	41.3	15.4073	0.0000	SURCHARGED
240 minute summer	Proposed 2	128	9.643	0.843	41.3	88.3754	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
240 minute summer	Proposed 1	1.000	Proposed 2	41.3	2.267	0.186	0.7092	
240 minute summer	Proposed 1	Infiltration		16.1				
240 minute summer	Proposed 2	Infiltration		0.8				

Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 91.11%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	Proposed 1	148	9.657	0.457	64.4	49.6643	0.0000	SURCHARGED
60 minute summer	Proposed 2	34	9.677	0.877	149.9	88.4147	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
240 minute summer	Proposed 1	1.000	Proposed 2	44.9	2.311	0.202	0.7092	
240 minute summer	Proposed 1	Infiltration		22.3				
60 minute summer	Proposed 2	Infiltration		0.8				

Results for 100 year Critical Storm Duration. Lowest mass balance: 91.11%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute summer	Proposed 1	148	9.638	0.438	59.9	40.2524	0.0000	SURCHARGED
60 minute summer	Proposed 2	36	9.654	0.854	136.8	88.3882	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
240 minute summer	Proposed 1	1.000	Proposed 2	48.4	2.269	0.218	0.7092	
240 minute summer	Proposed 1	Infiltration		22.3				
60 minute summer	Proposed 2	Infiltration		0.8				

Results for 100 year +45% CC +10% A Critical Storm Duration. Lowest mass balance: 91.11%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute summer	Proposed 1	124	9.803	0.603	112.1	120.2564	0.0000	FLOOD RISK
180 minute summer	Proposed 2	120	9.803	1.003	51.8	88.5570	0.0000	OK
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	
180 minute summer	Proposed 1	1.000	Proposed 2	51.8	2.391	0.233	0.7092	
180 minute summer	Proposed 1	Infiltration		22.3				
180 minute summer	Proposed 2	Infiltration		0.8				

Appendix A.5 – Maintenance Schedules

Operation and Maintenance Schedule – Pervious Pavement		
Maintenance Schedule	Required Action	Typical Frequency
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.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator 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 replace lost jointing material.	As required.
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, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

General Operation and Maintenance Table for Pervious Pavements in accordance with CIRIA C753 The SuDS Manual.

Operation and Maintenance Schedule – Soakaways		
Maintenance Schedule	Required Action	Typical Frequency
Routine maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial Actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

General Operation and Maintenance Table for Soakaways in accordance with CIRIA C753 The SuDS Manual.

Appendix A.6 – Infiltration test results

Hole ①

Soil Infiltration Testing – Guidance Notes

Summary: This note has been prepared by Herrington Consulting Ltd. to provide our clients with guidance on undertaking site-specific infiltration tests. The results of the infiltration test will enable us to appraise the surface water management strategy for an individual site.

1 Background

The hydraulic properties of a soil are site-specific. Some soils, such as sands and gravels, have high infiltration rates, whereas others, such as clays, have low infiltration rates. In order to determine the extent to which infiltration can be used to discharge surface water runoff from a site it is necessary to determine the infiltration rate of the soils. The only reliable way of doing so is to undertake a site-specific infiltration test.

2 Undertaking the infiltration test

Step 1

Determine and excavate the appropriate trial pit size. The test pit should be at approximately the same depth as the base of the proposed infiltration device, i.e. at the same level as the proposed base of the soakaway. The trial pit should be 0.3 to 1m wide and 1 to 3m long. If the area to be drained is less than 100m² then the pit should be at least 0.5m³ (i.e. 0.5m x 1m x 1m deep). If the drained area is to be greater than 100m² then the pit should be at least 2m³. The pit should have vertical sides trimmed square. It is helpful to put pegs in one of the side walls to indicate the 75% and 25% levels – enabling accurate water levels to be determined.

Step 2

Fill the pit with water. The inflow of water needs to be rapid so that the pit can be filled to its maximum depth in a short period of time, therefore it may be necessary to use a water bowser. Care should be taken as the water flows into the pit to prevent the walls from collapsing.

