FLOSH MEADOWS, CLEATOR, SR12 The Meadows

Drainage Strategy

Issue Date:

13 July 2022

Report Number:

1842-DS1

Client:

Lakeland Associates (Cleator) Ltd

Revision:

F

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Contents

Executive Summary

Site Location	The site is located off A5086, Cleator, CA23 3EP (nearest) at NGR 301752E 514082N. The 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 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. The developer has no legal right to utilise the mill race for disposal of surface water. The legalities of this issue are covered in greater detail within section 5.0.
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 sewers are 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. **Surface water should be discharged to the combined sewer at a restricted rate of 5.0 l/s, providing betterment of up to 95% compared to the greenfield run off rates.**
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 phase known as SR12, The Meadows, although the strategy also references the wider site, as the drainage from SR12A (4/17/2214) and Top Meadows (4/17/2390), discharges into the networks constructed for SR12. 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.

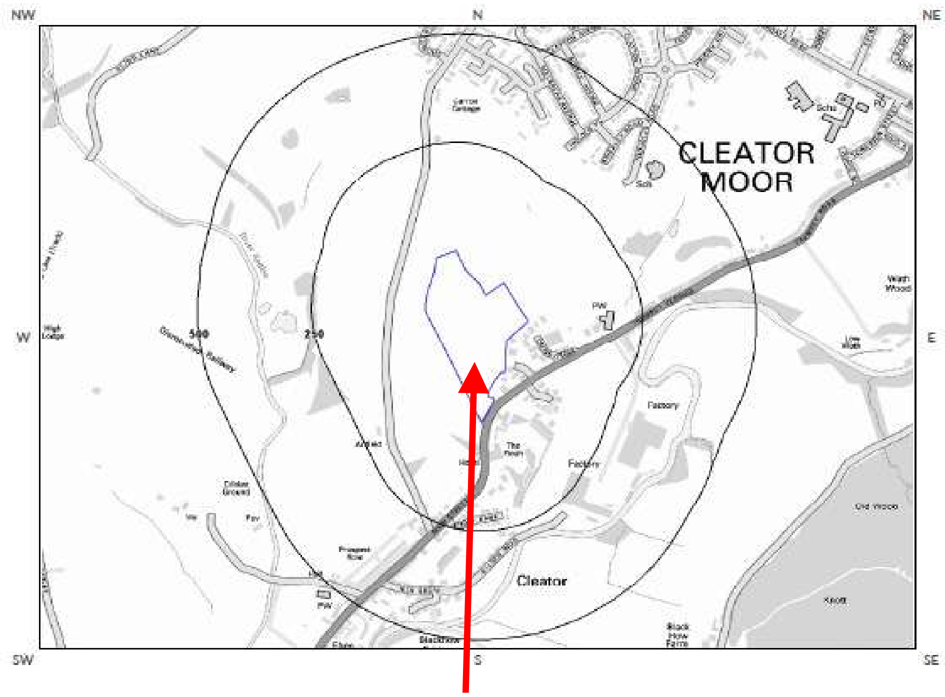


Figure 2.11 – Site Location

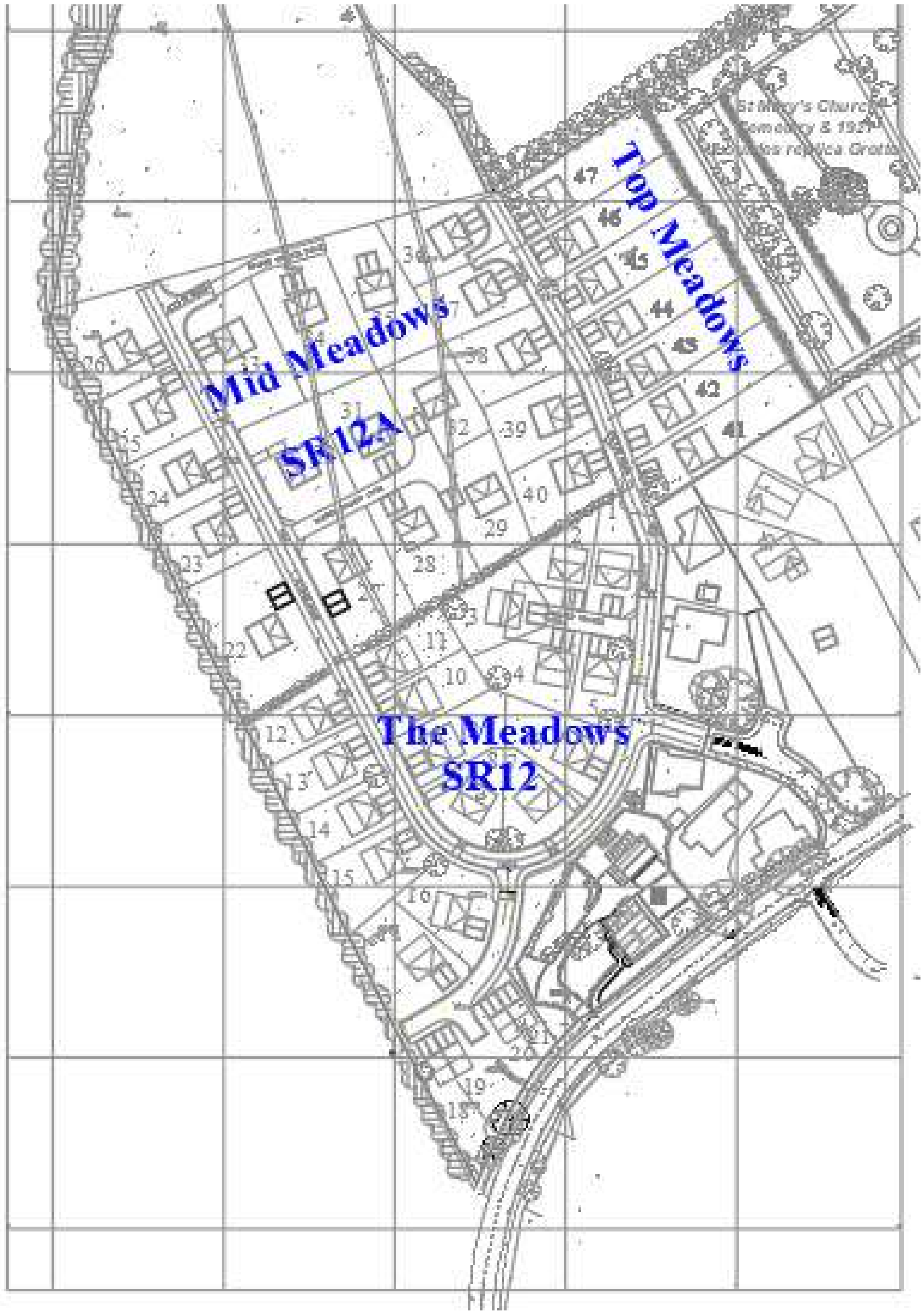


Figure 2.12 – Proposed Phasing

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.

