



LAND AT 4 BROOKFIELD PROVIDENCE HILL, BURSLEDON

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

January 2023

Vested Outsourcing Partners Ltd

MIXED USE SCHEME
LAND AT 4 BROOKFIELD, PROVIDENCE HILL, BURSLEDON

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY

CONTROLLED DOCUMENT

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Prepared by:	John Comer		14/10/2021
Checked by:	Nadine Hassan		14/10/2021
Approved by:	Rob Wilson		14/10/2021

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3	15/01/2023	JAC	Revisions to report to reflect site layout re-design.	RW	RW

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Vested Outsourcing Partners Ltd
Green Park House,
15 Stratton Street
Mayfair
London
W1J 8LQ



Paul Basham Associates Ltd
The Bothy,
Cams Hall Estate,
Fareham,
Hampshire,
PO16 8UT

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1. INTRODUCTION

- 1.1 This Flood Risk Assessment (FRA) and Drainage Strategy has been prepared by Paul Basham Associates on behalf of Vested Outsourcing Partners to support a full planning application for a mixed-use site. The land is located north of Providence Hill A27. The nearest postcode is SO31 8AP.

2. SITE DETAILS

- 2.1 The plot size is approximately 1.12 hectares, and the land is currently mostly open field with a small number of outhouses. The topographical survey shows the site's highest point is 52.7m AOD located in the far west corner of the site, while the lowest point is 34.59m AOD located in the northeast corner of the site. The topographical survey can be found in **Appendix A**.
- 2.2 The site is situated on the outskirts of Bursledon, Southampton, is approximately 300m south of the M27 and 1.3km west of the river Hamble. See **Figure 1** below for site location.



Figure 1: Site Location Plan

- 2.3 The site is currently accessed via a gravel driveway connected to the property at 4 Brookfield, Providence Hill. See **Figure 2** below.



Figure 2: Existing Site Access

- 2.4 The development aspirations for the site are for a 14-plot residential site to the eastern half, and a single veterinary practice with adjoining car park to the western half. See **Appendix B** for a site layout plan.

Site Geology

- 2.5 A review of the British Geological Survey (BGS) mapping indicates that the bedrock geology beneath the site is “Wittering Formation - Sand, silt and clay. Sedimentary bedrock formed between 56 and 41.2 million years ago during the Palaeogene period”. See **Figure 3** below for the BGS map extract.

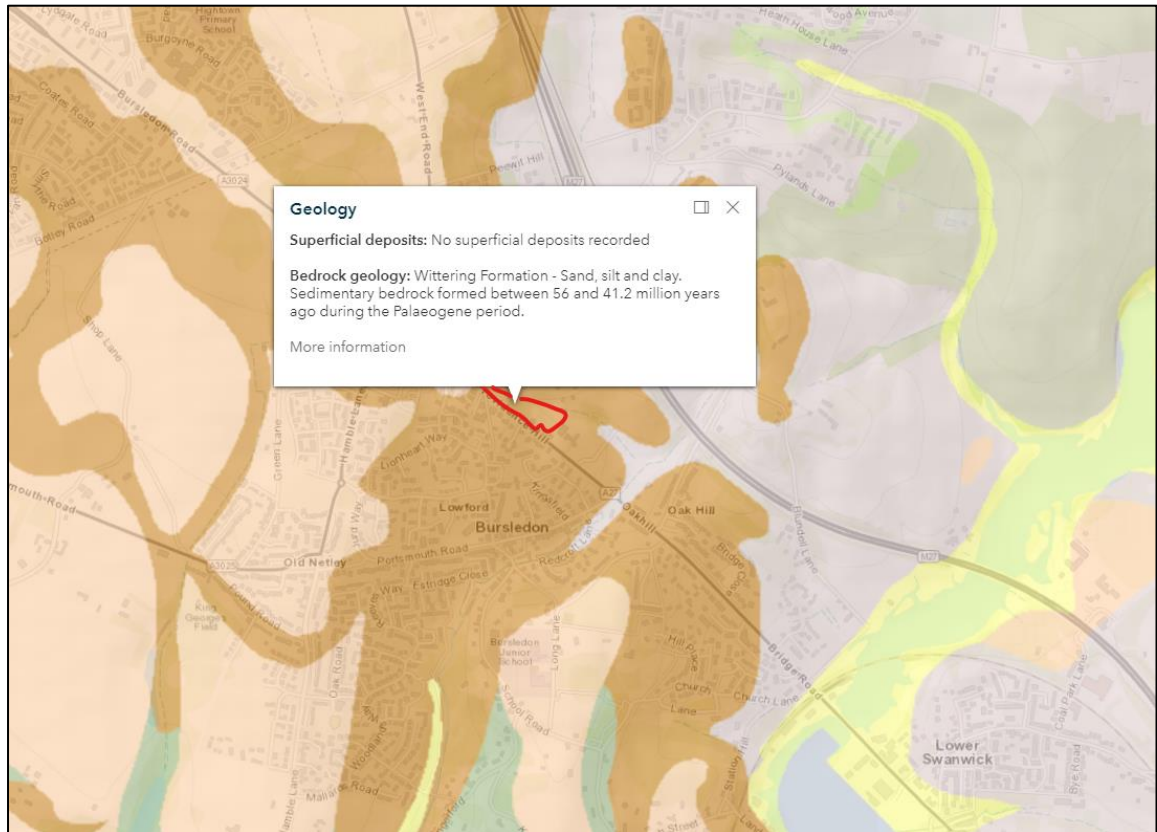


Figure 3: BGS Bedrock Mapping

2.6 A BGS 'Infiltration SuDS GeoReport' has been obtained and found the following:

Drainage Potential

The report found that the site sat between “may be compatible for infiltration SuDS” and “opportunities for infiltration SuDS”. Further investigation will be required to gain a better understanding of the properties of the soil. See **Figure 4** below.

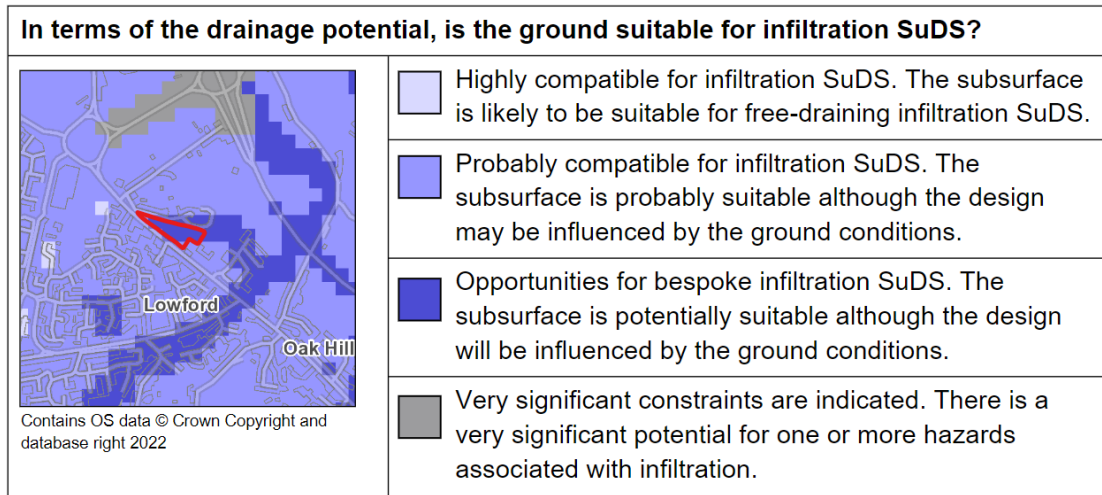


Figure 4: SuDS GeoReport Drainage Potential Extract

Ground Instability

2.7 The report found that “ground instability problems are probably present. Increased infiltration may result in ground instability”. As a result, although drainage potential may be present, ground instability concerns make infiltration not viable for this site. See **Figure 5** below.

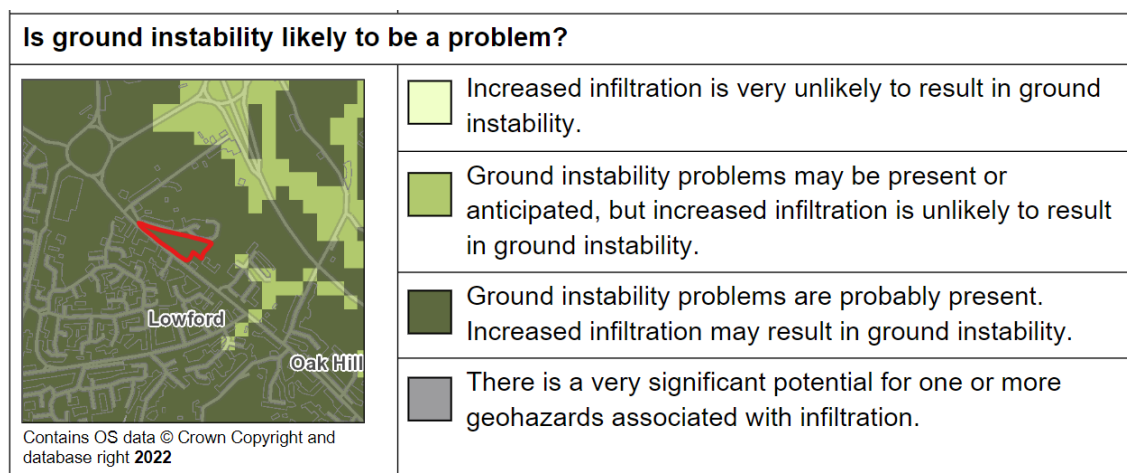


Figure 5: SuDS GeoReport Ground Instability Extract

Groundwater Susceptibility

2.8 The report found that “the groundwater is not expected to be especially vulnerable to contamination. See **Figure 6** below.

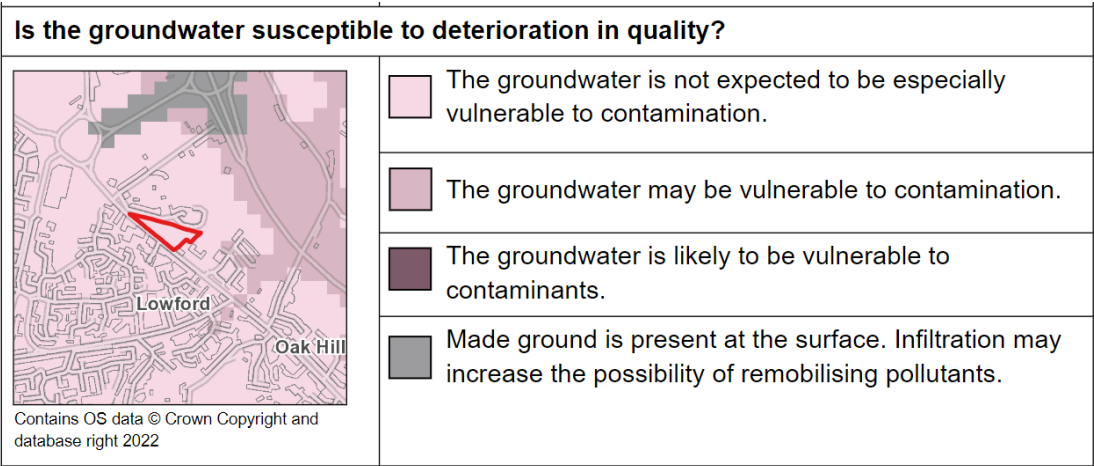


Figure 6: SuDS GeoReport Groundwater Susceptibility Extract

2.9 The full SuDS Georeport is contained within **Appendix C**.



3. EXISTING DRAINAGE

Existing Surface Water Drainage

- 3.1 The site is currently an open, undeveloped field and drains naturally. There is no apparent connection to a southern water public sewer.
- 3.2 There is an existing unnamed watercourse which runs adjacent to the northern boundary of the site.
- 3.3 The greenfield run-off rates for the site have been estimated using the HR Wallingford online calculator on the UK SuDS website. The run-off rate for the full site area of 1.12 hectares is 6.17 l/s while the rate for the proposed developed area of 0.45 hectares for the existing site is 2.48 l/s and is shown in **Figure 7** below. The full calculation outputs can be found in **Appendix D**.

Greenfield runoff rates	Default
Q _{BAR} (l/s):	2.48
1 in 1 year (l/s):	2.11
1 in 30 years (l/s):	5.71
1 in 100 year (l/s):	7.91
1 in 200 years (l/s):	9.28

Figure 7: Greenfield Runoff Rates

Existing Foul Water Drainage

- 3.4 The site does not currently produce any foul flows. No connections to existing Southern Water sewers are evident. There is a Southern Water foul water public sewer running in Providence Hill A27 to the south of the site. Southern Water sewer records can be found in **Appendix E**.

4. FLOOD RISK

Fluvial/tidal flooding

- 4.1 Flood mapping obtained from the government's 'flood map for planning' website has identified that the site falls entirely within Flood Zone 1. See **Figure 8** below.

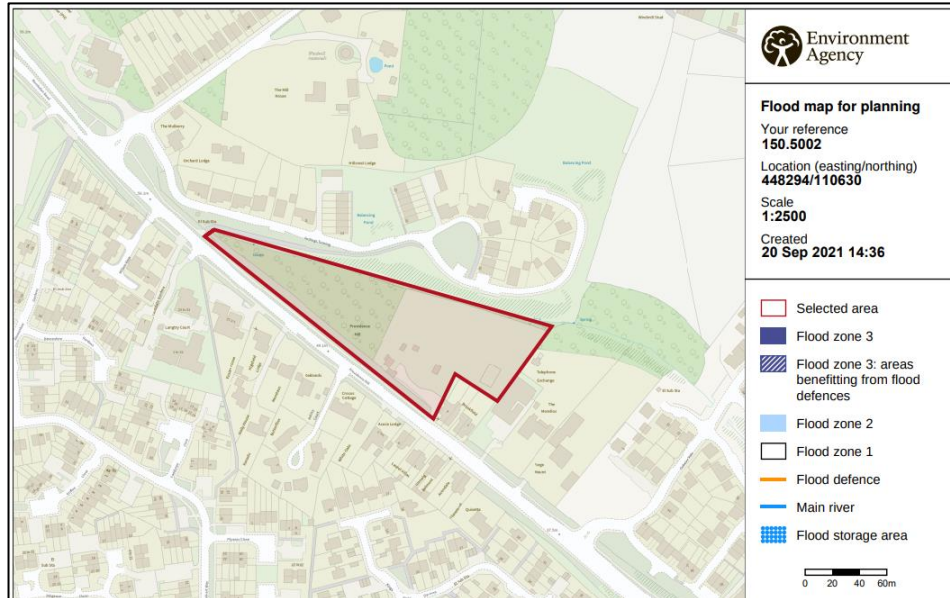


Figure 8: Flood Map for Rivers and Seas

Long term flood risk from rivers and seas

- 4.2 The long-term flood risk and from rivers and seas mapping shows the site is not considered to be at risk from river or sea flooding. See **Figure 9** below.

