LINDEN PARK, LITTLEHAMPTON, WEST SUSSEX BN17 7BJ
Rev A - 19 September 2017
6391A/2.3

REPORT FOR PLANNING CONDITIONS 6 AND 12

1.0 PLANNING CONDITION 6

1.1 Surface water runoff generated from within the bounds of the site must be prevented from discharging onto the public highway.

1.2 The portion of the site abutting the public highway is composed of permeable paving blocks. Rainwater falling on this area will discharge directly to ground by infiltrating through the blocks and permeable sub-base, and will not drain onto the public highway.

1.3 As an additional measure to protect the highway, the site will slope away from the boundary with the public highway at an average gradient of 1/60 over approximately 5.4m, from an existing back of footpath level of +5.170 to a proposed downslope level of +5.080 – refer to spot levels and falls indicated on the site drainage drawing contained in Appendix B.

2.0 PLANNING CONDITION 12

2.1 Development shall not commence until full details of the proposed surface water drainage scheme have been submitted to and approved in writhing to the Local Planning Authority. This should include winter groundwater monitoring results and soakage testing to BRE365, to support the infiltration drainage design.

2.2 The proposed drainage scheme is contained in Appendix B.

2.3 All surface water runoff from roofs and external areas will discharge to ground, with the exception of the bin store which will drain to the foul sewer.

2.4 The method of infiltration used is permeable paving, with sub-base storage sized to accommodate runoff from roofs and areas of impermeable surfacing, in addition to incident rainwater falling on the permeable paving itself.

2.5 Drainage from the roofs and impermeable areas are connected to the sub-base via distribution blocks. For details refer to Appendix C.

2.6 The permeable sub-base is composed of stones having 30% voids between them, and is sized for the 1 in 100 year + 40% event. The total volume required is 30.8m.cu - refer to Micro Drainage Results in Appendix D. The designed volume exceeds this at 37.1m.cu – refer to Site Drainage Plan in Appendix B - as the bottom of the stone sub-base has to be set slightly lower than storage volumes require in order to connect with the downstream ends of the surface water drains issuing from around the site.

2.7 The infiltration rate has been measured at the site by undertaking soakage tests to BRE365 at 1m below ground level. The results of these tests are contained in Appendix E. A range of tests were carried out over 3No trial pits. The lowest recorded rate was 8.9×10^{-6} m/s, which has been used to inform the design.

2.8 To ensure the effectiveness of infiltration at the site, winter groundwater monitoring has been carried out, the results of which are contained in Appendix F.

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2.9 3No boreholes were sunk and visits made to inspect them on 4No separate occasions over a period of three months from February to April 2017 – refer to Appendix F. At all inspections the boreholes were found to be dry to their maximum depths of 4.0 – 4.97m.

- End of report -

Report by

John Roberts BSc (Hons)

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Appendix A

Topographical Survey

N

Indicative Direction

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Drawing Naming Convention:

Job No\Code\Dwg type\Location\Ref

Code:	10 = Existing		11 = Proposed	
Dwg Type:	B = Building		E = Elevation	
	S = Section		T = Topographical	
Location:	B = Basement		C = Ceiling Plan	
	E = External		F = Front	
	G = Ground		S = Side	
	1 = First		Re = Rear	
	R = Roof		D = Drainage	
	M = Mezzanine		AA = Section A-A	
Ref	Ref to individual dwg I.D. (e.g. Revision)			

Standard Abbreviations (where applicable):

Building Survey		Land Survey	
AB	AIR BRICK	B	BOLLARD
ACU	AIR CONDITIONING UNIT	BT	B.T. COVER
AH	ACCESS HATCH	CBF	CLOSED BOARD FENCE
AP	ACCESS PANEL	CL	COVER LEVEL
AV	AIR VALVE	EP	ELECTRIC POLE
BH	BEAM HT	FB	FLOWER BED
BR	BOILER	FW	FOUL WATER
CB	CUPBOARD	GV	GAS VALVE
CC	CEILING CHANGE	HYD	FIRE HYDRANT
CIH	CLEAR INTERNAL HT	IC	INSPECTION COVER
C-H	CILL TO HEAD HT	IL	INVERT LEVEL
DB	DOOR BASE HT	IRF	IRON RAILING FENCE
DH	DOOR HEAD HT	MH	MANHOLE
DR	DRAIN	P	POST
EXF	EXTRACTOR FAN	PI	PIPE
FA	FIRE ALARM	PR	PLOT RATIO
FL	FLOOD LIGHT	RNB	ROAD NAME BOARD
F-C	FLOOR TO CILL HT	RS	ROAD SIGN
F-H	FLOOR TO HEAD HT	SC	STOP COCK
F-SPR	FLOOR TO SPRING HT	SI	SIGN
F-AP	FLOOR TO APEX HT	ST	STOP TAP
GEA	GROSS EXTERNAL AREA	SV	STOP VALVE
GIA	GROSS INTERNAL AREA	SW	STORM WATER
GSA	GROSS SITE AREA	TP	TELEGRAPH POLE
GU	GULLY	UTL	UNABLE TO LIFT
HT	HEATER	UTT	UNABLE TO TRACE
HW	HOT WATER TANK	VP	VENT PIPE
MIH	MAX. INTERNAL HT	WM	WATER METER
NIA	NET INTERNAL AREA	WT	WATER TAP
RAD	RADIATOR		
RE	RECESS		
RFV	RAISED FLOOR VOID		
RS	ROLLER SHUTTER		
RWP	RAIN WATER PIPE		
SKY	SKYLIGHT		
SVP	SOIL VENT PIPE		
V	VENT		
WA	WARDROBE		

Symbols (where applicable):

MASONRY WALL

NON-MASONRY WALL

2.65 FLOOR TO SUSPENDED CEILING HT

2.65 FLOOR TO STRUCTURAL CEILING HT

⊗ 10.00 FLOOR LEVEL RELATIVE TO DATUM

Notes:

LEVELS ARE BASED UPON OSBM 1 CLUN ROAD VALUE 6.105M

Rev	Date	By	Description

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Land Surveys

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Client:

Mr Howard Cammell c/o Caldotec

Project:

Site at Linden Park
Littlehampton
West Sussex

Drawing Title:

Topographical Survey

Date:	Scale:	Surveyor:	Drawn:	Checked:
21 1 2016	1:100@A1	PEG	PEG	JIA

Job No:	Drawing No:	Sheet No:	Rev:
8840	8840_10_B_T	1 OF 1	

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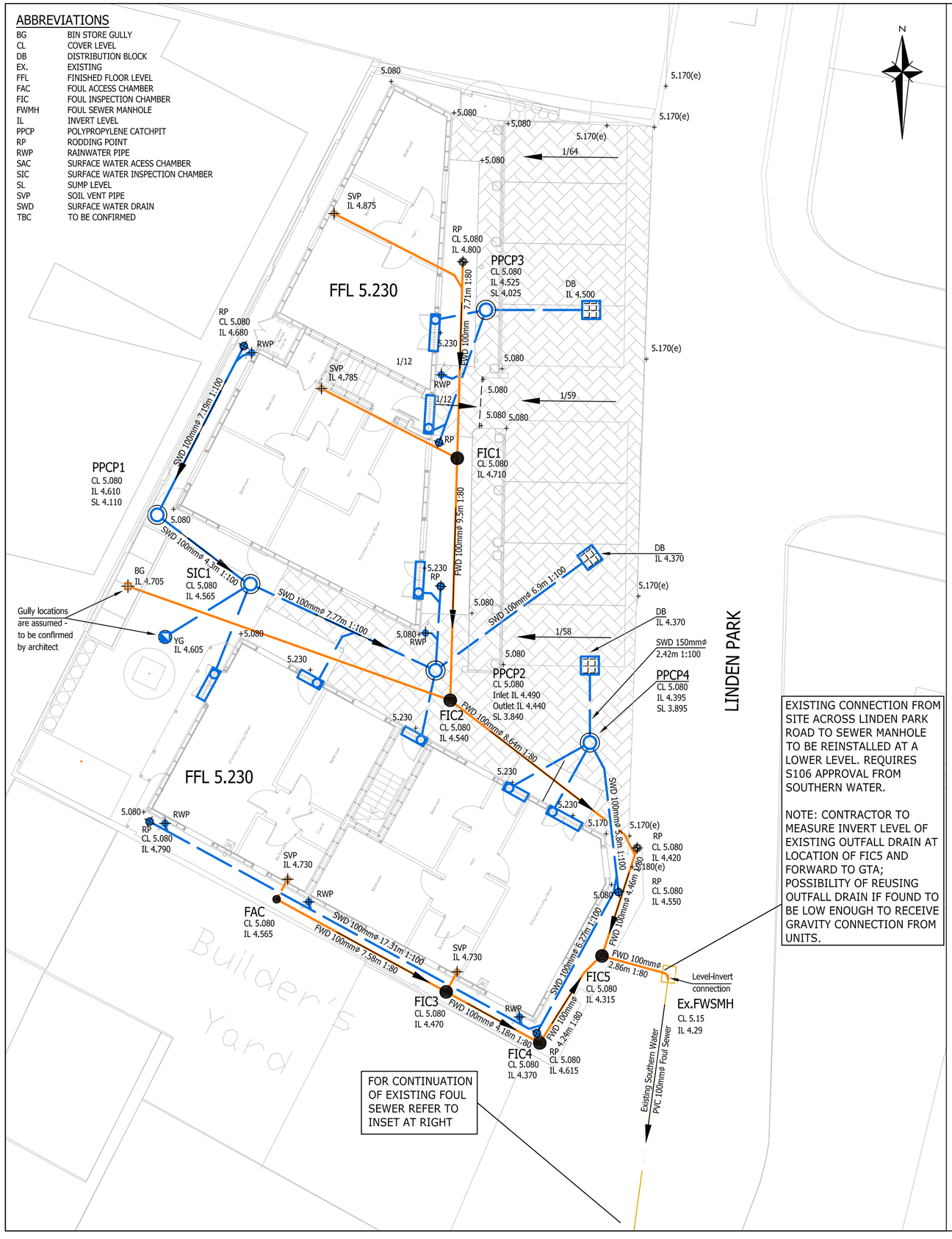
Appendix B

Site Drainage Plan

ABBREVIATIONS

BG	BIN STORE GULLY
CL	COVER LEVEL
DB	DISTRIBUTION BLOCK
EX.	EXISTING
FFL	FINISHED FLOOR LEVEL
FAC	FOUL ACCESS CHAMBER
FIC	FOUL INSPECTION CHAMBER
FWMH	FOUL SEWER MANHOLE
IL	INVERT LEVEL
PPCP	POLYPROPYLENE CATCHPIT
RP	RODDING POINT
RWP	RAINWATER PIPE
SAC	SURFACE WATER ACESS CHAMBER
SIC	SURFACE WATER INSPECTION CHAMBER
SL	SUMP LEVEL
SVP	SOIL VENT PIPE
SWD	SURFACE WATER DRAIN
TBC	TO BE CONFIRMED



EXISTING CONNECTION FROM SITE ACROSS LINDEN PARK ROAD TO SEWER MANHOLE TO BE REINSTALLED AT A LOWER LEVEL. REQUIRES S106 APPROVAL FROM SOUTHERN WATER.

NOTE: CONTRACTOR TO MEASURE INVERT LEVEL OF EXISTING OUTFALL DRAIN AT LOCATION OF FIC5 AND FORWARD TO GTA; POSSIBILITY OF REUSING OUTFALL DRAIN IF FOUND TO BE LOW ENOUGH TO RECEIVE GRAVITY CONNECTION FROM UNITS.

FOR CONTINUATION OF EXISTING FOUL SEWER REFER TO INSET AT RIGHT

KEY

- Proposed private foul drain
- Proposed foul sewer
- Existing foul sewer
- SVP — Foul drain point D307.0
- FAC — 300mm diameter foul Access Chamber - D202.18
- FIC — 450mm diameter foul Access Chamber - D202.6
- FWIC — Adoptable 450mm diameter foul Access Chamber - D202.6A
- BG — Trapped bin store gully - D209.1
- Ex.FWMH — Existing foul sewer manhole
- Proposed private surface water drain
- SIC — 450mm Surface Water Plastic Inspection Chamber - D202.6
- SAC — 300mm diameter Surface Water Access Chamber - D202.18
- PPCP — Surface water catchpit (plastic) - D210.2
- RP — External rodding point - D213.1
- RWP — SW drain point for RWP
- Drainage channel
- DB — Distribution block (refer to details sheet)
- YG — Yard gully trapped

GENERAL NOTES

1. The location, size, depth and identification of existing services that may be shown or referred to on this drawing have been assessed from non intrusive observations , record drawings or the like. The contractor shall safely carry out intrusive investigations, trial holes or soundings prior to commencing work to satisfy himself that it is safe to proceed and that the assessments are accurate. any discrepancies shall be notified to gta prior to works commencing.

