FLOSH MEADOWS, CLEATOR, SR12A AND TOP MEADOWS

Drainage Strategy

Issue Date:

15 September 2023

Report Number:

1842-DS11

Client:

Lakeland Associates (Cleator) Ltd

Revision:

E

Coast Consulting Engineers Ltd
7 Silverton Court, Northumberland Business Park, NE23 7RY
Tel. 0191 597 7879

Contents

Executive Summary

Site Location	The site is located off A5086, Cleator, CA23 3EP (nearest) at NGR 301752E 514082N. The overall development footprint measures approximately 3.30 Ha, entirely greenfield.
Site Proposals	The site is proposed to be developed with residential units.
Ground Conditions	The site is located in an area underlain by drift deposits consisting of soft - stiff clays. Surface water cannot be discharged utilising infiltration techniques.
Nearest Watercourse	The River Ehen is located 300m to the south of the overall site boundary beyond third party land. It is not possible to make a direct connection to a water course to dispose of surface water.
Nearest water feature	Within the development site, an historic man-made culverted mill race flows from north to south and outfalls via a culvert below the public highway located to the south. The mill race conveys flows from agricultural land located to the north of the development site. Surface water should discharge to the surface water feature. Surface water discharge should restricted to a greenfield rate matching Qbar for the development, in this case 32 litres/sec.
Nearest Surface Water Sewer.	Adjacent to proposed site entrance, discharging within 40m of the head of the run to a UU combined sewer at A5086. Another surface water sewer is located within Howthorne Fields to the south of Flosh Meadows. Neither sewer is suitable for disposal of surface water. The reasons are covered in greater detail within section 3.0.
Nearest Combined Sewer	On site adjacent to southern boundary
Nearest Foul Water Sewer	Adjacent to proposed site entrance, discharging within 40m to a UU combined sewer at A5086
SUDS	Pipes, flow control

The above summary should not be used in isolation and reference should be made the full report which provides a detailed assessment of the risks affecting the development.

1. Introduction

Coast Consulting Engineers have been commissioned by Lakeland Associates (Cleator) Ltd to produce a drainage strategy to accompany a planning application for a proposed development at Flosh Meadows, Cleator. This strategy is produced only for the phases known as SR12A Mid Meadows (4/17/2214) and Top Meadows (4/17/2390), although the strategy also references the wider site, as the drainage from SR12A and Top Meadows discharges into the phase known as SR12, The Meadows. This Assessment is reviewed in accordance with the National Planning Policy Framework (NPPF) for Development and Flood Risk.

A flood risk assessment has previously been completed by RWO Associates reference RO/14016.200 Version 3, dated October 2017 and has subsequently been approved. As such, this report does not assess flood risk to the proposed development.

2. Site location, Existing Topography, Geology and Proposals

2.1 Site Location

The site is located off A5086, Cleator, CA23 3EP (nearest) at NGR 301752E 514082N. The entire development footprint measures approximately 3.30 Ha, entirely greenfield.

The site location is indicated in Figure 2.11 and the proposed phasing in Figure 2.12 below.

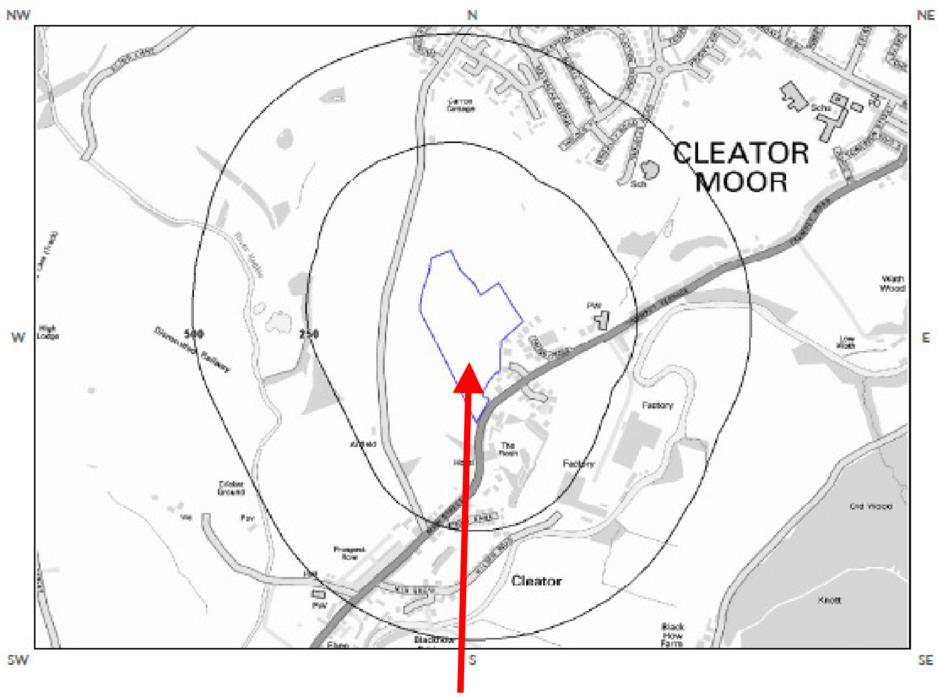


Figure 2.11 – Site Location

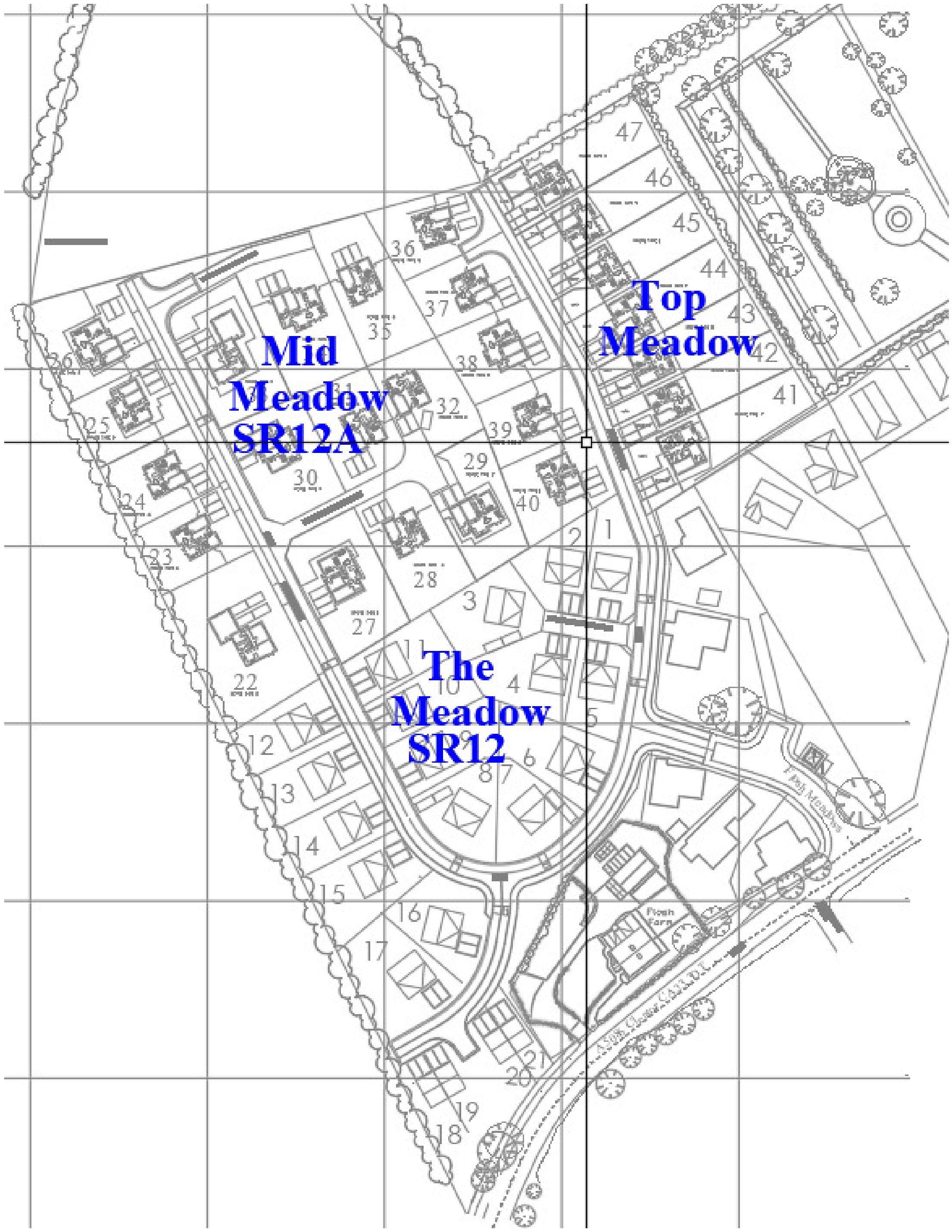


Figure 2.12 – Proposed Phasing

2.2 Existing Topography

A topographical survey of the site has been undertaken and is included in Appendix A. The overall development site generally falls in a southerly direction. Site levels range from approximately 67.50m AOD at the north of SR12A to 63.00m AOD at the southern extents of SR12.

The surrounding area is developed as follows:

North: Agricultural Land
East: Agricultural Land and residential properties
South: Residential properties
West: Agricultural Land

Figure 2.21 below extracted from Google maps shows the existing site.

Figure 2.21 – Satellite image of the existing site.

2.3 Existing sewers and watercourses

A combined sewer is located within the development land, adjacent to the southern boundary line of SR12. Adopted foul and surface water sewers are located within Flosh Meadows, adjacent to the proposed site entrance, the head of each run is located at the proposed site entrance. The adopted surface water and foul sewers outfall into a combined sewer approximately 40m downstream of the head of each run. All sewers are owned and maintained by United Utilities Ltd (UU). Figure 2.31 below shows the location of the existing public sewers within the vicinity of the site.

Within the overall development site, an historic man-made culverted mill race flows from north to south and outfalls via a culvert below the public highway located to the south of SR12. The mill race conveys flows from agricultural land located to the north of SR12A. Figure 2.32 overleaf shows the location of the natural watercourses within the vicinity of the site. Please also refer to Appendix C for further information on the existing drainage regime.

The River Ehen is located approximately 300m to the south of the site boundary, beyond third party land.

