Consulting Civil Engineers

Foul and Surface Water Drainage Report

Gardner Road, Southwick

For

WOODHART GROUP

Rev – **P2**

Reference **C2481**

Date **January 2023**

Revision	Date of Issue	Comments	Prepared By	Checked By
P1	04.01.2022	Initial Issue	SFC	CS
P2	27.01.2023	Drainage layout revised	SFC	CS
P3	11.03.2023	Drainage layout revised	SFC	CS

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1 Introduction

1.1.1 CGS Civils Ltd have been appointed by Woodhart Group to undertake a drainage strategy report for a proposed development at Gardner Road, Southwick.

1.1.2 The purpose of this drainage report is to demonstrate how the development area can be satisfactorily drained without increasing flood risk onsite and elsewhere and to satisfy the requirements of planning conditions 9 and 11 which relate to surface water drainage and foul drainage respectively.

1.1.3 The existing site consists of garages and associated hardstanding. The proposed development will consist of 2 residential properties and associated parking.

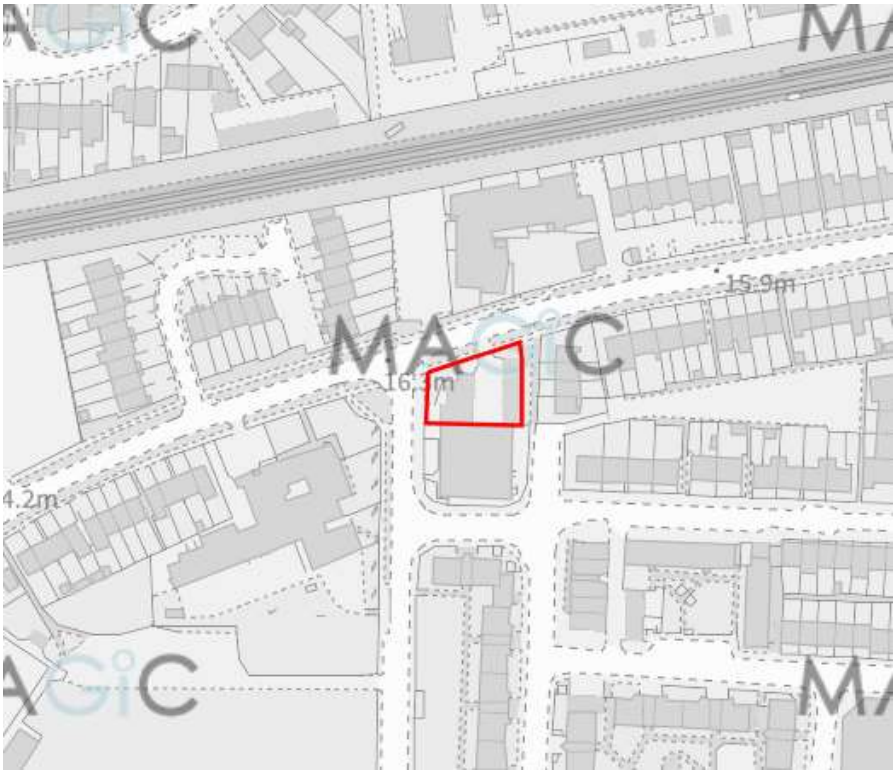
1.1.4 The proposed development is located as OS Grid Reference TQ 25337 05269 and has the post code BN41 1AR

1.1.5 The total red line boundary is approximately 0.072 Ha and the proposed development will result in a total of 0.024 Ha of hardstanding, 0.013 Ha of which being roof areas with the remaining 0.013 Ha being permeable-paved parking area.

1.1.6 The proposed site will make use of a modified existing access onto Gardner Road.

1.1.7 The proposed site plan can be found in **Appendix A.**

Fig 1. Site Location



2 Site Geology

2.1 Site Investigation

2.1.1 A series of infiltration tests were carried out by Ashdown Site Investigation Ltd and published in their report of the 16th of April 2021 (**Appendix C** of this report). These tests were carried out in order to inform the drainage strategy prepared by HOP Consulting ltd in their Sustainable Drainage Assessment of August 2021.

2.1.2 Investigations confirmed that the site is underlain by made ground to 700-800mm depth and sandy clay of the River Terrace Deposits between 1.3m and 2m depth

2.1.3 6 Infiltration tests were carried out, with the results ranging from 9.5 x 10-6EXP m/sec to 4.6 x 10-5EXP m/sec and is therefore deemed to be of moderate infiltration potential.

2.1.4 Groundwater Monitoring was carried out by Ashdown between March and May of 2021. No groundwater was detected within the 4.3m deep boreholes. The results of this investigation are shown in **Appendix D** of this report.

3 Proposed Drainage Strategy

3.1 SuDS Hierarchy

3.1.1 All options for the destination of run-off generated on site have been assessed in line with the SuDS hierarchy as set out in Building Regulations Part H document and DEFRA's Draft National Standards for SuDS.

Discharge Destination	
Discharge to Ground	Yes
Discharge to Watercourse	No
Discharge to Surface Water Sewer	No
Discharge to Other Sewer	No

3.2 Surface Water Drainage

3.2.1 Based upon the results of the Ashdown infiltration testing and groundwater monitoring it is proposed that the site discharge all surface water to ground through infiltration.

3.2.2 All roof areas are to be collected into a positive drainage network and discharged into a cellular soakaway in each of the rear gardens.

3.2.3 The parking area will discharge surface water to ground through permeable paving and porous, clean stone sub-base.

3.2.4 The soakaways and porous sub-base volumes have been designed to cater for the critical 1 in 100-year storm +45% without flooding.

3.2.5 Additional excavation and backfill with clean stone may be required to ensure that the porous sub-base can discharge directly into the river terrace deposits beneath the made ground.

3.2.6 Hydraulic calculations have been carried out and can be found at **Appendix E** of this report.

3.2.7 The suitability of the proposed methods as they relate to water quality were discussed and proven in HOP's Sustainable Drainage Report of August 2021.

3.3 Foul water drainage

3.3.1 The foul drainage will be connected to the existing public foul sewer located in West Road, adjacent to the proposed development.

3.3.2 Subject to Section 106 approval, it is proposed that the 2 new properties share a lateral connection which will connect to the existing sewer through a new junction.

3.3.3 Interpolating between the record levels, there is more than enough fall available for this connection though this must be confirmed on site prior to the connection being finalised.

4.1 Maintenance

4.1.1 During construction, the Contractor will be responsible for maintaining the drainage and SuDS (Sustainable Drainage Systems). Upon handover, the developer will appoint a maintenance firm to take on the responsibility of these duties as laid out in this report.

4.1.2 The maintenance schedule for the proposed development will be split down into two separate categories; SuDS features and regular private drainage.

4.2 SuDS at Gardner Road, Southwick

4.2.1 As listed above, in section 5.1.2, the SuDS features used on site will be a cellular soakaway and permeable paving

4.2.2 The SuDS features have been designed for easy maintenance and comprise:

- Regular Day-to-Day care – litter collection, regular gardening to control vegetation growth and checking inlets where water enters the SuDS features
- Occasional tasks – checking the SuDS features and removing any silt that builds up in the SuDS feature
- Remedial work – repairing damage where necessary

4.3 SuDS Drainage Maintenance Specification

4.3.1 **Soakaway**

In order to maintain the functioning of the attenuation tanks, the following maintenance requirements should be adhered to:

Table 21.3 Operation and maintenance requirements for attenuation storage tanks

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae, or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from per-treatment structures and/or internal forebays	Annually, or as required
Remedial Actions	Repair/rehabilitate 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
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

4.3.2 Permeable Paving

In order to maintain the functioning of the permeable paving, the following maintenance requirements should be adhered to:

Table 21.3 Operation and maintenance requirements for permeable paving

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation rate and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

4.4 General Drainage Maintenance Specification

4.4.1 Inlet Structures and Inspection Chambers

- Inlet structures such as rainwater downpipes, road gullies and channel drains should be free from obstruction at all times to all free flow through the SuDS
- Inspection Chambers and Rodding Eyes are used on bends or where pipes come together. They allow access and cleaning to the system if necessary.

