AMENDED

Flood Risk Assessment

for

Proposed Residential Development at
Bentletts Scrap Yard
Claygate Road
Collier Street
Kent

1129-1008

February 2016

Rec'd 15.03.16

Proposed Residential Development
Bentletts Scrap Yard
Claygate Road
Collier Street
Kent

Flood Risk Assessment
With Drainage Strategy Layout

February 2016

Prepared by	Reviewed by
Ray Clark	Mark Dann

Client: Wealden Homes

0 INTRODUCTION

a) Instructions were received from Wealden Homes to undertake a further Flood Risk Assessment to appraise a 25 dwelling development at Bentletts Scrap yard, Claygate Road, Collier Street, Kent. The previous assessment was for a 31 dwelling scheme.

b) The assessment has been undertaken in compliance with the Technical Guidance to the National Planning Policy Framework March 2012 (NPPF).

c) The information used for the preparation of this assessment is given in the Appendices.

d) This assessment has been prepared by Ray Clark under guidance by RCD Consultants Ltd.

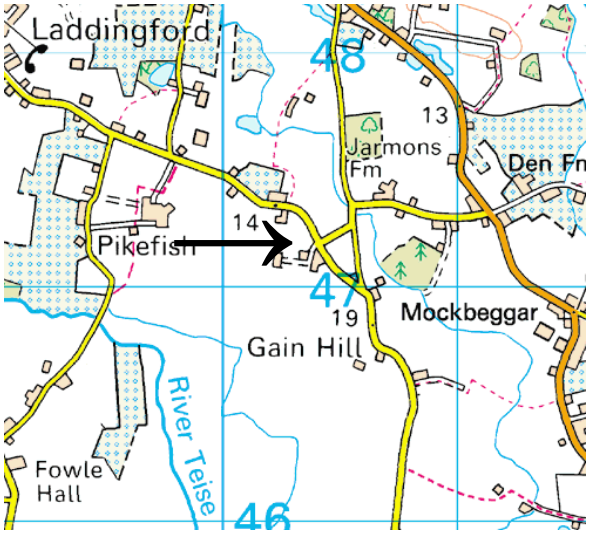
e) The Client's attention is drawn to the Conditions and Limitations within Appendix F of this report.

1 DEVELOPMENT DESCRIPTION & LOCATION

a) ***What type of development is proposed and where will it be located?***

The development site comprises the construction of 25 dwellings. The site is located at Bentletts Scrap Yard, Claygate Road, Collier Street, Kent.

THE SITE



The site lies approximately 1Km from the nearest watercourse, River Teise, which is due southwest of the site. The subject site lies at approximately 50.5m AOD.

The existing site is classified as 'Brownfield' as it is an existing commercial vehicle scrap yard.

b) ***What is the vulnerability classification?***

In accordance with Table 2 in NPPF (March 2012), the proposed buildings are classified as “more vulnerable” being of residential use.

c) ***Is the proposed development consistent with the Local Development Documents?***

As far as Flood Risk is concerned the development is consistent with the Local Development Documents as it is located in Flood Zone 1, which is an area where **flooding does not occur**, refer to the Environment Agency mapping below and in the Appendices.

d) ***Please provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this development type?***

The development is located within flood zone 1 and as identified in table 3 of the NPPF (March 2012) the development is appropriate for zone 1. The Sequential and Exception tests are therefore not required.

2 DEFINITION OF THE FLOOD HAZARD

a) ***What sources of flooding could affect the site?***

Potential Source	**Yes/No**
Flooding from Rivers	No
Flooding from the Sea	No
Flooding from Land	No
Flooding from Groundwater	No
Flooding from Sewers	No
Flooding from Reservoirs, Canals and other Artificial Sources	No

b) ***For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available?***

FLOODING FROM RIVERS

The River Teise is approximately 1Km southwest of the proposed development.

The site lies on a ridge of land approximately 5-10m above surrounding levels associated with the River Teise. These surrounding areas are known to flood during extended rainfall events.

The Strategic Flood Risk Assessment, SFRA, confirms that there have been no reported instances of flooding from watercourses within the vicinity of the site.

The SFRA was prepared by Mott MacDonald in 2008.

The risk of flooding within the development boundaries, from Rivers, is considered to be low.

FLOODING FROM THE SEA

The site is not close to the sea and there have been no recorded instances of the site flooding due to the Sea.

FLOODING FROM LAND

The site lies on a ridge of high ground bounded by ditches and slopes towards Claygate Road.

It is therefore considered that the risk of flooding from the land is low.

FLOODING FROM GROUNDWATER

The risk of flooding from ground water is considered to be low as the underlying strata is impermeable Weald clay.

FLOODING FROM SEWERS

There are no public sewers within the vicinity of the site and all existing private sewers will be removed as part of the demolition process.

The risk of flooding from sewers is therefore low.

FLOODING FROM RESERVIORS, CANALS AND OTHER ARTIFICIAL SOURCES

The SFRA confirms that there have been no instances of flooding within the vicinity of the site.

c) ***What are the existing surface water drainage arrangements for this site?***

Surface water currently discharges to ditches adjacent to the site boundaries and as the site is predominantly hard standing this will be in the form of overland flows at an unrestricted rate during extreme storm events.

The existing hard standing areas have been measured at approximately 1.34Ha

The current owner has a trade effluent licence to discharge treated water to the ditches.

3 PROBABILITY

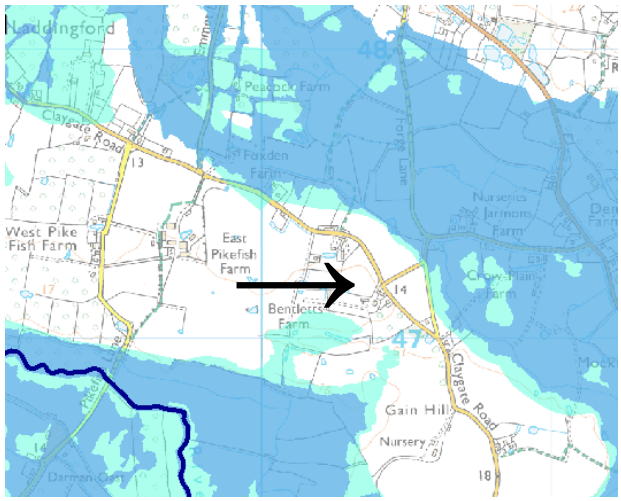
a) *Which flood zone is the site within?*

The relevant flood map attached to the SFRA which is included in the Appendix represents current best estimates of zone 2 and zone 3 flooding as defined in Table 1 of NPPF March 2012.

Zone 1	Low Probability of river or sea flooding
Zone 2	Medium Probability of river or sea flooding
Zone 3a	High Probability of river or sea flooding
Zone 3b	Functional Floodplain

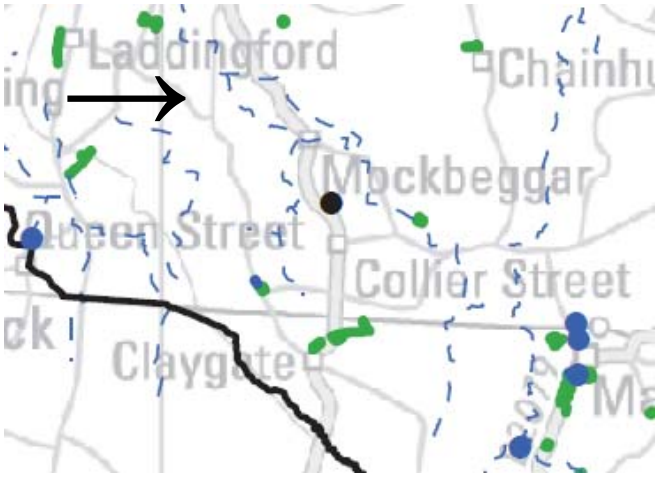
The map contained within the SFRA (extracts below) confirms that the site falls within Zone 1. A full copy of the map is included in Appendix A.

THE SITE



Extract from EA website showing risk of flooding from rivers

THE SITE



Extract from SFRA Map – Flood Risk Problems

b) ***If there is a Strategic Flood Risk Assessment covering this site, what does it show?***

A SFRA has been prepared by Mott MacDonald and Maidstone Borough Council and is dated May 2008. This shows that the site lies with Flood Zone 1 and is at a low risk of flooding.

c) ***What is the probability of the site flooding taking account of the contents of the SFRA and of any further site-specific assessments?***

The SFRA confirms that the site is located in Zone 1.

There will be a **decrease in runoff** from the site and this will be attenuated to a flow rate of 5.1l/s for the worst case 1 in 100 year storm event and will discharge to the stream on the northern boundary of the site.

The proposed drainage system will be designed to take account of a 30% climate change.

The residual risk of flooding is considered to be low.

d) ***What are the existing rates and volumes of run-off generated by this site?***

The site is currently Brownfield. Estimated flow rates (including an increase in rainfall intensity of 30%) are given in the following table:

Storm Return Period	Existing Flow Rate	Proposed Flow Rate (30% CC)
2 year	169.7l/s	5.0
30 years	327.5l/s	5.0
100 years	452.5l/s	5.1

Estimated volumes are as follows for storms of 6 hour duration (including an increase in rainfall intensity of 30% for the proposed development).

Storm Return Period	Existing Volume	Proposed Volume
2 year	319.1m^3	96.2m^3
30 years	573.6m^3	172.9m^3
100 years	741.2m^3	223.5m^3

4 CLIMATE CHANGE

a) ***How is flood risk at the site likely to be affected by climate change?***

The proposed development is for residential use and can be categorised to a 60yr design life.

In accordance with table 5 of NPPF March 2012 a 30% increase in peak rainfall intensity has been included in the development design calculations.