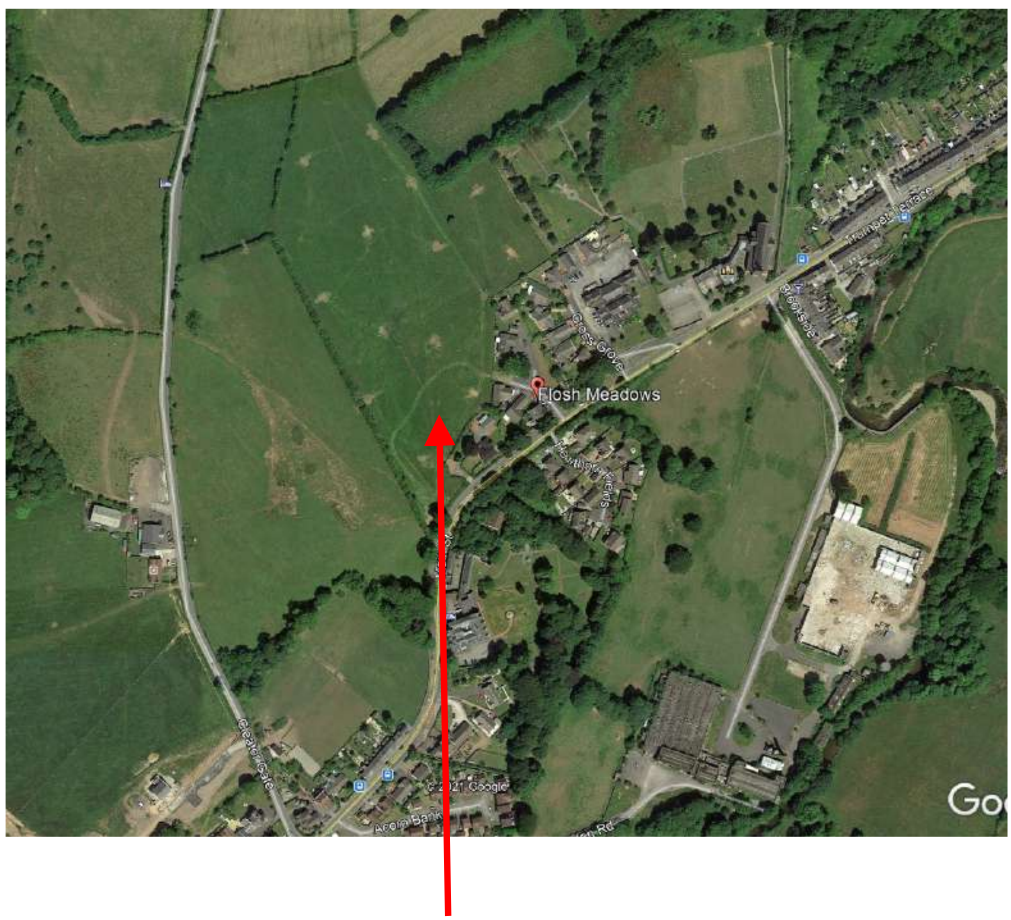


Figure 2.21 – Satellite image of the existing site.

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.

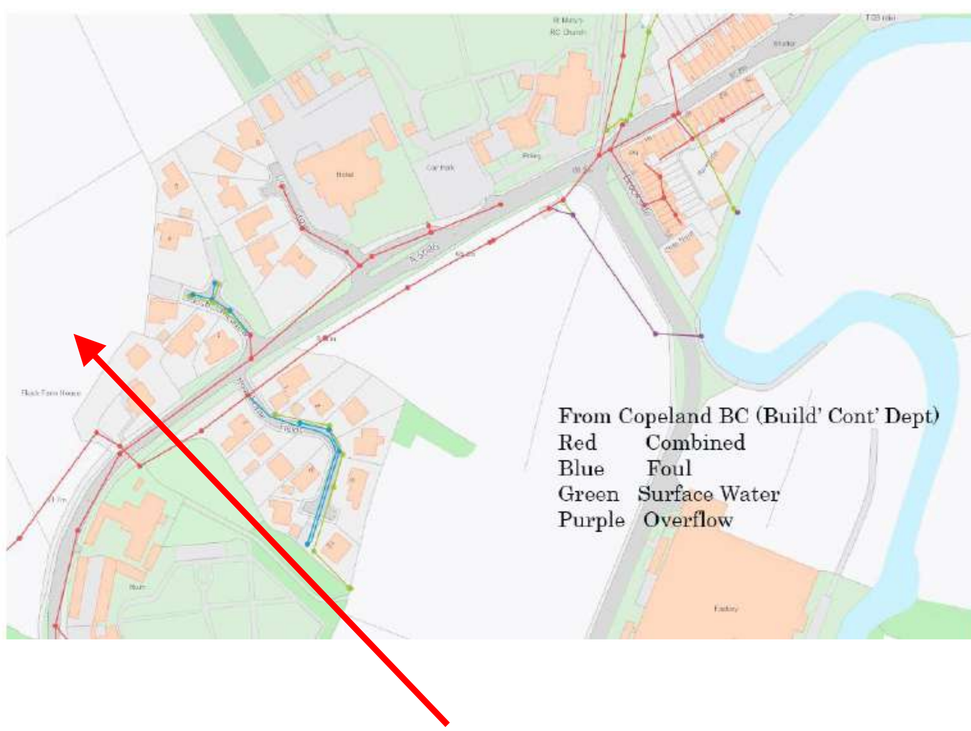


Figure 2.31 – sewers.

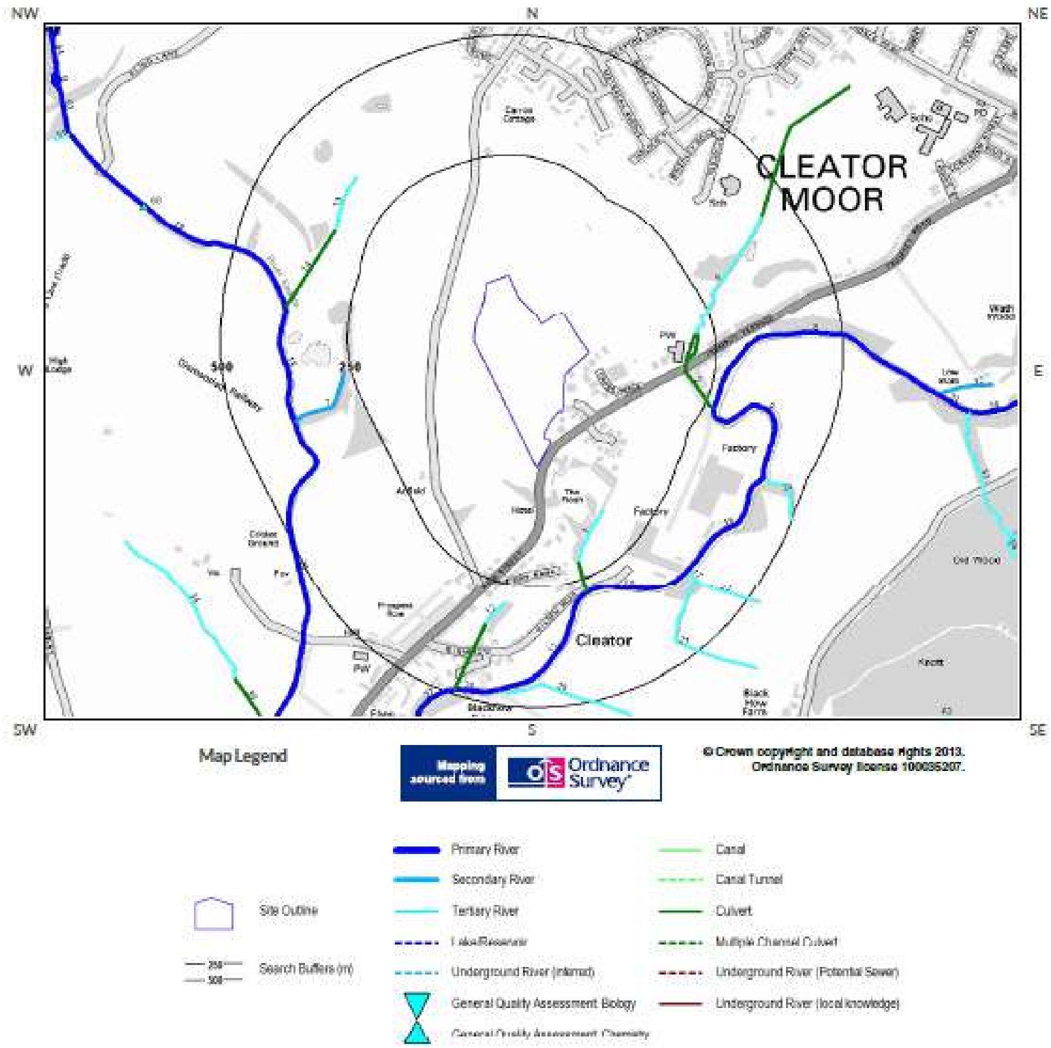


Figure 2.32 – watercourses.

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.

