

**Yapton Lane,
Walberton, West Sussex**

2	11/2/2022	<i>Scheme base plan updated</i>
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A	Existing Layout & Proposed Site Layout
B	EA Flood Mappings, Local Sewer Plan & Soils Data
C	Surface Water Assessment
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1. Introduction

- 1.1 Instructions were received from Land Quest UK (Southern) Ltd to undertake a Flood Risk Assessment (FRA) and set out a Drainage Strategy (DS) for a planning application for the development a 48 Dwellings on land at Yapton Lane, Walberton, West Sussex.
- 1.2 This assessment has been undertaken by A P Traves BSc CEng MIStructE MCIHT.
- 1.3 The client's attention is drawn to the conditions and limitations contained in Appendix D.

2. Development Description & Location

- 2.1 The site comprises the northern part of an arable field, with a wooded margin on the eastern side. The site area is some 2.46 Ha located at Yapton Lane, Walberton, West Sussex (grid ref 497550 105600). The site extents are indicated on the annotated aerial photograph contained in Appendix A. The topographic survey is also shown on the drawing contained in Appendix A of this report.
- 2.2 It is proposed to develop 48 dwellings on the site. The proposed layout is identified on SDA Design drawing number 20-1092-SK10-B contained in Appendix A of this report.

3. Local Development Documents & Strategic Flood Risk Assessment

- 3.1 The Arun DC Strategic Flood Risk Assessment (SFRA) has been reviewed and this indicates the following:
- 3.2 SFRA map set C indicates the site is located in Flood Zone FZ1.
- 3.3 SFRA map set D indicates the site will remain outside the 2106 climate change flood risk area.
- 3.4 SFRA map tile F-33 shows the coarse division of the Arun DC into 1km² grid squares and indicates the 1,000,000m² grid square for the site, in common with most of the district has susceptibility to groundwater flooding. This should not be mistaken for groundwater flood risk which is different. Paragraph 5.7 of the SFRA confirms *"This data shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge."* It also advises that *"It does not show the likelihood of groundwater flooding occurring. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding."* It also advises *"It should be noted that although an area may be designated as susceptible to groundwater flooding, this does not mean that groundwater flooding will definitely be a problem within these areas, rather it provides an indication of potential risk."* The SFRA however later continues to identify that in 2012 and 2013/2014 significant events of groundwater flooding were reported in the Westergate/Barnham area but not in Walberton. The SFRA-2008 map G1 indicated groundwater flood risk and groundwater emergence zones. The site is not indicated to be in a groundwater emergence zone on this older mapping.
- 3.5 SFRA map H does not indicate any historical flooding to the site but does indicate a record of surface water flooding to Yapton Road outside of the site.
- 3.6 SFRA map G does not indicate the site to be in an EA flood warning area.
- 3.7 Flood mapping data has been reviewed from the Environment Agency (EA) website. (refer to Appendix B). This indicates the following:
- 3.8 The EA mapping indicates the site is located in FZ1.
- 3.9 The EA mapping indicates the site is at very low (<0.1% AEP) surface water flood risk.

- 3.10 The EA mapping indicates the site is not in an area of reservoir flood risk.

4. Catchment Flood Management & Shoreline Management Plans

- 4.1 The site is at an elevation of some 13-14 m AOD and is remote from the influence of tidal flooding. Shoreline Management Plans are not applicable at this location.
- 4.2 The Arun and Western Streams Catchment Flood Management plan summary – December 2009 (CFMP) indicates the site falls within sub-area 6 Coastal plains and East Wittering Catchments. The CFMP states that policy 4 is the preferred policy approach:

“Areas of low moderate or high flood risk where we are already managing existing flood risk effectively but where we may need to take further actions to keep pace with climate change.”

- 4.3 Overall the SMP and CFMP do not present any issues that would prohibit the development of this site with respect to flood issues provided the surface water drainage is based on SuDS principles.

5. Catchment Data

- 5.1 The BGS mapping indicates the site geology to comprise undifferentiated Sand, Silt and Clay River Terrace Deposits over London Clay.
- 5.2 A series of geotechnical investigations and monitoring have been made at the site between November 2020 and April 2021 which is reported on in GESL reports 19427/RG01/201127, GE19427/RG01/210319 and GE19427a/210426. The investigations comprised a total of 7 No window sample bores up to 3m deep and 12 trial pits up to 1.95m deep.

- 5.3 The ground conditions are summarised in the GESL reports as comprising:

TOPSOIL:

RIVER TERRACE DEPOSITS: Clay with low to moderate proportions of Sand and Gravel..

A plan of the investigation hole locations and set of hole logs is contained in Appendix B.

- 5.4 Groundwater monitoring wells were installed to the 7 initial holes and the groundwater levels monitored over Winter 2020-2021. Each hole exhibited a seasonal GWL profile rising to shallowest readings in early February 2021/late January 2021 and subsequently receding again. The peak GWLs relative to existing ground level trended from some 1.9mbgl in the north of the site (WS01) to around 1.4mbgl in the southwest of the field (WS04/WS06) which lies outside of the proposed development area.

A copy of the GWL results is contained in Appendix B.

Winter 2020-2021 rainfall average and Winter 2020-2021 GWLs in the region were higher than normal to notably high in February 2021 corresponding to the peak levels observed on the site. The site observations are therefore considered to be above the long term seasonal average levels expected at the site.

A copy of rainfall and GWL elements of the National Hydrological Summary for the UK February 2021 is contained in Appendix B.

- 5.5 Falling head permeability tests were undertaken in the 7 initial holes in November 2020 reflecting permeability in the depth range 1-3mbgl. The northern three holes Ws01, WS02 and Ws03 indicated an estimated permeability of $3.8\text{--}4.41 \times 10^{-6}$ m/sec. there was insufficient infiltration in the other 4 holes (which lie outside of the proposed development area) to determine a permeability value.

