

Structural & Civil Engineers

ABSTRACT Consulting Limited
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**Riverside Industrial Estate
Littlehampton
BN17 5DF**

**Surface / Foul Water Drainage Strategy
Report**

Project No. AC19021

Report No. R1 Rev B

December 2020

Issue, Revision & Check

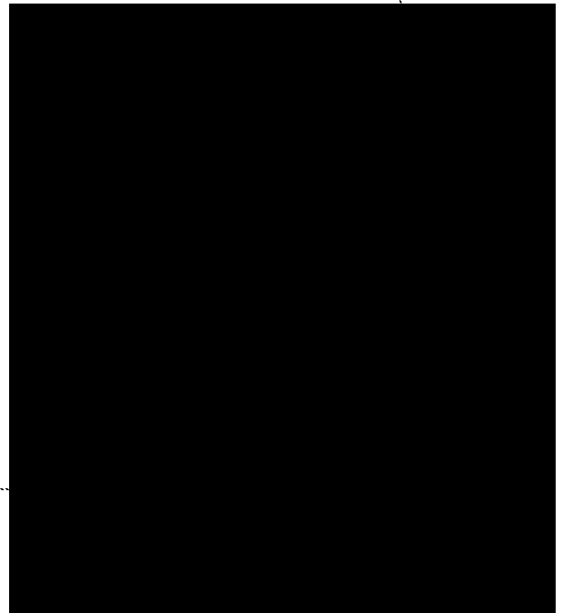
First Issue 04/11/2020
Rev A 23/11/2020
Rev B 21/12/2020

Signed

By Alvin Jones

Checked Martin Howell MEng (Hons)

Approved Matthew Woods BEng (Hons)



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AC19021: Riverside Industrial Estate Littlehampton – Surface / Foul Water Drainage Strategy Report

1. Introduction

ABSTRACT Consulting have been appointed by London & Cambridge Properties to undertake a drainage strategy for the proposed development to support a detailed planning application. This report incorporates a SUDS assessment and maintenance strategy to assist with a planning application.

The site is located in the north part Riverside Industrial Estate, Littlehampton, BN17 5DF, south of Bridge Road ordnance survey grid TQ017025. A site location plan has been provided in Appendix A.

The site was occupied by hard standing in the form of parking areas associated with the nearby industrial units.

The proposals are to develop the site with new light industrial unit as well as associated access and parking areas. A proposed site layout can be found in Appendix B.

2. Existing Drainage

The site currently has a shallow foul water drain from the adjacent unit to the east crossing the site via two chambers and ultimately connecting to a private foul water manhole to the south-west to the north-eastern corner of the unit opposite. The surface water connects to a surface water drain to the south of the site which flows north-west and ultimately discharges into Wickfarm Ditch. This is demonstrated on the Topographic Survey plan in Appendix C. The sewer records in Appendix D show that there are no public sewers in the immediate vicinity.

Table 1 below demonstrates the surface water flows generated by the pre-development site for a number of different storm return periods. Calculations to support these figures can be found in Appendix E.

Return Period	Flow Rate Generated (ls⁻¹)
1:1 year	11.0
1:30 year	26.9
1:100 year	34.8

Table 1 – Pre-Development Surface Water Flows

3. Proposed Foul Drainage

The proposed development will intercept the existing foul outlet from the adjacent unit to the east and divert this around the footprint of the proposed building and connect into the existing foul manhole to the south.

New drainage will be provided to service the new unit and connect into this new foul system.

All foul drainage is proposed to discharge under gravity via the private foul drainage system.

A drainage layout can be found in Appendix F.

4. SUDS Assessment

Sustainable Urban Drainage Systems (SUDS) is the philosophy of trying to replicate, as closely as possible, the natural drainage from a site before development.

There are a number of SUDS features that should be considered for any development and these are set out in a hierarchy. These are summarised along with their suitability for the site in table 2 below.

SUDS Feature	Site Specific Notes	Proposed Use
1) Store Rainwater for Later Use		
Rainwater Harvesting	Limited number of users in units would reduce the amount of water used.	Not proposed for use as the benefit is negligible.
2) Use Infiltration Techniques		
Green Roofs	Pitched roofs are unsuitable for green roofs.	Not proposed for use due to the pitched roof.
Soakaways	The site is underlain by clay to 4m over clay, with groundwater found at 0.5m. (British Geological Survey Borehole extract found in Appendix G)	Not proposed for use due to unsuitable ground conditions.
Permeable Paving	The site is underlain by made ground over London Clay with no soakage potential.	Not proposed for use due to unsuitable ground conditions.
3) Attenuate Rainwater in Ponds / Open Features for Gradual Release		
Swales / Detention Basins / Ponds	There are no large flat spaces on site suitable for surface features due to the site layout / constraints.	Not proposed due to site constraints.
4) Attenuate Rainwater in Tanks for Gradual Release		
Reduced Discharge and Storage	Existing site discharges to surface water drain.	Proposed for use as there are nearby surface water drains.

Table 2 – SUDS Features Hierarchy and Summary

It is proposed to manage all surface water flows using a flow control device incorporating a Hydrobrake and below ground attenuation tank to store the excess volume.

5. Proposed Surface Water Drainage

The pre-development impermeable area of the site is 1,407m² which represents 60% of the total site area. Post development this will reduce to 1,249m² (53%). Therefore surface water flows generated by the site will reduce post development.

Current guidance is to reduce offsite discharge rates so as to reduce the flood risk of properties downstream of the development.

Due to the underlying ground strata having no soakage potential it is not possible to discharge surface water to ground.

1110m² of the site shall be discharged through the new surface water drainage system, with the remaining 139m² being paths that will discharge to adjacent soft landscaping and there disperse into the upper layers of the soil.

Arun District Council's policy is to reduce offsite flows to as close to greenfield runoff rates as practically possible.

Using IH124 to calculate greenfield runoff rates for 1,110m² (the impermeable area served by the new drainage system) the runoff rates are as per table 3 overleaf, these are backed up by calculations within Appendix E.

Return Period	Greenfield Runoff Rate (ls ⁻¹)
1:1 year	0.3
1:30 year	0.9
1:100 year	1.3

Table 3 – Greenfield Runoff Rates

The greenfield runoff rates are too low to practically limit the new rates to. Therefore offsite flow rates from the new development will be controlled at 2ls⁻¹ through the use of a Hydrobrake flow control device to ensure post development offsite flow rates from the controlled area are considerably less than the pre development flow rates.

Table 4 below demonstrates that offsite flow rates will be significantly reduced from the pre development offsite flow rates. Calculations to back these up can be found in Appendix E.

Return Period	Flow Rate Generated (ls ⁻¹)			% of Pre Development Flow Rate
	Pre Development	Greenfield Runoff	Proposed	
1:1 year	11.0	0.3	1.8	16.4%
1:30 year	26.9	0.9	1.9	7.1%
1:100 year	34.8	1.3	-	-
1:100 year + 40% c.c.	-	-	1.9	5.5%

Table 4 – Post-Development Surface Water Flows

The drainage layout found in Appendix F demonstrates how surface water will be collected via high capacity channel drains and rainwater pipes and temporarily stored in a below ground attenuation tank before discharge to the existing surface water drain to the south-west of the proposed unit.

Due to the large nature of the parking areas and the potential vehicle types (HGVs) that will be accessing it surface water flows from the hard standing will pass through suitably sized Class 1 By Pass Separators in order to improve the water quality prior to discharge. The separator will also be fitted with an appropriate alarm system to provide additional warning should it require action.

The attenuation tanks have been sized to accept surface water flows for all storm events up to and including the 1:100 year event with a 40% allowance for climate change. Calculations proving this can be found in Appendix H.

In the event of surface water drainage system exceedance / failure surface water will pond within the access road and parking areas before running into the road network to the south. This is as per the current situation and therefore has not changed post development.

It is shown that post development offsite surface water flows have reduced.

6. Implementation

The new below ground surface and foul water drainage systems will be constructed as part of the overall development and will be operational prior to first occupation.

7. Adoption

It is not proposed to offer the new below ground surface and foul water drainage systems to Southern Water for Adoption.

8. Drainage Maintenance

The surface water drainage system serving the development will be managed and maintained by the client.

The pipework within the site is designed to be self-cleansing in accordance with Part H of the Building Regulations and as such should have no specific maintenance requirements other than general clearance of silts and debris as and when required.

The use of trapped gullies, catchpits, and inspection chambers will allow future access to maintain the system.