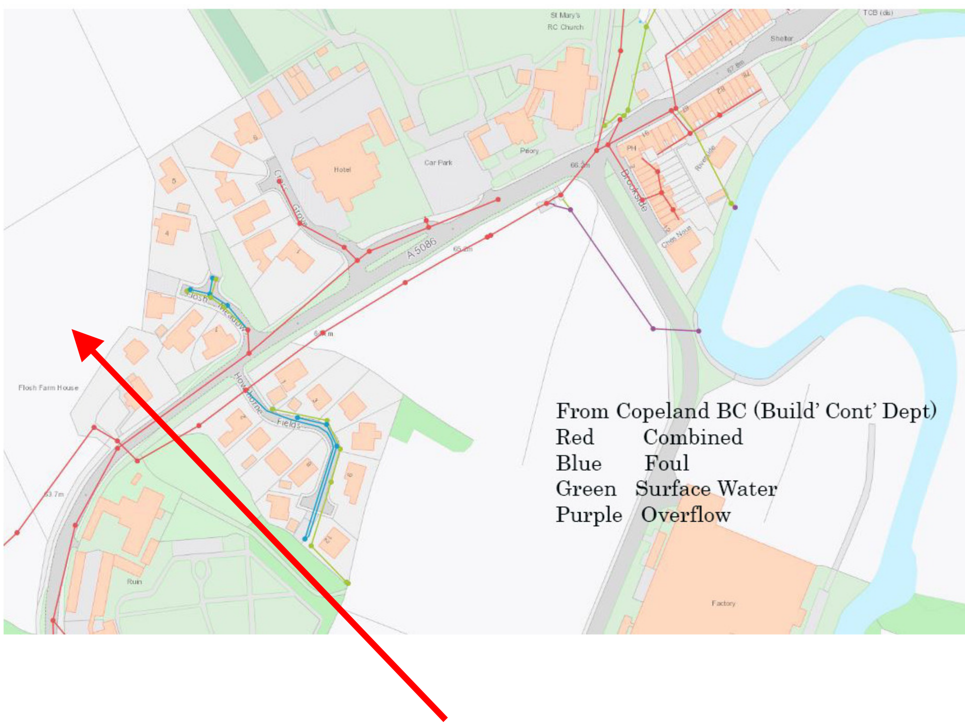


Figure 2.31 – sewers.

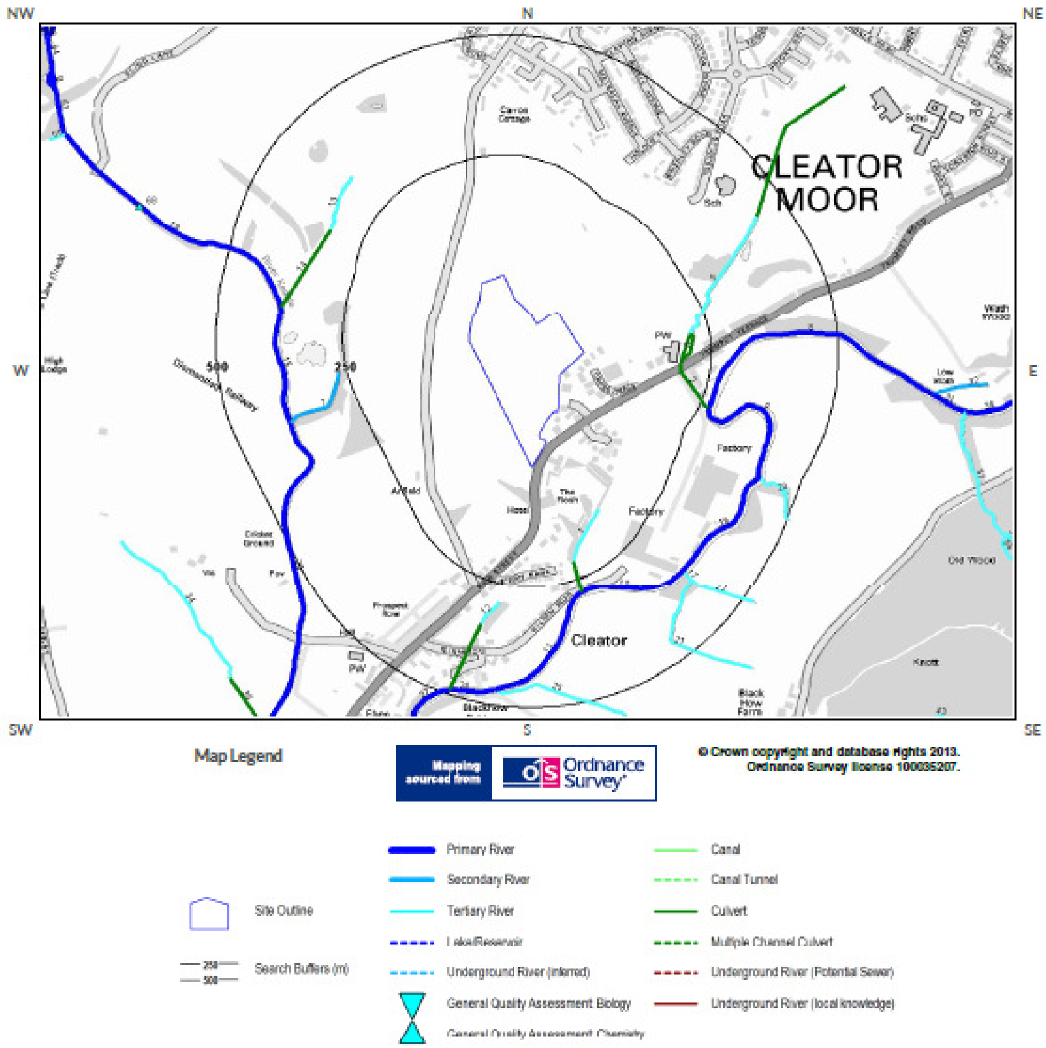


Figure 2.32 – watercourses.

2.4 Geology

A phase 2 intrusive investigation of ground conditions has been completed by Geo Environmental Engineering Ltd, reference 2018-3167 dated 09.08.2018. The report states that the site is underlain by varying ground conditions, largely comprising soft to stiff clays. Ground water was encountered across the site at depths of between 1.50m to 2.90m.

2.5 Development Proposals

The site is proposed to be developed with residential units. A copy of the proposed architectural site layout can be found in Appendix B.

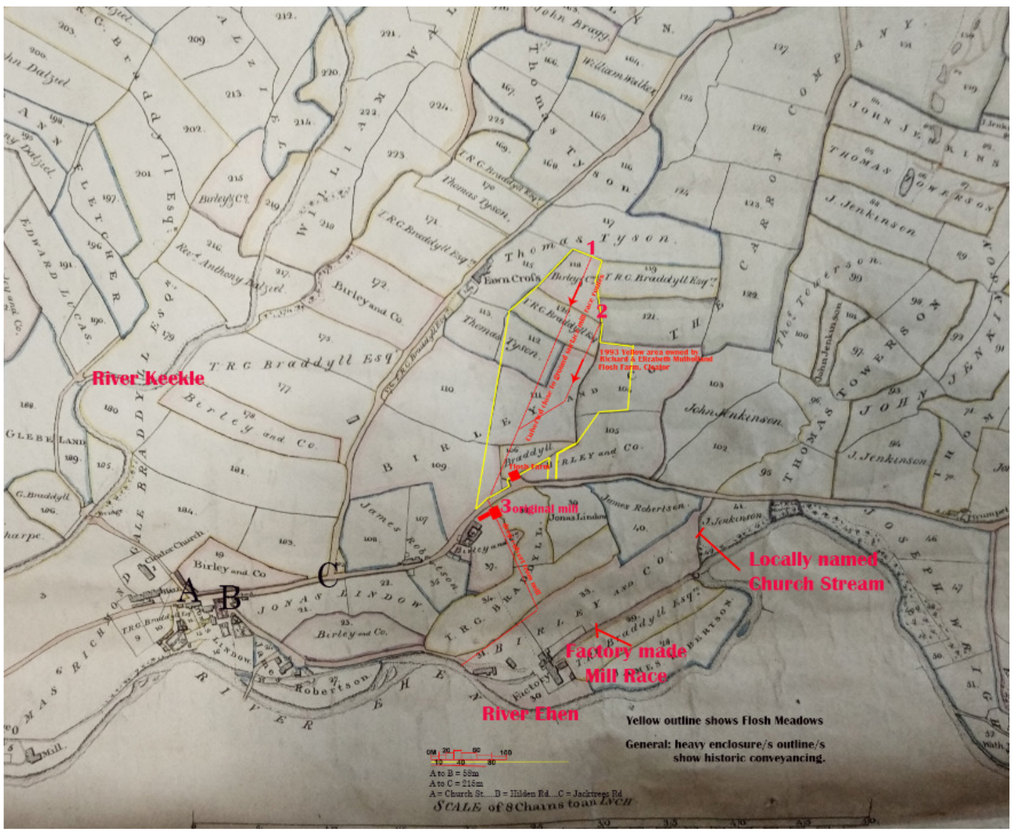
3. Surface Water Disposal

3.1 Existing Surface Water Drainage

There are no existing sewers serving the greenfield site.

An existing historic, man-made, culverted, mill race flows through the site from north to south. The race outfalls from the development via a culvert below the public highway located to the south of SR12. The race is not a natural watercourse and is not identified on GroundSure plans (ref figure 2.32) above or historic Pre 1800's mining plans (ref figure 3.11) below.

Please also refer to Appendix C for further information on the existing drainage regime.



3.2 Proposed Surface Water Drainage

In line with national standards, consideration has been given to the preferred hierarchy for disposal of surface water from the development, as contained in Part H of the Building Regulations. The hierarchy is as follows:

1. By infiltration
2. To watercourse
3. To sewer

As noted earlier, superficial deposits comprise of soft - stiff clays with a low permeability. It is considered that utilisation of infiltration techniques will not be applicable for the proposed development.

The nearest watercourse to the development is located approximately 300m to the south of the site boundary, beyond third party land. As such, it will not be possible to make a direct connection to a watercourse.

Following discussions between the developer and the LLFA, it has been agreed to discharge surface water to the Mill Race located within the site boundary.

3.3 SUDS Techniques

In line with National Planning Policy, SUDS techniques will be utilised as part of the design of the surface water network. The applicable techniques and the benefits that they bring to the development are outlined below.

- Flow control: A vortex flow control device will be utilised to restrict flows to the equivalent of existing site greenfield rate (Qbar)

- Surface water conveyance: Surface water will be conveyed through the development utilising below ground pipes.

- Surface water treatment: Attenuated surface water flows will be stored in a piped network.

3.4 SuDS Maintenance

Regular inspection and maintenance is key to the effective operation of SuDS features. Maintenance responsibility for SuDS features proposed as part of the development is to be placed with a responsible organisation and in this case a nominated management and maintenance company.
Removal of debris and any settled silt from SuDS features is the key maintenance requirement for the continued effective operation of the SuDS features. Most of the maintenance activities can be undertaken as part of regular landscape maintenance activities.

3.5 Post Development Discharge Rate

Proposed surface water discharge rates will be limited from the development to the equivalent of the pre-development Qbar green field run off rate, for all storms up to and including 1 in 100 year return period rainfall event + 40% increase in rainfall intensity to account for the predicted effects of climate change.

In line with national and local standards the greenfield run off rate for 3.30 Ha of developed land has been calculated using the Institute of Hydrology (IH) Report 124 Flood Estimation for Small Catchments (1994) method, with flow rate linearly interpolated due to site being smaller than 50Ha. HR Wallingford Greenfield runoff rate estimation for sites tool, available at **https://www.uksuds.com** has been used to calculate Qbar run off rate at 32.02 l/sec. An assessment of the allowable discharge rate is outlined below in figure 3.51.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	32.02	32.02
1 in 1 year (l/s):	27.85	27.85
1 in 30 years (l/s):	54.43	54.43
1 in 100 year (l/s):	66.59	66.59
1 in 200 years (l/s):	75.88	75.88

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Figure 3.51 Greenfield run off rates.