2. Tender or billing drawings shall not be used for construction or the ordering of materials.

3. Do not scale. All dimensions and levels to be site confirmed.

4. This drawing shall be read in conjunction with all relevant architects, consultants drawings and specifications, together with H&S plan requirements

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6. All drawings specifications and recommendations made by gta are subject to Local Authority and other relevant Statutory Authorities approval. Any works or services made abortive due to the client proceeding prior to these approvals is considered wholly at the Clients risk. gta hold no responsibility for resulting abortive works or costs.

PERMEABLE PAVING

AREA 206m.sq
SUB-BASE DEPTH 600mm
SUB-BASE VOLUME 37.08m.cu (30% volds)
MIN COVER LEVEL 5.080
MIN TOP OF STONE 4.970
BOTTOM OF STONE 4.370
SIZED FOR THE 1 IN 100 YEAR + 40% EVENT
MEASURED INFILTRATION RATE 8.9 x 10^{-6} m/s

DESIGN NOTES

1. PERMEABLE PAVING SOAKAWAY SIZE BASED ON MEASURED INFILTRATION RATE (TO BRE365) OF 8.9 x 10^{-6} m/s.

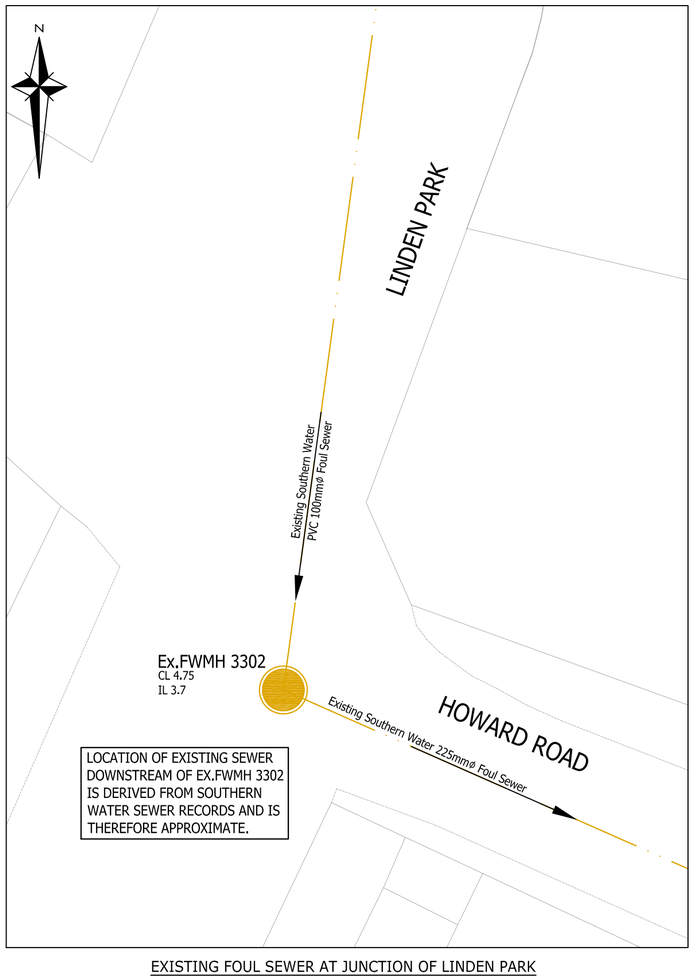
2. APPROVAL TO BE GAINED FROM SOUTHERN WATER FOR INDIRECT CONNECTION TO FOUL SEWER.

3. FINISHED FLOOR LEVELS SHOWN ARE PROVISIONAL - TO BE CONFIRMED BY ARCHITECT.

4. LOCATION OF BIN STORE AND YARD GULLIES SHOWN ARE PROVISIONAL - TO BE CONFIRMED BY ARCHITECT.

5. CONTRACTOR TO ESTABLISH LOCATIONS OF ALL EXISTING SERVICES PRIOR TO COMMENCING.

6. EXISTING TREES TO BE PROTECTED WHERE EXCAVATIONS RUN CLOSE.



LOCATION OF EXISTING SEWER DOWNSTREAM OF EX.FWMH 3302 IS DERIVED FROM SOUTHERN WATER SEWER RECORDS AND IS THEREFORE APPROXIMATE.

EXISTING FOUL SEWER AT JUNCTION OF LINDEN PARK WITH HOWARD ROAD

Rev	Amendments	Date	Dsn	Chk
B	SOME SPOT LEVELS AND FALLS ADDED.	19.09.17	JR	MR
A	REVISED TO LATEST SITE PLAN, CCTV DRAINAGE SURVEY RESULTS AND BRE365 SOAKAGE TESTING.	06.09.17	JR	MR
-	INITIAL ISSUE	21.07.16	JR	MR

Status: PRELIMINARY

Client: CAMMELLS PROPERTY VENTURES

Architect: CALDOTEC LTD

Project: LINDEN PARK, LITTLEHAMPTON BN17 7BJ

Title: SITE DRAINAGE

Date	Scale @ A2
JUNE 2016	1:125
Clients Ref.	Project Ref. 6391

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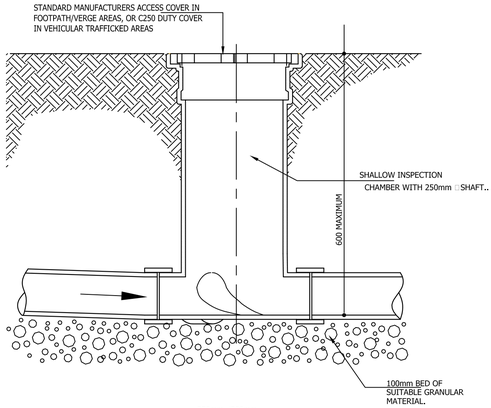
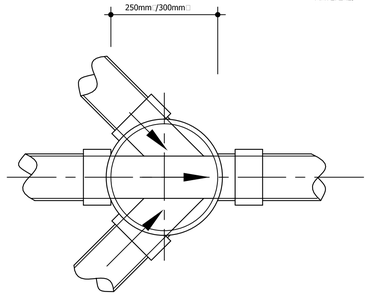
Drawing Number	Rev.
6391/100	B

