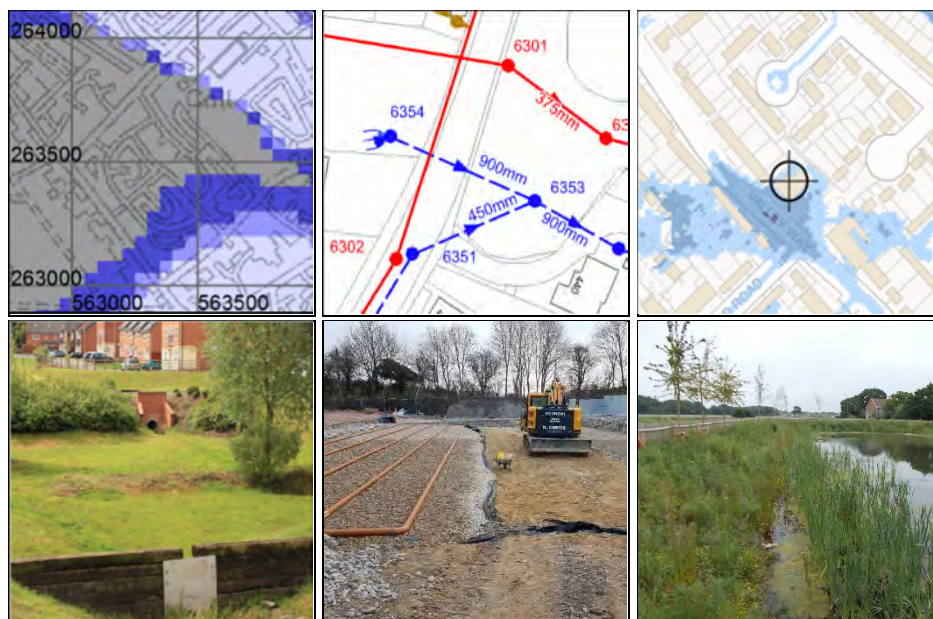




Flood Risk Assessment and Drainage Strategy

**Land off Horndean Road
Emsworth, Hants**

Reference: 1946

Issue: **Date:**

1 24/7/2019

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Appendices

A	Existing Layout & Proposed Site Layout
B	EA Flood Mappings, Local Sewer Plan & Soils Data
C	Surface Water Assessment
D	Conditions & Limitations

1. Introduction

- 1.1 Instructions were received from Metis Homes to undertake a Flood Risk Assessment (FRA) and set out a Drainage Strategy (DS) for a planning application for the development of 16 residential dwellings on land to the rear of 15-27 Horndean Road, Emsworth, Hants PO10 7PT.
- 1.2 This assessment has been undertaken by A P Traves BSc CEng MStructE 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 approximately 0.92 Ha of land to rear of 15-27 Horndean Road, Emsworth, Hants (grid ref 474500 106840). The site extents are indicated on the annotated aerial photograph in Appendix A. The existing topography is shown on drawing 112552-SU-01-A contained in Appendix A of this report.
- 2.2 The site comprises an irregular shaped parcel of land to the rear of 15-27 Horndean Road with access on to Horndean Road between No 29 and 35. The site is predominantly laid to grass.
- 2.3 It is proposed to develop the high ground on the northern and eastern parts of the site for 16 dwellings with the lower southwestern part retained as open space. The proposed layout is shown on the ADP Architects layout drawing contained in Appendix A of this report.

3. Local Development Documents & Strategic Flood Risk Assessment

- 3.1 The Strategic Flood Risk Assessment (SFRA) for Partnership for Urban South Hampshire (PUSH) has been reviewed and this indicates the following:
- 3.2 Local flood interactive mapping is held on the PUSH SFRA web portal. This has been out of service for around 9 months for update, and the date at which it is due to go back on line has been continually deferred by PUSH. There is currently no access to the mappings so other sources have been used where available
- 3.3 Hampshire CC Groundwater Management Plan (GWMP) does not identify groundwater issues within Emsworth.
- 3.4 Flood mapping data has been reviewed from the Environment Agency (EA) website. (refer to Appendix B). This indicates the following:
- 3.5 The EA mapping indicates the proposed housing area is within FZ1 low flood risk, and the proposed open space area is within FZ2/3 high risk.
- 3.6 The EA mapping indicates the proposed housing is at very low (<0.1% AEP) risk of surface water flooding. The retained open space area is at low (<1% AEP) risk of surface water flooding. The watercourse forming the western boundary of the site has an inherent surface water flood risk as this contains water throughout the year. It is not proposed to undertake development within the channel.
- 3.7 The EA mapping indicates the site is not in an area of reservoir flood risk.
- 3.8 MAGIC mapping indicates the site is not in a Source Protection Zone (SPZ).
- 3.9 MAGIC mapping indicates the site is not within a drinking water safeguard or protection zone.

- 3.10 The Havant Borough Core Strategy-March 2011 sets out environmental policy with respect to flood risk and climate change in CS15 Flood and Erosion Risk. This is supported by Havant Borough Local Plan 2036 (Draft) policies E12 Managing Flood Risk in New Development and E13 Drainage Infrastructure in New Development.
- 3.11 CS15 requires that unacceptable levels of flood risk are avoided and that surface water is proactively managed through promotion of sustainable drainage techniques.
- 3.12 E12 requires that any new development will be safe over its lifetime, including the access, without increasing flood risk elsewhere.
- 3.13 E13 requires that any new development will have no net increase in surface water run-off compared with the pre-development rate and the drainage system does not increase flood risk elsewhere.
- 3.14 Chapter 9 of this report identifies that the proposed build area is in flood zone 1 (Low risk). CS15, E12 and E13 can therefore be met by:
- Implementing a surface water drainage strategy that manages flood risk from the new development.
 - Provision of a satisfactory sustainable surface water drainage system.
- 3.15 In essence the local policies replicate the requirements of current national policies and practice, and in meeting national policy local policy will also be met.

4. Catchment Flood Management & Shoreline Management Plans

- 4.1 The site is at an elevation of some 8-9 m AOD and is remote from the influence of tidal flooding. Shoreline Management Plans are not applicable at this location.
- 4.2 The South East Hampshire Catchment Flood Management Plan summary – December 2009 (CFMP) indicates the site falls within sub-area 5 Havant and Denmead. The CFMP states that policy 4 is the preferred policy approach:
- “Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.”*
- 4.3 Overall the CFMP does 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 BGS mapping indicates the site geology generically comprises Head deposits and River Terrace deposits over London Clay. The site falls from a level of some 10m AOD where it abuts Horndean Road to some 7m AOD on the bank of the watercourse forming the western boundary of the site.
- 5.2 A Geotechnical site investigation was undertaken by Geo Environmental Services Ltd and the key findings of their report GE18313-GAR-JUL19 are discussed in the following paragraphs. The soil logs are reproduced in Appendix B.
- 5.3 6No. dynamic sampler boreholes (WS01WS06) were made to depths between 3.60m and 4.00m below ground level (bgl). No distinction could be made between the Head deposits and River Terrace deposits. All superficial deposits were therefore identified as Head deposits.
- 5.4 Head deposits are indicated on the logs to comprise sandy gravelly Silt (in places down to 0.5-1.20m bgl) over sandy gravelly Clay (down to 1.0-2.8 mbgl). The laboratory

classifications however determine the upper layer where present to be silty gravelly Clay. The primary character of the Head deposits is determined as Clay.

- 5.5 The London Clay is indicated to comprise a sandy Clay with sandy Claystone.
- 5.6 Groundwater was encountered at between 2.33m bgl and 3.70m bgl within the Head Deposits during the investigation, and between 1.13m bgl and 2.06m bgl within the standpipes during the return visit undertaken on the 5th July
- 5.7 It was concluded during the investigation that the primary Clay characteristic of the soil which was readily evident in combination with the high groundwater levels recorded in July (Summer) to just under 1.1m bgl, would render the soil unsuitable for infiltration drainage.