Please refer to Appendix D for further information on green field run off rates.
Note – the 'developed land' includes for all phases of the proposed development.

3.6 Surface Water Attenuation

Surface water will be restricted for all events up to an including the 100 year event with a 50% allowance for climate change and a 10% allowance for urban creep. Attenuated flows will be contained on site within a designated storage system. Please refer to the calculations and drainage strategy contained within Appendix E.
Note – the allowable discharge rate and drainage calculations include for all phases of the development.

By restricting the peak rate of discharge from the site Qbar to the watercourse for all events up to and including the 100-year event, **the proposed development will provide betterment from the existing regime in line with the table below**.

Return period	greenfield rate	Proposed	Betterment
Qbar	32.02 l/s	32.0 l/s	**0%**
30	54.43 l/s	32.0 l/s	**31%**
100	66.59 l/s	32.0 l/s	**52%**
100+50%	99.85 l/s	32.0 l/s	**68%**

3.7 Proposed Foul Drainage

It is proposed to discharge a portion of the foul water to the adjacent UU combined sewer and a portion to the existing foul sewer in Flosh Meadows, both via gravity connections.

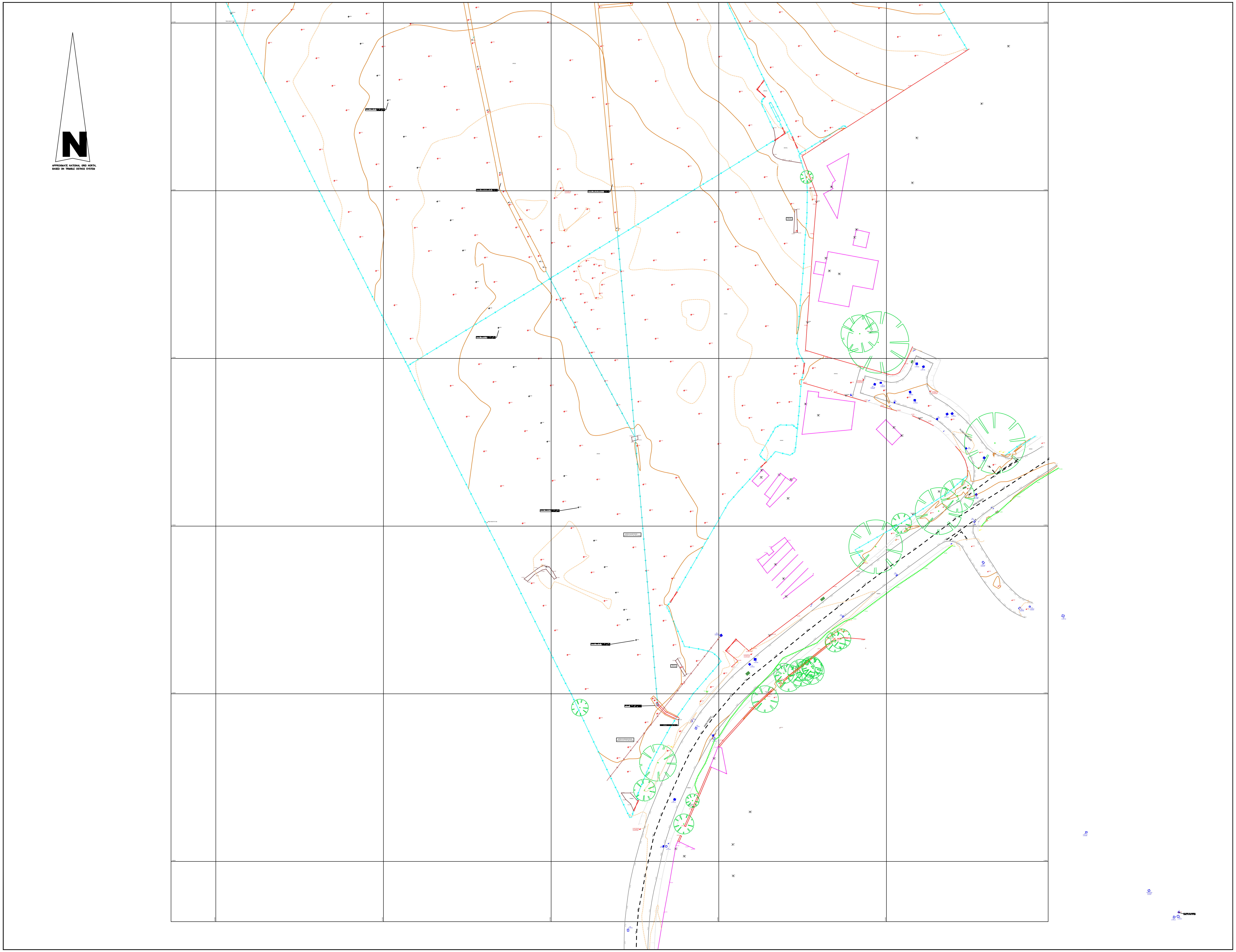
4. References

The following reference documents have been used in the preparation of this report.

- National Planning Policy Framework 2021.
- PPG 2021.
- Environment Agency online flood maps.
- Sewers for Adoption 6th Edition - WRC plc, April 2006.
- Building Regulations Document H 2010.
- Improving the Flood Performance of New Buildings – Defra.
- Rainfall runoff management for developments SC030219 – Defra.
- Susdrain.org
- The SuDS Manual CIRIA C753.

Appendices

Appendix A



KEY

LINETYPES

VERGE	CONCRETE EDGE
FENCE - CHAIN LINK	FOOTPATH
FENCE - METAL	TRACK
FENCE - WOODEN	BUILDING
FENCE - POST & RAIL	TREE
HEDGE	GATE
WALL	SURVEY STATION
BARRIER	EAVES
CHANNEL LINE	

UTILITY KEY

LINETYPES

BT BELOW GROUND	WATER BELOW GROUND
BT ABOVE GROUND	WATER ABOVE GROUND
BT ASSUMED ROUTE	WATER ASSUMED ROUTE
CATV BELOW GROUND	UNKNOWN BELOW GROUND
CATV ABOVE GROUND	UNKNOWN ABOVE GROUND
CATV ASSUMED ROUTE	GPR BELOW GROUND
COMMS BELOW GROUND	COMBINED WATER SEWER
COMMS ABOVE GROUND	ASSUMED COMBINED WATER SEWER ROUTE
COMMS ASSUMED ROUTE	FOUL WATER SEWER
GAS BELOW GROUND	ASSUMED FOUL WATER SEWER ROUTE
GAS ABOVE GROUND	STORM WATER SEWER
GAS ASSUMED ROUTE	ASSUMED STORM WATER SEWER ROUTE
ELECTRIC BELOW GROUND	REINSTATEMENT SCAR
ELECTRIC ABOVE GROUND	SURVEY BOUNDARY
ELECTRIC ASSUMED ROUTE	

ABBREVIATIONS

(AC)	ASSUMED CONNECTION	INT	INTERCEPTOR
A/G	ABOVE GROUND	KV	KILO VOLT
(AR)	ASSUMED ROUTE	LD	LOOP DETECTOR
ASB	ASBESTOS CEMENT	LH	LAMP HOLE
AV	AIR VALVE	LP	LAMP POST
BB	BELISHA BEACON	LV	LOW VOLTAGE
BD	BACK DROP	MK	MARKER
BL	BASE LEVEL	MH	MANHOLE
BO	BOLLARD	MT	METER
BOL	BOLLARD LIGHT	M/WELL	MONITORING WELL
BT	BRITISH TELECOM	O/H	OVERHEAD
CATV	CABLE TELEVISION	PE	POLYETHYLENE
CB	CONTROL BOX	PTG	PIPE TO GROUND
CI	CAST IRON	PVC	POLYVINYL CHLORIDE
CL	COVER LEVEL	TFR	TAKEN FROM RECORDS
CR	CABLE RISER	RE	RODDING EYE
CWS	COMBINED WATER SEWER	RED	REDUNDANT SERVICE
d	DEPTH OF SERVICE	RWP	RAIN WATER PIPE
DCH	DRAINAGE CHANNEL	SC	STOP COCK
DI	DUCTILE IRON	SI	SPUN IRON
DIS	DISUSED	SOF	SOFFIT
EOT	END OF TRACE	SP	SOIL PIPE
EP	ELECTRIC POLE	SWS	SURFACE WATER SEWER
ER	EARTH ROD	SV	STOP VALVE
FFP	FUEL TANK FILL POINT	TL	TRAFFIC LIGHT
FH	FIRE HYDRANT	TLC	TRAFFIC LIGHT COVER
FWS	FOUL WATER SEWER	TP	TELECOM POLE
GPR	GROUND PENETRATING RADAR	UTL	UNABLE TO LIFT
GR	GAS RISER	UTS	UNABLE TO SURVEY
GV	GAS VALVE	UTT	UNABLE TO TRACE
GY	GULLY	VC	VITRIFIED CLAY
HV	HIGH VOLTAGE	VP	VENT PIPE
IC	INSPECTION COVER	WL	WATER LEVEL
Id	INVERT DEPTH	WO	WASH OUT
IL	INVERT LEVEL	WR	WATER RISER

DISCLAIMER

Unless otherwise stated, all services shown on this plan have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to be direct.

No guarantee can be given that all services have been shown.
In ideal conditions the depth accuracies for the underground utilities located is +/- 10% of depth.

Utilities traced using GPR techniques show depths approximately from ground level to the top of the utility. Utilities traced using Electromagnetic techniques provide an estimated depth which is measured from ground level to the centre of the utility. Drainage and pipes traced using Sonde Electromagnetic techniques show depths at approximately the Invert Level.

Where services are shown as 'Taken From Records' on the drawing we are not liable for any loss that may arise due to a lack of accuracy in that guided information.

Due to BT's policy we are not permitted to lift their inspection chamber covers.

Reference should be made to the methodology used on site as detailed within the latest version of SiteScan Procedures for Utility Location Surveys.

SiteScan recommend that all excavations are to be carried out in accordance with HSG 47 (Avoiding Danger from Underground Services).

Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run in close proximity, separation may be impossible. Successful tracing of non-metallic pipes may be limited.

Existing record information showing underground services is often incomplete and of doubtful accuracy. It should be regarded only as an indication and cannot be guaranteed.