Standard typical maintenance associated with any property will be required for the roof water, gullies and channels, typically consisting of ensuring that the system is clear of any leaves or other debris. This should be carried out as required.

Table 5 sets out the various elements of the drainage system and suggested maintenance requirements.

The separator will be fitted with an alarm to notify the client when it requires immediate action.

Drainage Element	Inspection Requirements	Maintenance Requirements	Inspection Schedule
Gutters & Rainwater Downpipes	Visual inspection to check for blockages.	Clear and blockages / debris found.	Yearly
Channel Drains and Sump Units	Visual inspection for silt / debris.	Clear silt / debris.	Initially after 3 months, then every 6 months.
Pipework	Designed to be self-cleansing, only required if flooding issue occurs, then by specialist CCTV company.	As recommended by specialist CCTV survey company.	When required.
Catchpits	Visual inspection for silt / debris.	Clear silt / debris.	Initially after 3 months, then every 6 months.
Hydrobrake Chamber	Visual inspection for silt / debris.	Clear silt / debris.	Initially after 3 months, then every 6 months.
Attenuation Tank	CCTV survey to check distributor pipe is clear of debris, visual inspection of surface to check for deformation indicating an issue with the tank below.	Clear silt / debris. Excavation and replacement if required.	Yearly
By Pass Separators	As specified / required by manufacturer.	As required by manufacturer.	As required by manufacturer.
Below ground drainage system MUST only be worked on / entered by suitably trained and qualified people using appropriate Health and Safety equipment			
*Access to gutters and roof level downpipes to be discussed and agreed with Client. Due to nature of building specialised access equipment will be required.			

Table 5 – SUDS Maintenance Summary

9. Demonstrate Completion of Works Through Independent Testing

All below ground drainage serving the buildings and the externals will be regularly inspected during the course of construction (air tests / water tests / CCTV surveys as appropriate and deemed necessary – pipework only) and signed off by an approved Building Control Officer.

10. Construction Phase Drainage System

The proposed below ground surface water drainage system is not intended to be used as part of the construction phase drainage system.

Catchpits have been designed into the below ground drainage system to assist with the collection and management of silts and debris and to facilitate access to maintain the system.

11. Conclusions

The site was occupied by hardstanding incorporating parking and access. Existing foul water discharges to the private foul sewer to the south. Surface water discharges to an existing surface water drain running from south-east to north-west across the site ultimately discharging into the Wickfarm Ditch to the west of the site.

The proposed development will form a new connection to the existing surface water manhole and the foul will be connected via an existing manhole.

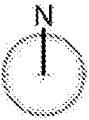
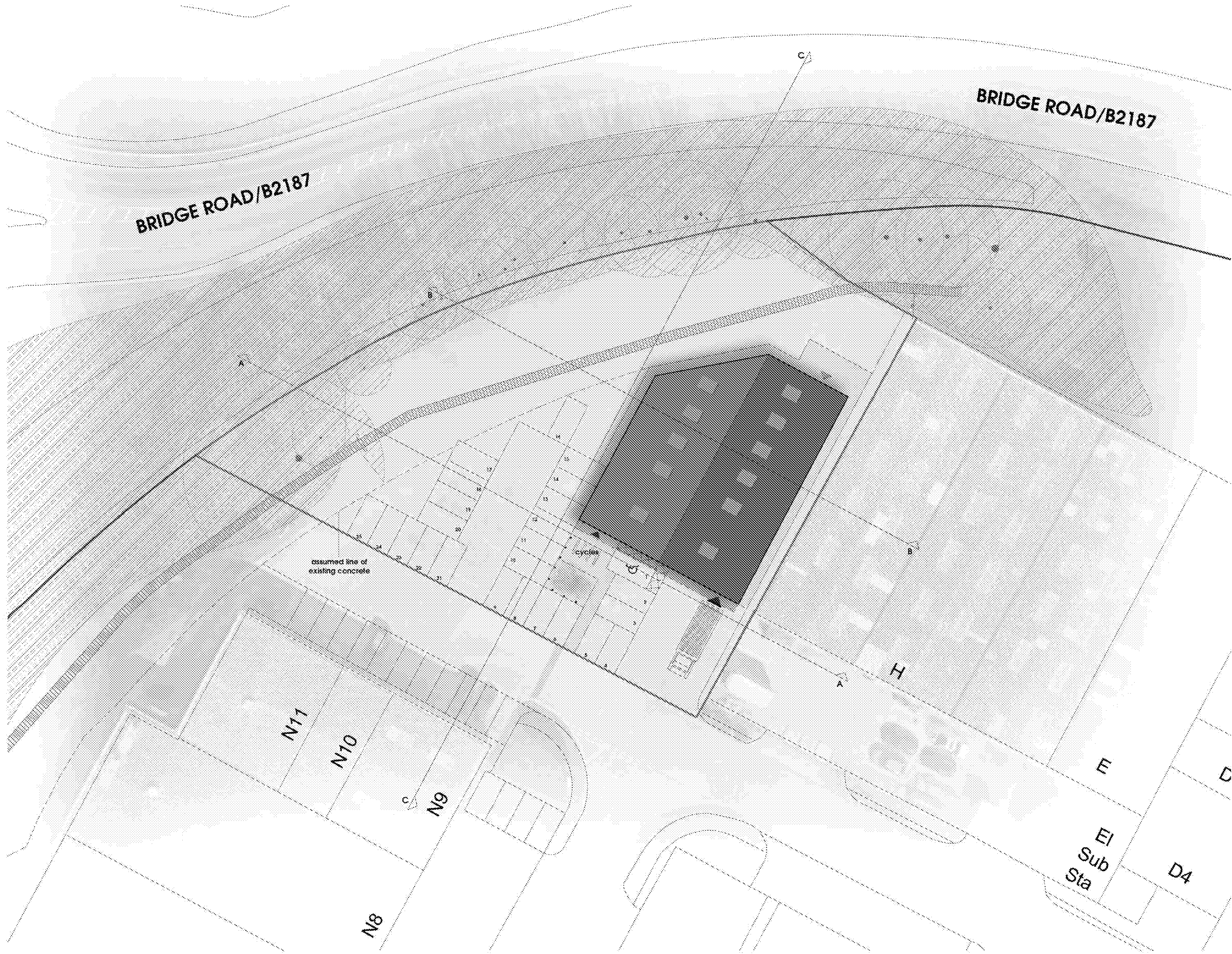
In order to reduce flood risk offsite flow rates shall be controlled through the use of a Hydrobrake to reduce offsite flows to 2ls^{-1} with below ground attenuation tanks to store the excess volumes for all storms up to and including the 1:100 year event with a 40% allowance for climate change.

A class 1 by pass separators will be used to treat the discharges from the parking areas and access prior to discharge to the drain.

Appendix A – Site Location Plan



Appendix B – Proposed Site Plan



**schedule of
accommodation**

Unit 1 GEA - 5680sqft/528sqm
(including 46sqm first floor mezz)

5 no. allocated car parking spaces
(including 1 no. disabled space)
+ 1 no. goods parking space
+ cycle spaces

20 no. unallocated car parking spaces

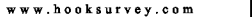
culvert drainage pipe to be diverted
away from new unit

existing culvert

trees to be retained

AC19021R1 - Surface / Foul Water Drainage Strategy Report

Appendix C – Topographic Survey



AC19021R1 - Surface / Foul Water Drainage Strategy Report

Appendix D – Southern Water Sewer Records

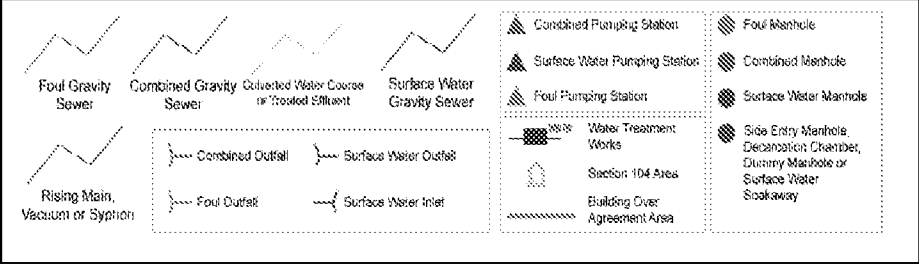


(c) Crown copyright and database rights 2020 Ordnance Survey 100031673 Date: 01/09/20 Scale: 1:1250 Map Centre: 501766,102497 Data updated: 18/08/20 Our Ref: 432188 - 1 Wastewater Plan A3

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2020 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



cnewlands@rsk.co.uk
Riverside



Appendix E – Offsite Surface Water Flows Calculations

Pre Development Offsite Flows

Impermeable area = 1,407 m²

Micro Drainage Rainfall Profiles

1:1 year, 15 minute storm	28.110 mmhr ⁻¹
1:30 year, 15 minute storm	68.836 mmhr ⁻¹
1:100 year, 15 minute storm	89.024 mmhr ⁻¹

Offsite Flow Rates

1:1 year, 15 minute storm	11.0 ls ⁻¹
1:30 year, 15 minute storm	26.9 ls ⁻¹
1:100 year, 15 minute storm	34.8 ls ⁻¹

Greenfield Runoff Rates

IH 124 gives greenfield runoff rates for a 50ha site, guidance for sites smaller than this is to linearly interpolate down to the site size (1,140m² drained area), greenfield rates calculated using Micro Drainage.