6. Sewage Authority Data

- 6.1 There is an existing 225mm DN foul sewer within Horndean Road to the front of the site at a projected invert level of some 6.15m AOD (3.7m deep). A copy of the local sewer plan is contained in Appendix B. The existing site has no foul water drainage infrastructure and is not currently connected to the sewer, although the adjacent existing dwellings along Horndean Road are serviced by this sewer.
- 6.2 The proposed development will discharge foul water (FW) to the existing public FW sewer on the spine supported by MH5801. A sewer capacity check has been undertaken by Southern Water which confirms there is adequate capacity in the local sewerage network to accommodate the foul flow from the development at MH5801. A copy of this check is contained in Appendix B.
- 6.3 The standing wastewater Infrastructure Charge (IC), which came into force from 1st April 2018, will be paid.
- 6.4 The proposed foul water drainage spine is shown on the drainage schematic in Appendix C. The spatial arrangement and levels enable a gravity connection to be made to the public sewer. The particulars of individual plot connections to the new spine can be secured by standard planning condition.

7. Site Particulars

- 7.1 A walkover site reconnaissance was undertaken on 8 June 2019. The site is some 0.92 Ha in area and is located on the west side of Horndean Road. There is a small outbuilding/stable to the eastern side of the site and the remainder of the site comprises grass paddock.
- 7.2 The site falls east to west, away from Horndean Road at some 10m AOD to some 7m AOD on the bank of the watercourse forming the western boundary of the site.
- 7.3 The proposed dwellings are to be located on the land in excess of 8.3-8.5m to the north and east sides of the site. The lower lying land (7.0-7.5m AOD) to the south west corner of the site falls to the south west and is to be retained as open space within the FZ2/3 flood plain.
- 7.4 The small watercourse to the western boundary of the site falls from an invert level of some 6.7m AOD at the north west corner of the site to an invert level of some 5.9m AOD at the southwest corner, where it enters a short length of culverted field crossing with a cover and bank level of some 7m AOD before reverting to open channel a few metres downstream of this.
- 7.5 Surface water runoff drains from the site by natural east to west topographic falls towards the south west corner of the site and discharges to the watercourse on the western boundary.

- 7.6 The land to the north and east of the site comprises residential dwellings. The land to the south comprises ancillary maintained grass public open space to the municipal sports facilities further south and east on that parcel. The land to the west currently comprises agricultural land but is identified in the emerging Local Plan as a key development site within the settlement boundary.

8. Source-Pathway-Receptor Assessments

- 8.1 The site is at an elevation of some 8-10m AOD and is not susceptible to tidal flooding.
- 8.2 The EA mapping indicates the majority of the site, including the proposed dwellings, is at low risk (<0.1%AEP) of fluvial flooding. The far south west corner of the proposed open space lies in FZ2 (0.1-1%AEP) where between some 7.3 and 7.4m AOD, and FZ3 (>1%AEP) where below some 7.3m AOD
- 8.3 The EA mapping indicates the majority of the site, including the proposed dwellings, is at very low risk (<0.1%AEP) of surface water flooding. The far south west corner of the proposed open space lies in 0.1-1%AEP where below some 7.5m AOD. The watercourse inherently contains water and the channel is defined to be >1% AEP.
- 8.4 The EA mapping indicates the site is not in an area of reservoir flood risk.
- 8.5 The SFRA does not indicate any groundwater flooding to the site.
- 8.6 The SFRA does not indicate any sewer flooding at the site
- 8.7 The critical flood source is pluvial run-off from within the site. The site surface water drainage system will accord with the principles of CIRIA C753.
- 8.8 The flood receptors of the development would be:
- Residential dwellings
 - Users of the residential dwellings
- 8.9 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 residential | More vulnerable |

9. Flood Probability

- 9.1 The EA flood zones shown on the outputs and included in Appendix B represents 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 proposed dwellings are located in Flood Zone 1 (low risk).

- 9.3 The proposed open space in FZ2/3 will remain as soft landscaping (water compatible) at medium/high risk.

10. Climate Change

- 10.1 The new climate change allowances for flood risk assessment GOV.UK 15 February 2019 update have been used. Climate change values for the site are:

- Peak river flow: Table 1, South East, third epoch, higher central +45%
- Peak rainfall intensity: Table 2, 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.

- 10.3 The JBA hydraulic modelling of the stream identifies the following flows at node 902, located adjacent the south west corner of the site:

Q ₁₀₀	1.55 m ³ /sec
Q _{100+45%CC}	2.25 m ³ /sec
Q ₁₀₀₀	2.70 m ³ /sec

The 1%AEP +45%CC flow rate lies between the 1%AEP and 0.1%AEP flow rates. Therefore the 1%AEP + 45%CC flood zone will lie within the current 0.1%AEP flood zone (FZ2).

11. Detailed Development Proposals & Surface Water Strategy

- 11.1 Surface water drainage must accord with a receptor hierarchy in which Tier 1 (infiltration) must be considered first.
- 11.2 The site soils investigation by GESL (refer to Section 5) concluded during the investigation that the primary Clay characteristic of the soil which was readily evident in combination with the high groundwater levels recorded in July (Summer) to just under 1.1m bgl, would render the soil unsuitable for infiltration drainage (Tier 1).
- 11.3 The existing site falls towards and discharges surface water run-off to the watercourse on the western boundary. A Tier 2 (discharge to watercourse) strategy will therefore be maintained.
- 11.4 The existing site comprises softscape save for a small outbuilding. A UKsuds IOH124 greenfield runoff calculation for the site has been made (Refer to Appendix C). This indicated the following rates:

Q _{bar}	1.79 l/sec
Q ₁	1.52 l/sec
Q ₃₀	4.11 l/sec
Q ₁₀₀	5.70 l/sec

The existing stable roof comprise some 40m² at an existing unattenuated run-off rate of 50 mm/hr. The existing brownfield run-off rate from this is 0.55 l/sec.

The net total Q_{BAR} flow rate is 2.34 l/sec.

There are two approaches to setting post development discharge rates. Either a variable rate discharge and provision of separate long-term storage which itself is limited to a discharge rate of 2 l/sec/Ha; or set a flat discharge of Q_{BAR} or 2 l/sec/Ha and provide adequate storage to facilitate this. In both cases there is a pragmatic lower threshold to mitigate the potential blockage risk associated with small orifices for low flow rates. This is

accepted to be 5 l/sec where discharging to open water bodies to allow for vegetation or 2 l/sec where discharging into sewers or piped systems which inherently have no vegetation.

11.5 The proposed site characteristics comprise:

Traditional Roof	875 m ²
Pavement	1,780 m ²
Soft landscape	6,560 m ²

A UKsuds W5-074/A/TR/1 rev E assessment of surface water storage requirement for the proposed development has been made (Refer to Appendix C). The assessment indicated the following assessed requirements:

Interception storage	11 m ³	discharge rates for net site
Attenuation storage	252 m ³	
Long term storage	nil	
Treatment storage	32 m ³	
Total storage (excluding treatment)	263 m ³	
		Q _{bar} 2.0 l/sec
		Q ₁ 2.0 l/sec
		Q ₁₀₀ 2.0 l/sec

11.6 A drainage schematic for the principal drainage spines and associated storage is contained in Appendix C. It is proposed to provide a net 252m³ of attenuation storage as geocellular storage at the locations indicated, with outfall regulated by hydrobrake or similar vortex control device. Examination of the proposed site layout indicates there would be sufficient space to accommodate the required tanks as indicated. It is concluded that the proposed layout could support the appropriate attenuation storage for 2 l/sec outfall to a swale in the open space landscape area connecting to the watercourse.

11.7 The surface water drainage system will be designed to accommodate a 1 in 100 year +40% combined climate change and urban creep rainfall event. With respect to the Non-statutory Technical Standards for Sustainable Drainage Systems (NTS SuDS) the design accords with requirements S2 and S5-9. Design and construction details will accord with Building Regulations, so according with S10-11 and S13-14. The surface water design does not include pumping so S12 is not applicable. The detailed design can be secured by standard planning condition as usual.

11.8 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.