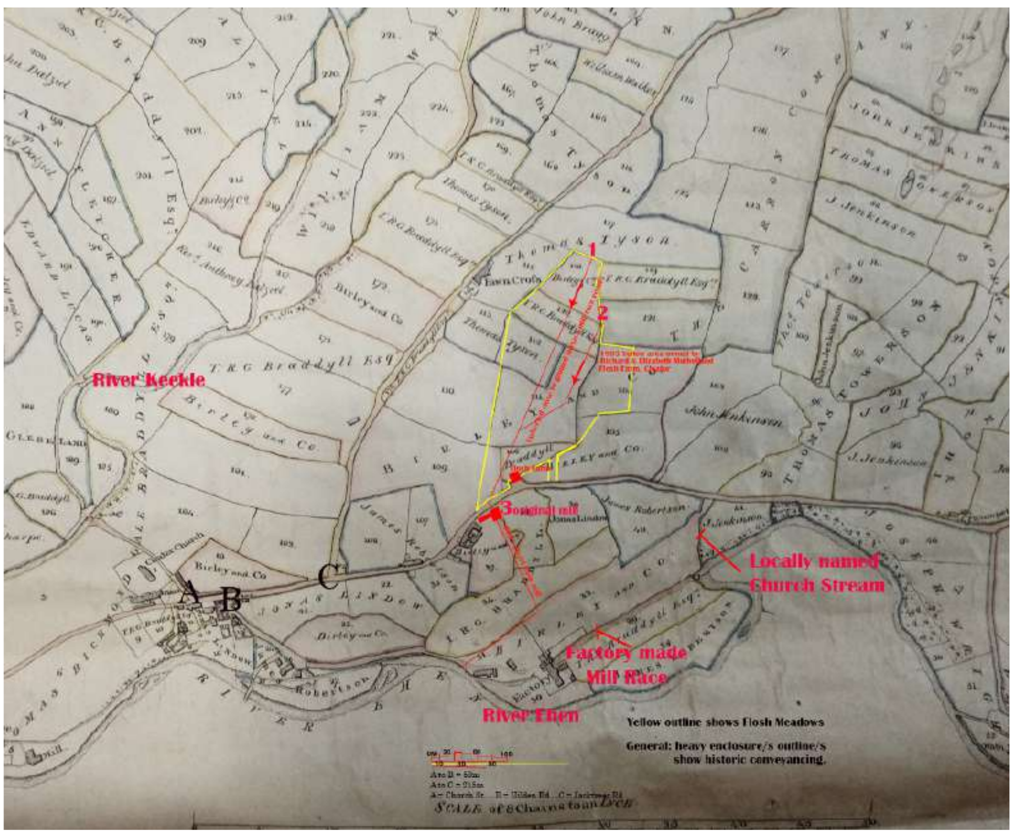
3. Surface Water Disposal

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

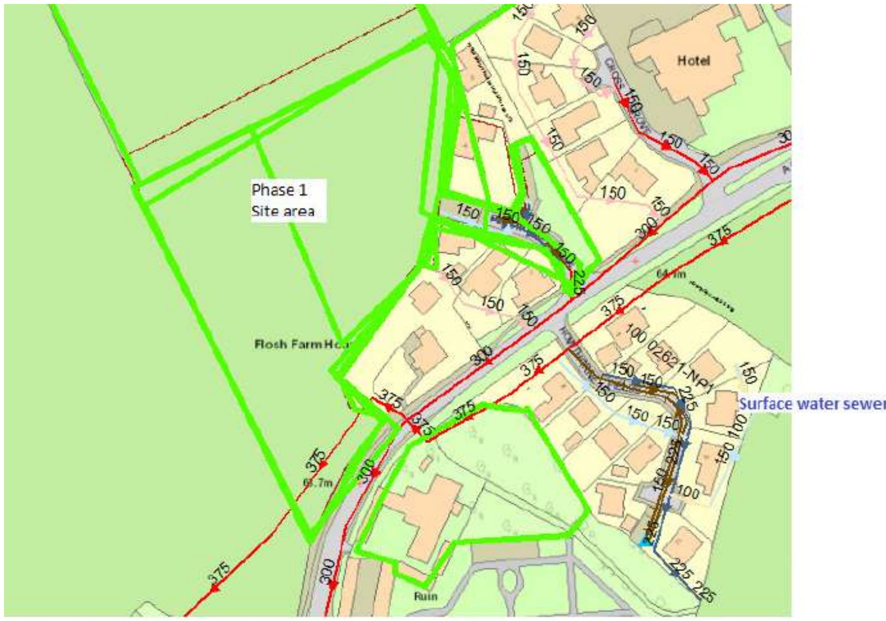
As noted earlier, superficial deposits comprise of soft - stiff clays with a low permeability. It is considered that utilisation of infiltration techniques will not be applicable for the proposed development.

Initially the developer intended to discharge the proposed surface water to the on-site man-made mill race. Following completion of the initial design of the proposed surface water strategy, it was confirmed by the developers' legal representatives and United Utilities Ltd that the developer has no legal right to utilise the mill race for disposal of surface water. The legalities of this issue are covered in section 5.0.

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.

As noted earlier, a surface water sewer is located adjacent to the site entrance at Flosh Meadows. The sewer outfalls into a combined sewer approximately 40m downstream of the head of the run. The surface water sewer has limited capacity and was not suggested by United Utilities as an option for discharge of surface water.

Following discussions with United Utilities, two alternative options have been explored to discharge surface water to an existing United Utilities surface water sewer. The sewer is located within a public highway known as Howthorne Fields, opposite Flosh Meadows. Due to the constraints of the existing highway levels and utilities/sewers, a gravity connection cannot be made to the Howthorne Fields sewers, as the proposed sewer will not achieve the necessary cover to soffit required by UU. Additionally, the LLFA were consulted regarding the installation of a surface water pumping station to achieve a discharge to the adopted surface water sewer. The LLFA stated that their preference is to avoid surface water pumping stations due to the increased flood risk in the event of failure. Refer to Appendix E for options A and B.



Due to the issues noted above, it is proposed to discharge surface water to the adjacent combined sewer owned by United Utilities. United Utilities have confirmed a maximum discharge rate of 5 l/s for surface water to the combined sewer (refer to Appendix C).

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 or betterment of existing site greenfield rate
- 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 4.1.

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 4.1 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.

The approved RWO Associates FRA and Drainage strategy stipulates a more stringent discharge rate of 5 l/s for all events up to and including the 100-year event, with a 40% allowance for climate change.

Following discussions with United Utilities, a discharge of rate of 5 l/s has been agreed to the adjacent surface water sewer. This provides **significant betterment** compared to the greenfield rate of discharge (32.02 l/s).

3.6 Surface Water Attenuation

Surface water will be restricted for all events up to an including the 100 year event with a 40% 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	5.0 l/s	85%
30	54.43 l/s	5.0 l/s	91%
100	66.59 l/s	5.0 l/s	93%
100+40%	93.22 l/s	5.0 l/s	95%

4. Foul Water Disposal

4.1 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.

5. Legal statement on the use of Mill Race for SW disposal, provided by Baines Wilson LLP

Annex 4

Re: Flosh Meadows Drainage Strategy

baines wilson LLP
Lawyers for Business

I am asked to consider the ability of the current owner of the land known as Flosh Meadows and registered at the Land Registry with title number CU185362 (the "Property") to discharge surface water from a new residential development (to be constructed) to an existing, on site, mill stream. The surface water will subsequently leave the Property and cross third party land in a number of separate ownerships to eventually discharge into the River Ehen.

The nature and description of the existing infrastructure is discussed at paragraph 2.3 of the Report and therefore I do not propose to repeat here.

Typically, the necessary rights would arise in one of 3 distinct ways:

Option 1. By express rights.

Option 2. By a right that has arisen by prescription.

Option 3. As a result of riparian rights.

In summary (although discussed in greater detail below) I conclude as follows; the Owner does not benefit from an express right, a right by prescription to discharge in the manner the Owner desires has not been established and the Owner does not benefit from riparian rights.

Option 1

The most obvious, and from a legal perspective best, option would be an express right to enable the discharge. I have studied the registered title to the Property (title number CU185362) and such a right is not registered for the benefit of the Property. In addition the owner has confirmed they are unaware of any deeds, licences or other consents that may appertain to the proposed or existing discharge. It is therefore, concluded that no express rights can be evidenced and option 1 must, therefore, be disregarded.

Option 2

With regard to option 2, there are 3 alternative options under which a right by prescription may have arisen to consider; the common law, the fiction of lost modern grant and the rules under the Prescription Act 1832. In this instance I believe the pertinent method to consider is the fiction of lost modern grant.

For a prescriptive right to be substantiated under the doctrine of lost modern grant a number of 'hurdles' must be overcome. Paraphrasing those:

a. The claimed right must have been in use (as of right) for a period in excess of 20 years (see Tehidy Minerals Ltd v Norman (*[1971] 2 Q.B. 528 at 546*);
b. The dominant owner must have 'acquiesced' to the rights existence (*Liverpool Corp v Coghill [1918] 1 Ch. 307*).

I am informed by the owner that the current infrastructure, as existing, has been in situ for a significant period of time (and likely beyond 20 years). I take that as fact.

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For a right by prescription to exist it must be evidenced that the 'grantor' and 'grantee' are able to competently grant and receive the right (*Daniel v North (1809) 11 East 372*). To establish that a right has indeed arisen it would therefore be necessary to consider the ownership of all third party land-owners and determine whether, during the appropriate period, they had the adequate capacity for the easement to be granted. I have seen no evidence that the third party land owners have the necessary competency and therefore consider that the Owner would fail on this ground.

For the right by prescription to be established it must also be exercised 'as of right', quoting Gale on Easements at para 4-114

""As of right" requires one to look at the quality and character of the user and to ask whether the user is of a kind which would be enjoyed by a person having such a right. The user must be such as to convey the impression that such a right is asserted; it is not relevant to inquire into the subjective beliefs of the persons carrying on the user and, in particular, it is not necessary for such persons to show that they believed that they already possessed the right claimed.If a right is to be claimed by prescription, the persons claiming that right

"must by their conduct bring home to the landowner that a right is being asserted against him, so that the landowner has to choose between warning the trespassers off or eventually finding that they have established the asserted right against him"."

