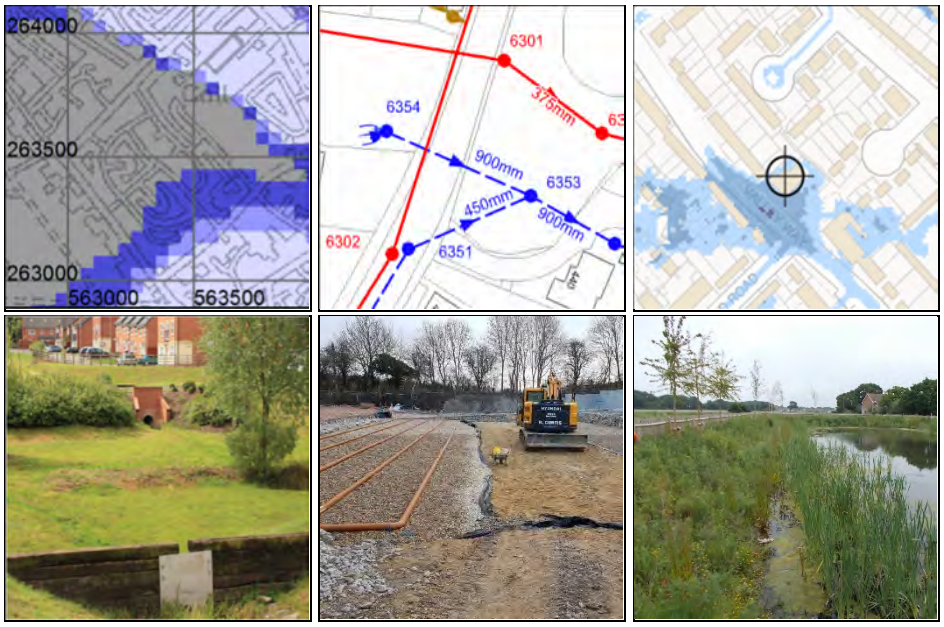

Drainage Strategy and Flood Risk Statement

Land Adjacent 54 Long Copse Lane
Emsworth, Hants

Reference: 20053

Issue:	**Date:**	
1	7/6/2021	
2	12/6/2021	*Updated for public FW position*
3	25/11/2021	*Site layout updated*
4	3/12/2021	*P3/4 FFL updated*
5	3/2/2022	*Udated for extra parking bay*

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Appendices

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

1. Introduction

1.1 Instructions were received from the Horne and Barry families to set out the Drainage Strategy (DS) and provide a Flood Risk Statement for a planning application for the development of 9 residential dwellings on land adjacent 54 Long Copse Lane, Emsworth, Hants.

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 some 0.44Ha of land to the south of Long Copse Lane, Emsworth, Hants (grid ref 475175 107850). The site extents are indicated on the annotated aerial photograph in Appendix A. The existing topography is shown on P Stubbington drawing 6323/01 contained in Appendix A of this report.

2.2 The site comprises a small paddock.

2.3 It is proposed to develop the site for 9 dwellings. The proposed layout is identified on ADP Architects drawing number 1882-01-L contained in Appendix A of this report.

3. Surface Water Discharge (Existing)

3.1 The site comprises a small grass paddock and falls north to south from about 25.5m AOD to about 22m AOD. There is a surface water ditch along the southern boundary falling to the east which turns to the south adjacent the south east corner of the site and then runs south along the eastern boundary of the Skylark Avenue estate, then to the pond north of Westbourne Road and to the River Ems just east of the pond.

3.2 The land south and west of the site comprises residential dwellings. The land north of the site is understood to be proposed for residential housing. The land to the east of the site is public open space.

3.3 Site run-off currently discharges by overland flow to the south east.

4. Surface Water Strategy

4.1 The site lies on the River Ems catchment. The River Ems is gauged at NRFA station 41015 (grid ref SU 755 073). The catchment above the station comprises some 58 km2 and is characterised: The Ems - which is ephemeral over much of its length - is a Chalk stream draining the South Downs; Drift cover is minimal. A rural catchment with significant woodland and scattered settlements. Geology principally chalk, therefore flow is predominantly from groundwater. Largely rural with significant woodland. No significant

4.2 A geotechnical investigation of the site was undertaken by Messrs GESL (report GE19085-GARv2 Sept 2020). A series of 6 holes were made to 4.0mbgl which encountered gravelly CLAY Head deposits to around 0.6mbgl overlying CLAY and sandy CLAY bedrock of the London Clay Formation.

4.3 Permeability testing was undertaken in 4 holes and the results indicate a low permeability of between 8.16 x 10^{-7} and 3.61 x 10^{-6} m/sec. It was concluded from the low results on the first test cycle that infiltration drainage of surface water on the site would not be viable at this value and subsequent test cycles were not warranted as these yield progressively reduced values owing to the wetting from previous test cycles.

4.4 Groundwater was not encountered during the investigations save for hole WS06 where water was encountered at 3.8mbgl rising to 3.65mbgl.

4.5 Extracts from the GESL site investigation are contained in Appendix B.

4.6 Surface water drainage must accord with a receptor hierarchy in which Tier 1 (infiltration) must be considered first.

4.7 Infiltration discharge (Tier 1) is not considered to be suitable for this site as there is insufficient permeability.

4.8 The existing overland run off pathway from the site is to ditch at the south east corner of the site. It is proposed to maintain Tier 2 discharge to watercourse.

4.9 The site comprises some 0.44 Ha. An IOH124 greenfield runoff assessment has been undertaken using the UKSUDs tool sheet. This indicates the following greenfield run-off rates for particular events:

Q_1 0.74 l/sec
$Q_{BAR(2)}$ 0.87 l/sec
Q_{30} 2.01 l/sec
Q_{100} 2.79 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.

4.10 The proposed positively drained site surfaces (roofs and drives) amount to some 1,645m^2. An assessment calculation for the storage required for 1,645m^2 drained area attenuated to 2 l/sec for a 1%AEP +40% Climate Change +10% Urban Creep storm is contained in Appendix C. This indicates a storage volume of some 121.2m^3 would be required. There are a number of means by which this volume could be provided and a geocellular tank has been used for illustration purposes. Allowing a minimum 0.6m cover over a 1.2m tank depth located under the lower end of the site road would have a total depth to invert of some 1.8m ie around 21.1m AOD, so would be elevated above the receiving watercourse invert of some 20.5m AOD, enabling discharge. Examination of the proposed site layout indicates there would be sufficient space to accommodate the required tank footprint of 107.5m^2. It is concluded that the proposed layout could support the appropriate attenuation storage for 2 l/sec outfall to the ditch in the southeast corner.

4.11 The outfall will lie just beyond the eastern boundary of the site in land controlled by Havant BC. The rights for construction of a headwall and discharge at this location have been secured from Havant BC.

4.12 The UKSUDS surface water storage assessment tool has been used to confirm the sizings. A copy of this calculation is contained in Appendix C. This calculation also includes for a 30% runoff from a further 1,630m^2 of pervious surfaces and consequently reports a slightly value.

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

4.14 Simple index approach calculations are contained in Appendix C. It has been assumed for illustration that the pavements driveways will collect run-off via use of Smart Sponge ® or filters in conventional gulleys or by use of a interceptor/'Downstream Defender' etc.

4.15 The surface water drainage system will be designed to accommodate a 1 in 100 year +40% climate change 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, and S6-9. Design and construction details will accord with Building Regulations and Sewers for Adoption, as appropriate, so according with S10-11 and S13-14. The design does not include pumping so S12 is not applicable.

4.16 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.

4.17 In summary source control will be provided by:

- Attenuation storage as outlined in paragraph 4.10
- Provision of water butts as outlined in paragraph 4.16

4.18 Calculations are contained in Appendix C which demonstrate there will be no increase in discharge as a result of the proposed development.