Inlet Structures and Inspection Chambers	
Regular Maintenance	**Frequency**
Inlet Structures Inspect rainwater downpipes, channel drains and road gullies, removing obstructions and silt as necessary. Check that there is no physical damage. Strim vegetation 1m min surround to structures and keep area free from silt and debris	Monthly
Inspections Chambers and below ground control chambers. Remove cover and inspect, ensuring that the water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt. Undertake inspection after leaf fall in Autumn	Annually
Occasional Maintenance Check topsoil levels are 20mm above edges of chambers to avoid mower damage.	As necessary
Remedial Work Repair physical damage if necessary	As required

4.4.2 Below ground drainage pipes

- Below ground drainage pipes convey water to the SuDS system. They should always be free from obstruction to allow free flow.

Below Ground Drainage Pipes	
Regular Maintenance	**Frequency**
Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months then annually
Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
Remove sediment from pre-treatment inlet structures and inspection chambers.	Annually or as required
Maintain vegetation to designed limits within the vicinity of below ground drainage pipes and tanks.	Monthly or as required
Remedial Work Repair physical damage if necessary	 As required
Monitoring Inspect all inlets, outlets and vents to ensure that they are in good conditions and operating as designed.	 Annually
Survey inside of pipe runs for sediment build up and remove if necessary.	Every 5 years or as required

5 Summary and Conclusions

5.1.1 CGS Civils was instructed by Woodhart Group to produce a Drainage Statement to enable the discharge of planning conditions 9 and 11 of the Adur District Council planning consent AWDM/1247/21 for Gardner Road, Southwick.

5.1.2 The Surface Water will discharge to ground through infiltration at rates determined by the Ashdown Site Investigation infiltration testing results. Cellular soakaways will deal with roof runoff and the parking areas will utilise a permeable paving system.

5.1.3 The Foul drainage will be connected to the public foul sewer in West Road subject to S106 approval. The proposed connection is conventional and ought therefore to be approved without complication.

5.1.4 The report has demonstrated that the proposed drainage measures ensure that suitable means of surface water and foul drainage can be achieved for the proposed development.

6 Appendices

6.1 Appendix A – Site Plan

This drawing is copyright © of Yelo Architects Limited



01 Site Plan
Scale:1:200

1:200 @ A1
Scale in Metres
0 1 2 3 4 5 10 15 20

N

External Works Key

- Tarmac (Permeable)
- Turfed grass
- Shrub planting
- 450 x 450mm Marshalls Charnwood textured concrete paving (Permeable)
- P — Parking space (Permeable Tarmac)
- R — Refuse bin
- S — 1.2 x 1.8m timber close boarded shed for cycle storage
- W — 150l Water butt
- RD — Rotary drier
- Close boarded timber fence on retaining wall
- Close boarded timber fence
- TP — Telegraph Pole
- MH — Manhole
- ECP — Ducting for future Electric vehicle charging point

LANDSCAPE NOTE:
All hard surfaces are to be permeable in compliance with drainage report.

ISSUED FOR
PLANNING

Rev	Date	Description
-	-	-
-	-	-
-	-	-
-	-	-
-	-	-
A	31/08/21	Low knee rail added
-	30/06/21	Issued for Planning

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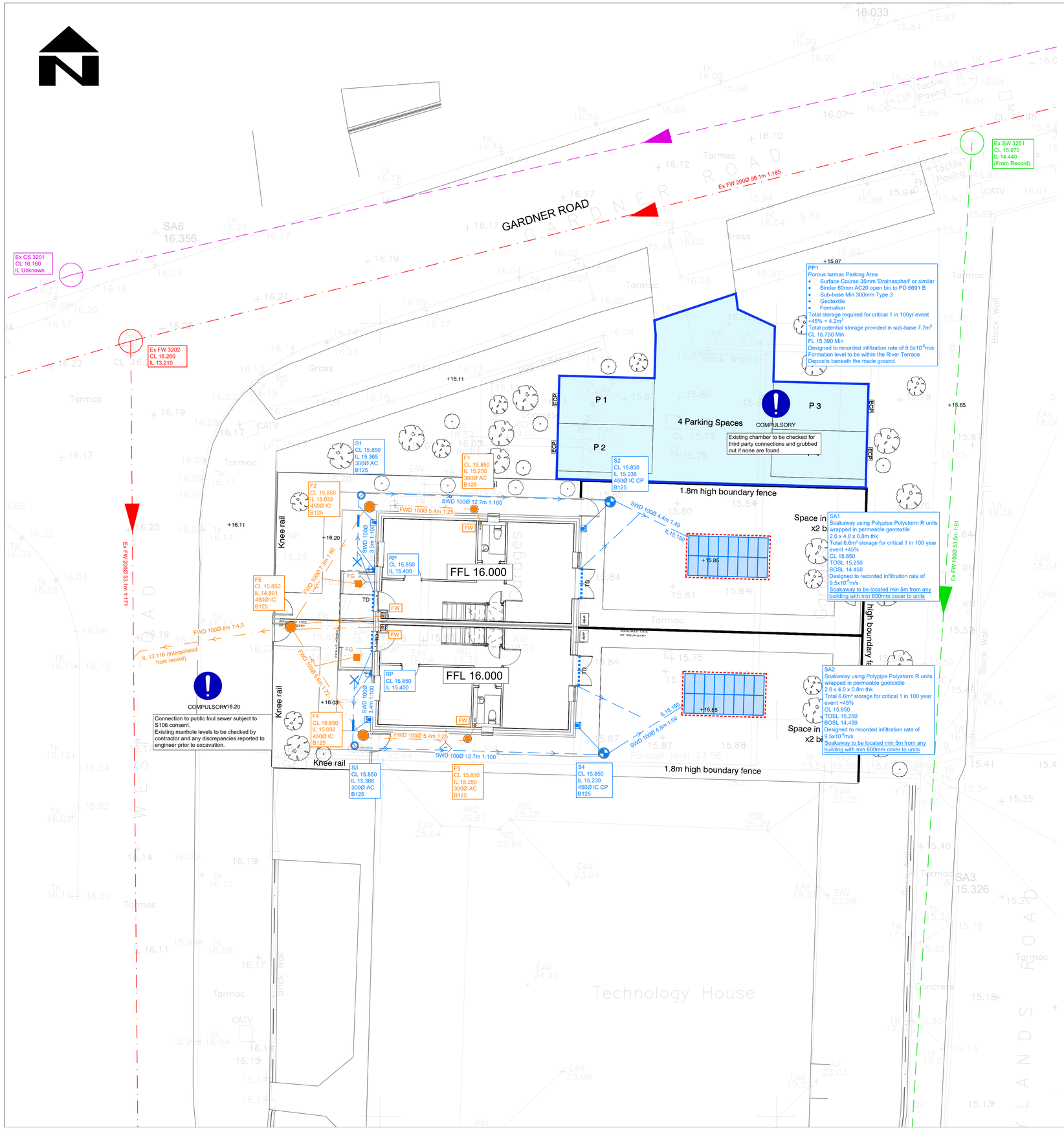
PROJECT	YO415-AWDC Infill
DRAWING TITLE	Gardner Road Proposed Site Plan
DRAWING NO	YO415-055
SCALE	1:200 @A1
DATE	31/08/21
REV	A