- 5.6 The Winter GWLs and falling head permeability results were then discussed with ADC Drainage Engineers and it was concluded that shallow BRE365 permeability test pits should be undertaken to explore the potential for near surface infiltration. A series of 7 test holes were made between 0.6 and 1.2mbgl in March with locations limited by available access into the crop and prevailing surface ground conditions at the time. Holes TP1 and TP2 on the northern edge of the proposed development area gave a consistent set of results with 4.0 and 3.9×10^{-5} m/sec respectively at the third cycle. Hole TP3 on the southern edge of the proposed development area gave a lower cycle 1 test value of 1.6×10^{-5} m/sec but there was insufficient fall in the water level to determine a cycle 2 value. Holes TP5, T6 and TP7 sought to identify if the remainder of the field south of the proposed development parcel in the north had sufficient permeability to locate an infiltration basin in that area. However the detailed BRE365 testing here corroborated the findings of the first phase of investigation with poor permeability values of failure to drain sufficient water. When considered in conjunction with the shallower relative depth to peak winter GWL in this half of the field it was concluded that shallow infiltration in the development parcel on the northern part of the field would need to be the strategy.
- 5.7 A Third phase of investigation comprising a series of 5 further BRE365 test pits was undertaken 12th April 2021, as soon as the field crop and surface conditions permitted, to obtain results for the northern end of the western side and central area of the southern part of the over field there were not possible to access in the previous phase. Hole TP305 at the northern end of the western boundary gave a cycle 1 test value of 3.3×10^{-5} m/sec. although there was insufficient time to complete cycle 2 the rate of fall during the time available was similar to cycle 1 and consistent with cycle 3 tests results in nearby TP1 and TP2 of phase 2 (4×10^{-5}) m/sec. the cycle 2 and 3 results for TP302 of around 4×10^{-5} m/sec are cautioned by GESL as this part had to be partially backfilled. The results in the remaining holes were 1.3×10^{-5} , 8.4×10^{-5} m/sec and two cases of insufficient fall in water to determine.
- 5.8 It is known from LPA record document relating to the surface water drainage arrangements to Walberton Place care home adjacent the north west corner of the site that adequate infiltration is present immediately to the other side of the site boundary and opposite the proposed site infiltration pond. The phase 1 investigation logs confirm the presence of a more gavel based and less clayey soil stratum to the north and west of the development parcel, which is where it is proposed to locate the infiltration basin/pond. The existing pond some 150m south west of the site was inspected and it is evident that the water level in the pond reflects local GWLs and that the pond is also located into a more permeable strata at depth which is saturated. Sensitivity calculations were undertaken for notional drained area catchments of 6,000 and 10,000m² with a soil permeability of 3×10^{-5} m/sec. For a 6,000m² catchment a 500m² infiltration footprint would require just under 400m³ of storage and half drain in just under 6 hours. For a 10,000m² catchment a 800m² footprint would require around 650m³ of storage and half drain in just under 6 hours. The infiltration basin shown on SDA Design drawing number 20-1092-COL2 contained in Appendix A has a footprint on some 1,000m² and private parking courts and driveways of permeable pavement provide a further 1,600m² of footprint for a final proposed drained surface area of some 8,200m². Further BRE365 permeability testing has been scheduled for January 2022 to allow a final design permeability value to be agreed with ADC Drainage Engineers but it is apparent from the existing data sets and the proposed layout and sensitivity calculations that the proposed strategy is both appropriate and feasible and will provide a Tier 1 infiltration discharge solution.

6. Sewage Authority Data

- 6.1 Blacksmith's Corner, approximately 100m north of the site along Yapton Lane is served by an existing 175mm DN foul sewer.
- 6.2 The proposed development will discharge to MH 6702 of the public foul sewer at Blacksmith's Corner via a rising main connection from an on site wastewater pumping

station. The change in network foul water load in the context of the 175mm DN sewer size is considered *de minimis*, but notwithstanding this the standing wastewater Infrastructure Charge (IC), which came into force from 1st April 2018, will be paid. Should any downstream reinforcement be required Southern Water will deliver this from the development ICs they will collect.

7. Site Particulars

- 7.1 The site comprises the northern part of an arable field with a wooded margin on the eastern side. The site area is some 2.46 Ha.
- 7.2 The site falls north east to south west from approx. 14 mAOD to approx. 13 mAOD. Yapton Lane forms the ridge line and watershed between two catchments. Westwards including the site to Yapton Rife and eastwards from Yapton Lane to Little Tortington Stream
- 7.3 There are no existing surface water drainage features within the site and natural run-off drains overland to the south west to the pond and watercourse some 150m southwest of the site. This watercourse forms part of the channel system to the Yapton Rife catchment which drains to the south west.
- 7.4 The land to the north of the site comprises residential dwellings, with a small business premises 'The to the north east boundary and a care home to the north west boundary.
- 7.5 The land to the south comprises the remainder of the arable field under the applicant's control with allotment gardens to the south of this.
- 7.6 The land to the east and west comprises agricultural fields.

8. Source-Pathway-Receptor Assessment

- 8.1 The site is at an elevation of above 13-14m AOD and is not susceptible to tidal flooding.
- 8.2 The EA mapping indicates the site is at very low risk of surface water flooding.
- 8.3 The EA mapping indicates the site is not at risk of reservoir flooding.
- 8.4 There are no public sewers within the site.
- 8.5 The SFRA and Winter GWL monitoring at the site do not indicate to lie within a groundwater emergence zone.
- 8.6 The critical flood source is pluvial flooding and run-off within the site. The site surface water system will accord with the principles of CIRIA C753.
- 8.7 The flood receptors of the development would be:
 - Residential dwellings
 - Residents of the dwellings
- 8.8 The proposed development and existing site classifications to Table 2 (Paragraph 066 Reference ID: 7-066-20140306) are as follows:
 - Existing agricultural Less vulnerable
 - Proposed dwellings More vulnerable

9. Flood Probability

- 9.1 The EA flood zones shown on the outputs and included in Appendix B represent current best estimates of zone 2 and zone 3 flooding. It does not take account of potential climate change impacts. The flood zone definitions to Table 1 (NPPG Reference ID: 7-065-20140306) are as follows:

Zone 1	Low probability of flooding (<0.1% AEP)
Zone 2	Medium probability of tidal flooding (0.1-0.5% AEP)
	Medium probability of fluvial flooding (0.1-1% AEP)
Zone 3a	High probability of tidal flooding (>0.5% AEP)
	High probability of fluvial flooding (>1% AEP)
Zone 3b	Functional floodplain (>5% AEP probability of flooding)

The flood map does not differentiate between zones 3a and 3b.

Zone 3b is only considered appropriate for water-compatible development.

Zone 3a is additionally considered appropriate for less vulnerable uses.

- 9.2 The site is wholly in flood zone 1 (low risk).

10. Climate Change

- 10.1 The proposed development is in flood zone 1. The new climate change allowances for flood risk assessment GOV.UK 20 July 2021 update have been used. Climate change values for the site are:

- Peak rainfall intensity: Table 1, third epoch, upper end +40%

- 10.2 Surface water drainage strategy is discussed in Chapter 11. The volumes and flows for this strategy have been derived in accordance with CIRIA C753 and include for climate change effects.

