**NOTES:**

- Do not scale from this drawing.
- All dimensions are in metres unless otherwise stated.
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A Updated Masterplan
First Issue
KM LW LW 03.12.21
KM LW LW 01.11.21



6150 Knights Court, Solihull Parkway, Birmingham, B37 7WY
T +44 (0)121 329 4330 E mail@brookbanks.com
W brookbanks.com

Hallam Land Management

Land at Pagham II

Illustrative Surface Water
Drainage Strategy

Status	Status Date	
Drawn	Checked	Date
Scale	Number	Rev
Draft		DEC 2021
KM	LW	01.11.21
1:1000	10821-DR-01	A

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE
RELEVANT LOCAL AUTHORITIES, IT SHOULD BE UNDERSTOOD THAT
ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR
CONSTRUCTION. SHOULD THE CONTRACTOR COMMENCE SITE WORK
PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT HIS OWN RISK.

Appendix B - IoH Greenfield Runoff Rates

Calculated by: Alejandro Ortiz
Site name: Pagham II
Site location:

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

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 4.9

Methodology

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

SPR estimation method: Calculate from SOIL type

Soil characteristics Default Edited

SOIL type:	3	3
------------	---	---

HOST class:	N/A	N/A
-------------	-----	-----

SPR/SPRHOST:	0.37	0.37
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Hydrological characteristics Default Edited

SAAR (mm):	694	694
------------	-----	-----

Hydrological region:	7	7
----------------------	---	---

Growth curve factor 1 year:	0.85	0.85
-----------------------------	------	------

Growth curve factor 30 years:	2.3	2.3
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Growth curve factor 100 years:	3.19	3.19
--------------------------------	------	------

Growth curve factor 200 years:	3.74	3.74
--------------------------------	------	------

Site Details

Latitude: 50.78329° N

Longitude: 0.73661° W

Reference: 3315680026

Date: Nov 01 2021 09:16

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):	13.94	13.94
-------------------------	-------	-------

1 in 1 year (l/s):	11.85	11.85
--------------------	-------	-------

1 in 30 years (l/s):	32.05	32.05
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1 in 100 year (l/s):	44.45	44.45
----------------------	-------	-------

1 in 200 years (l/s):	52.12	52.12
-----------------------	-------	-------

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.ukuds.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.ukuds.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.

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Appendix C - WinDES Detention Calculations



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Innovyze	Source Control 2019.1	

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.203	0.203	4.8	238.9	O K
30 min Summer	0.252	0.252	5.0	298.8	O K
60 min Summer	0.311	0.311	5.1	371.9	O K
120 min Summer	0.379	0.379	5.1	458.7	O K
180 min Summer	0.423	0.423	5.1	515.5	O K
240 min Summer	0.455	0.455	5.1	557.8	O K
360 min Summer	0.501	0.501	5.1	618.8	O K
480 min Summer	0.533	0.533	5.1	661.7	O K
600 min Summer	0.557	0.557	5.1	693.6	O K
720 min Summer	0.575	0.575	5.1	718.0	O K
960 min Summer	0.565	0.565	5.1	705.3	O K
1440 min Summer	0.540	0.540	5.1	671.2	O K
2160 min Summer	0.507	0.507	5.1	626.2	O K
2880 min Summer	0.475	0.475	5.1	583.7	O K
4320 min Summer	0.443	0.443	5.1	541.7	O K
5760 min Summer	0.408	0.408	5.1	496.3	O K
7200 min Summer	0.374	0.374	5.1	452.3	O K
8640 min Summer	0.341	0.341	5.1	410.9	O K
10080 min Summer	0.311	0.311	5.1	373.1	O K
15 min Winter	0.227	0.227	4.9	267.9	O K
30 min Winter	0.281	0.281	5.0	335.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
		(m³)	(m³)	
15 min Summer	72.878	0.0	209.3	26
30 min Summer	45.836	0.0	264.6	41
60 min Summer	28.828	0.0	366.3	70
120 min Summer	18.132	0.0	461.8	130
180 min Summer	13.824	0.0	527.7	188
240 min Summer	11.404	0.0	579.2	248
360 min Summer	8.694	0.0	657.3	366
480 min Summer	7.172	0.0	714.3	486
600 min Summer	6.178	0.0	754.6	604
720 min Summer	5.468	0.0	778.5	724
960 min Summer	4.288	0.0	777.5	960
1440 min Summer	3.044	0.0	749.0	1184
2160 min Summer	2.161	0.0	1021.4	1540
2880 min Summer	1.695	0.0	1065.3	1936
4320 min Summer	1.261	0.0	1174.0	2768
5760 min Summer	1.023	0.0	1304.1	3568
7200 min Summer	0.869	0.0	1384.4	4328
8640 min Summer	0.761	0.0	1452.0	5104
10080 min Summer	0.680	0.0	1507.7	5848
15 min Winter	72.878	0.0	235.4	26
30 min Winter	45.836	0.0	295.7	40

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.347	0.347		5.1	417.6 O K
120 min Winter	0.423	0.423		5.1	516.2 O K
180 min Winter	0.473	0.473		5.1	581.1 O K
240 min Winter	0.509	0.509		5.1	629.9 O K
360 min Winter	0.562	0.562		5.1	701.3 O K
480 min Winter	0.600	0.600		5.1	752.6 O K
600 min Winter	0.628	0.628		5.1	791.8 O K
720 min Winter	0.651	0.651		5.1	832.9 O K
960 min Winter	0.645	0.645		5.1	815.3 O K
1440 min Winter	0.619	0.619		5.1	778.7 O K
2160 min Winter	0.573	0.573		5.1	715.8 O K
2880 min Winter	0.530	0.530		5.1	657.3 O K
4320 min Winter	0.478	0.478		5.1	588.0 O K
5760 min Winter	0.422	0.422		5.1	514.0 O K
7200 min Winter	0.367	0.367		5.1	443.8 O K
8640 min Winter	0.318	0.318		5.1	380.8 O K
10080 min Winter	0.274	0.274		5.0	326.2 O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	28.828	0.0	411.0	70
120 min Winter	18.132	0.0	517.3	128
180 min Winter	13.824	0.0	589.9	186
240 min Winter	11.404	0.0	645.9	244
360 min Winter	8.694	0.0	727.6	360
480 min Winter	7.172	0.0	779.1	476
600 min Winter	6.178	0.0	800.9	592
720 min Winter	5.468	0.0	860.2	708
960 min Winter	4.288	0.0	786.7	934
1440 min Winter	3.044	0.0	755.0	1360
2160 min Winter	2.161	0.0	1142.6	1672
2880 min Winter	1.695	0.0	1190.8	2112
4320 min Winter	1.261	0.0	1303.3	2992
5760 min Winter	1.023	0.0	1461.0	3856
7200 min Winter	0.869	0.0	1551.3	4616
8640 min Winter	0.761	0.0	1627.7	5368
10080 min Winter	0.680	0.0	1691.4	6064