4.19 The existing flood flow path is north to south across the site. The proposed development will maintain the north to south fall across the site. A pre and post development flow route plan is contained in Appendix C.

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

4.21 A schedule of O&M maintenance requirements for the SuDS infrastructure is also contained in Appendix C. The maintenance will be undertaken by individual plot owners up to point on any shared drainage assets. Beyond this the surface water infrastructure will be maintained by the estate management company

4.22 This Drainage Strategy identifies the form ,scale/size and disposition of the surface water drainage infrastructure required to accord with national and local policy requirements. A detailed design of network is in production to address potential requests from the LLFA The final details for this can be secured by an appropriately worded planning condition linked to this strategy.

5. Flood Source-Pathway-Receptor Assessments

5.1 The site is at an elevation of some 22 mAOD and is not susceptible to tidal flooding.

5.2 The EA flood mapping indicates that the site is wholly in Flood Zone (FZ) 1. The site is therefore at low risk of fluvial flooding (<0.1% AEP).

5.3 The EA mapping indicates the site is not at risk of reservoir flooding.

5.4 The EA mapping indicates the site is at very low risk of surface water flooding (<0.1%AEP).

5.5 The SFRA does not indicate any records of sewer flooding at the site.

5.6 Groundwater flood susceptibility mapping contained within the GESL geotechnical report indicates the site does not lie at a location potentially susceptible to groundwater flooding. Hampshire CC Groundwater Management Plan (GWMP) does not identify groundwater issues within Emsworth. The site is therefore considered to be at low risk of groundwater flooding.

5.7 The critical flood source is surface water flooding and run-off within the site. The site surface water system will accord with the principles of CIRIA C753.

5.8 The new flood receptors of the development would be:

- Residential dwellings
- Users of residential dwellings

5.9 The proposed development and existing site classifications to Table 2 (Paragraph 066 Reference ID: 7-066-201400306) are as follows:

- Proposed residential — More vulnerable
- Existing — Less vulnerable

5.10 Overall the development is considered to be a low flood risk.

6. Flood Probability

6.1 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.

6.2 The site is wholly in flood zone 1.

7. Climate Change

7.1 The proposed development is in flood zone 1. The new climate change allowances for flood risk assessment GOV.UK 22 July 2021 update have been used. Climate change values for the site are:

- Peak rainfall intensity: Table 2, third epoch, central range — +20%
- Peak rainfall intensity: Table 2, third epoch, upper end — +40%

7.2 Surface water drainage strategy is discussed in Chapter 4. The volumes and flows for this strategy have been derived in accordance with CIRIA C753 and include for climate change effects.

8. Flood Risk Management Measures

8.1 The source pathway receptor assessment is contained in Chapter 5.

8.2 Paragraph 5.7 identifies that surface water flooding and site surface run-off within the site 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 4. The strategy accords with CIRIA C753 SuDS Manual.

8.3 A minimum FFL + 0.15m standard DPC clearance above ambient ground level should be provided.

9. Foul Water Strategy

9.1 A 150 mm DN public foul water sewer is located within the site. A copy of the Southern Water sewer plan is contained in Appendix B.

9.2 The proposed development will discharge to the public sewer within the site. The change in network load 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, this is however considered unlikely.

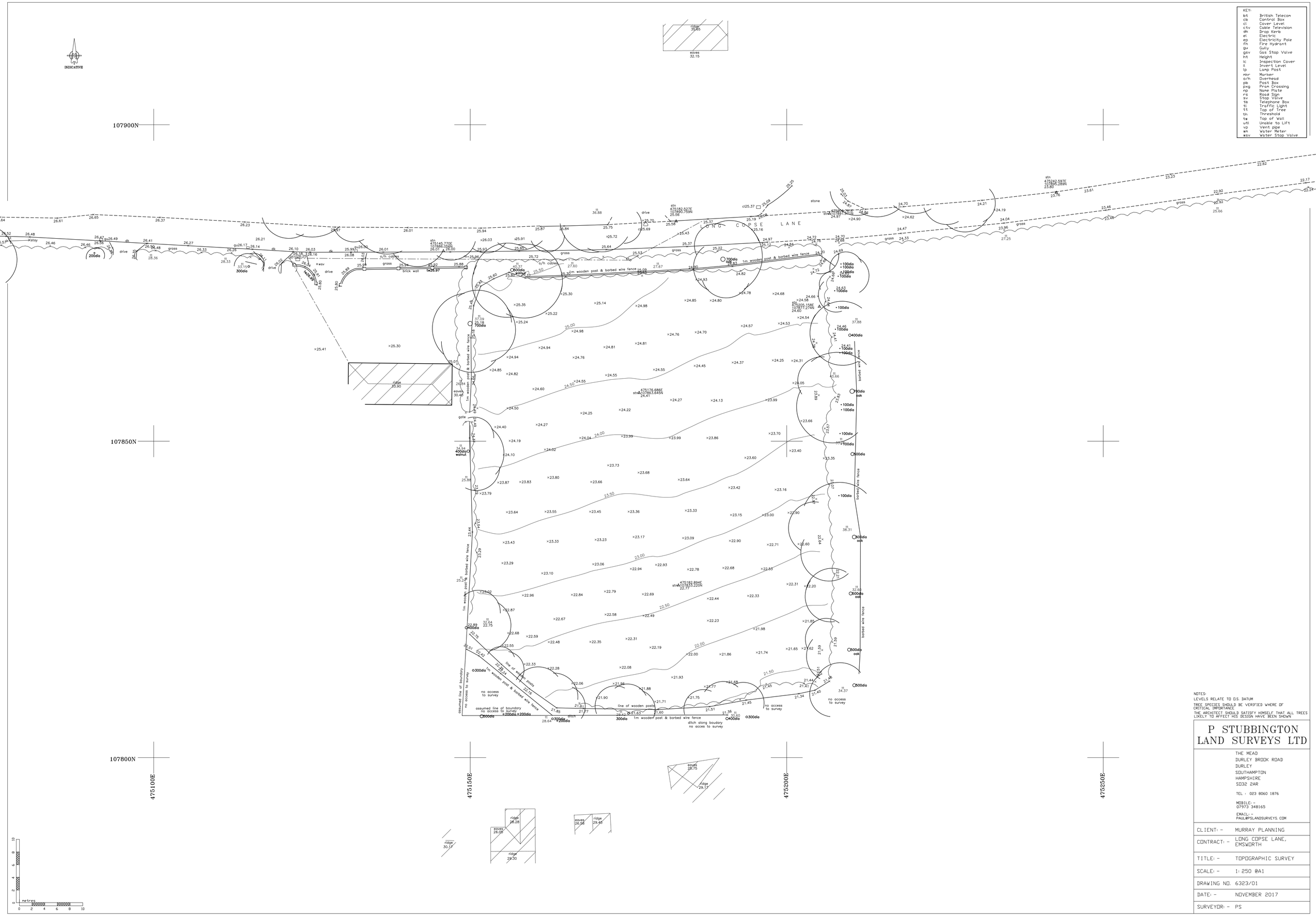
10. Off Site Impacts

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

11. Residual Risks

11.1 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:

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

NOTES:

LEVELS RELATE TO O.S. DATUM

TREE SPECIES SHOULD BE VERIFIED WHERE OF CRITICAL IMPORTANCE

THE ARCHITECT SHOULD SATISFY HIMSELF THAT ALL TREES LIKELY TO AFFECT HIS DESIGN HAVE BEEN SHOWN

P STUBBINGTON
LAND SURVEYS LTD

THE MEAD
DURLEY BROOK ROAD
DURLEY
SOUTHAMPTON
HAMPSHIRE
SO32 2AR

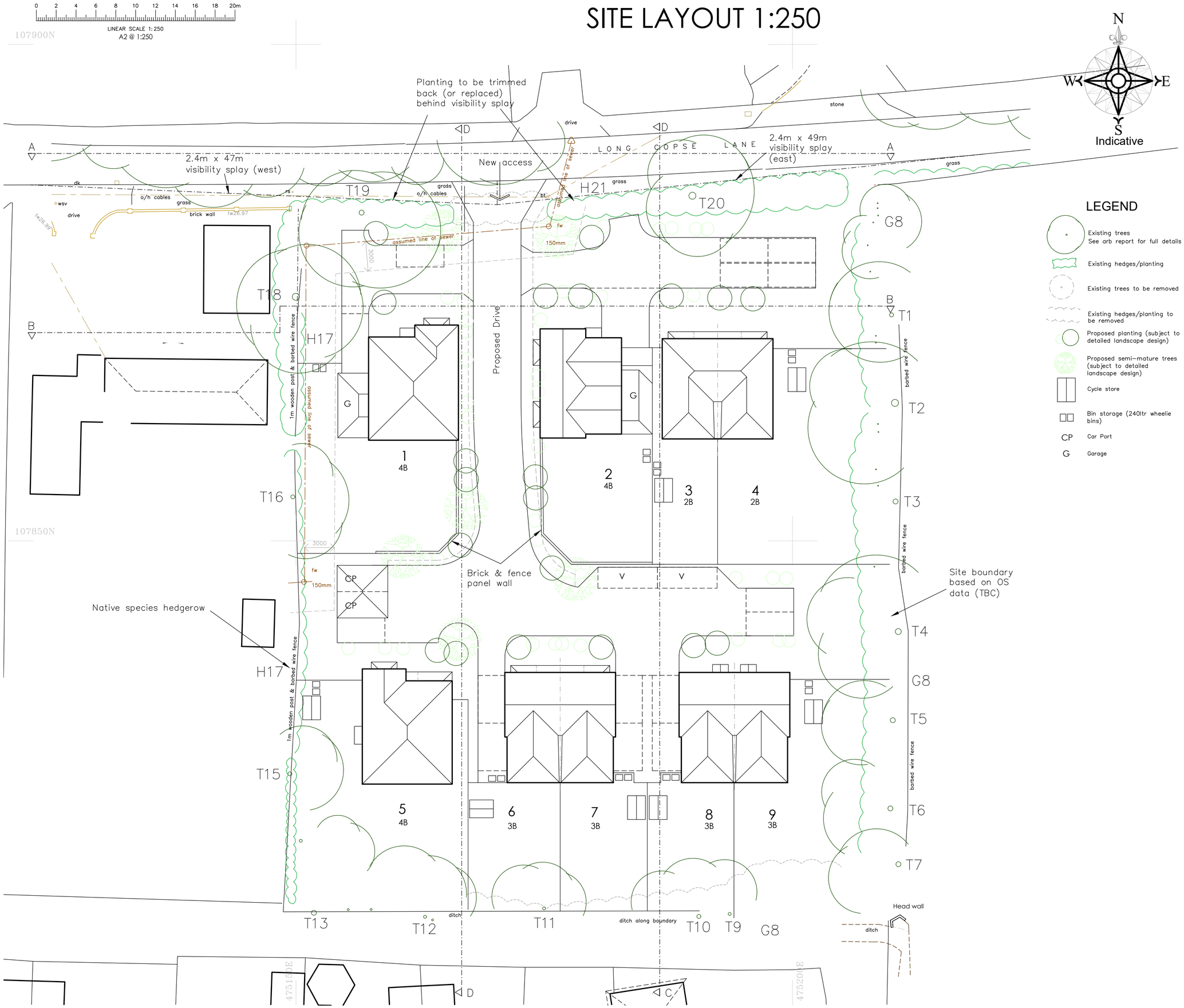
TEL : 023 8060 1876

MOBILE:-
07973 348165

EMAIL:-
PAUL@PSLANDSURVEYS.COM

CLIENT:-	MURRAY PLANNING
CONTRACT:-	LONG COPSE LANE, EMSWORTH
TITLE:-	TOPOGRAPHIC SURVEY
SCALE:-	1:250 @A1
DRAWING NO.	6323/01
DATE:-	NOVEMBER 2017
SURVEYOR:-	PS

SITE LAYOUT 1:250



N
W E
S
Indicative

LEGEND

- Existing trees See arb report for full details
- Existing hedges/planting
- Existing trees to be removed
- Existing hedges/planting to be removed
- Proposed planting (subject to detailed landscape design)
- Proposed semi-mature trees (subject to detailed landscape design)
- Cycle store
- Bin storage (240ltr wheelie bins)
- CP Car Port
- G Garage

RIBA Chartered Practice
arb Architects Registration Board

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Drawing For Planning Purposes Only

All dimensions and details on this drawing are for planning purposes and should not be used for fabrication and erection purposes. DO NOT scale from this drawing, except for planning purposes, use figured dimensions if available. Any discrepancies should be highlighted without delay.

Note: This drawing has been produced with information from a topographical survey carried out by others. All information therefore derived from the survey drawing is assumed to be accurate and ADP Architects Ltd cannot be held accountable for any discrepancies discovered on site.

IF IN DOUBT ASK FOR CONFIRMATION.

The site is based on a topogaphical survey undertaken by Paul Stubbington Land Surveys Ltd Ref: 6323/01. Surrounding information copied from Ordnance Surveys Promap. Crown Copyright. Licence Number 100022432

Schedule of Accommodation

PLOT	TYPE	SEMI/DET	GIA sqm
1	4B	DET	172.40
2	4B	DET	153.70
3	2B	SEMI	95.30
4	2B	SEMI	95.30
5	4B	DET	174.80
6	3B	SEMI	105.00
7	3B	SEMI	105.00
8	3B	SEMI	103.50
9	3B	SEMI	103.50
Total GIA			1108.50
Proposed Garages			36.40
Proposed Car Ports			25.00
Proposed Cycle Stores			24.50

SITE AREA/DENSITY
0.45 Hectares = 18 DPH

rev:	date:	note:
L	03.02.22	Additional visitor parking space
K	24.11.21	Plots 2, 3-4 amended roof plans
J	11.11.21	Sewer easement indicated
I	10.11.21	Plots 3 & 4 parking update
H	03.11.21	Semi-detached units (P3&4) /carports/visitior space added
G	5.07.21	Plot 2 adjusted
F	11.06.21	Planning Issue
E	08.06.21	T19 reinstated/tree & hedge notes added
D	07.05.21	Section Lines added
C	6.04.21	Arb update/amends to plot 1 & 3
B	5.03.21	Red line to include vis splays
A	4.03.21	Consultants Issue