5 DETAILED DEVELOMENT PROPOSALS

a) ***Please provide details of the development layout, referring to the relevant drawings.***

The proposed redevelopment comprises 25 dwellings with an impermeable area of 4040m^2.

The drives will be constructed in porous paved materials to mimic Greenfield conditions.

The access road will also be constructed in porous paving but will be connected to the main drainage system to act as surface water attenuation during the worst case 1 in 100 year storm event.

A balancing pond will be incorporated into the design to provide additional surface water attenuation

A site drainage strategy layout is provided in Appendix C.

The flood receptors for the proposed development are the Residential Units.

The proposed development is classified as more vulnerable to table 2 of NPPF March 2012.

With regard to the proposed drainage strategy there is a preference to dispose of surface water run by infiltration methods. If infiltration is not possible then discharging to a watercourse should be considered before discharge to a sewer. The following table considers each of the options:

Method	Yes/No	Reason
Infiltration	No	Investigations show that the soils beneath the site are not capable of supporting an infiltration system.
Watercourse	Yes	There are ditches within the vicinity of the site
Sewers	No	There are no public surface water sewers within the vicinity of the site

The surface water generated by the roofs will be attenuated in line with NPPF March 2012 and discharge will be restricted to 5.1l/s for the worst case 1 in 100 year storm event. Attenuation will be in the form of ponds, porous paving and large diameter sewers up to 600mm.

Discharge of surface water will be to the ditch running along the northern boundary of the site

b) ***Where appropriate, demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding.***

The entire site is located in area of low flood risk.

6 FLOOD RISK MANAGEMENT MEASURES

a) ***How will the site be protected from flooding, including the potential impacts of climate change, over the developments lifetime?***

The site is located in Zone 1 and is not at risk of flooding and flood risk management measures are not required. The design of the proposed drainage system will include a 30% increase in rainfall intensity to allow for the effects of climate change over the design life of the buildings.

7 OFF SITE IMPACTS

a) ***How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?***

The existing scrapyard site has an approximate impermeable area of 1.34Ha and this will be reduced to 0.404Ha.

The proposed drainage will discharge to the ditch at a restricted rate of 5.1l/s for the worst case 1 in 100 year storm event.

The attenuation system will be designed to cater for a climate change allowance of 30%.

The surface water calculations shown in Appendix D and E show that both flow rate and volume of water entering the ditch will be significantly reduced as a result of the proposed development.

The risk of flooding elsewhere will therefore decrease as a result of the proposed development.

b) ***How will you prevent run-off from the completed development causing an impact elsewhere?***

The surface water will be restricted to 5.1l/s for the worst case 1 in 100 year storm event and the design/calculations will include a 30% Climate Change allowance.

This is considerably lower than the prevailing existing conditions, estimated to be 452.5l/s for the worst case 1 in 100 year storm event.

The 741.2m^3 volume of pre-development surface water runoff will be reduced to 223.5m^3 as a result of the new development thus providing an additional capacity of 517.7m^3 within the downstream watercourse.

8 RESIDUAL RISKS

a) ***What flood-related risks will remain after you have implemented the measures to protect the site from flooding?***

The drainage system will require periodic maintenance the details of which should be included in the overall building management plan to be handed over to the appointed management company.

b) ***How and by whom will these risks be managed over the lifetime of the development?***

A management company will be appointed to ensure that the open spaces, ditches and ponds are maintained to ensure storage volume is not compromised within the attenuation system.

9 CONCLUSIONS

- The site currently drains treated surface water under a trade effluent licence to ditches at the site boundaries.

- The proposed development is located in Zone 1 and is at low risk of flooding.

- The redevelopment will bring about a considerable reduction in surface water discharge due to the decrease in impermeable area of the site and this will reduce any flooding impact elsewhere.

- All hardstandings will be constructed in porous paving materials to mimic Greenfield conditions.

- Roof drainage will discharge to an attenuation system and shall be restricted to 5.1l/s for the worst case 1 in 100 year storm event.

- Water quality from the proposed development will be considerably higher than existing because the porous paving will filter silt and contaminants. Currently the majority of the site is allowed to discharge to the stream unchecked and without any treatment.

- The porous paving of the new development is a recognised construction technique for the removal of spilled hydrocarbons before surface water discharge to the watercourses, hence no petrol interceptor will be required.

- The discharge of treated foul water will require an environmental permit from the Environment Agency.

APPENDIX A:

Flood Risk Map (from SFRA)
Flooding Hotspot map (from SFRA)

Legend

EA Main Rivers

IDB Drains

Maidstone Borough Boundary

Area of Search

Source of Flooding

Sewer Flooding

Surface Water Flooding

Groundwater Flooding

Unknown Source

Scale 1:95,000

Maidstone Borough SFRA

Figure 4.1
Reported Flood Incidents

May 2008

Mott MacDonald

MAIDSTONE Borough Council

0 2 4 8 Kilometres

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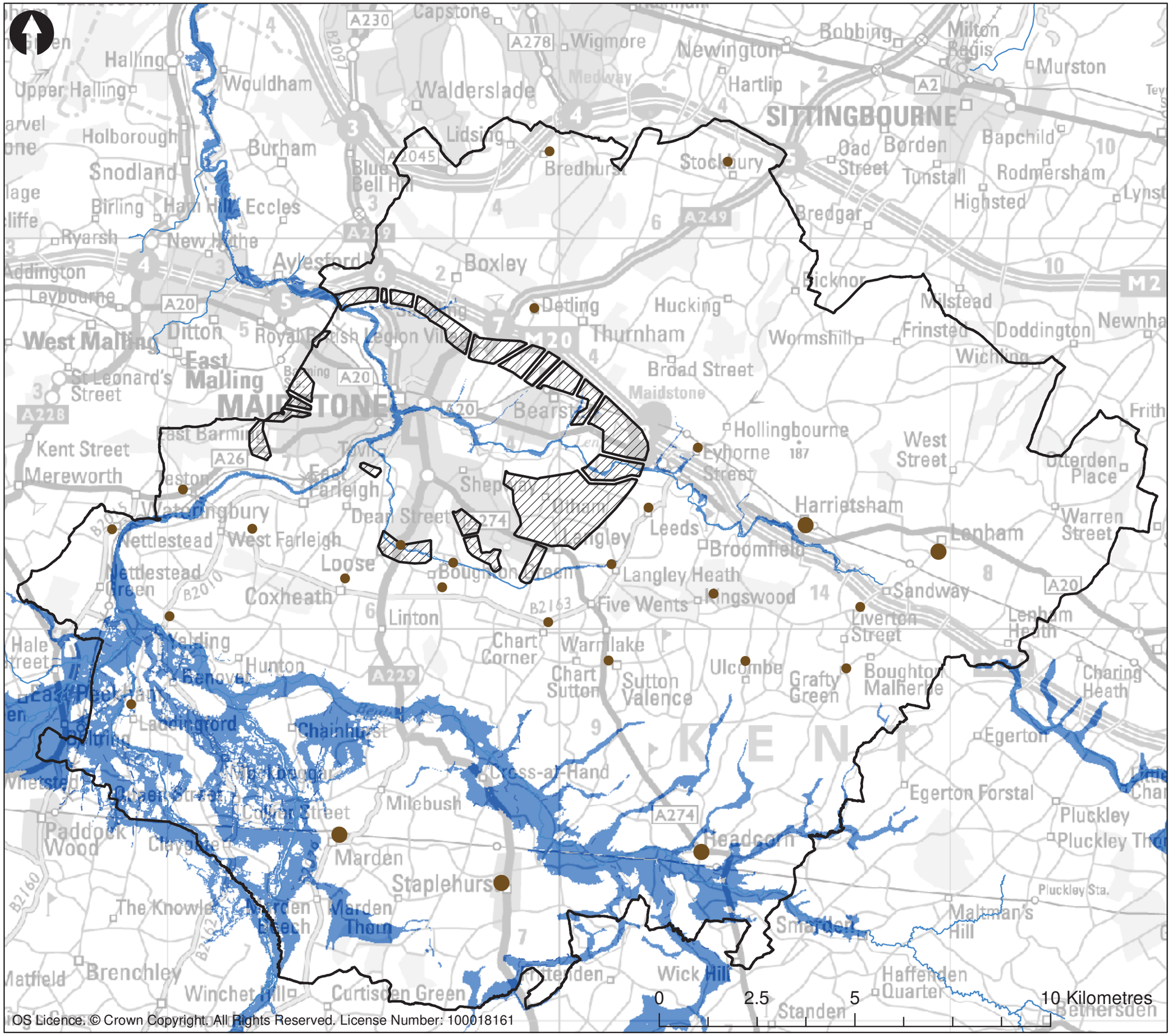

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Legend

- EA Main Rivers
- IDB Drains
- Maidstone Borough Boundary
- Area of Search
- Rural Service Centre
- Larger Rural Settlement
- 1 in 100-year Flood Extent

Scale 1:95,000

Maidstone Borough SFRA

Figure 5.2
1 in 100 year Flood Extent (Flood Zone 3a)