I believe that this is a difficult 'hurdle' for the owner to overcome and suggest that the nature of the claimed prescriptive right is such that the dominant owner has not had the opportunity to acquiesce to the discharge as they are likely unaware that it exists. It is relevant to add that the burden of proving that the prescriptive easement exists is placed upon the party claiming it. Therefore, the Owner has again failed to establish that he has enjoyed the use of any existing water discharge (if any) as of right.

Whilst my conclusion is that a right by prescription is unlikely to be established, for the purpose of this exercise it is worth considering the position should the owner be able to do so.

A right established by prescription is necessarily bookended by it's historic use (which gave rise to the right). The Owner proposes to significantly alter the Property by undertaking a residential development. This triggers the well-worn question as to whether that would give rise to an excessive use of the prescriptive easement established from historic use (notwithstanding that I do not consider one has been established).

The Court of Appeal considered this very point in McAdams Homes Ltd v Robinson *[2004] EWCA Civ 214; [2004] 3 E.G.L.R. 93*. The Court of Appeal held that the question of excessive user should be determined by asking two questions: first, whether the alteration in the dominant tenement involved a "radical change in character" or a "change in identity" and, secondly, whether the alteration would result in a substantial increase or alteration in the burden on the servient land.

It would seem clear from the McAdams case that the change from agricultural to residential as proposed will be a radical change in character. In determining whether the alteration would result in an alteration to the burden on the servient land. I am informed that currently surface water from the whole of the Property does not drain to the mill stream. It is a factual question as to whether attenuation features on site can mitigate any additional burden on the servient land. However, I also note that the prescriptive right can only benefit the land it currently

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benefits. To extend that to additional land would be, by definition, excessive and therefore fail.

In summary I do not believe that a right by prescription can be established. Furthermore, should the Owner successfully do so I believe the right would be contravened by utilising it for the benefit of a residential development on the Property. It is also sensible to comment that reliance on prescriptive rights is unacceptable to the current proposed funder of the scheme (this has been confirmed by their own independently instructed solicitor).

Option 3

In connection with riparian rights the following extract from para 6-01 of Gale on Easements is pertinent to quote;

"*Rights in respect of water can be divided into natural rights and acquired rights. Watercourses can be divided into natural watercourses and artificial watercourses. It is possible to have natural rights in respect of natural watercourses but not in respect of artificial watercourses*"

It is therefore essential to establish the nature and type of the watercourse that passes through the Property. I refer to the description given at paragraphs 2.3 of this report which clearly identifies this as a mill stream. That makes it clear that the watercourse was created to service a mill. The case of Burrows v Lang *[1901] 2 Ch. 502* provides confirmation that the Courts would consider a mill steam to be a temporary artificial watercourse. As such no riparian rights are conferred upon the Owner and any right may only be acquired by prescription (which we have established above is not viable).

I therefore conclude that the Owner does not have the benefit of riparian rights.

Finally, the Owners has asked that I consider the potential for the Land Drainage Acts to confer the appropriate rights upon him to enable the discharge to be used. The Land Drainage Acts give powers to the relevant authorities and not the landowner. I see no application of those 'Acts' to these circumstances.

28 May 2021

Baines Wilson LLP

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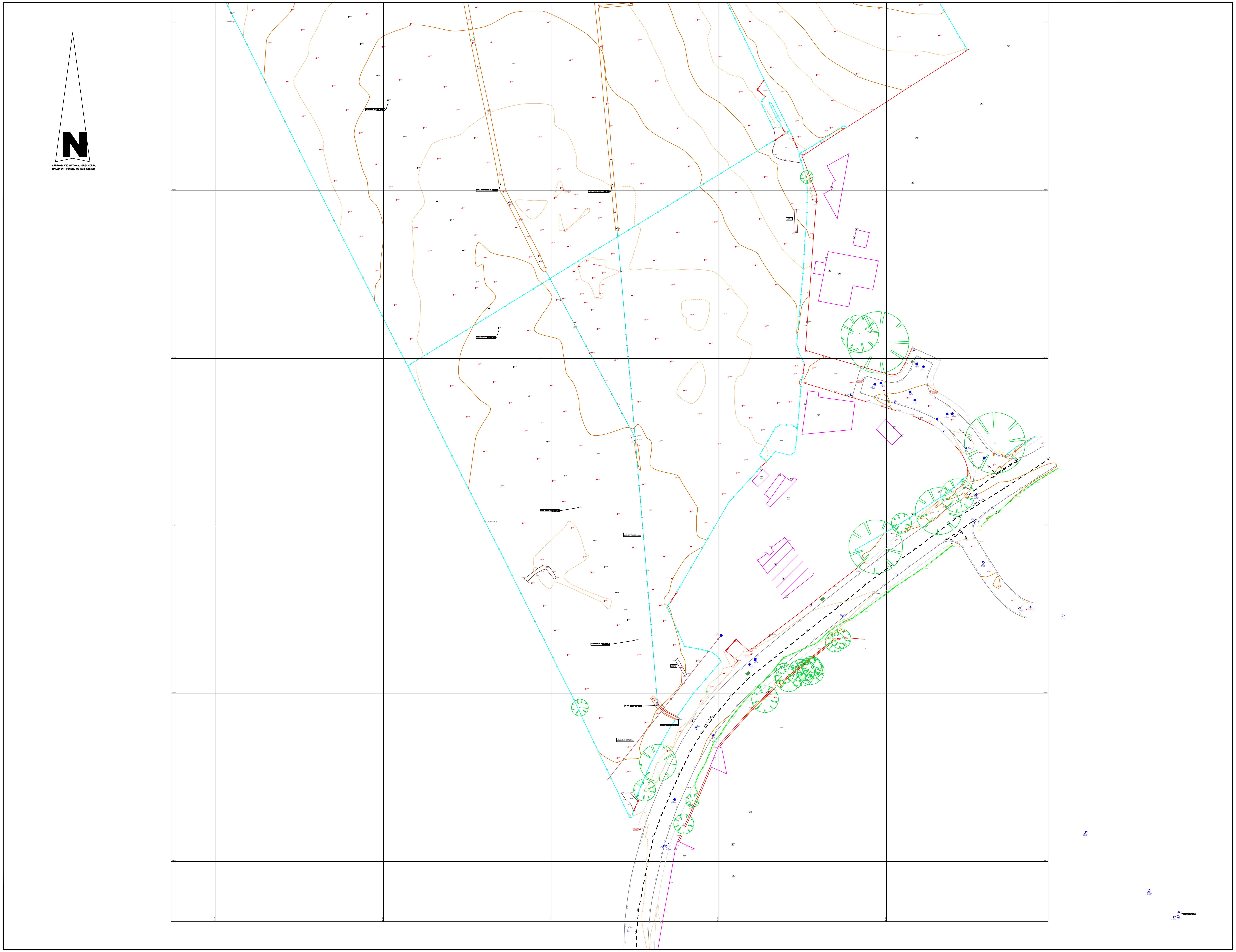
6. References