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Innovyze	Source Control 2019.1	

Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.243	Cv (Summer)	0.750
Return Period (years)	30	D3 (1km)	0.359	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.308	Shortest Storm (mins)	15
Site Location		F (1km)	2.319	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+0
D1 (1km)	0.419	Winter Storms	Yes		

Time Area Diagram

Total Area (ha) 1.780

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To:	(ha)	From:	To:	(ha)
0	4 0.593	4	8 0.593	8	12 0.593

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Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1138.0	1.500	1773.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0104-5100-1200-5100
Design Head (m)	1.200
Design Flow (l/s)	5.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points Head (m) Flow (l/s)

Design Point (Calculated)	1.200	5.1
Flush-Flo™	0.358	5.1
Kick-Flo®	0.749	4.1
Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)						
0.100	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.8	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.1	1.600	5.8	4.000	9.0	8.000	12.5
0.400	5.1	1.800	6.2	4.500	9.5	8.500	12.8
0.500	5.0	2.000	6.5	5.000	10.0	9.000	13.2
0.600	4.8	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.0	6.000	10.9		
1.000	4.7	2.600	7.3	6.500	11.3		

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.420	0.420	5.1	512.0	O K
30 min Summer	0.508	0.508	5.1	628.2	O K
60 min Summer	0.611	0.611	5.1	768.6	O K
120 min Summer	0.731	0.731	5.1	936.6	O K
180 min Summer	0.808	0.808	5.1	1048.4	O K
240 min Summer	0.865	0.865	5.1	1132.6	O K
360 min Summer	0.948	0.948	5.1	1256.9	O K
480 min Summer	1.007	1.007	5.1	1347.7	O K
600 min Summer	1.052	1.052	5.1	1418.2	O K
720 min Summer	1.088	1.088	5.1	1475.0	O K
960 min Summer	1.089	1.089	5.1	1476.6	O K
1440 min Summer	1.073	1.073	5.1	1450.1	O K
2160 min Summer	1.026	1.026	5.1	1376.9	O K
2880 min Summer	0.978	0.978	5.1	1302.4	O K
4320 min Summer	0.947	0.947	5.1	1255.2	O K
5760 min Summer	0.914	0.914	5.1	1204.8	O K
7200 min Summer	0.879	0.879	5.1	1152.9	O K
8640 min Summer	0.844	0.844	5.1	1100.2	O K
10080 min Summer	0.807	0.807	5.1	1046.3	O K
15 min Winter	0.467	0.467	5.1	573.9	O K
30 min Winter	0.565	0.565	5.1	704.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
		(m³)	(m³)	
15 min Summer	155.021	0.0	410.4	27
30 min Summer	95.387	0.0	429.3	41
60 min Summer	58.693	0.0	734.8	72
120 min Summer	36.115	0.0	825.7	130
180 min Summer	27.184	0.0	808.8	190
240 min Summer	22.222	0.0	790.3	250
360 min Summer	16.727	0.0	766.0	370
480 min Summer	13.673	0.0	753.6	488
600 min Summer	11.694	0.0	748.9	608
720 min Summer	10.292	0.0	750.3	728
960 min Summer	7.998	0.0	747.2	966
1440 min Summer	5.606	0.0	737.6	1444
2160 min Summer	3.929	0.0	1514.4	2144
2880 min Summer	3.053	0.0	1459.9	2448
4320 min Summer	2.243	0.0	1352.9	3204
5760 min Summer	1.802	0.0	2295.0	4032
7200 min Summer	1.521	0.0	2414.2	4840
8640 min Summer	1.324	0.0	2504.7	5704
10080 min Summer	1.177	0.0	2526.2	6552
15 min Winter	155.021	0.0	425.4	27
30 min Winter	95.387	0.0	431.0	41

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Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.679	0.679	5.1	862.7	O K
120 min Winter	0.811	0.811	5.1	1052.5	O K
180 min Winter	0.896	0.896	5.1	1178.3	O K
240 min Winter	0.959	0.959	5.1	1273.7	O K
360 min Winter	1.051	1.051	5.1	1415.7	O K
480 min Winter	1.117	1.117	5.1	1520.4	O K
600 min Winter	1.168	1.168	5.1	1602.6	O K
720 min Winter	1.209	1.209	5.1	1669.4	Flood Risk
960 min Winter	1.214	1.214	5.1	1677.0	Flood Risk
1440 min Winter	1.202	1.202	5.1	1658.8	Flood Risk
2160 min Winter	1.162	1.162	5.1	1593.7	O K
2880 min Winter	1.111	1.111	5.1	1511.1	O K
4320 min Winter	1.070	1.070	5.1	1446.7	O K
5760 min Winter	1.026	1.026	5.1	1376.9	O K
7200 min Winter	0.976	0.976	5.1	1300.3	O K
8640 min Winter	0.924	0.924	5.1	1220.5	O K
10080 min Winter	0.869	0.869	5.1	1138.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	58.693	0.0	801.0	70
120 min Winter	36.115	0.0	813.3	130
180 min Winter	27.184	0.0	789.3	188
240 min Winter	22.222	0.0	773.8	246
360 min Winter	16.727	0.0	760.2	364
480 min Winter	13.673	0.0	761.2	482
600 min Winter	11.694	0.0	773.1	598
720 min Winter	10.292	0.0	786.2	716
960 min Winter	7.998	0.0	785.3	948
1440 min Winter	5.606	0.0	773.7	1406
2160 min Winter	3.929	0.0	1528.0	2076
2880 min Winter	3.053	0.0	1482.4	2708
4320 min Winter	2.243	0.0	1420.4	3376
5760 min Winter	1.802	0.0	2566.6	4328
7200 min Winter	1.521	0.0	2692.1	5264
8640 min Winter	1.324	0.0	2736.9	6152
10080 min Winter	1.177	0.0	2624.3	7064

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Rainfall Details

Rainfall Model	FEH	D2 (1km)	0.243	Cv (Summer)	0.750
Return Period (years)	100	D3 (1km)	0.359	Cv (Winter)	0.840
FEH Rainfall Version	1999	E (1km)	0.308	Shortest Storm (mins)	15
Site Location		F (1km)	2.319	Longest Storm (mins)	10080
C (1km)	-0.026	Summer Storms	Yes	Climate Change %	+40
D1 (1km)	0.419	Winter Storms	Yes		

Time Area Diagram

Total Area (ha) 1.780

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From:	To:	(ha)	From:	To:	(ha)
0	4 0.593	4	8 0.593	8	12 0.593

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Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1138.0	1.500	1773.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0104-5100-1200-5100
Design Head (m)	1.200
Design Flow (l/s)	5.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points Head (m) Flow (l/s)

Design Point (Calculated)	1.200	5.1
Flush-Flo™	0.358	5.1
Kick-Flo®	0.749	4.1
Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)						
0.100	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.8	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.1	1.600	5.8	4.000	9.0	8.000	12.5
0.400	5.1	1.800	6.2	4.500	9.5	8.500	12.8
0.500	5.0	2.000	6.5	5.000	10.0	9.000	13.2
0.600	4.8	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.0	6.000	10.9		
1.000	4.7	2.600	7.3	6.500	11.3		