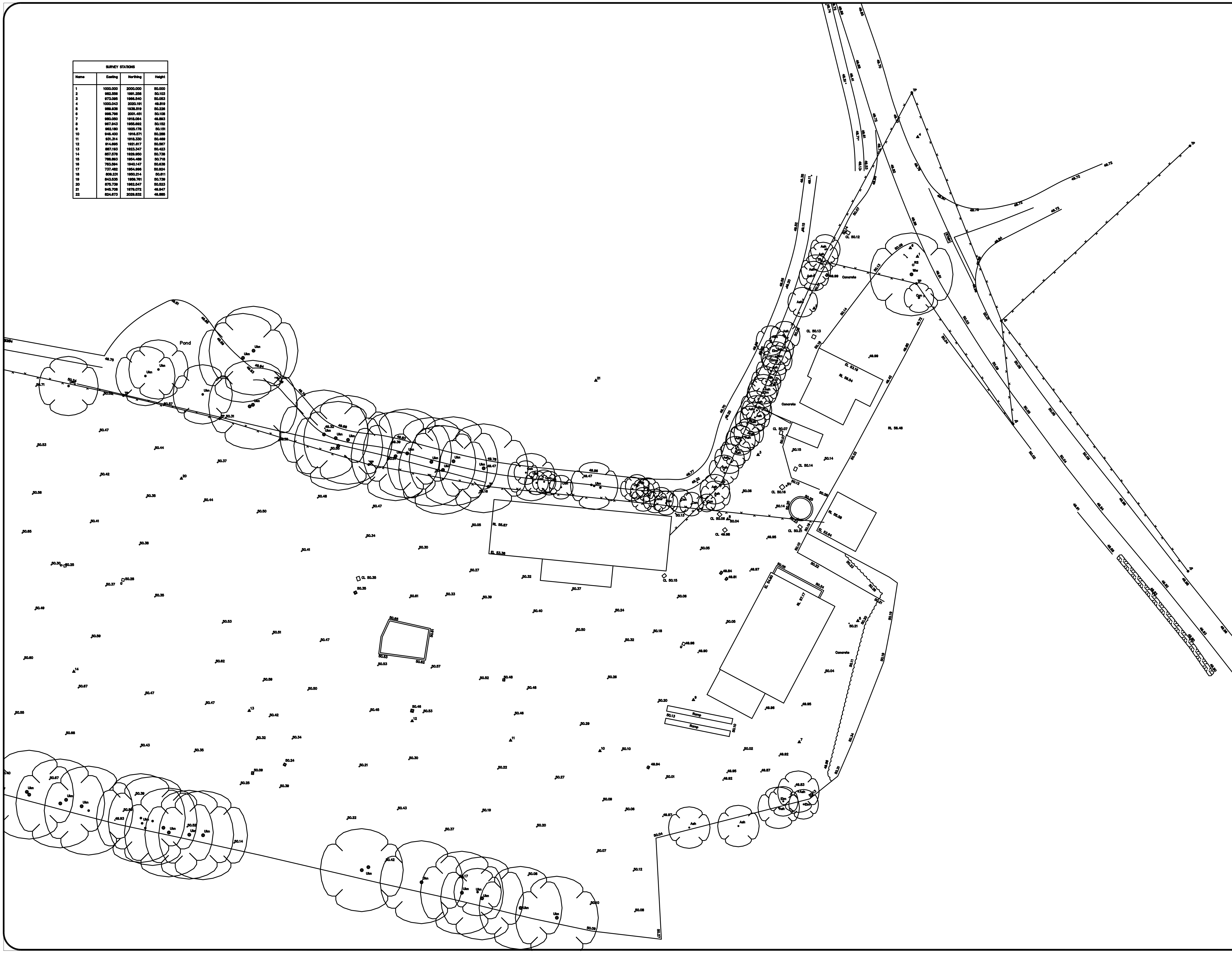
May 2008

Mott MacDonald

MAIDSTONE Borough Council

APPENDIX B:

Topographical Survey



SURVEY STATIONS			
Name	Easting	Northing	Height
1	1000.000	2000.000	50.000
2	982.556	1991.258	50.103
3	973.095	1988.540	50.053
4	1000.043	2020.191	49.819
5	989.936	1938.519	50.226
6	998.796	2001.451	50.108
7	980.050	1918.064	49.893
8	967.943	1955.692	50.152
9	962.180	1925.178	50.151
10	946.400	1916.571	50.288
11	931.314	1918.330	50.469
12	914.695	1921.617	50.567
13	887.193	1923.347	50.423
14	857.578	1929.950	50.738
15	788.893	1954.489	50.718
16	783.594	1940.147	50.638
17	737.482	1954.996	50.924
18	809.231	1950.214	50.611
19	843.535	1959.761	50.739
20	875.739	1962.547	50.523
21	945.708	1979.072	49.947
22	824.673	2029.832	49.885

Aston Land Surveys

8 THAMES AVENUE, HIGH HALSTOW,
ROCHESTER, KENT. ME3 8TE
TELEPHONE 01634 251584
MOBILE 07831 628524

LEGEND

EXTENT OF VEGETATION
HEDGES
BUSH
TREE (Trunk drawn to scale)
DEAD TREE
SINGLE GATE
DOUBLE GATE
OVERHEAD CABLE
WALL
BUILDING
ORDNANCE SURVEY BENCH MARK — OSBM Value 28.86

BOLLARD	B
BOREHOLE	BH
BUS STOP	BS
BRITISH TELECOM BOX	BT BOX
BRITISH TELECOM MANHOLE	BTMH
CABLE TELEVISION MANHOLE	CATV
FIRE HYDRANT	FH
FOOTPATH	FP
GULLY	G
LAMP POST	LP
MANHOLE	MH
POST BOX	PB
ROAD SIGN	RS
STOP VALVE	SV
SURVEY STATION	
TELEPHONE CALL BOX	TCB
TRAFFIC LIGHT	TL
TELEGRAPH POLE	TP
SPOT LEVEL	+ 28.86
COVER LEVEL	CL 28.86
INVERT LEVEL	IL 28.86
UNABLE TO LIFT	UTL
DITCH	
BANKING	

TREE LEGEND

ALDER	ALD	LOCUST	LCS
ASH	ASH	LONDON PLANE	LPN
ASPEN	ASP	MAPLE	MPL
BEECH	BCH	OAK	OAK
CEDAR	CED	PINE	PNE
CYPRESS	CYP	POPLAR	POP
DEAD	DED	RHODODENDRONS	RDN
ELDER	ELD	ROWAN	RWN
ELM	ELM	SAPLING	SAP
FIR	FIR	SILVER BIRCH	SIB
FRUIT	FRT	SMOOTH JAPANESE MAPLE	SJM
HAWTHORN	HAW	SPRUCE	SPR
HOLLY	HLY	SWEET CHESTNUT	SCH
HORSE CHESTNUT	HCH	SYCAMORE	SYC
HORNBEAM	HBM	WALNUT	WNT
LABURNUM	LBN	WHITEBEAM	WBM
LARCH	LAR	WILLOW	WLW
LAUREL	LRL	YEW	YEW
LIME	LIM		

FENCE DESCRIPTIONS

BARBED WIRE FENCE	BWF	INTERWOVEN FENCE	IWF
CLOSE BOARD FENCE	CBF	OPEN BOARD FENCE	OBF
CORRUGATED IRON FENCE	CIF	POST AND CHAIN FENCE	PCF
CHAIN LINK FENCE	CLF	POST AND RAIL FENCE	PRF
CHESTNUT PALING	CPF	POST AND WIRE FENCE	PWF
IRON RAILINGS	IRF	WIRE MESH FENCE	WMF

Project

Bentletts Yard Laddingford

Drawing Title

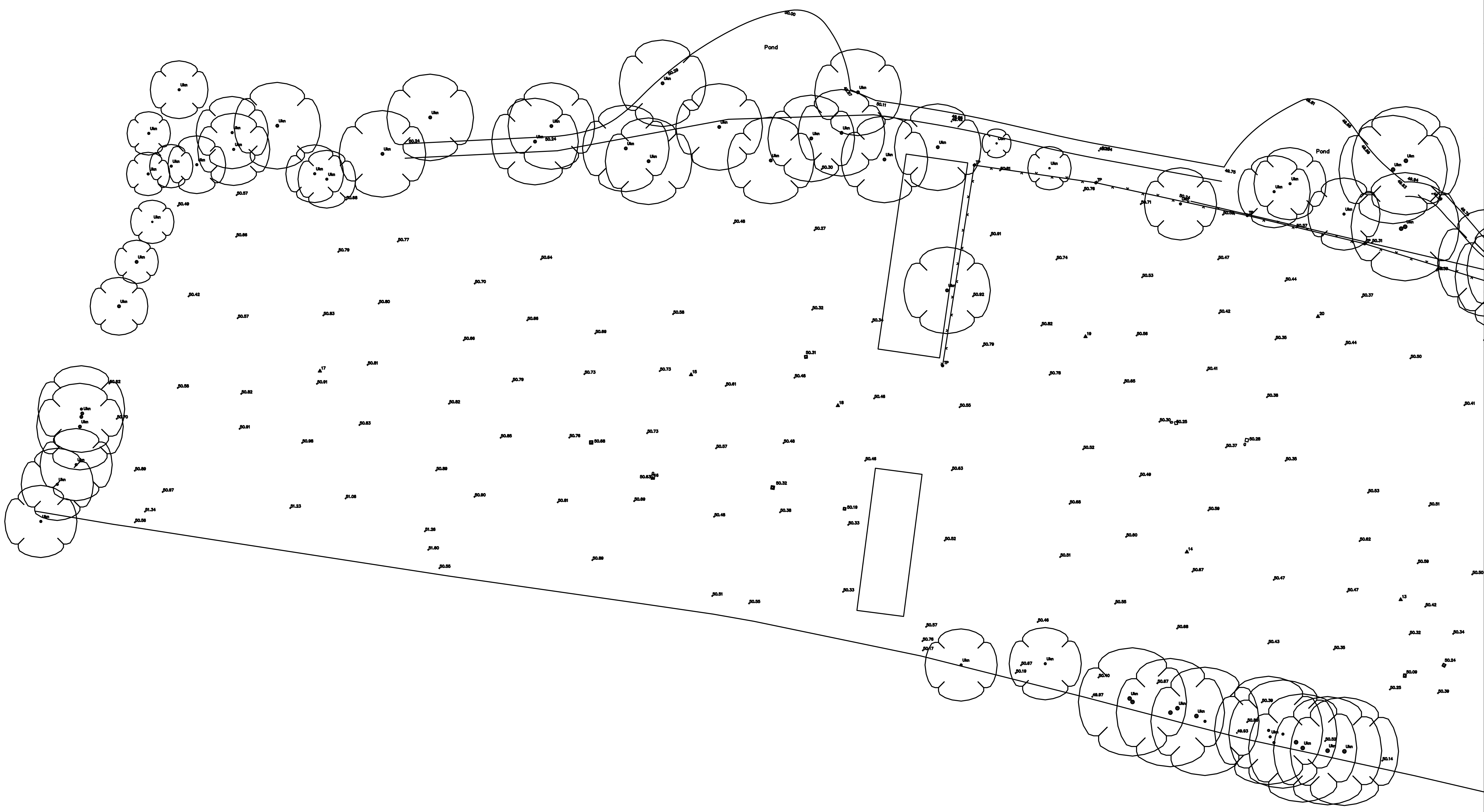
Site Survey

Scale	Drawn By
1:200	T.S.
Date	Checked By
Feb '14	B.S.