6.2 Appendix B – Drainage Layout



DRAINAGE LEGEND (1:100)

EXISTING FEATURES

- Ex FWD — Existing foul water sewer/drain and manhole
- Ex SWD — Existing surface water sewer/drain and manhole
- Ex SWD — Existing combined water sewer/drain and manhole

PROPOSED FEATURES

- SWD — Storm water sewer/drain
- Pipe crossing (thickening denotes pipe above)
- TD — Threshold drain
- Rainwater pipe connecting via Back-inlet gully
- Storm water access chamber (300Ø)
- Storm water inspection chamber (450Ø)
- Storm water catchpit chamber (450Ø)
- Storm water rodding eye
- Porous tarmac parking area
- FWD — Foul water sewer/drain
- FG — Trapped foul gully
- FW — Soil stack (type TBC by architect/m&e engineer)
- Foul water access chamber (300Ø)
- Foul water inspection chamber (450Ø)
- 00.000 — Finished floor level
- 100Ø 4.5m 1:100 Z BED — Pipe info - diameter, length, gradient, bedding type

ABBREVIATIONS

MH	- MANHOLE
IC	- INSPECTION CHAMBER
AC	- ACCESS CHAMBER
CP	- CATCHPIT
BC	- BRAKE CHAMBER
RE	- RODDING EYE
IL	- INVERT LEVEL
SL	- SUMP LEVEL
CL	- COVER LEVEL

Site Specific Notes

1. Shared soakaway required due to space available after offsets from proposed and existing buildings.
2. Capacities of soakaway and porous sub-base based on worst infiltration test result of $9.5x10^{-6}$m/s

STANDARD DRAINAGE NOTES

1. DO NOT SCALE FROM THIS DRAWING, REFER TO FIGURED DIMENSIONS ONLY. THE CONTRACTOR SHOULD CHECK ALL DIMENSIONS ON SITE.
2. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECT AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT AND/OR ENGINEER IMMEDIATELY, SO THAT CLARIFICATION CAN BE SOUGHT PRIOR TO THE COMMENCEMENT OF WORK.
5. BEFORE COMMENCING CONSTRUCTION THE CONTRACTOR MUST CHECK THE INVERT LEVELS OF EXISTING SEWERS TO WHICH CONNECTIONS ARE MADE. IN ADDITION THE CONTRACTOR MUST LOCATE AND DETERMINE INVERT LEVELS OF THE EXISTING SPURS TO WHICH CONNECTIONS ARE PROPOSED. ANY DISCREPANCIES ARE TO BE NOTIFIED TO THE ENGINEER IMMEDIATELY, PRIOR TO CONSTRUCTION.
6. ALL DRAINAGE WORKS SHOULD COMMENCE AT THE PROPOSED DOWNSTREAM CONNECTION POINT, THE WORKS CONTINUING UPSTREAM FOLLOWING CONFIRMATION OF THE TIE-IN INVERT LEVELS TO THE ENGINEER. CONNECTIONS TO MANHOLES OR LARGER SIZED PIPES ETC. SHOULD BE SOFFIT TO SOFFIT UNLESS OTHERWISE INSTRUCTED BY THE ENGINEER, IF THIS IS NOT POSSIBLE INFORM THE ENGINEER IMMEDIATELY.
7. COVER LEVELS SHOWN ARE APPROXIMATE. COVERS AND FRAMES SHALL BE SET TO FINISHED GROUND LEVELS AND FALLS.
8. ALL UN-REFERENCED PIPES ARE TO BE 100mm DIA
9. ALL PIPES TO BE ADOPTED, OR CONNECTING TO ADOPTED SEWERS, TO BE VITRIFIED CLAY TO BS EN 295 AND BS65 (SWS ONLY), OR CONCRETE PIPES TO BE EN 1916 AND BS5911:PART 1.
10. ROAD GULLY OUTLET PIPES ARE TO BE 150mm DIA. WITH CONCRETE SURROUND AND FLEXIBLE JOINTS. ALL GULLIES SHALL BE FITTED WITH GRADE D400 GRATINGS AND FRAMES TO BS EN124, UNLESS OTHERWISE STATED.
11. ALL ADOPTABLE SEWERS SHALL BE CONSTRUCTED TO THE STANDARDS AND SPECIFICATION LAID DOWN DOWN IN 'SEWERS FOR ADOPTION' 6th EDITION, WITH A VIEW TO ADOPTION UPON COMPLETION OF WORKS.
12. ALL PRIVATE DRAINAGE TO BE IN ACCORDANCE WITH THE BUILDING REGULATIONS APPROVED DOCUMENT PART-H, AND TO THE SATISFACTION OF THE BUILDING CONTROL INSPECTOR.
13. THE CONTRACTOR IS TO KEEP A RECORD OF ANY VARIATIONS MADE ON SITE, INCLUDING THE RELOCATION OF SEWERS OR DRAINS, SO THAT AN AS CONSTRUCTED DRAWING CAN BE PREPARED UPON COMPLETION OF THE PROJECT.
14. STUB CONNECTIONS TO ADOPTABLE MANHOLES SHALL BE MADE FROM VITRIFIED CLAY AND CONSIST OF TWO ROCKER PIPES LAID AT THE SAME GRADIENT AS THE UP OR DOWNSTREAM PIPE.
15. IF ANY SUB SOIL DRAINAGE SYSTEMS ARE UNCOVERED DURING THE WORKS CONTACT THE ENGINEER FOR INSTRUCTIONS. SUB SOIL DRAINS ARE TO BE DIVERTED AROUND NEW WORKS AND CONNECTED INTO THE SURFACE WATER.
16. NO PRIVATE AREAS ARE TO DRAIN ONTO ADOPTABLE AREAS AND VICE VERSA.
17. ALL EXISTING MANHOLE COVER'S, GULLIES, ETC, ARE TO BE RAISED/LOWERED TO SUIT NEW LEVELS.
18. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONFIRM THE LOCATION AND DEPTH OF ALL EXISTING SERVICES AND UTILITIES THAT MAY BE PRESENT
19. UPON COMPLETION BUT PRIOR TO HANDOVER, CONTRACTOR TO CARRY OUT FULL CCTV SURVEY OF DRAINAGE SYSTEM WHICH IS TO BE REVIEWED BY ENGINEER TO ENSURE SATISFACTORY INSTALLATION
20. MANHOLE AND CHAMBER COVER GRADES:

- 'A15' IN ALL LANDSCAPED AREAS AND ON FOOTPATHS
- 'B125' IN ALL DRIVEWAYS
- 'C250' IN PRIVATE PARKING AREAS
- 'D400' IN CARRIAGEWAY/ACCESS ROAD

Prefixed to drawing numbers shall signify the following:-

PL = PLANNING	Shall not be used for contract or construction purposes
P = PRELIMINARY	Shall not be used for contract or construction purposes
T = TENDER	Shall not be used for construction purposes
C = CONSTRUCTION	These are the only drawings that shall be used for construction purposes
R = RECORD	Record of actual completed work

REV	DATE	DESCRIPTION	BY	CHK	APP
P4	11.03.23	Soakaway split	SFC	CS	CS
P3	30.01.23	Surfacing note revised	SFC	CS	CS
P2	27.01.23	Updated to architect's comments	SFC	CS	CS
P1	30.12.22	PRELIMINARY ISSUE	SFC	CS	CS