Appendix D – Southern Water Sewer Records




Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0001	F	5.75	0.00	
0101	F	5.94	0.00	
0102	F	0.00	0.00	
0201	F	6.18	3.39	
0202	F	6.42	5.24	
0203	F	6.03	3.38	
0204	F	0.00	0.00	
0301	F	6.07	3.76	
0303	F	6.30	4.68	
0304	F	6.27	4.29	
0305	F	6.38	4.05	
0306	F	6.25	3.96	
0307	F	6.10	3.82	
0308	F	0.00	0.00	
0309	F	0.00	0.00	
0502	F	5.97	4.21	
0601	F	5.93	3.33	
0701	F	5.56	2.90	
0702	F	5.61	3.17	
0703	F	5.54	3.52	
0704	F	5.52	3.65	
0705	F	5.60	3.77	
0706	F	5.62	3.26	
0801	F	6.04	4.29	
0901	F	5.81	2.27	
0902	F	5.81	2.13	
1504	F	0.00	0.00	
1505	F	0.00	0.00	
2501	F	6.17	3.33	
2601	F	6.33	3.55	
2602	F	6.31	3.47	
2603	F	5.96	3.80	
2604	F	0.00	0.00	
2701	F	6.06	4.52	
2702	F	6.23	4.99	
2703	F	5.84	4.42	
2704	F	5.63	4.81	
2801	F	6.10	4.19	
3503	F	6.29	3.15	
3504	F	6.28	4.57	
3701	F	6.59	5.50	
3801	F	5.67	3.77	
4501	F	6.32	5.05	
4502	F	6.31	5.26	
4601	F	6.34	4.70	
4602	F	6.43	4.85	
4701	F	6.53	4.27	
4702	F	0.00	0.00	
4801	F	5.94	3.92	
4802	F	5.89	3.39	
5507	F	0.00	0.00	
5601	F	5.97	3.53	
5602	F	5.93	4.85	
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8701	F	6.13	4.47	
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9001	F	6.02	3.82	
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9204	F	5.77	4.90	
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9606	F	0.00	0.00	
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9702	F	6.05	4.48	
9801	F	6.02	4.26	
9802	F	6.06	4.56	
9803	F	6.03	4.38	
9804	F	6.04	4.57	
9805	F	6.07	4.76	
9806	F	6.07	4.96	
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9903	F			

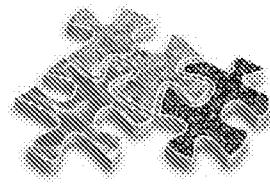
Appendix E – Topographic Survey







Appendix F – GEG Groundwater Monitoring



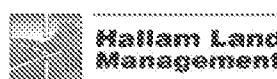
**GROUNDWATER & INITIAL GAS MONITORING
FACTUAL REPORT**



**'PAGHAM PHASE II'
LAND WEST OF PAGHAM ROAD
PAGHAM, WEST SUSSEX
PO21 3PY**

APRIL 2021

Prepared for:



**REPORT TITLE:****GROUNDWATER
& INITIAL GAS
MONITORING
FACTUAL REPORT****Site Address:**

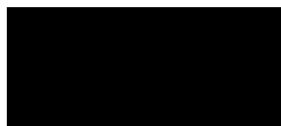
‘Pagham Phase II’
Land West of Pagham Road
Pagham
West Sussex
PO21 3PY

Performed By:

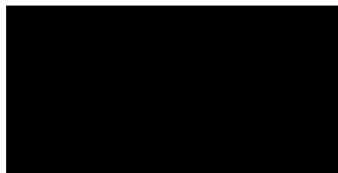
Geo Environmental Group
GEG House
17 Graham Road
Malvern
WR14 2HR

On Behalf Of:

Hallam Land Management
c/o Brookbanks
6150 Knights Court
Solihull Parkway
Birmingham
B37 7WY

Written by:

Matthew Perks
BSc(Hons) MSc FGS
Principal Geo-Environmental Engineer

Checked & Approved by:

Mark Rawlings
BSc(Hons) MSc FGS CGeol
Associate Director

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1. INTRODUCTION

1.1 General

Geo Environmental Group (GEG) were commissioned by Brookbanks on behalf of Hallam Land Management (HLM) (the Client) to undertake groundwater monitoring at a site known as 'Land at Pagham Phase II, West Sussex'.

The aim of the investigation was to:

- Undertake the installation of groundwater monitoring boreholes with subsequent groundwater over the winter months.
- Produce a factual report detailing the work undertaken.

A Phase I Review & Phase II Geo-Environmental Assessment was previously undertaken on a site adjacent to the north east known as 'Land at Pagham, West Sussex' by GEG on behalf of Brookbanks/HLM (Ref. GEG-19-623/PI_PII, dated 30th January 2020).

1.2 Available Information

The following drawings were supplied by Brookbanks:

- 'Pagham Phase II - Groundwater Monitoring Location Plan Request,' Brookbanks on behalf of HLM, Drawing No. 10461-SI-02, dated 10th December 2020.
- Various utility company service drawings.

GEG also purchased additional utility company service drawings of the site.

1.3 Proposed Site Development

It is understood that the site is proposed for residential development; no further information is available at this stage.

1.4 Scope

The works performed by GEG included:

- Preliminary ground investigation for the installation of standpipes for subsequent groundwater monitoring.

Limitations to the scope of the report are outlined in Section 6.



2. SITE SETTING

2.1 Site Location

The site is located in Pagham (approximately 4.5 km west of the centre of Bognor Regis) in West Sussex, at the approximate National Grid Reference 489149E, 98972N. It lies on the western side of Pagham Road south of Rookery Farm and covers an area of approximately 4.6 ha.

A section of the 1:25,000 Ordnance Survey (OS) map identifying the site location is shown in Figure 1 of Appendix A. The site layout plan is presented in Figure 2 (Appendix A) and a photographic record is provided in Appendix B.

2.2 Site Description

The site comprised a relatively level arable agricultural field bounded by mature hedgerow with occasional deciduous trees.

Topographically, the site was relatively level at an elevation of approximately 5m AOD.

2.3 Adjacent Land Uses

A summary of surrounding land-use in the immediate vicinity of the site is provided below.

North East	Small drain followed by Rockery Farm.
South East	Pagham Road followed by an agricultural field.
South West	Residential development.
North West	Residential development and agricultural fields.

3. GEOLOGY, HYDROLOGY, HYDROGEOLOGY

3.1 Published Geology

Reference to the 1:50,000 scale British Geological Survey digital mapping of the area (solid and drift) indicates that the solid geology beneath the site comprises the London Clay Formation of the Palaeogene period. It is described as poorly laminated, blue grey or grey brown, slightly calcareous, silty to very silty clay, clayey silt and sometimes silt, with some layers of sandy clay. It commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand.