Drawing No BYL/1260/1 of 2

NOTES

1. TREES – The tree species have been identified to the best of the surveyors knowledge, with the mean spread drawn to scale. Tree heights are approximate.
2. DRAINAGE – All drainage has been surveyed by visual inspection only and should be cross checked in critical areas.
3. FENCES – Fences shown are not necessarily legal boundaries.
4. GRID – The survey grid is based on arbitrary co-ordinates. Not Ordnance Survey.



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Aston Land Surveys

8 THAMES AVENUE, HIGH HALSTOW,
ROCHESTER, KENT. ME3 8TE
TELEPHONE 01634 251584
MOBILE 07831 628524

LEGEND

TREE LEGEND

FENCE DESCRIPTIONS

Project: Bentletts Yard, Laddingford

Drawing Title: Site Survey

Scale	Drawn By	Date	Checked By	Drawing No
1:200	T.S.	Feb '14	B.S.	BYL/1260/2 of 2

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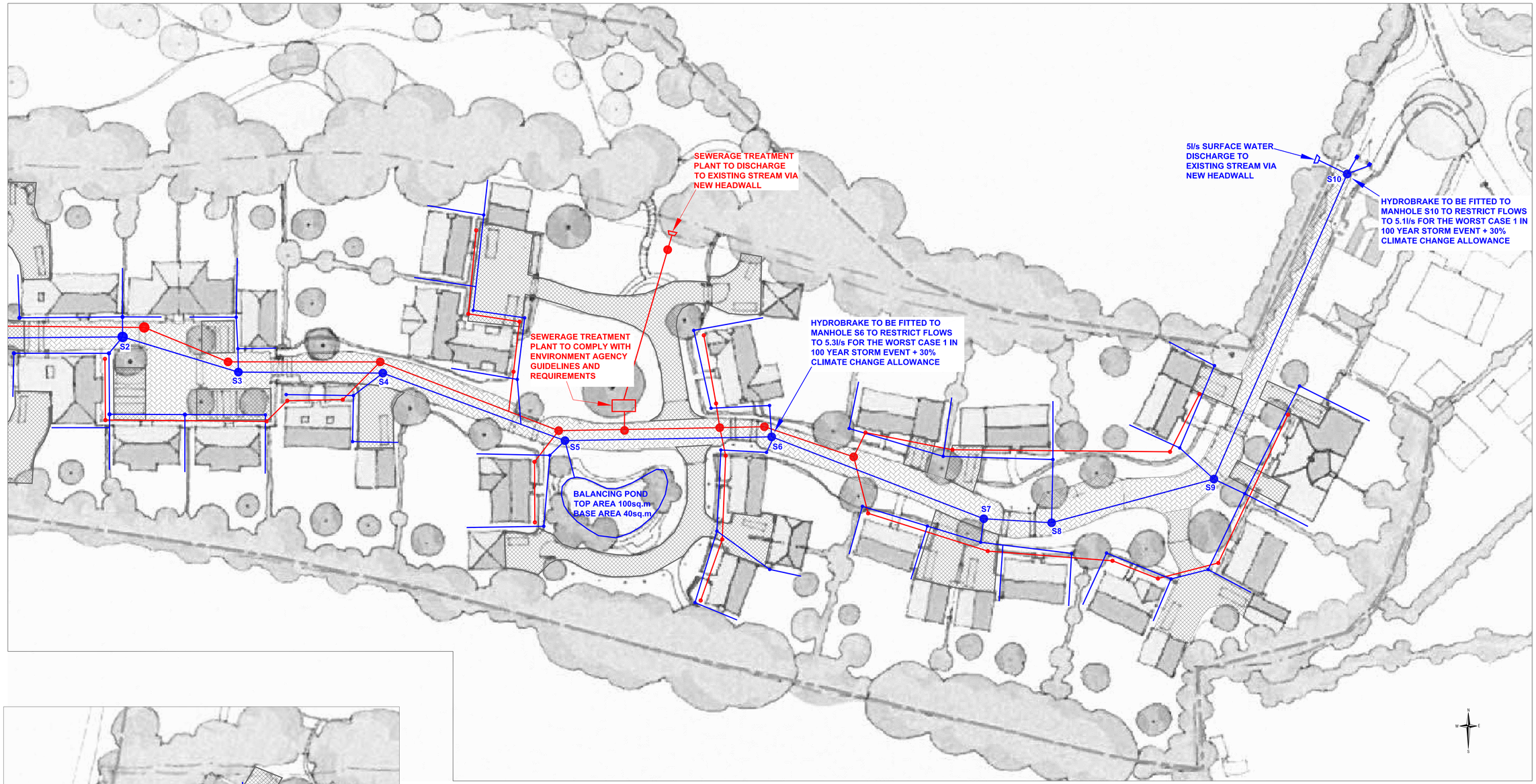
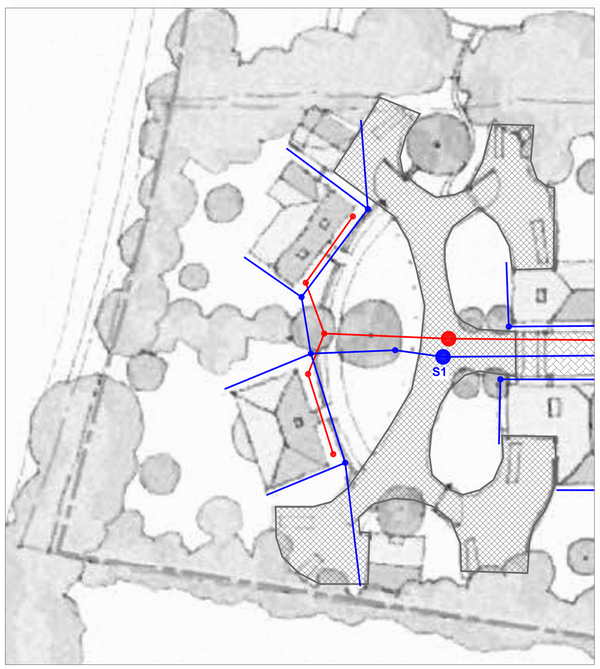
4. GRID – The survey grid is based on arbitrary co-ordinates. Not Ordnance Survey.
5. LEVELS – Levels relate to OSBM value

APPENDIX C:

Proposed Drainage Strategy Layout





DRAWING LEGEND	
SURFACE WATER DRAINAGE	
	PCC MANHOLE
	INSPECTION CHAMBER
	450x900 ROAD GULLY
	SURFACE WATER SEWER
	POROUS PAVING ROAD CONSTRUCTION
	POROUS PAVING DRIVE CONSTRUCTION
FOUL WATER DRAINAGE	
	PCC MANHOLE
	INSPECTION CHAMBER
	FOUL WATER SEWER

PRE-DEVELOPMENT
IMPERMEABLE
AREA = 1.34Ha

POST
DEVELOPMENT
IMPERMEABLE
AREA = 0.404Ha

STORM EVENT (1 IN)	EXISTING FLOW (l/s)	PROPOSED FLOW (l/s)
2	2	5.0
30	30	5.0
100	100	5.1

360 MINUTE STORM DURATION		
STORM EVENT (1 IN)	EXISTING VOLUME (cu.m)	PROPOSED VOLUME (cu.m)
2	319.1	96.2
30	573.6	172.9
100	741.2	223.5

PROPOSED DRAINAGE
CALCULATIONS INCLUDE A 30%
CLIMATE CHANGE ALLOWANCE

NOTES

CONTRACTORS MUST VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING ANY WORK ON SHOP DRAWINGS

DO NOT SCALE FROM THIS DRAWING

RCD CONSULTANTS LTD COPYRIGHT

NOTES

1. ALL DIMENSIONS IN MILLIMETERS UNLESS NOTED OTHERWISE.

2. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER ENGINEERING DRAWINGS AND CALCULATIONS ASSOCIATED WITH THIS PROJECT.

3. POROUS PAVING DEPTH SUBJECT TO SOAKAGE TESTING IN ACCORDANCE WITH BRE365.

4. DRAINAGE POSITIONS ARE INDICATIVE ONLY AND ARE SUBJECT TO DETAILED DESIGN.

5. SEWERAGE TREATMENT PLANT TO BE DESIGNED AND INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATION AND SPECIFICATION.