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Richmond Court, 94 Botley Road, Park Gate, Southampton, SO31 1BA

project name/address:
**Residential Developement
Long Copse Lane
Emsworth
PO10 7UR**

client:
Nova Planning

drawing title:
Site Layout

job number:	drawing number:	revision:
1882	01	L

drawing scale/size:	date:	drawn:
1:250 (A2)	Feb 2020	

Aerial view of site

Appendix B

Environment Agency

Flood map for planning

Your reference
20053

Location (easting/northing)
475180/107846

Scale
1:2500

Created
1 Jun 2021 15:11

- 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

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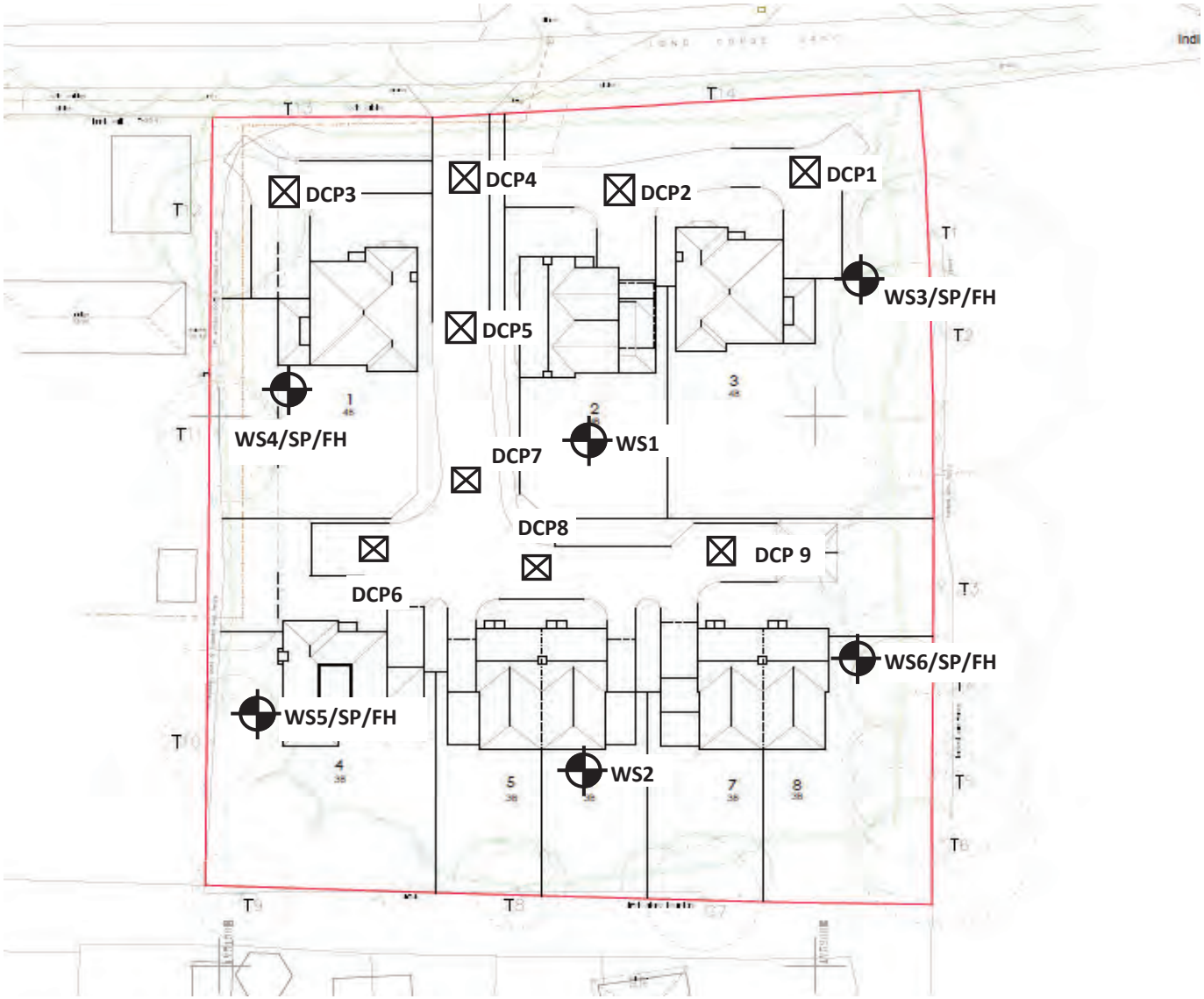
Extent of flooding from surface water

High Medium Low Very low Location you selected

Extent of flooding from reservoirs

Maximum extent of flooding Location you selected



Project:	Long Copse Road, Emsworth PO10 7UR			**Title**	Proposed Exploratory Hole Locations
Client:	Metis Homes			**Geo-Environmental Services Ltd** **Unit 7 Danworth Farm, Cuckfield Road** **Hurstpierpoint, West Sussex BN6 9GL** **+44(0)1273 832972 www.gesl.net**	Geo-Environmental
Ref No:	GE19085	**Revision:**	1		
Drawn:	LL	**Date:**	14/07/2020		
Figure:	3	**Scale:**	Not To Scale		

Geo-Environmental	Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net	Borehole Log	Borehole No. **WS01** Sheet 1 of 1

Project Name:	Long copse Lane, Emmsworth	Project No. GE19085	Co-ords: 475173E - 107865N	Hole Type WLS
Location:	Long Copse Road, Emsworth PO10 7UR		Level:	Scale 1:25
Client:	Metis Homes		Dates: 17/07/2020	Logged By RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					Grass over dark brown silty slightly gravelly CLAY with frequent rootlets and roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. TOPSOIL	
		0.25	PP	1.0kg/cm2	0.30			Firm becoming stiff brown silty slightly gravelly desiccated CLAY with occasional rootlets and roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. HEAD DEPOSITS	
		0.50	B						
		0.50	D		0.60				
		0.50	ES						
		0.50	PP	1.5kg/cm2				Light brown, orangish brown and greyish brown mottled very clayey fine to coarse angular to subrounded flint GRAVEL. HEAD DEPOSITS	
		0.75	PP	0.5kg/cm2					
		1.00	D		1.00				1
		1.00	PP	0.5kg/cm2				Stiff becoming very stiff light brown, orangish brown and bluish grey mottled CLAY with occasional rootlets and rare roots up to 10mm. LONDON CLAY	
		1.25	PP	2.0kg/cm2					
		1.50	D						
		1.50	PP	2.5kg/cm2					
		1.75	PP	3.0kg/cm2					
		2.00	D		2.00				2
		2.00	PP	3.0kg/cm2				Very stiff orangish brown and bluish grey mottled sandy slightly gravelly CLAY with rare rootlets. Sand is fine. Gravel is fine to medium angular to flint. LONDON CLAY	
		2.25	PP	3.5kg/cm2	2.20			Very stiff orangish brown and bluish grey mottled slightly sandy CLAY with rare rootlets. Sand is fine. LONDON CLAY	
		2.50	D						
		2.50	PP	3.5kg/cm2					
		2.75	PP	3.5kg/cm2					
		3.00	D		3.00				3
		3.00	PP	3.5kg/cm2				Very stiff orangish brown and bluish grey mottled CLAY with rare rootlets. LONDON CLAY	
		3.25	PP	3.0kg/cm2					
		3.50	D						
		3.50	PP	3.0kg/cm2					
		3.75	PP	3.5kg/cm2					
		4.00	D		4.00				4
		4.00	PP	4.0kg/cm2				End of Borehole at 4.00m	
									5

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

AGS

Geo-Environmental	Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net	# Borehole Log	Borehole No. **WS02** Sheet 1 of 1