The solid geology is conjectured to be overlain by superficial deposits of River Terrace Deposits (RTD) across the majority of the site, described generically as sand and gravel, locally with lenses of silt, clay or peat. The westernmost section of the site is conjectured to be overlain by Raised Beach Deposits 1, generically described as shingle, sand, silt and clay. Raised Marine Deposits (clay, silt, sand and gravel) are also indicated to overlie the central part of the western boundary.



No faults are conjectured to intersect the site at the surface.

3.2 Hydrogeology

3.2.1 Groundwater Designation

The database search report indicates that the solid geology directly beneath the site is designated as Unproductive Strata.

Unproductive Strata - are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The superficial deposits of the River Terrace Deposits are characterised as a Secondary A Aquifer and the Raised Beach and Marine Deposits as a Secondary Undifferentiated Aquifer.

Secondary A Aquifers are defined as permeable layers capable of supporting water supplies at a local rather than a strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

Secondary (Undifferentiated) Aquifers are assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

3.2.2 Groundwater Source Protection Zone

The site does not lie within a currently defined Groundwater Source Protection Zone (GWSPZ).

3.3 Hydrology

3.3.1 Nearest Watercourse

The nearest surface water feature is a drain adjacent to the north of the site flowing westwards (via a pond approximately 25m west of the site) towards the Pagham Rife approximately 225m west of the site.

3.3.2 Surface Water Flooding

According to the Environment Agency online 'Flood Map for Planning', the majority of the site lies within Flood Zone 1, being land that lies outside the 1 in 1000 year (0.1%AEP) flood risk area and hence has a low probability of flooding.

However, Flood Zones 2 and 3 marginally extend over the north western boundary of the site.

Flood Zone 2: This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.



Flood Zone 3: This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

3.4 Ordnance

According to regional unexploded bomb risks maps provided by Zetica, the site falls within an area of low bomb risk and therefore no further action is required.

4. INTRUSIVE INVESTIGATION

4.1 Site Works Overview

The following section outlines the scope of the intrusive investigation carried out by GEG in accordance with the Brookbanks specification and details the ground conditions encountered and the chemical testing undertaken.

All work was undertaken in general accordance with British Standard guidance (BS:5930:2015 and BS:10175) and the ICE UK Specification for Ground Investigation (2nd Edition 2012) guidelines.

Prior to commencement of the works, service plans were viewed in order to investigate the location of all major services and each exploratory hole location screened with a cable avoidance tool.

The exploratory holes were logged and sampled by an experienced geo-environmental engineer from GEG. The ground conditions encountered were recorded on the exploratory hole logs (Appendix C). Where the sample is disturbed but some guidance as to the in-situ consistency can be sensibly given, the consistency term is given in brackets, in accordance with BS:5930:2015.

The locations of the exploratory holes are shown on Figure 2 presented in Appendix A.

4.1.1 Limitations of Intrusive Investigation

There were no limitations to access across the site for the duration of the intrusive investigation.

4.1.2 Reinstatement

All boreholes were installed with 50mm diameter gas and groundwater monitoring standpipes and lockable flush cover. The surface covers were removed following completion of the groundwater monitoring to allow crop rotation.

4.2 Site Works

4.2.1 General

The intrusive investigation was undertaken on 21st and 22nd January 2021 and comprised window sample boreholes.



4.2.2 Window Sample Holes

7 No. window sample boreholes (WS01-WS07) were drilled using a Competitor Dart dynamic sampling rig to a maximum depth of 5.00m. Each window sample hole was preceded by concrete coring and a hand excavated service avoidance pit to a maximum depth of 1.20m below ground level (BGL).

All boreholes were installed with 50mm diameter standpipes to depths detailed on the exploratory hole logs for subsequent groundwater monitoring. Although, boreholes typically refused on dense SAND prior to reaching 5.00m depth, all standpipes were installed below the groundwater level encountered during drilling.

4.2.3 Rationale for Exploratory Holes

The rationale for the exploratory locations, which was undertaken in accordance with the Brookbanks' specification, is given in Table 1 below. A plan showing the location of the exploratory holes is included as Figure 2.

Table 1. Rationale for Exploratory Holes

Exploratory Hole	Rationale
WS01-WS07	General coverage

4.2.4 Initial Gas Monitoring

Initial gas monitoring was undertaken on 26th February and 26th March 2021. The standpipes were monitored for methane, carbon dioxide, oxygen, hydrogen sulphide and the borehole flow rate using a GA2000 gas analyser. Atmospheric pressure and trend was also recorded.

Table 2. Gas Monitoring Results

Borehole	Date	Atmospheric Pressure (mb)	Atmospheric Pressure Trend	Methane (% Vol.)	Carbon Dioxide (% Vol.)	Oxygen (% Vol.)	Hydrogen Sulphide (ppm)	Borehole Flow (l/hr)
WS01	26/02/21	Borehole location flooded at surface						
	26/03/21	1008	Falling	0.0	0.3	18.8	0	0.0
WS02	26/02/21	1035	Rising	0.0	0.2	19.6	0	0.5
	26/03/21	1008	Falling	0.0	0.5	16.5	0	0.0
WS03	26/02/21	1033	Rising	0.0	0.0	20.3	0	0.7
	26/03/21	Falling						
WS04	26/02/21	Borehole location flooded at surface						
	26/03/21	1007	Falling	0.0	0.1	20.5	0	0.0
WS05	26/02/21	1035	Rising	0.0	0.1	21.1	0	0.3



Borehole	Date	Atmospheric Pressure (mb)	Atmospheric Pressure Trend	Methane (% Vol.)	Carbon Dioxide (% Vol.)	Oxygen (% Vol.)	Hydrogen Sulphide (ppm)	Borehole Flow (l/hr)
	26/03/21	1008	Falling	0.0	0.1	20.8	0	0.0
WS06	26/02/21	1033	Rising	0.0	0.6	20.1	0	1.0
	26/03/21	1007	Falling	0.0	0.9	19.4	0	0.1
WS07	26/02/21	1035	Rising	0.0	0.0	21.2	0	0.2
	26/03/21	1007	Falling	0.0	0.3	20.7	0	0.1

The gas monitoring results recorded low methane concentrations of 0.0% and low carbon dioxide concentrations of 0.0% to 0.9% with a maximum borehole flow rate 1.0 l/hr.

The water levels were monitored using a dip meter; results are presented in Section 4.3.6.

4.3 Ground Conditions Encountered

The ground conditions encountered are described below and broadly confirmed the published geology.

4.3.1 Made Ground

No Made Ground was encountered in the exploratory holes.

4.3.2 Topsoil

Typically soft CLAY topsoil was encountered across site to depths of 0.30m to 0.40m.