	1 year	30 year	100 year
IH 124 (50ha)	152.8 ls ⁻¹	407.5 ls ⁻¹	573.6 ls ⁻¹
Site Specific (6990m ²)	0.3 ls ⁻¹	0.9 ls ⁻¹	1.3 ls ⁻¹

Post Development Offsite Flows

Micro Drainage Model Results

Impermeable area = 1,110 m²

1:1 year event	1.8 ls ⁻¹
1:30 year event	1.9 ls ⁻¹
1:100 +40% allowance for c.c.	1.9 ls ⁻¹

Remaining Uncontrolled Paths

Impermeable area = 139 m²

1:1 year, 15 minute storm	1.1 ls ⁻¹
1:30 year, 15 minute storm	2.7 ls ⁻¹
1:100 year, 15 minute storm +40%	4.8 ls ⁻¹

Total Offsite Flow Rates

2.9 ls ⁻¹
4.6 ls ⁻¹
6.7 ls ⁻¹



NOTES

- DO NOT SCALE THIS DRAWING.
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POST DEVELOPMENT AREAS

SOFT LANDSCAPING AREA = 1,096m²

HARDSTANDING AREA = 738m²

BUILDING ROOF AREA = 501m²

TOTAL IMPERMEABLE AREA = 1,249m²

TOTAL AREA = 2,335m²

PRE DEVELOPMENT AREAS

SOFT LANDSCAPING AREA = 928m²

HARDSTANDING AREA = 1,407m²

BUILDING ROOF AREA = 0m²

TOTAL IMPERMEABLE AREA = 1,407m²

TOTAL AREA = 2,335m²

PRELIMINARY ISSUE

P2	20/11/2020	MH	MH	ROOT PROTECTION ZONE ADDED
P1	04/11/2020	MH	MH	PRELIMINARY ISSUE
Rev	Date	By	Crtd.	Revision notes

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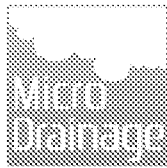
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ESTATE, LITTLEHAMPTON,
BN17 5DF.**

Drawing Title
MEASURED AREAS LAYOUT.

Client
LONDON & CAMBRIDGE PROPERTIES

Scale at A1: 1:200	Drawn: MH Date: NOV'2020	Checked: MH Date: NOV'2020
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Drawing No.: AC19021-SK-C-005	Revision: P2
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Abstract Consulting Ltd		Page 1
The Highland Suite Great Hollenden Business Centre Sevenoaks Kent TN15 0SQ		
Date 04/11/2020 10:04 File	Designed by Martinhowell Checked by	
Causeway Source Control 2020.1		

IH 124 Mean Annual Flood

Input

Return Period (years)	1	Soil	0.400
Area (ha)	50.000	Urban	0.000
SAAR (mm)	734	Region Number	Region 7

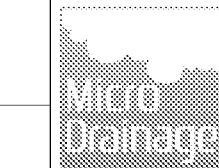
Results l/s

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QBAR Urban 179.8

Q1 year 152.8

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Q2 years 158.4
Q5 years 230.2
Q10 years 291.3
Q20 years 360.2
Q25 years 386.3
Q30 years 407.5
Q50 years 471.1
Q100 years 573.6
Q200 years 674.3
Q250 years 706.7
Q1000 years 927.9

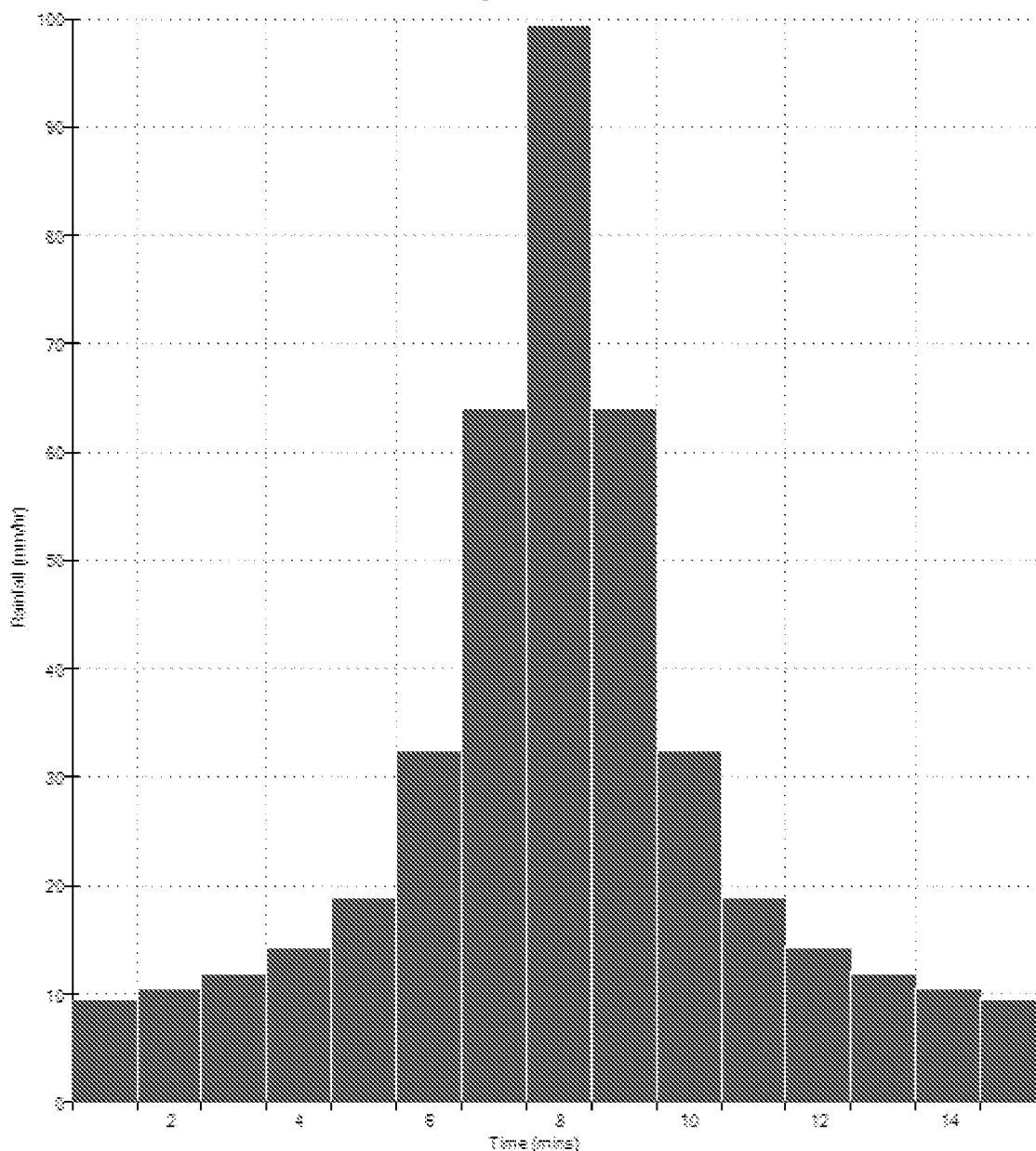
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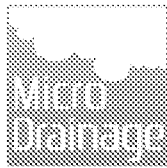
Rainfall profile

Storm duration (mins) 15

FSR Data
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M5-60 (mm) 19.000
Ratio R 0.350
Peak Intensity (mm/hr) 99.342
Ave. Intensity (mm/hr) 28.110
Return Period (years) 1.0