11.9 In summary source control will be provided by:

- Attenuation storage as outlined in paragraph 11.6
- Provision of water butts as outlined in paragraph 11.8

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

11.11 The use comprises generally low and very low pollution hazard levels (C753 Table 26.2) and does not require groundwater risk screening.

11.12 Simple index approach calculations are contained in Appendix C. These demonstrate that the proposed SuDS infrastructure can provide the mitigation necessary. It is proposed to provide a swale to treat attenuated run-off prior to discharge into the watercourse.

11.13 The existing site falls east to west. The site morphology is not going to be altered so there will be no impact on local flood flow pathways and exceedance flows will continue to discharge west from the site to watercourse, as currently occurs.

- 11.14 A schedule of O&M maintenance requirements for the SuDS infrastructure is also contained in Appendix C. Individual plot drainage will be maintained by the owners. Common assets will be maintained by the estate management company

12. Sequential & Exceptions Tests

- 12.1 The proposed dwellings are located in FZ1 and inherently meet 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 Paragraph 8.7 identifies that on site surface run-off is the governing flood source. The management of the storage and conveyance of these volumes and flows is provided for by the surface water strategy set out in Chapter 11. The strategy accords with CIRIA C753 SuDS Manual.
- 13.3 The surface water strategy mimics the existing run-off regime. There will therefore be no adverse impact on flood flow rates outside the site.

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 2019_{AD} + CC rainfall. The residual flood risk is therefore pluvial events in excess of 1:100 year 2019_{AD} + CC rainfall.
- 15.2 The level of the built site is located well above 1:100 year 2019_{AD} + CC fluvial flood level from the watercourse. The residual flood risk is therefore fluvial events in excess of 1:100 year 2019_{AD} + CC.

Appendix A



Site location





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SITE PLAN PROPOSAL

Appendix B



Flood map for planning

Your reference
1946

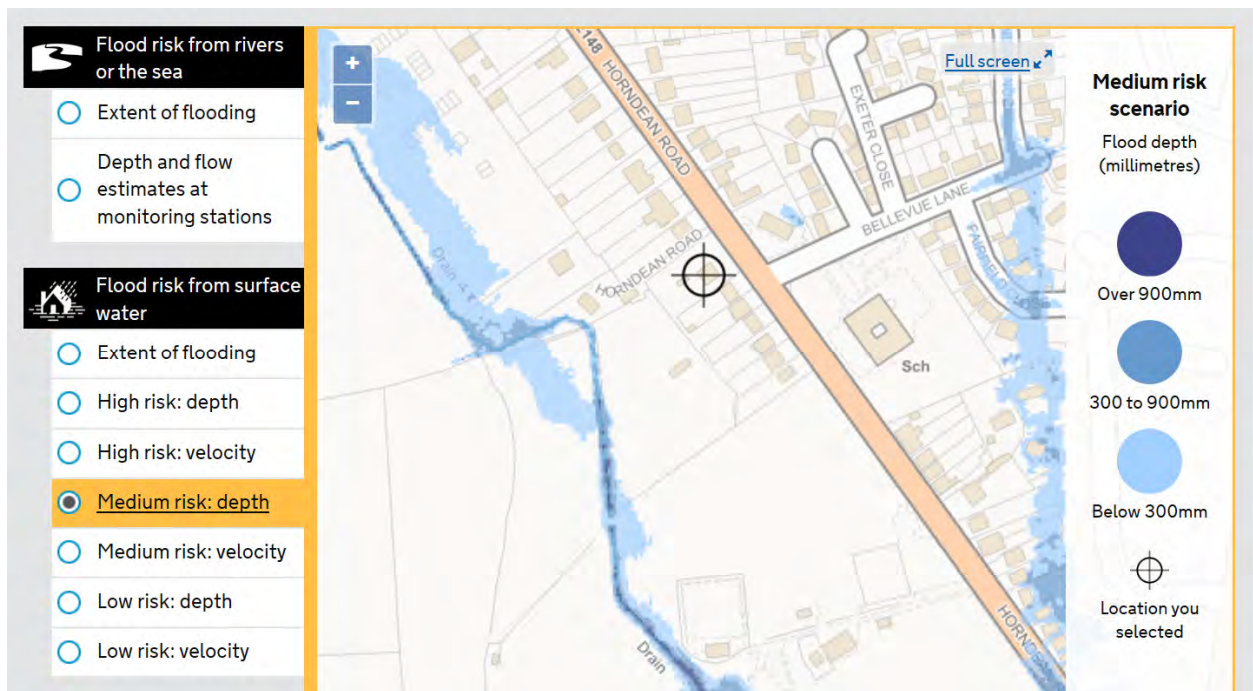
Location (easting/northing)
474511/106822