Project Name:	Long copse Lane, Emmsworth	Project No. GE19085	Co-ords:	475177E - 107835N	Hole Type WLS
Location:	Long Copse Road, Emsworth PO10 7UR		Level:		Scale 1:25
Client:	Metis Homes		Dates:	17/07/2020	Logged By RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					Grass over dark brown silty slightly gravelly CLAY with frequent rootlets and roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. TOPSOIL	
		0.25	PP	0.5kg/cm2	0.30				
		0.50	B					Very stiff light brown, orangish brown and bluish grey mottled slightly gravelly desiccated CLAY with occasional rootlets and rare roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. HEAD DEPOSITS	
		0.50	D						
		0.50	ES						
		0.50	PP	4.0kg/cm2					
		0.75	PP	4.0kg/cm2	0.80				
		1.00	D					Stiff becoming very stiff light brown, orangish brown and bluish grey mottled CLAY with occasional rootlets and rare roots up to 10mm. LONDON CLAY	1
		1.00	PP	2.5kg/cm2					
		1.25	PP	1.5kg/cm2					
		1.50	D						
		1.50	PP	2.0kg/cm2					
		1.75	PP	2.2kg/cm2	1.80				
		2.00	D					Very stiff light brown, orangish brown and bluish grey mottled slightly sandy CLAY with rare rootlets. Sand is fine. LONDON CLAY	2
		2.00	PP	2.5kg/cm2					
		2.25	PP	3.0kg/cm2					
		2.50	D						
		2.50	PP	3.5kg/cm2					
		2.75	PP	2.5kg/cm2					
		3.00	D						3
		3.00	PP	2.5kg/cm2					
		3.25	PP	3.5kg/cm2					
		3.50	D						
		3.50	PP	3.5kg/cm2					
		3.75	PP	3.5kg/cm2					
		4.00	D		4.00			End of Borehole at 4.00m	4
		4.00	PP	3.5kg/cm2					
									5

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

AGS

Geo-Environmental	Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net	# Borehole Log	Borehole No. **WS03** Sheet 1 of 1

Project Name:	Long copse Lane, Emmsworth	Project No. GE19085	Co-ords:	475192E - 107870N	Hole Type WLS
Location:	Long Copse Road, Emsworth PO10 7UR		Level:		Scale 1:25
Client:	Metis Homes		Dates:	17/07/2020	Logged By RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					Grass over dark brown silty slightly gravelly CLAY with frequent rootlets and roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. TOPSOIL	
		0.25	PP	1.0kg/cm2	0.30			Very stiff brown silty gravelly desiccated CLAY with frequent rootlets and roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. HEAD DEPOSITS	
		0.50	B						
		0.50	D		0.60			Very stiff brown, orangish brown and greyish brown mottled slightly sandy desiccated CLAY with occasional rootlets and rare roots up to 5mm. Sand is coarse angular flint. LONDON CLAY	
		0.50	ES						
		0.50	PP	2.5kg/cm2					
		0.75	PP	3.5kg/cm2	0.80				
		1.00	D					Very stiff brown, orangish brown and greyish brown mottled slightly sandy CLAY with occasional rootlets and rare roots up to 5mm. Sand is coarse angular flint. LONDON CLAY	1
		1.00	PP	3.0kg/cm2	1.10				
		1.25	PP	2.5kg/cm2				Very stiff brown, orangish brown and bluish grey mottled CLAY with occasional rootlets and rare roots up to 5mm. LONDON CLAY	
		1.50	D						
		1.50	PP	2.5kg/cm2					
		1.75	PP	2.8kg/cm2					
		2.00	D						2
		2.00	PP	3.0kg/cm2					
		2.25	PP	3.5kg/cm2					
		2.50	D						
		2.50	PP	3.5kg/cm2					
		2.75	PP	3.0kg/cm2					
		3.00	D						3
		3.00	PP	2.5kg/cm2					
		3.25	PP	2.5kg/cm2					
		3.50	D						
		3.50	PP	2.5kg/cm2					
		3.75	PP	3.0kg/cm2					
		4.00	D		4.00			End of Borehole at 4.00m	4
		4.00	PP	2.5kg/cm2					
									5

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

AGS

Geo-Environmental	Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net	# Borehole Log	Borehole No. **WS04** Sheet 1 of 1

Project Name:	Long copse Lane, Emmsworth	Project No. GE19085	Co-ords: 475158E - 107869N	Hole Type WLS
Location:	Long Copse Road, Emsworth PO10 7UR		Level:	Scale 1:25
Client:	Metis Homes		Dates: 17/07/2020	Logged By RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					Grass over dark brown silty slightly gravelly CLAY with frequent rootlets, roots up to 10mm and rare brick fragments. TOPSOIL	
		0.25	PP	0.5kg/cm2	0.30				
		0.50	B					Firm becoming stiff light brown and brown mottled silty slightly gravelly desiccated CLAY with rare rootlets and roots up to 10mm. HEAD DEPOSITS	
		0.50	D		0.60				
		0.50	ES					Very stiff light brown, orangish brown and bluish grey mottled slightly silty slightly gravelly CLAY with rare rootlets. Gravel is fine to medium angular to subrounded flint. HEAD DEPOSITS	
		0.50	PP	1.0kg/cm2					
		0.75	PP	4.0kg/cm2	0.90				
		1.00	D					Very stiff light brown, brown and bluish grey mottled slightly sandy CLAY with rare rootlets. Sand is fine. LONDON CLAY	1
		1.00	PP	4.0kg/cm2					
		1.25	PP	3.5kg/cm2					
		1.50	D						
		1.50	PP	3.0kg/cm2					
		1.75	PP	3.5kg/cm2					
		2.00	D						2
		2.00	PP	3.0kg/cm2					
		2.25	PP	2.5kg/cm2					
		2.50	D						
		2.50	PP	3.0kg/cm2					
		2.75	PP	3.0kg/cm2					
		3.00	D						3
		3.00	PP	3.5kg/cm2					
		3.25	PP	3.0kg/cm2					
		3.50	D						
		3.50	PP	2.5kg/cm2					
		3.75	PP	2.5kg/cm2					
		4.00	D		4.00			End of Borehole at 4.00m	4
		4.00	PP	3.0kg/cm2					
									5

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

AGS

Geo-Environmental	Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net	Borehole Log	Borehole No. **WS05** Sheet 1 of 1

Project Name:	Long copse Lane, Emmsworth	Project No. GE19085	Co-ords: 475157E - 107834N	Hole Type WLS
Location:	Long Copse Road, Emsworth PO10 7UR		Level:	Scale 1:25
Client:	Metis Homes		Dates: 17/07/2020	Logged By RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					Grass over dark brown silty slightly gravelly desiccated CLAY with frequent rootlets and roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. TOPSOIL	
		0.25	PP	0.5kg/cm2	0.30				
		0.50	B					Firm becoming stiff brown silty gravelly desiccated CLAY with occasional rootlets. Gravel is fine to coarse angular to subrounded flint. HEAD DEPOSITS	
		0.50	D						
		0.50	ES						
		0.50	PP	1.5kg/cm2	0.70				
		0.75	PP	4.0kg/cm2				Very stiff light brown, orangish brown and bluish grey mottled slightly gravelly desiccated CLAY with occasional rootlets. Gravel is fine to medium angular to subrounded flint. LONDON CLAY	
		1.00	D						1
		1.00	PP	4.0kg/cm2					
		1.25	PP	3.5kg/cm2	1.20			Very stiff light brown, orangish brown and bluish grey mottled slightly gravelly CLAY with occasional rootlets. Gravel is fine to medium angular to subrounded flint. LONDON CLAY	
		1.50	D						
		1.50	PP	4.0kg/cm2					
		1.75	PP	3.2kg/cm2					
		2.00	D		2.00				2
		2.00	PP	3.5kg/cm2				Very stiff brown, orangish brown and bluish grey mottled slightly sandy CLAY. Sand is fine. LONDON CLAY	
		2.25	PP	3.2kg/cm2					
		2.50	D						
		2.50	PP	4.0kg/cm2					
		2.75	PP	4.5kg/cm2					
		3.00	D						3
		3.00	PP	3.5kg/cm2					
		3.25	PP	3.5kg/cm2					
		3.50	D						
		3.50	PP	3.5kg/cm2					
		3.75	PP	3.5kg/cm2					
		4.00	D		4.00			End of Borehole at 4.00m	4
		4.00	PP	3.5kg/cm2					
									5