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

RICHARD MULHOLLAND
CLIENT

LAND AT FLOSH MEADOWS
CLEATOR
CUMBRIA
PROJECT TITLE

TOPOGRAPHICAL SURVEY
DRAWING TITLE

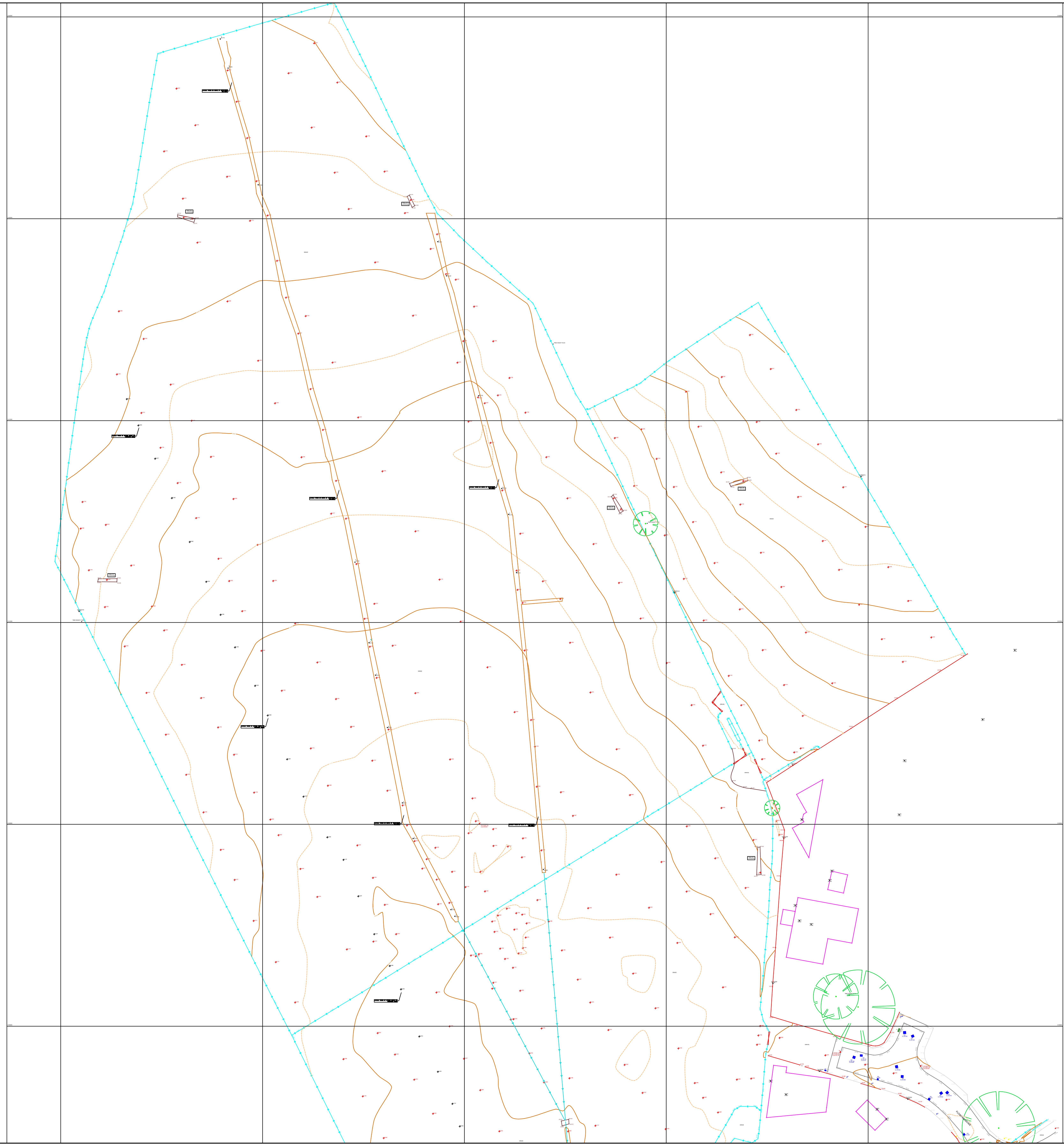
SCALE AT A1	DATE	GRID/DATUM
1:500 @ A1	18.03.14	OSTN02

SURVEYED BY	DRAWN BY	APPROVED
NP	NP	NG

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

N

APPROXIMATE NATIONAL GRID NORTH,
BASED ON TRIMBLE OSTN02 SYSTEM



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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 SURVEYED	NP	NG
A	INITIAL RELEASE	NP	NG

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FISH QUAY
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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	2/2	C

Appendix B

revision	date	notes
R 03	15/09/2017	further refinements to shared surface
R 02	12/09/2017	shared surface corrected
R 01	05.09.2017	minor changes to planting and notes
R 00	05.09.2017	original drawing

Key

- Existing vegetation
- Planting included in consented housing development proposals
- Proposed planting
- Existing and consented houses and other buildings. (no ridge lines shown)
- Proposed houses (ridge lines shown)
- Existing, consented and proposed access roads.
- Consented and proposed shared surfaces.
- No-build zone in consented housing development.

drawing number
01

drawing name
Illustrative layout

project
Housing at SR12A, Flosh Meadows

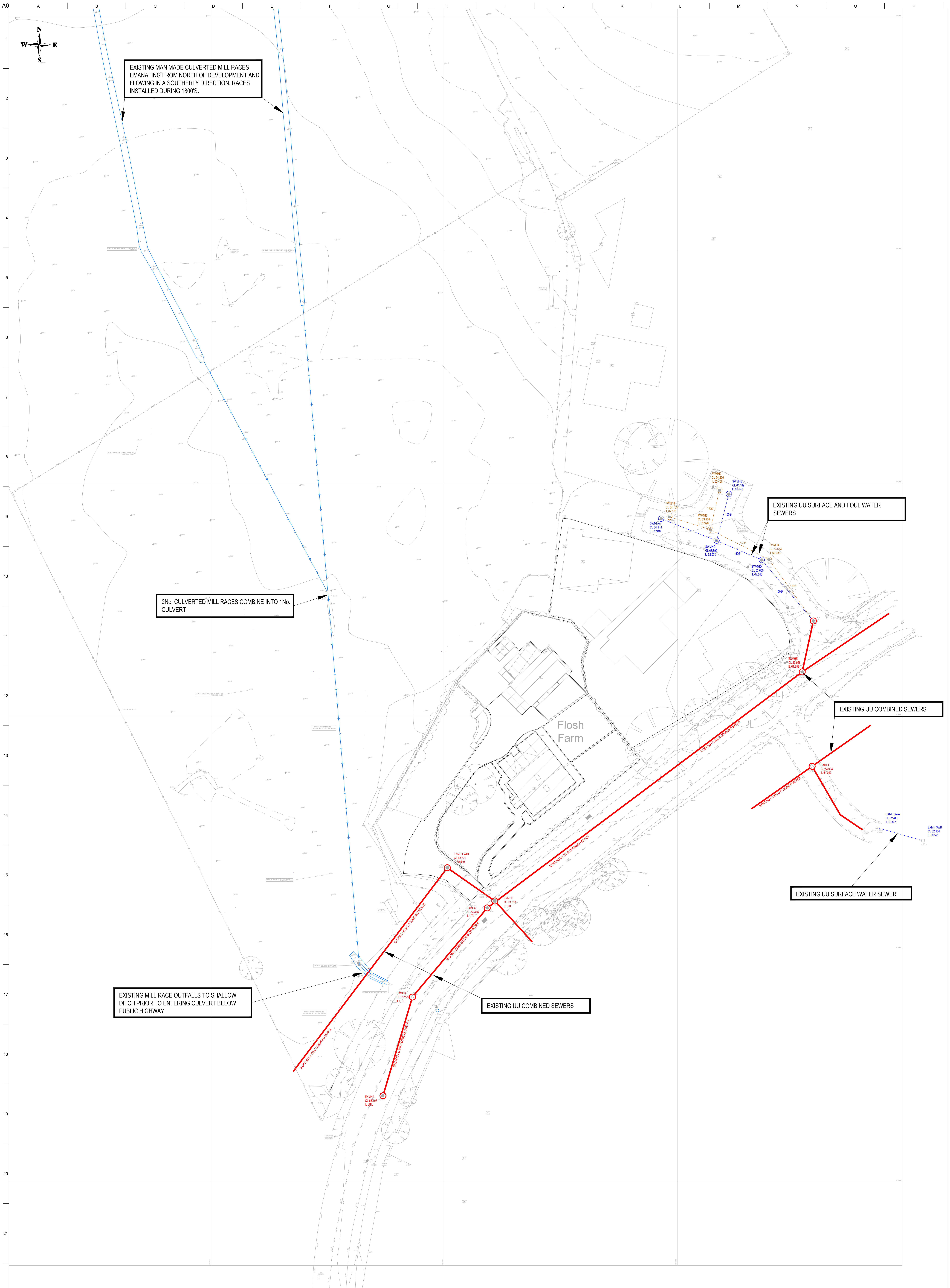
client
Mr and Mrs Mulholland
Flosh Farm, Cleator

Eden Environment Ltd
www.edenenvironment.com

produced for:
Lakeland Associates (Cleator) Ltd, The Flosh Farm House, Cleator, Cumbria. CA23 3DT
Directors: RW & E Mulholland. Registered in England and Wales no. 3184247. VAT no. 206997278

This illustration is based on a layout provided by Lakeland Associates (Cleator) Ltd.

Appendix C



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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

Richard Hall

From: Hunt, Timothy <Timothy.Hunt@uuplc.co.uk>
Sent: 06 September 2021 16:07
To: Richard Hall
Subject: S104: Flosh Meadows, Cleator Moor (Surface Water) 4200011332

Richard,

Under the circumstances we will accept a connection of surface water to the combined sewer to the south of the site at a rate not exceeding 5 l/s

This will mean that you will need to increase the storage volume of the storm tank slightly

Thanks Tim

United Utilities
Water for the North West

Tim Hunt
Developer Services Engineer (North Area)
Developer Services & Metering
Customer Services
T: 01925 679376
unitedutilities.com

From: Richard Hall [mailto:rh@coastconsult.co.uk]
Sent: 02 September 2021 15:39
To: Hunt, Timothy <Timothy.Hunt@uuplc.co.uk>
Subject: Flosh Meadows - Surface Water

Hi Tim,

Further to our conversation yesterday, please refer to the enclosed plans and summary below.