11. Detailed Development Proposals & Surface Water Strategy

- 11.1 As set out in paragraph 5.8 an infiltration discharge solution for surface water shared between private parking court/driveway permeable pavement and an infiltration basin/pond is proposed to provide a Tier 1 infiltration discharge.
- 11.2 Pending the results of a final phase of additional infiltration testing, in a few weeks in January 2022, a provisional set of illustrative calculations has been prepared. The first set considers the roof areas to plots 15-42 draining to their associated permeable pavements and the permeable pavement areas to plots 2-9 and plot 43 to drain their own footprint only. This has a net drained catchment of 3,175m² draining to a net permeable pavement footprint of some 1,650m² (ie approximately 2:1 drained to footprint area ratio). The second set of calculations considers the remaining drained area of the highways and other plots and driveways of some 5,025m² draining to the infiltration basin/pond with a footprint of 1,000m². Greater more specific detail of the design and proposed arrangements will be able to be provided following the phase 4 additional testing in a few weeks time in January 2022.

The calculations indicate a 300mm thick CGA foundation to the permeable pavements of 35% void content would provide 175m³ of storage against a requirement of 163m³ with a half drain time of 2½ hours. The infiltration pond/basin would provide storage of 540m³ against a requirement for 360m³ with a half drain time of 8½ hours.

- 11.3 The surface water drainage system will be designed to accommodate a 1 in 100 year +40% and +10% urban creep rainfall event. With respect to the Non-statutory Technical Standards for Sustainable Drainage Systems (NTS SuDS) the design accords with requirements S2, S4 and S7-9. Design and construction details will accord with Building Regulations and Sewers for Adoption, as appropriate, so according with S10-11 and S13-14. The extension to the farm buildings complex will drain by gravity to the existing pump facilities to the west which accord with S12.
- 11.4 The proposed development is low-medium pollution hazard levels (C753 Table 26.2) and does not require groundwater risk screening.

- 11.5 Simple index approach calculations are contained in Appendix C. The permeable pavement construction and infiltration basin/pond proposed will provide the required level of mitigation index.
- 11.6 Water butts should be installed to intercept roof water run-off. These will reduce the annual volume of surface water discharge but will not make a material contribution to regulation of critical run-off as these tend to be full during Winter months as there is minimal demand for irrigation in these months.
- 11.7 In summary source control will be provided by:
- Provision of permeable pavement and infiltration basin/pond as outlined in paragraph 11.2
 - Provision of water butts as outlined in paragraph 11.5
- 11.8 The existing north east to south west exceedance flow path on the site down towards the pond and watercourse south west of the site and into Yapton Rife will be retained.
- 11.9 The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.
- 11.10 A schedule of O&M maintenance requirements for the SuDS infrastructure is also contained in Appendix C. The maintenance will be undertaken by the operators.

12. Sequential & Exceptions Tests

- 12.1 The site is located within an area with low flood risk (section 8 refers) and inherently meets the Sequential Test.
- 12.2 Application of the Exceptions Test is not required.

13. Flood Risk Management Measures

- 13.1 The source pathway receptor assessment is contained in Chapter 8.
- 13.2 FFLs should be set at least 150mm above external ground levels.

14. Off Site Impacts

- 14.1 The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.

15. Residual Risks

- 15.1 The proposed surface water strategy for the development provides for flood events up to 1:100 year 2022_{AD} + CC rainfall. The residual flood risk is therefore events in excess of 1:100 year 2022_{AD} + CC rainfall.

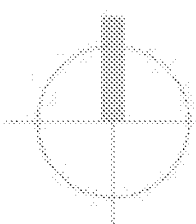
Appendix A





- Key
- Red Line Boundary
 - Blue Line Boundary
 - Existing trees
 - View line boundary
 - Existing services and potential easement
 - Rear Wall
 - Drainage Ponds
 - Site Roads
 - Retained PROW and footpaths
 - New Site entrance
 - LAP
 - Landscape buffers
 - Building Frontages and development area
 - Yapton Lane road

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YAPTON LANE
WALBERTON

LAND QUEST

DRAWING TITLE
CONCEPT LAYOUT
PLAN

+44) 1902 595 090
design@sdadesigngroup.com
Ground Floor Studio, Unit 2,
East Horton Business Park,
Rensselaer Lane, Fair Oak,
Hampshire, SO50 7HJ



100% 1:500 A1 ML 1:400 16/02/2021

INFORMATION

20-1092-SK 10B



Aerial view of site

Appendix B

Flood map for planning

Your reference
20159

Location (easting/northing)
497558/105620

Scale
1:2500

Created
16 Dec 2021 9:06

-  Selected area
-  Flood zone 3
-  Flood zone 3: areas benefitting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Flood storage area