NOTES

REV	AMENDMENT	DRAWN	CHECKED
C	SURVEY EXTENDED	NP	NG
B	DRAINAGE ROUTES SURVEYED	NP	NG
A	INITIAL RELEASE	NP	NG

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SiteScan
Information to build on

CLIENT: RICHARD MULHOLLAND

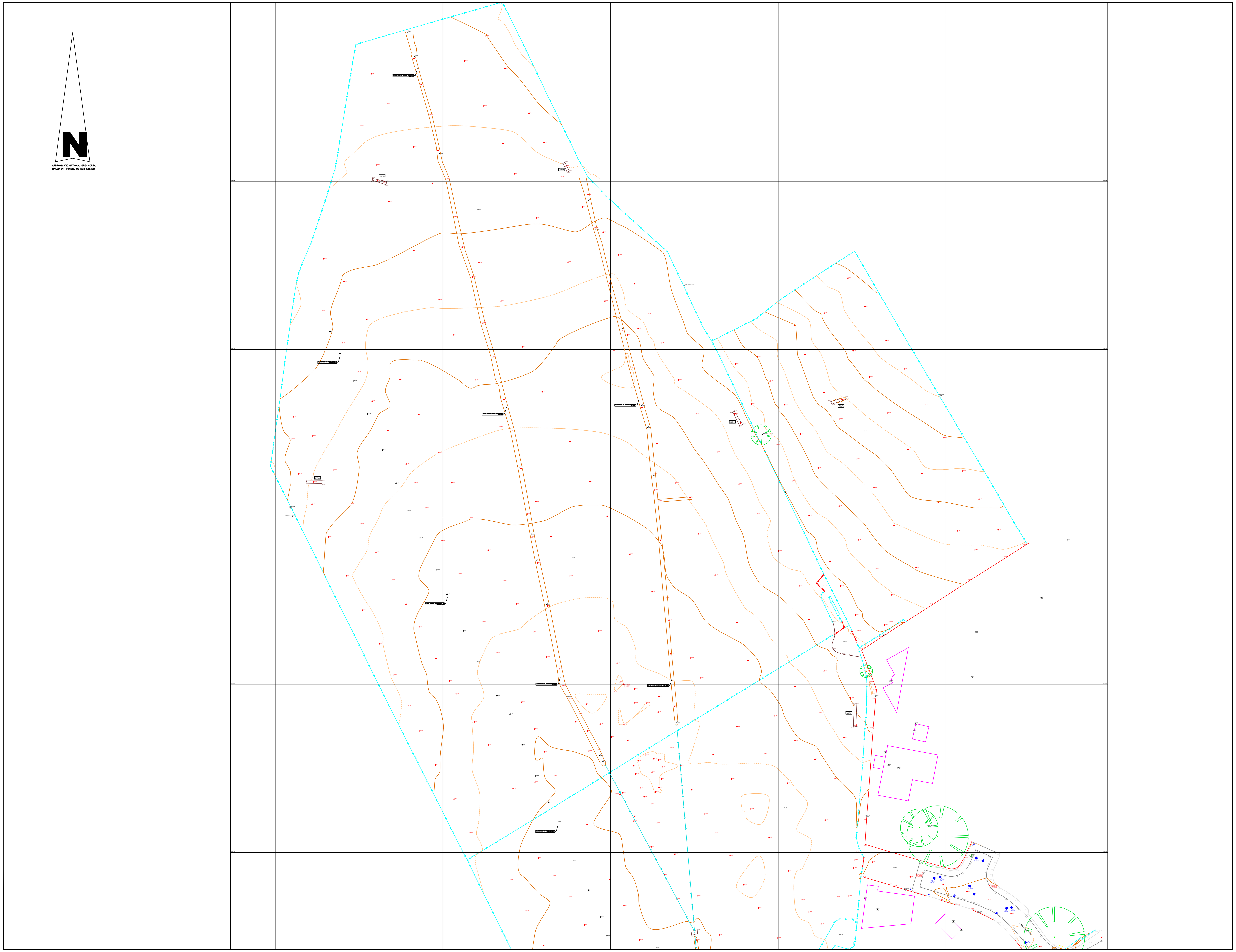
PROJECT TITLE: LAND AT FLOSH MEADOWS
CLEATOR
CUMBRIA

DRAWING TITLE: TOPOGRAPHICAL SURVEY

SCALE AT A1	DATE	GRID/DATUM
1:500 @ A1	18.03.14	OSTN02

SURVEYED BY	DRAWN BY	APPROVED
NP	NP	NG

PROJECT No.	SHEET No.	REV
P14053	1/2	C



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CUMBRIA

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SCALE AT A1: 1:500 @ A1	DATE: 18.03.14	GRID/DATUM: OSTN02
SURVEYED BY: NP	DRAWN BY: NP	APPROVED: NG
PROJECT No.: P14053	SHEET No.: 2/2	REV: C

Appendix B

HEDGE KEY

NEW HAWTHORN HEDGE
DOUBLE LAYER OF WHIPS
PLANTED AT 6 L/M HEIGHT
40-60cm

MATERIALS SCHEDULE

Driveway - Permeable block paving 100x 200mm
Colour - Dark grey

Patios and paving to rear - Concrete pre-cast concrete flags 500x 500mm

Paths to front - Indian Stone random pattern / size

PARKING BAY SIZES 2500 x 5000mm

Issue -
PLANNING

Client -
Mr & Mrs Mulholland

Project -
Housing Development

location / Postcode / what3words
Flosh Meadows, Cleator, Cumbria
media, others, logbook

Drawing Title - Proposed Site Plan - SR12, SR12A & Top Meadow

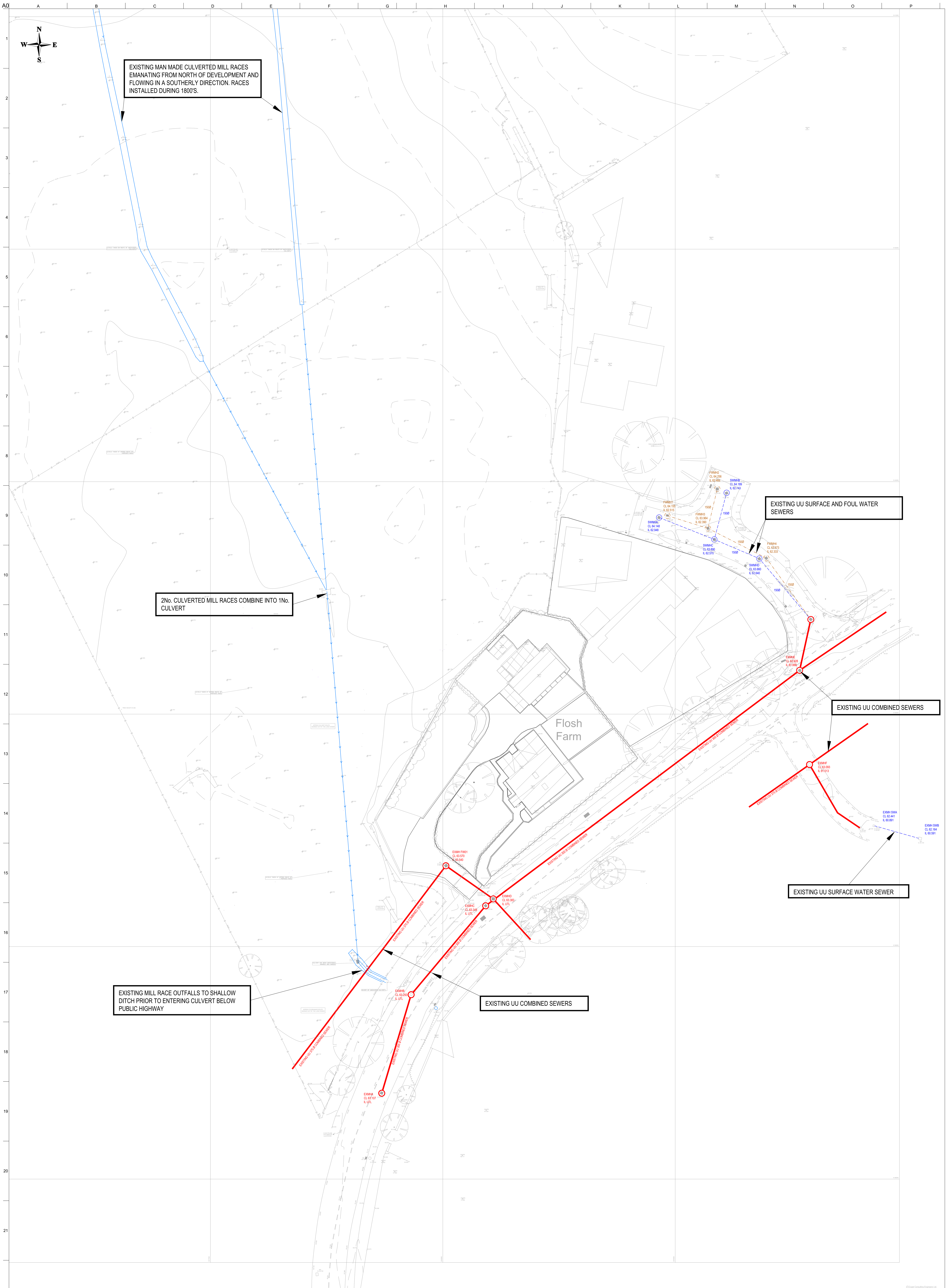
Job No — 1236	Dwg No — 20
DATE : 10 Oct 2021	Scale- 1: 500
Bitmap3721042191.png	RIBA Chartered ARCHITECTS
Rev : -	Paper A0

E - greenswallow@btinternet.com
M - 07970 96 41 84

Registerd Ofice : Green Swallow North Limited
Swallow Barn, Blindcrake, Cumbria. CA14 0QP

DIMENSIONS TO BE CHECKED ON SITE
FIGURED DIMENSIONS TO BE TAKEN IN PREFERENCE TO SCALED DIMENSIONS

Appendix C



LEGEND

- LAND DRAINAGE
- UU COMBINED WATER SEWER
- UU FOUL WATER SEWER
- UU SURFACE WATER SEWER

Issue	Date	Description	By	Chkd	Appd
P3	19-05-21	Updated to reflect client comments	RH	RH	PL
P2	23-04-21	Updated to reflect client comments	RH	RH	PL
P1	22-04-21	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS

7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client: MR R.W. MULHOLLAND

Job Title: FLOSH MEADOWS CUMBRIA

Drawing Title: EXISTING DRAINAGE

Scale at A0: 1:250

Drawing Status: **PRELIMINARY**

Job No: 1842 | Drawing No: 201 | Issue: P3

Appendix D

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	richard hall
Site name:	Flosh Meadows
Site location:	Cleator

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

Site Details

Latitude:	54.51164° N
Longitude:	3.51942° W
Reference:	2032601581
Date:	May 28 2021 13:23