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Causeway		Source Control 2020.1

Rainfall profile

Storm duration (mins) 15

FSR Data

Region England and Wales

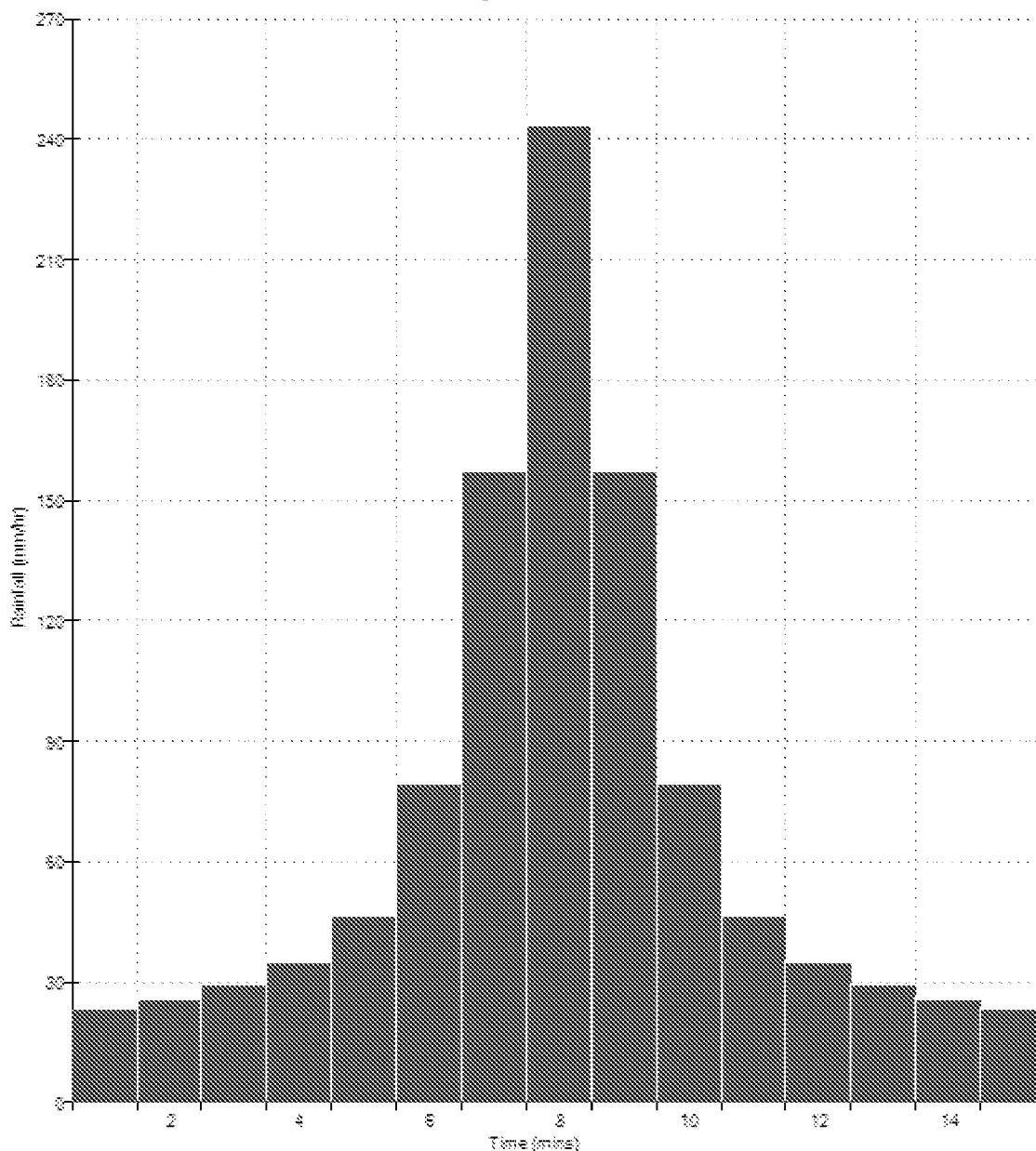
M5-60 (mm) 19.000

Ratio R 0.350

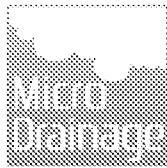
Peak Intensity (mm/hr) 243.268

Ave. Intensity (mm/hr) 68.836

Return Period (years) 30.0



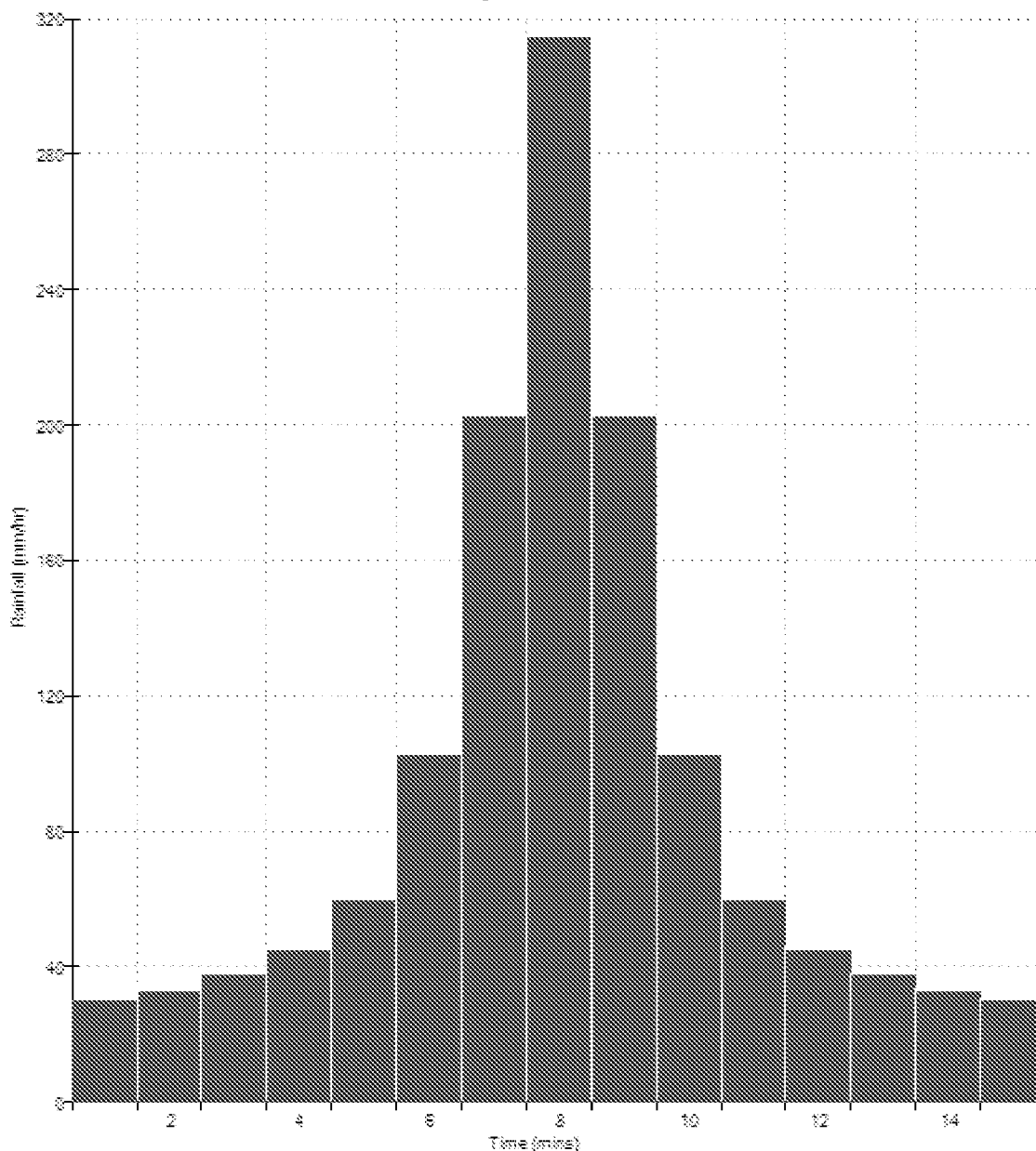
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Rainfall profile