6. ALL ADOPTABLE DRAINAGE WORKS ARE TO BE CARRIED OUT TO THE REQUIREMENTS AND FULL SATISFACTION OF SOUTHERN WATER SERVICES LTD.

7. ALL ADOPTABLE HIGHWAY WORKS ARE TO BE CARRIED OUT TO THE REQUIREMENTS AND FULL SATISFACTION OF KENT COUNTY COUNCIL.

8. ALL SEWERS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH WATER AUTHORITIES ASSOCIATION PUBLICATION `SEWERS FOR ADOPTION 7TH EDITION`.

9. ALL BUILDING DRAINAGE TO BE INSTALLED AND TESTED IN COMPLIANCE WITH THE BUILDING REGULATIONS 2000 DRAINAGE AND WASTE DISPOSAL APPROVED DOCUMENT H 2002 EDITION.

10. ALL COMPONENTS AND MATERIALS ARE TO BE MANUFACTURED AND SUPPLIED IN ACCORDANCE WITH THE RELEVANT BRITISH STANDARDS, AND LAID AND BACKFILLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS AND THE RELEVANT BRITISH STANDARDS.

11. THE CONTRACTOR SHALL, BEFORE COMMENCING THE WORKS, VERIFY ALL SITE AND SETTING OUT DIMENSIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE TRUE AND PROPER SETTING OUT OF THE WORKS AND FOR THE CORRECTNESS OF THE POSITION, LEVELS, DIMENSIONS, AND ALIGNMENT OF ALL PARTS OF THE WORKS.

12. SMALL LIGHTWEIGHT ACCESS COVERS SHOULD BE SECURED (FOR EXAMPLE WITH SCREWS) TO DETER UNAUTHORISED ACCESS.

13. INSPECTION CHAMBERS AND MANHOLES IN BUILDINGS TO HAVE MECHANICALLY FIXED AIRTIGHT COVERS UNLESS THE DRAIN ITSELF HAS WATERTIGHT ACCESS COVERS.

14. ALL ABOVE GROUND DRAINAGE TO INCORPORATE RODDING ACCESS FACILITIES.

15. INSITU CONCRETE FOR USE IN GENERAL DRAINAGE WORKS, GRADE TO BS; 5328.

17. ALL GULLIES TO BE TRAPPED.

18. SEWERAGE TREATMENT PLANT WILL BE SUBJECT TO ENVIRONMENTAL PERMIT APPLICATION TO THE ENVIRONMENT AGENCY.

19. ACCESS ROAD AND DRIVES TO BE CONSTRUCTED IN POROUS PAVING MATERIAL TO COMPLY WITH WATER QUALITY REQUIREMENTS WITHIN THE SUDS MANUAL.

20. DISHCARGE TO THE EXISTING WATERCOURSE WILL BE SUBJECT TO KENT COUNTY COUNCIL AND INTERNAL DRAINAGE BOARD APPROVAL.

21. HIGHWAY POROUS PAVING CONSTRUCTION AND BALANCING POND TO PROVIDE SURFACE WATER ATTENUATION DURING HEAVY RAINFALL EVENTS.

REV	AMENDMENT	DATE	CHKD
P2	PLANNING ISSUE	13.01.16	MGC
P1	PLANNING ISSUE	29.11.14	MGC

STATUS: FOR PLANNING

RCD

RCD CONSULTANTS LTD
23 HASTINGS ROAD, MAIDSTONE, KENT, ME15 7SH
TELEPHONE: 01622 766 300 MOBILE: 07702 052 137
EMAIL: southeast@rcd-uk.com

CLIENT
WEALDEN HOMES

PROJECT
CLAYGATE ROAD
COLLIER STREET
KENT

DRAWING TITLE
DRAINAGE STRATEGY

CIVILS

SCALE	DRAWN BY	CHECKED	DATE
1:200 @ A0 NTS @ A3	RAC	MGC	SEPT 2014

DRAWING NUMBER
1129-1008-ENG-01

REVISION
P2

APPENDIX D:

Existing Surface Water Calculations

18 Deyley Way Singleton Ashford TN23 5HX	1129-1008-EXIST CLAYGATE ROAD COLLIER STREET
Date JAN 2016 File 1129-1008-EXISTING 1601...	Designed by RAC Checked by
Micro Drainage	Network 2015.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.841	4-8	0.499

Total Area Contributing (ha) = 1.340

Total Pipe Volume (m³) = 45.239

Network Design Table 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)
1.000	40.000	0.100	400.0	0.350	5.00	0.0	0.600	o	600
1.001	40.000	0.100	400.0	0.340	0.00	0.0	0.600	o	600
1.002	40.000	0.100	400.0	0.325	0.00	0.0	0.600	o	600
1.003	40.000	0.100	400.0	0.325	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.55	50.000	0.350	0.0	0.0	0.0	1.21	342.5	47.4
1.001	50.00	6.10	49.900	0.690	0.0	0.0	0.0	1.21	342.5	93.4
1.002	50.00	6.65	49.800	1.015	0.0	0.0	0.0	1.21	342.5	137.4
1.003	50.00	7.20	49.700	1.340	0.0	0.0	0.0	1.21	342.5	181.5

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18 Deyley Way Singleton Ashford TN23 5HX	1129-1008-EXIST CLAYGATE ROAD COLLIER STREET
Date JAN 2016 File 1129-1008-EXISTING 1601...	Designed by RAC Checked by
Micro Drainage	Network 2015.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.000	1.000	Open Manhole	1500	1.000	50.000	600				
2	51.000	1.100	Open Manhole	1500	1.001	49.900	600	1.000	49.900	600	
3	51.000	1.200	Open Manhole	1500	1.002	49.800	600	1.001	49.800	600	
4	51.000	1.300	Open Manhole	1500	1.003	49.700	600	1.002	49.700	600	
DITCH	51.000	1.400	Open Manhole	450		OUTFALL		1.003	49.600	600	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	600	1	51.000	50.000	0.400	Open Manhole	1500
1.001	o	600	2	51.000	49.900	0.500	Open Manhole	1500
1.002	o	600	3	51.000	49.800	0.600	Open Manhole	1500
1.003	o	600	4	51.000	49.700	0.700	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	40.000	400.0	2	51.000	49.900	0.500	Open Manhole	1500
1.001	40.000	400.0	3	51.000	49.800	0.600	Open Manhole	1500
1.002	40.000	400.0	4	51.000	49.700	0.700	Open Manhole	1500
1.003	40.000	400.0	DITCH	51.000	49.600	0.800	Open Manhole	450

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)
1.003	DITCH	51.000	49.600	49.600	450	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
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	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	15
Ratio R	0.350		

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Summary of Results for 15 minute 2 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	50.232	-0.368	0.000	0.20		56.9	OK
1.001	2	50.185	-0.315	0.000	0.34		97.9	OK
1.002	3	50.121	-0.279	0.000	0.46		134.7	OK
1.003	4	50.032	-0.268	0.000	0.58		169.7	OK

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18 Deyley Way Singleton Ashford TN23 5HX	1129-1008-EXIST CLAYGATE ROAD COLLIER STREET
Date JAN 2016 File 1129-1008-EXISTING 1601...	Designed by RAC Checked by
Micro Drainage	Network 2015.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.841	4-8	0.499

Total Area Contributing (ha) = 1.340

Total Pipe Volume (m³) = 45.239

Network Design Table 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)
1.000	40.000	0.100	400.0	0.350	5.00	0.0	0.600	o	600
1.001	40.000	0.100	400.0	0.340	0.00	0.0	0.600	o	600
1.002	40.000	0.100	400.0	0.325	0.00	0.0	0.600	o	600
1.003	40.000	0.100	400.0	0.325	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.55	50.000	0.350	0.0	0.0	0.0	1.21	342.5	47.4
1.001	50.00	6.10	49.900	0.690	0.0	0.0	0.0	1.21	342.5	93.4
1.002	50.00	6.65	49.800	1.015	0.0	0.0	0.0	1.21	342.5	137.4
1.003	50.00	7.20	49.700	1.340	0.0	0.0	0.0	1.21	342.5	181.5

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18 Deyley Way Singleton Ashford TN23 5HX	1129-1008-EXIST CLAYGATE ROAD COLLIER STREET
Date JAN 2016 File 1129-1008-EXISTING 1601...	Designed by RAC Checked by
Micro Drainage	Network 2015.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.000	1.000	Open Manhole	1500	1.000	50.000	600				
2	51.000	1.100	Open Manhole	1500	1.001	49.900	600	1.000	49.900	600	
3	51.000	1.200	Open Manhole	1500	1.002	49.800	600	1.001	49.800	600	
4	51.000	1.300	Open Manhole	1500	1.003	49.700	600	1.002	49.700	600	
DITCH	51.000	1.400	Open Manhole	450		OUTFALL		1.003	49.600	600	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	600	1	51.000	50.000	0.400	Open Manhole	1500
1.001	o	600	2	51.000	49.900	0.500	Open Manhole	1500
1.002	o	600	3	51.000	49.800	0.600	Open Manhole	1500
1.003	o	600	4	51.000	49.700	0.700	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	40.000	400.0	2	51.000	49.900	0.500	Open Manhole	1500
1.001	40.000	400.0	3	51.000	49.800	0.600	Open Manhole	1500
1.002	40.000	400.0	4	51.000	49.700	0.700	Open Manhole	1500
1.003	40.000	400.0	DITCH	51.000	49.600	0.800	Open Manhole	450

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)
1.003	DITCH	51.000	49.600	49.600	450	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
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	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	15
Ratio R	0.350		