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 3.30

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	1271	1271
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	32.02	32.02
1 in 1 year (l/s):	27.85	27.85
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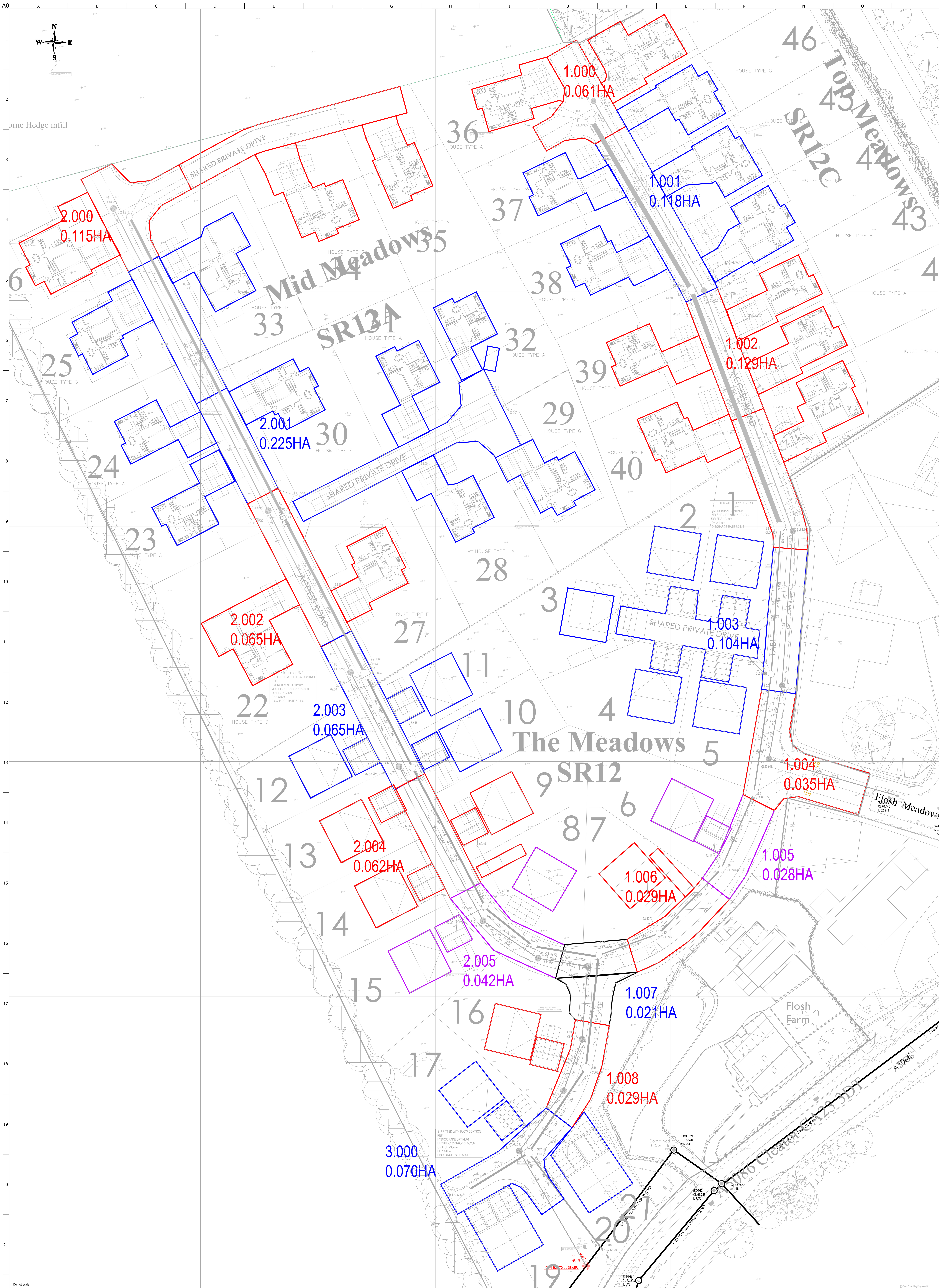
1 in 100 year (l/s):	66.59	66.59
1 in 200 years (l/s):	75.88	75.88

Appendix E



Issue	Date	Description	By	Chkd	Appd
T3	09/06/23	DRAINAGE LAYOUT REVISED	RH	PL	PL
T2	15/05/23	DRAINAGE LAYOUT REVISED	RH	PL	PL
T1	13/07/22	TENDER ISSUE	RH	PL	PL

COAST CONSULTING ENGINEERS

7 Silverton Court, Northumberland Business Park, NE23 7RY

0191 5977879

Client: MR R.W. MULHOLLAND

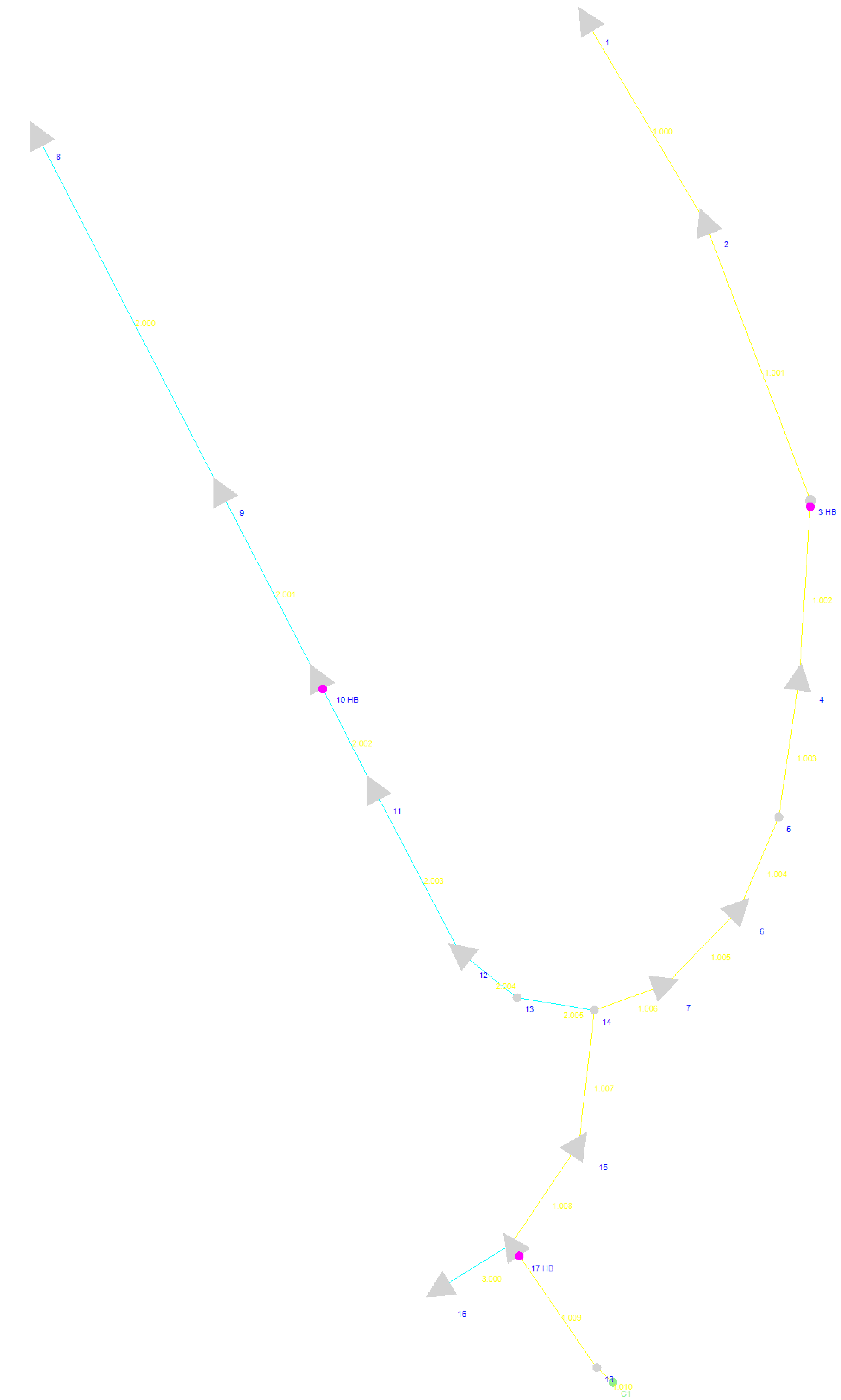
Job Title: FLOSH MEADOWS CUMBRIA

Drawing Title: IMPERMEABLE AREAS

Scale at A0: 1:250

Drawing Status: TENDER

Job No	Drawing No	Issue
1842	121	T3


1
2
3 HB
4
5
6
7
8
9
10 HB
11
12
13
14
15
16
17 HB
18

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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	Auto Design
1.000	41.957	0.105	399.6	0.061	5.00	0.0	0.600	o	975	Pipe/Conduit	
1.001	53.639	0.134	400.3	0.118	0.00	0.0	0.600	o	975	Pipe/Conduit	
1.002	31.512	0.185	170.3	0.129	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.150	169.9	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.104	169.7	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	18.982	0.112	169.5	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	13.655	0.080	170.7	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	71.706	0.221	324.5	0.115	5.00	0.0	0.600	o	525	Pipe/Conduit	
2.001	37.730	0.116	325.3	0.225	0.00	0.0	0.600	o	525	Pipe/Conduit	
2.002	22.253	0.068	325.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.003	33.218	0.102	325.7	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.041	323.1	0.062	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.005	14.105	0.043	328.0	0.042	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	24.092	0.074	325.6	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	21.726	0.067	324.3	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	

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	0.00	5.43	63.013	0.061	0.0	0.0	0.0	1.64	1225.0	0.0
1.001	0.00	5.97	62.908	0.179	0.0	0.0	0.0	1.64	1223.9	0.0
1.002	0.00	6.50	62.774	0.308	0.0	0.0	0.0	1.00	39.7	0.0
1.003	0.00	6.92	62.589	0.412	0.0	0.0	0.0	1.00	39.8	0.0
1.004	0.00	7.22	62.439	0.447	0.0	0.0	0.0	1.00	39.8	0.0
1.005	0.00	7.53	62.335	0.475	0.0	0.0	0.0	1.00	39.8	0.0
1.006	0.00	7.76	62.223	0.504	0.0	0.0	0.0	1.00	39.7	0.0
2.000	0.00	5.97	62.586	0.115	0.0	0.0	0.0	1.24	268.0	0.0
2.001	0.00	6.47	62.365	0.340	0.0	0.0	0.0	1.24	267.7	0.0
2.002	0.00	6.85	62.249	0.405	0.0	0.0	0.0	1.00	110.4	0.0
2.003	0.00	7.40	62.181	0.470	0.0	0.0	0.0	1.00	110.3	0.0
2.004	0.00	7.62	62.079	0.532	0.0	0.0	0.0	1.00	110.7	0.0
2.005	0.00	7.86	62.038	0.574	0.0	0.0	0.0	0.99	109.9	0.0
1.007	0.00	8.26	61.993	1.099	0.0	0.0	0.0	1.00	110.3	0.0
1.008	0.00	8.62	61.919	1.128	0.0	0.0	0.0	1.00	110.5	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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	Auto Design
3.000	15.459	0.048	322.1	0.070	5.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	26.775	0.109	245.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	3.900	0.016	243.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

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)
3.000	0.00	5.26	61.900	0.070	0.0	0.0	0.0	1.00	110.9	0.0
1.009	0.00	9.07	61.852	1.198	0.0	0.0	0.0	1.00	70.6	0.0
1.010	0.00	9.13	61.743	1.198	0.0	0.0	0.0	1.00	70.9	0.0