As discussed, there is a 'watercourse' running through the site. We had initially intended to discharge surface water from the development to the watercourse. This would have satisfied the planning hierarchy for disposal of surface water as the ground conditions are unsuitable for the use of infiltration techniques.

During the application for funding arrangements, it was discovered that the developer had no legal right to discharge to the 'watercourse', partly due to the fact that the watercourse is in fact man made and was constructed as a Mill Race, to feed a downstream mill wheel. This has been agreed as correct between legal teams representing the developer, Homes England, United Utilities and the Local Authority.

UU have previously confirmed that surface water can discharge to the existing sewer located within the extents of Howthorne Fields. Coast have reviewed various potential proposed routes for offsite drainage. The only route that appeared feasible is as shown on the enclosed plan. The route presents difficulties with buildability. Due to the depths and locations of existing sewers and utility apparatus, the proposed sewer becomes very shallow with cover to pipes as shallow as 0.625m. Both UU and the LA highways have agreed that this solution is acceptable, providing that a protection slab is installed in particularly shallow locations. Coasts view is that this will present a maintenance issue for the highway authority as a shallow hard spot will be situated at a depth of 0.325m below finished ground level and it is highly likely that the flexible surfacing will crack above the slab, presenting an opportunity for ingress of surface water and spalling of the road surface in due course.

In addition to the issues above, the depth of the proposed sewers are likely to lead to clashes with existing gas, water and electricity mains. The proposed depth of 0.625m to soffit and 0.850m to underside of the proposed pipe will be situated within the zone of the existing utility services, which are typically 0.60m – 0.90m below finished ground level. Again this will cause significant issues with buildability and may make the proposals unfeasible. The enclosed plans identify the location of existing utilities. We have requested water and electricity plans to further demonstrate the issue.

We have discussed the use of a surface water pumping station with the LLFA and they deem pumping station to be lower in the planning hierarchy than a connection to a combined sewer.

We believe that the only available option to the developer is to form a connection to the existing combined sewer located within the developers land at the southern boundary. We would be grateful if you could review this e mail and information and advise us accordingly.

The LLFA are satisfied that a combined connection is satisfactory given the work completed to date and subject to confirmation from UU of its acceptability.

If you have any queries, please let me know.

Kind regards,

Richard Hall

COAST
Consulting Engineers
Civil : Structural : Geotechnical

T: 0191 597 7879 **|DD:** 0191 495 7701 **|M:** 07951 057572
E : rh@coastconsult.co.uk **|** www.coastconsult.co.uk
North East : 7 Silverton Court, Northumberland Business Park, NE23 7RY.

this message by a third party.

United Utilities Group PLC, Haweswater House, Lingley Mere
Business Park, Lingley Green Avenue, Great Sankey,
Warrington, WA5 3LP
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www.unitedutilities.com/subsidiaries

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.

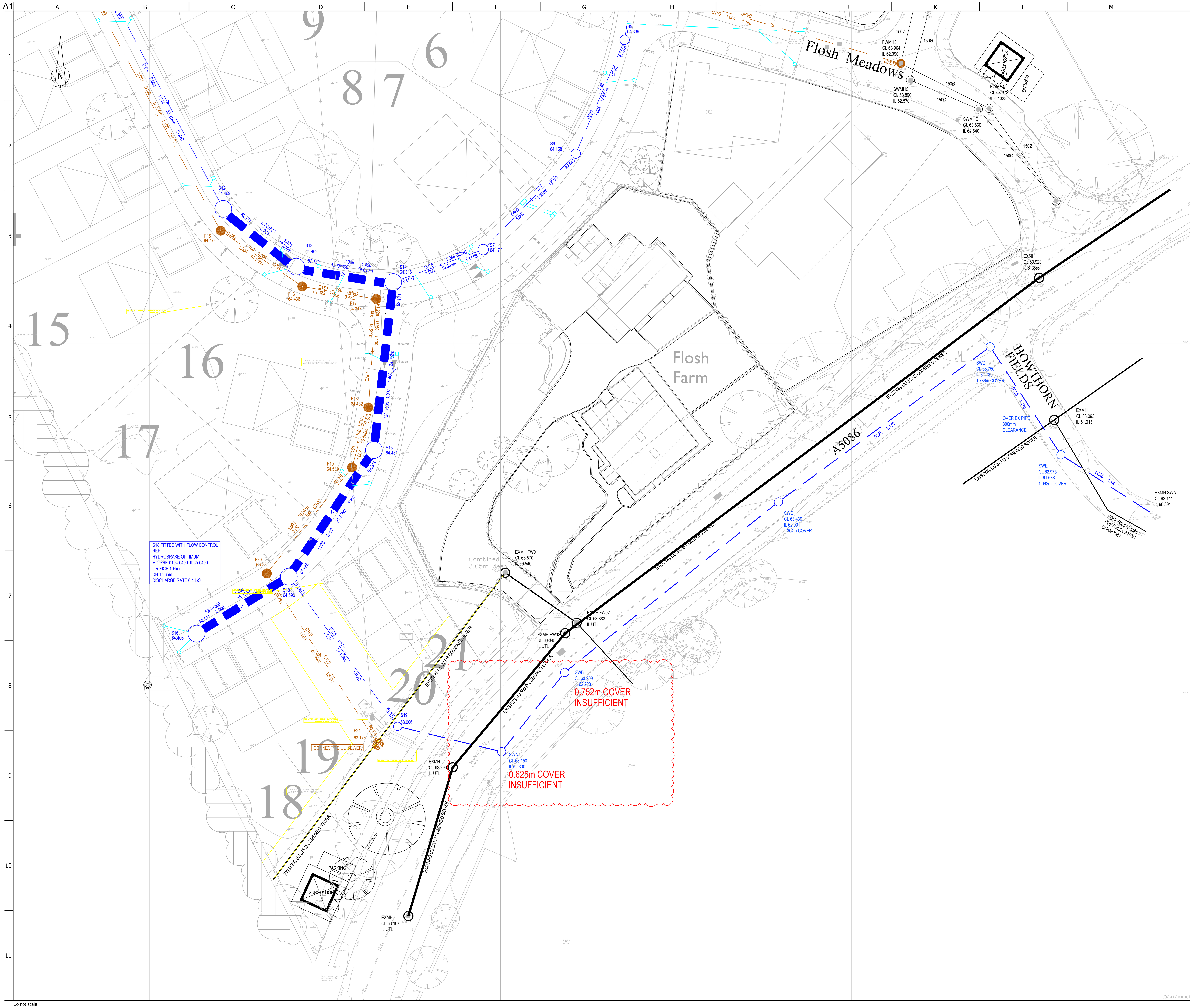
(3) Is SPR/SPRHOST ≤ 0.3?

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
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

Appendix E



FOLLOWING CONFIRMATION FROM THE PROJECT GEOTECHNICAL ENGINEERS THAT GROUND CONDITIONS ARE UNSUITABLE FOR THE USE OF INFILTRATION TECHNIQUES AND BY THE CLIENTS LEGAL REPRESENTATIVES THAT SURFACE WATER DISCHARGE TO AN ONSITE WATER COURSE WOULD NOT BE LEGALLY ACHIEVABLE, AN ALTERNATIVE POINT OF DISCHARGE FOR THE PROPOSED SW SYSTEM HAS BEEN PROVIDED BY UU, WITHIN AN ADJACENT CUL-DE-SAC, HOWTHORN FIELDS

THE PROPOSED OFF SITE SURFACE WATER SEWER ROUTE WILL CROSS EXISTING COMBINED SEWERS , OWNED BY UU, IN 3 LOCATIONS. ONCE WITHIN 'HOWTHORN FIELDS' AND TWICE WITHIN A5086.

WORKING BACK FROM THE PROPOSED POINT OF CONNECTION, UPSTREAM TOWARDS THE DEVELOPMENT SITE, AT MINIMUM GRADIENTS, A CLASH WILL OCCUR BETWEEN THE PROPOSED SW NETWORK AND THE EXISTING COMBINED SEWER.

THEREFORE THE PROPOSED SURFACE WATER SEWER WITHIN HOWTHORN FIELDS WILL NEED TO BE CONSTRUCTED ABOVE THE EXISTING COMBINED SEWER IN ORDER TO ACHIEVE A CONNECTION TO THE EXISTING SURFACE WATER NETWORK.