DESIGN SUBJECT TO THE APPROVAL OF:
PLANNING AUTHORITY
BUILDING CONTROL
SOUTHERN WATER

DESIGN SUBJECT TO THE CONFIRMATION OF:
LOCATION AND DEPTH OF EXISTING UTILITIES
WINTER GROUNDWATER LEVELS

PRELIMINARY

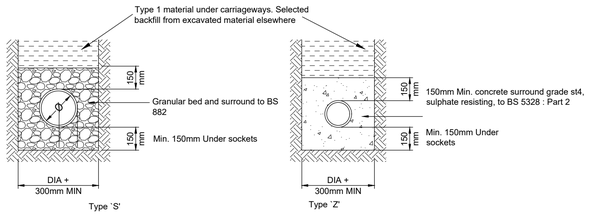
cgs civils
Consulting Civil Engineers

CLIENT: WOODHART GROUP
ARCHITECT: YELO ARCHITECTS LTD
JOB TITLE: GARDNER ROAD SOUTHWICK
DRAWING TITLE: PROPOSED DRAINAGE LAYOUT

DRAWN	ENGINEER	CHECKED	APPROVED
SFC	SFC	CS	CS

DATE	SCALE @ A1
DEC '22	1:100

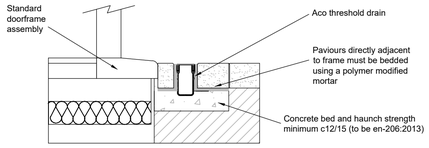
JOB No.	STATUS	DRAWING No.	REV.
C2481	P	101	4



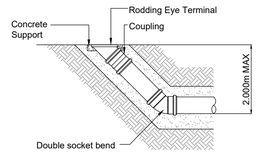
Drainage with more than
600mm cover - Landscaped
900mm cover - Roads
(Unless bedding type is stated on the drainage plans or specification)

Drainage with less than
600mm cover - Landscaped
900mm cover - Roads
(Unless bedding type is stated on the drainage plans or specification)

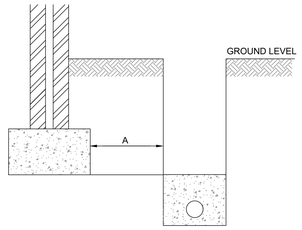
Pipe bedding details in private Areas



Aco Threshold Drain
(1:20)

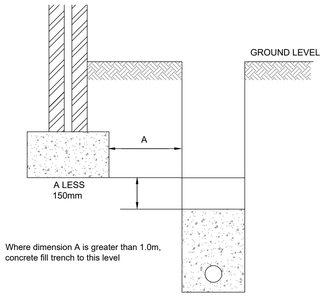


Rodding eye detail



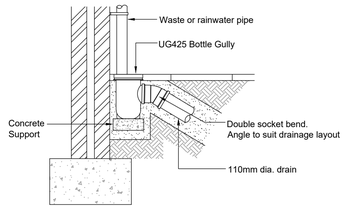
Where dimension A is less than 1.0m, concrete fill trench to level of underside of foundations.

Pipes near buildings

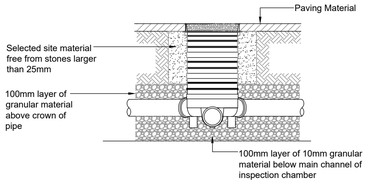


Where dimension A is greater than 1.0m, concrete fill trench to this level

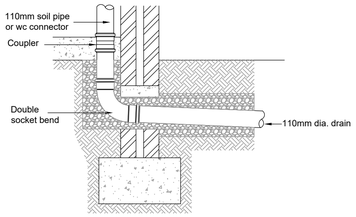
Pipes near buildings



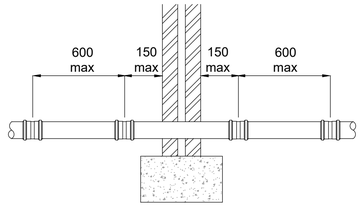
Bottle gully detail



300mmØ SHALLOW INSPECTION CHAMBER DETAIL

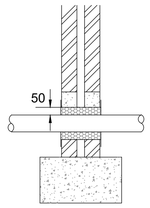


Soil pipe / wc connection



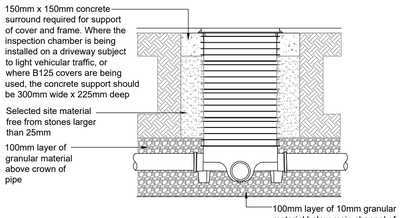
A. Short length of pipe bedded in wall with joints formed within 150mm of each wall face. Adjacent rocker pipes of 600mm max. length with flexible joints.

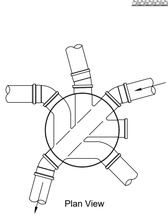
Pipes through wall detail



B. Arch or lintelled opening to give min 50mm space all round the pipe. Mask opeing on both sides of the wall with rigid sheet material to prevent entry of fill or vermin. Important Fill void with compressible material to prevent entry of gas.

Pipes through wall with lintel detail

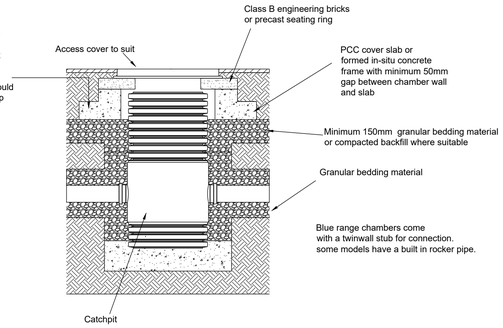




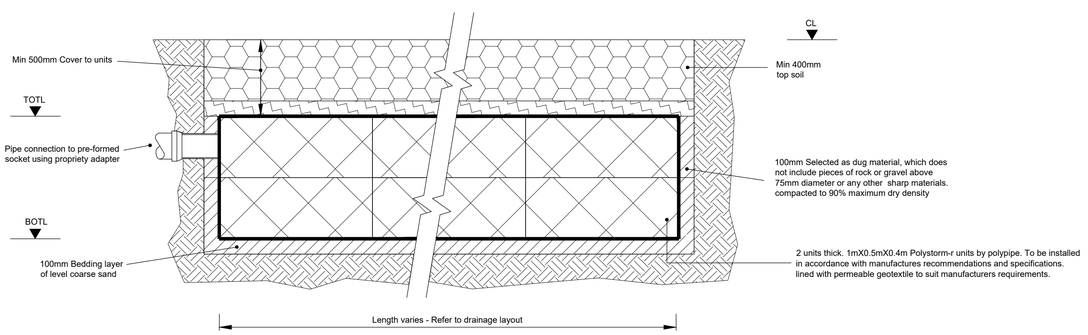
1. In all installations, the main channel of the inspection chamber should always be used. Where the chamber is being used as a change of direction for the drainage system, short radius bends of 11¼°, 15°, 30° and 45° can be used in the inlet and outlet to achieve the required angle.
2. Side inlet branch connections enter the inspection chamber approx. 55mm above the invert of the main channel
3. 320mm dia. chambers are supplied with 2no. blanking plugs for the side inlets and 460mm dia. chambers are supplied with 3no. blanking plugs.

460mmØ INSPECTION CHAMBER DETAIL

150mm x 150mm concrete surround required for support of cover and frame. Where the inspection chamber is being installed on a driveway subject to light vehicular traffic, or where B125 covers are being used, the concrete support should be 300mm wide x 225mm deep

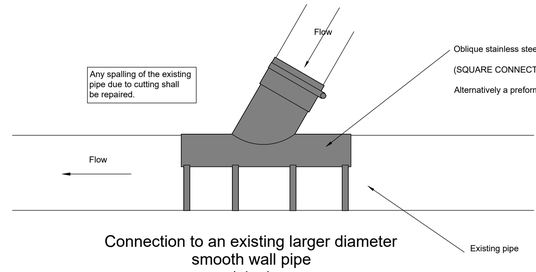


450mmØ/600mmØ Turtle Enviro Silt Trap Detail

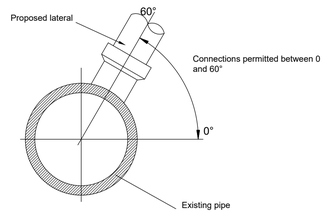


Trench soakaway using Polystorm Lite Geomodular units Landscaped areas only
0.8m deep

All storage tank drainage works shall be carried out in accordance with the specifications, method statements and recommendations of Polypipe



Connection to an existing larger diameter smooth wall pipe (plan)
(1:10)



Acceptable connection location (section)
(1:10)

Saddles where the connecting lateral protrudes or has the potential to protrude in to the main pipe will not be permitted.