0 20 40 60m

Page 2 of 2

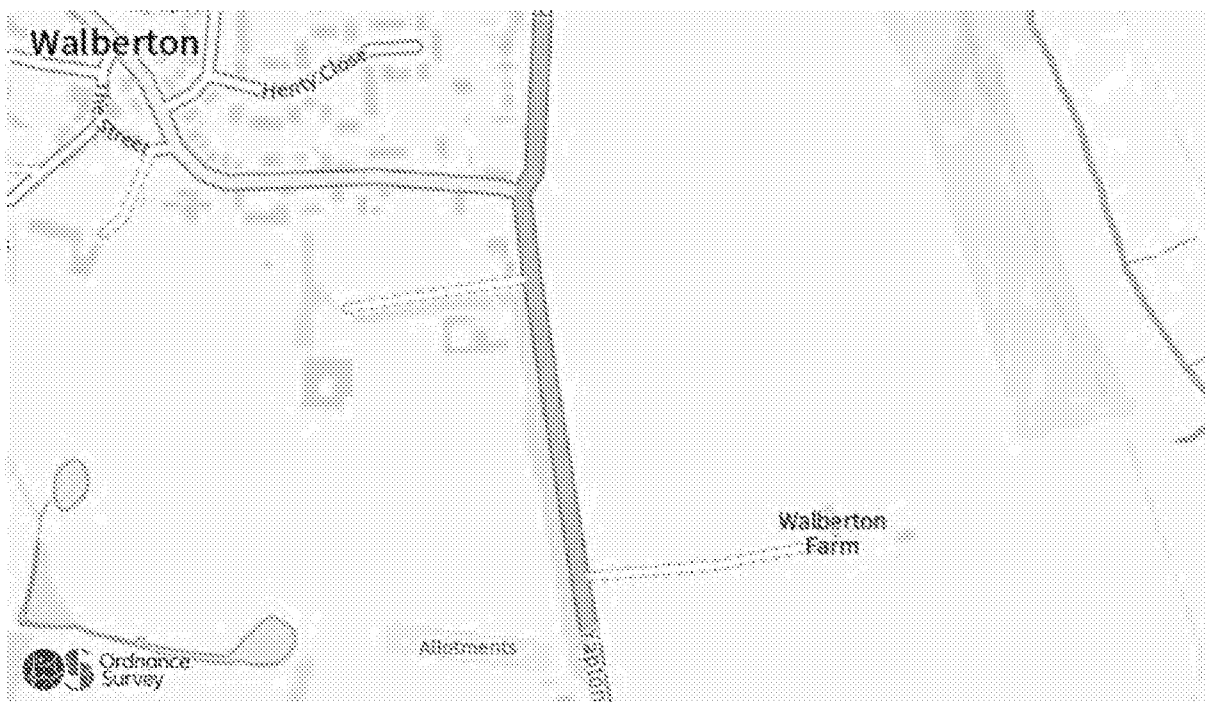


Extent of flooding from surface water

High
 Medium
 Low
 Very low

+
 Location you selected

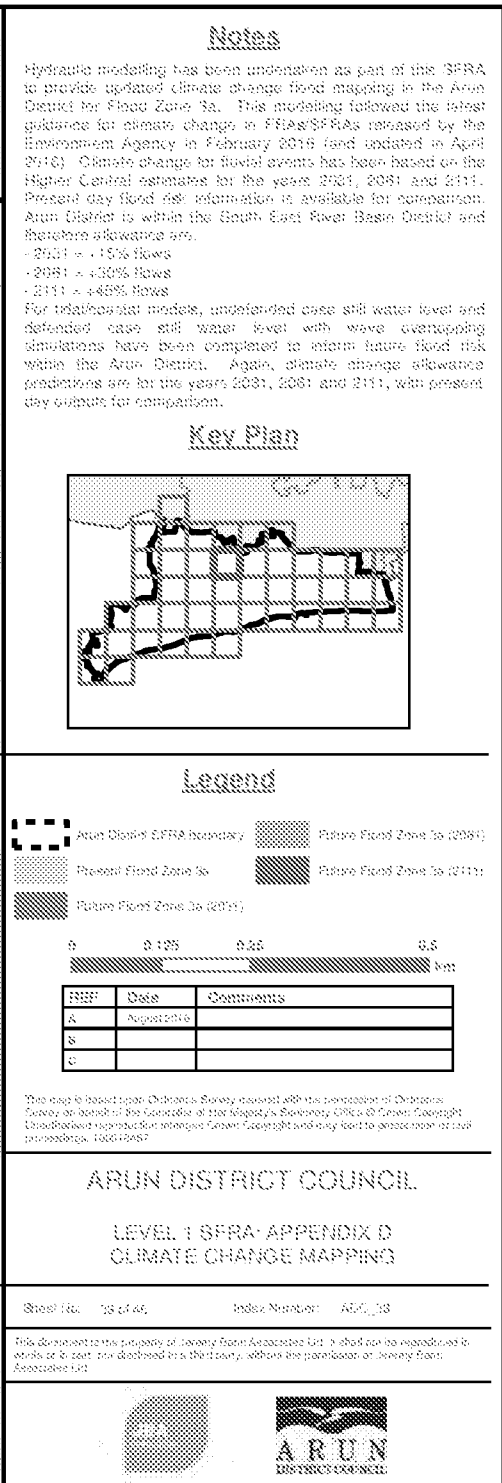
Surface water flood risk

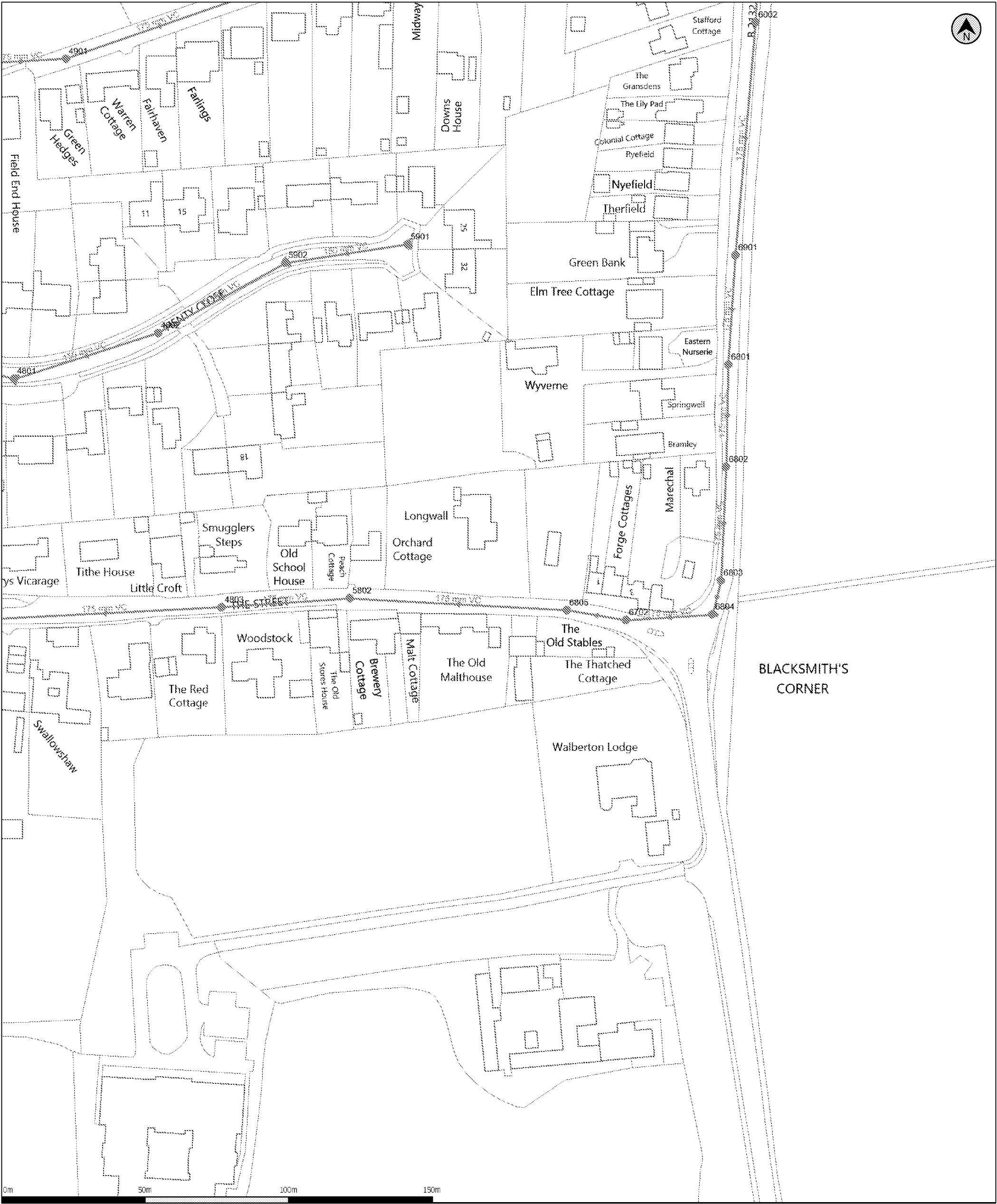


Maximum extent of flooding from reservoirs:

 when river levels are normal
  when there is also flooding from rivers
  Location you selected

Reservoir flood risk



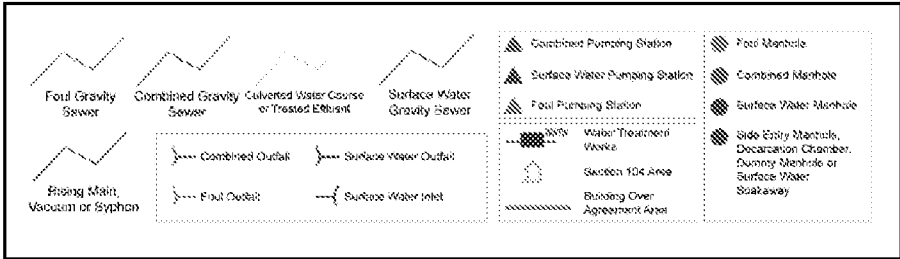


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Data updated: 21/12/20

Scale: 1:1250
Map Centre: 497581,105806

Date: 06/01/21
Our Ref: 471465 - 1

Wastewater Plan A3
Powered by digdat



darren@landquestuk.co.uk

Yapton Lane



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. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2020 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

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

Appendix C

Calculated by: Andy Traves

Site name: Yapton Lane

Site location: Walberton

Site Details

Latitude: 50.84177° N

Longitude: 0.61588° W

Reference: 1698437928

Date: Dec 16 2021 09:16

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.

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 2.46

Methodology

Q_{BAR} estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

Default Edited

SOIL type: 2 2

HOST class: N/A N/A

SPR/SPRHOST: 0.3 0.3

Hydrological characteristics

Default Edited

SAAR (mm): 766 766

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): 4.98 4.98

1 in 1 year (l/s): 4.23 4.23

1 in 30 years (l/s): 11.46 11.46

1 in 100 year (l/s): 15.89 15.89

1 in 200 years (l/s): 18.63 18.63

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:	Andy Traves
Site name:	Yapton Lane
Site location:	Walberton

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude:	50.84173° N
Longitude:	0.61637° W
Reference:	3343849109
Date:	Dec 16 2021 09:20

Site characteristics

Total site area (ha):	2.46
Significant public open space (ha):	0.82001
Area positively drained (ha):	1.63999
Impermeable area (ha):	0.82
Percentage of drained area that is impermeable (%):	50
Impervious area drained via infiltration (ha):	0.82
Return period for infiltration system design (year):	100
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.02
Net impermeable area for storage volume design (ha):	0.01
Pervious area contribution to runoff (%):	30

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Flow control to max of 2 l/s/ha or
Interception rainfall depth (mm):	Q_{bar} 5
Minimum flow rate (l/s):	4.98

Methodology

esti	IH124
Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	2	2
SPR:	0.3	0.3