ARUN DISTRICT COUNCIL LU/337/19/DOC

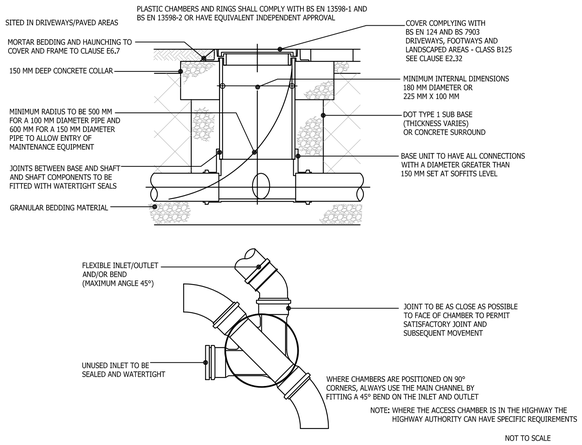
Appendix C

Site Drainage Details

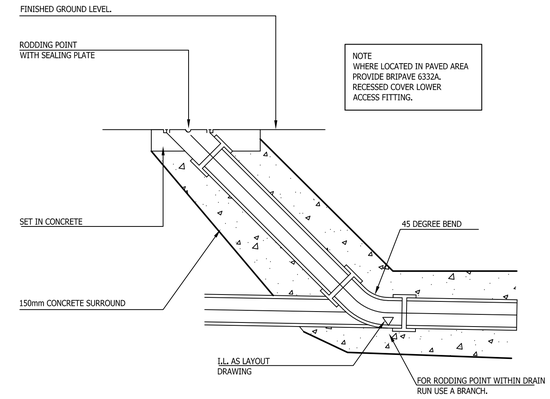




SHALLOW ACCESS INSPECTION CHAMBER - D202.18



ADOPTABLE INSPECTION CHAMBER DETAIL - TYPE 4 (FLEXIBLE MATERIAL DETAIL) - D202.6A



RODDING POINT SHALLOW DRAIN RUN - D213.1

GENERAL NOTES

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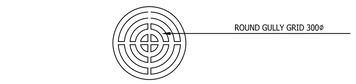
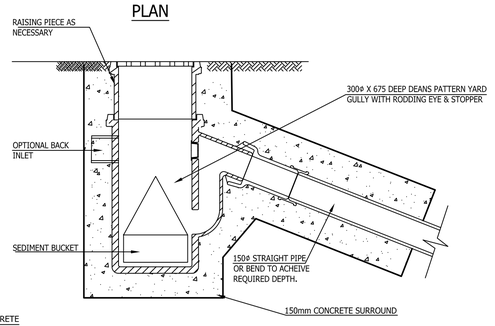
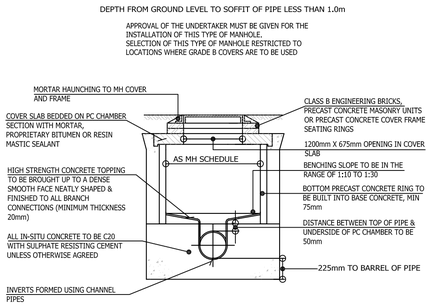


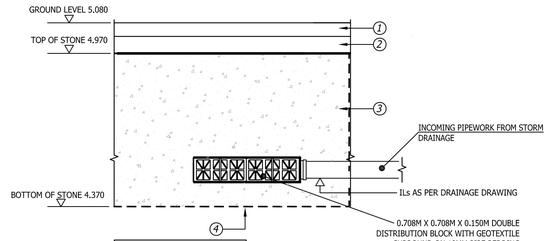
PLAN



BIN STORE GULLY - MEDIUM DUTY - D209.1



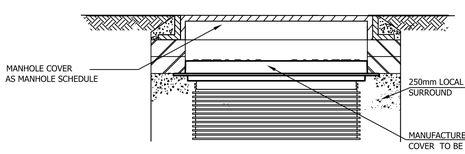
ADOTPABLE MANHOLE DETAIL DEPTH TO PIPE SOFFIT LESS THAN 1m - D202.3



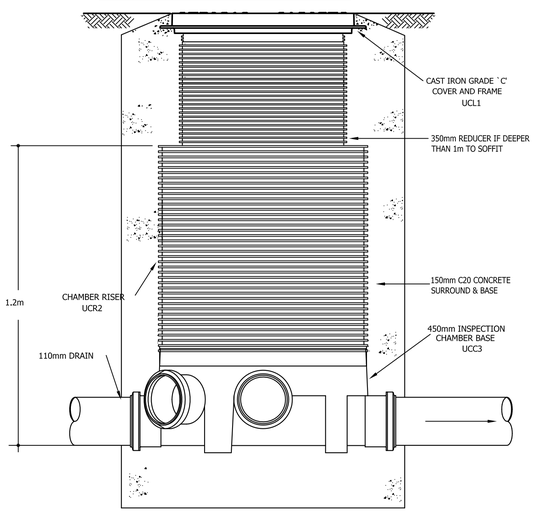
Permeable stone specifications as BS 7533 part 13

1. 60mm thick permeable paving blocks
2. 50mm thick compacted sand
3. Sub-base 10 - 63mm size open graded crushed rock with no fines (30% volds) (Surface water storage based on 1 in 100yr + 30%). Thicknesses as per drawing.
4. Permeable geotextile over compacted formation

DISTRIBUTION BLOCK WITHIN SUB-BASE STORAGE LAYER

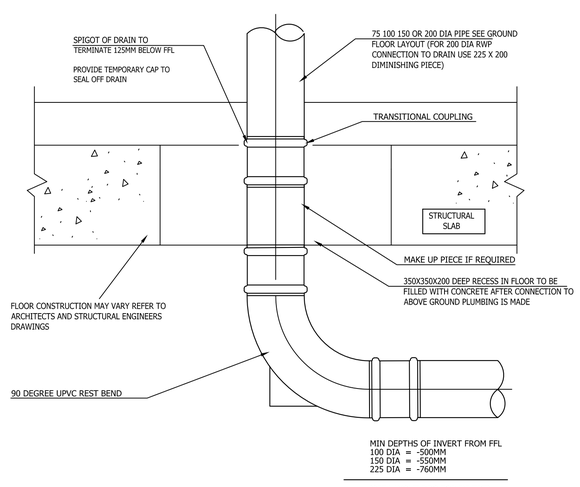


INSPECTION CHAMBER LOCATED CAR PARK AREAS.

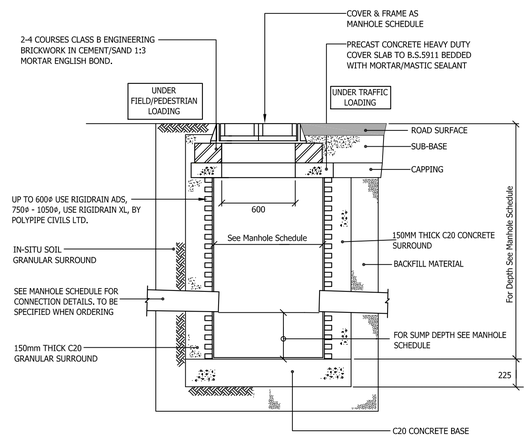


NOTE! ANY 450mm INSPECTION CHAMBER WITH A DEPTH EXCEEDING 1.2m THE INSPECTION CHAMBER MUST REDUCE TO 350mm dia AT THE 1.2m DEPTH TO THE COVER LEVEL. AS DETAIL ABOVE.