Connections of pipes of the same diameter must be made using preformed junctions at greater than 90 deg to the main flow.

Connections between new pipes shall be made using preformed junctions. Saddles will not be permitted to connect new laterals to new pipelines.

Condition of existing pipe to which the connection is proposed shall be assessed. If the existing pipe is damaged a sufficient length (as directed by the highway inspector) shall be replaced to ensure a satisfactory connection.

Where pipeline are installed in contaminated soil the designer shall ensure that material specified are resistant to any chemicals that may be present.

STANDARD DRAINAGE NOTES

1. DO NOT SCALE FROM THIS DRAWING, REFER TO FIGURED DIMENSIONS ONLY. THE CONTRACTOR SHOULD CHECK ALL DIMENSIONS ON SITE.
2. ALL DIMENSIONS IN MILLIMETRES AND ALL LEVELS ARE IN METERS UNLESS NOTED OTHERWISE.
3. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT ARCHITECT AND ENGINEERING DETAILS, DRAWINGS AND SPECIFICATIONS.
4. ANY DISCREPANCIES SHOULD BE REPORTED TO THE ARCHITECT AND/OR ENGINEER IMMEDIATELY, SO THAT CLARIFICATION CAN BE SOUGHT PRIOR TO THE COMMENCEMENT OF WORK.
5. BEFORE COMMENCING CONSTRUCTION THE CONTRACTOR MUST CHECK THE INVERT LEVELS OF EXISTING SEWERS TO WHICH CONNECTIONS ARE MADE. IN ADDITION THE CONTRACTOR MUST LOCATE AND DETERMINE INVERT LEVELS OF THE EXISTING SPURS TO WHICH CONNECTIONS ARE PROPOSED. ANY DISCREPANCIES ARE TO BE NOTIFIED TO THE ENGINEER IMMEDIATELY, PRIOR TO CONSTRUCTION.
6. ALL DRAINAGE WORKS SHOULD COMMENCE AT THE PROPOSED DOWNSTREAM CONNECTION POINT, THE WORKS CONTINUING UPSTREAM FOLLOWING CONFIRMATION OF THE TIE-IN INVERT LEVELS TO THE ENGINEER. CONNECTIONS TO MANHOLES OR LARGER SIZED PIPES ETC. SHOULD BE SOFFIT TO SOFFIT UNLESS OTHERWISE INSTRUCTED BY THE ENGINEER, IF THIS IS NOT POSSIBLE INFORM THE ENGINEER IMMEDIATELY.
7. COVER LEVELS SHOWN ARE APPROXIMATE. COVERS AND FRAMES SHALL BE SET TO FINISHED GROUND LEVELS AND FALLS.
8. ALL UN-REFERENCED PIPES ARE TO BE 100mm DIA
9. ALL PIPES TO BE ADOPTED, OR CONNECTING TO ADOPTED SEWERS, TO BE VITRIFIED CLAY TO BS EN 295 AND BS65 (SWS ONLY), OR CONCRETE PIPES TO BE EN 1916 AND BS5911:PART 1.
10. ROAD GULLY OUTLET PIPES ARE TO BE 150mm DIA. WITH CONCRETE SURROUND AND FLEXIBLE JOINTS. ALL GULLIES SHALL BE FITTED WITH GRADE D400 GRATINGS AND FRAMES TO BS EN124, UNLESS OTHERWISE STATED.
11. ALL ADOPTABLE SEWERS SHALL BE CONSTRUCTED TO THE STANDARDS AND SPECIFICATION LAID DOWN DOWN IN 'SEWERS FOR ADOPTION' 6th EDITION, WITH A VIEW TO ADOPTION UPON COMPLETION OF WORKS.
12. ALL PRIVATE DRAINAGE TO BE IN ACCORDANCE WITH THE BUILDING REGULATIONS APPROVED DOCUMENT PART-H, AND TO THE SATISFACTION OF THE BUILDING CONTROL INSPECTOR.
13. THE CONTRACTOR IS TO KEEP A RECORD OF ANY VARIATIONS MADE ON SITE, INCLUDING THE RELOCATION OF SEWERS OR DRAINS, SO THAT AN AS CONSTRUCTED DRAWING CAN BE PREPARED UPON COMPLETION OF THE PROJECT.
14. STUB CONNECTIONS TO ADOPTABLE MANHOLES SHALL BE MADE FROM VITRIFIED CLAY AND CONSIST OF TWO ROCKER PIPES LAID AT THE SAME GRADIENT AS THE UP OR DOWNSTREAM PIPE.
15. IF ANY SUB SOIL DRAINAGE SYSTEMS ARE UNCOVERED DURING THE WORKS CONTACT THE ENGINEER FOR INSTRUCTIONS. SUB SOIL DRAINS ARE TO BE DIVERTED AROUND NEW WORKS AND CONNECTED INTO THE SURFACE WATER.
16. NO PRIVATE AREAS ARE TO DRAIN ONTO ADOPTABLE AREAS AND VICE VERSA.
17. ALL EXISTING MANHOLE COVER'S, GULLIES, ETC, ARE TO BE RAISED/LOWERED TO SUIT NEW LEVELS.
18. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO CONFIRM THE LOCATION AND DEPTH OF ALL EXISTING SERVICES AND UTILITIES THAT MAY BE PRESENT
19. UPON COMPLETION BUT PRIOR TO HANDOVER, CONTRACTOR TO CARRY OUT FULL CCTV SURVEY OF DRAINAGE SYSTEM WHICH IS TO BE REVIEWED BY ENGINEER TO ENSURE SATISFACTORY INSTALLATION
20. MANHOLE AND CHAMBER COVER GRADES:

- 'A15' IN ALL LANDSCAPED AREAS AND ON FOOTPATHS
- 'B125' IN ALL DRIVEWAYS
- 'C250' IN PRIVATE PARKING AREAS
- 'D400' IN CARRIAGEWAY/ACCESS ROAD

Prefixed to drawing numbers shall signify the following:-

PL = PLANNING	Shall not be used for contract or construction purposes
P = PRELIMINARY	Shall not be used for contract or construction purposes
T = TENDER	Shall not be used for construction purposes
C = CONSTRUCTION	These are the only drawings that shall be used for construction purposes
R = RECORD	Record of actual completed work

REV	DATE	DESCRIPTION	BY	CHK	APP
P1	04.01.22	PRELIMINARY ISSUE	SFC	CS	CS

cgs civils
Consulting Civil Engineers

CLIENT: WOODHART GROUP

ARCHITECT: YELO ARCHITECTS LTD

JOB TITLE: GARDNER ROAD SOUTHWICK

DRAWING TITLE: DRAINAGE CONSTRUCTION DETAILS

DRAWN	ENGINEER	CHECKED	APPROVED
SFC	SFC	CS	CS

DATE	SCALE @ A1
JAN '23	1:20

JOB No.	STATUS	DRAWING No.	REV.
C2481	P	301	1

PRELIMINARY

6.3 Appendix C – Infiltration Testing

Land to the South of Gardner Road
Southwick
West Sussex

In Situ Infiltration Test Report

Report Beneficiary:
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Project Reference: P15091

Report Reference: R14769

Document Control			
Issue No.	**Status**	**Issue Date**	**Notes**
1	Final	16th April 2021	

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Limitations

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Exploratory Hole Records

Summary of Borehole Falling Head Soakage Test Results

Summary of Trial Pit Falling Head Soakage Test Results

1. INTRODUCTION

Ashdown Site Investigation Ltd was requested to undertake in situ infiltration testing and groundwater monitoring at a site located to the south of Gardner Road, Southwick, West Sussex to assist others with the design a sustainable drainage system (SuDS) for the proposed development. A copy of the proposed development layout is included in the appendices to this report.