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	90.86
FEH / FSR conversion factor:	1.18	1.18
SAAR (mm):	766	766
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Q_{BAR} for total site area (l/s):	4.98	4.98
Q_{BAR} for net site area (l/s):	0.04	0.04

Site discharge rates	Default	Edited	Estimated storage volumes	Default	Edited
1 in 1 year (l/s):	5	5	Attenuation storage 1/100 years (m ³):	0	0
1 in 30 years (l/s):	5	5	Long term storage 1/100 years (m ³):	0	0
1 in 100 year (l/s):	5	5	Total storage 1/100 years (m ³):	0	0

This report was produced using the storage estimation tool developed by HRWallingford 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 <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. 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 these data in the design or operational characteristics of any drainage scheme.

Project No : 20159
Project Title : Yapton Lane

Drainage blanket/CGA pavement or 2D planar infiltration (R156)

Site Location: Walberton Catchment ID: illustrative permeable pavement catchment

$r = 0.36$ (range 0.12 to 0.45)

Drained Area = 3175 m² Infiltration Area = 1650 m²

Design storm 1 in = 100 year

Runoff volume uplift = 40 % for climate change

Urban Creep allowance = 10 % uplift to Drained Area

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface 2.00 m

Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact? Yes

What Source Protection Zone (SPZ) is the proposed soakaway located in? None

What is known and proposed about potential contaminated ground on the site? EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience

Measured Soil Filtration Rate = 3.00E-05 m/s

Design Soil Filtration Rate = 6.00E-06 m/s

Storage media thickness = 0.30 m

Effective net porosity = 35 %

Depth of cover over media = 0.13 m

Storm Duration	5 min	10 min	15 min	30 min	1 hr	2 hr	4 hr	6 hr	10 hr	24 hr
(secs)	300	600	900	1800	3600	7200	14400	21600	36000	86400
$r = 0.36$ Value Z1	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
Rainfall M5 (mm)	7.2	10.2	12.4	15.8	20.0	24.4	29.6	33.4	38.0	48.4
M100/M5 gf Value Z2	1.84	1.91	1.95	2.00	2.03	2.01	1.97	1.94	1.91	1.82
Rainfall M100 (mm)	13.3	19.5	24.2	31.5	40.6	49.1	58.4	64.9	72.4	88.2
With CC & UC uplift (mm)	19.9	29.3	36.2	47.3	60.9	73.7	87.6	97.3	108.6	132.3
RUNOFF (m ³)	63.19	92.94	115.06	150.22	193.36	233.85	278.16	309.04	344.94	420.16
Infiltr capacity (m ³)	2.97	5.94	8.91	17.82	35.64	71.28	142.56	213.84	356.40	855.36
INFILTRATED (m ³)	2.97	5.94	8.91	17.82	35.64	71.28	142.56	213.84	344.94	420.16
Req'd STORAGE (m ³)	60.22	87.00	106.15	132.40	157.72	162.57	135.60	95.20	0.00	0.00
	pass	pass	pass	pass	pass	pass	pass	pass	pass	pass