4.3.3 River Terrace Deposits

River Terrace Deposits were encountered underlying the topsoil to depths of >2.50m to >4.00m and typically comprised horizons of variably gravelly firm CLAY and medium dense to dense SAND. Soft to firm CLAY was encountered from 1.60m to 2.30m in WS05.

4.3.4 Raised Beach / Marine Deposits

Raised Beach / Marine Deposits were not encountered in the exploratory holes. However, as these deposits are potentially similar in composition to the River Terrace Deposits, differentiation between the strata is sometimes problematic.

4.3.5 London Clay Formation

The London Clay Formation was encountered underlying the River Terrace Deposits in 1 No. location (WS02) from a depth of 3.00m to the base the exploratory hole. It comprised stiff CLAY.



4.3.6 *Groundwater*

Groundwater was encountered in all of the exploratory holes during the investigation, as detailed in Table 3A.

Table 3A. Groundwater Inflows Recorded During the Investigation

Exploratory Hole	Groundwater Depth (m)	Stratum
WS01	1.00	River Terrace Deposits
WS02	0.83	
WS03	0.78	
WS04	0.30	
WS05	0.90	
WS06	0.79	
WS07	0.38	

Groundwater levels recorded in the boreholes during the subsequent monitoring visits are summarised in Table 3B.

Table 3B. Groundwater Levels Recorded During the Monitoring Visits

Borehole	Date	Depth of Installation (m)	Groundwater Depth (m)
WS01	26.02.21	2.50	Flooded at Surface 0.74
	26.03.21		
WS02	26.02.21	4.00	0.88 1.08
	26.03.21		
WS03	26.02.21	2.00	0.77 0.85
	26.03.21		
WS04	26.02.21	2.00	0.44 0.81
	26.03.21		
WS05	26.02.21	2.00	0.86 1.08
	26.03.21		
WS06	26.02.21	2.50	1.15 1.38
	26.03.21		
WS07	26.02.21	1.50	0.76 0.99
	26.03.21		

It should be noted that groundwater levels may vary due to seasonal and other effects.

5. REFERENCES

1. British Standard Institute (1990) BS: 1377 Parts 1-9. Methods of Tests for Soils for Civil Engineering Purposes.
2. British Standard Institute (2015) BS: 5930 Code of Practice for Site Investigations. BSI, London.
3. British Standard Institute (2015+A1:2019) BS: 8485 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.



4. British Standard Institute (2011) BS: 10175 Code of Practice for Investigation of Potentially Contaminated Sites. BSI, London.
5. BRE Report 414 (2001). Protective measures for housing on gas-contaminated land. BRE Press, Berkshire.
6. BRE Digest 412 (February 1996). Desiccation in clay soils.
7. ICE Publishing (2012) UK Specification for Ground Investigation – Second Edition. Site Investigation Steering Group.
8. Wilson, S. & Card, G. CIRIA/Environmental Protection UK Ground Gas Seminar – 22nd June 2011 and 13th September 2011. A pragmatic approach to ground gas risk assessment for the 21st Century.

6. LIMITATIONS

As with all intrusive site investigations, there is a possibility that localised contamination 'hotspots'/geotechnical features remain undetected on the site. Therefore, as with standard practices, this report does not provide a warranty to cover limited localised contamination 'hotspots'/geotechnical features or any post-investigation importation of contamination.

The conclusions and recommendations stated herein are based on information available at the time of production. These may not necessarily apply if the site is to be utilised for a more or less sensitive purpose in the future, or if operational procedures or management alter over time.

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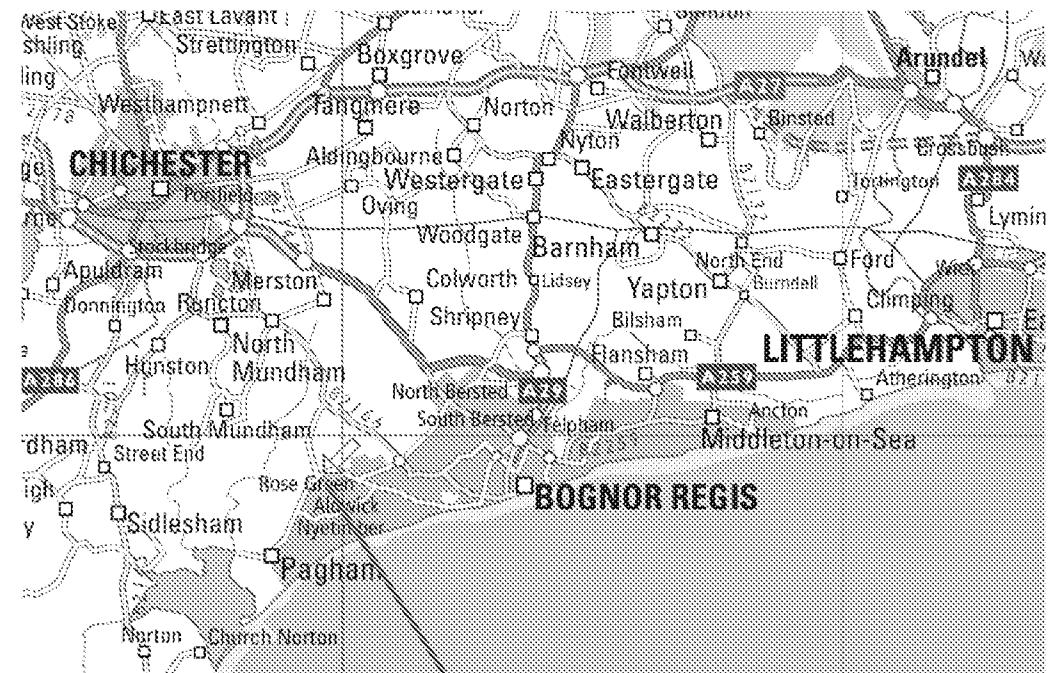
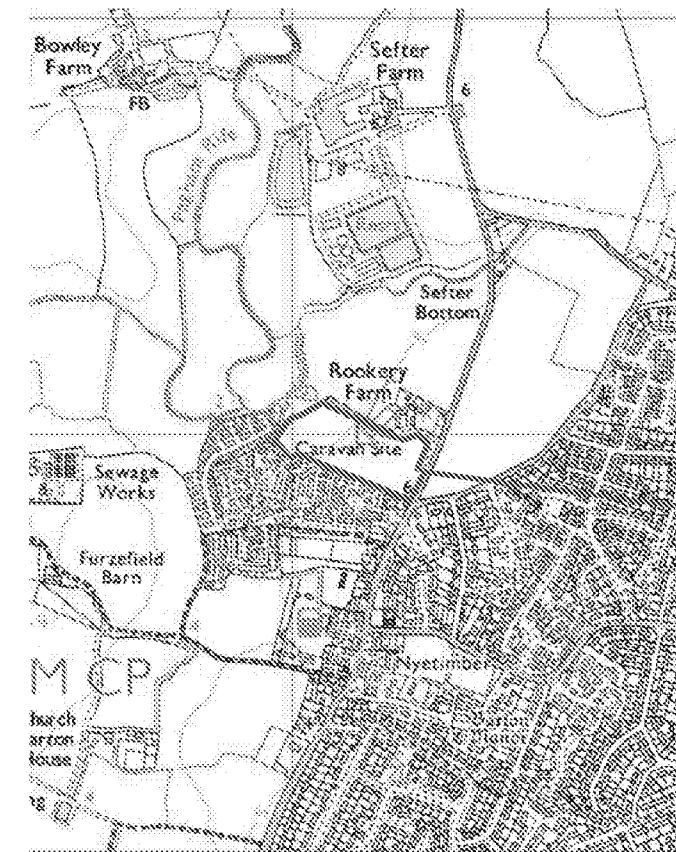
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APPENDIX A