WORKING BACK FROM THE EXISTING COMBINED SEWER TOWARDS THE SITE AT MINIMUM GRADIENTS, THE PROPOSED SW SEWER BECOMES TOO SHALLOW AS HIGHLIGHTED IN RED ON THE PLAN.

Issue	Date	Description	By	Chkd	Appd
P2	11-10-20	Issued for discussion	RH	RH	PL
P1	15-09-20	Preliminary Issue	RH	RH	PL

COAST CONSULTING ENGINEERS

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

Client
Mr R.W. Mulholland

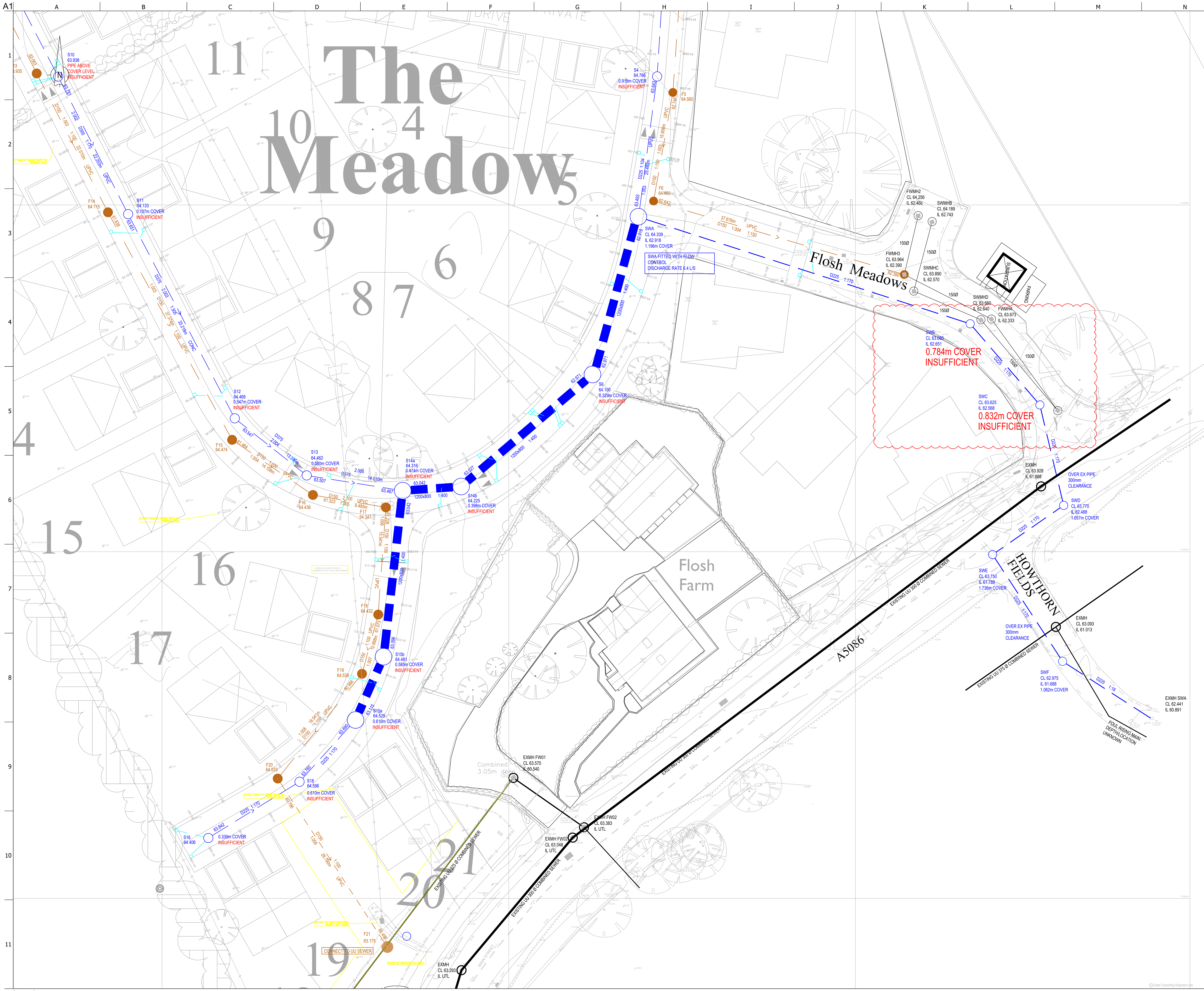
Job Title
THE MEADOW

Drawing Title
OPTION A
OFFSITE SW DRAINAGE
VIA A5086

Scale at A1
1:250

Drawing Status
PRELIMINARY

Job No	Drawing No	Issue
1842	SK01	P2



FOLLOWING CONFIRMATION FROM THE PROJECT GEOTECHNICAL ENGINEERS THAT GROUND CONDITIONS ARE UNSUITABLE FOR THE USE OF INFILTRATION TECHNIQUES AND BY THE CLIENTS LEGAL REPRESENTATIVES THAT SURFACE WATER DISCHARGE TO AN ONSITE WATER COURSE WOULD NOT BE LEGALLY ACHIEVABLE, AN ALTERNATIVE POINT OF DISCHARGE FOR THE PROPOSED SW SYSTEM HAS BEEN PROVIDED BY UU, WITHIN AN ADJACENT CUL-DE-SAC, HOWTHORN FIELDS

THE PROPOSED OFF SITE SURFACE WATER SEWER ROUTE WILL CROSS EXISTING COMBINED SEWERS , OWNED BY UU, IN 2 LOCATIONS. ONCE WITHIN 'HOWTHORN FIELDS' AND ONCE WITHIN A5086.

WORKING BACK FROM THE PROPOSED POINT OF CONNECTION, UPSTREAM TOWARDS THE DEVELOPMENT SITE, AT MINIMUM GRADIENTS, A CLASH WILL OCCUR BETWEEN THE PROPOSED SW NETWORK AND THE EXISTING COMBINED SEWER.

THEREFORE THE PROPOSED SURFACE WATER SEWER WITHIN HOWTHORN FIELDS WILL NEED TO BE CONSTRUCTED ABOVE THE EXISTING COMBINED SEWER IN ORDER TO ACHIEVE A CONNECTION TO THE EXISTING SURFACE WATER NETWORK.

WORKING BACK FROM THE EXISTING COMBINED SEWER TOWARDS THE SITE AT MINIMUM GRADIENTS, THE PROPOSED SW SEWER BECOMES TOO SHALLOW AS HIGHLIGHTED IN RED ON THE PLAN.

IN ADDITION, ON SITE LEVELS WILL NEED TO BE RAISED TO ACHIEVE THE MINIMUM REQUIRED DEPTH OF COVER AS SET OUT BY UU GUIDANCE.

Issue	Date	Description	By	Chkd	Appd
P3	11-10-20	Issued for discussion	RH	RH	PL
P2	22-09-20	Updated invert levels	xx	xx	PL
P1	15-09-20	Preliminary Issue	xx	xx	PL