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

AGS

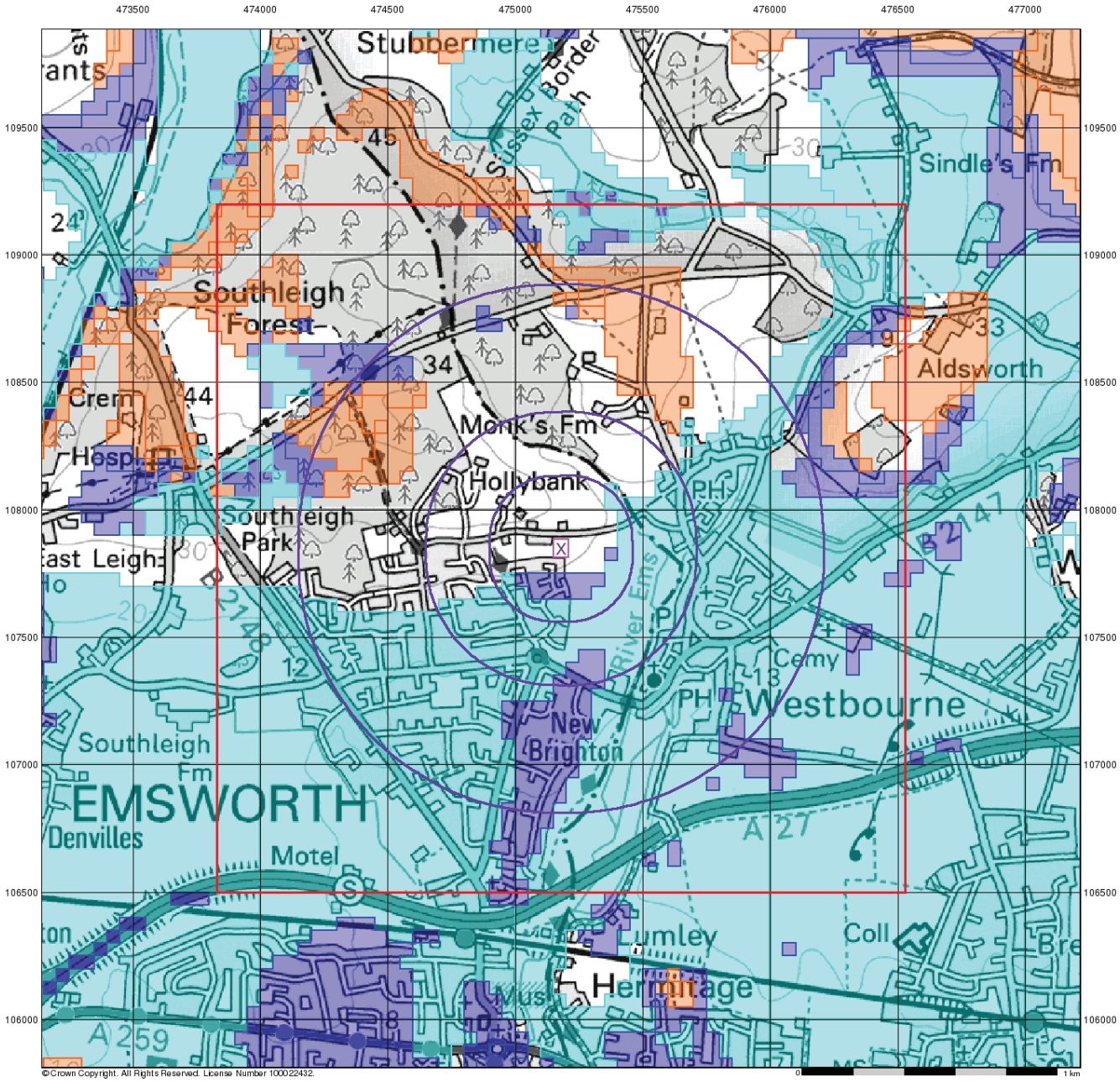
Geo-Environmental	Unit 7, Danworth Farm Hurstpierpoint BN6 9GL www.gesl.net	Borehole Log	Borehole No. **WS06** Sheet 1 of 1

Project Name:	Long copse Lane, Emmsworth	Project No. GE19085	Co-ords: 475192E - 107833N	Hole Type WLS
Location:	Long Copse Road, Emsworth PO10 7UR		Level:	Scale 1:25
Client:	Metis Homes		Dates: 17/07/2020	Logged By RG

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20	ES					Grass over dark brown silty slightly gravelly desiccated CLAY with frequent rootlets and roots up to 10mm. Gravel is fine to coarse angular to subrounded flint. TOPSOIL	
		0.25	PP	0.5kg/cm2	0.30				
		0.50	B					Firm becoming stiff brown silty gravelly desiccated CLAY with occasional rootlets. Gravel is fine to coarse angular to subrounded flint. HEAD DEPOSITS	
		0.50	D						
		0.50	ES						
		0.50	PP	5.0kg/cm2	0.70				
		0.75	PP	4.5kg/cm2				Very stiff brown slightly gravelly desiccated CLAY with occasional rootlets. Gravel is fine to coarse angular to subrounded flint. LONDON CLAY	
		1.00	D						1
		1.00	PP	5.0kg/cm2					
		1.25	PP	4.5kg/cm2	1.20			Very stiff light brown, orangish brown and bluish grey mottled slightly gravelly desiccated CLAY with occasional rootlets. Gravel is fine to medium angular to subrounded flint. LONDON CLAY	
		1.50	D						
		1.50	PP	3.5kg/cm2					
		1.75	PP	4.0kg/cm2					
		2.00	D						2
		2.00	PP	4.0kg/cm2					
		2.25	PP	4.0kg/cm2	2.20			Very stiff brown, orangish brown and greyish brown mottled slightly sandy CLAY with occasional rootlets and rare roots up to 5mm. Sand is coarse angular flint. LONDON CLAY	
		2.50	D						
		2.50	PP	3.5kg/cm2					
		2.75	PP	4.0kg/cm2					
		3.00	D		3.00				3
		3.00	PP	4.0kg/cm2				Very stiff brown, orangish brown and bluish grey mottled CLAY with occasional rootlets and rare roots up to 5mm. LONDON CLAY	
		3.25	PP	3.0kg/cm2					
		3.50	D						
		3.50	PP	3.5kg/cm2					
		3.75	PP	3.0kg/cm2					
		4.00	D		4.00				4
		4.00	PP	3.0kg/cm2				End of Borehole at 4.00m	
									5

Casing		Water Strikes (mbgl)		Chiselling (mbgl)		Remarks
Diameter	Depth (m)	Depth Strike	Rose to	Depth from	Depth to	
		3.80	3.65			

AGS



Geo-Environmental

BGS Flood GFS Data

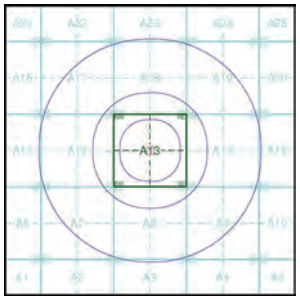
General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice

Agency and Hydrological (Flood)

- Limited Potential for Groundwater Flooding to Occur
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Potential for Groundwater Flooding to Occur at Surface

Site Sensitivity Context Map - Slice A



N

Order Details

Order Number:	247064009_1_1
Customer Ref:	GE19085
National Grid Reference:	475180, 107850
Slice:	A
Site Area (Ha):	0.44
Search Buffer (m):	1000

Site Details

Land off Long Copse Lane, Emsworth, PO10 7UR

Landmark INFORMATION GROUP
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

(c) Crown copyright and database rights 2021 Ordnance Survey 100031673 | Date: 01/06/21 | Scale: 1:1250 | Map Centre: 475175,107850 | Data updated: 17/05/21 | Our Ref: 568991 - 1 | Wastewater Plan A3

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 2021 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.