The specific objectives of the works were to:
a) Establish the expected geology and hydrogeology at the site;
b) Investigate the shallow ground and groundwater conditions at the test locations; and
c) Undertake in situ soakage testing and provide infiltration rates to assist others in undertaking design of SuDS.

The scope of the works covered by this report, and the terms and conditions under which they were undertaken, were set out within the offer letter Q10694, dated 18th March 2021. The instruction to proceed was received from the client.

A previous ground investigation was carried out at the site, the findings of which were provided in a Geotechnical Assessment report prepared by Ashdown Site Investigation Ltd[1].

[1] Ashdown Site Investigation Project No. P15000 Report No. R14670, dated 19th March 2021.

2. SITE CONTEXT

2.1 Site Details

The site comprises an approximately rectangular shaped plot of land located to the south of Gardner Road, Southwick, West Sussex and is centred on the approximate Ordnance Survey national grid reference TQ 2533 0526. A site location plan and site plan are presented as Figure 1 and Figure 2, respectively.

2.2 Geological and Hydrogeological Information

2.2.1 Expected Geology and Aquifer Designation

The stratigraphic succession that may be expected to underlie the site is presented in the following table.

Table 1. Expected Strata and Aquifer Designation

Type	Stratum	Aquifer Designation
Superficial	River Terrace Deposits (Brickearth)	Secondary B Aquifer
Bedrock	White Chalk Subgroup	Principal Aquifer

The River Terrace Deposits in this area were formerly denoted as the Brickearth and comprise brown sandy (fine) silt or clay largely originating from the solution weathering of the previously existing chalk. The material will have been reworked by water flow to produce some lateral variability in the grain size of the soil (sand and gravel) and can be expected to contain a variable content of flint.

The White Chalk Subgroup comprises a weak, white chalk locally with flint bands together with scattered nodular flints. It may be expected to have a deeply convoluted upper surface as a result of solution weathering. The presence of natural cavities in the chalk is very rare and solution features, if present, can be expected to be infilled with Quaternary deposits such as the River Terrace Deposits.

The infill material may be significantly weaker than the surrounding chalk. Solution features can comprise pipes extending to several metres deep into the chalk or conical depressions and basin shaped structures.

Areas of artificial deposits (made ground) are shown to be present ~200m south and ~200m north east of the site. The area to the north east of the site is potentially associated with the railway line, whilst the area to the south is associated with the backfilled timber ponds along the river.

2.2.2 Groundwater Source Protection Zones

The site does not lie within an Environment Agency Source Protection Zone with regard to the protection of the quality of groundwater that is abstracted for potable supply.

3. SITE WORKS

A trial pit, designated TP01, was excavated using hand tools to a depth of 1.00m below ground level. In addition, three boreholes, Denoted BH01 to BH03, were drilled to depths of between 2.30m and 4.50m below ground level. The fieldwork was carried out on 29th March 2021. The exploratory hole locations, together with the locations of previous exploratory holes drilled at the site, are shown on Figure 2.

Descriptions of the strata encountered and comments on groundwater conditions encountered at the test positions are shown in the exploratory hole records given in the appendices, together with notes to assist in their interpretation.

Falling head soakage testing was undertaken in the trial pit in general accordance with BRE guidance[2]. Borehole soakage testing was also carried out within borehole BH01 with the hole at a depth of 3.30m in general accordance with Kent County Council guidance[3].

To enable groundwater monitoring to be carried out a further borehole was drilled at the location of BH02, however during drilling, the borehole could not be progressed below 2.30m below ground level. Therefore, a third borehole, denoted BH03, was drilled to a depth of 4.50m and a standpipe was installed to a depth of 4.30m below ground level. A groundwater data logger was installed within standpipe. The results of the groundwater monitoring, scheduled to be undertaken until end of April 2021, will be issued under separate cover on completion of the monitoring period.

[2] Section 3.2.3 of Building Research Establishment (BRE) Digest 365, 2016.
[3] The Soakaway Design Guide published by Kent County Council, 2000.

4. GROUND CONDITIONS

4.1 Stratigraphy

4.1.1 Surface Covering

Each of the exploratory holes was excavated through a surface cover of topsoil some 200mm in thickness.

4.1.2 Made Ground

Made ground, generally comprising gravelly sandy clay, was recorded to depths of between 0.40m and 0.80m below ground level. The gravel fraction comprised variable quantities of flint, brick and concrete.

4.1.3 River Terrace Deposits

Underlying the made ground, the investigation progressed into undisturbed, slightly gravelly slightly sandy clay deposits which were recorded to the full depth of trial pit TP01 and to depths of between 1.30m and 2.00m below ground level at the borehole positions.

Beneath these clay soils, the investigation progressed into gravelly silt deposits which continued to the full depth of the investigation.

These soils are considered to represent the River Terrace Deposits indicated on the published geological map.

4.2 Groundwater Conditions and Stability

Each of the exploratory holes was recorded to remain dry and stable during the course of drilling/excavation.

Groundwater monitoring is ongoing, and the results of the monitoring will be issued separately on completion of the monitoring period.

It should be noted that water levels within the exploratory holes may not have equilibrated with the groundwater table at the time the readings were recorded and that groundwater levels should be expected to fluctuate seasonally.

5. STORMWATER INFILTRATION SYSTEMS

In-situ infiltration testing[4] was carried out in trial pit TP01.

For the initial two tests performed in the pit 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, and its base area. This figure was then divided by the test duration (time taken for the water level to fall between 75% and 25% of the initial test depth) to give the soil infiltration rate in metres per second.

During the third test performed within trial pit TP01, the water level within the test pit did not fall below 25% of the initial test depth due to the testing being limited to a single day, and calculation of the soil infiltration rate in full accordance with the BRE digest was not possible. For this test, the soil infiltration rate has therefore 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.

In-situ infiltration testing[5] was also undertaken in borehole BH01. From the test results, calculations were made to estimate the infiltration rate that could be expected for soakaways constructed to discharge into the underlying soils within the test zone.

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

Table 2. Calculated Infiltration Rates

Exploratory Hole	Test Response Zone Depth (m)		Stratum	Infiltration Rate (f) (m/sec)	Driving Head of Water (m)
	Top	Bottom			
TP01 Test 1	0.46	1.00	River Terrace Deposits	2.7×10^{-5}	-
TP01 Test 2	0.41	1.00	River Terrace Deposits	1.8×10^{-5}	-
TP01 Test 3	0.59	1.00	River Terrace Deposits	9.5×10^{-6}	-
BH01 Test 1	2.00	3.30	River Terrace Deposits	4.1×10^{-5}	0.9
BH01 Test 2	2.00	3.30	River Terrace Deposits	4.6×10^{-5}	1.0
BH01 Test 3	2.00	3.30	River Terrace Deposits	4.6×10^{-5}	0.9

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 River Terrace Deposits soils possess moderate infiltration characteristics. The results from the infiltration tests should be provided to engineers responsible for the design of the drainage system.

To comply with building regulations[6], point discharging infiltration systems (conventional ring or trench soakaways) are required to be constructed a minimum of 5.0m away from proposed or existing buildings.

Ashdown Site Investigation Ltd.