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Summary of Results for 15 minute 30 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	50.484	-0.116	0.000	0.34		99.8	OK
1.001	2	50.458	-0.042	0.000	0.62		181.8	OK
1.002	3	50.400	0.000	0.000	0.88		255.7	OK
1.003	4	50.308	0.008	0.000	1.12		327.5	SURCHARGED

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18 Deyley Way Singleton Ashford TN23 5HX	1129-1008-EXIST CLAYGATE ROAD COLLIER STREET
Date JAN 2016 File 1129-1008-EXISTING 1601...	Designed by RAC Checked by
Micro Drainage	Network 2015.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	0
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.350	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.841	4-8	0.499

Total Area Contributing (ha) = 1.340

Total Pipe Volume (m³) = 45.239

Network Design Table 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)
1.000	40.000	0.100	400.0	0.350	5.00	0.0	0.600	o	600
1.001	40.000	0.100	400.0	0.340	0.00	0.0	0.600	o	600
1.002	40.000	0.100	400.0	0.325	0.00	0.0	0.600	o	600
1.003	40.000	0.100	400.0	0.325	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.55	50.000	0.350	0.0	0.0	0.0	1.21	342.5	47.4
1.001	50.00	6.10	49.900	0.690	0.0	0.0	0.0	1.21	342.5	93.4
1.002	50.00	6.65	49.800	1.015	0.0	0.0	0.0	1.21	342.5	137.4
1.003	50.00	7.20	49.700	1.340	0.0	0.0	0.0	1.21	342.5	181.5

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18 Deyley Way Singleton Ashford TN23 5HX	1129-1008-EXIST CLAYGATE ROAD COLLIER STREET
Date JAN 2016 File 1129-1008-EXISTING 1601...	Designed by RAC Checked by
Micro Drainage	Network 2015.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.000	1.000	Open Manhole	1500	1.000	50.000	600				
2	51.000	1.100	Open Manhole	1500	1.001	49.900	600	1.000	49.900	600	
3	51.000	1.200	Open Manhole	1500	1.002	49.800	600	1.001	49.800	600	
4	51.000	1.300	Open Manhole	1500	1.003	49.700	600	1.002	49.700	600	
DITCH	51.000	1.400	Open Manhole	450		OUTFALL		1.003	49.600	600	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	600	1	51.000	50.000	0.400	Open Manhole	1500
1.001	o	600	2	51.000	49.900	0.500	Open Manhole	1500
1.002	o	600	3	51.000	49.800	0.600	Open Manhole	1500
1.003	o	600	4	51.000	49.700	0.700	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	40.000	400.0	2	51.000	49.900	0.500	Open Manhole	1500
1.001	40.000	400.0	3	51.000	49.800	0.600	Open Manhole	1500
1.002	40.000	400.0	4	51.000	49.700	0.700	Open Manhole	1500
1.003	40.000	400.0	DITCH	51.000	49.600	0.800	Open Manhole	450

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)
1.003	DITCH	51.000	49.600	49.600	450	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
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	Run Time (mins)	60
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	15
Ratio R	0.350		

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Summary of Results for 15 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	50.702	0.102	0.000	0.45		132.6	FLOOD RISK
1.001	2	50.669	0.169	0.000	0.85		247.0	SURCHARGED
1.002	3	50.593	0.193	0.000	1.21		352.8	SURCHARGED
1.003	4	50.434	0.134	0.000	1.55		452.5	SURCHARGED

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360 min Summer	50.412	4.412	661.8	O K
360 min Winter	50.942	4.942	741.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
360 min Summer	10.975	0.0	368
360 min Winter	10.975	0.0	368

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	360
Ratio R	0.350	Longest Storm (mins)	360
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.340

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.841	4	8	0.499

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Model Details

Storage is Online Cover Level (m) 51.000

Tank or Pond Structure

Invert Level (m) 46.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	150.0	5.000	150.0

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APPENDIX E:

Proposed Surface Water Calculations

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	30
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.000
Ratio R	0.350	Maximum Backdrop Height (m)	10.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.187	4-8	0.211	8-12	0.006

Total Area Contributing (ha) = 0.404

Total Pipe Volume (m³) = 66.586

Network Design Table 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)
1.000	25.000	0.050	500.0	0.025	5.00	0.0	0.600	o	450
1.001	20.000	0.050	400.0	0.046	0.00	0.0	0.600	o	450
1.002	25.000	0.050	500.0	0.047	0.00	0.0	0.600	o	450
1.003	34.000	0.080	425.0	0.013	0.00	0.0	0.600	o	450
1.004	36.000	0.080	450.0	0.043	0.00	0.0	0.600	o	600
1.005	39.000	0.100	390.0	0.032	0.00	0.0	0.600	o	600
1.006	12.000	0.030	400.0	0.085	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.46	49.900	0.025	0.0	0.0	1.0	0.90	143.5	4.4
1.001	50.00	5.79	49.850	0.071	0.0	0.0	2.9	1.01	160.7	12.5
1.002	50.00	6.25	49.800	0.118	0.0	0.0	4.8	0.90	143.5	20.8
1.003	50.00	6.83	49.750	0.131	0.0	0.0	5.3	0.98	155.8	23.1
1.004	50.00	7.36	49.670	0.174	0.0	0.0	7.1	1.14	322.7	30.6
1.005	50.00	7.89	49.590	0.206	0.0	0.0	8.4	1.23	346.9	36.3
1.006	50.00	8.05	49.490	0.291	0.0	0.0	11.8	1.21	342.5	51.2

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Network Design Table 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)
1.007	28.000	0.060	466.7	0.020	0.00	0.0	0.600	o	600
1.008	57.000	0.140	407.1	0.093	0.00	0.0	0.600	o	600
1.009	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	50.00	8.47	49.460	0.311	0.0	0.0	12.6	1.12	316.8	54.7
1.008	49.51	9.26	49.400	0.404	0.0	0.0	16.3	1.20	339.5	70.4
1.009	49.42	9.29	49.260	0.404	0.0	0.0	16.3	2.44	688.6	70.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.000	1.100	Open Manhole	1500	1.000	49.900	450				
2	51.000	1.150	Open Manhole	1500	1.001	49.850	450	1.000	49.850	450	
3	51.000	1.200	Open Manhole	1500	1.002	49.800	450	1.001	49.800	450	
4	51.000	1.250	Open Manhole	1500	1.003	49.750	450	1.002	49.750	450	
5	51.000	1.330	Open Manhole	1500	1.004	49.670	600	1.003	49.670	450	
6	51.000	1.410	Open Manhole	1500	1.005	49.590	600	1.004	49.590	600	
7	51.000	1.510	Open Manhole	1500	1.006	49.490	600	1.005	49.490	600	
8	51.000	1.540	Open Manhole	1500	1.007	49.460	600	1.006	49.460	600	
9	51.000	1.600	Open Manhole	1500	1.008	49.400	600	1.007	49.400	600	
10	51.000	1.740	Open Manhole	1500	1.009	49.260	600	1.008	49.260	600	
	51.000	1.790	Open Manhole	450		OUTFALL		1.009	49.210	600	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	450	1	51.000	49.900	0.650	Open Manhole	1500
1.001	o	450	2	51.000	49.850	0.700	Open Manhole	1500
1.002	o	450	3	51.000	49.800	0.750	Open Manhole	1500
1.003	o	450	4	51.000	49.750	0.800	Open Manhole	1500
1.004	o	600	5	51.000	49.670	0.730	Open Manhole	1500
1.005	o	600	6	51.000	49.590	0.810	Open Manhole	1500
1.006	o	600	7	51.000	49.490	0.910	Open Manhole	1500
1.007	o	600	8	51.000	49.460	0.940	Open Manhole	1500
1.008	o	600	9	51.000	49.400	1.000	Open Manhole	1500
1.009	o	600	10	51.000	49.260	1.140	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	25.000	500.0	2	51.000	49.850	0.700	Open Manhole	1500
1.001	20.000	400.0	3	51.000	49.800	0.750	Open Manhole	1500
1.002	25.000	500.0	4	51.000	49.750	0.800	Open Manhole	1500
1.003	34.000	425.0	5	51.000	49.670	0.880	Open Manhole	1500
1.004	36.000	450.0	6	51.000	49.590	0.810	Open Manhole	1500
1.005	39.000	390.0	7	51.000	49.490	0.910	Open Manhole	1500
1.006	12.000	400.0	8	51.000	49.460	0.940	Open Manhole	1500
1.007	28.000	466.7	9	51.000	49.400	1.000	Open Manhole	1500
1.008	57.000	407.1	10	51.000	49.260	1.140	Open Manhole	1500
1.009	5.000	100.0		51.000	49.210	1.190	Open Manhole	450

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)
1.009		51.000	49.210	49.210	450	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	30.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	360
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	3

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

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Simulation Criteria for Storm

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	180
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 7, DS/PN: 1.006, Volume (m³): 13.3

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	105
Invert Level (m)	49.490
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.295	4.9
Kick-Flo®	0.636	4.0
Mean Flow over Head Range	-	4.3

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)
0.100	3.6	1.200	5.4	3.000	8.3	7.000	12.4
0.200	4.8	1.400	5.8	3.500	8.9	7.500	12.8
0.300	4.9	1.600	6.2	4.000	9.5	8.000	13.2
0.400	4.9	1.800	6.5	4.500	10.1	8.500	13.6
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.0
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.4
0.800	4.5	2.400	7.5	6.000	11.5		
1.000	5.0	2.600	7.8	6.500	12.0		

Hydro-Brake Optimum® Manhole: 10, DS/PN: 1.009, Volume (m³): 18.8

Unit Reference	MD-SHE-0100-5000-1350-5000
Design Head (m)	1.350
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	100
Invert Level (m)	49.260
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	5.0
Flush-Flo™	0.401	5.0