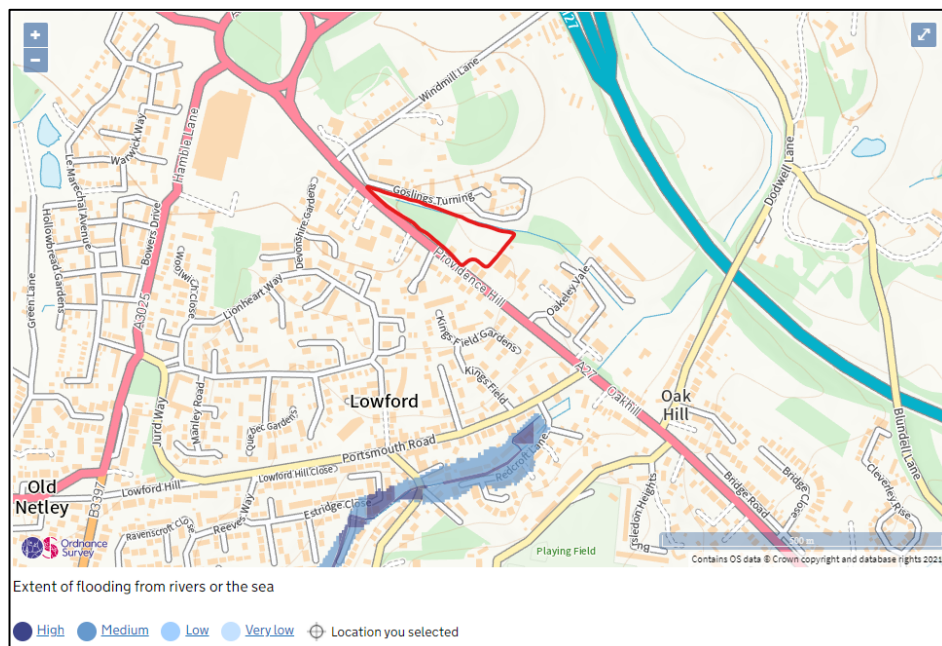


Figure 9: Long-Term Flood Risk from Rivers and Seas Map

Long-term flood risk from reservoirs

- 4.3 The long-term flood risk from reservoirs shows that the site is not considered to be at risk of reservoir flooding. See **Figure 10** below.

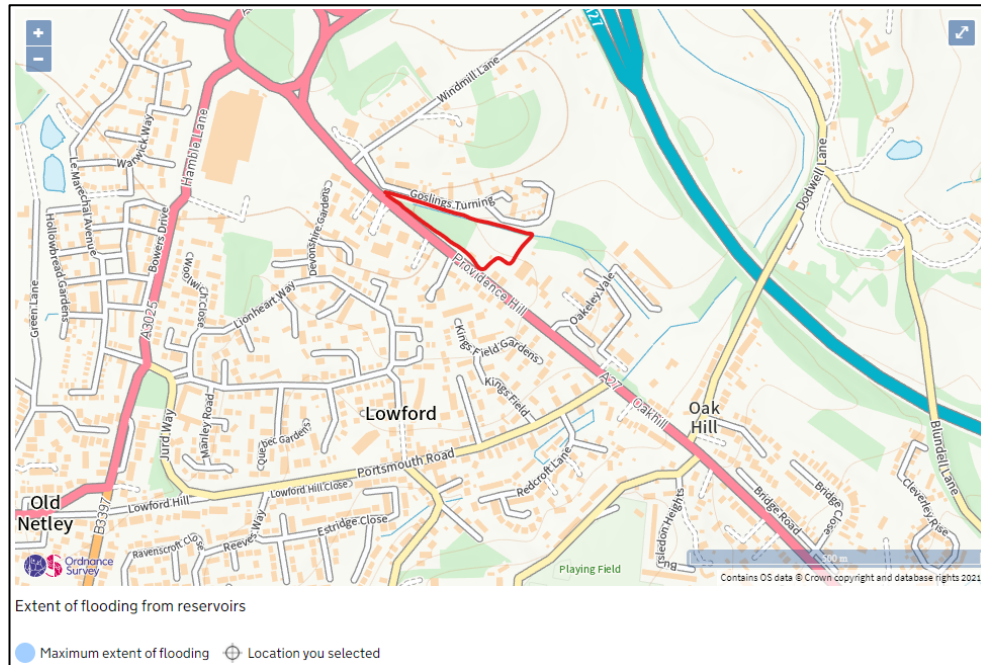


Figure 10: Long Term Flood Risk from Reservoirs Map

Long-term surface water flood risk

- 4.4 Surface water or 'pluvial' flooding results from rainfall running over ground before eventually entering a watercourse or sewer. It is usually associated with high intensity rainfall events but can also occur with lower intensity rainfall or melting snow where the ground is already saturated, frozen, developed (for example in an urban setting), or otherwise has low permeability.
- 4.5 The surface water flood risk map is shown in **Figure 11** and indicates that the majority of the site is at a very low risk of pluvial flooding, with the existing watercourse along the northern boundary providing a small area of high to low risk. This area is downhill from the properties and will remain undeveloped, as such will not impose a risk on the development.

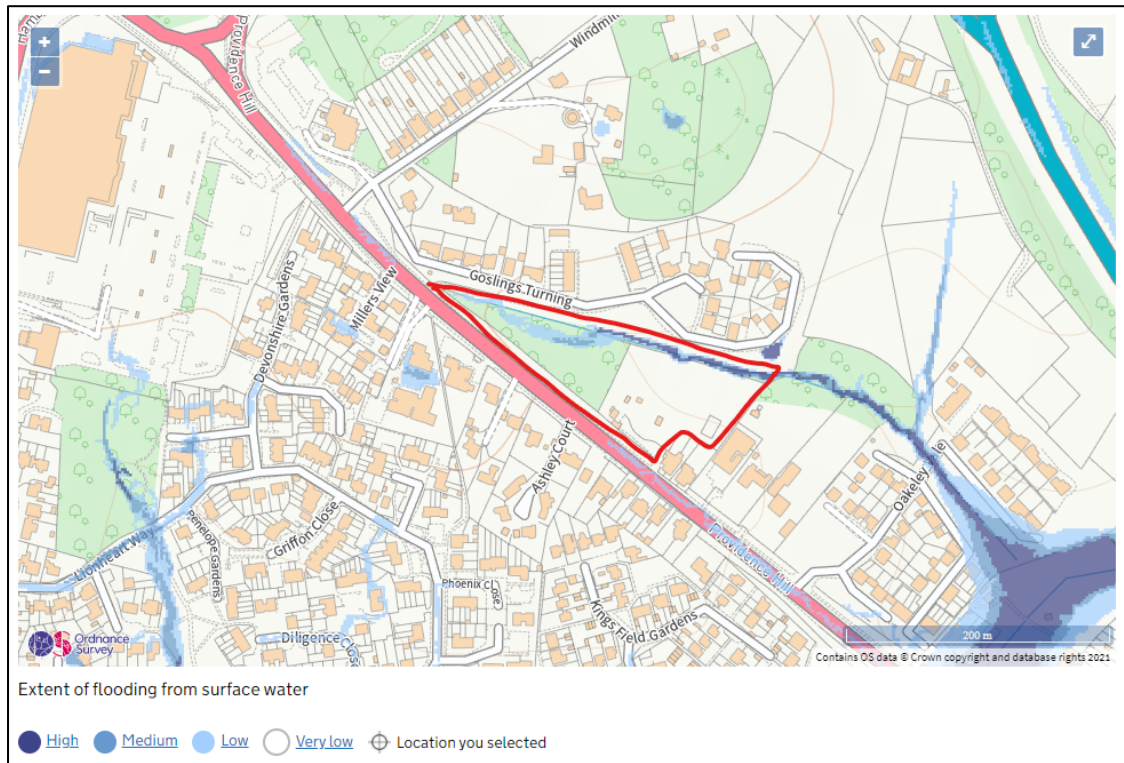


Figure 11: Long Term Flood Risk from Surface Water

National Planning Policy Framework (NPPF)

4.6 This report has been prepared considering the National Planning Policy Framework (NPPF) Technical Guidance and the Environment Agency's (EA) flood risk standing advice.

4.7 Table 3 from the NPPF Technical Guidance has been included as **Figure 12** below. This provides the classes of development (based on flood risk vulnerability) that are permitted within each of the flood zones. The Flood Risk Vulnerability Classification for the site is 'More Vulnerable' as it is a mixed commercial and residential development, which is defined in Table 2 of the Planning Practice Guidance. Based on this, as the full development is located within Flood Zone 1 the development is to be deemed appropriate and neither the Sequential Test nor the Exception Test are required.

Flood Zones	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

NPPF Table 3 - Flood risk vulnerability and flood zone 'compatibility'

Key: ✓ Development is appropriate ✗ Development should not be permitted.

Notes to table 3:

- This table does not show the application of the [Sequential Test](#) which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and [Exception Tests](#) do not need to be applied to [minor developments](#) and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
- Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

† In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.

* "In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water-compatible uses, should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows and not increase flood risk elsewhere

Figure 12: NPPF Planning Practice Guidance Table – Flood Risk Vulnerability and Flood Zone Compatibility

Groundwater Flooding

- 4.8 Groundwater flooding occurs when groundwater levels increase sufficiently for the water table to intersect the ground surface. Groundwater flooding can occur in a variety of geological settings including valleys and in areas underlain by chalk, and in river valleys with thick deposits of alluvium and river gravels.
- 4.9 There are no groundwater flooding incidents recorded in the proximity of the site as shown in the SFRA map set 1E data as seen in **Figure 13** below (site boundary in white).



Figure 13: SFRA Groundwater Flooding & Bedrock Permeability

- 4.10 The BGS Geo-report suggests that the site does not have persistent shallow groundwater, as shown in **Figure 14** below. However, the report does also suggest that the majority of the site groundwater are likely to be less than 3m below the existing ground surface for at least part of the year. See **Figure 15** below.

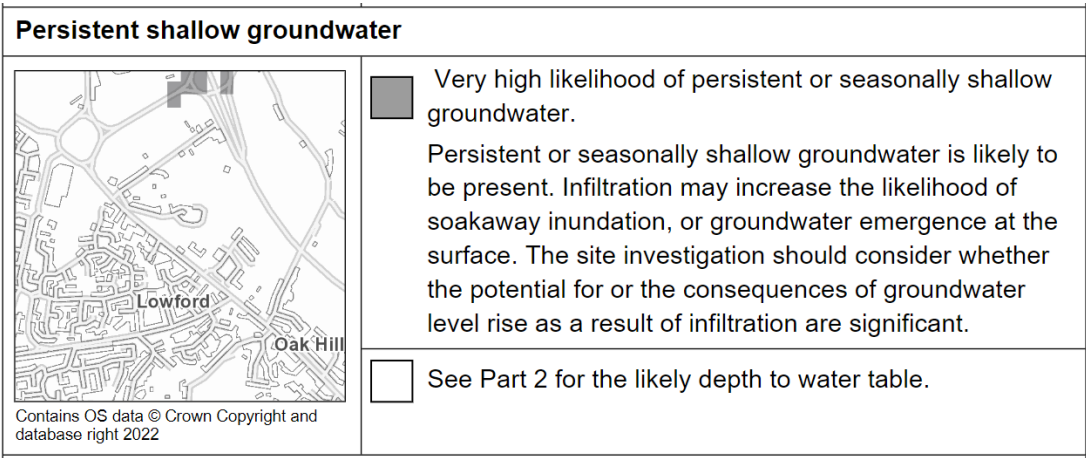


Figure 14: BGS GeoReport Persistent Shallow Groundwater

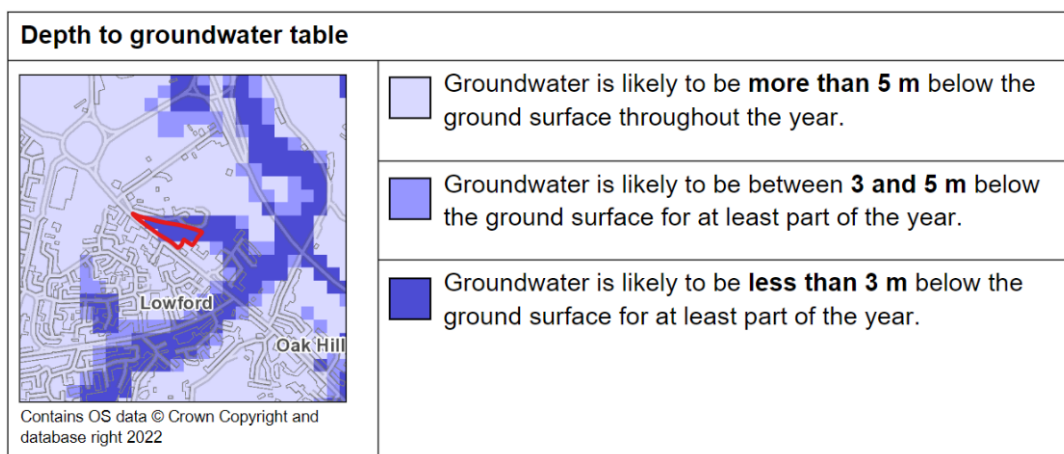


Figure 15: BGS GeoReport Depth to Groundwater Table

4.11 As a result of this depth to groundwater table, alongside the ground instability issues as highlighted in paragraph 2.7, infiltration is not deemed to be suitable for the site as a feasible method for discharging surface water. Instead, a discharge to the existing watercourse to the north of the site shall be pursued.

Sewer Flooding

- 4.12 Sewer flooding occurs when sewers are overwhelmed by intense rainfall or when they become blocked. The probability of this type of flooding occurring depends on the capacity of the local sewerage system and the amount of rain that falls. Land and property can be flooded with sewer water, and rivers may also be polluted by sewers that overflow.
- 4.13 Flooding due to existing foul or sewer drainage infrastructure failing has not been observed in the area by Southern Water, as shown in the SFRA map set 1F data shown in **Figure 16**.



Figure 16: Southern Water Observed Sewer Flooding

5. DRAINAGE STRATEGY

Potential Surface Water Drainage Strategy

- 5.1 In line with the Building Regulations Part H3, surface water shall discharge to one of the following, listed in order of priority:
- An adequate infiltration system: or, where not reasonably practicable,
 - A watercourse; or, where not reasonably practicable,
 - A sewer.
- 5.2 The proposals for the surface water drainage are to store surface run off from the roads and buildings in a vegetated detention basin on site. This vegetated detention basin will provide a first stage of natural filtration in accordance with the requirements of the Eastleigh local plan. The filtration will be provided by the planting contained within the basin. This will then pass through the flow control manhole S13 and run into a dual-swale system before discharging into the existing watercourse adjacent to the northern boundary of the site.
- 5.3 The dual swale system has been implemented to provide second and third stages of natural filtration in accordance with the requirements of the Eastleigh local plan. The filtration will be provided by the planting contained within the swales. This system will consist of two narrow swales separated by a gabion basket weir structure or similar. The system is not designed to attenuate any volume of water nor does it permit infiltration.
- 5.4 The discharge from the flow control manhole S13 will be at a rate that mimics the developed site's greenfield run off rate of 2.5 l/s as noted in paragraph 3.3, restricted by a HydroBrake flow control device. An ordinary watercourse consent will be required.
- 5.5 As per paragraphs 2.5 and 2.6 infiltration is not considered viable for this site. However, pervious paving is proposed to collect surface runoff from driveways and parking areas and provide short term storage at source. This also provides an additional stage of filtration. The pervious paving is to be type C, no infiltration.
- 5.6 A vortex separator / downstream defender has been specified upstream of the detention basin in order to remove oils and petrol residues from arriving at the detention basin.
- 5.7 See drawing **150.5002.501** in **Appendix F** for full details of the proposed drainage strategy.