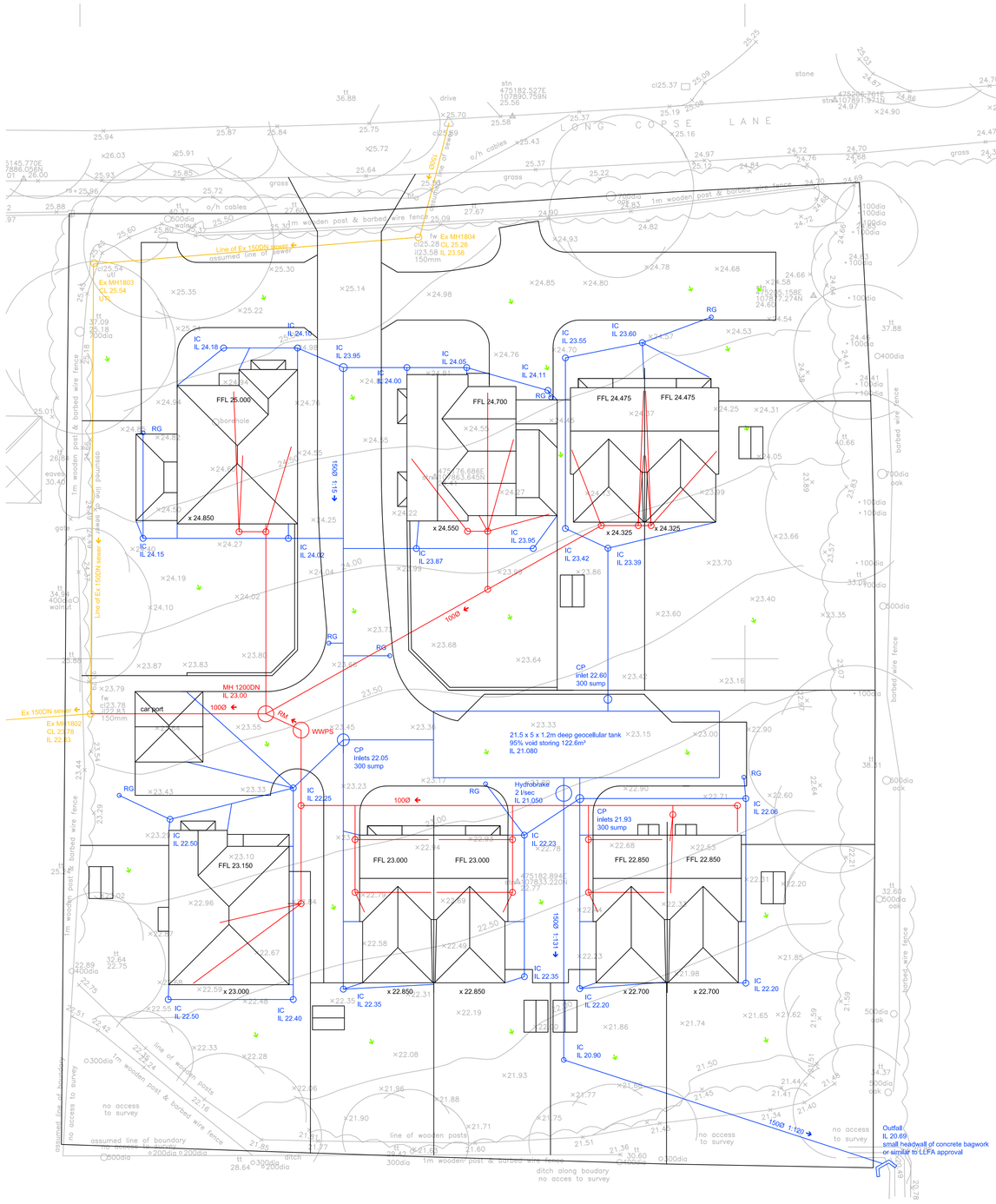
Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
WWTW Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

andytraves247@gmail.com

20053

WATER for LIFE from Southern Water.

Appendix C



Rev.	Amendment	Date
D	Parking updated	3-2-2021
C	P3 &4 FFLupdated	3-12-2021
B	Site layout updated	25-11-2021
A	Drainage layout updated for actual sewer position	12-06-2021
-	Initial issue to illustrate ditch connection only	13-07-2020

Original Sheet Size A1 (841 x 594)

0 10 mm 50

Aqua Callidus CONSULTING
52 Common Lane
Titchfield
Hants
PO14 4BU
07717 759149

Project
Land adjacent
54 Long Copse Lane
Emsworth

Subject
Drainage Strategy

Scale	Project No.	Drawing No.	Sheet No.	Revision
1:200	20053	ACC-20053-11	-	D

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Andy Traves
Site name:	Long Copse Lane
Site location:	Emsworth

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

Site Details

Latitude:	50.86527° N
Longitude:	0.93301° W
Reference:	2645412827
Date:	May 17 2020 11:19

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 0.436

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):	759	759
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.87	0.87
1 in 1 year (l/s):	0.74	0.74
1 in 30 years (l/s):	2.01	2.01
1 in 100 year (l/s):	2.79	2.79
1 in 200 years (l/s):	3.27	3.27

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.

Aqua Callidus Consulting Ltd
52 Common Lane
Titchfield, Hants,
PO14 4BU

t: 07717 759 149

www.aquacallidus.co.uk

Project No.: 20053
Project Title: Long Copse Lane

Detention Assessment to CIRIA C753

No infiltration

Site Location: Emsworth
Catchment ID: gross

r = 0.36 *(range 0.12 to 0.45)*
C_v = 1.00

Drained Area = 1645 m^2
Design storm 1 in = 100 year
Runoff volume uplift = 40 % for climate change
10 % for urban creep

Technical Assessment

Base area = 107.5 m^2

Base axis Length L_x = 21.50 m
Base axis Length L_y = 5.00 m
Discharge rate = 2.0 l/s
storage volume = 122.6 m^3
Storage depth = 1.20 m
Design volume = 122.6 m^3
storage porosity = 95 %
M5-60 Rainfall = 20 mm

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**
ith climate uplift (mm)	**18.6**	**27.3**	**33.8**	**44.2**	**56.8**	**68.7**	**81.8**	**90.8**	**101.4**	**123.5**
With urban creep (mm)	**20.4**	**30.1**	**37.2**	**48.6**	**62.5**	**75.6**	**89.9**	**99.9**	**111.5**	**135.9**
RUNOFF (m^3)	**33.6**	**49.4**	**61.2**	**79.9**	**102.9**	**124.4**	**148.0**	**164.4**	**183.5**	**223.5**
inflow rate (l/s)	112.0	82.4	68.0	44.4	28.6	17.3	10.3	7.6	5.1	2.6
storage rate (l/s)	110.0	80.4	66.0	42.4	26.6	15.3	8.3	5.6	3.1	0.6
Discharge (m^3)	**0.6**	**1.2**	**1.8**	**3.6**	**7.2**	**14.4**	**28.8**	**43.2**	**72.0**	**172.8**
Req'd STORAGE (m^3)	**33.0**	**48.2**	**59.4**	**76.3**	**95.7**	**110.0**	**119.2**	**121.2**	**111.5**	**50.7**
Residual drain time (h)	**4.6**	**6.7**	**8.3**	**10.6**	**13.3**	**15.3**	**16.6**	**16.8**	**15.5**	**7.0**

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	Andy Traves
Site name:	Long Copse Lane
Site location:	Emsworth

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:	50.86529° N
Longitude:	0.93311° W
Reference:	2270277914
Date:	May 17 2020 11:21

Site characteristics

Total site area (ha):	0.436
Significant public open space (ha):	0.11
Area positively drained (ha):	0.326
Impermeable area (ha):	0.163
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 (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):	0.33
Net impermable area for storage volume design (ha):	0.18
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.