Step 3

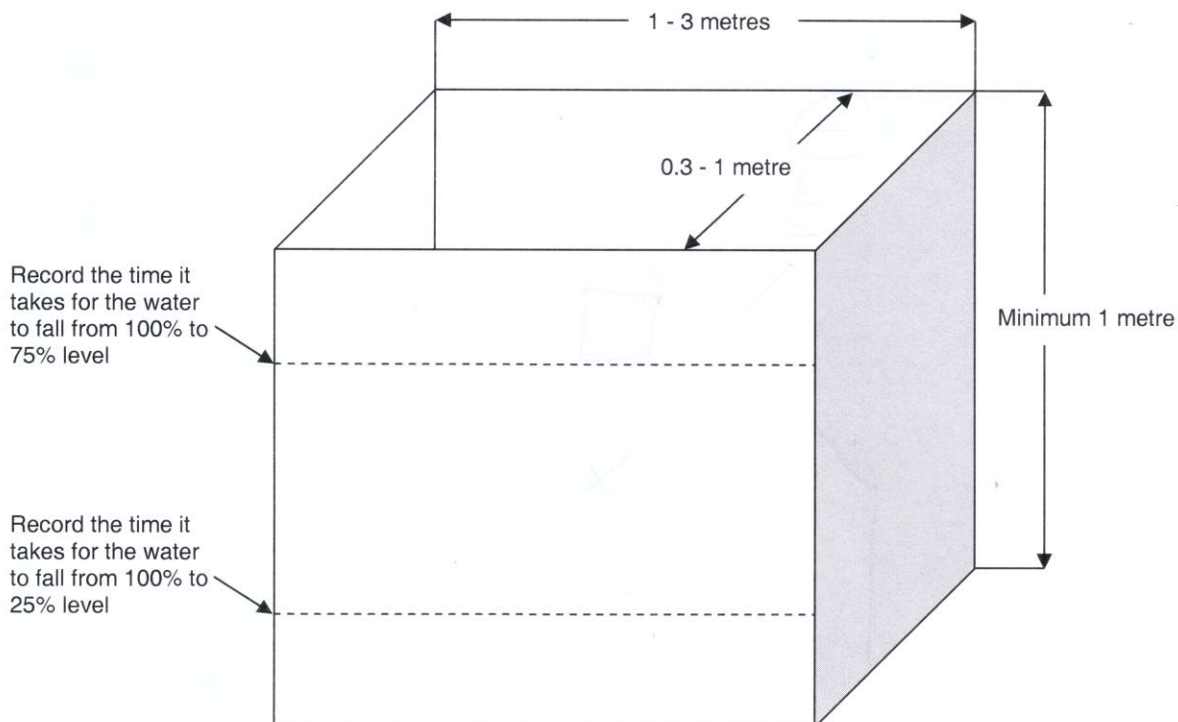
The following readings need to be taken: (1) the time in which the water level took to fall from 100% to 75% full and, (2) the time in which the water level took to fall from 100% to 25% full.

Step 4

The test will need to be repeated a further two times.

3 Recording the results

Please use the tables below to record the results. Once the three tests have been completed, return this form to Herrington Consulting and we will use the recorded data to calculate the infiltration rate of the soils.



	Width (in the range of 0.3 to 1m)	Length (range of 1 to 3m)	Depth (similar to proposed soakaway)
Trial pit dimensions	450 mm	1.000 m	1 m

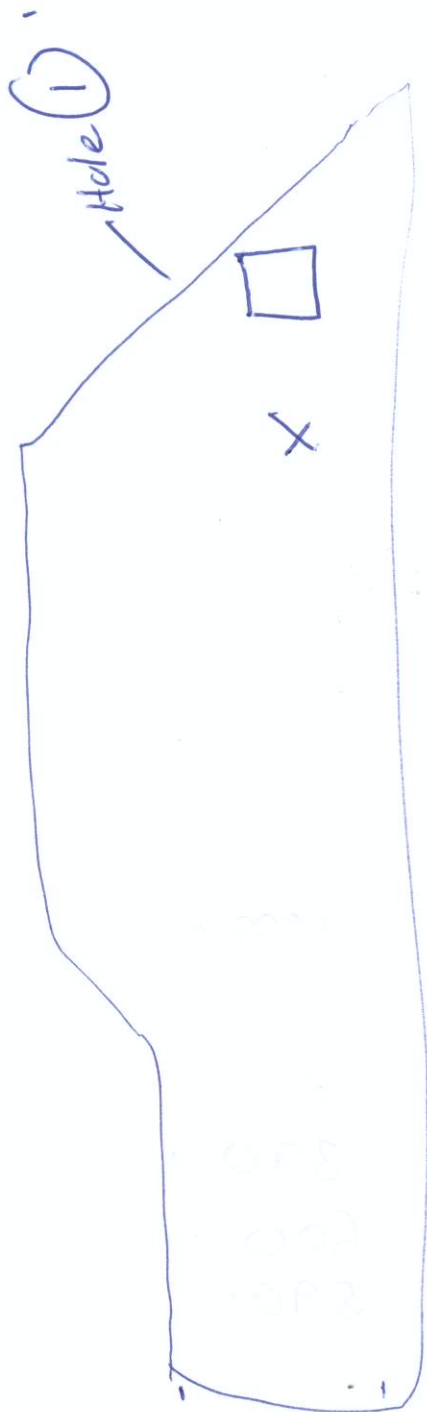
Test number	(A) Time taken to drop from 100% to 75% level (minutes)	(B) Time taken to drop from 100% to 25% level (minutes)	(B) - (A)
1	42	390	348
2	85	600	515
3	75	590	515

Signature of person undertaking the test

M. Smith

Date

21/09/19



Hole (2).