450mm INSPECTION CHAMBER - D202.6



DRAIN POINT TERMINATON - D307.0



NOTES

1. ROCKER PIPES 600mm LONG FOR 100 TO 450 DIA PIPEWORK (1000mm LONG UP TO 750 DIA) ON OUTLET AND EACH ENTRY STARTING 150mm FROM CONCRETE SURROUND.
2. FOR CHAMBERS DEEPER THAN 3000mm STEP IRONS TO BE REPLACED WITH GALVANISED LADDER TO B.S.4211 AND 729.

CATCHPIT CHAMBER POLYPROP CONSTRUCTION - D210.2

Rev	Amendments	Date	Dsn	Chk
-	INITIAL ISSUE	21.07.16	JR	MR

Status: PRELIMINARY

Client: CAMMELLS PROPERTY VENTURES

Architect: CALDOTECH LTD

Project: LINDEN PARK, LITTLEHAMPTON BN17 7BJ

Title: SITE DRAINAGE DETAILS

Date	Scale @ A1
JUNE 2016	
Clients Ref.	Project Ref. 6391

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Gloucester House, 66a Church Walk, Burgess Hill, West Sussex, RH15 9AS
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Drawing Number: 6391/101 | Rev.: -

ARUN DISTRICT COUNCIL LU/337/1/DOC

Appendix D

Micro Drainage Calculations

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

Half Drain Time : 286 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	4.582	0.212	0.9	13.0	O K
30 min Summer	4.655	0.285	0.9	17.5	O K
60 min Summer	4.726	0.356	0.9	21.8	O K
120 min Summer	4.782	0.412	0.9	25.3	O K
180 min Summer	4.799	0.429	0.9	26.3	O K
240 min Summer	4.799	0.429	0.9	26.4	O K
360 min Summer	4.791	0.421	0.9	25.8	O K
480 min Summer	4.779	0.409	0.9	25.1	O K
600 min Summer	4.765	0.395	0.9	24.2	O K
720 min Summer	4.750	0.380	0.9	23.3	O K
960 min Summer	4.721	0.351	0.9	21.5	O K
1440 min Summer	4.662	0.292	0.9	17.9	O K
2160 min Summer	4.584	0.214	0.9	13.1	O K
2880 min Summer	4.520	0.150	0.9	9.2	O K
4320 min Summer	4.441	0.071	0.9	4.4	O K
5760 min Summer	4.417	0.047	0.9	2.9	O K
7200 min Summer	4.410	0.040	0.7	2.4	O K
8640 min Summer	4.404	0.034	0.6	2.1	O K
10080 min Summer	4.400	0.030	0.6	1.9	O K
15 min Winter	4.611	0.241	0.9	14.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	124.633	0.0	18
30 min Summer	83.789	0.0	33
60 min Summer	53.779	0.0	62
120 min Summer	33.337	0.0	122
180 min Summer	24.832	0.0	180
240 min Summer	20.006	0.0	228
360 min Summer	14.706	0.0	286
480 min Summer	11.818	0.0	348
600 min Summer	9.966	0.0	416
720 min Summer	8.665	0.0	484
960 min Summer	6.943	0.0	618
1440 min Summer	5.071	0.0	882
2160 min Summer	3.696	0.0	1260
2880 min Summer	2.949	0.0	1616
4320 min Summer	2.142	0.0	2288
5760 min Summer	1.705	0.0	2936
7200 min Summer	1.427	0.0	3672
8640 min Summer	1.235	0.0	4400
10080 min Summer	1.093	0.0	5136
15 min Winter	124.633	0.0	18

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	4.693	0.323	0.9	19.8	O K
60 min Winter	4.775	0.405	0.9	24.8	O K
120 min Winter	4.843	0.473	0.9	29.0	O K
180 min Winter	4.867	0.497	0.9	30.5	O K
240 min Winter	4.872	0.502	0.9	30.8	O K
360 min Winter	4.861	0.491	0.9	30.1	O K
480 min Winter	4.844	0.474	0.9	29.1	O K
600 min Winter	4.825	0.455	0.9	27.9	O K
720 min Winter	4.803	0.433	0.9	26.6	O K
960 min Winter	4.757	0.387	0.9	23.8	O K
1440 min Winter	4.666	0.296	0.9	18.2	O K
2160 min Winter	4.548	0.178	0.9	10.9	O K
2880 min Winter	4.461	0.091	0.9	5.6	O K
4320 min Winter	4.413	0.043	0.8	2.6	O K
5760 min Winter	4.404	0.034	0.6	2.1	O K
7200 min Winter	4.399	0.029	0.5	1.8	O K
8640 min Winter	4.395	0.025	0.5	1.5	O K
10080 min Winter	4.392	0.022	0.4	1.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	83.789	0.0	33
60 min Winter	53.779	0.0	62
120 min Winter	33.337	0.0	120
180 min Winter	24.832	0.0	176
240 min Winter	20.006	0.0	232
360 min Winter	14.706	0.0	332
480 min Winter	11.818	0.0	376
600 min Winter	9.966	0.0	452
720 min Winter	8.665	0.0	528
960 min Winter	6.943	0.0	676
1440 min Winter	5.071	0.0	954
2160 min Winter	3.696	0.0	1324
2880 min Winter	2.949	0.0	1644
4320 min Winter	2.142	0.0	2204
5760 min Winter	1.705	0.0	2944
7200 min Winter	1.427	0.0	3672
8640 min Winter	1.235	0.0	4408
10080 min Winter	1.093	0.0	5120

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.350	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.063

Time (mins) From:	To:	Area (ha)
0	4	0.063

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Model Details

Storage is Online Cover Level (m) 5.080

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.03200	Width (m)	6.6
Membrane Percolation (mm/hr)	1000	Length (m)	31.0
Max Percolation (l/s)	56.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	4.370	Cap Volume Depth (m)	0.000

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Appendix E

BRE365 Soakage Test Results

ASHDOWN SITE INVESTIGATION
L•I•M•I•T•E•D

GEOTECHNICAL
AND
ENVIRONMENTAL
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242 6786

Date: 26th May 2017 **Our Ref**: R17-12138

Howard Cammell
Cammells Property Ventures Ltd
1 Riverside Wharf
River Road
Littlehampton
BN17 5BZ

Dear Howard,

Linden Park, Littlehampton, West Sussex
In Situ Infiltration Test Results

Outlined below are the findings from the recent in situ infiltration testing undertaken at the above site.