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:	--	94.71
FEH / FSR conversion factor:	1.23	1.23
SAAR (mm):	759	759
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological 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):	0.87	0.87
Q_{BAR} for net site area (l/s):	0.65	0.65

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 Qbar
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2

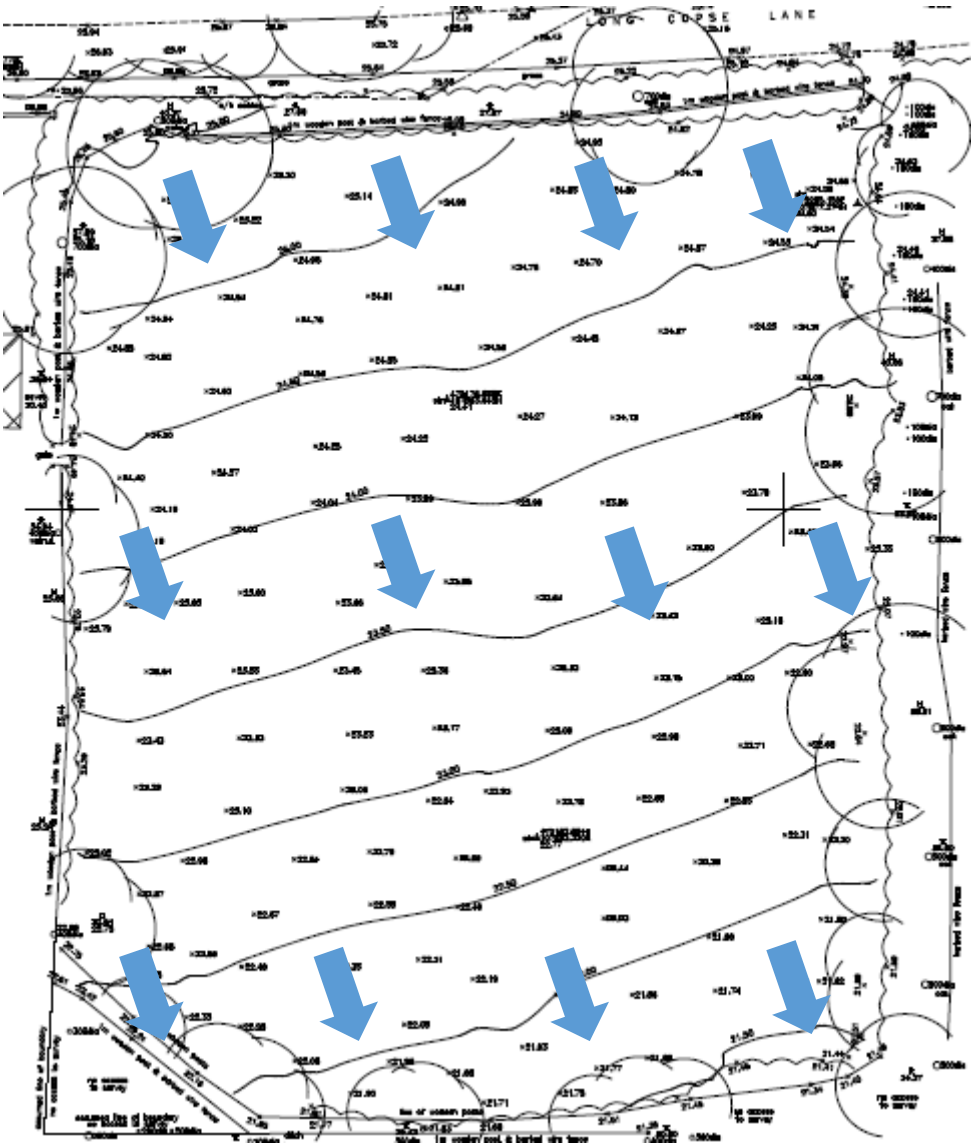
Site discharge rates

	Default	Edited
1 in 1 year (l/s):	2	2
1 in 30 years (l/s):	2	2
1 in 100 year (l/s):	2	2

Estimated storage volumes

	Default	Edited
Attenuation storage 1/100 years (m³):	133	133
Long term storage 1/100 years (m³):	0	0
Total storage 1/100 years (m³):	133	133

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.



Existing exceedance flow pathways

Post development exceedance flow pathways

Aqua Callidus Consulting Ltd
52 Common Lane, Titchfield,
Hants, PO14 4BU

t: 07717 759149
www.aquacallidus.co.uk

Date: 01/06/2021

Site Ref Long Copse Lane

SuDS Water Quality Management CIRIA C753 Ch26 **Simple Index Approach**

Catchment driveways

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	Hazard	TSS index	Metals index	HydroCar index
roads-low traffic	low	0.5	0.4	0.4

Treatments

To surface water discharge Y

	Component	TSS MIndex	Metals MIndex	HydroCa MIndex	factor
1	Separator	0.5	0.4	0.8	1.00
2	N/A	0	0	0	0.50
3	N/A	0	0	0	0.50
	mitigation index	**0.5**	**0.4**	**0.8**	
X1	N/A	0	0	0	1.00
	Enhanced mitigation index	**0.5**	**0.4**	**0.8**	
	Residual pollution index	**0**	**0**	**0**	

Land Use	Hazard	TSS index	Metals index	HydroCar index	*residual*
roads-low traffic	low	**0**	**0**	**0**	

Treatments

To groundwater discharge N

	Infiltration surface	TSS MIndex	Metals MIndex	HydroCa MIndex	factor
1	N/A	0	0	0	1.00
2	N/A	0	0	0	0.50
	Final residual pollution index	**0**	**0**	**0**	

Is a groundwater risk screening required? **N**

Notes:

Smart sponge ® gulley filtration/separation

Aqua Callidus Consulting Ltd
52 Common Lane, Titchfield,
Hants, PO14 4BU

t: 07717 759149
www.aquacallidus.co.uk

Date: 01/06/2021

Site Ref Long Copse Lane

SuDS Water Quality Management CIRIA C753 Ch26 **Simple Index Approach**

Catchment roof

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	Hazard	TSS index	Metals index	HydroCar index
roofs-residential	very low	0.2	0.2	0.05

**2 residential roofs remove gross solids and sediments*

Treatments

To surface water discharge Y

	Component	TSS MIndex	Metals MIndex	HydroCa MIndex	factor
1	Separator	0.5	0.4	0.8	1.00
2	N/A	0	0	0	0.50
3	N/A	0	0	0	0.50
	mitigation index	**0.5**	**0.4**	**0.8**	
X1	N/A	0	0	0	1.00
	Enhanced mitigation index	**0.5**	**0.4**	**0.8**	
	Residual pollution index	**0**	**0**	**0**	

Land Use	Hazard	TSS index	Metals index	HydroCar index	*residual*
roofs-residential	very low	**0**	**0**	**0**	

**2 residential roofs remove gross solids and sediments*

Treatments

To groundwater discharge N

	Infiltration surface	TSS MIndex	Metals MIndex	HydroCa MIndex	factor
1	N/A	0	0	0	1.00
2	N/A	0	0	0	0.50
	Final residual pollution index	**0**	**0**	**0**	

Is a groundwater risk screening required? **N**

Notes:

Smart sponge ® gulley filtration/separation

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.

	SUDS component												
O&M activity	Pond	Wetland	Detention basin	Infiltration basin	Soakawayu	Infiltration trench	Filter trench	Modular storage	Pervios 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 strimmed 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 reseeding (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.

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

CONDITIONS AND LIMITATIONS OF FLOOD RISK ASSESSMENT & DRAINAGE STRATEGIES October 2020

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