Soil Infiltration Testing – Guidance Notes

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Step 2

Fill the pit with water. The inflow of water needs to be rapid so that the pit can be filled to its maximum depth in a short period of time, therefore it may be necessary to use a water bowser. Care should be taken as the water flows into the pit to prevent the walls from collapsing.

Step 3

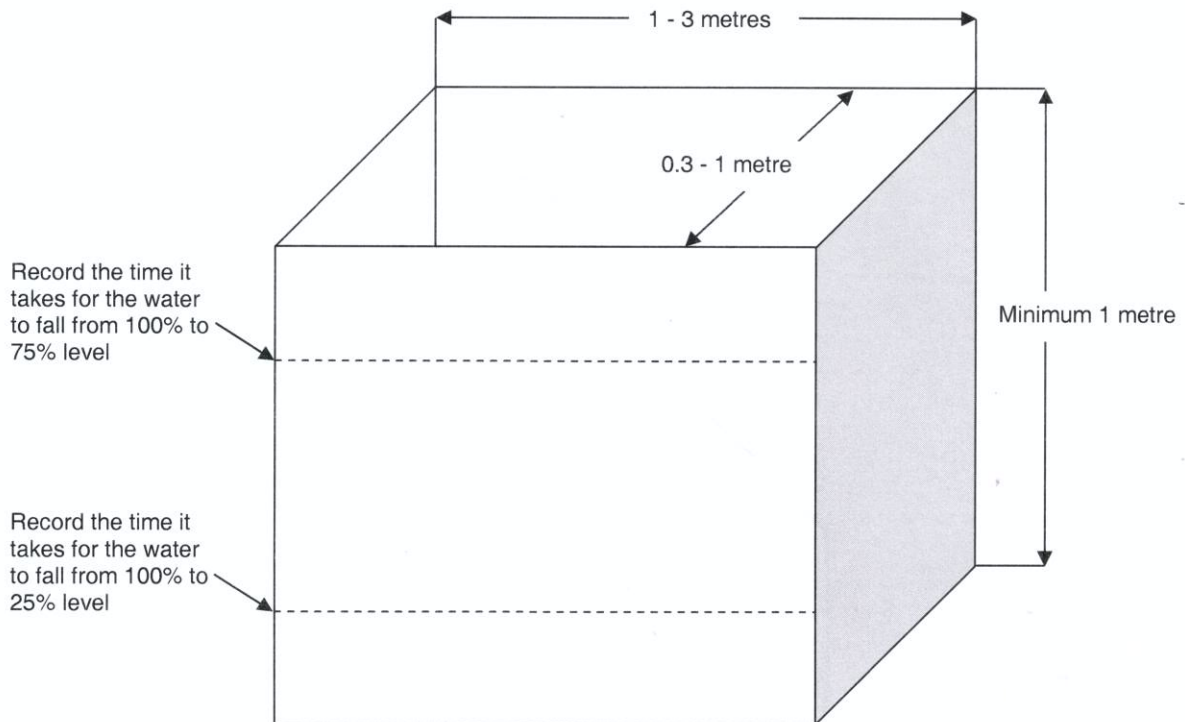
The following readings need to be taken: (1) the time in which the water level took to fall from 100% to 75% full and, (2) the time in which the water level took to fall from 100% to 25% full.

Step 4

The test will need to be repeated a further two times.

3 Recording the results

Please use the tables below to record the results. Once the three tests have been completed, return this form to Herrington Consulting and we will use the recorded data to calculate the infiltration rate of the soils.



	Width (in the range of 0.3 to 1m)	Length (range of 1 to 3m)	Depth (similar to proposed soakaway)
Trial pit dimensions	0.45 m	1 m	1 m

Test number	(A) Time taken to drop from 100% to 75% level (minutes)	(B) Time taken to drop from 100% to 25% level (minutes)	(B) - (A)
1	22	140	118
2	68	332	214
3	90	390	300

Signature of person undertaking the test

M. Smith

Date

21/09/19

Hole 2.

X



Hole (3)

Soil Infiltration Testing – Guidance Notes

Summary: This note has been prepared by Herrington Consulting Ltd. to provide our clients with guidance on undertaking site-specific infiltration tests. The results of the infiltration test will enable us to appraise the surface water management strategy for an individual site.

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The hydraulic properties of a soil are site-specific. Some soils, such as sands and gravels, have high infiltration rates, whereas others, such as clays, have low infiltration rates. In order to determine the extent to which infiltration can be used to discharge surface water runoff from a site it is necessary to determine the infiltration rate of the soils. The only reliable way of doing so is to undertake a site-specific infiltration test.