The objectives of the works were to:
a) investigate the shallow ground and groundwater conditions at the test locations; and
b) provide calculated soil infiltration rates to assist others in undertaking design of soakaways.

The scope of the commission and the terms and conditions under which the work was undertaken are set out within the offer letter Q16-5506/rev2, dated 20th April 2017. The instruction to proceed was received from the client an email dated 21st April 2017.

The analysis and discussions contained in this report are based on the ground and groundwater conditions encountered during the site work and in situ testing procedures. The possibility of a variation in ground and groundwater conditions away from the points investigated should not be overlooked. Groundwater conditions can vary both seasonally and due to other effects.

It is noted that the groundworks were undertaken and the report was prepared specifically for the Client's project and the recommendations given may not be appropriate to alternative schemes. The copyright for the report and licence for use shall remain vested in Ashdown Site Investigation Ltd (the Company) who disclaim all responsibility or liability (whether at common law or under the express or implied terms of the Contract between the Company and the Client) for any loss or damage of whatever nature in the event that this report is relied on by a third party, or is issued in circumstances or for projects for which it was not originally commissioned, or where the exploratory records and test results contained therein are interpreted by anyone other than the Company.

Site Works

The site work was carried out on the 17th May 2017. Three hand dug pits (denoted TP01 to TP03) were excavated to depths of between 0.95m and 1.20m below ground level to enable in situ soakage testing to be carried out. A site plan showing the locations of the trial pits is presented as Figure 1.

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Ground Conditions

The exploratory hole logs and in situ test results are attached to this report. Notes to assist in the interpretation of the records are also attached.

Stratigraphy

Each of the trial pits was excavated through a surface cover of concrete some 100mm to 220mm in thickness. It is noted that along the eastern end of trial pit TP02 concrete was recorded to extend to a depth of 0.6m below ground level.

Made ground, generally comprising sandy clayey gravel and/or gravelly clay was recorded to depths of between 0.55m and 0.60m below ground level. The gravel fraction comprised variable quantities of flint, brick, concrete, mortar and charcoal-like material.

Underlying the made ground, the investigation progressed into undisturbed gravelly clay deposits with subordinate horizons of sand. These soils continued to the full depth of investigation.

Whilst the published geological mapping data indicates the site to be underlain by the Raised Beach Deposits, Raised Marine Deposits and River Terrace Deposits are also shown in close proximity to the site. It is noted that the Raised Beach Deposits generally comprise gravel and sand and therefore the soils encountered are likely to be representative of a mixture of each of the nearby strata.

Groundwater and Stability

Each of the exploratory holes was recorded as being dry and stable on completion of excavation.

Stormwater Infiltration Systems

In situ soakage testing was carried out in general accordance with the requirements of BRE 365 'Soakaway Design'. From the results of the soakage tests, calculations were made to determine the infiltration rate that could be expected for soakaways constructed into the underlying soils.

For the majority of tests the soil infiltration rate (f) was calculated by dividing the volume of water lost between 75% and 25% of the initial test depth by the sum of the average surface area of the sides of the trial pit in contact with the water during the test monitoring period (time taken for the water level to fall between 75% and 25% of the initial test depth), and its base area. This figure was then divided by the test duration to give the soil infiltration rate in metres per second.

During the second test performed within trial pit TP01, the water level did not fall below 25% of the initial test depth and therefore for this test the soil infiltration rate has been calculated by dividing the volume of water lost during the test by the product of the average surface area of the trial

pit in contact with water during the test period and the test duration in seconds.

The infiltration rates derived from the tests are summarised in the following table.

Exploratory Hole	Test Response Zone Depth (m)		Infiltration Rate (m/sec)
	Top	Bottom	
TP01 Test 1	0.62	0.95	1.2×10^{-5}
TP01 Test 2	0.62	0.95	8.9×10^{-6}
TP02 Test 1	0.84	1.20	1.1×10^{-5}
TP03 Test 1	0.70	0.95	7.6×10^{-5}
TP03 Test 2	0.72	0.95	1.1×10^{-3}
TP03 Test 3	0.69	0.95	5.7×10^{-5}
TP03 Test 4	0.69	0.95	2.4×10^{-5}

The value 'f' is equivalent to the soil infiltration coefficient 'q' quoted in the Construction Industry Research and Information Association (CIRIA) Report 156.

The results from the infiltration tests indicate that the near surface natural soils are likely to be capable of disposing of storm runoff to the ground using infiltration systems.

It is understood that the monitoring of groundwater levels at the site is being undertaken by others. The depth to groundwater may have an impact on the available storage capacity of soakaways.

To minimise the risk of subsidence, point discharging infiltration systems (conventional ring or trench soakaways) should be constructed a minimum of 5.0m away from proposed or existing buildings.

In the event that discharge to ground via infiltration systems is proposed, it is recommended that designers of the system provide for the prevention of pollution of groundwater. In this regard appropriate consideration should be given to whether there is a need for inclusion of interceptors and oil separators. The Local Authority and/or relevant water company should be consulted in relation to consent for discharge of water from rooftops, areas of hardstanding and roadways to drains.

If you have any questions regarding the above, please do not hesitate to contact us.

Yours sincerely

Lucy Griffiths
for Ashdown Site Investigation Limited
encl.
Figure 1 – Site Plan
Exploratory Hole Records
Soakage Results

ASHDOWN SITE INVESTIGATION LIMITED	Site: Linden Park, Littlehampton, West Sussex	Trial Pit Location Plan Not To Scale	Figure 1 R17-12138

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U 'Undisturbed' Sample: - also known as 'U100' or 'U4' - 100mm diameter by 450mm long. The number of blows to drive in the sampling tube is shown after the test index letter in the SPT column.
Uo Sample not obtained.
U* Full penetration of sample not obtained.
Pi Piston Sample: 'Undisturbed' sample 100mm diameter by 600mm long.
D Disturbed Sample.
R Root Sample.
B Bulk Disturbed Sample.
W Water Sample.
J Jar Sample (sample taken in amber glass jar fitted with gas tight lid)
T Tub Sample
Vi Vial Sample

In situ Testing

S Standard penetration test (SPT): In the borehole record the depth of the test is that at the start of the normal 450mm penetration. The number of blows per 75mm penetration is recorded, with the initial 150mm for seating blows being recorded followed by the blows recorded for the remaining 300mm of the test. The total blows to achieve the standard penetration of 300mm, discounting the seating blows, is noted as the N value on the log. Where the full penetration of the test cannot be achieved (a refusal) the number of blows achieved and the penetration achieved will be reported.