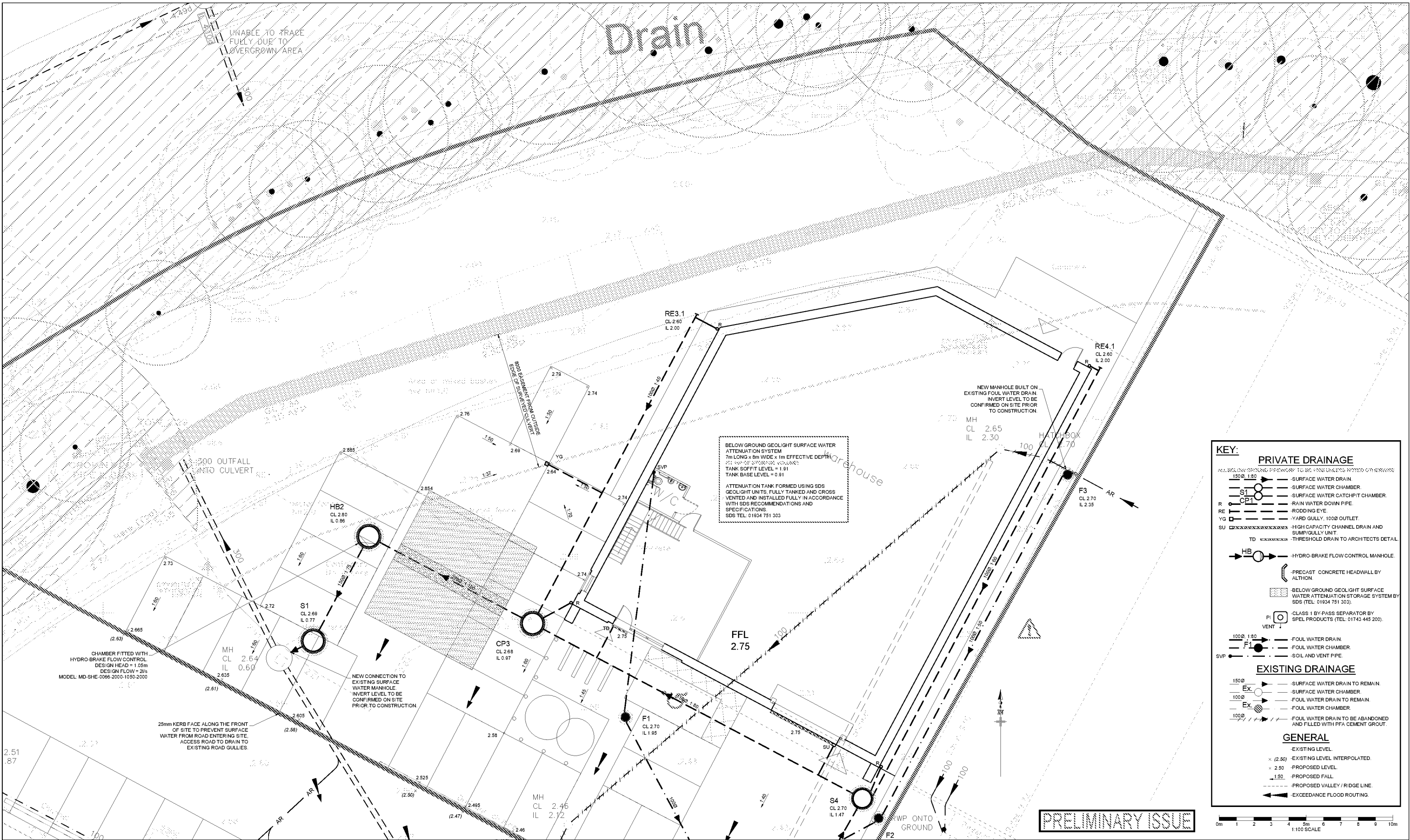
Storm duration (mins) 15

FSR Data
Region England and Wales
M5-60 (mm) 19.000
Ratio R 0.350
Peak Intensity (mm/hr) 314.610
Ave. Intensity (mm/hr) 89.024
Return Period (years) 100.0



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Appendix F – Proposed Drainage Layout



KEY:

PRIVATE DRAINAGE

- 150Ø 180 — SURFACE WATER DRAIN.
- S1 — SURFACE WATER CHAMBER.
- CP1 — SURFACE WATER CATCHPIT CHAMBER.
- R — RAIN WATER DOWN P.F.F.
- RE — RODDING EYE.
- YG — YARD GULLY, 100Ø OUTLET.
- SU — HIGH CAPACITY CHANNEL DRAIN AND SUMP/GULLY UNIT.
- TD — THRESHOLD DRAIN TO ARCHITECTS DETAIL.
- HB — HYDRO-BRAKE FLOW CONTROL MANHOLE.
- PRECAST CONCRETE HEADWALL BY ALTHON.
- BELOW GROUND GEOLIGHT SURFACE WATER ATTENUATION STORAGE SYSTEM BY SDS (TEL: 01934 751 303).
- P1 — CLASS 1 BY PASS SEPARATOR BY SPEL PRODUCTS (TEL: 01743 445 200).
- VENT — VENT.
- 100Ø 180 — FOUL WATER DRAIN.
- F1 — FOUL WATER CHAMBER.
- SVP — SOIL AND VENT PIPE.

EXISTING DRAINAGE

- 150Ø — SURFACE WATER DRAIN TO REMAIN.
- Ex. — SURFACE WATER CHAMBER.
- 100Ø — FOUL WATER DRAIN TO REMAIN.
- Ex. — FOUL WATER CHAMBER.
- 100Ø — FOUL WATER DRAIN TO BE ABANDONED AND FILLED WITH PFA CEMENT GROUT.

GENERAL

- EXISTING LEVEL.
- x (2.50) — EXISTING LEVEL INTERPOLATED.
- x 2.50 — PROPOSED LEVEL.
- 1.50 — PROPOSED FALL.
- PROPOSED VALLEY / RIDGE LINE.
- EXCEEDANCE FLOOD ROUTING.

0m 1 2 3 4 5m 6 7 8 9 10m
1:100 SCALE

NOTES

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 - GDM ARCHITECTS, PROPOSED SITE PLAN, 4079p002b, SEPT 2020
 - SDS SURVEY DESIGN SERVICES / SWEEPTCH PIPELINE TRACE DRAWING NO. SDS 207324 01 REV. DATED JUNE 2020.

CDM REGULATIONS 2015 RESIDUAL HAZARDS

RESIDUAL HAZARDS IDENTIFIED

CONSTRUCTION

- WORKING ON / OVER AND ADJACENT TO WATER.
- DRAINAGE ALONG EDGE OF EXISTING BUILDING TO BE INSTALLED IN SECTIONS TO AVOID UNDERMINING OF FOUNDATIONS.

FUTURE DEMOLITION

A. NO SIGNIFICANT RESIDUAL HAZARDS BEYOND THOSE KNOWN TO AN EXPERIENCED CONTRACTOR.

THIS REGISTER IS A NON-EXHAUSTIVE LIST OF RESIDUAL HAZARDS RELATING TO THE WORKS SHOWN ON THIS DRAWING THAT HAVE BEEN IDENTIFIED DURING THE DESIGN STAGE.

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A CONTRACTOR WITH THE APPROPRIATE SKILLS, KNOWLEDGE & EXPERIENCE AND IF THEY ARE AN ORGANISATION, THE ORGANISATIONAL CAPABILITY NECESSARY TO FULFIL THE ROLE.

Rev	Date	By	Chkd.	Revision notes
P3	31/10/2020	MH	MH	BUILDING SHAPE AMENDED, CULVERT DIVERSION REMOVED
P2	23/11/2020	MH	MH	ROOT PROTECTION ZONE ADDED
P1	04/11/2020	AJ	MRW	ISSUE FOR INFORMATION

Job Title
RIVERSIDE INDUSTRIAL ESTATE, LITTLEHAMPTON, BN17 5DF.