[4] Conducted in general accordance with the requirements of BRE 365, Soakaway Design.
[5] Conducted in accordance with The Soakaway Design Guide, published by Kent County Council, July 2000.
[6] The Building Regulations 2010; Part H; Drainage and Waste Disposal

FIGURES AND APPENDICES

Figure 1 Site Location Plan
Figure 2 Site Plan
Exploratory Hole Notes
Exploratory Hole Records
Summary of Borehole Falling Head Soakage Test Results
Summary of Trial Pit Falling Head Soakage Test Results



© OpenStreetMap contributors, CC BY-SA

ASHDOWN SITE INVESTIGATION LIMITED	Site Location Plan	Site Name	Figure No.	Project Reference
		Land to South of Gardner Road, Southwick, West Sussex	1	P15091



N

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

Unit 3
The Old Grain Store
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Ditchling
East Sussex
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Site:

Land to South of Gardner Road
Southwick
West Sussex

Report Ref:

P15091

Figure No.

2

Drawing Title

Site Plan

Scale

NTS

NOTES FOR THE INTERPRETATION OF EXPLORATORY HOLE RECORDS

1 Symbols and abbreviations

Samples

U 'Undisturbed' Sample: - 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.
U_o 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): Using the split spoon sampler.

C Standard Penetration Test (SPT): using a solid cone instead of the sampler - conducted usually in coarse grained soils or weak rocks.

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: Number of blows for 300mm penetration shown under Vane/Pen Test and N Value column.

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) and Part 2 Principles of classification (BS EN 14688-2) as well as the BS5930 code of Practice for Ground Investigations.

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) as well as the BS5930 code of Practice for Ground Investigations. TCR – Total Core Recovery, SCR – Solid Core Recovery, RQD – Rock Quality Designation, NI – Non Intact, If – indicative fracture spacing (min/ave/max), FI – Fracture Index.

4 Chalk Description

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.

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Site Name: Land to South of Gardner Road, Southwick, West Sussex

Job Number: P15091

Start Date: 29/03/2021

End Date: 29/03/2021

Borehole Number: **BH01** Sheet 1 of 1

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Topsoil.
							0.20	MADE GROUND: Brown slightly gravelly slightly sandy clay. Gravel is subangular to subrounded fine to coarse flint, brick and concrete.
	D	1.00					0.80	Brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse flint. (River Terrace Deposits)
	D	2.00					1.80	Light brown gravelly SILT. Gravel is subangular to subrounded fine to coarse chalk and flint. (River Terrace Deposits)
	D	3.00					3.30	End of borehole at 3.30m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole cased to 2.00m depth.
Borehole stable on completion.

Notes: No further progress below 3.30m depth - too hard/ dense.

Excavation Method: WLS

Borehole Diameter: Various

Made By: BA

ASHDOWN SITE INVESTIGATION LIMITED
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Site Name: Land to South of Gardner Road, Southwick, West Sussex

Job Number: P15091

Start Date: 29/03/2021

End Date: 29/03/2021

Borehole Number: **BH02**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Topsoil.
							0.20	MADE GROUND: Brown slightly gravelly sandy clay. Gravel is subangular to subrounded fine to coarse flint, brick and concrete.
	D	1.00					0.80	Brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse flint. (River Terrace Deposits)
	D	2.20					2.00	Light brown gravelly SILT. Gravel is subangular to subrounded fine to coarse flint and chalk. (River Terrace Deposits)
							2.30	End of borehole at 2.30m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole cased to 1.00m depth.
Borehole stable on completion.

Notes: No further progress below 2.30m depth - too hard/ dense.

Excavation Method: WLS

Borehole Diameter: Various

Made By: BA

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Site Name: Land to South of Gardner Road, Southwick, West Sussex

Job Number: P15091

Start Date: 29/03/2021

End Date: 29/03/2021

Borehole Number: **BH03**

Standpipe	Samples and In Situ Testing: Sample/ Test Type	Depth From (m)	Depth To (m)	Test Result	Dynamic Probe 0 5 10 15 20 25 30	Legend	Depth	Stratum Description
							0.00	Topsoil.
							0.20	MADE GROUND: Brown slightly gravelly slightly sandy clay. Gravel is subangular to subrounded fine to coarse flint, brick and concrete.
							0.70	Brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse flint. (River Terrace Deposits)
	D	1.50					1.30	Light brown very gravelly SILT. Gravel is subangular to subrounded fine to coarse flint and chalk. (River Terrace Deposits)
	D	2.50						
	D	3.50						with bands of brown very gravelly clay below 4.00m depth.
							4.50	End of borehole at 4.50m

Remarks

Groundwater: Borehole dry on completion.

Stability: Borehole stable on completion.

Notes: No further progress below 4.50m depth - too hard/ dense.
Standpipe installed to 4.30m depth; 4.30m to 2.30m slotted pipe with gravel surround; 2.30m to ground level plain pipe with bentonite seal; completed with end cap and security cover concreted flush with ground surface.

Excavation Method: WLS

Borehole Diameter: Various

Made By: BA

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Site Name: Land to South of Gardner Road, Southwick, West Sussex

Job Number: P15091

Start Date: 29/03/2021

End Date: 29/03/2021

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	Topsoil.
					0.20	MADE GROUND: Brown slightly gravelly slightly sandy clay. Gravel is subangular to subrounded fine to coarse flint, brick and concrete.
					0.40	Brown slightly gravelly slightly sandy CLAY. Gravel is subangular to subrounded fine to coarse flint. (River Terrace Deposits)
D	0.70					
					1.00	End of trial pit at 1.00m

Remarks

Groundwater: Trial pit dry on completion.

Stability: Trial pit stable on completion.

Notes: n/a

Excavation Method: HDP

Pit Length: 1.00m

Pit Width: 0.30m

Made By: BA

ASHDOWN SITE INVESTIGATION LIMITED

Site: Land to South of Gardener Road, Southwick, West Sussex	Project No.: P15091 Sheet No.: 1 of 1

SUMMARY OF BOREHOLE FALLING HEAD SOAKAGE TEST RESULTS

BH01 (Test 1)	
Time (mins)	Depth to water (m bgl)
0.0	0.00
1.0	0.55
2.0	0.86
3.0	1.10
4.0	1.27
5.0	1.42
8.0	1.74
11.0	1.95
15.5	2.13
Borehole Depth (m bgl)	3.30
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	77.00
Casing Diameter (mm)	105.00

BH01 (Test 2)	
Time (mins)	Depth to water (m bgl)
0.0	0.00
1.0	0.42
2.5	0.82
3.5	1.08
5.0	1.34
6.0	1.50
7.0	1.66
9.0	1.81
10.5	1.94
12.0	2.05
Borehole Depth (m bgl)	3.30
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	77.00
Casing Diameter (mm)	105.00

BH01 (Test 3)	
Time (mins)	Depth to water (m bgl)
0.0	0.00
1.0	0.60
2.0	0.83
3.0	1.03
6.5	1.55
10.0	1.90
13.0	2.08
Borehole Depth (m bgl)	3.30
Casing Depth (m bgl)	2.00
Borehole Diameter (mm)	77.00
Casing Diameter (mm)	105.00

Notes: bgl – below ground level.