C Standard Penetration Test (SPT) conducted usually in coarse grained soils or weak rocks using the same procedure as for the SPT but with a 50mm diameter, 60º apex solid cone fitted in place of the sampler. Variations in test results are indicated by the same symbols as for the SPT (above).

V Shear Vane Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

H Hand penetrometer Test: Undrained shear strength (cohesion) (kN/m^2) shown within the Vane/Pen Test and N Value column.

P Perth Penetrometer Test: See "In Situ Testing Notes" for full description. Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column. In sand the number of blows is approximately equivalent to the SPT "N" value.

Excavation Method

CP Cable Percussion Borehole
WLS Dynamic Sampler Borehole using windowless sampler tubes
WS Dynamic Sampler Borehole using window sampler tubes
TP Trial Pit excavated using mechanic excavator
HDP Trial Pit excavated using hand tools

2 Soil Description

Description and classification of soils has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of soil, Part 1 Identification and description (BS EN ISO 14688-1:2002+A1:2013) and Part 2 Principles of classification (BS EN 14688-2:2004+A1:2013) as well as the BS5930:2015 code of Practice for Ground Investigations.

Fine Grained Soils

The consistency of fine grained soils given in the report is based on visual inspection of the samples and the strength is based on results of in situ and/or laboratory undrained shear strength tests when carried out.

The consistency is determined on the following basis:

Consistency	**Manual Test**
Very Soft	Soil exudes between fingers when squeezed in hand
Soft	Soils can be moulded by light finger pressure
Firm	Cannot be moulded by finger but rolled to 3mm threads without breaking/crumbling
Stiff	Crumbles/breaks when rolled to 3mm thick threads but can be moulded into a lump again
Very Stiff	Cannot be moulded and crumbles under pressure, can be indented by thumbnail

The terms used for the designation of the undrained shear strength are as follows:

Undrained Shear Strength	
Extremely to Very Low	<20 kPa
Low	20-40 kPa
Medium	40-75 kPa
High	75-150 kPa
Very High	150-300 kPa
Extremely high	300-600 kPa

Note: The undrained shear strength of the soils is measured either by laboratory testing or in the field using hand shear vane.

It is recognised that any coarse grained soil that has in excess of approximately 35% fine grained soil (clay and silt) can often be expected to behave as a fine grained soil despite the dominance of coarse grained material within the soil mass. To reflect this, it is the soil type that dominates the behaviour of the soil mass that appears on the exploratory hole records.

Coarse Grained Soils

The relative densities of coarse grained soils (sand and gravel) given in the report are based on field estimations and the results of the Standard Penetration Test (SPT) and equivalent correlation from other testing. The classification in terms of "N" Values is as follows:

SPT 'N' Value	**Relative Density**
0-4	Very Loose
4-10	Loose
10-30	Medium Dense
30-50	Dense
Greater than 50	Very Dense

3 Rock Description

Description and classification of rocks has been carried out using as a general basis the British Standard Geotechnical investigation and testing – Identification and classification of rock, Part 1 Identification and classification (BS EN ISO 14689-1:2003) as well as the BS5930:2015 code of Practice for Ground Investigations.

The description of rock mass includes the type of rock, structure, discontinuities and weathering.

The unconfined compressive strength of rock material is determined on the following basis:

Term	**Field Identification**	**Unconfined Compressive Strength (MPa)**
Extremely Weak	Indented by thumbnail	Less than 1
Very Weak	Crumbles under firm blows with point of geological hammer, peeled by pocket knife	1 to 5
Weak	Peeled by pocket knife with difficulty, shallow indentations made by firm blow with geological hammer	5 to 25
Medium Strong	Cannot be peeled or scraped with knife, can be fractured with single firm blow of geological hammer	25 to 50
Strong	Requires more than one blow of geological hammer to fracture	50 to 100
Very Strong	Requires may blows of geological hammer to fracture it	100 to 250
Extremely Strong	Can only be chipped with geological hammer	Greater and 250

The terms describing discontinuity and bedding spacing are as follows:

Bedding Thickness	
Very Thick	>2000mm
Thick	2000-600mm
Medium	600-200mm
Thin	200-60mm
Very Thin	60-20mm
Thickly Laminated	20-6mm
Thinly Laminated	<6mm

Discontinuity Spacing	
Very Wide	>2000mm
Wide	2000-600mm
Medium	600-200mm
Close	200-60mm
Very Close	60-20mm
Extremely Close	<20mm

Chalk

Chalk description is based on BS EN ISO 14688, BS EN ISO 14689 and BS5930. The classification of chalk generally follows the guidance offered by the Construction Industry Research and Information Association (CIRIA) C574, 'Engineering in Chalk'. This is based on assessment of chalk density, discontinuity and aperture spacing, and the proportion of intact chalk to silt of chalk. See additional chalk classification notes.

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Tel: 01273 483119

Site Name: Linden Park, Littlehampton, West Sussex

Job Number: R17-12138

Start Date: 17/05/2017

End Date: 17/05/2017

Trial Pit Number: **TP01**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Concrete
D	0.30				0.22	MADE GROUND: Dark grey black clayey sandy angular to rounded, fine to coarse, gravel of flint, brick, and rare mortar. Sand is fine to coarse.
D	0.50				0.55	Brown slightly gravelly silty sandy CLAY. Gravel is angular to subrounded fine to coarse flint. Sand is fine to coarse. (Raised Beach Deposits/Raised Marine Deposits/ River Terrace Deposits).
D	0.80				0.95	End of trial pit at 0.95m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion

Notes: n/a

Excavation Method: HDP

Pit Length: 0.35m

Pit Width: 0.35m

Made By: PC

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Site Name: Linden Park, Littlehampton, West Sussex

Job Number: R17-12138

Start Date: 17/05/2017

End Date: 17/05/2017

Trial Pit Number: **TP02**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Concrete
					0.10	Concrete continues to 0.60m on east side of pit.
D	0.30					MADE GROUND: Dark grey black sandy clayey angular to sub rounded, fine to coarse gravel of flint, brick, concrete, and rare mortar. Sand is fine to coarse.
					0.60	Dark grey brown gravelly silty sandy CLAY. Gravel is fine to medium, angular to subrounded flint. Sand is fine to coarse. (Raised Marine Deposits).
D	0.90					
D	1.10				1.00	Orange brown fine to coarse SAND. (Raised Marine Deposits).
					1.20	End of trial pit at 1.20m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion

Notes: n/a

Excavation Method: HDP

Pit Length: 0.45m

Pit Width: 0.40m

Made By: PC

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Tel: 01273 483119

Site Name: Linden Park, Littlehampton, West Sussex

Job Number: R17-12138

Start Date: 17/05/2017

End Date: 17/05/2017

Trial Pit Number: **TP03**

Samples and In Situ Testing				Legend	Depth/ Reduced Level	Stratum Description
Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result			
					0.00	Concrete with steel reinforcement
					0.18	MADE GROUND: Sandy gravel of crushed concrete with a membrane encountered at 0.20m
D	0.30				0.40	MADE GROUND: Dark brown sandy gravelly clay. Gravel is subangular to subrounded fine to coarse brick, flint, and rare charcoal-like material. Sand is fine to coarse.
D	0.50					
D	0.65				0.60	Brown sandy slightly gravelly CLAY. Gravel is fine to medium, subrounded to subangular flint. Sand is fine to medium. (River Marine Deposits).
D	0.90				0.70	Orange brown slightly gravelly fine to coarse SAND. Gravel is fine to medium angular to rounded, flint. (River Marine Deposits).
					0.95	End of trial pit at 0.95m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: 0.35m

Pit Width: 0.30m

Made By: PC

ASHDOWN SITE INVESTIGATION LIMITED

Site: Linden Park, Littlehampton, West Sussex	Report No.: R17-12138 Sheet No.: 1 of 4

SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP01 (Test 1)	
Time (mins)	Depth to water (m bgl)
0	0.62
1	0.63
2	0.63
4	0.64
8	0.68
16	0.74
30	0.79
60	0.83
90	0.87
97	Dry
Pit Length - 0.35m Pit Width - 0.35m Pit Depth - 0.95m bgl	

TP01 (Test 2)	
Time (mins)	Depth to water (m bgl)
0	0.62
1	0.62
2	0.63
4	0.64
6	0.64
8	0.65
10	0.65
12	0.66
15	0.66
30	0.70
60	0.75
90	0.80
Pit Length - 0.35m Pit Width - 0.35m Pit Depth - 0.95m bgl	

Remarks: bgl - below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Linden Park, Littlehampton, West Sussex	Report No.: R17-12138 Sheet No.: 2 of 4

SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP02	
Time (mins)	Depth to water (m bgl)
0	0.84
1	0.86
2	0.87
4	0.89
8	0.91
10	0.92
12	0.93
15	0.94
30	0.98
60	1.02
90	1.07
120	1.12
150	1.14
180	Dry
Pit Length - 0.45m Pit Width - 0.40m Pit Depth – 1.20m bgl	

Remarks: bgl - below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Linden Park, Littlehampton, West Sussex	Report No.: R17-12138 Sheet No.: 3 of 4

SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP03 (Test 1)	
Time (mins)	Depth to water (m bgl)
0	0.70
1	0.79
2	0.81
4	0.83
6	0.84
8	0.86
10	0.88
12	0.89
15	0.91
22	Dry
Pit Length - 0.35m Pit Width - 0.30m Pit Depth - 0.95m bgl	

TP03 (Test 2)	
Time (mins)	Depth to water (m bgl)
0	0.72
1	0.89
2	Dry
Pit Length - 0.35m Pit Width - 0.30m Pit Depth - 0.95m bgl	

Remarks: bgl - below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Linden Park, Littlehampton, West Sussex	Report No.: R17-12138 Sheet No.: 4 of 4

SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP03 (Test 3)	
Time (mins)	Depth to water (m bgl)
0	0.69
1	0.75
2	0.78
4	0.81
6	0.82
8	0.83
10	0.86
12	0.87
15	0.88
24	Dry
Pit Length - 0.35m Pit Width - 0.30m Pit Depth - 0.95m bgl	

TP03 (Test 4)	
Time (mins)	Depth to water (m bgl)
0	0.69
1	0.73
2	0.76
4	0.79
6	0.80
8	0.81
10	0.81
12	0.82
15	0.83
30	0.87
60	0.94
90	Dry
Pit Length - 0.35m Pit Width - 0.30m Pit Depth - 0.95m bgl	

Remarks: bgl - below ground level.

Appendix F

Winter Groundwater Monitoring Results

Flow was monitored for a period of two minutes where possible; maximum flow was recorded. Ground gases, including concentrations of methane, carbon dioxide, hydrogen sulphide and carbon monoxide were monitored for up to five minutes. During monitoring, ground gas readings were logged every thirty seconds.

5.2.2 Groundwater

A groundwater sample was recovered, where possible, from each of the installations.

Groundwater monitoring was completed in accordance with BS6068:2009 Water Quality Sampling: Guidance on Sampling of Groundwater.

A two phase dip meter was used to determine the presence of LNAPL (Light Non Aqueous Phase Liquids) and DNAPL (Dense Non Aqueous Phase Liquids). Each well was purged before a sample was taken and retained in a 1 litre coloured glass bottle (Winchester).

6.0 Geology & Ground Conditions

The following ground conditions were encountered during the SI;

Concrete – Encountered in all exploratory holes to a maximum depth of ~0.20mbgl.

Made Ground – Encountered in all exploratory holes to maximum depth of 0.50mbgl and generally comprised a dark brown medium SAND with occasional flints and pebble sized brick fragments.

Raised Beach Deposits (Sand and Gravel) – These deposits were identified within all exploratory holes undertaken to the maximum drilled depth of 5.00mbgl. This stratum generally comprised of a medium dense light brown sandy fine to course flint GRAVEL. Gravels are fine to medium subangular to subrounded of flint. This is considered to be representative of the River Beach Deposits.

It should be further noted that at the greater depths, chalk was encountered, that would coincide with the bedrock geology being recorded as Lewes Nodular Chalk, Seaford Chalk Formation and the Newhaven Chalk Formation.

7.0 Groundwater Conditions

Groundwater was not encountered in any of the windowless sampler boreholes during investigative works undertaken and subsequent rounds of monitoring.

Exploratory Hole	MON1 Standing Level (mbgl)	MON2 Standing Level (mbgl)	MON3 Standing Level (mbgl)
WS1	Dry	Dry	Dry
WS2	Dry	Dry	Dry
WS4	Dry	Dry	Dry

Table 2: Groundwater levels recorded in installed position

ARUN DISTRICT COUNCIL LU/337/19/DOC

Your Environment

Dip Meter Results

Visit Number	Date	Depth of Borehole (m)			Water Level (m)		
		WS1	WS4	WS5	WS1	WS4	WS5
1	14/02/2017	4.48	4.00	4.97	Dry	Dry	Dry
2	22/02/2017	4.48	4.00	4.97	Dry	Dry	Dry
3	27/02/2017	4.48	4.00	4.97	Dry	Dry	Dry
4	21/04/2017	4.48	4.00	4.97	Dry	Dry	4.52