Drawing Title
DRAINAGE STRATEGY SKETCH SHEET 1 OF 2.

abstrud consulting
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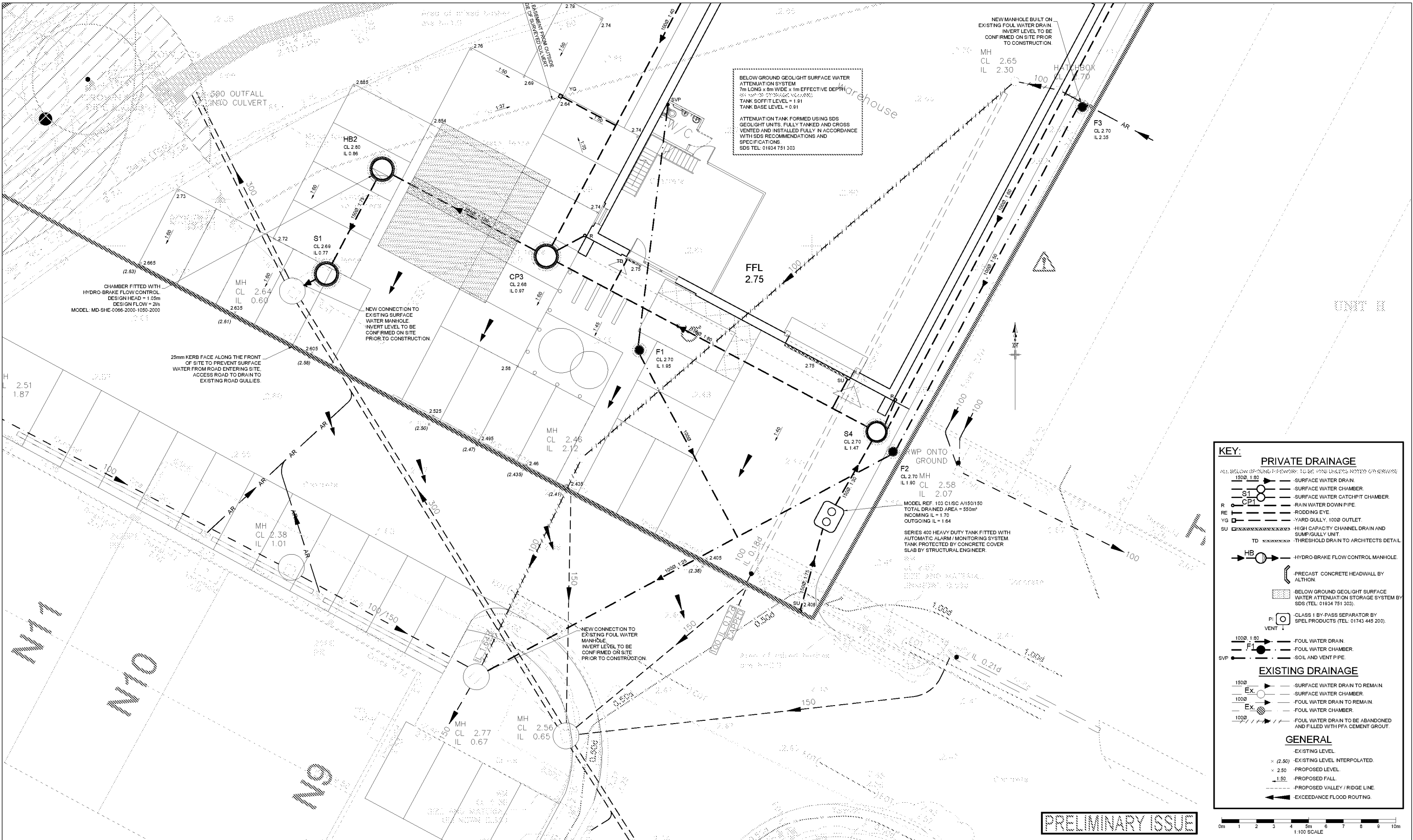
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AJ
Date:
NOV/2020

Checked:
MRW
Date:
NOV/2020

Drawing No.:
AC19021-SK-C-003

Revision:
P3



KEY:

PRIVATE DRAINAGE

ALL BELOW GROUND PIPEWORK TO BE UNDER THE MOTED OR KERB

- 1500 1.80 — SURFACE WATER DRAIN
- SURFACE WATER CHAMBER
- S1 — SURFACE WATER CATCH/PIT CHAMBER
- R — RAIN WATER DOWN PIPE
- RE — RODDING EYE
- YG — YARD GULLY, 1000 OUTLET
- SU — HIGH CAPACITY CHANNEL DRAIN AND SUMP/GULLY UNIT
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- 1000 1.80 — FOUL WATER DRAIN
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- SVP — SOIL AND VENT PIPE

EXISTING DRAINAGE

- 1500 — SURFACE WATER DRAIN TO REMAIN
- Ex. — SURFACE WATER CHAMBER
- 1000 — FOUL WATER DRAIN TO REMAIN
- Ex. — FOUL WATER CHAMBER
- 1000 — FOUL WATER DRAIN TO BE ABANDONED AND FILLED WITH PFA CEMENT GROUT

GENERAL

- EXISTING LEVEL
- x (2.50) — EXISTING LEVEL INTERPOLATED
- > 2.50 — PROPOSED LEVEL
- 1.50 — PROPOSED FALL
- PROPOSED VALLEY / RIDGE LINE
- EXCEEDANCE FLOOD ROUTING

0m 1 2 3 4 5 6 7 8 9 10m
1:100 SCALE

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 - HOOK SURVEY PARTNERSHIP, TOPOGRAPHICAL SURVEY, S167471, REV.
 - GDM ARCHITECTS, FEASIBILITY PLAN, 4076/SK02, FEB 2020
 - SDS SURVEY DESIGN SERVICES / SWEEPTCH PIPELINE TRACE DRAWING NO. SDS 207324.01 REV., DATED JUNE 2020.

CDM REGULATIONS 2015 RESIDUAL HAZARDS

RESIDUAL HAZARDS IDENTIFIED

CONSTRUCTION

- WORKING ON / OVER AND ADJACENT TO WATER.
- DRAINAGE ALONG EDGE OF EXISTING BUILDING TO BE INSTALLED IN SECTIONS TO AVOID UNDERMINING OF FOUNDATIONS.

FUTURE DEMOLITION

- NO SIGNIFICANT RESIDUAL HAZARDS BEYOND THOSE KNOWN TO AN EXPERIENCED CONTRACTOR.

THIS REGISTER IS A NON-EXHAUSTIVE LIST OF RESIDUAL HAZARDS RELATING TO THE WORKS SHOWN ON THIS DRAWING THAT HAVE BEEN IDENTIFIED DURING THE DESIGN STAGE.

IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A CONTRACTOR WITH THE APPROPRIATE SKILLS, KNOWLEDGE & EXPERIENCE, AND IF THEY ARE AN ORGANISATION, THE ORGANISATIONAL CAPABILITY NECESSARY TO FULFIL THE ROLE.

Rev	Date	By	Chkd.	Revision notes
P3	21/12/2020	MH	MH	BUILDING SHAPE AMENDED, CULVERT DIVERSION REMOVED.
P2	25/11/2020	MH	MH	ROOT PROTECTION ZONE ADDED
P1	04/11/2020	AJ	MRW	ISSUE FOR INFORMATION

Job Title
RIVERSIDE INDUSTRIAL ESTATE, LITTLEHAMPTON, BN17 5DF.

Drawing Title
DRAINAGE STRATEGY SKETCH SHEET 2 OF 2.

abstruct consulting
The Highland Suite, Great Hollenden Business Centre,
Mill Lane, Underwiler, Saverock, Kent TN11 5 0SQ
T: 01732 838050 E: info@abstruct-consulti.com www.abstruct-consulti.com

Client
LONDON & CAMBRIDGE PROPERTIES

Scale at A1: 1:100	Drawn: AJ Date: NOV/2020	Checked: MRW Date: NOV/2020
Drawing No.: AC19021-SK-C-004	Revision: P3	

Appendix G – British Geological Survey Borehole Extract

GROUND EXPLORATIONS LTD.

BOREHOLE NO. 19

TQ00SW/16

Contract Name LITTLEHAMPTON.

Report No. 4412/SJB.

Client West Sussex County Council,

Site Address

Address County Surveyor's Department,

Littlehampton,

County Hall,

West Sussex.

Chichester, Sussex.

0177 0259

Standing Water Level 6' 0"

Method of Boring Shell/auger.

Water Struck 7' 0"

Diameter 6 ins.