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Hydro-Brake Optimum® Manhole: 10, DS/PN: 1.009, Volume (m³): 18.8

Control Points	Head (m)	Flow (l/s)
Kick-Flo®	0.825	4.0
Mean Flow over Head Range	-	4.4

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)
0.100	3.3	1.200	4.7	3.000	7.3	7.000	10.8
0.200	4.6	1.400	5.1	3.500	7.8	7.500	11.2
0.300	4.9	1.600	5.4	4.000	8.3	8.000	11.6
0.400	5.0	1.800	5.7	4.500	8.8	8.500	11.9
0.500	4.9	2.000	6.0	5.000	9.2	9.000	12.2
0.600	4.8	2.200	6.3	5.500	9.7	9.500	12.5
0.800	4.1	2.400	6.5	6.000	10.1		
1.000	4.3	2.600	6.8	6.500	10.5		

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Storage Structures for Storm

Porous Car Park Manhole: 3, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	34.0
Max Percolation (l/s)	94.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

Tank or Pond Manhole: 5, DS/PN: 1.004

Invert Level (m) 50.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	40.0	1.000	100.0

Porous Car Park Manhole: 7, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	120.0
Max Percolation (l/s)	166.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

Porous Car Park Manhole: 10, DS/PN: 1.009

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	92.0
Max Percolation (l/s)	127.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

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Summary of Results for 180 minute 2 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	50.058	-0.292	0.000	0.01		1.4	OK
1.001	2	50.058	-0.242	0.000	0.03		3.8	OK
1.002	3	50.057	-0.193	0.000	0.05		6.1	OK
1.003	4	50.057	-0.143	0.000	0.04		6.0	OK
1.004	5	50.056	-0.214	0.000	0.02		6.5	OK
1.005	6	50.056	-0.134	0.000	0.02		5.1	OK
1.006	7	50.055	-0.035	0.000	0.03		4.9	OK
1.007	8	49.856	-0.204	0.000	0.02		5.6	OK
1.008	9	49.855	-0.145	0.000	0.03		9.0	OK
1.009	10	49.854	-0.006	0.000	0.01		5.0	OK

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	30
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.000
Ratio R	0.350	Maximum Backdrop Height (m)	10.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.187	4-8	0.211	8-12	0.006

Total Area Contributing (ha) = 0.404

Total Pipe Volume (m³) = 66.586

Network Design Table 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)
1.000	25.000	0.050	500.0	0.025	5.00	0.0	0.600	o	450
1.001	20.000	0.050	400.0	0.046	0.00	0.0	0.600	o	450
1.002	25.000	0.050	500.0	0.047	0.00	0.0	0.600	o	450
1.003	34.000	0.080	425.0	0.013	0.00	0.0	0.600	o	450
1.004	36.000	0.080	450.0	0.043	0.00	0.0	0.600	o	600
1.005	39.000	0.100	390.0	0.032	0.00	0.0	0.600	o	600
1.006	12.000	0.030	400.0	0.085	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.46	49.900	0.025	0.0	0.0	1.0	0.90	143.5	4.4
1.001	50.00	5.79	49.850	0.071	0.0	0.0	2.9	1.01	160.7	12.5
1.002	50.00	6.25	49.800	0.118	0.0	0.0	4.8	0.90	143.5	20.8
1.003	50.00	6.83	49.750	0.131	0.0	0.0	5.3	0.98	155.8	23.1
1.004	50.00	7.36	49.670	0.174	0.0	0.0	7.1	1.14	322.7	30.6
1.005	50.00	7.89	49.590	0.206	0.0	0.0	8.4	1.23	346.9	36.3
1.006	50.00	8.05	49.490	0.291	0.0	0.0	11.8	1.21	342.5	51.2

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Network Design Table 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)
1.007	28.000	0.060	466.7	0.020	0.00	0.0	0.600	o	600
1.008	57.000	0.140	407.1	0.093	0.00	0.0	0.600	o	600
1.009	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	50.00	8.47	49.460	0.311	0.0	0.0	12.6	1.12	316.8	54.7
1.008	49.51	9.26	49.400	0.404	0.0	0.0	16.3	1.20	339.5	70.4
1.009	49.42	9.29	49.260	0.404	0.0	0.0	16.3	2.44	688.6	70.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.000	1.100	Open Manhole	1500	1.000	49.900	450				
2	51.000	1.150	Open Manhole	1500	1.001	49.850	450	1.000	49.850	450	
3	51.000	1.200	Open Manhole	1500	1.002	49.800	450	1.001	49.800	450	
4	51.000	1.250	Open Manhole	1500	1.003	49.750	450	1.002	49.750	450	
5	51.000	1.330	Open Manhole	1500	1.004	49.670	600	1.003	49.670	450	
6	51.000	1.410	Open Manhole	1500	1.005	49.590	600	1.004	49.590	600	
7	51.000	1.510	Open Manhole	1500	1.006	49.490	600	1.005	49.490	600	
8	51.000	1.540	Open Manhole	1500	1.007	49.460	600	1.006	49.460	600	
9	51.000	1.600	Open Manhole	1500	1.008	49.400	600	1.007	49.400	600	
10	51.000	1.740	Open Manhole	1500	1.009	49.260	600	1.008	49.260	600	
	51.000	1.790	Open Manhole	450		OUTFALL		1.009	49.210	600	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	450	1	51.000	49.900	0.650	Open Manhole	1500
1.001	o	450	2	51.000	49.850	0.700	Open Manhole	1500
1.002	o	450	3	51.000	49.800	0.750	Open Manhole	1500
1.003	o	450	4	51.000	49.750	0.800	Open Manhole	1500
1.004	o	600	5	51.000	49.670	0.730	Open Manhole	1500
1.005	o	600	6	51.000	49.590	0.810	Open Manhole	1500
1.006	o	600	7	51.000	49.490	0.910	Open Manhole	1500
1.007	o	600	8	51.000	49.460	0.940	Open Manhole	1500
1.008	o	600	9	51.000	49.400	1.000	Open Manhole	1500
1.009	o	600	10	51.000	49.260	1.140	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	25.000	500.0	2	51.000	49.850	0.700	Open Manhole	1500
1.001	20.000	400.0	3	51.000	49.800	0.750	Open Manhole	1500
1.002	25.000	500.0	4	51.000	49.750	0.800	Open Manhole	1500
1.003	34.000	425.0	5	51.000	49.670	0.880	Open Manhole	1500
1.004	36.000	450.0	6	51.000	49.590	0.810	Open Manhole	1500
1.005	39.000	390.0	7	51.000	49.490	0.910	Open Manhole	1500
1.006	12.000	400.0	8	51.000	49.460	0.940	Open Manhole	1500
1.007	28.000	466.7	9	51.000	49.400	1.000	Open Manhole	1500
1.008	57.000	407.1	10	51.000	49.260	1.140	Open Manhole	1500
1.009	5.000	100.0		51.000	49.210	1.190	Open Manhole	450

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)
1.009		51.000	49.210	49.210	450	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	30.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	360
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	3

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

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Simulation Criteria for Storm

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	180
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 7, DS/PN: 1.006, Volume (m³): 13.3

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	105
Invert Level (m)	49.490
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.295	4.9
Kick-Flo®	0.636	4.0
Mean Flow over Head Range	-	4.3

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)
0.100	3.6	1.200	5.4	3.000	8.3	7.000	12.4
0.200	4.8	1.400	5.8	3.500	8.9	7.500	12.8
0.300	4.9	1.600	6.2	4.000	9.5	8.000	13.2
0.400	4.9	1.800	6.5	4.500	10.1	8.500	13.6
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.0
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.4
0.800	4.5	2.400	7.5	6.000	11.5		
1.000	5.0	2.600	7.8	6.500	12.0		

Hydro-Brake Optimum® Manhole: 10, DS/PN: 1.009, Volume (m³): 18.8

Unit Reference	MD-SHE-0100-5000-1350-5000
Design Head (m)	1.350
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	100
Invert Level (m)	49.260
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	5.0
Flush-Flo™	0.401	5.0

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Hydro-Brake Optimum® Manhole: 10, DS/PN: 1.009, Volume (m³): 18.8

Control Points	Head (m)	Flow (l/s)
Kick-Flo®	0.825	4.0
Mean Flow over Head Range	-	4.4

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)
0.100	3.3	1.200	4.7	3.000	7.3	7.000	10.8
0.200	4.6	1.400	5.1	3.500	7.8	7.500	11.2
0.300	4.9	1.600	5.4	4.000	8.3	8.000	11.6
0.400	5.0	1.800	5.7	4.500	8.8	8.500	11.9
0.500	4.9	2.000	6.0	5.000	9.2	9.000	12.2
0.600	4.8	2.200	6.3	5.500	9.7	9.500	12.5
0.800	4.1	2.400	6.5	6.000	10.1		
1.000	4.3	2.600	6.8	6.500	10.5		

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Storage Structures for Storm

Porous Car Park Manhole: 3, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	34.0
Max Percolation (l/s)	94.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

Tank or Pond Manhole: 5, DS/PN: 1.004

Invert Level (m) 50.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	40.0	1.000	100.0

Porous Car Park Manhole: 7, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	120.0
Max Percolation (l/s)	166.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

Porous Car Park Manhole: 10, DS/PN: 1.009

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	92.0
Max Percolation (l/s)	127.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