ASHDOWN SITE INVESTIGATION LIMITED

Site: Land to South of Gardener Road, Southwick, West Sussex	Project No: P15091 Sheet No.: 1 of 1

SUMMARY OF TRIAL PIT FALLING HEAD SOAKAGE TEST RESULTS

TP01 (Test 1)	
Time (mins)	Depth to water (m bgl)
0	0.46
2	0.48
4	0.50
8	0.54
11	0.58
22	0.67
37	0.76
51	0.81
55	0.83
63	0.87
Pit Length – 1.00m Pit Width - 0.30m Pit Depth – 1.00 m bgl	

TP01 (Test 2)	
Time (mins)	Depth to water (m bgl)
0	0.41
3	0.44
9	0.49
15	0.53
19	0.54
32	0.61
55	0.70
86	0.80
101	0.85
Pit Length – 1.00m Pit Width - 0.30m Pit Depth – 1.00 m bgl	

TP01 (Test 3)	
Time (mins)	Depth to water (m bgl)
0	0.59
1	0.59
3	0.59
5	0.60
12	0.62
22	0.65
32	0.68
46	0.71
61	0.74
78	0.76
Pit Length – 1.00m Pit Width - 0.30m Pit Depth – 1.00 m bgl	

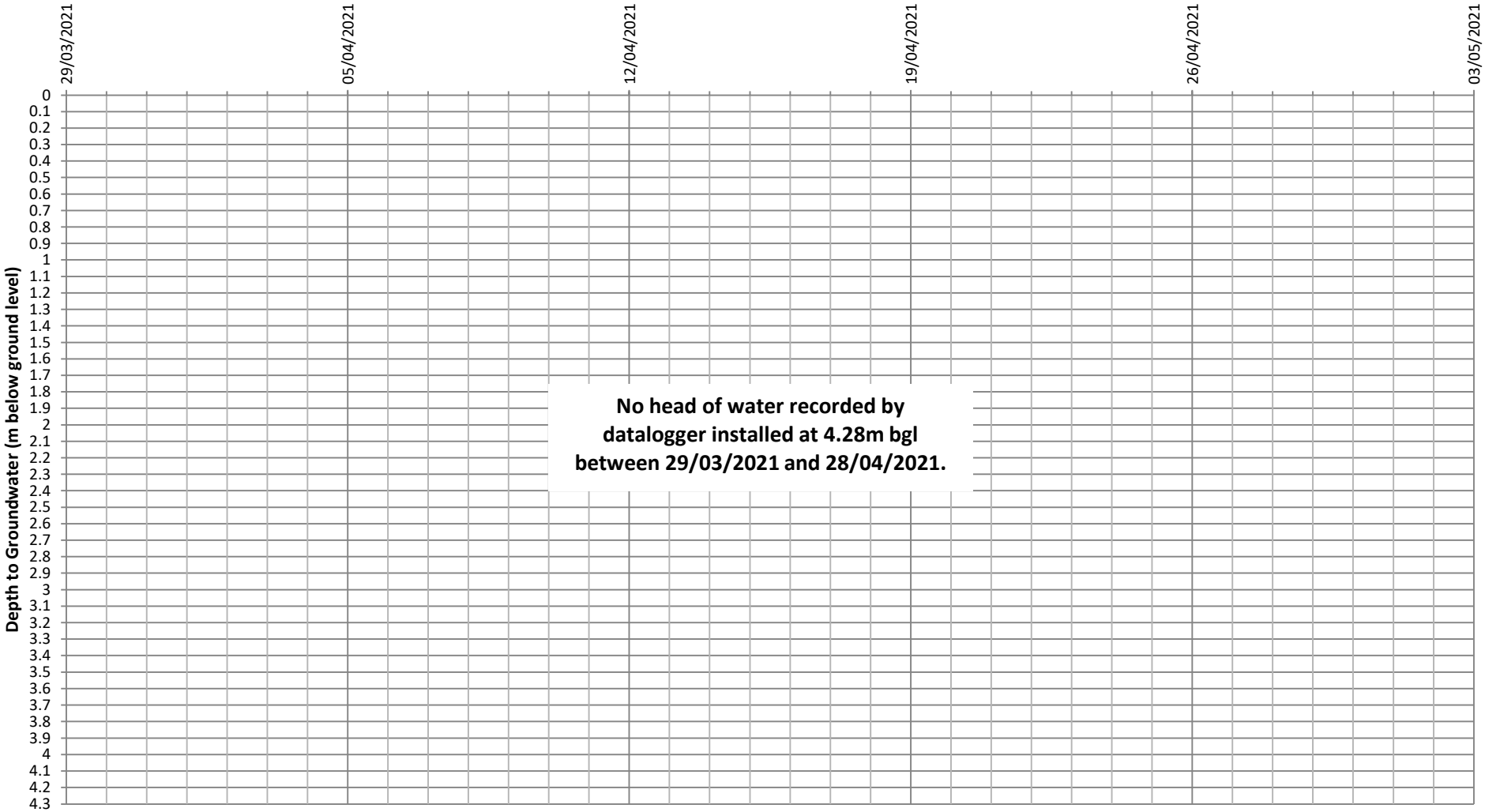
Remarks: bgl - below ground level.

6.4 Appendix D – Groundwater Monitoring

Ashdown Site Investigation Limted

Site: Land to South of Gardner Road, Southwick, West Sussex	Report No. P15091

Groundwater Monitoring Results - BH03



6.5 Appendix E – Hydraulic calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	10	Maximum Rainfall (mm/hr)	500.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.350	Preferred Cover Depth (m)	1.200
CV	0.950	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
roof	0.007	5.00	15.850	1200	0.000	0.000	0.485
sa	0.000		15.850	1200	10.000	0.000	0.700

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	roof	sa	10.000	0.600	15.365	15.150	0.215	46.5	225	5.09	96.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1	1.923	76.4	2.3	0.260	0.475	0.007	0.0	27	0.871

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	720
Ratio-R	0.350	Additional Storage (m³/ha)	20.0
Summer CV	0.950	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160
30	120	240	480	720	1440	2880

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0
100	45	0	0

Node sa Online Weir Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.590
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	15.800	Width (m)	0.001		

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Node sa Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	14.450	Depth (m)	0.800
Side Inf Coefficient (m/hr)	0.03400	Time to half empty (mins)		Inf Depth (m)	
Safety Factor	3.0	Pit Width (m)	2.000	Number Required	1
Porosity	0.95	Pit Length (m)	4.000		

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Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	roof	10	15.392	0.027	2.2	0.0379	0.0000	OK
1440 minute winter	sa	990	14.801	-0.349	0.1	2.6681	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	roof	1	sa	2.2	0.838	0.028	0.0259	
1440 minute winter	sa	Weir		0.0				0.0
1440 minute winter	sa	Infiltration		0.0				

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Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute summer	roof	900	15.673	0.308	0.5	0.4369	0.0000	FLOOD RISK
960 minute summer	sa	900	15.673	0.523	0.5	6.6755	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
960 minute summer	roof	1	sa	0.5	0.540	0.007	0.3977	
960 minute summer	sa	Weir		0.0				0.0
960 minute summer	sa	Infiltration		0.0				

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Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	500.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.350	Preferred Cover Depth (m)	0.600
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Parking	0.010	5.00	15.850	1200	0.000	0.000	0.570

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1	Parking	SA	10.000	0.600	15.025	14.450	0.575	17.4	225	5.05	151.4

Name	US Depth (m)
1	0.600

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	20.000	Drain Down Time (mins)	240
Ratio-R	0.350	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	Check Discharge Volume	x

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	0	0

Node SA Online Weir Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.590
Replaces Downstream Link	✓	Design Flow (l/s)	5.0		
Invert Level (m)	0.000	Width (m)	0.003		

Node Parking Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.03400	Invert Level (m)	15.280	Slope (1:X)	29.0
Side Inf Coefficient (m/hr)	0.03400	Time to half empty (mins)	300	Depth (m)	0.250
Safety Factor	1.5	Width (m)	20.000	Inf Depth (m)	
Porosity	0.95	Length (m)	5.000		

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Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	Parking	96	15.400	0.120	2.1	4.1296	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)
120 minute winter	Parking	Infiltration	0.5

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