Free Flowing Outfall Details for 180518 SW1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	C1	63.006	61.727	61.727	1350	0

Simulation Criteria for 180518 SW1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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 Storage Structures	13
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	19.600
Return Period (years)	2	Ratio R	0.223
Region	England and Wales	Profile Type	Summer

Synthetic Rainfall Details

Cv (Summer)	0.750	Storm Duration (mins)	30
Cv (Winter)	0.840		

Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3 HB, DS/PN: 1.002, Volume (m³): 45.9

Unit Reference	MD-SHE-0107-7000-2119-7000
Design Head (m)	2.119
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	62.774
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.119	7.0	Kick-Flo®	0.957	4.8
Flush-Flo™	0.469	6.1	Mean Flow over Head Range	-	5.6

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	3.7	1.200	5.4	3.000	8.2	7.000	12.3
0.200	5.4	1.400	5.8	3.500	8.9	7.500	12.7
0.300	5.9	1.600	6.1	4.000	9.4	8.000	13.1
0.400	6.0	1.800	6.5	4.500	10.0	8.500	13.5
0.500	6.1	2.000	6.8	5.000	10.5	9.000	13.9
0.600	6.0	2.200	7.1	5.500	11.0	9.500	14.3
0.800	5.6	2.400	7.4	6.000	11.4		
1.000	4.9	2.600	7.7	6.500	11.9		

Hydro-Brake® Optimum Manhole: 10 HB, DS/PN: 2.002, Volume (m³): 13.2

Unit Reference	MD-SHE-0107-6000-1575-6000
Design Head (m)	1.575
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	62.249
Minimum Outlet Pipe Diameter (mm)	150

Hydro-Brake® Optimum Manhole: 10 HB, DS/PN: 2.002, Volume (m³): 13.2

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.575	6.0	Kick-Flo®	0.952	4.7
Flush-Flo™	0.468	5.9	Mean Flow over Head Range	-	5.2

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	5.3	3.000	8.1	7.000	12.1
0.200	5.3	1.400	5.7	3.500	8.7	7.500	12.5
0.300	5.7	1.600	6.0	4.000	9.3	8.000	12.9
0.400	5.9	1.800	6.4	4.500	9.8	8.500	13.3
0.500	5.9	2.000	6.7	5.000	10.3	9.000	13.7
0.600	5.9	2.200	7.0	5.500	10.8	9.500	14.0
0.800	5.5	2.400	7.3	6.000	11.3		
1.000	4.9	2.600	7.6	6.500	11.7		

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 9.6

Unit Reference	MD-SHE-0235-3200-1642-3200
Design Head (m)	1.642
Design Flow (l/s)	32.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	235
Invert Level (m)	61.852
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.642	32.0	Kick-Flo®	1.101	26.4
Flush-Flo™	0.503	32.0	Mean Flow over Head Range	-	27.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.8	0.200	23.7	0.300	30.6	0.400	31.7

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 9.6

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.500	32.0	1.800	33.4	4.000	49.1	7.500	66.6
0.600	31.8	2.000	35.2	4.500	52.0	8.000	68.8
0.800	31.0	2.200	36.8	5.000	54.7	8.500	70.8
1.000	28.8	2.400	38.4	5.500	57.3	9.000	72.8
1.200	27.5	2.600	39.9	6.000	59.8	9.500	74.8
1.400	29.6	3.000	42.8	6.500	62.2		
1.600	31.6	3.500	46.1	7.000	64.4		

Storage Structures for 180518 SW1.SWS

Cellular Storage Manhole: 1, DS/PN: 1.000

Invert Level (m) 63.585 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	51.8	0.0	0.521	0.0	0.0
0.520	51.8	0.0			

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 63.015 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	220.0	0.0	0.521	0.0	0.0
0.520	220.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 1.003

Invert Level (m) 62.589 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	129.5	0.0	0.521	0.0	0.0
0.520	129.5	0.0			

Cellular Storage Manhole: 6, DS/PN: 1.005

Invert Level (m) 62.335 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.9	0.0	0.521	0.0	0.0
0.520	25.9	0.0			

Cellular Storage Manhole: 7, DS/PN: 1.006

Invert Level (m) 62.224 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.9	0.0	0.521	0.0	0.0
0.520	25.9	0.0			

Cellular Storage Manhole: 8, DS/PN: 2.000

Invert Level (m) 63.413 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	77.7	0.0	0.521	0.0	0.0
0.520	77.7	0.0			

Cellular Storage Manhole: 9, DS/PN: 2.001

Invert Level (m) 62.621 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	388.5	0.0	0.521	0.0	0.0
0.520	388.5	0.0			

Cellular Storage Manhole: 10 HB, DS/PN: 2.002

Invert Level (m) 62.249 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	170.0	0.0	0.521	0.0	0.0
0.520	170.0	0.0			

Cellular Storage Manhole: 11, DS/PN: 2.003

Invert Level (m) 62.181 Infiltration Coefficient Side (m/hr) 0.00000
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Cellular Storage Manhole: 11, DS/PN: 2.003

Porosity 0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	200.0	0.0	0.521	0.0	0.0
0.520	200.0	0.0			

Cellular Storage Manhole: 12, DS/PN: 2.004

Invert Level (m) 62.079 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	129.5	0.0	0.521	0.0	0.0
0.520	129.5	0.0			

Cellular Storage Manhole: 15, DS/PN: 1.008

Invert Level (m) 61.919 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.521	0.0	0.0
0.520	30.0	0.0			

Cellular Storage Manhole: 16, DS/PN: 3.000

Invert Level (m) 61.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	51.8	0.0	0.521	0.0	0.0
0.520	51.8	0.0			

Cellular Storage Manhole: 17 HB, DS/PN: 1.009

Invert Level (m) 61.852 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Cellular Storage Manhole: 17 HB, DS/PN: 1.009

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	77.7	0.0	0.521	0.0	0.0
0.520	77.7	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

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 Coeffiecient	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 Storage Structures	13
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.220
Region	England and Wales	Cv (Summer)	1.000
M5-60 (mm)	18.600	Cv (Winter)	1.000

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	2
Climate Change (%)	0

PN	**US/MH Name**	**Storm**	**Return Period**	**Climate Change**	**First (X) Surcharge**	**First (Y) Flood**	**First (Z) Overflow**	**Overflow Act.**	**Water Level (m)**
1.000	1	240 Summer	2	+0%					63.117
1.001	2	240 Summer	2	+0%					63.117
1.002	3 HB	240 Summer	2	+0%	2/15 Summer				63.116
1.003	4	120 Summer	2	+0%					62.684
1.004	5	60 Summer	2	+0%					62.547
1.005	6	60 Summer	2	+0%					62.451
1.006	7	60 Summer	2	+0%					62.349
2.000	8	15 Summer	2	+0%					62.686
2.001	9	480 Summer	2	+0%					62.618
2.002	10 HB	480 Summer	2	+0%					62.617
2.003	11	360 Summer	2	+0%					62.256
2.004	12	360 Summer	2	+0%					62.194
2.005	13	360 Summer	2	+0%					62.181
1.007	14	360 Summer	2	+0%					62.174

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.871	0.000	0.00		80	4.4	OK	
1.001	2	-0.766	0.000	0.01		83	6.1	OK	
1.002	3 HB	0.117	0.000	0.16			6.0	SURCHARGED	
1.003	4	-0.130	0.000	0.37		140	13.7	OK	
1.004	5	-0.117	0.000	0.46			16.5	OK	
1.005	6	-0.109	0.000	0.52			18.8	OK	
1.006	7	-0.099	0.000	0.60		51	20.8	OK	
2.000	8	-0.425	0.000	0.08		6	19.1	OK	
2.001	9	-0.272	0.000	0.07		102	15.9	OK	
2.002	10 HB	-0.007	0.000	0.06		192	5.8	OK	
2.003	11	-0.300	0.000	0.08		315	7.8	OK	
2.004	12	-0.260	0.000	0.11		248	9.5	OK	
2.005	13	-0.231	0.000	0.13			10.8	OK	
1.007	14	-0.194	0.000	0.29			27.8	OK	

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.008	15	360 Summer	2	+0%					62.152
3.000	16	360 Summer	2	+0%					62.138
1.009	17 HB	360 Summer	2	+0%					62.137
1.010	18	360 Summer	2	+0%					61.897

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.008	15	-0.142	0.000	0.29		126	27.7	OK	
3.000	16	-0.137	0.000	0.02		115	2.0	OK	
1.009	17 HB	-0.015	0.000	0.40		154	25.4	OK	
1.010	18	-0.146	0.000	0.52			25.4	OK	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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	Auto Design
1.000	41.957	0.105	399.6	0.061	5.00	0.0	0.600	o	975	Pipe/Conduit	
1.001	53.639	0.134	400.3	0.118	0.00	0.0	0.600	o	975	Pipe/Conduit	
1.002	31.512	0.185	170.3	0.129	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.150	169.9	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.104	169.7	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	18.982	0.112	169.5	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	13.655	0.080	170.7	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	71.706	0.221	324.5	0.115	5.00	0.0	0.600	o	525	Pipe/Conduit	
2.001	37.730	0.116	325.3	0.225	0.00	0.0	0.600	o	525	Pipe/Conduit	
2.002	22.253	0.068	325.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.003	33.218	0.102	325.7	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.041	323.1	0.062	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.005	14.105	0.043	328.0	0.042	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	24.092	0.074	325.6	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	21.726	0.067	324.3	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	

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	0.00	5.43	63.013	0.061	0.0	0.0	0.0	1.64	1225.0	0.0
1.001	0.00	5.97	62.908	0.179	0.0	0.0	0.0	1.64	1223.9	0.0
1.002	0.00	6.50	62.774	0.308	0.0	0.0	0.0	1.00	39.7	0.0
1.003	0.00	6.92	62.589	0.412	0.0	0.0	0.0	1.00	39.8	0.0
1.004	0.00	7.22	62.439	0.447	0.0	0.0	0.0	1.00	39.8	0.0
1.005	0.00	7.53	62.335	0.475	0.0	0.0	0.0	1.00	39.8	0.0
1.006	0.00	7.76	62.223	0.504	0.0	0.0	0.0	1.00	39.7	0.0
2.000	0.00	5.97	62.586	0.115	0.0	0.0	0.0	1.24	268.0	0.0
2.001	0.00	6.47	62.365	0.340	0.0	0.0	0.0	1.24	267.7	0.0
2.002	0.00	6.85	62.249	0.405	0.0	0.0	0.0	1.00	110.4	0.0
2.003	0.00	7.40	62.181	0.470	0.0	0.0	0.0	1.00	110.3	0.0
2.004	0.00	7.62	62.079	0.532	0.0	0.0	0.0	1.00	110.7	0.0
2.005	0.00	7.86	62.038	0.574	0.0	0.0	0.0	0.99	109.9	0.0
1.007	0.00	8.26	61.993	1.099	0.0	0.0	0.0	1.00	110.3	0.0
1.008	0.00	8.62	61.919	1.128	0.0	0.0	0.0	1.00	110.5	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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	Auto Design
3.000	15.459	0.048	322.1	0.070	5.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	26.775	0.109	245.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	3.900	0.016	243.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