Ground Level 8.53

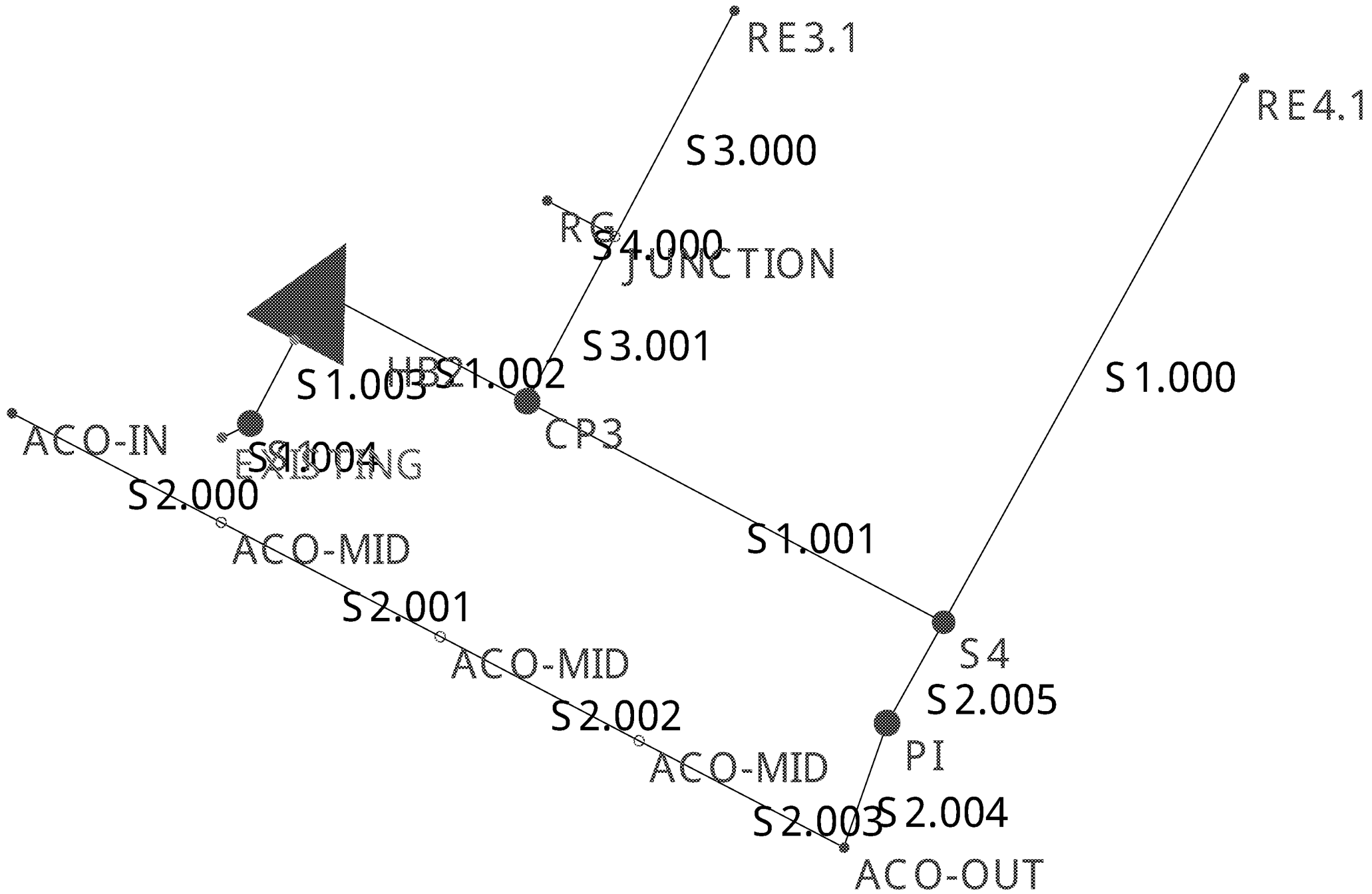
Start 19.6.68. Finish 19.6.68.

Remarks

JARS		CORES		BULK	
2552	1' 6"	2553	3' 6"		
2554	7' 0"				
2555	9' 0"				
2556	Water				
Description				Thickness	Depth
Topsoil				1' 0"	1' 0"
Brown sandy clay and flints } ? GRACONTH				2' 0"	3' 0"
Firm brown chalky clay } second deposits				4' 6"	7' 6"
Weathered chalk				2' 6"	10' 0"
TOTALS				10' 0"	10' 0"

- Notes
1. Descriptions are in accordance with B.S. Code of Practice C.P. 2001
Clients are requested to compare with samples submitted.
 2. Core samples are nominally 4 ins. diameter and 18 ins. long.
Depths shown are to top of sample.

Appendix H – Surface Water Calculations



Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.079	4-8	0.031

Total Area Contributing (ha) = 0.110

Total Pipe Volume (m³) = 3.271

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Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
S1.000	28.362	0.480	59.1	0.013	5.00	0.0	0.600	o	100	Pipe/Conduit
S2.000	10.752	0.050	215.0	0.010	5.00	0.0	0.600	Q22	-2	Pipe/Conduit
S2.001	11.272	0.110	102.5	0.017	0.00	0.0	0.600	Q22	-2	Pipe/Conduit
S2.002	10.231	0.070	146.2	0.014	0.00	0.0	0.600	Q22	-2	Pipe/Conduit
S2.003	10.552	0.020	527.6	0.014	0.00	0.0	0.600	Q22	-2	Pipe/Conduit
S2.004	6.021	0.080	75.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S2.005	5.275	0.170	31.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.001	21.504	0.270	79.6	0.016	0.00	0.0	0.600	o	150	Pipe/Conduit
S3.000	11.660	0.295	39.5	0.007	5.00	0.0	0.600	o	100	Pipe/Conduit
S4.000	3.487	0.315	11.1	0.007	5.00	0.0	0.600	o	100	Pipe/Conduit
S3.001	8.516	0.215	39.6	0.000	0.00	0.0	0.600	o	100	Pipe/Conduit
S1.002	10.680	0.110	97.1	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.003	6.819	0.090	75.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit
S1.004	1.444	0.020	72.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S1.000	2.000	0.013	0.0	1.00	7.9
S2.000	2.280	0.010	0.0	0.89	35.6
S2.001	2.230	0.027	0.0	1.30	51.8
S2.002	2.120	0.041	0.0	1.08	43.3
S2.003	2.050	0.055	0.0	0.56	22.6
S2.004	1.780	0.055	0.0	1.16	20.5
S2.005	1.640	0.055	0.0	1.81	32.1
S1.001	1.470	0.083	0.0	1.13	19.9
S3.000	2.000	0.007	0.0	1.23	9.7
S4.000	2.020	0.007	0.0	2.34	18.3
S3.001	1.705	0.014	0.0	1.23	9.7
S1.002	0.970	0.110	0.0	1.33	52.8
S1.003	0.860	0.110	0.0	1.16	20.4
S1.004	0.770	0.110	0.0	1.18	20.9

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.013	0.013	0.013
2.000	User	-	100	0.010	0.010	0.010
2.001	User	-	100	0.017	0.017	0.017
2.002	User	-	100	0.014	0.014	0.014
2.003	User	-	100	0.014	0.014	0.014
2.004	-	-	100	0.000	0.000	0.000
2.005	-	-	100	0.000	0.000	0.000
1.001	User	-	100	0.016	0.016	0.016
3.000	User	-	100	0.007	0.007	0.007
4.000	User	-	100	0.007	0.007	0.007
3.001	-	-	100	0.000	0.000	0.000
1.002	User	-	100	0.013	0.013	0.013
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.110	0.110	0.110

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
---------------------	--------------	--------------	--------------	------------------	----------	--------

S1.004	EXISTING	2.640	0.750	0.600	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Storm

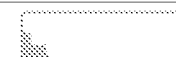
Hydro-Brake® Optimum Manhole: HB2, DS/PN: S1.003, Volume (m³): 2.6

Unit Reference	MD-SHE-0066-2000-1050-2000
Design Head (m)	1.050
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	66
Invert Level (m)	0.860
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.050	2.0	Kick-Flo®	0.592	1.5
Flush-Flo™	0.292	1.9	Mean Flow over Head Range	-	1.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	0.800	1.8	2.000	2.7	4.000	3.7	7.000	4.8
0.200	1.9	1.000	2.0	2.200	2.8	4.500	3.9	7.500	5.0
0.300	1.9	1.200	2.1	2.400	2.9	5.000	4.1	8.000	5.1
0.400	1.9	1.400	2.3	2.600	3.0	5.500	4.3	8.500	5.3
0.500	1.8	1.600	2.4	3.000	3.2	6.000	4.5	9.000	5.4
0.600	1.6	1.800	2.6	3.500	3.5	6.500	4.6	9.500	5.6

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Storage Structures for Storm