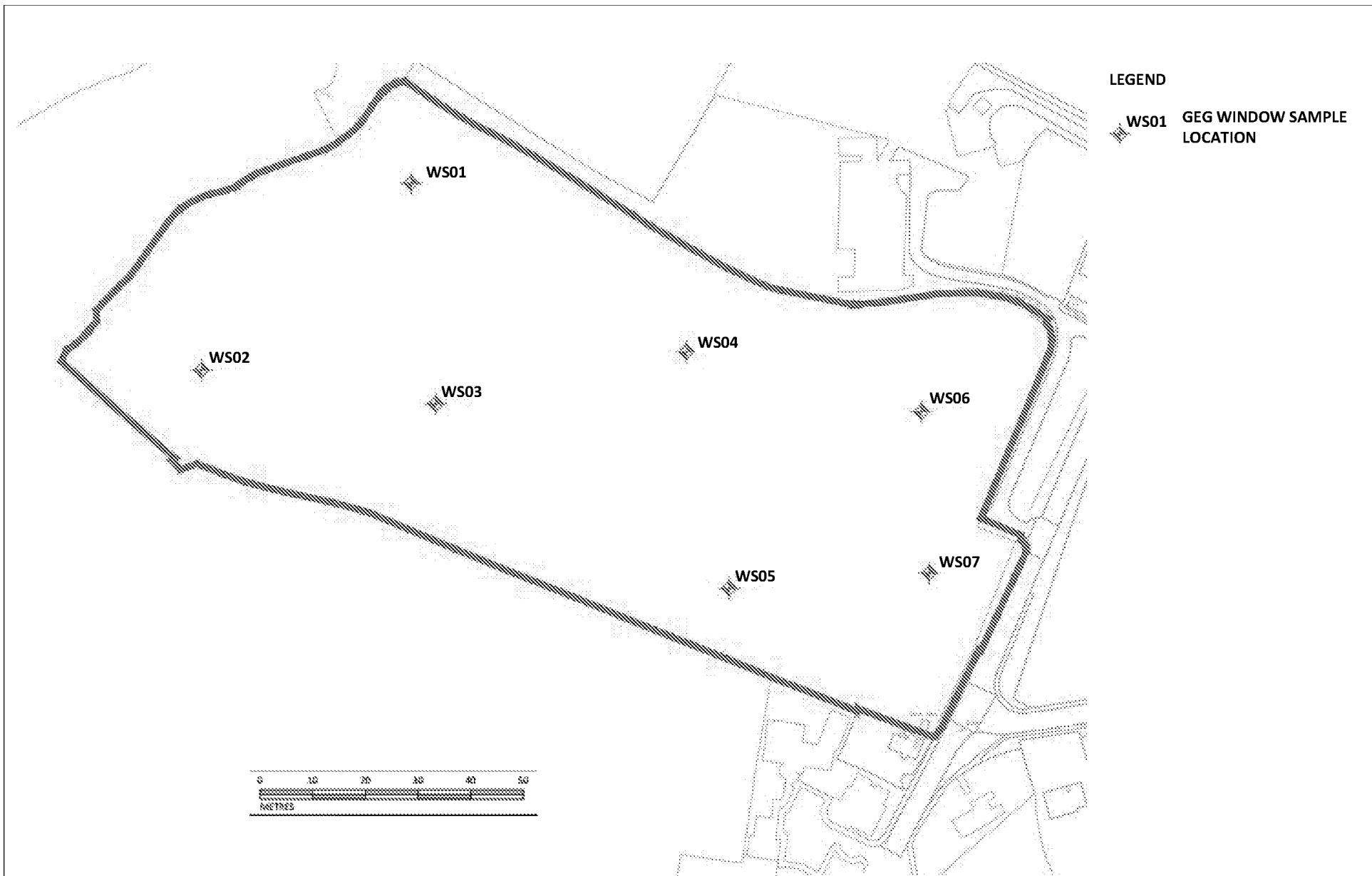
FIGURES AND PLANS



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TITLE: FIGURE 1: SITE LOCATION PLAN	CLIENT: BROOKBANKS / HLM	DRAWN/CHECKED:		GEG House, 17 Graham Road Malvern, WR14 2HR Tel. 01684 212526 Fax 01684 576917 admin@g-eg.co.uk, www.g-eg.co.uk	Geo Environmental Group
SITE: PAGHAM PHASE II, WEST SUSSEX	PROJECT No.: GEG-20-666	SCALE: NTS	DATE: 03/02/21	REVISION: A	





TITLE: FIGURE 2: EXPLORATORY HOLE LOCATION PLAN		CLIENT: BROOKBANKS / HLM		DRAWN/CHECKED: JM / MP		GEG House, 17 Graham Road Malvern, WR14 2HR Tel. 01684 212526 Fax 01684 576917 admin@g-eg.co.uk, www.g-eg.co.uk	Geo Environmental Group
SITE: PAGHAM PHASE II, WEST SUSSEX	PROJECT No.:	GEG-20-666	SCALE:	AS SHOWN	DATE:	15/03/21	REVISION: A





APPENDIX B

PHOTOGRAPHIC RECORD



Photo 1: View west across the northern boundary of the site.



Photo 2: View south across the eastern section of the site.



Photo 3: View south west across the site.



Photo 4: View west across the site.