Surface Water MicroDrainage Calculations

- 5.8 MicroDrainage calculations have been undertaken and show that for all 1-in-1-year, 1-in-30-year and 1-in-100-year events plus a 40% allowance for climate change there is no flooding. The scheme also allows for 10% urban creep on all roof areas. The full MicroDrainage output is contained within **Appendix G**.

Potential Foul Water Drainage Strategy

- 5.9 Based on the accommodation schedule provided on the site layout plan the foul flows from the residential section of the site are estimated to be approximately 10,500 l/day. This figure is derived from an assumption of 150 l/day per person as per both Building Regulations Document H paragraph 2.39 & Flows & Loads 5 guidance.
- 5.10 Flows and loads 5 guidance estimates that a small hospital would be approximately 450 l/day per activity. Based off of this we have estimated flows from the vet clinic to equate to around 4,500 l/day.
- 5.11 Foul flows produced by residential portion of the site are to be drained via a gravity system to a single type 2 pumping station located at the bottom of the site, with a rising main running back up the highway and connecting to the existing public foul water sewer opposite the site entrance along with the commercial rising main.
- 5.12 Foul flows produced by the commercial portion of the site are to be drained via a gravity system to a single type 1 pumping station located within the vet clinic car park, with a rising main running back up the car park and connecting to the existing public foul water sewer opposite the site entrance along with the residential rising main.
- 5.13 Based on the estimated figures derived from Building Regulations Document H and Flows & Loads 4 as noted in paragraphs 5.8 & 5.9, to provide for up to 24-hours storage in the event of a pump failure a minimum of 12.5m³ is required for the residential pump and 4.5m³ for the commercial pump.
- 5.14 In accordance with Natural England requirements, a Nitrogen Budget Calculator has been filled out and determined that the site will generate additional nitrogen. As a result, nitrogen mitigation will be required. See **Appendix H** for Nitrogen budget calculator. Nitrate mitigation is often achieved in the form of off-site nature-based solutions, or simply financial contributions to local LPAs.
- 5.15 See drawing **150.5002.501** in **Appendix F** for full details of the proposed drainage strategy.

6. WATER QUALITY

- 6.1 The proposed vegetated detention basin will provide adequate water quality uplift for the site. See **Table 1**.

Land Use	Pollution Hazard Indices		
	Total Suspended Solids	Metals	Hydrocarbons
Low Traffic Roads	0.5	0.4	0.4
SuDS Component	Pollution Mitigation Indices		
	Total Suspended Solids	Metals	Hydrocarbons
Detention Basin	0.5	0.5	0.6
Swale 1	0.25	0.30	0.30
Swale 2	0.12	0.15	0.15
Permeable Paving	0.70	0.60	0.70
Sufficiency of water treatment	Sufficient	Sufficient	Sufficient

Table 1: UK SuDS Water Quality Toolkit Summary

- 6.2 The detention basin and dual swale system are designed in sequence and are more than sufficient at mitigating pollution hazards. Permeable paving is also proposed, and this will treat a portion of the site.

7. MANAGEMENT & MAINTAINACNE STRATEGY

7.1 The proposed maintenance schedule for the detention basin is shown in **Table 2**.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly (Or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (Spring, before nesting season and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required.
	Check and mechanical devices e.g penstock	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial Actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Table 2: Proposed Maintenance Regime for an Vegetated Detention Basin

7.2 The proposed maintenance schedule for the permeable paving is shown in **Table 3**.

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 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 50mm 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 pointing material	As required
	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, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 3: Proposed Maintenance Regime for Permeable Paving

7.3 The proposed maintenance schedule for the swales is shown in **Table 4**.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly (Or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or as required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required.
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by reseeded or re-turfing	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 4: Proposed Maintenance Regime for a Swale

8. SUMMARY AND CONCLUSION

- 8.1 The site falls entirely within flood zone 1. The development is appropriate for the site according to NPPF guidance.
- 8.2 The site has been assessed for all sources of flood risk including canals, reservoirs, surface water and sewers. This report concludes that the site is at low risk of flooding from rivers, seas and reservoirs, with a low to high risk of flooding due to surface water.
- 8.3 Surface water runoff from the site shall be attenuated in a basin located in the north-eastern portion of the site. This shall then discharge into the watercourse adjacent to the northern boundary of the site at 2.5 l/s, a rate that mimics the greenfield run off rate of the site.
- 8.4 MicroDrainage calculations have been carried out and show that the site will not flood in 1-in-1, 1-in-30 or 1-in-100-year storm events (with 40% climate change and 10% creep to roofs).
- 8.5 Foul flows produced on site shall be taken off site and connected to existing public sewers by a mixture of gravity and pumped systems.
- 8.6 The site has been determined to generate additional nitrogen; mitigation will be required.
- 8.7 As a result of the proposed development there is no increase in flood risk either on site or downstream and it is considered that the development is suitable in the context of flood risk.
- 8.8 The proposed system is determined to provide “Sufficient” water treatment in accordance with the Combined Pollution Mitigation Indices of the UK SuDS Water Quality Toolkit.
- 8.9 The SuDS Management and Maintenance plan shall be implemented as outlined in **Section 7** of this report to maintain the design performance of the SuDS components and it is the responsibility of the site freeholder, leaseholder, or the appointed agent.

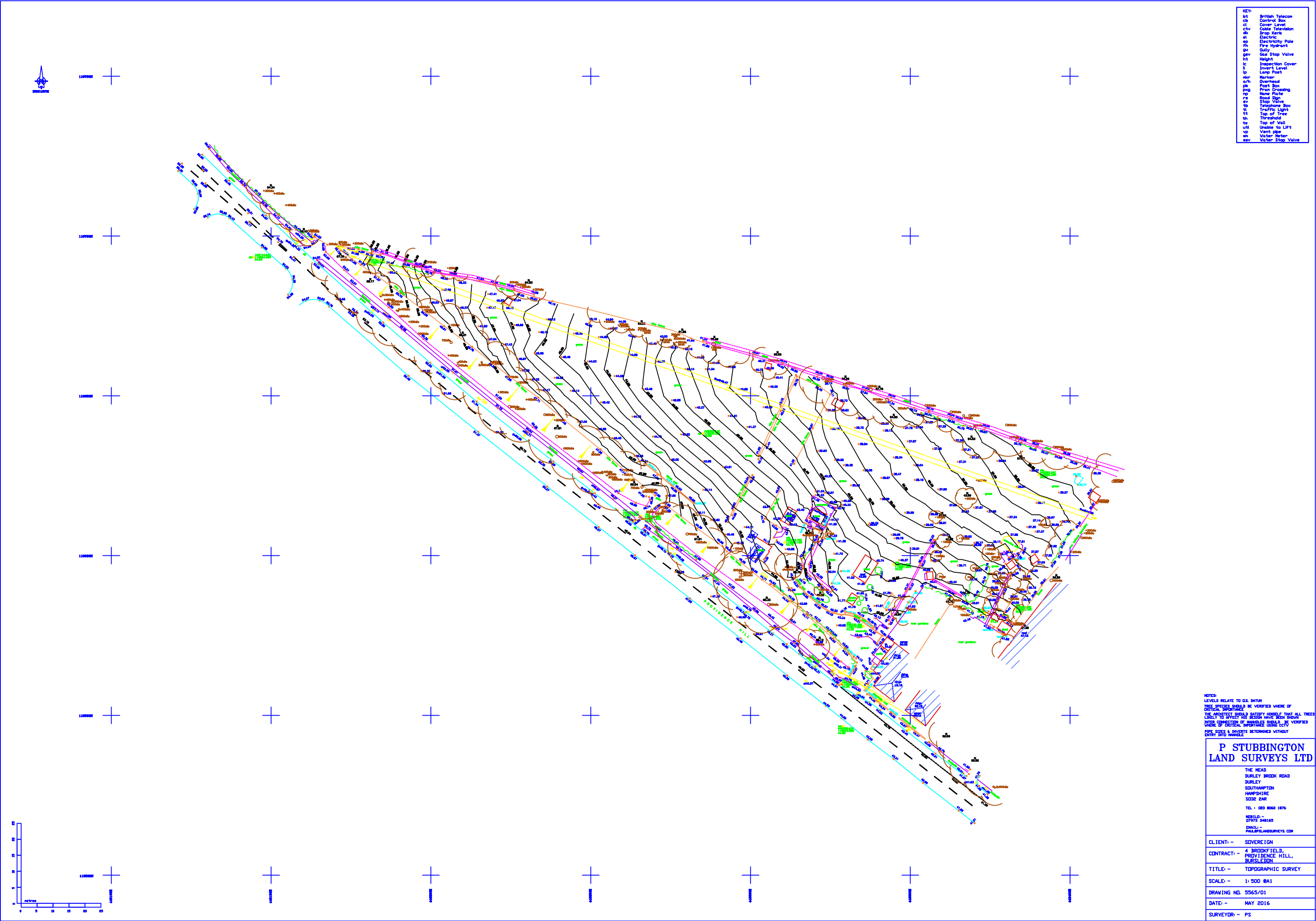
General

- 8.10 It is important to note that the surface and foul water strategies outlined in this report may not necessarily form the final design. It is simply a demonstration of the most suitable and technically feasible designs for the proposed development, based on the information available at present. Site constraints and economic appraisals undertaken as part of the design stage may result in suitable amendments to the current strategies.

Appendix A

Topographical Survey

KEY	
bt	British Telecom
cb	Control Box
cl	Cover Level
ctv	Cable Television
sk	Drop Kerb
el	Electric
ep	Electricity Pole
fh	Fire Hydrant
gu	Gully
gsv	Gas Stop Valve
ht	Height
ic	Inspection Cover
il	Invert Level
lp	Lamp Post
mr	Marker
o/h	Overhead
pb	Post Box
pcg	Pylon Crossing
np	Name Plate
rs	Road Sign
sv	Stop Valve
tb	Telephone Box
tl	Traffic Light
tt	Top of Tree
th	Threshold
tv	Top of Wall
utl	Unable to Lift
vp	Vent pipe
vm	Victor Meter
wsv	Water Stop Valve

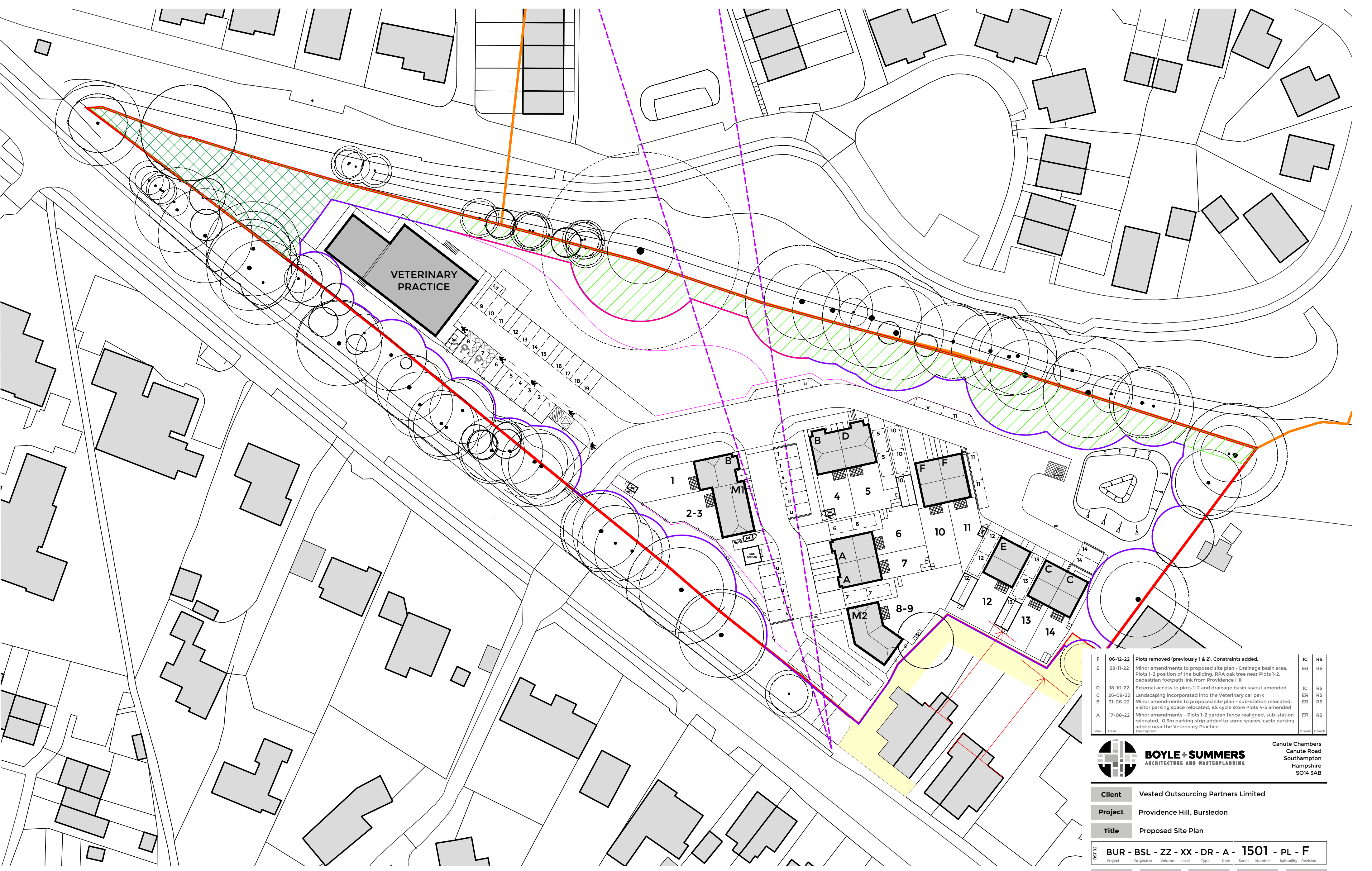


NOTES:
 LEVELS RELATE TO D.S. DATUM
 THESE SPECIES SHOULD BE VERIFIED WHERE OF
 CRITICAL IMPORTANCE
 THE ARCHITECT SHOULD SATISFY HIMSELF THAT ALL TREES
 LIKELY TO AFFECT THE DESIGN HAVE BEEN SHOWN
 WITH CORRECTION OF HANDLES SHOULD BE VERIFIED
 WHERE OF CRITICAL IMPORTANCE USING CTV
 PIPE SIZES & INVERTS DETERMINED WITHOUT
 ENTRY INTO MANHOLE