TOTAL STORAGE AVAILABLE 173.25 m³

Time to drain full to half full = 2.3 hours

Overall Assessment

Media base elevation above seasonal high GWL 1.57 m meets GP3

Will the soakaway drain from full to half full in 24 hours or less? Yes pass

Does the soakaway provide sufficient storage? Yes pass

Project No : 20159
Project Title : Yapton Lane

Oval Infiltration Basin (R156)

Site Location: Walberton	Catchment ID: remaining catchment
$r = 0.36$ (range 0.12 to 0.45)	
Drained Area = 5025 m ²	Base long axis = 35.7 m
Design storm 1 in = 100 year	Base short axis = 35.7 m
Design-operational = 40 % for climate change	Infiltration Area = 1001.11 m ²
Urban Creep allowance = 10 % uplift to Drained Area	Side slopes 1 in = 3

Site Considerations

Where determined, what is the depth to highest seasonal groundwater level (GWL) from surface	1.80 m
Is the infiltration far enough from drainage mounds/fields or other soakaways etc to avoid impact?	Yes
What Source Protection Zone (SPZ) is the proposed soakaway located in?	None
What is known and proposed about potential contaminated ground on the site?	EA/LPA accept infiltration

Technical Assessment

Consequence of failure = 2-Minor inconvenience	
Measured Soil Filtration Rate = 3.00E-05 m/s	
Design Soil Filtration Rate = 6.00E-06 m/s	
Operational depth from base = 0.50 m	O/A depth rim-base = 0.80 m
Effective net porosity = 100 %	

	DESIGN LOAD incl CC + UC									
RUNOFF (m ³)	100.01	147.09	182.11	237.76	306.02	370.11	440.24	489.10	545.93	664.98
Infiltr capacity (m ³)	1.80	3.60	5.41	10.81	21.62	43.25	86.50	129.74	216.24	518.98
INFILTRATED (m ³)	1.80	3.60	5.41	10.81	21.62	43.25	86.50	129.74	216.24	518.98
Req'd STORAGE (m ³)	98.21	143.49	176.70	226.94	284.40	326.86	353.74	359.36	329.69	146.01

TOTAL STORAGE AVAILABLE	543.80 m ³	Long axis at operational depth	38.7 m
Time to drain full to half full =	8.3 hours	Short axis at operational depth =	38.7 m

Overall Assessment

Base elevation above seasonal high GWL	1.00 m	meets GP3
Will the basin drain from full to half full in 24 hours or less? (sensitivity case)	Yes	pass
Does the basin provide sufficient storage?	Yes	pass

Date: 16/12/2021

Site Ref

Yapton Lane

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

Permeable pavement

Is discharge to: SPZ1? N Drinking Water Protection Area? N

Is site in close proximity to an area with sensitive environmental designation?
if so how close? m

Is an additional treatment component required due to sensitivity?

Y

Land Use

car parks -infrequent turn over

Hazard

low

TSS index	Metals index	HydroCar index
0.5	0.4	0.4

Treatments

To surface water discharge N

Component

- N/A
 - N/A
 - N/A
- mitigation index
- X1 N/A
- Enhanced mitigation index
- Residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	1.00
0	0	0	0.50
0	0	0	0.50
0	0	0	
0	0	0	1.00
0	0	0	
0.5	0.4	0.4	

Land Use

car parks -infrequent turn over

Hazard

low

TSS index	Metals index	HydroCar index	residual
0.5	0.4	0.4	

Treatments

To groundwater discharge Y

Infiltration surface

- Permeable pavement
 - N/A
- Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0.7	0.6	0.7	1.00
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

N

Notes:

Date: 16/12/2021

Site Ref

Yapton Lane

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

Permeable pavement

Is discharge to: SPZ1? N Drinking Water Protection Area? N

Is site in close proximity to an area with sensitive environmental designation? N

if so how close? m

Is an additional treatment component required due to sensitivity?

Y

Land Use

roofs-residential

Hazard

very low

TSS index	Metals index	HydroCar index
0.2	0.2	0.05

*2 residential roofs remove gross solids and sediments

Treatments

To surface water discharge N

Component

- N/A
- N/A
- N/A

mitigation index

X1 N/A

Enhanced mitigation index

Residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	1.00
0	0	0	0.50
0	0	0	0.50
0	0	0	
0	0	0	1.00
0	0	0	
0.2	0.2	0.05	

Land Use

roofs-residential

Hazard

very low

TSS index	Metals index	HydroCar index
0.2	0.2	0.05

residual

*2 residential roofs remove gross solids and sediments

Treatments

To groundwater discharge Y

Infiltration surface

- Permeable pavement
- N/A

Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0.7	0.6	0.7	1.00
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

N

Notes:

Date: 16/12/2021

Site Ref

Yapton Lane

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

Pond/basin

Is discharge to: SPZ1? N Drinking Water Protection Area? N

Is site in close proximity to an area with sensitive environmental designation?

N

if so how close?

m

Is an additional treatment component required due to sensitivity?