Geo Environmental Group
Geotechnical, Environmental &
Ecological Consultants



Geo Environmental Group
GEG House
17 Graham Road
Malvern
WR14 2HR

Client: Brookbanks / HLM

Project: Pagham Phase II, West Sussex

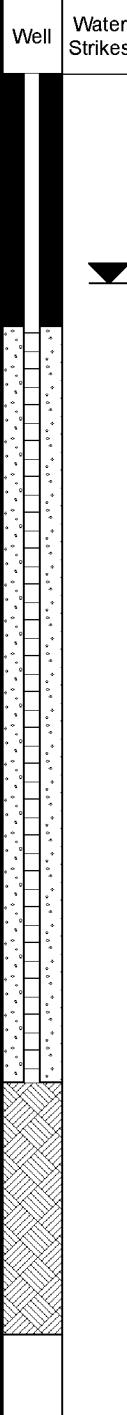
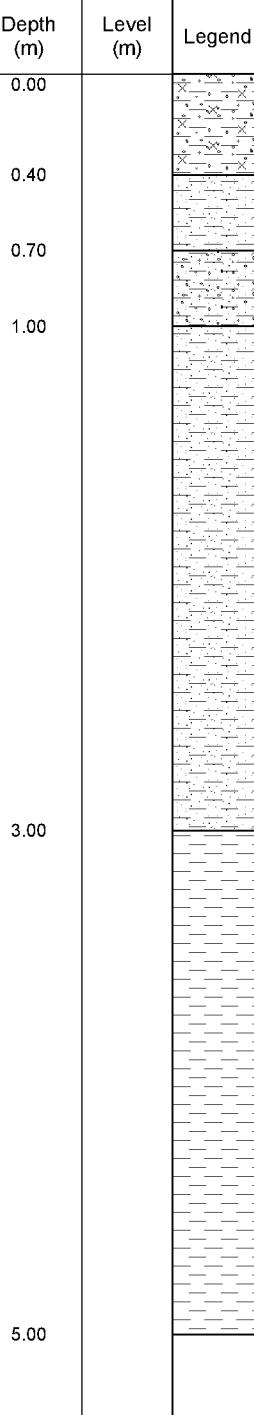
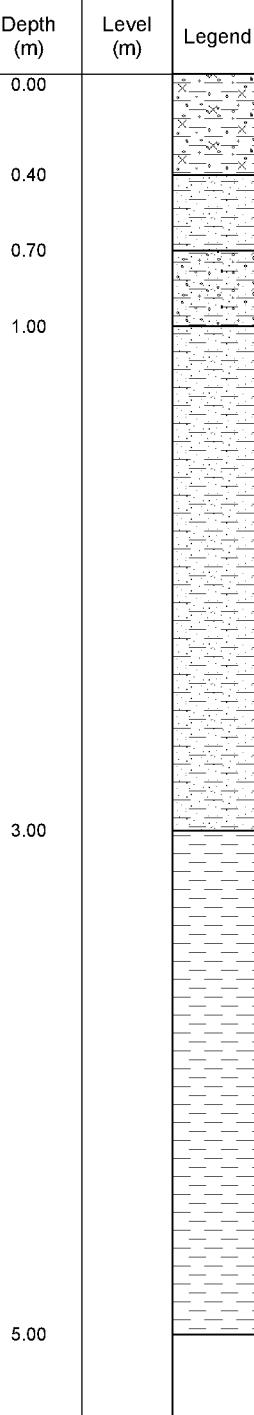
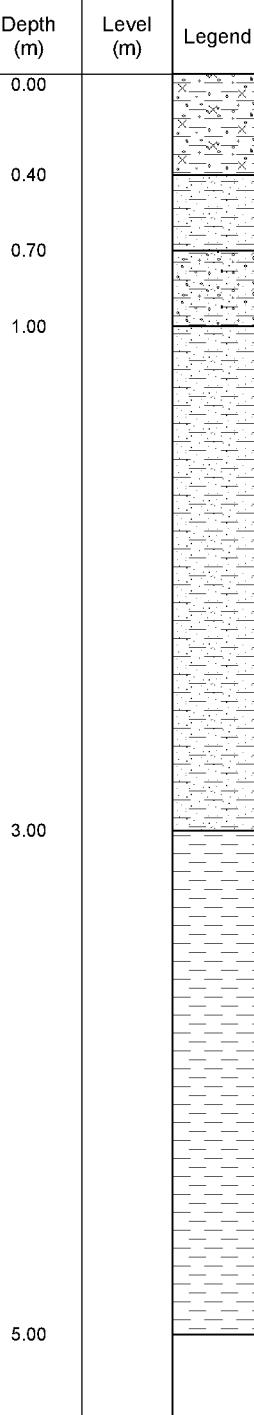
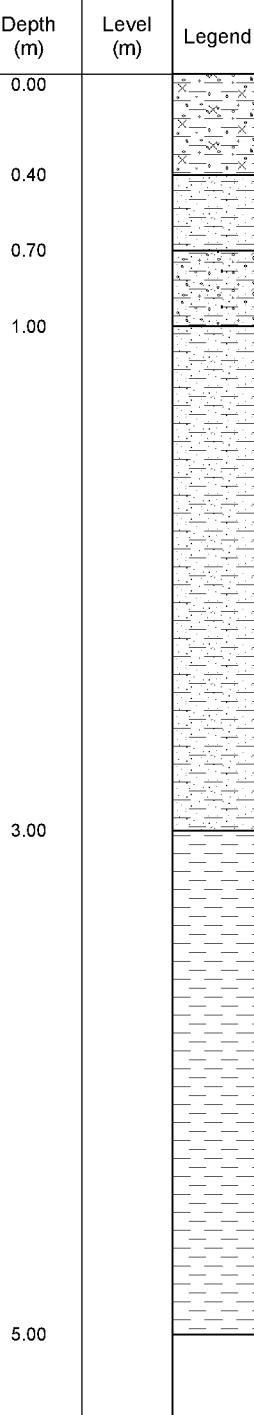
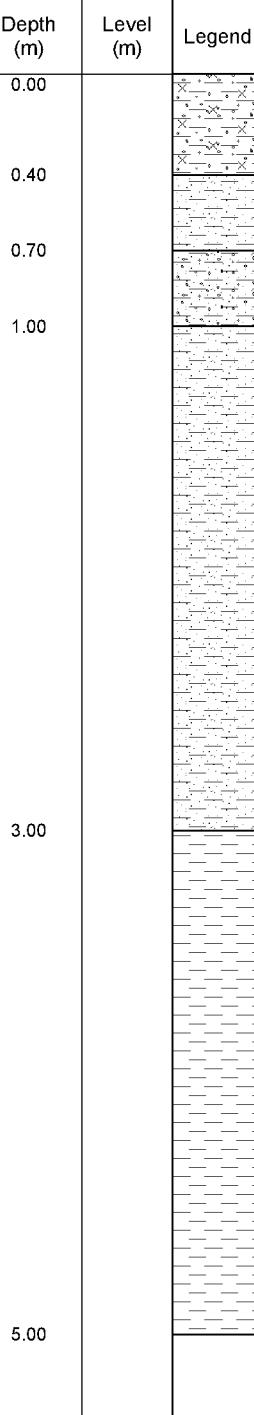
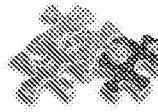
Project No.: GEG-20-666



APPENDIX C

EXPLORATORY HOLE LOGS

 Geo-Environmental Group			Borehole Log			Borehole No. WS01		
						Sheet 1 of 1		
Project Name: Pagham II		Project No. GEG-20-666	Co-ords:		Hole Type WS			
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD			Level:		Scale 1:31			
Client: Brookbanks / HLM			Dates: 21/01/2021		Logged By AT			
Well	Water Strikes	Sample and In-Situ Testing		Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type					
				0.00			Soft brown slightly gravelly silty CLAY. Gravel is fine to medium mixed lithologies. (TOPSOIL)	
				0.30			Firm light brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)	0.5
				1.60			Medium dense light brown slightly clayey gravelly fine to medium SAND. Gravel is fine to coarse sub-rounded to sub-angular flint. (RIVER TERRACE DEPOSITS)	1.0
				2.50			End of Borehole at 2.500m	1.5
								2.0
								2.5
								3.0
								3.5
								4.0
								4.5
								5.0
								5.5
Remarks 1. Service pit to 1.20m. 2. Groundwater encountered at 1.00m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.50m, response zone 2.50-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.								