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)
3.000	0.00	5.26	61.900	0.070	0.0	0.0	0.0	1.00	110.9	0.0
1.009	0.00	9.07	61.852	1.198	0.0	0.0	0.0	1.00	70.6	0.0
1.010	0.00	9.13	61.743	1.198	0.0	0.0	0.0	1.00	70.9	0.0

Free Flowing Outfall Details for 180518 SW1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	C1	63.006	61.727	61.727	1350	0

Simulation Criteria for 180518 SW1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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 Storage Structures	13
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	19.600
Return Period (years)	2	Ratio R	0.223
Region	England and Wales	Profile Type	Summer

Synthetic Rainfall Details

Cv (Summer) 0.750 Storm Duration (mins) 30
Cv (Winter) 0.840

Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3 HB, DS/PN: 1.002, Volume (m³): 45.9

Unit Reference	MD-SHE-0107-7000-2119-7000
Design Head (m)	2.119
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	62.774
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.119	7.0	Kick-Flo®	0.957	4.8
Flush-Flo™	0.469	6.1	Mean Flow over Head Range	-	5.6

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	3.7	1.200	5.4	3.000	8.2	7.000	12.3
0.200	5.4	1.400	5.8	3.500	8.9	7.500	12.7
0.300	5.9	1.600	6.1	4.000	9.4	8.000	13.1
0.400	6.0	1.800	6.5	4.500	10.0	8.500	13.5
0.500	6.1	2.000	6.8	5.000	10.5	9.000	13.9
0.600	6.0	2.200	7.1	5.500	11.0	9.500	14.3
0.800	5.6	2.400	7.4	6.000	11.4		
1.000	4.9	2.600	7.7	6.500	11.9		

Hydro-Brake® Optimum Manhole: 10 HB, DS/PN: 2.002, Volume (m³): 13.2

Unit Reference	MD-SHE-0107-6000-1575-6000
Design Head (m)	1.575
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	62.249
Minimum Outlet Pipe Diameter (mm)	150

Hydro-Brake® Optimum Manhole: 10 HB, DS/PN: 2.002, Volume (m³): 13.2

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.575	6.0	Kick-Flo®	0.952	4.7
Flush-Flo™	0.468	5.9	Mean Flow over Head Range	-	5.2

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	5.3	3.000	8.1	7.000	12.1
0.200	5.3	1.400	5.7	3.500	8.7	7.500	12.5
0.300	5.7	1.600	6.0	4.000	9.3	8.000	12.9
0.400	5.9	1.800	6.4	4.500	9.8	8.500	13.3
0.500	5.9	2.000	6.7	5.000	10.3	9.000	13.7
0.600	5.9	2.200	7.0	5.500	10.8	9.500	14.0
0.800	5.5	2.400	7.3	6.000	11.3		
1.000	4.9	2.600	7.6	6.500	11.7		

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 9.6

Unit Reference	MD-SHE-0235-3200-1642-3200
Design Head (m)	1.642
Design Flow (l/s)	32.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	235
Invert Level (m)	61.852
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.642	32.0	Kick-Flo®	1.101	26.4
Flush-Flo™	0.503	32.0	Mean Flow over Head Range	-	27.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.8	0.200	23.7	0.300	30.6	0.400	31.7

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m^3): 9.6

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.500	32.0	1.800	33.4	4.000	49.1	7.500	66.6
0.600	31.8	2.000	35.2	4.500	52.0	8.000	68.8
0.800	31.0	2.200	36.8	5.000	54.7	8.500	70.8
1.000	28.8	2.400	38.4	5.500	57.3	9.000	72.8
1.200	27.5	2.600	39.9	6.000	59.8	9.500	74.8
1.400	29.6	3.000	42.8	6.500	62.2		
1.600	31.6	3.500	46.1	7.000	64.4		

Storage Structures for 180518 SW1.SWS

Cellular Storage Manhole: 1, DS/PN: 1.000

Invert Level (m) 63.585 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	51.8	0.0	0.521	0.0	0.0
0.520	51.8	0.0			

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 63.015 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	220.0	0.0	0.521	0.0	0.0
0.520	220.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 1.003

Invert Level (m) 62.589 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	129.5	0.0	0.521	0.0	0.0
0.520	129.5	0.0			

Cellular Storage Manhole: 6, DS/PN: 1.005

Invert Level (m) 62.335 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.9	0.0	0.521	0.0	0.0
0.520	25.9	0.0			

Cellular Storage Manhole: 7, DS/PN: 1.006

Invert Level (m) 62.224 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.9	0.0	0.521	0.0	0.0
0.520	25.9	0.0			

Cellular Storage Manhole: 8, DS/PN: 2.000

Invert Level (m) 63.413 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	77.7	0.0	0.521	0.0	0.0
0.520	77.7	0.0			

Cellular Storage Manhole: 9, DS/PN: 2.001

Invert Level (m) 62.621 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	388.5	0.0	0.521	0.0	0.0
0.520	388.5	0.0			

Cellular Storage Manhole: 10 HB, DS/PN: 2.002

Invert Level (m) 62.249 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	170.0	0.0	0.521	0.0	0.0
0.520	170.0	0.0			

Cellular Storage Manhole: 11, DS/PN: 2.003

Invert Level (m) 62.181 Infiltration Coefficient Side (m/hr) 0.00000
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Cellular Storage Manhole: 11, DS/PN: 2.003

Porosity 0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	200.0	0.0	0.521	0.0	0.0
0.520	200.0	0.0			

Cellular Storage Manhole: 12, DS/PN: 2.004

Invert Level (m) 62.079 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	129.5	0.0	0.521	0.0	0.0
0.520	129.5	0.0			

Cellular Storage Manhole: 15, DS/PN: 1.008

Invert Level (m) 61.919 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.521	0.0	0.0
0.520	30.0	0.0			

Cellular Storage Manhole: 16, DS/PN: 3.000

Invert Level (m) 61.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	51.8	0.0	0.521	0.0	0.0
0.520	51.8	0.0			

Cellular Storage Manhole: 17 HB, DS/PN: 1.009

Invert Level (m) 61.852 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Cellular Storage Manhole: 17 HB, DS/PN: 1.009

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	77.7	0.0	0.521	0.0	0.0
0.520	77.7	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

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 Storage Structures	13
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.220
Region	England and Wales	Cv (Summer)	1.000
M5-60 (mm)	18.600	Cv (Winter)	1.000

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	30
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	360 Summer	30	+0%					63.286
1.001	2	360 Summer	30	+0%					63.286
1.002	3 HB	360 Summer	30	+0%	30/15 Summer				63.286
1.003	4	60 Summer	30	+0%					62.721
1.004	5	60 Summer	30	+0%					62.600
1.005	6	60 Summer	30	+0%					62.524
1.006	7	60 Summer	30	+0%					62.437
2.000	8	600 Summer	30	+0%					62.751
2.001	9	600 Summer	30	+0%					62.751
2.002	10 HB	600 Summer	30	+0%	30/30 Summer				62.750
2.003	11	240 Summer	30	+0%					62.328
2.004	12	240 Summer	30	+0%					62.323
2.005	13	240 Summer	30	+0%					62.318
1.007	14	240 Summer	30	+0%					62.313

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.702	0.000	0.01		183	6.1	OK	
1.001	2	-0.597	0.000	0.01		181	5.2	OK	
1.002	3 HB	0.287	0.000	0.16			6.1	SURCHARGED	
1.003	4	-0.093	0.000	0.65		41	23.7	OK	
1.004	5	-0.064	0.000	0.85			30.4	OK	
1.005	6	-0.036	0.000	0.93		20	33.4	OK	
1.006	7	-0.011	0.000	1.00		18	34.5	OK	
2.000	8	-0.360	0.000	0.03		250	8.6	OK	
2.001	9	-0.139	0.000	0.08		233	18.9	OK	
2.002	10 HB	0.126	0.000	0.06		405	5.9	SURCHARGED	
2.003	11	-0.227	0.000	0.10		101	9.9	OK	
2.004	12	-0.131	0.000	0.17		96	14.0	OK	
2.005	13	-0.094	0.000	0.18			14.7	OK	
1.007	14	-0.055	0.000	0.41			39.2	OK	

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.008	15	240 Summer	30	+0%	30/240 Summer				62.296
3.000	16	240 Summer	30	+0%	30/240 Summer				62.280
1.009	17 HB	240 Summer	30	+0%	30/60 Summer				62.278
1.010	18	240 Summer	30	+0%					61.916

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.008	15	0.002	0.000	0.40		122	37.5	SURCHARGED	
3.000	16	0.005	0.000	0.03		126	2.9	SURCHARGED	
1.009	17 HB	0.126	0.000	0.48		135	30.8	SURCHARGED	
1.010	18	-0.127	0.000	0.63			30.8	OK	

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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	Auto Design
1.000	41.957	0.105	399.6	0.061	5.00	0.0	0.600	o	975	Pipe/Conduit	
1.001	53.639	0.134	400.3	0.118	0.00	0.0	0.600	o	975	Pipe/Conduit	
1.002	31.512	0.185	170.3	0.129	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.150	169.9	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.104	169.7	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	18.982	0.112	169.5	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	13.655	0.080	170.7	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	71.706	0.221	324.5	0.115	5.00	0.0	0.600	o	525	Pipe/Conduit	
2.001	37.730	0.116	325.3	0.225	0.00	0.0	0.600	o	525	Pipe/Conduit	
2.002	22.253	0.068	325.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.003	33.218	0.102	325.7	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.041	323.1	0.062	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.005	14.105	0.043	328.0	0.042	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	24.092	0.074	325.6	0.021	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	21.726	0.067	324.3	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	

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	0.00	5.43	63.013	0.061	0.0	0.0	0.0	1.64	1225.0	0.0
1.001	0.00	5.97	62.908	0.179	0.0	0.0	0.0	1.64	1223.9	0.0
1.002	0.00	6.50	62.774	0.308	0.0	0.0	0.0	1.00	39.7	0.0
1.003	0.00	6.92	62.589	0.412	0.0	0.0	0.0	1.00	39.8	0.0
1.004	0.00	7.22	62.439	0.447	0.0	0.0	0.0	1.00	39.8	0.0
1.005	0.00	7.53	62.335	0.475	0.0	0.0	0.0	1.00	39.8	0.0
1.006	0.00	7.76	62.223	0.504	0.0	0.0	0.0	1.00	39.7	0.0
2.000	0.00	5.97	62.586	0.115	0.0	0.0	0.0	1.24	268.0	0.0
2.001	0.00	6.47	62.365	0.340	0.0	0.0	0.0	1.24	267.7	0.0
2.002	0.00	6.85	62.249	0.405	0.0	0.0	0.0	1.00	110.4	0.0
2.003	0.00	7.40	62.181	0.470	0.0	0.0	0.0	1.00	110.3	0.0
2.004	0.00	7.62	62.079	0.532	0.0	0.0	0.0	1.00	110.7	0.0
2.005	0.00	7.86	62.038	0.574	0.0	0.0	0.0	0.99	109.9	0.0
1.007	0.00	8.26	61.993	1.099	0.0	0.0	0.0	1.00	110.3	0.0
1.008	0.00	8.62	61.919	1.128	0.0	0.0	0.0	1.00	110.5	0.0