P STUBBINGTON LAND SURVEYS LTD	
THE HEAD BURLEY BROOK ROAD BURLEY SOUTHAMPTON HAMPSHIRE SO5E 2AR	
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CLIENT:-	SOVEREIGN
CONTRACT:-	4 BROOKFIELD, PROVIDENCE HILL, BURLESDON
TITLE:-	TOPOGRAPHIC SURVEY
SCALE:-	1: 500 @A1
DRAWING NO.	5565/01
DATE:-	MAY 2016
SURVEYOR:-	PS

Appendix B

Architect Site Layout Plan



F	06-12-22	Plots removed (previously 1 & 2). Constraints added.	IC	RS
E	28-11-22	Minor amendments to proposed site plan - Drainage basin area, Plots 1-2 position of the building, RPA oak tree near Plots 1-2, pedestrian footpath link from Providence Hill	ER	RS
D	18-10-22	External access to plots 1-2 and drainage basin layout amended	IC	RS
C	26-09-22	Landscaping incorporated into the Veterinary car park	ER	RS
B	31-08-22	Minor amendments to proposed site plan - sub-station relocated, visitor parking space relocated, BS cycle store Plots 4-5 amended	ER	RS
A	17-08-22	Minor amendments - Plots 1-2 garden fence realigned, sub-station relocated, 0.3m parking strip added to some spaces, cycle parking added near the Veterinary Practice	ER	RS
Rev.	Date	Description	Drawn	Check



BOYLE+SUMMERS
ARCHITECTURE AND MASTERPLANNING

Canute Chambers
Canute Road
Southampton
Hampshire
SO14 3AB

Client Vested Outsourcing Partners Limited

Project Providence Hill, Bursledon

Title Proposed Site Plan

BS1012

BUR - BSL - ZZ - XX - DR - A -						1501 - PL - F			
Project	Originator	Volume	Level	Type	Role	Series	Number	Suitability	Revision

B+S Ref.	Date	Scale @ A2	Drawn	Checked
21119	May 2022	1:500	ER	RS

Tel: 023 8063 1432 www.boyleandsummers.co.uk

Other than for the purposes of planning, do not scale these drawings. Use written dimensions only. All dimensions to be checked on site prior to commencement of work.

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PLANNING



Appendix C

BGS GeoReport

Paul Basham Associates
The Bothy
Cams Hall Estate
Fareham
PO16 8UT

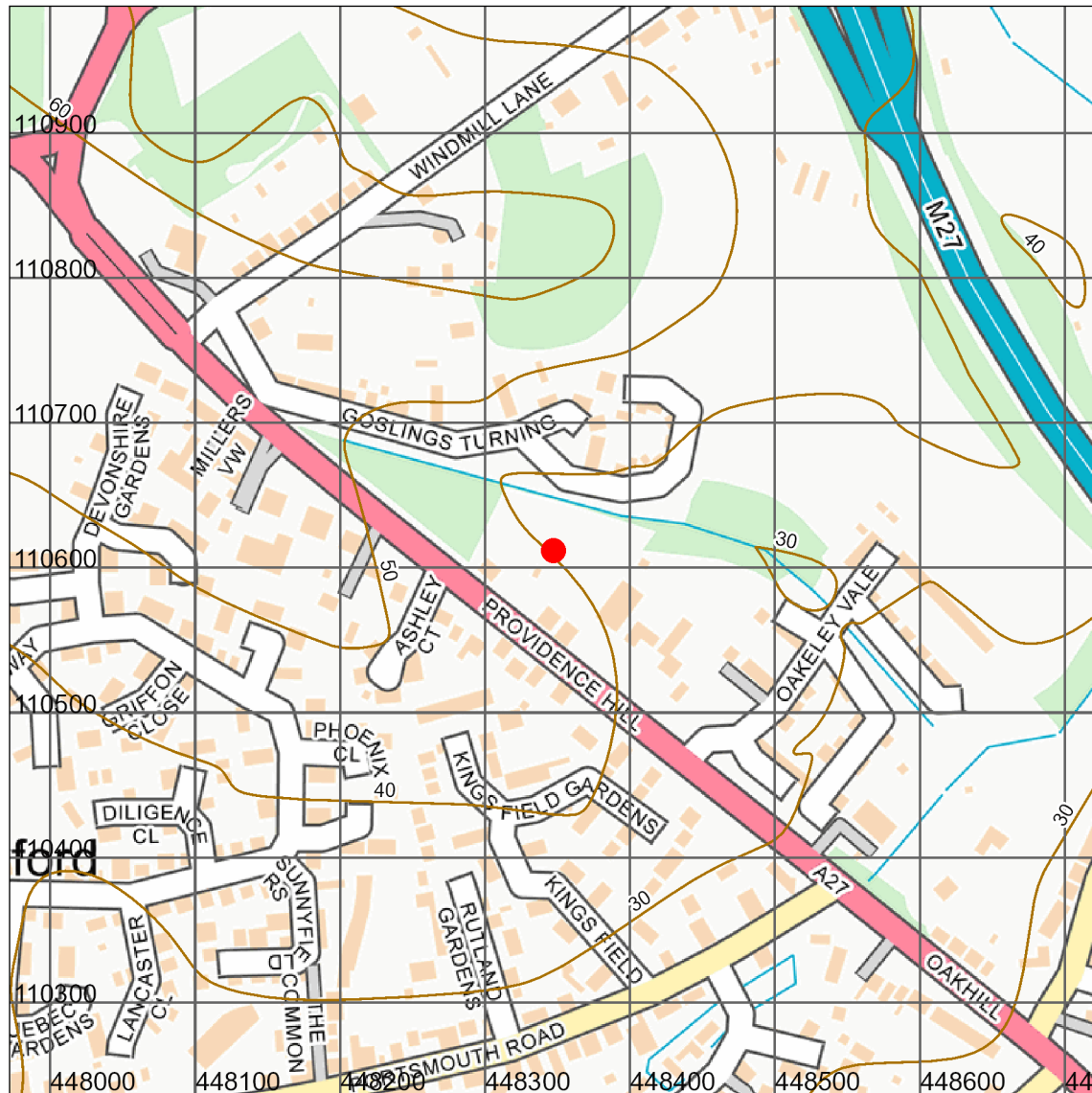
Infiltration SuDS GeoReport:

This report provides information on the suitability of the subsurface for the installation of infiltration sustainable drainage systems (SuDS). It provides information on the properties of the subsurface with respect to significant constraints, drainage, ground stability and groundwater quality protection.

Report Id: *BGS_325123/32696*

Client reference: Providence PO8502

Search location



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Search location indicated in red

Point centred at: 448347,110612

Assessment for an infiltration sustainable drainage system

Introduction

Sustainable drainage systems (SuDS) are drainage solutions that manage the volume and quality of surface water close to where it falls as rain. They aim to reduce flow rates to rivers, increase local water storage capacity and reduce the transport of pollutants to the water environment. There are four main types of SuDS, which are often designed to be used in sequence. They comprise:

- **source control:** systems that control the rate of runoff
- **pre-treatment:** systems that remove sediments and pollutants
- **retention:** systems that delay the discharge of water by providing surface storage
- **infiltration:** systems that mimic natural recharge to the ground.

This report focuses on infiltration SuDS. It provides subsurface information on the properties of the ground with respect to drainage, ground stability and groundwater quality protection. It is intended principally for those involved in the preliminary assessment of the suitability of the ground for infiltration SuDS, and those involved in assessing proposals from others for sustainable drainage, but it may also be useful to help house-holders judge whether or not further professional advice should be sought. If in doubt, users should consult a suitably-qualified professional about the results in this report before making any decisions based upon it.

This GeoReport is structured in two parts:

- **Part 1. Summary data.**

Comprises three maps that summarise the data contained within Part 2.

- **Part 2. Detailed data.**

Comprises a further 24 maps in four thematic sections:

- **Very significant constraints.** Maps highlight areas where infiltration may result in adverse impacts due to factors including: ground instability (soluble rocks, non-coal shallow mining and landslide hazards); persistent shallow groundwater, or the presence of made ground, which may represent a ground stability or contamination hazard.
- **Drainage potential.** Maps indicate the drainage potential of the ground, by considering subsurface permeability, depth to groundwater and the presence of floodplain deposits.
- **Ground stability.** Maps indicate the presence of hazards that have the potential to cause ground instability resulting in damage to some buildings and structures, if water is infiltrated to the ground.
- **Groundwater protection.** Maps provide key indicators to help determine whether the groundwater may be susceptible to deterioration in quality as a result of infiltration.

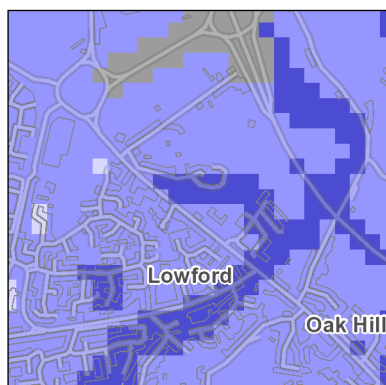
This report considers the suitability of the subsurface for the installation of infiltration SuDS, such as soakaways, infiltration basins or permeable pavements. It provides subsurface data to indicate whether, and which type of infiltration system may be appropriate. It does not state that infiltration SuDS are, or are not, appropriate as this is highly dependent on the design of the individual system. This report therefore describes the subsurface conditions at the site, allowing the reader to determine the suitability of the site for infiltration SuDS.

The map and text data in this report is similar to that provided in the '*Infiltration SuDS Map: Detailed*' national map product. For further information about the data, consult the '*User Guide for the Infiltration SuDS Map: Detailed*', available from <http://nora.nerc.ac.uk/16618/>.

PART 1: SUMMARY DATA

This section provides a summary of the data.

In terms of the drainage potential, is the ground suitable for infiltration SuDS?



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-  Highly compatible for infiltration SuDS. The subsurface is likely to be suitable for free-draining infiltration SuDS.
-  Probably compatible for infiltration SuDS. The subsurface is probably suitable although the design may be influenced by the ground conditions.
-  Opportunities for bespoke infiltration SuDS. The subsurface is potentially suitable although the design will be influenced by the ground conditions.
-  Very significant constraints are indicated. There is a very significant potential for one or more hazards associated with infiltration.

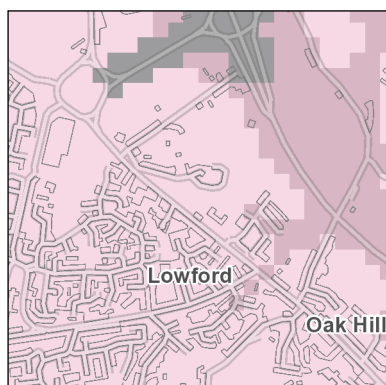
Is ground instability likely to be a problem?



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-  Increased infiltration is very unlikely to result in ground instability.
-  Ground instability problems may be present or anticipated, but increased infiltration is unlikely to result in ground instability.
-  Ground instability problems are probably present. Increased infiltration may result in ground instability.
-  There is a very significant potential for one or more geohazards associated with infiltration.

Is the groundwater susceptible to deterioration in quality?



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-  The groundwater is not expected to be especially vulnerable to contamination.
-  The groundwater may be vulnerable to contamination.
-  The groundwater is likely to be vulnerable to contaminants.
-  Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

PART 2: DETAILED DATA

This section provides further information about the properties of the ground and will help assess the suitability of the ground for infiltration SuDS.

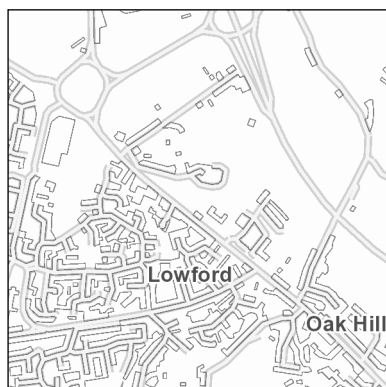
Section 1. Very significant constraints

Where maps are overlain by grey polygons, geological or hydrogeological hazards may exist that could be made worse by infiltration. The following hazards are considered:

- soluble rocks
- landslides
- shallow mining
- shallow groundwater
- made ground

For more information read 'Explanation of terms' at the end of this report.

Soluble rock hazard

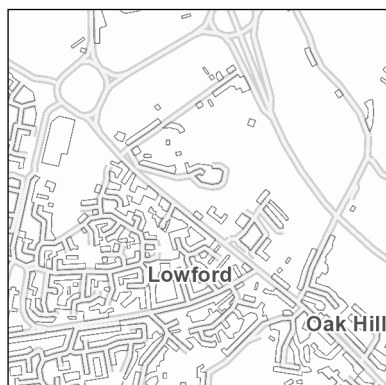


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☒ Very significant soluble rock hazard.
Soluble rocks are present with a very significant possibility of localised subsidence that could be initiated or made worse by infiltration. The site investigation should consider whether the potential for or the consequences of subsidence as a result of infiltration are significant.

☐ Very significant soluble rock hazards are not present; however this hazard may still need to be considered. See Part 3.

Landslide hazard

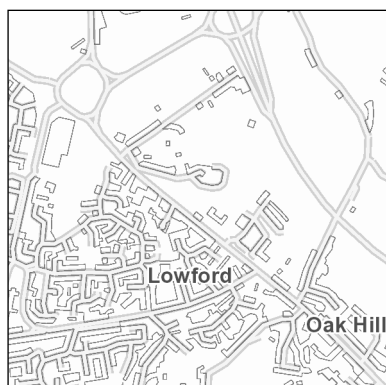


Contains OS data © Crown Copyright and database right 2022

☒ Very significant landslide hazard.
Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail. The site investigation should consider whether the potential for or the consequences of landslide as a result of infiltration are significant.

☐ Very significant landslide hazards are not present; however this hazard may still need to be considered. See Part 3.

Shallow mining hazard

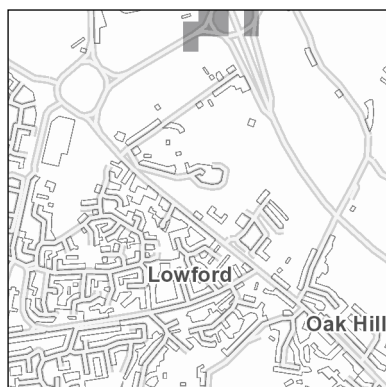


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☒ Very significant mining hazard.
Shallow mining is likely to be present with a very significant possibility of localised subsidence that could be initiated or made worse by increased infiltration. Also, infiltration may increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of subsidence and/or remobilisation of pollutants as a result of infiltration are significant.