Scale
1:2500

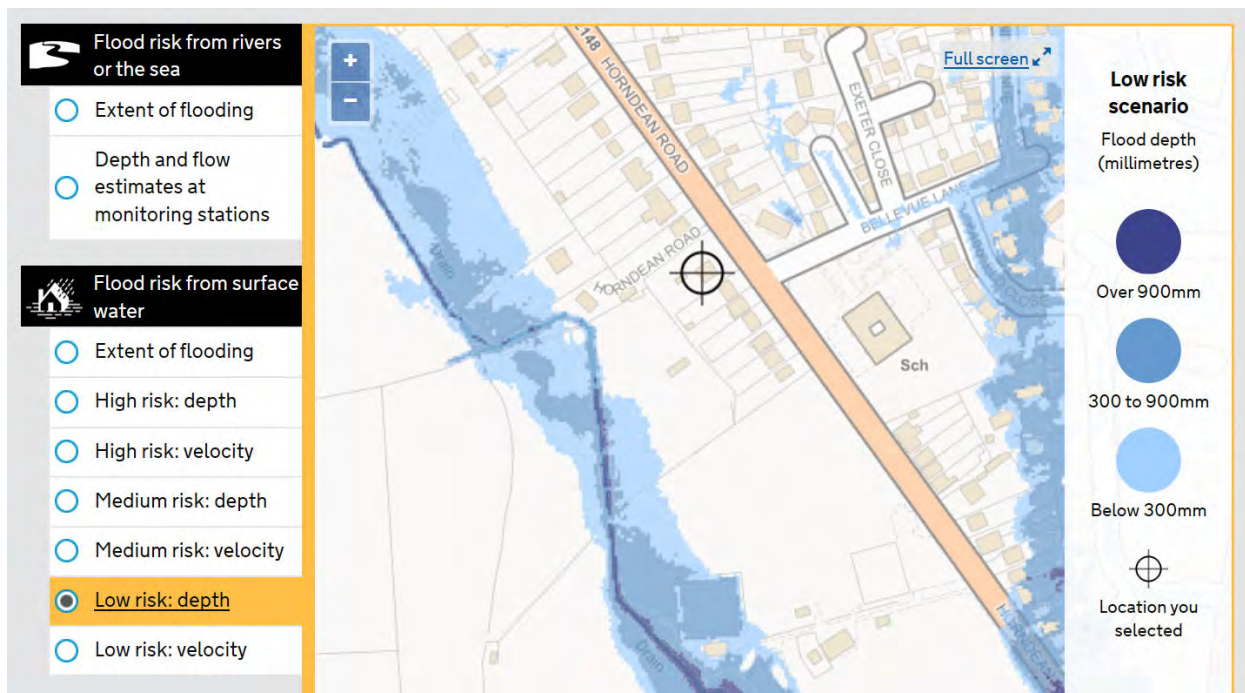
Created
20 Jul 2019 12:49

-  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

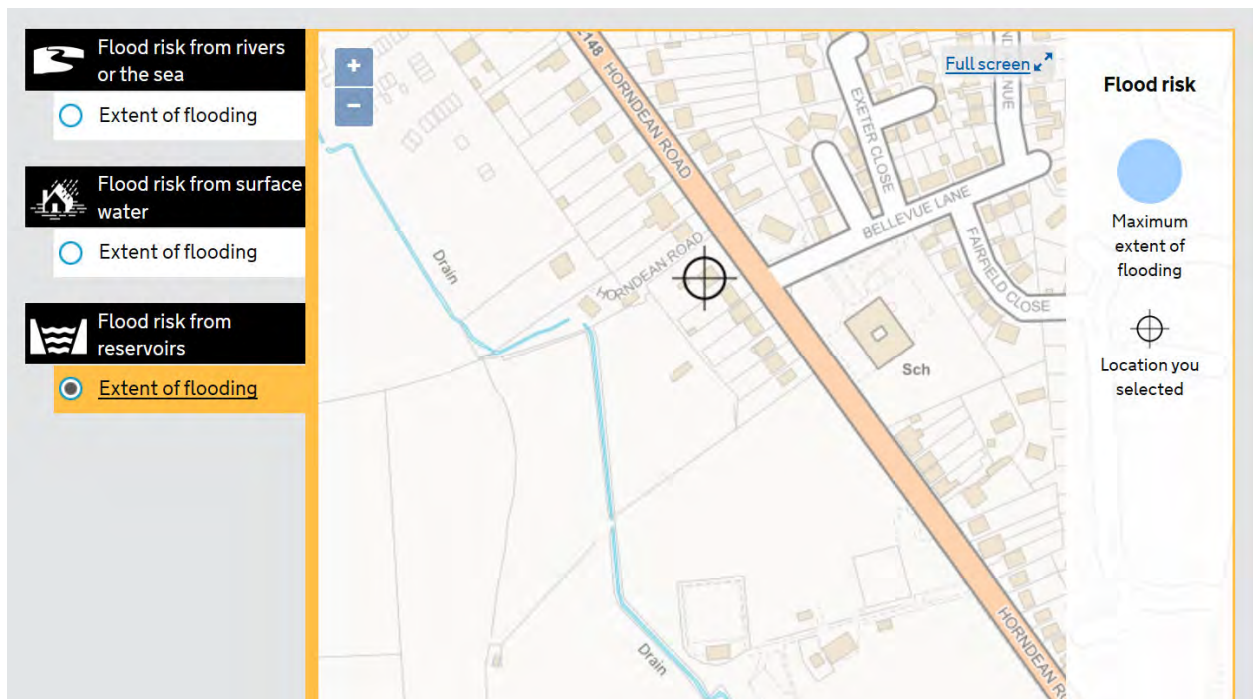
0 20 40 60m



1% AEP Surface water flood risk (Medium)

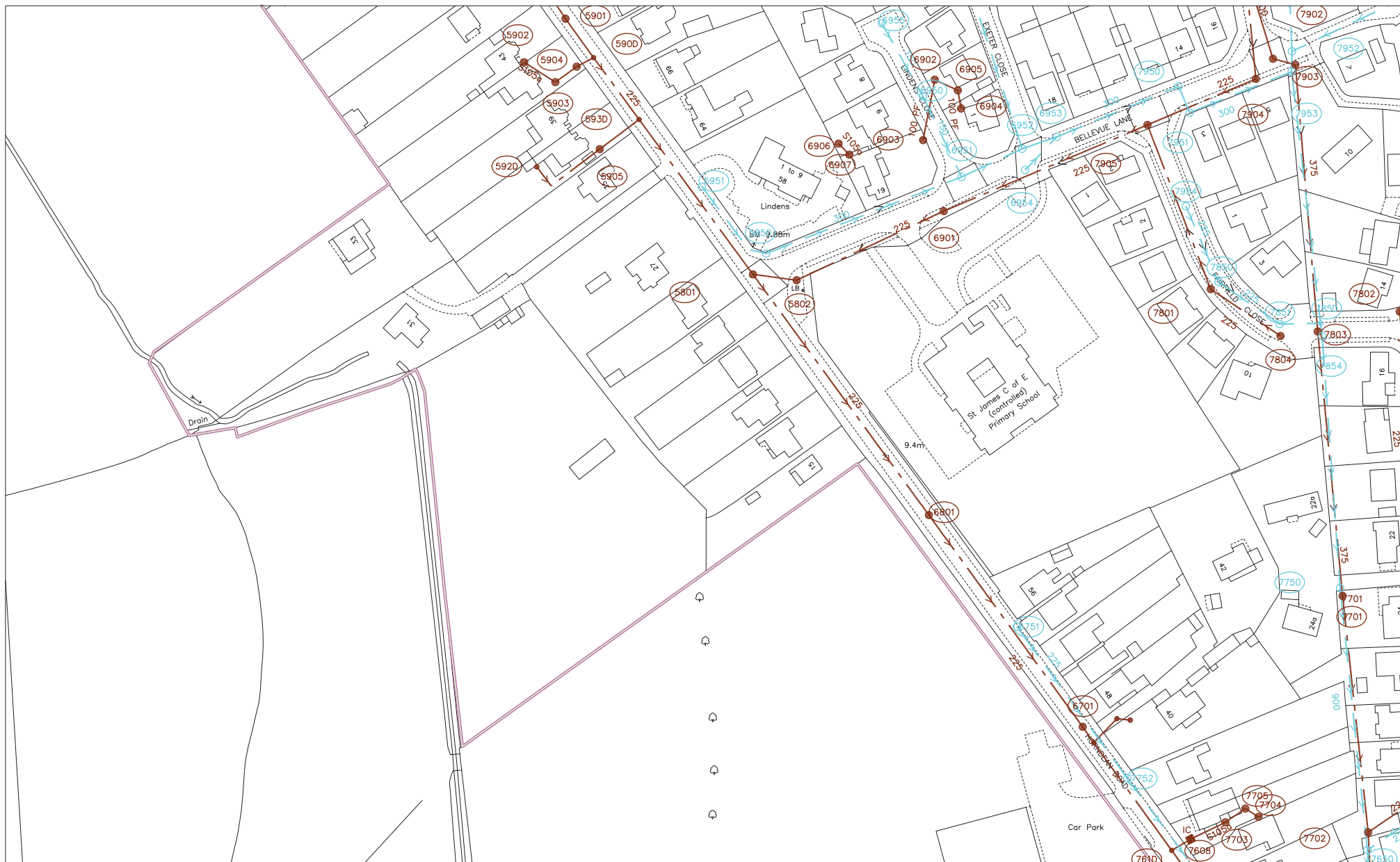


0.1% AEP Surface water flood risk (Low)



Reservoir flood risk

SEWER RECORDS PAGE 1 OF 2



O.S. REF.

SU7406NE

Title: 341587_Rare Of 15-27 Horndean

Drawn by: rohandas

Scale: 1:1250

Date: 20/06/2019

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

The actual positions 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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Southern Water