 Geo-Environmental Group			<h1>Borehole Log</h1>			Borehole No. WS02 Sheet 1 of 1							
Project Name: Pagham II			Project No. GEG-20-666		Co-ords:								
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD			Level:		Scale 1:31								
Client: Brookbanks / HLM			Dates: 22/01/2021		Logged By AT								
Well	Water Strikes	Sample and In Situ Testing		Depth (m)	Level (m)	Legend	Stratum Description						
		Depth (m)	Type				Results						
													
Remarks													
1. Service pit to 1.20m. 2. Groundwater encountered at 0.83m. 3. 50mm standpipe installed 4.00m, response zone 4.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 4. Equipment used: Dando Terrier Window Sampling Rig.													



Borehole Log

Borehole No.

WS03

Sheet 1 of 1

Project Name: Pagham II			Project No. GEG-20-666		Co-ords:		Hole Type WS	
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD			Level:		Scale 1:31			
Client: Brookbanks / HLM			Dates: 22/01/2021		Logged By AT			
Well	Water Strikes	Sample and In Situ Testing		Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type				Results	
				0.00			Soft brown silty CLAY. (TOPSOIL)	
				0.30			Firm light brown sandy CLAY. (RIVER TERRACE DEPOSITS)	0.5
				1.50			Medium dense light brown clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)	1.0
				2.50			End of Borehole at 2.500m	1.5
								2.0
								2.5
								3.0
								3.5
								4.0
								4.5
								5.0
								5.5
Remarks								
1. Service pit to 1.20m. 2. Groundwater encountered at 0.78m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.00m, response zone 2.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.								



Borehole Log

Borehole No.

WS04

Sheet 1 of 1

Project Name: Pagham II			Project No. GEG-20-666		Co-ords:		Hole Type WS
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD			Level:		Scale 1:31		
Client: Brookbanks / HLM			Dates: 21/01/2021		Logged By AT		
Well	Water Strikes	Sample and In Situ Testing		Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type				
				0.00			Soft brown slightly gravelly silty CLAY. Gravel is fine to medium sub-angular to sub-rounded mixed lithologies. (TOPSOIL)
				0.30			Firm light brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)
				1.50			Medium dense orangish brown slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)
				3.00			End of Borehole at 3.000m
Remarks							
1. Service pit to 1.20m. 2. Groundwater encountered at 0.30m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.00m, response zone 2.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.							





Borehole Log

Borehole No.

WS05

Sheet 1 of 1

Project Name: Pagham II			Project No. GEG-20-666		Co-ords:		Hole Type WS	
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD			Level:		Scale 1:31			
Client: Brookbanks / HLM			Dates: 22/01/2021		Logged By AT			
Well	Water Strikes	Sample and In Situ Testing		Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type				Results	
				0.00			Soft brown silty CLAY. (TOPSOIL)	
				0.30			Firm brown slightly sandy CLAY. (RIVER TERRACE DEPOSITS)	0.5
				1.60			Soft to firm light brown sandy slightly gravelly CLAY. Gravel is fine to coarse sub-angular flint. (RIVER TERRACE DEPOSITS)	1.0
				2.30			Dense light brown slightly gravelly fine to medium SAND. Gravel is fine to coarse sub-angular to sub-rounded flint. (RIVER TERRACE DEPOSITS)	1.5
				3.00			End of Borehole at 3.000m	2.0
								2.5
								3.0
								3.5
								4.0
								4.5
								5.0
								5.5
Remarks								
1. Service pit to 1.20m. 2. Groundwater encountered at 0.90m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.00m, response zone 2.00-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.								



Borehole Log

Borehole No.

WS06

Sheet 1 of 1

Project Name: Pagham II			Project No. GEG-20-666		Co-ords:		Hole Type WS							
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD			Level:		Scale 1:31									
Client: Brookbanks / HLM			Dates: 21/01/2021		Logged By AT									
Well	Water Strikes	Sample and In Situ Testing		Depth (m)	Level (m)	Legend	Stratum Description							
		Depth (m)	Type				Results							
Remarks						End of Borehole at 4.00m								
1. Service pit to 1.20m. 2. Groundwater encountered at 0.79m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 2.50m, response zone 2.50-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.														



Borehole Log

Borehole No.

WS07

Sheet 1 of 1

Project Name: Pagham II			Project No. GEG-20-666		Co-ords:		Hole Type WS						
Location: Hook Lane, Rose Green, Bognor Regis, PO21 3PD			Level:		Scale 1:31								
Client: Brookbanks / HLM			Dates: 21/01/2021		Logged By AT								
Well	Water Strikes	Sample and In Situ Testing		Depth (m)	Level (m)	Legend	Stratum Description						
		Depth (m)	Type					Results					
				0.00		Soft brown slightly gravelly CLAY. Gravel is fine to medium sub-angular to sub-rounded mixed lithologies. (TOPSOIL)							
				0.30		Firm brown silty CLAY. (RIVER TERRACE DEPOSITS)							
				1.90		Medium dense light brown slightly clayey slightly gravelly fine to medium SAND. Gravel is fine to medium sub-angular flint. (RIVER TERRACE DEPOSITS)							
				2.00		End of Borehole at 2.000m							
Remarks													
1. Service pit to 1.20m. 2. Groundwater encountered at 0.38m. 3. Borehole refused on medium dense SAND with continual collapse of sides due to groundwater. 4. 50mm standpipe installed 1.50m, response zone 1.50-1.00m, bentonite seal 1.00-0.30m, flush cover concreted 0.30-0.00m. 5. Equipment used: Dando Terrier Window Sampling Rig.													



www.g-eg.co.uk

Project Office Address:
133-135 Southgate Street,
London NW1 2AB
Project Reference:
133-135 Southgate Street, NW1,
London
Project No:
133-135



APPENDIX O: Exceedance Flow Plan

KEY

SITE BOUNDARY

OVERLAND EXCEEDENCE FLOW ROUTE

NOTES:

1. This drawing is based on the proposed layout undertaken by Thrive Architects, drawing number: BARG230419_SL_01_P9, received 22/10/2024.
2. The contributing areas delineated on this plan are based on the proposed layout and may be subject to adjustment based on modifications.
3. Exceedence Flow arrows to be considered during development levels design.
4. Proposed layout is indicative and subject to detailed design.