☐ Very significant mining hazards are not present; however this hazard may still need to be considered. See Part 3.

Persistent shallow groundwater



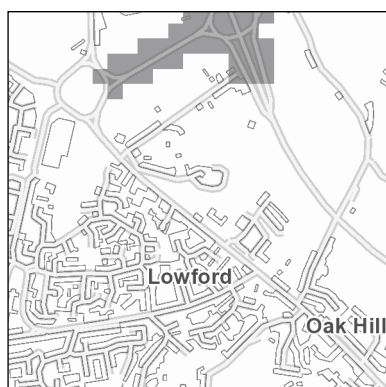
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☒ Very high likelihood of persistent or seasonally shallow groundwater.

Persistent or seasonally shallow groundwater is likely to be present. Infiltration may increase the likelihood of soakaway inundation, or groundwater emergence at the surface. The site investigation should consider whether the potential for or the consequences of groundwater level rise as a result of infiltration are significant.

☐ See Part 2 for the likely depth to water table.

Made ground



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☒ Made ground present.
Made ground is present at the surface. Infiltration may affect ground stability or increase the possibility of remobilising pollutants. The site investigation should consider whether the potential for or consequences of ground instability and/or pollutant leaching as a result of infiltration are significant.

☐ None recorded

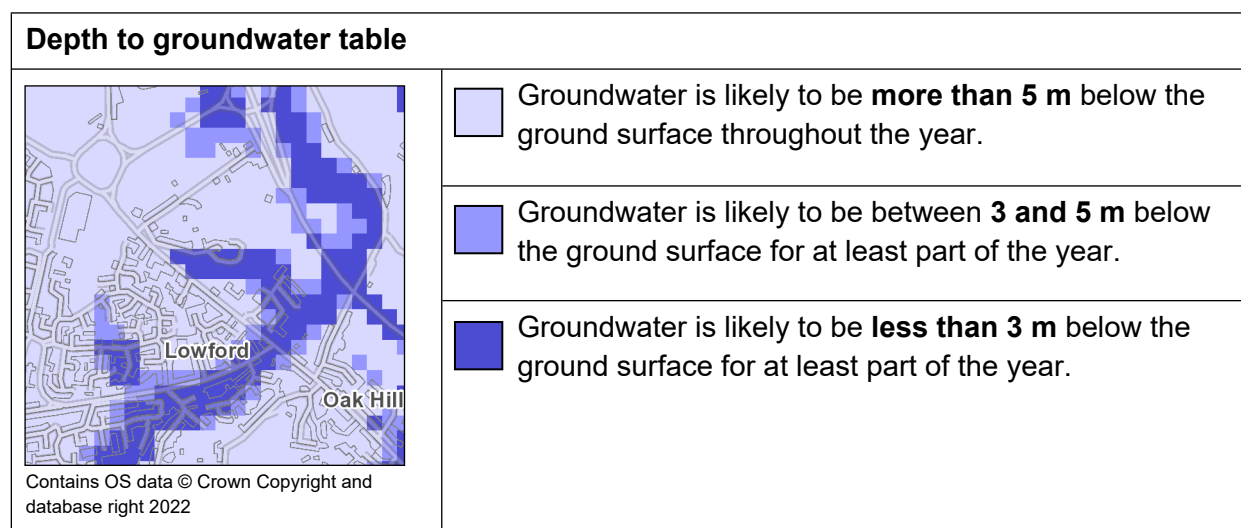
Section 2. Drainage potential

The following pages contain maps that will help you assess the drainage potential of the ground by considering the:

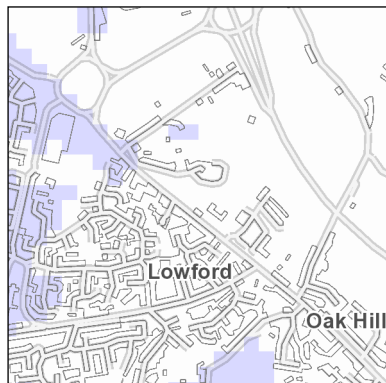
- depth to water table
- permeability of the superficial deposits
- thickness of the superficial deposits
- permeability of the bedrock
- presence of floodplains

Superficial deposits are not present everywhere and therefore some areas of the *superficial deposit permeability* map may not be coloured. Where this is the case, the *bedrock permeability* map shows the likely permeability of the ground. Superficial deposits in some places are very thin and hence in these places you may wish to consider both the permeability of the superficial deposits and the permeability of the bedrock. The *superficial thickness* map will tell you whether the superficial deposits are thin (< 3 m thick) or thick (>3 m). Where they are over 3 m thick, the permeability of the bedrock may not be relevant.

For more information read 'Explanation of terms' at the end of this report.



Superficial deposit permeability



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Superficial deposits are likely to be **free-draining**.



The superficial deposit permeability is **spatially variable**, but likely to permit moderate infiltration.

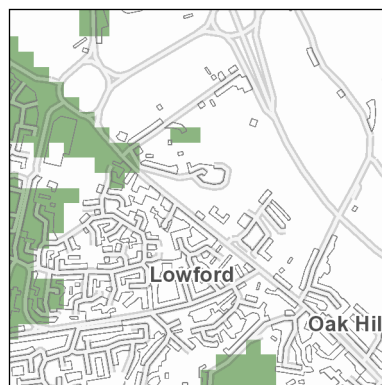


Superficial deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

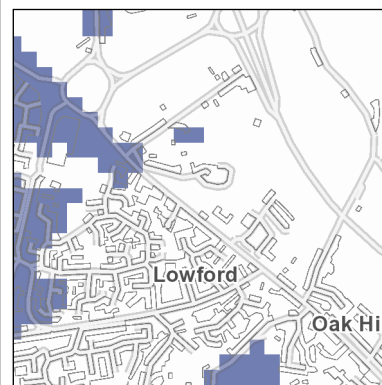
-  Very Low
-  Low
-  Moderate
-  High
-  Very High

Minimum



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Maximum



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Superficial deposit thickness



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The thickness of superficial deposits is **< 3 m** and hence the permeability of the ground may be dependent on both the superficial deposits (where present) and underlying bedrock (see below).



The thickness of superficial deposits is **> 3 m** and hence the permeability of the superficial deposits is likely to determine the permeability of the ground.

Bedrock permeability



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Bedrock deposits are likely to be **free-draining**.



The bedrock permeability is **spatially variable**, but likely to permit moderate infiltration.



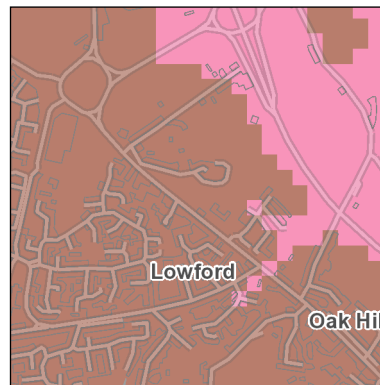
Bedrock deposits are likely to be **poorly draining**.

These maps show the permeability range that is summarised above.

Key

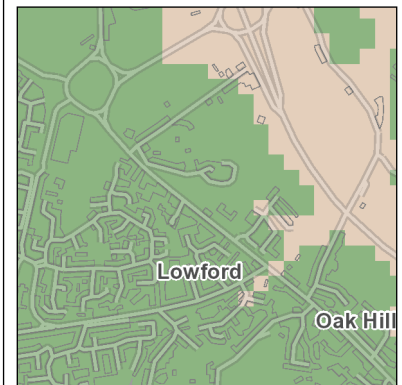
- Very Low
- Low
- Moderate
- High
- Very High

Minimum



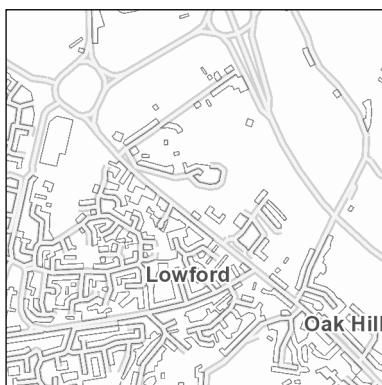
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Maximum



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Geological indicators of flooding



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Superficial floodplain deposits or low-lying coastal areas have been identified. Groundwater levels may rise in response to high river or tide levels, potentially causing inundation of subsurface infiltration SuDS.

Section 3. Ground stability

The following pages contain maps that will help you assess whether infiltration may impact the stability of the ground. They consider hazards associated with:

- soluble rocks
- landslides
- shallow mining
- running sands
- swelling clays
- compressible ground, and
- collapsible ground

In the following maps, geohazards that are identified in green are unlikely to prevent infiltration SuDS from being installed, but they should be considered during design. For more information read 'Explanation of terms' at the end of this report.

Soluble rocks	
 Contains OS data © Crown Copyright and database right 2022	 Increased infiltration is unlikely to result in subsidence.
	 Increased infiltration is unlikely to cause localised subsidence, but potential impacts should be considered.
	 Increased infiltration may result in localised subsidence. The potential for or the consequences of subsidence associated with soluble rocks should be considered.
	 Very significant possibility of localised subsidence that could be initiated or made worse by infiltration.

Landslides



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-  Increased infiltration is unlikely to lead to slope instability.
-  Slope instability problems may be present or anticipated, but increased infiltration is unlikely to cause instability
-  Slope instability problems are probably present or have occurred in the past, and increased infiltration may result in slope instability.
-  Slope instability problems are almost certainly present and may be active. An increase in moisture content as a result of infiltration may cause the slope to fail.

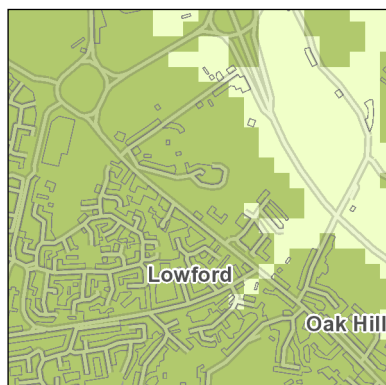
Shallow mining



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-  Increased infiltration is unlikely to lead to subsidence.
-  Shallow mining is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
-  Shallow mining could be present with a significant possibility that localised subsidence could be initiated or made worse by increased infiltration.
-  Shallow mining is likely to be present, with a very significant possibility that localised subsidence may be initiated or made worse by increased infiltration.

Running sand



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-  Increased infiltration is unlikely to cause ground collapse associated with running sands.
-  Running sand is possibly present. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
-  Significant possibility for running sand problems. Increased infiltration may result in a geohazard.

Swelling clays



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-  Increased infiltration is unlikely to cause shrink-swell ground movement.
-  Ground is susceptible to shrink-swell ground movement. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
-  Ground is susceptible to shrink-swell ground movement. Increased infiltration may result in a geohazard.

Compressible ground



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-  Increased infiltration is unlikely to lead to ground compression.
-  Compressibility and uneven settlement hazards are probably present. Increased infiltration may result in a geohazard.

Collapsible ground



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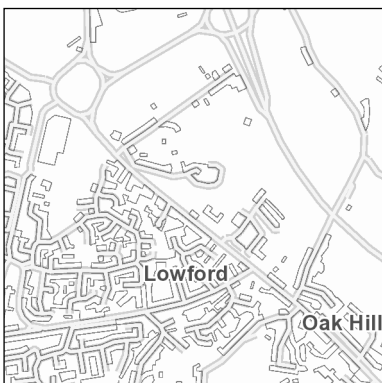
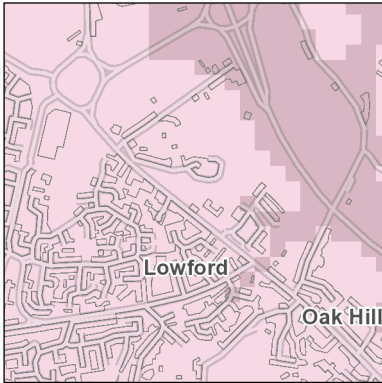
-  Increased infiltration is unlikely to result in subsidence.
-  Deposits with potential to collapse when loaded and saturated are possibly present in places. Increased infiltration is unlikely to cause a geohazard, but potential impacts should be considered.
-  Deposits with potential to collapse when loaded and saturated are probably present in places. Increased infiltration may result in a geohazard.

Section 4. Groundwater quality protection

The following pages contain maps showing some of the information required to ensure the protection of groundwater quality. Data presented includes:

- groundwater source protection zones (Environment Agency data)
- predominant flow mechanism
- made ground

For more information read 'Explanation of terms' at the end of this report.

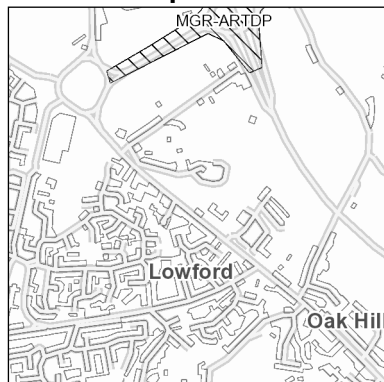
Groundwater source protection zones	
 Contains OS data © Crown Copyright and database right 2022 Derived in part from Source Protection Zone data provided under licence from the Environment Agency © Environment Agency 2022.	 Groundwater is not within a source protection zone.
	 Source protection zone IV
	 Source protection zone III
	 Source protection zone II
	 Source protection zone I
Predominant flow mechanism	
 Contains OS data © Crown Copyright and database right 2022	 Water is likely to percolate through the unsaturated zone to the groundwater through either the pore space in granular media or through porespace and fractures; these processes have some potential for contaminant removal and breakdown.
	 Water is likely to percolate through the unsaturated zone to the groundwater through fractures, a process which has little potential for contaminant removal and breakdown.

Made ground	
 Contains OS data © Crown Copyright and database right 2022	 Made ground is present at the surface. Infiltration may increase the possibility of remobilising pollutants.

Section 5. Geological Maps

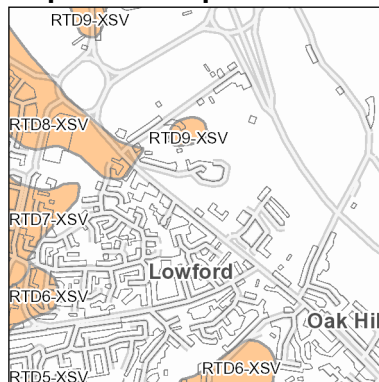
The following maps show the artificial, superficial and bedrock geology within the area of interest.