474797

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
5801X	9.707		225	UNK	CIRC																		
5802X	9.684		225	UNK	CIRC																		
5850X	9.77	8.72	300	UNK	CIRC																		
5901X	10.053	6.393	225	UNK	CIRC																		
5903X			UNK	UNK	CIRC																		
5904X			UNK	UNK	CIRC																		
5905X			UNK	UNK	CIRC																		
590DX			225	UNK	CIRC																		
592DX			UNK	UNK	CIRC																		
593DX			225	UNK	CIRC																		
5951X	10.022	9.002	UNK	UNK	CIRC																		
6701X	8.832	5.322	UNK	UNK	CIRC																		
670DX			UNK	UNK	CIRC																		
671DX			UNK	UNK	CIRC																		
6751X	9.465	8.685	225	UNK	CIRC																		
6801X	9.246	5.626	225	UNK	CIRC																		
6901X	9.254	6.434	225	UNK	CIRC																		
6902X			100	PF	CIRC																		
6904X			100	PF	CIRC																		
6905X			100	PF	CIRC																		
6907X			UNK	UNK	CIRC																		
6950X	9.231	8.371	150	UNK	CIRC																		
6951X	9.174		300	UNK	CIRC																		
6952X	9.052		300	UNK	CIRC																		
6953X	8.868		300	UNK	CIRC																		
6954X	9.016	8.016	UNK	UNK	CIRC																		
6955X			150	UNK	CIRC																		
7608X			UNK	UNK	CIRC																		
761DX			UNK	UNK	CIRC																		
7650X	6.837		900	UNK	CIRC																		
7701X			UNK	UNK	CIRC																		
7702X	6.631		375	UNK	CIRC																		
7703X			UNK	UNK	CIRC																		
7704X			UNK	UNK	CIRC																		
7705X			UNK	UNK	CIRC																		
770DX			UNK	UNK	CIRC																		
7750X	7.142	5.462	900	UNK	CIRC																		
7752X	8.646	8.066	225	UNK	CIRC																		
7801X	7.937	7.017	UNK	UNK	CIRC																		
7802X	8.475	6.415	225	UNK	CIRC																		
7803X	7.807	6.037	375	UNK	CIRC																		
7804X	7.778	7.178	225	UNK	CIRC																		
7850X	7.943	7.283	225	UNK	CIRC																		
7851X	7.789	6.989	UNK	UNK	CIRC																		
7852X	8.45	6.99	225	UNK	CIRC																		
7854X	7.803	5.943	UNK	UNK	CIRC																		
785DX			UNK	UNK	CIRC																		
7902X	8.137	6.577	UNK	UNK	CIRC																		
7903X	8.23	5.47	375	UNK	CIRC																		
7904X	8.283	7.003	225	UNK	CIRC																		
7905X	8.472		225	UNK	CIRC																		
7950X	8.491	7.341	UNK	UNK	CIRC																		
7951X	8.493	7.313	300	UNK	CIRC																		
7952X	8.076	6.286	UNK	UNK	CIRC																		
7953X	8.2	6.28	UNK	UNK	CIRC																		
7954X	8.056	7.476	225	UNK	CIRC																		

LINE STYLES / COLOURS	MATERIALS	LEGEND - SEWERS	SHAPES (S)
Brown Orange Dark Blue Purple Light Blue Yellow Green	AK Asphalt BAC Bonded Asbestos Cement BBC BKA (Common) BRE BKA (Engineering) CC Concrete Box Culvert CI Cast Iron CO Concrete (H-Hub) CP Concrete (Pre-Cast) CSB Concrete Segments (boxed) CSU Concrete Segments (unboxed) DI Ductile Iron GRP Glass Reinforced Plastic MAR Masonry in regular Courses MAR Masonry in random Courses PP Polypropylene PP Polyethylene PP Reinforced Plastic Matte SI Spin Iron ST Steel VC Vitreous Clay XOC Other ZZZ Unknown	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) Factor station (SW) Factor station (F&C) Ejector station (SW) Ejector station (F&C) Waterlight door (SW) Waterlight door (F&C) Flushing ch. Man (SW) Flushing ch. Man (F&C) Flushing ch. Man (SW) Flushing ch. Man (F&C) Demarcation Chamber Washout (SW) Washout (F&C) Roofing Eye (SW) Roofing 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 release Dummy/S24 manhole Outlet Periscope chamber Dampboards Storm Overflow Backsiphon manhole Other (S) Other Change in sewer (S) Change in sewer Reflex valve Cascade Anode Valve Obical Valve AP Valve Hatch box (SW) Hatch box (F&C) Direction arrow Emptying valve Catchpit Soakaway Intal Balancing Pond	Wastewater treatment works Moore treatment works Cut-off headworks Vent Vent column Total storage tank Blank end Head of Public Sewer Micro Pumping Station SHAPES (S) A Arched B Round C Circular E Elliptical H Horseshoe R Rectangular S Square T Trapezoidal U U Shape X Other NODE REFERENCING SYSTEM 1st digit: hundred metre existing identifier 2nd digit: hundred metre existing identifier 3rd digit: sewer type identifier 4th digit: next sequential node

Drawn by: rohandas

Title: 341587_Rare Of 15-27 Hordean

Date: 20/06/2019



**WATER
for LIFE**

from
**Southern
Water** 

Aqua Callidus Consulting
52 Common Lane
Titchfield
Fareham
Portsmouth
Hampshire
PO14 4BU

Your ref

Our ref
DS_CC_PDE-110971

Date
15 July 2019

Contact

Tel 0330 303 0119

Site: R/O 15-27 Horndean Road, Emsworth, Hampshire, PO10 7PT.

Dear Andy,

We have completed the capacity check for the above development site and the results are as follows:

Foul Water

Following initial investigations, there is currently adequate capacity in the local sewerage network to accommodate a foul flow for the above development at/downstream of manhole reference SU74065801. Please note that no surface water flows (existing or proposed) can be accommodated within the existing foul sewerage system.

It should be noted that this information is only a hydraulic assessment of the existing sewerage network and does not grant approval for a connection to the public sewerage system. A formal S106 connection application is required to be completed and approved by Southern Water Services. Please see the link below:

<https://developerservices.southernwater.co.uk/ConnectiontoPublicSewer/ApplicationForm>

Should you require any further information, please contact us at the above mentioned phone number or address shown in the footer.

Yours sincerely,



Developer Services

Please note: - The information provided above does not grant approval for any designs/drawings submitted for the capacity analysis. The results quoted above are only valid for 12 months from the date of issue of this letter.

Southern Water Developer Services, Sparrowgrove House, Sparrowgrove, Otterbourne, Winchester, Hampshire, SO21 2SW
[southernwater.co.uk](https://www.southernwater.co.uk)

Southern Water Services Ltd, Registered Office: Southern House, Yeoman Road, Worthing BN13 3NX Registered in England No. 2366670

Project Title: Horndean Road, Emsworth
Location : Horndean Road, Emsworth
Project No. : GE18313
Client : Metis Homes

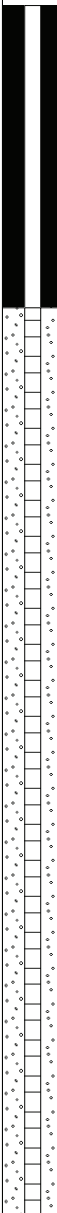
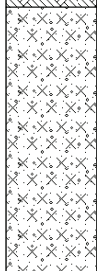
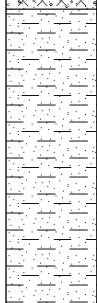
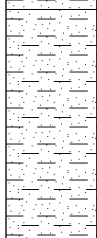
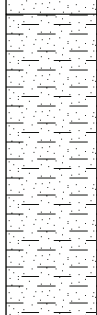
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Scale: 1:1000
Engineer: Jason Kanellis



- Legend Key
- Locations By Type - IP
 - Locations By Type - WLS
 - Locations By Type - DCP

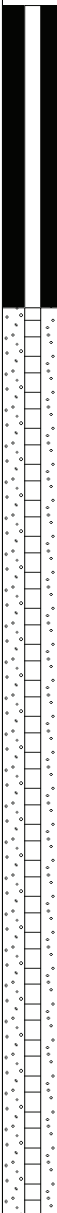
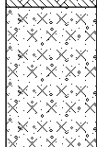
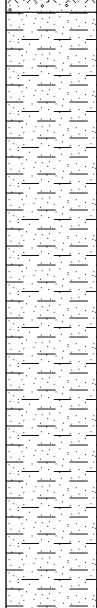
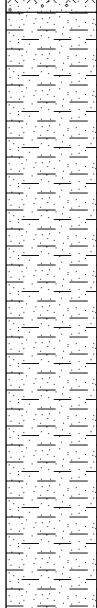
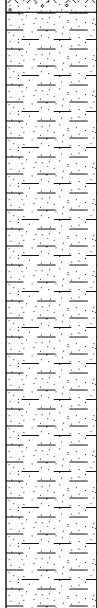
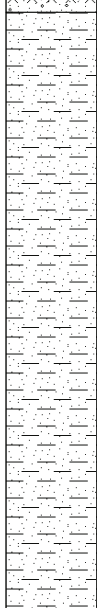