2 Undertaking the infiltration test

Step 1

Determine and excavate the appropriate trial pit size. The test pit should be at approximately the same depth as the base of the proposed infiltration device, i.e. at the same level as the proposed base of the soakaway. The trial pit should be 0.3 to 1m wide and 1 to 3m long. If the area to be drained is less than 100m² then the pit should be at least 0.5m³ (i.e. 0.5m x 1m x 1m deep). If the drained area is to be greater than 100m² then the pit should be at least 2m³. The pit should have vertical sides trimmed square. It is helpful to put pegs in one of the side walls to indicate the 75% and 25% levels – enabling accurate water levels to be determined.

Step 2

Fill the pit with water. The inflow of water needs to be rapid so that the pit can be filled to its maximum depth in a short period of time, therefore it may be necessary to use a water bowser. Care should be taken as the water flows into the pit to prevent the walls from collapsing.

Step 3

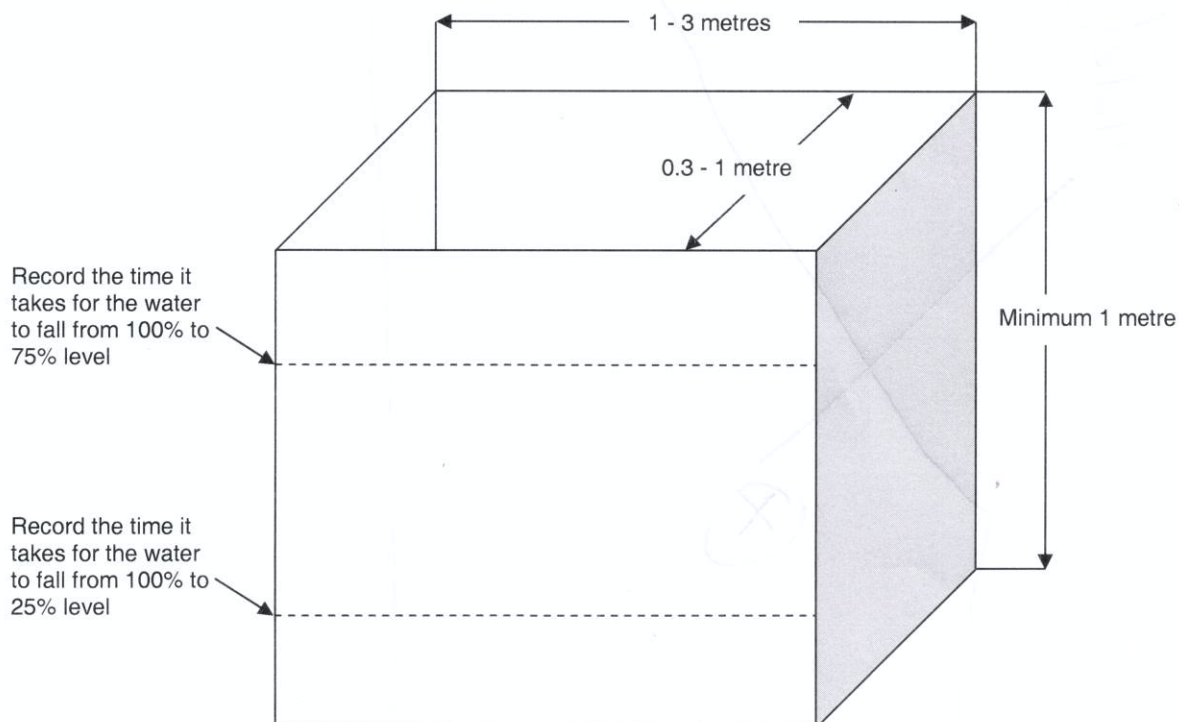
The following readings need to be taken: (1) the time in which the water level took to fall from 100% to 75% full and, (2) the time in which the water level took to fall from 100% to 25% full.

Step 4

The test will need to be repeated a further two times.

3 Recording the results

Please use the tables below to record the results. Once the three tests have been completed, return this form to Herrington Consulting and we will use the recorded data to calculate the infiltration rate of the soils.



	Width (in the range of 0.3 to 1m)	Length (range of 1 to 3m)	Depth (similar to proposed soakaway)
Trial pit dimensions	0.45 m	1 m	1.500 m

Test number	(A) Time taken to drop from 100% to 75% level (minutes)	(B) Time taken to drop from 100% to 25% level (minutes)	(B) - (A)
1	24	720	696
2	30	780	750
3	55	900	845

Signature of person undertaking the test

Mark Sidi

Date

21/09/19

Hole 3