Artificial deposits



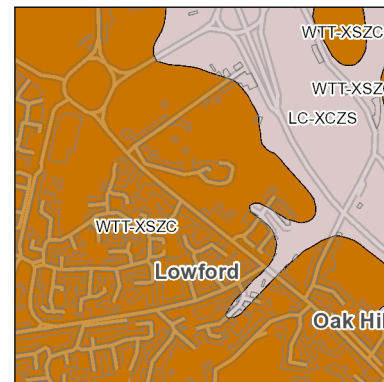
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Superficial deposits

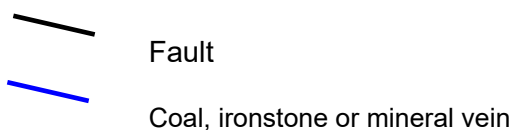


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Bedrock



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Note: Faults and Coals, ironstone & mineral veins are shown for illustration and to aid interpretation of the map. Not all such features are shown and their absence on the map face does not necessarily mean that none are present

Key to Artificial deposits:

Map colour	Computer Code	Rock name	Rock type
	MGR-ARTDP	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT

Key to Superficial deposits:

Map colour	Computer Code	Rock name	Rock type
	RTD5-XSV	RIVER TERRACE DEPOSITS, 5	SAND AND GRAVEL
	RTD6-XSV	RIVER TERRACE DEPOSITS, 6	SAND AND GRAVEL
	RTD7-XSV	RIVER TERRACE DEPOSITS, 7	SAND AND GRAVEL
	RTD8-XSV	RIVER TERRACE DEPOSITS, 8	SAND AND GRAVEL
	RTD9-XSV	RIVER TERRACE DEPOSITS, 9	SAND AND GRAVEL

Key to Bedrock geology:

Map colour	Computer Code	Rock name	Rock type
	LC-XCZS	LONDON CLAY FORMATION	CLAY, SILT AND SAND
	WTT-XSZC	WITTERING FORMATION	SAND, SILT AND CLAY

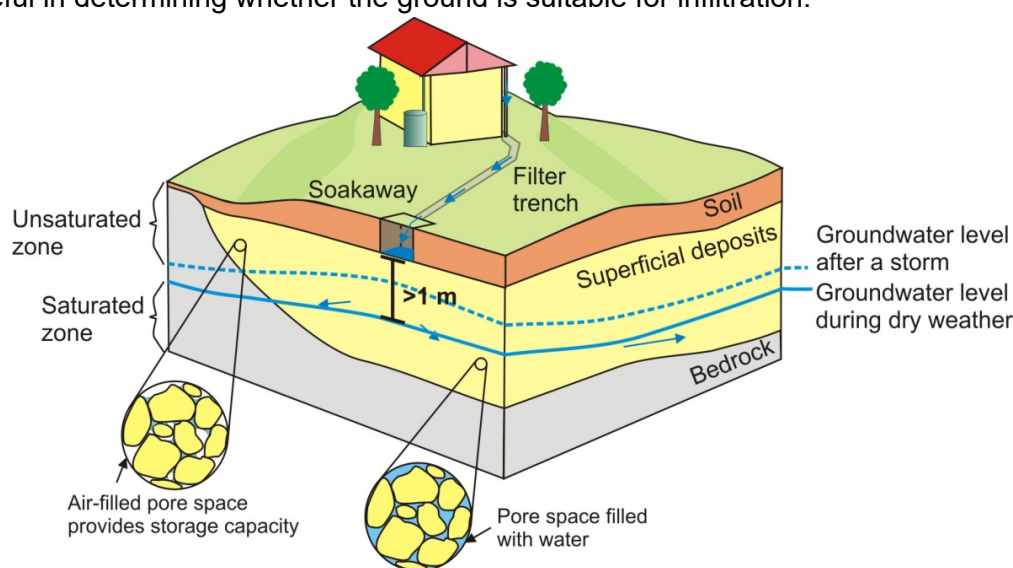
Limitations of this report:

- This report is concerned with the potential for infiltration-to-the-ground to be used as a SuDS technique at the site described. It only considers the subsurface beneath the search area and does NOT consider potential surface or subsurface impacts outside of that area.
- This report is NOT an alternative for an on-site investigation or soakaway test, which might reach a different conclusion.
- This report must NOT be used to justify disposal of foul waste or grey water.
- This report is based on and limited to an interpretation of the records held by the British Geological Survey (BGS) at the time the search is performed. The datasets used (with the exception of that showing depth to water table) are based on 1:50 000 digital geological maps and not site-specific data.
- Other more specific and detailed ground instability information for the site may be held by BGS, and an assessment of this could result in a modified assessment.
- To interpret the maps correctly, the report must be viewed and printed in colour.
- The search does NOT consider the suitability of sites with regard to:
 - previous land use,
 - potential for, or presence of contaminated land
 - presence of perched water tables
 - shallow mining hazards relating to coal mining. Searches of coal mining should be carried out via The Coal Authority Mine Reports Service: www.coalminingreports.co.uk.
 - made ground, where not recorded
 - proximity to landfill sites (searches for landfill sites or contaminated land should be carried out through consultation with local authorities/Environment Agency)
 - zones around private water supply boreholes that are susceptible to groundwater contamination.
- This report is supplied in accordance with the GeoReports Terms & Conditions available separately, and the copyright restrictions described at the end of this report

Explanation of terms

Depth to groundwater

In the shallow subsurface, the ground is commonly unsaturated with respect to water. Air fills the spaces within the soil and the underlying superficial deposits and bedrock. At some depth below the ground surface, there is a level below which these spaces are full of water. This level is known as the groundwater level, and the water below it is termed the groundwater. When water is infiltrated, the groundwater level may rise temporarily. To ensure that there is space in the unsaturated zone to accommodate this, there should be a minimum thickness of 1 m between the base of the infiltration system and the water table. An estimate of the *depth to groundwater* is therefore useful in determining whether the ground is suitable for infiltration.



Groundwater flooding

Groundwater flooding occurs when a rise in groundwater level results in very shallow groundwater or the emergence of groundwater at the surface. If infiltration systems are installed in areas that are susceptible to groundwater flooding, it is possible that the system could become inundated. The susceptibility map seeks to identify areas where the geological conditions and water tables indicate that groundwater level rise could occur under certain circumstances. A high susceptibility to groundwater flooding classification does not mean that groundwater flooding has ever occurred in the past, or will do so in the future as the susceptibility maps do not contain information on how often flooding may occur. The susceptibility maps are designed for planning; identifying areas where groundwater flooding might be an issue that needs to be taken into account.

Geological indicators of flooding

In floodplain deposits, groundwater level can be influenced by the water level in the adjacent river. Groundwater level may increase during periods of fluvial flood and therefore this should be taken into account when designing infiltration systems on such deposits. The *geological indicators of flooding* dataset shows where there is geological evidence (floodplain deposits) that flooding has occurred in the past.

For further information on flood-risk, the likely frequency of its recurrence in relation to any proposed development of the site, and the status of any flood prevention measures in place, you are advised to contact the local office of the Environment Agency (England and Wales) at www.environment-agency.gov.uk/ or the Scottish Environment Protection Agency (Scotland) at www.sepa.org.uk.

Artificial ground

Artificial ground comprises deposits and excavations that have been created or modified by human activity. It includes ground that is worked (quarries and road cuttings), infilled (back-filled quarries), landscaped (surface re-shaping), disturbed (near surface mineral workings) or classified as made ground (embankments and spoil heaps). The composition and properties of artificial ground are often unknown. In particular, the permeability and chemical composition of the artificial ground should be determined to ensure that the ground will drain and that any contaminants present will not be remobilised.

Superficial permeability

Superficial deposits are those geological deposits that were formed during the most recent period of geological time (as old as 2.6 million years before present). They generally comprise relatively thin deposits of gravel, sand, silt and clay and are present beneath the pedological soil in patches or larger spreads over much of Britain. The ease with which water can percolate through these deposits is controlled by their permeability and varies widely depending on their composition. Those deposits comprising clays and silts are less permeable and thus infiltration is likely to be slow, such that water may pool on the surface. In comparison, deposits comprising sands and gravels are more permeable allowing water to percolate freely.

Bedrock permeability

Bedrock forms the main mass of rock forming the Earth. It is present everywhere, commonly beneath superficial deposits. Where the superficial deposits are thin or absent, the ease with which water will percolate into the ground depends on the permeability of the bedrock.

Natural ground instability

Natural ground instability refers to the propensity for upward, lateral or downward movement of the ground that can be caused by a number of natural geological hazards (e.g. ground dissolution/compressible ground). Some movements associated with particular hazards may be gradual and of millimetre or centimetre scale, whilst others may be sudden and of metre or tens of metres scale. Significant natural ground instability has the potential to cause damage to buildings and structures, especially when the drainage characteristics of a site are altered. It should be noted, however, that many buildings, particularly more modern ones, are built to such a standard that they can remain unaffected in areas of significant ground movement.

Shrink-swell

A shrinking and swelling clay changes volume significantly according to how much water it contains. All clay deposits change volume as their water content varies, typically swelling in winter and shrinking in summer, but some do so to a greater extent than others. Contributory circumstances could include drought, leaking service pipes, tree roots drying-out the ground or changes to local drainage patterns, such as the creation of soakaways. Shrinkage may remove support from the foundations of buildings and structures, whereas clay expansion may lead to uplift (heave) or lateral stress on part or all of a structure; any such movements may cause cracking and distortion.

Landslides (slope stability)

A landslide is a relatively rapid outward and downward movement of a mass of ground on a slope, due to the force of gravity. A slope is under stress from gravity but will not move if its strength is greater than this stress. If the balance is altered so that the stress exceeds the strength, then movement will occur. The stability of a slope can be reduced by removing ground at the base of the slope, by placing material on the slope, especially at the top, or by increasing the water content of the materials forming the slope. Increase in subsurface water content beneath a soakaway could increase susceptibility to landslide hazards. The assessment of landslide hazard refers to the stability of the present land surface. It does not encompass a consideration of the stability of excavations.

Soluble rocks (dissolution)

Some rocks are soluble in water and can be progressively removed by the flow of water through the ground. This process tends to create cavities, potentially leading to the collapse of overlying materials and possibly subsidence at the surface. The release of water into the subsurface from infiltration systems may increase the dissolution of rock or destabilise material above or within a cavity. Dissolution cavities may create a pathway for rapid transport of contaminated water to an aquifer or water course.

Compressible ground

Many ground materials contain water-filled pores (the spaces between solid particles). Ground is compressible if a building (or other load) can cause the water in the pore space to be squeezed out, causing the ground to decrease in thickness. If ground is extremely compressible the building may sink. If the ground is not uniformly compressible, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The compressibility of the ground may alter as a result of changes in subsurface water content caused by the release of water from soakaways.

Collapsible deposits

Collapsible ground comprises certain fine-grained materials with large pore spaces (the spaces between solid particles). It can collapse when it becomes saturated by water and/or a building (or other structure) places too great a load on it. If the material below a building collapses it may cause the building to sink. If the collapsible ground is variable in thickness or distribution, different parts of the building may sink by different amounts, possibly causing tilting, cracking or distortion. The subsurface underlying a soakaway will experience an increase in water content that may affect the stability of the ground. This hazard is most likely to be encountered only in parts of southern England.

Running sand

Running sand conditions occur when loosely-packed sand, saturated with water, flows into an excavation, borehole or other type of void. The pressure of the water filling the spaces between the sand grains reduces the contact between the grains and they are carried along by the flow. This can lead to subsidence of the surrounding ground. Running sand is potentially hazardous during the drainage system installation. During installation, excavation of the ground may create a space into which sand can flow, potentially causing subsidence of surrounding ground.

Shallow mining hazards (non coal)

Current or past underground mining for coal or for other commodities can give rise to cavities at shallow or intermediate depths, which may cause fracturing, general settlement, or the formation of crown-holes in the ground above. Spoil from mineral workings may also present a pollution hazard. The release of water into the subsurface from soakaways may destabilise material above or within a cavity. Cavities arising as a consequence of mining may also create a pathway for rapid transport of contaminated water to an aquifer or watercourse. The mining hazards map is derived from the geological map and considers the potential for subsidence associated with mining on the basis of geology type. Therefore if mining is known to occur within a certain rock, the map will highlight the potential for a hazard within the area covered by that geology.

For more information regarding underground and opencast **coal mining**, the location of mine entries (shafts and adits) and matters relating to subsidence or other ground movement induced by **coal mining** please contact the Coal Authority, Mining Reports, 200 Lichfield Lane, Mansfield, Nottinghamshire, NG18 4RG; telephone 0845 762 6848 or at www.coal.gov.uk. For more information regarding other types of mining (i.e. non-coal), please contact the British Geological Survey.

Groundwater source protection zones

In England and Wales, the Environment Agency has defined areas around wells, boreholes and springs that are used for the abstraction of public drinking water as source protection zones. In conjunction with Groundwater Protection Policy the zones are used to restrict activities that may impact groundwater quality, thereby preventing pollution of underlying aquifers, such that drinking water quality is upheld. The Environment Agency can provide advice on the location and implications of source protection zones in your area (www.environment-agency.gov.uk/)

Contact Details

Keyworth Office

British Geological Survey
Environmental Science Centre
Nicker Hill
Keyworth
Nottingham
NG12 5GG
Tel: 0115 9363143
Email: enquiries@bgs.ac.uk

Wallingford Office

British Geological Survey
Maclean Building
Wallingford
Oxford
OX10 8BB
Email: enquiries@bgs.ac.uk

Edinburgh Office

British Geological Survey
Lyell Centre
Research Avenue South
Edinburgh
EH14 4AP
Tel: 0131 6671000
Email: enquiry@bgs.ac.uk

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- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
- Raw data may have been transcribed from analogue to digital format, or may have been acquired by means of automated measuring techniques. Although such processes are subjected to quality control to ensure reliability where possible, some raw data may have been processed without human intervention and may in consequence contain undetected errors.
- Detail, which is clearly defined and accurately depicted on large-scale maps, may be lost when small-scale maps are derived from them.
- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
- The most appropriate techniques for copying original records are used, but there may be some loss of detail and dimensional distortion when such records are copied.
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- Data, information and related records, which have been donated to BGS, have been produced for a specific purpose, and that may affect the type and completeness of the data recorded and any interpretation. The nature and purpose of data collection, and the age of the resultant material may render it unsuitable for certain applications/uses. You must verify the suitability of the material for your intended usage.
- If a report or other output is produced for you on the basis of data you have provided to BGS, or your own data input into a BGS system, please do not rely on it as a source of information about other areas or geological features, as the report may omit important details.
- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
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**Report issued by
BGS Enquiry Service**

Appendix D

HR Wallingford Greenfield Runoff Calculations

Calculated by:	John Comer
Site name:	Providence Hill
Site location:	Bursledon

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.

Site Details

Latitude:	50.89335° N
Longitude:	1.31507° W
Reference:	2615263451
Date:	Sep 17 2021 11:18

Runoff estimation approach**Site characteristics**

Total site area (ha):	1.12
-----------------------	-----------------------------------

Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	784	784
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes**(1) Is Q_{BAR} < 2.0 l/s/ha?**

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):	6.17	6.17
1 in 1 year (l/s):	5.25	5.25
1 in 30 years (l/s):	14.2	14.2
1 in 100 year (l/s):	19.69	19.69
1 in 200 years (l/s):	23.09	23.09

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at 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 www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of 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, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Calculated by:

Site name:

Site location:

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.