 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS01 Sheet 1 of 1	
Project Name: Horndean Road, Emsworth		Project No. GE18313		Co-ords: 474510E - 106886N		Hole Type WLS	
Location: Horndean Road, Emsworth				Level:		Scale 1:25	
Client: Metis Homes				Dates: 26-06-2019		Logged By TS	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30		 Dark brown gravelly sandy silt with nettle cover and frequent rootlets and roots. Gravel is occasional fine subangular brick and flint. MADE GROUND	1	
									 Brown sandy gravelly SILT with occasional rootlets. Gravel is fine to medium subrounded to subangular flint. HEAD DEPOSITS
		0.80	D		1.20		 Stiff to very stiff orangish brown sandy CLAY with occasional rootlets up to 1mm. HEAD DEPOSITS	2	
		1.50 1.50	D PP	3.5kg/cm2					
		2.00 2.00	D PP	2.5kg/cm2	2.20		 Stiff orangish brown and grey sandy CLAY with occasional fine subangular flint and mudstone. LONDON CLAY	3	
		2.50 2.60	PP D	2.2kg/cm2					
		2.80	PP	2.5kg/cm2	3.00		 Very stiff dark grey fine sandy CLAY with frequent very fine selenite crystals. LONDON CLAY		
		3.20 3.20	D PP	3.5kg/cm2					
		4.00 4.00	D PP	3.8kg/cm2	4.00		End of Borehole at 4.00m	4	
		5							

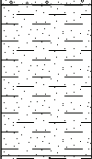
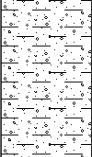
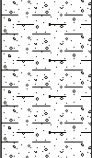
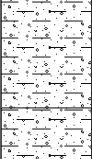
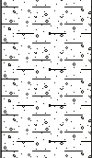
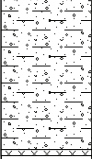
Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		3.70	3.70				

 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS02 Sheet 1 of 1	
Project Name: Horndean Road, Emsworth		Project No. GE18313		Co-ords: 474472E - 106856N		Hole Type WLS	
Location: Horndean Road, Emsworth				Level:		Scale 1:25	
Client: Metis Homes				Dates: 26-06-2019		Logged By TS	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30		Brown gravelly sandy silt with grass cover and frequent roots and rootlets. Gravel is occasional fine subrounded flint. TOPSOIL	1	
		0.60	D				Brown gravelly sandy SILT with occasional rootlets. Gravel is abundant fine to coarse subangular to subrounded flint. HEAD DEPOSITS		
	1.00	D				Stiff orangish brown and grey sandy CLAY with occasional rootlets and roots up to 3mm and reddish brown ferruginous lenses. HEAD DEPOSITS			
	1.00	PP	3.0kg/cm2						
	1.20	PP	2.8kg/cm2						
	1.50	D							
		1.60	PP	2.5kg/cm2	2.80		Stiff to very stiff dark grey fine sandy CLAY with occasional very fine selenite crystals. LONDON CLAY	3	
	2.00	D							
	2.00	PP	2.8kg/cm2						
	2.40	PP	2.5kg/cm2						
	2.50	D							
		3.00	PP	2.8kg/cm2	4.00		Stiff to very stiff dark grey fine sandy CLAY with occasional very fine selenite crystals. LONDON CLAY	4	
		3.20	D						
		3.40	PP	3.5kg/cm2					
		4.00	D		4.00		Stiff to very stiff dark grey fine sandy CLAY with occasional very fine selenite crystals. LONDON CLAY	4	
		4.00	PP	3.0kg/cm2					
End of Borehole at 4.00m									

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		3.56	3.56				

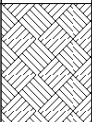
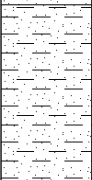
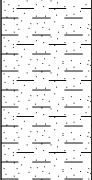
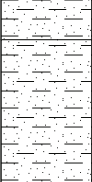
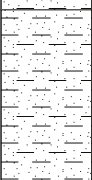
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS03 Sheet 1 of 1	
Project Name: Horndean Road, Emsworth		Project No. GE18313		Co-ords: 474505E - 106855N		Hole Type WLS	
Location: Horndean Road, Emsworth				Level:		Scale 1:25	
Client: Metis Homes				Dates: 26-06-2019		Logged By TS	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.20		 Brown sandy gravelly silt with grass cover and rootlets. TOPSOIL	1	
		0.40	D						 Brown sandy gravelly SILT. Gravel is abundant fine to medium subrounded flint. HEAD DEPOSITS
		0.40	PP	0.5kg/cm2	0.50		 Soft brownish orange and light grey sandy CLAY with occasional rootlets. HEAD DEPOSITS		
		0.70	D						 Firm to stiff orangish brown sandy gravelly CLAY with occasional rootlets and roots up to 3mm. Gravel is occasional fine to medium subangular flint. HEAD DEPOSITS
		0.70	PP	0.5kg/cm2	1.00		 Firm to stiff orangish brown sandy gravelly CLAY with occasional rootlets and roots up to 3mm. Gravel is occasional fine to medium subangular flint. HEAD DEPOSITS		
		1.20	D						 Stiff to very stiff orangish brown and grey sandy gravelly CLAY with occasional very fine selenite crystals. Gravel is occasional fine to medium subangular flint and ferruginous inclusions. LONDON CLAY
		1.20	PP	1.0kg/cm2	2.40		 Stiff to very stiff orangish brown and grey sandy gravelly CLAY with occasional very fine selenite crystals. Gravel is occasional fine to medium subangular flint and ferruginous inclusions. LONDON CLAY		
		1.80	D						 Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m
		1.80	PP	2.0kg/cm2			 Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m		
		2.10	D						 Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m
		2.10	PP	2.0kg/cm2			 Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m		
		2.60	D						 Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m
2.60	PP	2.0kg/cm2			 Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m				
3.00	PP	3.0kg/cm2				Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m			
3.10	D				Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m				
3.20	PP	3.2kg/cm2				Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m			
3.40	PP	3.0kg/cm2			Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m				
3.60	D					Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m			
					Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m				
						Dark grey fine sandy CLAYSTONE. Hole terminated due to natural obstruction (Claystone). LONDON CLAY End of Borehole at 3.60m			

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to	
		2.40	2.40			

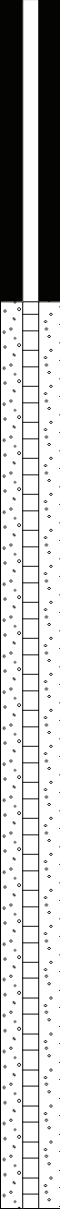
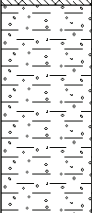
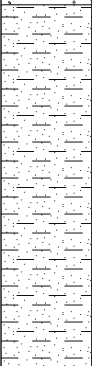
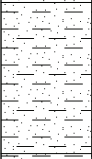
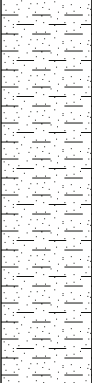


 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS04 Sheet 1 of 1	
Project Name: Horndean Road, Emsworth		Project No. GE18313		Co-ords: 474490E - 106807N		Hole Type WLS	
Location: Horndean Road, Emsworth				Level:		Scale 1:25	
Client: Metis Homes				Dates: 26-06-2019		Logged By TS	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	ES		0.40			Brown silty sandy gravelly clay with frequent rootlets up to 4 mm. Gravel is frequent fine to medium subangular flint. TOPSOIL	1 2 3 4 5
		0.60	PP	0.8kg/cm2				1.00	
		0.70	D						
		0.80	PP	1.0kg/cm2					
		1.20	D		2.30		Soft to firm orangish brown and grey sandy CLAY with occasional rootlets up to 3mm and fine reddish brown ferruginous inclusions. HEAD DEPOSITS		
		1.20	PP	1.0kg/cm2					
		1.60	PP	1.2kg/cm2	2.80		Firm orangish brown sandy CLAY with occasional fine reddish brown ferruginous inclusions. HEAD DEPOSITS		
		1.90	D						
		2.00	PP	2.0kg/cm2		Stiff dark grey sandy CLAY with frequent very fine selenite crystals. LONDON CLAY			
		2.50	D						
		2.50	PP	1.8kg/cm2	4.00		End of Borehole at 4.00m		
		3.00	PP	2.0kg/cm2					
		3.20	D						
		3.20	PP	2.0kg/cm2					
		3.60	PP	2.5kg/cm2					
		4.00	D						
4.00	PP	2.0kg/cm2							