Y

Land Use

roads-low traffic

Hazard

low

TSS index	Metals index	HydroCar index
0.5	0.4	0.4

Treatments

To surface water discharge N

Component

- N/A
- N/A
- N/A

mitigation index

X1 N/A

Enhanced mitigation index

Residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	1.00
0	0	0	0.50
0	0	0	0.50
0	0	0	
0	0	0	1.00
0	0	0	
0.5	0.4	0.4	

Land Use

roads-low traffic

Hazard

low

TSS index	Metals index	HydroCar index	residual
0.5	0.4	0.4	

Treatments

To groundwater discharge Y

Infiltration surface

- Vegetated soil
- N/A

Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0.6	0.5	0.6	1.00
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

N

Notes:

Date: 16/12/2021

Site Ref

Yapton Lane

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

Pond/basin

Is discharge to: SPZ1? ☐ N Drinking Water Protection Area? ☐ N
Is site in close proximity to an area with sensitive environmental designation? ☐ N
if so how close? m
Is an additional treatment component required due to sensitivity? ☐ Y

Land Use

roofs-residential

Hazard

very low

TSS index	Metals index	HydroCar index
0.2	0.2	0.05

*2 residential roofs remove gross solids and sediments

Treatments

To surface water discharge ☐ N

Component
1 N/A
2 N/A
3 N/A
mitigation index
X1 N/A
Enhanced mitigation index
Residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	1.00
0	0	0	0.50
0	0	0	0.50
0	0	0	
0	0	0	1.00
0	0	0	
0.2	0.2	0.05	

Land Use

roofs-residential

Hazard

very low

TSS index	Metals index	HydroCar index
0.2	0.2	0.05

residual

*2 residential roofs remove gross solids and sediments

Treatments

To groundwater discharge ☐ Y

Infiltration surface
1 Vegetated soil
2 N/A
Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0.6	0.5	0.6	1.00
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

☐ N

Notes:

SUDS operation and maintenance - general

There are three categories on maintenance activities:

Regular maintenance consists of basic tasks done on a frequent and predictable schedule, including vegetation management, litter and debris removal, and inspections.

Occasional maintenance comprises tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example). The table below summarises the likely maintenance activities required for each SUDS component and specific maintenance activities is given in the following sections.

Remedial maintenance comprises intermittent tasks that may be required to rectify faults associated with the system. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict. Remedial maintenance items can comprise items such as:

- inlet/outlet repairs
- erosion repairs
- reinstatement or realignment of edgings, barriers, rip-rap or other erosion control
- infiltration surface rehabilitation
- replacement of blocked filter fabrics
- construction stage sediment removal (although this activity should have been undertaken before the maintenance contract)
- system rehabilitation immediately following a pollution event.

O&M activity	SUDS component												
	Pond	Wetland	Detention basin	Infiltration basin	Soakaway	Infiltration trench	Filter trench	Modular storage	Pervious pavements	Swale/bioretention/greenroofs	Filter strip	Sand filter	Pre-treatment systems
Regular maintenance													
Inspection	■	■	■	■	■	■	■	■	■	■	■	■	■
Litter/debris removal	■	■	■	■	□	■	■	□	■	■	■	■	■
Grass cutting	■	■	■	■	□	■	■	□	□	■	■	□	□
Wee/invasive plant control	□	□	□	□		□	□		□	□	□	□	□
Shrub management	□	□	□	□					□	□	□		□
Shoreline vegetation management	■	■	□										□
Aquatic vegetation management	■	■	□										□
Occasional maintenance													
Sediment management *	■	■	■	■	■	■	■	■	■	■	■	■	■
Vegetation/plant replacement	□	□	□	□						□	□		□
Vacuum sweeping and brushing									■				
Remedial maintenance													
Structure rehabilitation/repair	□	□	□	□	□	□	□	□	□	□	□	□	□
Infiltration surface reconditioning				□	□	□	□		□	□	□	□	

■ will be required

□ may be required

* sediment to be collected upstream of the main device

GENERAL MAINTENANCE

Litter/debris removal

This is an integral part of SUDS maintenance and reduces the risks of inlet and outlet blockages, retains amenity value and minimises pollution risks. High litter removal frequencies may be required at high profile commercial/retail parks where aesthetics are a major driver.

Grass cutting

It is recommended that grass cutting be minimised around SUDS facilities, apart from swales and filter strips and structural embankments where a height of 100–150 mm is recommended to prevent the plants falling over, or “lodging”, when water flows across the surface. In general, allowing grass to grow tends to enhance water quality performance. Short grass around a wet system such as pond or wetland provides an ideal habitat for nuisance species such as geese; allowing the grass to grow is an effective means of discouraging them. Grass around wet pond or wetland systems should not be cut to the edge of the permanent water. Grass cutting is an activity undertaken primarily to enhance the perceived aesthetics of the facility. The frequency of cutting will tend to depend on surrounding land uses, and public requirements. Therefore, grass cutting should be done as infrequently as possible, recognising the aesthetic concerns of local residents. However, grass around inlet and outlet infrastructure should be trimmed closely to reduce risks to system performance. If a manicured, parkland effect is required, then cutting will need to be undertaken more regularly than for meadow type grass areas, which aim to maximise habitat and biodiversity potential.

Weed/invasive plant control

Weeds are generally defined as vegetation types that are unwanted in a particular area. For SUDS, weeds are often alien or invasive species, which do not enhance the technical performance or aesthetic value of the system, or non-native species and the spread of which is undesirable. In some places, weeding has to be done by hand to prevent the destruction of surrounding vegetation (hand weeding should generally be required only during the first year, ie during plant establishment). However, over grassed surfaces, mowing can be an effective management measure. The use of herbicides and pesticides should be prohibited since they cause water quality deterioration. The use of fertilisers should also be limited or prohibited to minimise nutrient loadings which are damaging to water bodies.

Shrub management

Shrubs tend to be densely planted and are likely to require weeding at the base, especially during the first year to ensure that they get enough water. Shrubs should be selected so they can grow to their maximum natural height without pruning.

Aquatic/shoreline vegetation management

Aquatic plant aftercare in the first 1–3 years may be required to ensure establishment of planted vegetation and control nuisance weeds/invasive plants. Once established, the build-up of dead vegetation from previous seasons should be removed at convenient intervals to reduce organic silt accumulation (eg every three years and at the end of landscape contract periods).

Emergent vegetation may need to be harvested every 5–10 years to maintain flood attenuation volumes, optimise water quality treatment potential and ensure fresh growth, although this is often not required. Care should be taken to avoid nesting birds during the breeding season and to avoid great crested newt and water vole habitats. The typical window for this activity is towards the end of the growing season (September and October). As vegetation matures, plant height may also become a safety issue in residential areas.

Where emergent vegetation is managed, up to 25 per cent can be removed by cutting at 100 mm above soil level using shearing action machinery. Up to 25 per cent of submerged vegetation can be cut and raked out at any one time, using approved rakes, grabs or other techniques, depending on whether clay or waterproof membranes are present. Aquatic vegetation arisings should be stacked close to the water's edge for 48 hours to de-water and allow wildlife to return to the SUDS feature. They should then be removed to wildlife piles, compost heaps or off site before decomposition, rotting or damage to existing vegetation can occur.