Site Details

Latitude:

Longitude:

Reference:

Date:

Runoff estimation approach

Site characteristics

Total site area (ha):

Methodology

Q_{BAR} estimation method:

SPR estimation method:

Soil characteristics	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	784	784
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates	Default	Edited
Q_{BAR} (l/s):	2.48	2.48
1 in 1 year (l/s):	2.11	2.11
1 in 30 years (l/s):	5.71	5.71
1 in 100 year (l/s):	7.91	7.91
1 in 200 years (l/s):	9.28	9.28

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at 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 www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of 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, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Appendix E

Southern Water Sewer Records



Foreman Homes Ltd
Unit 1 Station Industrial Park
Duncan Road
Park Gate
SO31 1BX

Your Ref smk
Our Ref 191464
Date 12 March 2015
Contact searches@southernwater.co.uk
Fax 01634 844514
DX:400450 Chatham 5

Attention: Laura Whitaker

Dear Sirs

Provision of Public Sewer and Water Main Record Extracts – VAT Receipt
Misery, Bursledon, Hampshire

Further to your recent enquiry regarding the provision of Southern Water apparatus record extracts for the above location.

Please 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. Therefore actual positions of the disclosed (and any undisclosed) infrastructure should be determined on site, because Southern Water does not accept any responsibility for inaccuracy or omission regarding the enclosed plan and accordingly it should not be considered to be a definitive document.

I confirm payment of the appropriate fee in the sum of £ **48.00**

The breakdown of costs is as follows: -

- Provision of record extracts £ 40.00
- VAT @ 20.0% £ 8.00

VAT Registration Number 813 0378 56

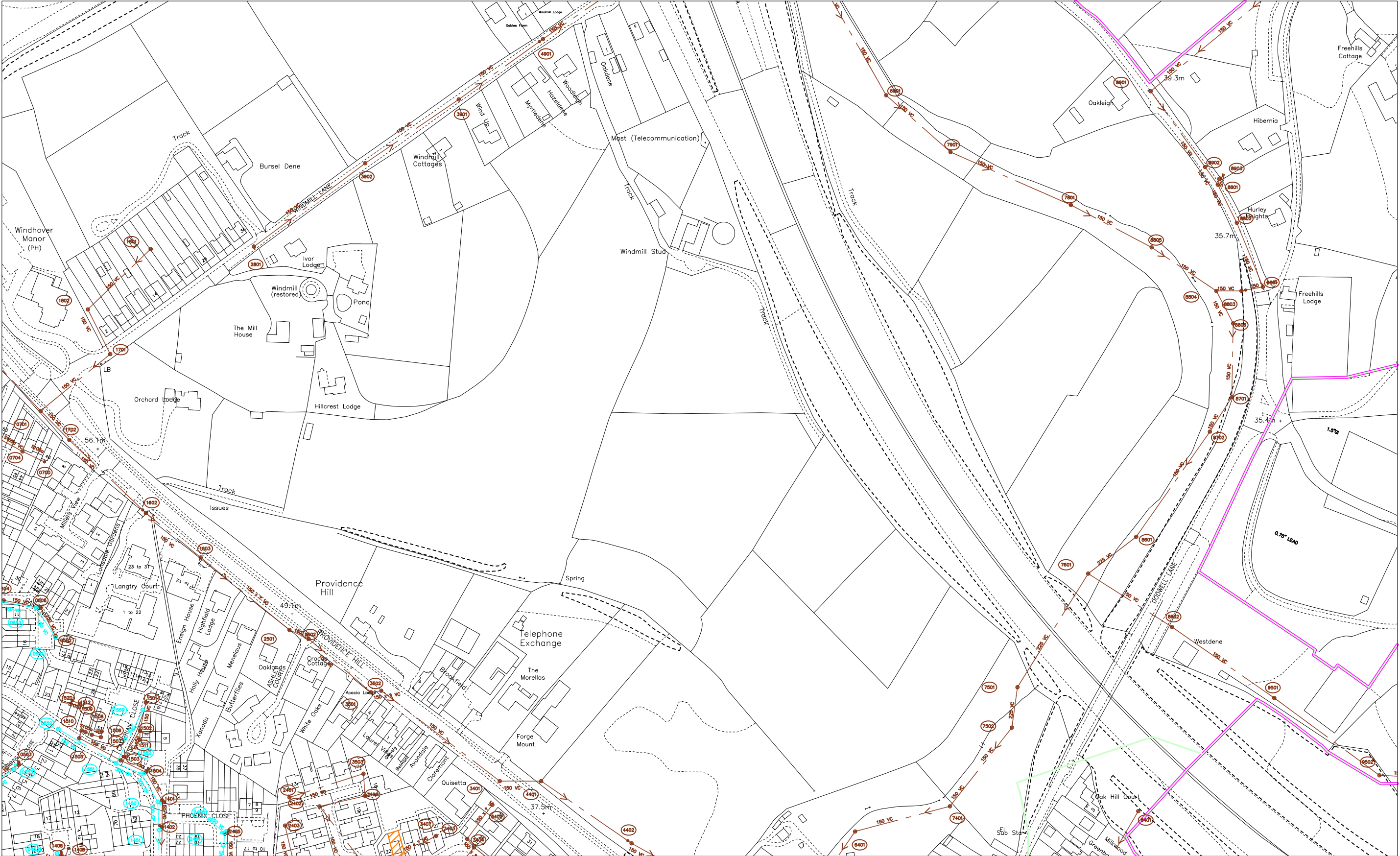
Should you require any additional information regarding this matter please contact this office at the address given at the foot of this letter.

Yours faithfully

Land Search Department

SEWER RECORDS PAGE 1 OF 2

111024



110446

448059

O.S. REF.

SU4810NE

Title: 191464_Misery, Bursledon, Hamp

Drawn by: mondalb

Scale: 1:2500

Date: 12/03/2015

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

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449005

SEWER RECORDS PAGE 2 OF 2

Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape	Node	Cover	Invert	Size	Material	Shape
0453X	37.66	35.77	150	VC	CIRC	7502X	23.64	22.21	150	VC	CIRC												
0502X	51.06	48.62	150	VC	CIRC	7601X	24.96	23.45	225	VC	CIRC												
0503X	43.9	40.62	150	VC	CIRC	7801X	29.84	28.21	150	VC	CIRC												
0551X	51.03	48.98	150	VC	CIRC	7901X	31.41	29.68	150	VC	CIRC												
0552X	46.28	44.63	150	VC	CIRC	8401X			150	VC	UNK												
0553X	43.42		150	VC	CIRC	8601X	25.55	23.87	225	VC	CIRC												
0604X	49.98	47.65	150	VC	CIRC	8602X	34.06		150	VC	CIRC												
0605X	51.46	48.44	150	VC	CIRC	8701X	29.05	25.46	150	VC	CIRC												
0653X	51.42	48.87	150	VC	CIRC	8702X	27.28	25.04	150	VC	CIRC												
0701X	57.3	55.03	150	VC	CIRC	8801X	35.93	34.43	150	VC	CIRC												
0704X	53.83		UNK	UNK	CIRC	8802X	35.53	33.85	150	VC	CIRC												
1401X	45.34	42.25	150	VC	CIRC	8803X	42.48	38.01	150	VC	CIRC												
1402X	44.19	41.39	150	VC	CIRC	8804X	28.94	26.35	150	VC	CIRC												
1406X	37.55	35.7	150	VC	CIRC	8805X	28.9	27.14	150	VC	CIRC												
140DX			UNK	VC	CIRC	8806X	29.27	26.09	150	VC	CIRC												
1450X	45.24	42.4	300	CP	CIRC	8901X	39.1	37.2	150	VC	CIRC												
1451X	44.14	41.47	300	CP	CIRC	8902X	36.38	34.83	150	VC	CIRC												
1501X	48.8	47.45	150	VC	CIRC	8903X			UNK	UNK	CIRC												
1502X	47.08	45.81	150	VC	CIRC	9501X	37.68		150	VC	CIRC												
1503X	45.04	42.6	150	VC	CIRC	9502X	34.87		UNK	UNK	UNK												
1504X	45.62	42.49	150	VC	CIRC				150	VC	UNK												
1505X	45.42	44.02	150	VC	CIRC																		
1506X			UNK	VC	CIRC																		
1507X			UNK	VC	CIRC																		
1508X			UNK	VC	CIRC																		
1509X			UNK	VC	CIRC																		
1510X			100	VC	CIRC																		
1511X			UNK	UNK	CIRC																		
1511X			UNK	UNK	CIRC																		
152DX			UNK	UNK	CIRC																		
1550X	48.32	46.55	150	VC	CIRC																		
1551X	44.94	43.08	300	CP	CIRC																		
1552X	45.59	42.55	300	CP	CIRC																		
1602X	54.16	51.12	150	VC	CIRC																		
1603X			150	VC	UNK																		
1701X	58.86	57.29	150	VC	CIRC																		
1702X	56.89	54.62	150	VC	CIRC																		
1801X	61.57	58.41	150	VC	CIRC																		
1802X	59.76	57.72	150	VC	CIRC																		
2401X	46.97	45.65	150	VC	CIRC																		
2402X	43.37	41.92	150	VC	CIRC																		
2403X	44.8	42.95	150	VC	CIRC																		
2405X	44.91	42.24	150	VC	CIRC																		
2450X	45.48	43.73	150	VC	CIRC																		
2451X	44.91	42.12	150	VC	CIRC																		
2501X	48.72	47.11	150	VC	CIRC																		
2502X	48.43	46.81	150	VC	CIRC																		
2801X	59.21	57.45	150	VC	CIRC																		
3401X	39.31	37.43	150	VC	CIRC																		
3402X			150	VC	UNK																		
3403X			150	VC	UNK																		
3404X	40.06	38.05	150	VC	CIRC																		
3406X	43.61	42.16	150	VC	CIRC																		
3407X			150	VC	UNK																		
3501X			150	VC	UNK																		
3502X	45.41	43.41	150	VC	CIRC																		
3503X			150	VC	UNK																		
3901X	49.89	48.13	150	VC	CIRC																		
3902X	54.4	52.7	150	VC	CIRC																		
4401X			UNK	UNK	UNK																		
4402X	31.33	29.18	150	VC	CIRC																		
4901X	46.28	43.62	150	VC	CIRC																		
6401X			150	VC	CIRC																		
6901X			150	VC	CIRC																		
7401X			150	VC	CIRC																		
7501X	24.85	22.48	225	VC	CIRC																		

LINE STYLES / COLOURS

Brown

Dark Blue

Purple

Light Blue

Yellow

Green

Foul

Foul Syphon Sewer

Foul Vacuum Main

Foul Rising Main

Combined

Combined Syphon Sewer

Combined Rising Main

Lateral Drain

Building Over Agreement Area

Treated Effluent

Sludge

Sewer Catchment

Section 104 Area

Surface Water

Surface Water Rising Main

Private

Access Shaft

Decommissioned

MATERIALS

AK Alkathene

BAC Bonded Asbestos Cement

BRC Brick (Common)

BRE Brick (Engineering)

CC Concrete Box Culvert

CI Cast Iron

CO Concrete (In-Situ)

CP Concrete (Pre-Cast)

CSB Concrete Segments (bolted)

CSU Concrete Segments (unbolted)

DI Ductile Iron

GRC Glass Reinforced Concrete

GRP Glass Reinforced Plastic

MAC Masonry in regular Courses

MAR Masonry in random Courses

PE Polyethylene

PF Pitch Fibre

PP Polypropylene

PVC Polyvinyl Chloride

RPM Reinforced Plastic Matrix

SI Spun Iron

ST Steel

VC Vitrified Clay

XXX Other

ZZZ Unknown

LEGEND - SEWERS

Manhole (SW)

Manhole (F&C)

Lamp hole (SW)

Lamp hole (F&C)

Pumping Station (SW)

Pumping Station (F&C)

Side entry manhole (SW)

Side entry Manhole (F&C)

Blind shaft (SW)

Blind shaft (F&C)

Ejector station (SW)

Ejector station (F&C)

Watertight door (SW)

Watertight door (F&C)

Flushing ch. Min-e (SW)

Flushing ch. Min-e (F&C)

Flushing ch. No-e (SW)

Flushing ch. No-e (F&C)

Demarcation Chamber

Washout (SW)

Washout (F&C)

Rodding Eye (SW)

Rodding Eye (F&C)

Gauging point (SW)

Gauging point (F&C)

Intercept chamber (SW)

Intercept chamber (F&C)

Storm Tank (SW)

Storm Tank (F&C)

Vortex chamber (SW)

Vortex chamber (F&C)

Label ellipse

Dummy/S24 manhole

Outfall

Penstock chamber

Damboards

Storm Overflow

Backdrop manhole

Other (s)

Other

Change in sewer (s)

Change in sewer

Reflex valve

Flap valve

Cascade

Anode

Valve

Closed Valve

Air Valve

Hatch box (SW)

Hatch box (F&C)

Direction arrow

Emptying valve

Catchpit

Soakaway

Inlet

Balancing Pond

SHAPES (S)

A Arched

B Barrel

C Circular

E Egg

H Horseshoe

R Rectangular

S Square

T Trapezoidal

U U Shape

X Other

Wastewater treatment works

Marine treatment works

Outfall headworks

Vent

Vent column

Tidal storage tank

Blank end

Head of Public Sewer

Micro Pumping Station

1st digit: hundred metre easting identifier

2nd digit: hundred metre northing identifier

3rd digit: sewer type identifier

4th digit: next sequential node

Drawn by: mondalb

Title: 191464_Misery, Bursledon, Hamp

Date: 12/03/2015



110978



110492

448049

LEGEND - MAINS

- | | | | |
|--|--|--|------------------------------------|
| | Distribution Main / Communication pipe | | Clockwise closing valve |
| | Trunk Main | | Fire Hydrant |
| | Raw water main | | Washout |
| | Non potable | | Washout hydrant |
| | Abandoned main | | Meter |
| | Proposed Main | | Capped end |
| | Fire main | | Emptying plug |
| | Non SWS | | Stopcock |
| | Sluice valve | | Leak Noise Correlator Survey Point |
| | Closed valve | | Anode |
| | Air valve | | Telemetry cable |
| | Butterfly valve | | Access point / hatchbox |
| | Pressure reducing valve | | |
| | Reflux valve | | |
| | Motorised valve | | |

MATERIALS

- | | | | |
|--|----------------------------|--|------------------------------------|
| | Dialysis machine | | Alkathene |
| | Break pressure tank | | Cast iron |
| | Change node | | Spun (grey) iron |
| | Pumping station | | Concrete |
| | Booster station | | Ductile iron |
| | Insertion Flow Meter Point | | Bonded Asbestos Cement |
| | Water tower | | Glass reinforced plastic |
| | Service reservoir | | Glass reinforced epoxy |
| | Water Supply Works | | (Unplasticised) Polyvinyl chloride |
| | Bore hole / Well | | Polyethylene |
| | Intake | | Steel |
| | Customer site | | Concrete segments bolted |
| | Swab insertion point | | Concrete segments unbolted |
| | | | Galvanised iron |
| | | | Ductile sleeve |
| | | | Concrete pre-stressed |
| | | | High performance polyethylene |
| | | | Unknown |