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		2.33	2.33				

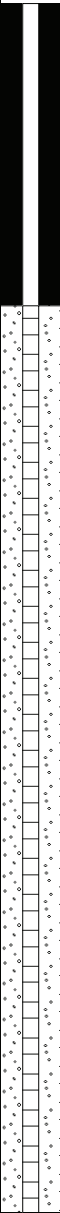
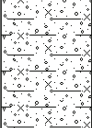
 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log		Borehole No. WS05 Sheet 1 of 1	
Project Name: Horndean Road, Emsworth		Project No. GE18313		Co-ords: 474493E - 106766N	
Location: Horndean Road, Emsworth		Level:		Hole Type WLS	
Client: Metis Homes		Dates: 26-06-2019		Scale 1:25	
Logged By TS					

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES		0.30		Dark brown gravelly silty clay with frequent rootlets and grass cover. Gravel is occasional fine subangular flint. TOPSOIL		
		0.50	D						Soft brown gravelly CLAY. Gravel is occasional fine to coars subangular to subrounded flint. HEAD DEPOSITS
		0.80	PP	1.0kg/cm2	1.00		Firm to stiff orangish brown and light grey sandy CLAY with rare rootlets up to 1mm. Very fine rare selenite crystals. LONDON CLAY	1	
		1.20	D						
		1.20	PP	1.0kg/cm2					
		1.60	D						
		1.60	PP	1.5kg/cm2	2.20		Stiff orangish brown and dark grey sandy CLAY with occasional fine reddish brown ferruginous inclusions and frequent very fine selenite crystals. LONDON CLAY	2	
		1.80	PP	1.0kg/cm2					
		2.00	D						
		2.00	PP	1.5kg/cm2					
		2.10	PP	2.5kg/cm2	2.70		Stiff dark grey silty sandy CLAY with frequent very fine selenite crystals. LONDON CLAY	3	
		2.40	PP	2.5kg/cm2					
		2.50	D						
		2.60	PP	2.2kg/cm2					
		2.80	PP	2.8kg/cm2	4.00		End of Borehole at 4.00m	4	
		3.00	D						
	3.00	PP	2.2kg/cm2						
	3.20	PP	3.5kg/cm2						
	3.50	D						5	
	3.60	PP	3.5kg/cm2						
	4.00	D							
	4.00	PP	2.8kg/cm2						

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to	
		3.00	2.70			



 Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net		Borehole Log				Borehole No. WS06 Sheet 1 of 1	
Project Name: Horndean Road, Emsworth		Project No. GE18313		Co-ords: 474538E - 106811N		Hole Type WLS	
Location: Horndean Road, Emsworth				Level:		Scale 1:25	
Client: Metis Homes				Dates: 26-06-2019		Logged By TS	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.10	ES		0.20		Light brown gravely sandy silt with frequent rootlets and grass cover. Gravel is occasional subangular flint fragments. TOPSOIL		
		0.40	D				Light brownish grey clayey silty sandy fine to medium subangular flint GRAVEL with occasional rootlets up to 2mm. HEAD DEPOSITS		
		0.60	ES		0.70				
		0.80	D						
		0.80	PP	0.5kg/cm2					
		0.90	PP	0.2kg/cm2	1.00		Very soft to soft orangish brown CLAY with rare rootlets up to 1mm and occasional fine subrounded reddish brown ferruginous inclusions. HEAD DEPOSITS		
		1.10	PP	1.0kg/cm2			Firm light yellowish brown and orangish brown fine sandy gravely CLAY. Gravel is frequent fine to coarse subangular flint and occasional fine reddish brown ferruginous inclusions. HEAD DEPOSITS		
		1.30	PP	1.0kg/cm2	2.00				
		1.50	D						
		1.60	PP	1.5kg/cm2					
		1.80	PP	1.2kg/cm2					
		2.10	PP	2.0kg/cm2	3.00		Stiff brown and orangish brown sandy CLAY. Frequent very fine selenite crystals. LONDON CLAY		
		2.30	PP	2.0kg/cm2					
		2.50	D						
		2.60	PP	2.5kg/cm2					
		2.80	PP	2.8kg/cm2	4.00		Very stiff to very stiff grey CLAY with occasional fine sand lenses. Frequent very fine selenite crystals. LONDON CLAY		
		3.10	PP	4.0kg/cm2					
		3.30	PP	4.0kg/cm2					
	3.50	D							
	3.60	PP	4.5kg/cm2		4.00				
	3.80	PP	4.2kg/cm2						
	4.00	PP	4.2kg/cm2						
End of Borehole at 4.00m								4	
5									

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks	
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to		
		5.00	5.00				

Appendix C



Revision	Amendment	Approved	Revision Date

Original Sheet Size A3 [420 x 297]

010 mm50



Aqua Callidus

52 Common Lane, Titchfield

Hants, PO14 4BU

07717 759149

Scale

1:1000

Project No.

1946

Project				
HORNDEN ROAD EMSWORTH HANTS				
Sheet				
DRAINAGE SCHEMATIC				
Drawing No.	Sheet. No.	Revision		
ACC1946-01	-	1		

Calculated by:

Site name:

Site location:

Site coordinates

Latitude:

Longitude:

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Reference:

Date:

Methodology

IH124

Site characteristics

Total site area (ha)	0.92
----------------------	------

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	2	2
HOST class	---	---
SPR/SPRHOST	0.3	0.3

Hydrological characteristics

	Default	Edited
SAAR (mm)	739	739
Hydrological region	7	7
Growth curve factor: 1 year	0.85	0.85
Growth curve factor: 30 year	2.3	2.3
Growth curve factor: 100 year	3.19	3.19

Notes:

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

Normally limiting discharge rates which are less than 2.0 l/s/ha 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 consents are usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be 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 may be a requirement for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	1.79	1.79
1 in 1 year (l/s)	1.52	1.52
1 in 30 years (l/s)	4.11	4.11
1 in 100 years (l/s)	5.7	5.7

Calculated by:

Site name:

Site location:

Site coordinates

Latitude:

Longitude:

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 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 drainage scheme.

Reference:

Date:

Methodology

IH124

Site characteristics

Total site area (ha)	0.92
Significant public open space (ha)	0.39
Area positively drained (ha)	0.53
Pervious area contribution (%)	30
Impermeable area (ha)	0.265
Percentage of drained area that is impermeable (%)	50
Impervious area drained via infiltration (ha)	0
Return period for infiltration system design (year)	10
Impervious area drained to rainwater harvesting systems (ha)	0
Return period for rainwater harvesting system design (year)	10
Compliance factor for rainwater harvesting system design (%)	66
Net site area for storage volume design (ha)	0.53
Net impermeable area for storage volume design (ha)	0.29

* 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 Qbar and other flow rates will have been reduced accordingly.

Design criteria

Volume control approach

	Default	Edited
Climate change allowance factor	1.4	1.4
Urban creep allowance factor	1.1	1.1
Interception rainfall depth (mm)	5	5
Minimum flow rate (l/s)	2	2

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
Qbar total site area (l/s)	1.79	--
SOIL type	2	2
HOST class	N/A	N/A
SPR	0.3	0.3

Hydrology

	Default	Edited
SAAR (mm)	739	739
M5-60 Rainfall Depth (mm)	20	20
'r' Ratio M5-60/M5-2 day	0.4	0.4
Rainfall 100 yrs 6 hrs	63	
Rainfall 100 yrs 12 hrs	94.71	
FEH/FSR conversion factor	1.23	1.23
Hydrological region	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 year	3.19	3.19

Site discharge rates

	Default	Edited
Qbar total site area (l/s)	1.79	1.79
Qbar net site area (l/s)	1.03	1.03
1 in 1 year (l/s)	2	2
1 in 30 years (l/s)	2	2
1 in 100 years (l/s)	2	2

Estimated storage volumes

	Default	Edited
Interception storage (m³)	11	11
Attenuation storage (m³)	252	252
Long term storage (m³)	0	0
Treatment storage (m³)	32	32
Total storage (excluding treatment) (m³)	263	263

Date: 28/07/2019

Site Ref

Horndean Road

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

estate road

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? **N** m

Is an additional treatment component required due to sensitivity? **N**

Land Use

roads-low traffic

Hazard

low

TSS index	Metals index	HydroCar index
0.5	0.4	0.4

Treatments

To surface water discharge **Y**

Component

- 1 Swale
 - 2 N/A
 - 3 N/A
- mitigation index basic OK
- X1 N/A
- Enhanced mitigation index n/a
- Residual pollution index

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

Land Use

roads-low traffic

Hazard

low

TSS index	Metals index	HydroCar index	residual
0	0	0	

Treatments

To groundwater discharge **N**

Infiltration surface

- 1 N/A
 - 2 N/A
- Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	0.50
0	0	0	0.50
0	0	0	

Is a groundwater risk screening required?