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Summary of Results for 180 minute 30 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	50.598	0.248	0.000	0.02		2.4	SURCHARGED
1.001	2	50.599	0.299	0.000	0.05		6.5	SURCHARGED
1.002	3	50.599	0.349	0.000	0.08		9.5	SURCHARGED
1.003	4	50.598	0.398	0.000	0.06		8.7	SURCHARGED
1.004	5	50.597	0.327	0.000	0.14		38.1	SURCHARGED
1.005	6	50.597	0.407	0.000	0.07		19.4	SURCHARGED
1.006	7	50.597	0.507	0.000	0.03		4.9	SURCHARGED
1.007	8	50.540	0.480	0.000	0.02		5.6	SURCHARGED
1.008	9	50.540	0.540	0.000	0.04		11.2	SURCHARGED
1.009	10	50.538	0.678	0.000	0.01		5.0	SURCHARGED

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	Add Flow / Climate Change (%)	30
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.000
Ratio R	0.350	Maximum Backdrop Height (m)	10.000
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.187	4-8	0.211	8-12	0.006

Total Area Contributing (ha) = 0.404

Total Pipe Volume (m³) = 66.586

Network Design Table 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)
1.000	25.000	0.050	500.0	0.025	5.00	0.0	0.600	o	450
1.001	20.000	0.050	400.0	0.046	0.00	0.0	0.600	o	450
1.002	25.000	0.050	500.0	0.047	0.00	0.0	0.600	o	450
1.003	34.000	0.080	425.0	0.013	0.00	0.0	0.600	o	450
1.004	36.000	0.080	450.0	0.043	0.00	0.0	0.600	o	600
1.005	39.000	0.100	390.0	0.032	0.00	0.0	0.600	o	600
1.006	12.000	0.030	400.0	0.085	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.46	49.900	0.025	0.0	0.0	1.0	0.90	143.5	4.4
1.001	50.00	5.79	49.850	0.071	0.0	0.0	2.9	1.01	160.7	12.5
1.002	50.00	6.25	49.800	0.118	0.0	0.0	4.8	0.90	143.5	20.8
1.003	50.00	6.83	49.750	0.131	0.0	0.0	5.3	0.98	155.8	23.1
1.004	50.00	7.36	49.670	0.174	0.0	0.0	7.1	1.14	322.7	30.6
1.005	50.00	7.89	49.590	0.206	0.0	0.0	8.4	1.23	346.9	36.3
1.006	50.00	8.05	49.490	0.291	0.0	0.0	11.8	1.21	342.5	51.2

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Network Design Table 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)
1.007	28.000	0.060	466.7	0.020	0.00	0.0	0.600	o	600
1.008	57.000	0.140	407.1	0.093	0.00	0.0	0.600	o	600
1.009	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	50.00	8.47	49.460	0.311	0.0	0.0	12.6	1.12	316.8	54.7
1.008	49.51	9.26	49.400	0.404	0.0	0.0	16.3	1.20	339.5	70.4
1.009	49.42	9.29	49.260	0.404	0.0	0.0	16.3	2.44	688.6	70.4

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	51.000	1.100	Open Manhole	1500	1.000	49.900	450				
2	51.000	1.150	Open Manhole	1500	1.001	49.850	450	1.000	49.850	450	
3	51.000	1.200	Open Manhole	1500	1.002	49.800	450	1.001	49.800	450	
4	51.000	1.250	Open Manhole	1500	1.003	49.750	450	1.002	49.750	450	
5	51.000	1.330	Open Manhole	1500	1.004	49.670	600	1.003	49.670	450	
6	51.000	1.410	Open Manhole	1500	1.005	49.590	600	1.004	49.590	600	
7	51.000	1.510	Open Manhole	1500	1.006	49.490	600	1.005	49.490	600	
8	51.000	1.540	Open Manhole	1500	1.007	49.460	600	1.006	49.460	600	
9	51.000	1.600	Open Manhole	1500	1.008	49.400	600	1.007	49.400	600	
10	51.000	1.740	Open Manhole	1500	1.009	49.260	600	1.008	49.260	600	
	51.000	1.790	Open Manhole	450		OUTFALL		1.009	49.210	600	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	450	1	51.000	49.900	0.650	Open Manhole	1500
1.001	o	450	2	51.000	49.850	0.700	Open Manhole	1500
1.002	o	450	3	51.000	49.800	0.750	Open Manhole	1500
1.003	o	450	4	51.000	49.750	0.800	Open Manhole	1500
1.004	o	600	5	51.000	49.670	0.730	Open Manhole	1500
1.005	o	600	6	51.000	49.590	0.810	Open Manhole	1500
1.006	o	600	7	51.000	49.490	0.910	Open Manhole	1500
1.007	o	600	8	51.000	49.460	0.940	Open Manhole	1500
1.008	o	600	9	51.000	49.400	1.000	Open Manhole	1500
1.009	o	600	10	51.000	49.260	1.140	Open Manhole	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	25.000	500.0	2	51.000	49.850	0.700	Open Manhole	1500
1.001	20.000	400.0	3	51.000	49.800	0.750	Open Manhole	1500
1.002	25.000	500.0	4	51.000	49.750	0.800	Open Manhole	1500
1.003	34.000	425.0	5	51.000	49.670	0.880	Open Manhole	1500
1.004	36.000	450.0	6	51.000	49.590	0.810	Open Manhole	1500
1.005	39.000	390.0	7	51.000	49.490	0.910	Open Manhole	1500
1.006	12.000	400.0	8	51.000	49.460	0.940	Open Manhole	1500
1.007	28.000	466.7	9	51.000	49.400	1.000	Open Manhole	1500
1.008	57.000	407.1	10	51.000	49.260	1.140	Open Manhole	1500
1.009	5.000	100.0		51.000	49.210	1.190	Open Manhole	450

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)
1.009		51.000	49.210	49.210	450	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Foul Sewage per hectare (l/s)	0.000
Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	30.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Run Time (mins)	360
Manhole Headloss Coeff (Global)	0.500	Output Interval (mins)	3

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0		

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Simulation Criteria for Storm

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	180
Ratio R	0.350		

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 7, DS/PN: 1.006, Volume (m³): 13.3

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	105
Invert Level (m)	49.490
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.295	4.9
Kick-Flo®	0.636	4.0
Mean Flow over Head Range	-	4.3

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)
0.100	3.6	1.200	5.4	3.000	8.3	7.000	12.4
0.200	4.8	1.400	5.8	3.500	8.9	7.500	12.8
0.300	4.9	1.600	6.2	4.000	9.5	8.000	13.2
0.400	4.9	1.800	6.5	4.500	10.1	8.500	13.6
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.0
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.4
0.800	4.5	2.400	7.5	6.000	11.5		
1.000	5.0	2.600	7.8	6.500	12.0		

Hydro-Brake Optimum® Manhole: 10, DS/PN: 1.009, Volume (m³): 18.8

Unit Reference	MD-SHE-0100-5000-1350-5000
Design Head (m)	1.350
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	100
Invert Level (m)	49.260
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	5.0
Flush-Flo™	0.401	5.0

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Hydro-Brake Optimum® Manhole: 10, DS/PN: 1.009, Volume (m³): 18.8

Control Points	Head (m)	Flow (l/s)
Kick-Flo®	0.825	4.0
Mean Flow over Head Range	-	4.4

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)
0.100	3.3	1.200	4.7	3.000	7.3	7.000	10.8
0.200	4.6	1.400	5.1	3.500	7.8	7.500	11.2
0.300	4.9	1.600	5.4	4.000	8.3	8.000	11.6
0.400	5.0	1.800	5.7	4.500	8.8	8.500	11.9
0.500	4.9	2.000	6.0	5.000	9.2	9.000	12.2
0.600	4.8	2.200	6.3	5.500	9.7	9.500	12.5
0.800	4.1	2.400	6.5	6.000	10.1		
1.000	4.3	2.600	6.8	6.500	10.5		

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Storage Structures for Storm

Porous Car Park Manhole: 3, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	34.0
Max Percolation (l/s)	94.4	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

Tank or Pond Manhole: 5, DS/PN: 1.004

Invert Level (m) 50.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	40.0	1.000	100.0

Porous Car Park Manhole: 7, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	120.0
Max Percolation (l/s)	166.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

Porous Car Park Manhole: 10, DS/PN: 1.009

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	92.0
Max Percolation (l/s)	127.8	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	50.500	Cap Volume Depth (m)	0.000

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Summary of Results for 180 minute 100 year Winter (Storm)

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000	1	50.719	0.369	0.000	0.03		3.0	FLOOD RISK
1.001	2	50.719	0.419	0.000	0.06		8.4	FLOOD RISK
1.002	3	50.719	0.469	0.000	0.10		12.3	FLOOD RISK
1.003	4	50.719	0.519	0.000	0.10		13.3	FLOOD RISK
1.004	5	50.718	0.448	0.000	0.02		6.4	FLOOD RISK
1.005	6	50.718	0.528	0.000	0.02		5.3	FLOOD RISK
1.006	7	50.718	0.628	0.000	0.03		4.9	FLOOD RISK
1.007	8	50.634	0.574	0.000	0.02		5.5	SURCHARGED
1.008	9	50.635	0.635	0.000	0.04		13.5	SURCHARGED
1.009	10	50.633	0.773	0.000	0.01		5.1	SURCHARGED

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Volume (m³)	Status
360 min Summer	47.330	1.330	199.5	O K
360 min Winter	47.490	1.490	223.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
360 min Summer	10.975	0.0	372
360 min Winter	10.975	0.0	372

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	360
Ratio R	0.350	Longest Storm (mins)	360
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.404

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.187	4	8	0.211	8	12	0.006

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Model Details

Storage is Online Cover Level (m) 51.000

Tank or Pond Structure

Invert Level (m) 46.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	150.0	5.000	150.0

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APPENDIX F:

Conditions and Limitations

1. This report is for planning purposes and does not constitute a design document. It is the duty of the project designers, to confirm the content of this report and to design the scheme in accordance with their own research and other extraneous parameters.

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