Cellular Storage Manhole: HB2, DS/PN: S1.003

Invert Level (m) 0.910 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	53.8	0.0	1.000	53.8	0.0	1.001	0.0	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged
									Level (m)	Depth (m)
S1.000	RE4.1	15 Winter	1	+0%	100/15 Summer				2.031	-0.069
S2.000	ACO-IN	15 Winter	1	+0%					2.309	-0.196
S2.001	ACO-MID	15 Winter	1	+0%					2.265	-0.190
S2.002	ACO-MID	15 Winter	1	+0%	100/15 Summer				2.167	-0.178
S2.003	ACO-MID	15 Winter	1	+0%	100/15 Summer				2.129	-0.146
S2.004	ACO-OUT	15 Winter	1	+0%	30/15 Winter				1.841	-0.089
S2.005	PI	15 Winter	1	+0%	30/15 Summer				1.689	-0.101
S1.001	S4	15 Winter	1	+0%	30/15 Summer				1.544	-0.076
S3.000	RE3.1	15 Winter	1	+0%					2.021	-0.079
S4.000	RG	15 Winter	1	+0%					2.035	-0.085
S3.001	JUNCTION	15 Winter	1	+0%					1.734	-0.071
S1.002	CP3	15 Winter	1	+0%	30/30 Summer				1.050	-0.145
S1.003	HB2	60 Winter	1	+0%	1/30 Winter				1.028	0.018
S1.004	S1	60 Winter	1	+0%					0.811	-0.109

PN	US/MH Name	Flooded		Half Drain		Pipe		Status	Level Exceeded
		Volume (m ³)	Flow / Cap.	Overflow (l/s)	Time (mins)	Flow (l/s)			
S1.000	RE4.1	0.000	0.20			1.6		OK	
S2.000	ACO-IN	0.000	0.04			1.3		OK	
S2.001	ACO-MID	0.000	0.07			3.1		OK	
S2.002	ACO-MID	0.000	0.12			4.5		OK	
S2.003	ACO-MID	0.000	0.35			6.0	FLOOD RISK*		
S2.004	ACO-OUT	0.000	0.35			6.0		OK	
S2.005	PI	0.000	0.23			6.0		OK	
S1.001	S4	0.000	0.48			9.1		OK	
S3.000	RE3.1	0.000	0.10			0.9		OK	
S4.000	RG	0.000	0.06			0.8		OK	
S3.001	JUNCTION	0.000	0.18			1.8		OK*	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded		Half Drain Pipe		Status	Level Exceeded
		Volume (m³)	Flow / Cap. (l/s)	Time (mins)	Flow (l/s)		
S1.002	CP3	0.000	0.27		12.0	OK	
S1.003	HB2	0.000	0.10	43	1.8	SURCHARGED	
S1.004	S1	0.000	0.17		1.8	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

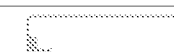
Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

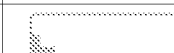
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged
									Level (m)	Depth (m)
S1.000	RE4.1	15 Winter	30	+0%	100/15 Summer				2.051	-0.049
S2.000	ACO-IN	15 Winter	30	+0%					2.325	-0.180
S2.001	ACO-MID	15 Winter	30	+0%					2.292	-0.163
S2.002	ACO-MID	15 Winter	30	+0%	100/15 Summer				2.220	-0.125
S2.003	ACO-MID	15 Winter	30	+0%	100/15 Summer				2.201	-0.074
S2.004	ACO-OUT	15 Winter	30	+0%	30/15 Winter				1.931	0.001
S2.005	PI	15 Winter	30	+0%	30/15 Summer				1.836	0.046
S1.001	S4	15 Winter	30	+0%	30/15 Summer				1.769	0.149
S3.000	RE3.1	15 Winter	30	+0%					2.034	-0.066
S4.000	RG	15 Winter	30	+0%					2.045	-0.075
S3.001	JUNCTION	15 Winter	30	+0%					1.752	-0.053
S1.002	CP3	120 Winter	30	+0%	30/30 Summer				1.319	0.124
S1.003	HB2	120 Winter	30	+0%	1/30 Winter				1.317	0.307
S1.004	S1	480 Summer	30	+0%					0.812	-0.108

PN	US/MH Name	Flooded		Half Drain		Pipe		Level Exceeded
		Volume (m ³)	Flow / Cap. (l/s)	Flow / Cap. (l/s)	Time (mins)	Flow (l/s)	Status	
S1.000	RE4.1	0.000	0.50			3.8	OK	
S2.000	ACO-IN	0.000	0.10			3.1	OK	
S2.001	ACO-MID	0.000	0.18			8.6	FLOOD RISK*	
S2.002	ACO-MID	0.000	0.34			12.9	FLOOD RISK*	
S2.003	ACO-MID	0.000	1.02			17.3	FLOOD RISK*	
S2.004	ACO-OUT	0.000	1.02			17.4	SURCHARGED	
S2.005	PI	0.000	0.64			16.5	SURCHARGED	
S1.001	S4	0.000	1.25			23.5	SURCHARGED	
S3.000	RE3.1	0.000	0.25			2.3	OK	
S4.000	RG	0.000	0.14			2.1	OK	
S3.001	JUNCTION	0.000	0.44			4.3	OK*	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded		Half Drain		Pipe Flow (l/s)	Status	Level Exceeded
		Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Time (mins)			
S1.002	CP3	0.000	0.26			11.4	SURCHARGED	
S1.003	HB2	0.000	0.11		107	1.9	SURCHARGED	
S1.004	S1	0.000	0.17			1.9	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
 Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
 Hot Start Level (mm) 0 Inlet Coefficient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
 Foul Sewage per hectare (l/s) 0.000

 Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status ON
 Inertia Status ON

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged
									Level (m)	Depth (m)
S1.000	RE4.1	15 Winter	100	+40%	100/15 Summer				2.453	0.353
S2.000	ACO-IN	15 Winter	100	+40%					2.423	-0.082
S2.001	ACO-MID	15 Winter	100	+40%					2.417	-0.038
S2.002	ACO-MID	15 Winter	100	+40%	100/15 Summer				2.404	0.059
S2.003	ACO-MID	15 Winter	100	+40%	100/15 Summer				2.386	0.111
S2.004	ACO-OUT	15 Winter	100	+40%	30/15 Winter				2.362	0.432
S2.005	PI	15 Winter	100	+40%	30/15 Summer				2.251	0.461
S1.001	S4	15 Winter	100	+40%	30/15 Summer				2.155	0.535
S3.000	RE3.1	15 Winter	100	+40%					2.047	-0.053
S4.000	RG	15 Winter	100	+40%					2.054	-0.066
S3.001	JUNCTION	120 Winter	100	+40%					1.805	0.000
S1.002	CP3	240 Winter	100	+40%	30/30 Summer				1.820	0.625
S1.003	HB2	240 Winter	100	+40%	1/30 Winter				1.818	0.808
S1.004	S1	240 Winter	100	+40%					0.812	-0.108

PN	US/MH Name	Flooded		Half Drain	Pipe	Status	Level Exceeded
		Volume (m³)	Flow / Cap.	Overflow (l/s)	Time (mins)		
S1.000	RE4.1	0.000	0.78			6.0	FLOOD RISK
S2.000	ACO-IN	0.000	0.18			5.4	FLOOD RISK
S2.001	ACO-MID	0.000	0.29			13.8	FLOOD RISK*
S2.002	ACO-MID	0.000	0.51			19.1	FLOOD RISK*
S2.003	ACO-MID	0.000	1.50			25.6	FLOOD RISK*
S2.004	ACO-OUT	0.000	1.23			21.0	FLOOD RISK
S2.005	PI	0.000	0.85			22.0	FLOOD RISK
S1.001	S4	0.000	1.72			32.4	SURCHARGED

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The Highland Suite Great Hollanden Business Centre Sevenoaks Kent TN15 0SQ		
Date 21/12/2020 12:45	Designed by Martinhowell	
File AC19021 - SW Calcs P3.MDX	Checked by	
Causeway		Network 2020.1

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded		Half Drain		Pipe Flow (l/s)	Status	Level Exceeded
		Volume (m³)	Flow / Cap. (l/s)	Overflow	Time (mins)			
S3.000	RE3.1	0.000	0.45			4.1	OK	
S4.000	RG	0.000	0.25			3.8	OK	
S3.001	JUNCTION	0.000	0.28			2.7	SURCHARGED*	
S1.002	CP3	0.000	0.28			12.4	SURCHARGED	
S1.003	HB2	0.000	0.11			1.9	SURCHARGED	
S1.004	S1	0.000	0.18			1.9	OK	