AK Drawn by: mondalb

CI Scale: 1:2500

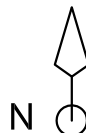
SI Date: 12/03/2015

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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O.S.Ref: SU4810NE

TITLE: 191464_Misery, Bursledon, Hamp



WARNING: BAC pipes are constructed of Bonded Asbestos Cement

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement

449016

Appendix F

Proposed Drainage Strategy



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 - ANY VARIATIONS OR DISCREPANCIES BETWEEN THESE DRAWINGS IN TERMS OF DIMENSIONS OR DETAILS SHOULD BE DRAWN TO THE ATTENTION OF THE ARCHITECT AND/OR THE ENGINEER FOR CLARIFICATION.
 - PAUL BASHAM ASSOCIATES ACCEPTS NO RESPONSIBILITY FOR THE ACCURACY OF BACKGROUND INFORMATION PRODUCED BY THIRD PARTIES - THIS MUST BE TREATED AS INDICATIVE ONLY.
 - ALL DIMENSIONS AND LEVELS ARE IN METRES. DO NOT SCALE THIS DRAWING, PRINT, PLOT OR DISK.
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EXCEEDANCE LEGEND

- Blue arrow: EXCEEDANCE FLOW
Red line: SITE BOUNDARY

PRELIMINARY
DRAWING/DESIGN IS STILL "IN DEVELOPMENT"
YOU ARE ADVISED TO MAKE DUE ALLOWANCE

J	REVISED TO SUIT LATEST ARCHITECT SITE LAYOUT	21/12/2022	JAC	RW
H	REVISED TO SUIT LATEST ARCHITECT SITE LAYOUT	21/12/2022	JAC	RW
G	REMOVED PLOTS 1 & 2. RETAINING WALLS & BASIN BANK PROFILES ADJUSTED	14/12/2022	JAC	RW
F	REVISED BASIN LAYOUT & SOUTH-EAST FOOTWAY ARRANGEMENT	25/11/2022	JAC	RW
E	REVISED TO SUIT LATEST DISCUSSION WITH PLANNERS	20/10/2022	RW	RW
D	REVISED TO SUIT LATEST ARCHITECT SITE LAYOUT	07/09/2022	JAC	RW
C	REVISED TO SUIT LATEST ARCHITECT SITE LAYOUT	12/05/2022	JAC	RW
B	REVISED TO SUIT LATEST ARCHITECT SITE LAYOUT	04/05/2022	JAC	RW
A	REVISED TO SUIT RE-DESIGN SITE LAYOUT	07/04/2022	JAC	RW
Rev	Description	Date	By	Chkd



Paul Basham Associates Ltd
The Botby, Cams Hall Estate, Fareham, PO16 8UT
01329 711 000
info@paulbashamassociates.com www.paulbashamassociates.com



Project Name LAND AT 4 BROOKFIELD PROVIDENCE HILL, BURSLEDON			
Title DRAINAGE EXCEEDANCE FLOWS			
Project Phase PRELIMINARY			
Checked By RW	Checked Date 14/10/2021	Drawn By JAC	Drawn Date 14/10/2021
Client Drawing No. -	Scale 1:250	(AT A1 SIZE)	
PBA Drawing No. 150.5002.501	Revision J		

Appendix G

MicroDrainage Calculations

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Lancaster Court Fareham Hampshire, PO15 5TU	150.5002 Providence Hill Bursledon	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Surface Network 1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	19.300	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Surface Network 1

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.260	4-8	0.134

Total Area Contributing (ha) = 0.394

Total Pipe Volume (m³) = 11.898

Network Design Table for Surface Network 1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	38.872	0.486	80.0	0.101	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	14.802	2.304	6.4	0.027	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	26.519	4.195	6.3	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.44	44.511	0.101	0.0	0.0	0.0	1.46	58.2	13.7
2.000	50.00	5.06	46.404	0.027	0.0	0.0	0.0	4.00	70.7	3.6
1.001	50.00	5.53	44.025	0.146	0.0	0.0	0.0	5.24	208.3	19.8

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Network Design Table for Surface Network 1

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.000	12.829	0.321	40.0	0.073	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	8.629	0.216	40.0	0.007	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.002	23.394	0.585	40.0	0.023	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	21.030	0.156	135.2	0.019	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	39.753	3.892	10.2	0.065	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	20.686	0.259	80.0	0.045	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	11.772	0.157	75.1	0.011	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	9.753	1.357	7.2	0.006	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	5.378	0.250	21.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	14.744	0.100	147.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.007	4.981	0.100	49.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.008	10.373	0.200	51.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	50.00	5.10	40.940	0.073	0.0	0.0	0.0	2.07	82.5	9.8
3.001	50.00	5.17	40.619	0.080	0.0	0.0	0.0	2.07	82.5	10.8
3.002	50.00	5.36	40.403	0.102	0.0	0.0	0.0	2.07	82.5	13.9
1.002	50.00	5.79	39.755	0.268	0.0	0.0	0.0	1.35	95.4	36.3
1.003	50.00	5.92	39.599	0.332	0.0	0.0	0.0	4.95	349.7	45.0
4.000	50.00	5.31	36.273	0.045	0.0	0.0	0.0	1.12	19.9	6.1
4.001	50.00	5.48	36.014	0.056	0.0	0.0	0.0	1.16	20.5	7.5
1.004	50.00	5.95	35.707	0.394	0.0	0.0	0.0	5.90	417.1	53.4
1.005	50.00	5.97	34.350	0.394	0.0	0.0	0.0	3.40	240.7	53.4
1.006	50.00	6.16	34.100	0.394	0.0	0.0	0.0	1.29	91.4	53.4
1.007	50.00	6.22	34.000	0.394	0.0	0.0	0.0	1.43	25.3«	53.4
1.008	50.00	6.35	33.900	0.394	0.0	0.0	0.0	1.40	24.7«	53.4

Free Flowing Outfall Details for Surface Network 1

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	S8	35.000	33.700	0.000	0	0

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Innovyze Network 2020.1.3		

Simulation Criteria for Surface Network 1

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	10.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.300	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Surface Network 1

Hydro-Brake® Optimum Manhole: S13, DS/PN: 1.008, Volume (m³): 1.9

Unit Reference	MD-SHE-0068-2500-1500-2500
Design Head (m)	1.500
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	68
Invert Level (m)	33.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	2.5
Flush-Flo™	0.300	2.0
Kick-Flo®	0.609	1.7
Mean Flow over Head Range	-	2.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.7	1.200	2.3	3.000	3.4	7.000	5.1
0.200	2.0	1.400	2.4	3.500	3.7	7.500	5.3
0.300	2.0	1.600	2.6	4.000	3.9	8.000	5.4
0.400	2.0	1.800	2.7	4.500	4.2	8.500	5.6
0.500	1.9	2.000	2.9	5.000	4.4	9.000	5.8
0.600	1.7	2.200	3.0	5.500	4.6	9.500	5.9
0.800	1.9	2.400	3.1	6.000	4.8		
1.000	2.1	2.600	3.2	6.500	4.9		

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Storage Structures for Surface Network 1

Tank or Pond Manhole: S7, DS/PN: 1.007

Invert Level (m) 34.100

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	191.6	0.500	210.1	1.000	230.8	1.500	253.8
0.100	195.2	0.600	214.1	1.100	235.3	1.600	258.6
0.200	198.8	0.700	218.2	1.200	239.7	1.700	263.6
0.300	202.5	0.800	222.3	1.300	244.3	1.788	268.0
0.400	206.3	0.900	226.5	1.400	249.0	1.789	158.1

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

Simulation Criteria

Areal Reduction Factor 1.000

Hot Start (mins) 0

Hot Start Level (mm) 0

Manhole Headloss Coeff (Global) 0.500

Foul Sewage per hectare (l/s) 0.000

Additional Flow - % of Total Flow 10.000

MADD Factor * 10m³/ha Storage 2.000

Inlet Coefficient 0.800

Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0

Number of Storage Structures 1

Number of Online Controls 1

Number of Time/Area Diagrams 0

Number of Offline Controls 0

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 200.0

Analysis Timestep 2.5 Second Increment (Extended)

DTS Status ON

DVD Status OFF

Inertia Status OFF

Profile(s) Summer and Winter

Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 1, 30, 100

Climate Change (%) 0, 40, 40

	US/MH		Return	Climate	First (X)	First (Y)	First (Z)	Overflow	Water
	PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Level
								Act.	(m)
1.000	S14	15 Winter	100	+40%	100/15 Summer				44.848
2.000	S1	15 Winter	100	+40%					46.455
1.001	S2	15 Winter	100	+40%					44.133
3.000	S9	15 Winter	100	+40%					41.072
3.001	S15	15 Winter	100	+40%	100/15 Summer				40.921
3.002	S16	15 Winter	100	+40%	100/15 Summer				40.809
1.002	S3	15 Winter	100	+40%	30/15 Summer				40.441
1.003	S4	15 Winter	100	+40%					39.769
4.000	S10	15 Winter	100	+40%	30/15 Summer				37.236
4.001	S11	15 Winter	100	+40%	30/15 Summer				36.897
1.004	S12	15 Winter	100	+40%	100/15 Summer				36.600
1.005	S5	15 Winter	100	+40%	30/15 Summer				35.891
1.006	S6	720 Winter	100	+40%	30/15 Summer				35.422
1.007	S7	720 Winter	100	+40%	1/15 Summer				35.419
1.008	S13	720 Winter	100	+40%	1/15 Summer				35.424

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Summary of Critical Results by Maximum Level (Rank 1) for Surface Network 1

PN	US/MH Name	Surcharged		Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m³)	Flow / Cap.	Overflow (l/s)				
1.000	S14	0.112	0.000	1.11			61.0	SURCHARGED	
2.000	S1	-0.098	0.000	0.26			16.7	OK	
1.001	S2	-0.117	0.000	0.46			88.0	OK	
3.000	S9	-0.093	0.000	0.64			45.4	OK	
3.001	S15	0.077	0.000	0.72			47.0	SURCHARGED	
3.002	S16	0.180	0.000	0.79			59.4	SURCHARGED	
1.002	S3	0.387	0.000	1.88			157.0	SURCHARGED	
1.003	S4	-0.130	0.000	0.60			194.5	OK	
4.000	S10	0.814	0.000	1.20			22.4	SURCHARGED	
4.001	S11	0.733	0.000	1.60			29.7	SURCHARGED	
1.004	S12	0.593	0.000	0.73			213.7	SURCHARGED	
1.005	S5	1.241	0.000	1.70			213.0	SURCHARGED	
1.006	S6	1.022	0.000	0.29			22.2	SURCHARGED	
1.007	S7	1.269	0.000	0.16			3.2	SURCHARGED	
1.008	S13	1.374	0.000	0.11			2.5	FLOOD RISK	

Appendix H

Nitrogen Budget Calculator

Nitrogen Budget Calculation

Planning Application Reference No.	
Site Name:	Land at 4 Brookfield, Providence Hill, Bursledon
Additional Information:	
Date:	13 January 2023

Stage 1	Calculate total Nitrogen in kg per year derived from the development that would exit the Wastewater Treatment Works (WwTW) into Solent catchments after treatment	
Step 1	Calculate additional population	
	Enter the number of units proposed	14
	Net population increase per housing unit	2.40
	Total net population increase generated by the development	33.60
Step 2	Calculate wastewater volume generated by the development	
	Water use in litres per person per day	110
	Total wastewater volume generated by the development (litres per day)	3,696
Step 3	Confirm receiving WwTW and permit limit	
	Select the wastewater treatment works the development will connect to	Peel Common
	Wastewater treatment works' permit limit (mg per litre)	9.0
	Wastewater treatment works' discharge level (mg per litre)	8.1
Step 4	Calculate total nitrogen in kg per year discharged by the WwTW	
	Deduct acceptable Nitrogen loading in wastewater (mg per litre)	6.1
	Total Nitrogen discharged by WwTW (mg per day)	22,545.6
	Total Nitrogen discharged by WwTW (kg per day)	0.0225
	Total Nitrogen discharged by WwTW (kg per year)	8.2

Stage 2	Calculate existing (pre-development) nitrogen from current land use of the development site	
Step 1	Total area of development site	
	Enter the total area of the development site (hectares)	1.12
Step 2	Identify current land uses of the development site	
	Enter area currently used for urban development (hectares)	0.02
	Enter area currently used for open space / greenfield (hectares)	1.10
	Enter area currently used for woodland (hectares)	0.00
	Enter area currently used for community food growing / catchment average (hectares)	0.00
	Enter area currently used for cereals (hectares)	0.00
	Enter area currently used for dairy (hectares)	0.00
	Enter area currently used for general cropping (hectares)	0.00
	Enter area currently used for horticulture (hectares)	0.00
	Enter area currently used for pig farming (hectares)	0.00
	Enter area currently used for lowland grazing (hectares)	0.00
	Enter area currently used for mixed farming (hectares)	0.00
	Enter area currently used for poultry farming (hectares)	0.00
	Check to help ensure that sum total of land uses in Step 2 equals site area in Step 1	1.1
Step 3	Calculate nitrogen load from current land usage	
	Total Nitrogen load from current land usage (kg per year)	5.8

Nitrogen Budget Calculation

Stage 3	Calculate nitrogen load for the non-built land uses proposed for the development site	
Step 1	Identify proposed land uses of the development site	
	Enter the total urban area to be created (hectares)	0.68
	Enter the total designated open space / SANG area to be created (hectares)	0.44
	Enter the total nature reserve area to be created (hectares)	0.00
	Enter the total woodland area to be created (hectares)	0.00
	Enter the total community orchard area to be created (hectares)	0.00
	Enter the total community food growing / allotment area to be created (hectares)	0.00
	<i>Check to help ensure that sum total of proposed land uses equals site area in Stage 2</i>	1.12
Step 2	Calculate total Nitrogen load from proposed land uses	
	<i>Total Nitrogen load from future land uses (kg per year)</i>	11.92

Stage 4	Calculate the net change in Nitrogen load from the proposed development	
Step 1	Identify Nitrogen load from wastewater (Stage 1)	
	<i>Nitrogen leaving wastewater treatment works (kg per year)</i>	8.23
Step 2	Calculate net change in Nitrogen load from land use changes	
	<i>Total Nitrogen load from future land use (kg per year)</i>	6.14
Step 3	Calculate total Nitrogen budget for the development site	
	<i>Nitrogen budget for the site (kg per year)</i>	14.37
Step 4	Calculate precautionary buffer if Nitrogen budget exceeds zero	
	<i>Precautionary Nitrogen buffer (kg per year)</i>	2.87

Total Nitrogen budget for the proposed development (kg per year)	17.2
Development will generate additional Nitrogen - Mitigation is required Please liaise with your Local Planning Authority for advice on next steps	