N

Notes:

Date: 28/07/2019

Site Ref

Horndean Road

SuDS Water Quality Management CIRIA C753 Ch26

Simple Index Approach

Catchment

roofs

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?

N

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 **Y**

Component

1 Swale

2 N/A

3 N/A

mitigation index

basic OK

X1 N/A

Enhanced mitigation index

n/a

Residual pollution index

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

Land Use

roofs-residential

Hazard

very low

TSS index	Metals index	HydroCar index
0	0	0

residual

*2 residential roofs remove gross solids and sediments

Treatments

To groundwater discharge **N**

Infiltration surface

1 N/A

2 N/A

Final residual pollution index

TSS MIndex	Metals MIndex	HydroCa MIndex	factor
0	0	0	0.50
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).

Separators/interceptors operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Removal of litter and debris.	6 monthly
Occasional maintenance	Change of filter media.	As required
	Removal of sediment, oil, grease and floatables.	As required
Remedial actions	Replacement of malfunctioning parts.	As required
Monitoring	Inspect for evidence of poor operation.	6 monthly
	Inspect filter media and establish appropriate replacement frequencies.	6 monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies.	Monthly in the first year of operation, then every 6 months.

For oil/water separators, the following items should be undertaken every six months as a minimum:

- check volume of sludge
- check thickness of light liquid
- check function of automatic closure device
- empty the separator if required
- check the coalescing material and clean or change if necessary (Class 1 only)
- check the function of the warning device (if fitted).

General inspection of oil/water separators should occur at a maximum frequency of five years, and should cover the following:

- watertightness of system
- structural condition
- internal coatings
- in-built parts
- electrical devices and installations
- checking of adjustment of automatic closure devices.
-

It is of key importance that the separator is filled with clean water before it is put into operation and each time after it is emptied for maintenance. Failure to do so will cause the separator to malfunction until stormwater builds up the required permanent water level in the facility. It is possible to fit an alarm to separators that will indicate when the collected oil volume is at a maximum, and this may be a regulatory requirement.

Swales operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal.	Monthly (or as required).
	Grass cutting – 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).
Occasional maintenance	Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where possible.	Annually.
	Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, if required.	Annually, or if bare soil is exposed over 10% or more of the swale treatment area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeded.	As required
	Re-level 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 build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required
	Remove and dispose of oils or petrol residues using safe standard practices.	As required
Monitoring	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 when required.
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	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.

Bioretention areas operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Litter and debris removal.	Monthly (or more frequently for aesthetic reasons).
	Mulching – remove and replace.	Annually
	Pruning and trimming of trees – recycle back into mulch.	2 years
	Spiking, scarifying and thatch removal.	3 years 9when mulching)
Occasional maintenance	Watering of plants.	As required
	Weeding.	As required (probably annually)
Remedial actions	Removal of damaged or silt covered vegetation to a depth 50 mm below original design level.	As required
	Treatment of diseased trees.	As required
	Treatment and restoration of eroded areas.	As required
	Re-turfing.	As required
	Reinstatement of design levels, restoration or improvement of infiltration and silt removal.	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly/after large storms.
	Inspect infiltration surfaces for ponding. Record dewatering time of the facility to determine if maintenance is necessary.	Monthly or when required
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Half yearly
	Test planting soil for pH – if adjustment is necessary, amalgamate with appropriate substances.	Annually

Adequate access must be provided for all bioretention areas for inspection and maintenance, including the appropriate equipment and vehicles.

When found necessary, infiltration in the facility should be restored or improved by removing silt or damaged vegetation and reinstating design levels. Damaged or siltcovered vegetation should be removed to a depth 50 mm below original design level and cultivated to a fine tilth. Infiltration rates can also be affected by the build-up of “thatch”. Any re-turfing that is required should be done using turf of a quality and appearance to match the existing sward.

Maintenance will usually be carried out manually, although a suction tanker can be used for sediment/debris removal for large systems or in public environments

Modular systems operation and maintenance

Maintenance schedule	Required action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly
	Debris removal from catchment surface (where may cause risks to performance)	Monthly
	Where rainfall infiltrates into blocks from above, check surface of filter for blockage by silt, algae or other matter. Remove and replace surface infiltration medium as necessary.	Monthly (and after large storms)
	Remove sediment from pre-treatment structures	Annually, or as required
Occasional maintenance	-	-
Remedial actions	Repair/rehabilitation of inlets, outlet , overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually and after large storms

Appendix D

ENGINEER'S INSPECTION CONDITIONS AND LIMITATIONS



1. The report is a record of a visual inspection carried out by, or under the direction of a Chartered Structural Engineer and must not be misinterpreted as a Structural Survey such as would be carried out by a Chartered Surveyor. The report is not a Valuation Survey.
2. The inspection is strictly limited to the items requested and these will be detailed in the report. No consideration will be given to any other aspects or parts of the building.
3. The report is confidential to the Client(s) and has been prepared to their instructions for their own purposes only and it is not permitted to disclose this report to any other parties (except the Clients own Solicitors, Surveyors, Building Societies or Estate Agents) without the prior consent of Aqua Callidus Consulting Ltd.
4. The copyright of this report remains the property of Aqua Callidus Consulting Ltd.
5. No liability for the contents of this report is accepted to any parties other than the Client(s). No parties other than the client should rely upon this report.
6. Unless specifically stated otherwise:-
 - a) Trial holes will not be excavated prior to the preparation of the report and the depth and construction of the foundations and type of sub-soil will not be inspected.
 - b) All external observations will be carried out by eye from the ground level only. Internal inspection is made within the limits of ready accessibility and it is not normal practice to lift floor coverings or floor boards, remove fixtures, panels or plaster, or move heavy items of furniture or bulky goods or materials.
 - c) No inspection will be made of any roof voids, floor joists, wall cavities, drainage pipework or any other hidden or inaccessible parts.
 - d) No timbers will be checked for damp, rot, infestation by wood-boring insects or other defects.
 - e) It should not be construed that any parts of the construction comply with the requirements of the Building Regulations Act or standard practice either current or as current at the time of original construction. No enquiries to any Authorities will be made.
 - f) No testing or enquiries into the presence of or susceptibility to pollution, contamination, radiation, methane, radon or other gases or hazardous substances has been carried out.
7. Unless specifically stated otherwise in the report, any recommendations for works given in the report are outline only and are to be confirmed or modified as appropriate at detailed design stage.
8. Where trial holes are specifically included in our instructions the condition of the footing and the founding soil relates only to the point of excavation and does not necessarily confirm a continuation of the same conditions throughout the non-inspected areas of the structure. Whilst such trial pits will usually provide a reasonable indication as to the general state of the foundations and ground conditions, these can not be determined with complete certainty.
9. Under the Construction (Design & Management) Regulations latest edition, the Client has obligations for ensuring Health and Safety arising from any construction work. If it is proposed to proceed with construction work based upon information or recommendations contained in this report, these regulations apply. Further details of any issues arising from our report or the Clients obligations generally are available on request.
10. Unless dealt with more specifically above the Association of Consulting Engineers Conditions of Engagement Short Form Agreement 2002 apply.