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for 180518 SW1.SWS

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	Auto Design
3.000	15.459	0.048	322.1	0.070	5.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	26.775	0.109	245.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.010	3.900	0.016	243.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

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)
3.000	0.00	5.26	61.900	0.070	0.0	0.0	0.0	1.00	110.9	0.0
1.009	0.00	9.07	61.852	1.198	0.0	0.0	0.0	1.00	70.6	0.0
1.010	0.00	9.13	61.743	1.198	0.0	0.0	0.0	1.00	70.9	0.0

Free Flowing Outfall Details for 180518 SW1.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.010	C1	63.006	61.727	61.727	1350	0

Simulation Criteria for 180518 SW1.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	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 Storage Structures	13
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	19.600
Return Period (years)	2	Ratio R	0.223
Region	England and Wales	Profile Type	Summer

Synthetic Rainfall Details

Cv (Summer) 0.750 Storm Duration (mins) 30
Cv (Winter) 0.840

Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3 HB, DS/PN: 1.002, Volume (m³): 45.9

Unit Reference	MD-SHE-0107-7000-2119-7000
Design Head (m)	2.119
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	107
Invert Level (m)	62.774
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.119	7.0	Kick-Flo®	0.957	4.8
Flush-Flo™	0.469	6.1	Mean Flow over Head Range	-	5.6

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	3.7	1.200	5.4	3.000	8.2	7.000	12.3
0.200	5.4	1.400	5.8	3.500	8.9	7.500	12.7
0.300	5.9	1.600	6.1	4.000	9.4	8.000	13.1
0.400	6.0	1.800	6.5	4.500	10.0	8.500	13.5
0.500	6.1	2.000	6.8	5.000	10.5	9.000	13.9
0.600	6.0	2.200	7.1	5.500	11.0	9.500	14.3
0.800	5.6	2.400	7.4	6.000	11.4		
1.000	4.9	2.600	7.7	6.500	11.9		

Hydro-Brake® Optimum Manhole: 10 HB, DS/PN: 2.002, Volume (m³): 13.2

Unit Reference	MD-SHE-0107-6000-1575-6000
Design Head (m)	1.575
Design Flow (l/s)	6.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	62.249
Minimum Outlet Pipe Diameter (mm)	150

Hydro-Brake® Optimum Manhole: 10 HB, DS/PN: 2.002, Volume (m³): 13.2

Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.575	6.0	Kick-Flo®	0.952	4.7
Flush-Flo™	0.468	5.9	Mean Flow over Head Range	-	5.2

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	5.3	3.000	8.1	7.000	12.1
0.200	5.3	1.400	5.7	3.500	8.7	7.500	12.5
0.300	5.7	1.600	6.0	4.000	9.3	8.000	12.9
0.400	5.9	1.800	6.4	4.500	9.8	8.500	13.3
0.500	5.9	2.000	6.7	5.000	10.3	9.000	13.7
0.600	5.9	2.200	7.0	5.500	10.8	9.500	14.0
0.800	5.5	2.400	7.3	6.000	11.3		
1.000	4.9	2.600	7.6	6.500	11.7		

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 9.6

Unit Reference	MD-SHE-0235-3200-1642-3200
Design Head (m)	1.642
Design Flow (l/s)	32.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	235
Invert Level (m)	61.852
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.642	32.0	Kick-Flo®	1.101	26.4
Flush-Flo™	0.503	32.0	Mean Flow over Head Range	-	27.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.8	0.200	23.7	0.300	30.6	0.400	31.7

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 9.6

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.500	32.0	1.800	33.4	4.000	49.1	7.500	66.6
0.600	31.8	2.000	35.2	4.500	52.0	8.000	68.8
0.800	31.0	2.200	36.8	5.000	54.7	8.500	70.8
1.000	28.8	2.400	38.4	5.500	57.3	9.000	72.8
1.200	27.5	2.600	39.9	6.000	59.8	9.500	74.8
1.400	29.6	3.000	42.8	6.500	62.2		
1.600	31.6	3.500	46.1	7.000	64.4		

Storage Structures for 180518 SW1.SWS

Cellular Storage Manhole: 1, DS/PN: 1.000

Invert Level (m) 63.585 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	51.8	0.0	0.521	0.0	0.0
0.520	51.8	0.0			

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 63.015 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	220.0	0.0	0.521	0.0	0.0
0.520	220.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 1.003

Invert Level (m) 62.589 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	129.5	0.0	0.521	0.0	0.0
0.520	129.5	0.0			

Cellular Storage Manhole: 6, DS/PN: 1.005

Invert Level (m) 62.335 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.9	0.0	0.521	0.0	0.0
0.520	25.9	0.0			

Cellular Storage Manhole: 7, DS/PN: 1.006

Invert Level (m) 62.224 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	25.9	0.0	0.521	0.0	0.0
0.520	25.9	0.0			

Cellular Storage Manhole: 8, DS/PN: 2.000

Invert Level (m) 63.413 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	77.7	0.0	0.521	0.0	0.0
0.520	77.7	0.0			

Cellular Storage Manhole: 9, DS/PN: 2.001

Invert Level (m) 62.621 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	388.5	0.0	0.521	0.0	0.0
0.520	388.5	0.0			

Cellular Storage Manhole: 10 HB, DS/PN: 2.002

Invert Level (m) 62.249 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	170.0	0.0	0.521	0.0	0.0
0.520	170.0	0.0			

Cellular Storage Manhole: 11, DS/PN: 2.003

Invert Level (m) 62.181 Infiltration Coefficient Side (m/hr) 0.00000
Infiltration Coefficient Base (m/hr) 0.00000 Safety Factor 2.0

Cellular Storage Manhole: 11, DS/PN: 2.003

Porosity 0.95

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	200.0	0.0	0.521	0.0	0.0
0.520	200.0	0.0			

Cellular Storage Manhole: 12, DS/PN: 2.004

Invert Level (m) 62.079 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	129.5	0.0	0.521	0.0	0.0
0.520	129.5	0.0			

Cellular Storage Manhole: 15, DS/PN: 1.008

Invert Level (m) 61.919 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	30.0	0.0	0.521	0.0	0.0
0.520	30.0	0.0			

Cellular Storage Manhole: 16, DS/PN: 3.000

Invert Level (m) 61.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	51.8	0.0	0.521	0.0	0.0
0.520	51.8	0.0			

Cellular Storage Manhole: 17 HB, DS/PN: 1.009

Invert Level (m) 61.852 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Cellular Storage Manhole: 17 HB, DS/PN: 1.009

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	77.7	0.0	0.521	0.0	0.0
0.520	77.7	0.0			

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

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 Coeffiecient	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 Storage Structures	13
Number of Online Controls	3	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.220
Region	England and Wales	Cv (Summer)	1.000
M5-60 (mm)	18.600	Cv (Winter)	1.000

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360
Return Period(s) (years)	100
Climate Change (%)	50

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	360 Winter	100	+50%	100/180 Summer				64.689
1.001	2	360 Winter	100	+50%	100/180 Summer				64.689
1.002	3 HB	360 Winter	100	+50%	100/15 Summer				64.690
1.003	4	60 Summer	100	+50%	100/30 Summer				62.851
1.004	5	120 Summer	100	+50%	100/15 Summer				62.788
1.005	6	180 Summer	100	+50%	100/15 Summer				62.729
1.006	7	360 Summer	100	+50%	100/15 Summer				62.700
2.000	8	360 Winter	100	+50%	100/180 Summer				63.794
2.001	9	360 Winter	100	+50%	100/60 Summer				63.794
2.002	10 HB	360 Winter	100	+50%	100/15 Summer				63.792
2.003	11	360 Summer	100	+50%	100/120 Summer				62.691
2.004	12	360 Summer	100	+50%	100/60 Summer				62.685
2.005	13	360 Summer	100	+50%	100/60 Summer				62.680
1.007	14	360 Summer	100	+50%	100/60 Summer				62.674
1.008	15	360 Summer	100	+50%	100/30 Summer				62.656

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.701	0.000	0.01		99	7.6	SURCHARGED	
1.001	2	0.806	0.000	0.01			6.5	SURCHARGED	
1.002	3 HB	1.691	0.000	0.18			6.7	FLOOD RISK	
1.003	4	0.037	0.000	0.77		25	28.3	SURCHARGED	
1.004	5	0.124	0.000	1.00			35.6	SURCHARGED	
1.005	6	0.169	0.000	1.01		110	36.3	SURCHARGED	
1.006	7	0.252	0.000	0.91		149	31.3	SURCHARGED	
2.000	8	0.683	0.000	0.06		62	14.5	SURCHARGED	
2.001	9	0.904	0.000	0.09			21.5	SURCHARGED	
2.002	10 HB	1.168	0.000	0.06			5.9	FLOOD RISK	
2.003	11	0.136	0.000	0.15		160	15.3	SURCHARGED	
2.004	12	0.232	0.000	0.26		199	21.6	SURCHARGED	
2.005	13	0.268	0.000	0.26			21.7	SURCHARGED	
1.007	14	0.306	0.000	0.38			36.0	SURCHARGED	
1.008	15	0.362	0.000	0.39		254	36.2	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for 180518 SW1.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3.000	16	360 Summer	100	+50%	100/30 Summer				62.640
1.009	17 HB	360 Summer	100	+50%	100/15 Summer				62.639
1.010	18	240 Summer	100	+50%					61.920

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.000	16	0.365	0.000	0.16		254	13.9	SURCHARGED	
1.009	17 HB	0.487	0.000	0.50		273	32.0	SURCHARGED	
1.010	18	-0.123	0.000	0.66			32.0	OK	

Issue	Date	Description	By	Chkd	Appd
P5	15-09-23	FFL'S ADDED	RH	RH	PL
P4	09-06-23	DRAINAGE LAYOUT REVISED	RH	RH	PL
P3	15/05/23	DRAINAGE LAYOUT REVISED	RH	PL	PL
P2	07/06/22	UPDATED TO SUIT CLIENT COMMENTS	RH	PL	PL
P1	01/06/22	PLANNING ISSUE	RH	PL	PL

COAST CONSULTING ENGINEERS
7 Silverton Court, Northumberland Business Park, NE23 7RY
0191 5977879

Client: MR R.W. MULHOLLAND

Job Title: FLOSH MEADOWS CUMBRIA

Drawing Title: SR12A & TOP MEADOWS ENGINEERING LAYOUT

Scale at A0: 1:250

Drawing Status: PLANNING

Job No	Drawing No	Issue
1842	1002	P5

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