Algae removal may be undertaken for aesthetic purposes during the first 3–5 years of a pond/wetland's life. The growth of algae, which is considered by some to be visually intrusive, is encouraged by nutrients introduced into the water body. This situation should settle down once upstream construction activities are complete.

Management of green waste

Appropriate methods should be implemented to dispose of green waste, including

- The development of wildlife piles
- On- or off-site composting
- Disposal to landfill

REMEDIAL MAINTENANCE

Structure rehabilitation/repair

There will come a time with most SUDS techniques when a major overhaul of the system is required to remove clogged filters, geotextiles, gravel etc. This will typically be between 10 and 25 years, depending on the technique and factors such as the type of catchment and sediment load. For example the use of geotextiles close to the surface in pervious surfaces traps the majority of sediment in a relatively easily accessible location. Reconstruction of the surface layer and bedding layer is all that is required, rather than reconstruction of the whole pavement depth.

Major overhaul is most likely to be required on techniques that rely on filtration through soils or aggregates, such as sand filters and infiltration devices. Other SUDS techniques are unlikely to need major overhaul if routine maintenance is undertaken as required (for example ponds and wetlands).

Rehabilitation activities for each SUDS component are described on the following tables.

Infiltration surface rehabilitation

In the event that grassed surface permeability has reduced, there are a number of landscape techniques that can be used to open the surface to encourage infiltration. Such activities are not commonplace and are likely to be required only in circumstances where silt has not been effectively managed upstream.

1. Scarifying to remove “thatch”. Thatch is a tightly intermingled organic layer of dead and living shoots, stems and roots, developing between the zone of green vegetation and the soil surface. Scarifying with tractor-drawn or self-propelled equipment to a depth of at least 50 mm breaks up silt deposits, removes dead grass and other organic matter and relieves compaction of the soil surface.
2. Spiking or tining the soil, using aerating equipment to encourage water percolation. This is particularly effective if followed by top dressing with a medium to fine sand, and is best undertaken when the soil is moist. Spiking or tining with tractor drawn or self-propelled equipment penetrates and perforates soil layers to a depth of at least 100 mm (at 100 mm centres) and allows the entry of air, water, nutrients and top dressing materials.
3. As a last resort, it may be necessary to remove and replace the grass and topsoil by:
 - removing accumulated silt and (subject to a toxicity test) applying to land or dispose of to landfill
 - removing damaged turf which should be composted
 - cultivating remaining topsoil to required levels
 - re turfing (using turf of a quality and appearance to match existing) or reseeded (to BS 7370: Part 3, Clause 12.6 (BSI, 1991) using seed to match existing turf) area to required levels. It may be necessary to supply and fix fully biodegradable coir blanket to protect seeded soil. Turf and seeded areas should be top dressed with fine sieved topsoil to BS 3882 (BSI, 1994) to achieve final design levels. Watering will be required to promote successful germination and/or establishment.

Water butts operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Cleaning of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters of silts and other debris..	Annually (or following poor performance).
Occasional maintenance	Replacement of any filters.	As required
Remedial actions	Repair of erosion damage, or damage to tank.	As required
Monitoring	Inspection of the tank for debris and sediment build up.	Annually (or following poor performance).
	Inspection of inlets, outlets and withdrawal devices.	Annually (or following poor performance).
	Inspection of areas receiving overflow, for evidence of erosion.	After extreme storms.
	Inspection of roof drain filters	Annually (or following poor performance).

Pervious pavement operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Brushing and vacuuming.	Three times/year at end of winter, mid-summer, after autumn leaf fall, or as required based on site-specific observations of clogging or manufacturers' recommendations.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required
	Removal of weed.	As required
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users.	As required
	Rehabilitation of surface and upper sub-structure.	As required (if infiltration performance is reduced as a result of significant clogging).
Monitoring	Initial inspection.	Monthly for 3 months after installation.
	Inspect for evidence of poor operation and/or weed growth. If required take remedial action.	3-monthly, 48 h after large storms.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually
	Monitor inspection chambers.	Annually

Infiltration basin operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter, debris and trash removal.	Monthly
	Grass cutting – for landscaped areas and access routes.	Monthly (during growing season), or as required.
	Grass cutting – meadow grass in and around basin.	Half yearly (spring – before nesting season, and autumn).
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required).
Occasional maintenance	Re-seed areas of poor vegetation growth.	Annually, or as required.
	Prune and trim trees and remove cuttings.	As required
	Remove sediment from pre-treatment system when 50% full.	As required
Remedial actions	Repair of erosion or other damage by re-seeding or re-turfing.	As required
	Realignment of rip-rap.	As required
	Repair/rehabilitation of inlets, outlets and overflows.	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates.	As required
	Re-level uneven surfaces and reinstate design levels.	As required
Monitoring	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 pre-treatment systems for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly.
	Inspect infiltration surfaces for compaction and ponding.	Monthly

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on-site if there is an appropriate safe and acceptable location to do so.

Pond operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter removal.	As required
	Grass cutting – public areas.	Monthly (during growing season)
	Grass cutting – meadow grass.	Half yearly (spring, before nesting season, and autumn)
	Inspect vegetation to pond edge and remove nuisance plants (for first 3 years).	Monthly (at start, then as required)
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above pond base; include max 25% of pond surface).	Annually.
	Remove 25% of bank vegetation from waters edge to a minimum of 1 m above water level.	Annually.
	Tidy all dead growth before start of growing season.	Annually.
	Remove sediment from forebay.	1–5 years, or as required.
	Remove sediment from one quadrant of the main body of ponds without sediment forebays.	2-10 years.
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%.	>25 years (usually).
Remedial actions	Repair of erosion or other damage.	As required
	Aerate pond when signs of eutrophication are detected.	As required
	Realignment of rip-rap or other damage.	As required
	Repair/rehabilitation of inlets, outlets and overflows.	As required
Monitoring	Inspect structures for evidence of poor operation.	Monthly/after large storms.
	Inspect banksides, structures, pipework etc for evidence of physical damage.	Monthly/after large storms.
	Inspect water body for signs of eutrophication.	Monthly (May–October).
	Inspect silt accumulation rates and establish appropriate removal; frequencies.	Half yearly.
	Check penstocks and other mechanical devices.	Half yearly.

Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For industrial site runoff sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on-site if there is an appropriate safe and acceptable location to do so.

Appendix D

CONDITIONS AND LIMITATIONS OF FLOOD RISK ASSESSMENT & DRAINAGE STRATEGIES

October 2020

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