COAST CONSULTING ENGINEERS

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

Client
Mr R.W. Mulholland

Job Title
THE MEADOW

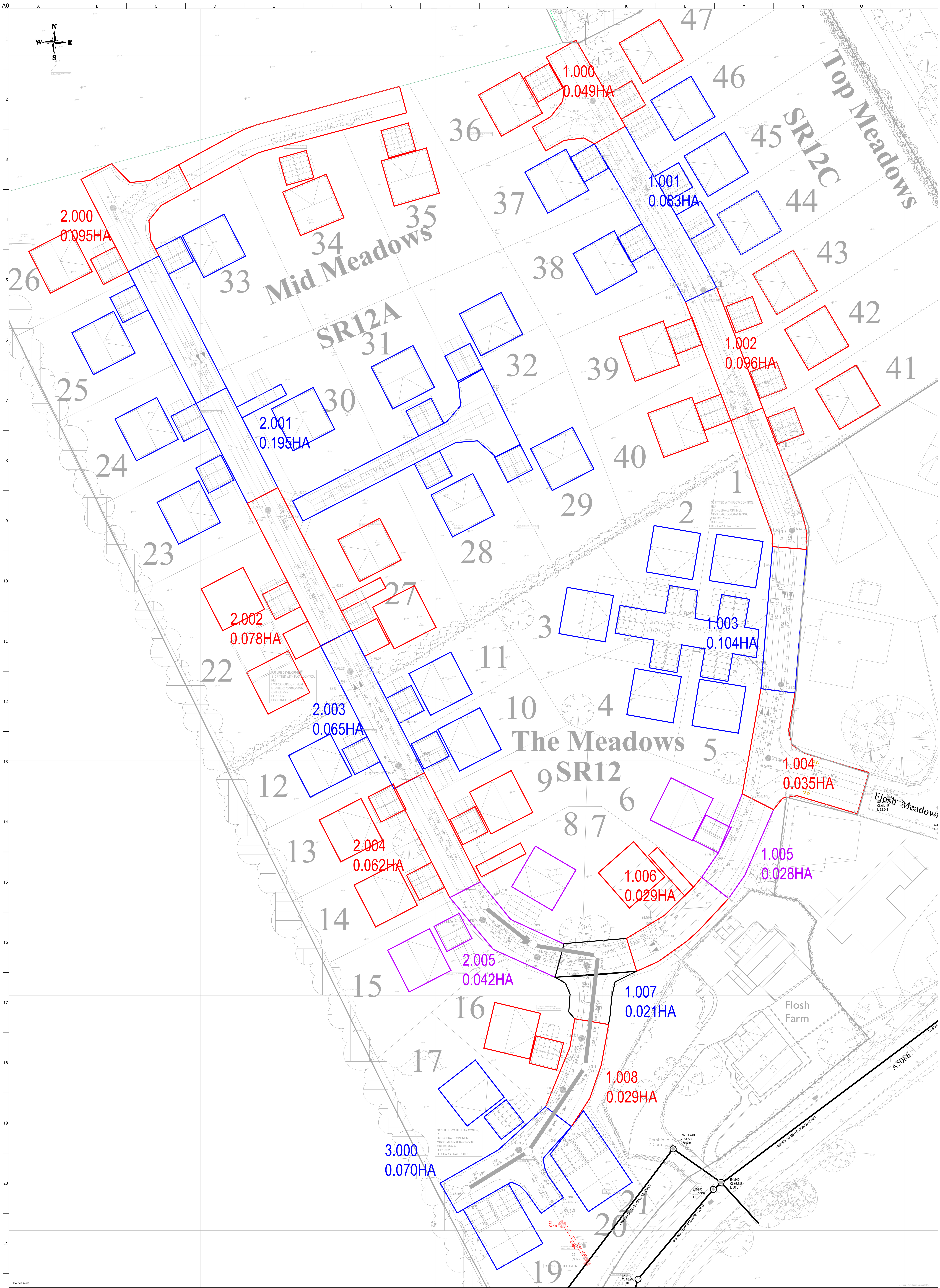
Drawing Title
OPTION B
OFFSITE SW DRAINAGE
VIA FLOSH MEADOWS

Scale at A1
1:250

Drawing Status
PRELIMINARY

Job No	Drawing No	Issue
1842	SK02	P3

Do not scale



Issue	Date	Description	By	Chkd	Appd
T1	13/07/22	TENDER ISSUE	RH	PL	PL

Drawing Title

COAST CONSULTING ENGINEERS

7 Silverton Court, Northumberland Business Park, NE23 7RY

0191 5977879

Client: MR R.W. MULHOLLAND

Job Title: FLOSH MEADOWS CUMBRIA

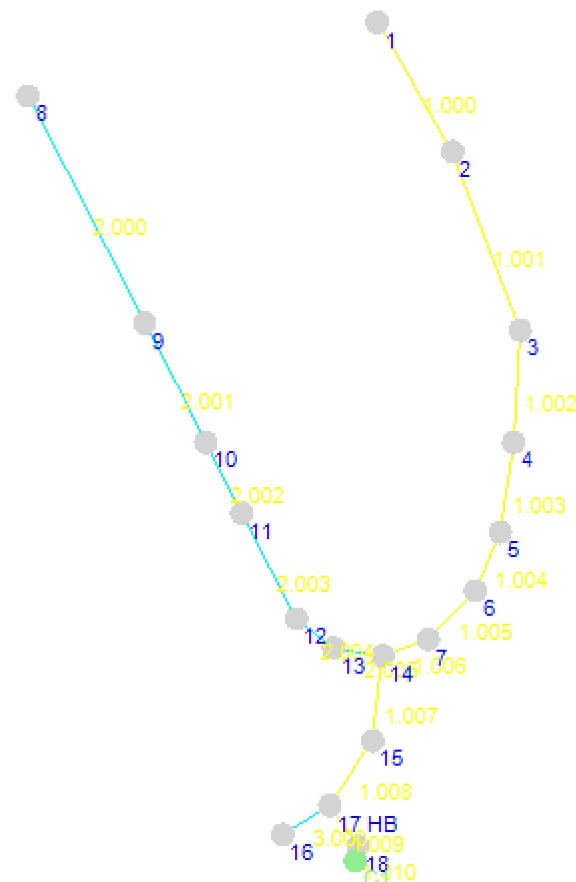
Drawing Title: IMPERMEABLE AREAS

Scale at A0: 1:250

Drawing Status: **TENDER**

Job No	Drawing No	Issue
1842	121	T1

Coast Consulting Engineers Ltd		Page 1
Suite 6, Vita House Fish Quay North Shields NE30 1JA		
Date 04/11/2021 15:33 File 211012 REVISED COMBINED OUTFALL.MDX	Designed by Richard Checked by	
Innovyze	Network 2020.1	



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	0.420	99.9	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	53.639	1.516	35.4	0.083	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.512	0.770	40.9	0.096	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.255	100.0	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.177	100.0	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	18.982	0.077	245.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	13.655	0.192	71.1	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	71.706	0.718	99.9	0.095	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	37.730	0.314	120.2	0.195	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	22.253	0.091	245.0	0.078	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	33.218	0.136	245.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.033	400.0	0.062	0.00	0.0	0.600	o	825	Pipe/Conduit	
2.005	14.105	0.035	400.0	0.042	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.007	24.092	0.048	501.9	0.021	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.008	21.726	0.041	529.9	0.029	0.00	0.0	0.600	o	825	Pipe/Conduit	
3.000	15.459	0.039	400.0	0.070	5.00	0.0	0.600	o	825	Pipe/Conduit	
1.009	13.858	0.082	170.0	0.000	0.00	0.0	0.600	o	225	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	5.70	64.855	0.049	0.0	0.0	0.0	1.01	17.8	0.0
1.001	0.00	6.10	64.360	0.132	0.0	0.0	0.0	2.21	87.7	0.0
1.002	0.00	6.36	62.844	0.228	0.0	0.0	0.0	2.05	81.5	0.0
1.003	0.00	6.68	62.074	0.332	0.0	0.0	0.0	1.31	52.0	0.0
1.004	0.00	6.87	61.744	0.367	0.0	0.0	0.0	1.57	111.1	0.0
1.005	0.00	7.19	61.568	0.395	0.0	0.0	0.0	1.00	70.7	0.0
1.006	0.00	7.29	61.415	0.424	0.0	0.0	0.0	2.15	237.6	0.0
2.000	0.00	6.19	62.776	0.095	0.0	0.0	0.0	1.01	17.8	0.0
2.001	0.00	6.72	61.983	0.290	0.0	0.0	0.0	1.19	47.4	0.0
2.002	0.00	7.09	61.594	0.368	0.0	0.0	0.0	1.00	70.7	0.0
2.003	0.00	7.57	61.428	0.433	0.0	0.0	0.0	1.15	127.4	0.0
2.004	0.00	7.72	60.843	0.495	0.0	0.0	0.0	1.48	790.2	0.0
2.005	0.00	7.88	60.809	0.537	0.0	0.0	0.0	1.48	790.2	0.0
1.007	0.00	8.18	60.773	0.982	0.0	0.0	0.0	1.32	704.7	0.0
1.008	0.00	8.46	60.725	1.011	0.0	0.0	0.0	1.28	685.7	0.0
3.000	0.00	5.17	61.323	0.070	0.0	0.0	0.0	1.48	790.2	0.0
1.009	0.00	8.69	60.684	1.081	0.0	0.0	0.0	1.00	39.8	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
1.010	4.168	0.025	170.0	0.000	0.00	0.0	0.600	o	225	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)
1.010	0.00	8.76	60.603	1.081	0.0	0.0	0.0	1.00	39.8	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	60.578	60.578	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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.223		

Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 5.0

Unit Reference	MD-SHE-0075-3400-2049-3400
Design Head (m)	2.049
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	62.844
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.049	3.4
Flush-Flo™	0.327	2.5
Kick-Flo®	0.667	2.0
Mean Flow over Head Range	-	2.6

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	2.0	1.200	2.7	3.000	4.1	7.000	6.0
0.200	2.4	1.400	2.8	3.500	4.4	7.500	6.2
0.300	2.5	1.600	3.0	4.000	4.6	8.000	6.4
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.6
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.8
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.6		
1.000	2.4	2.600	3.8	6.500	5.8		

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Unit Reference	MD-SHE-0075-3100-1610-3100
Design Head (m)	1.610
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	61.594
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.610	3.1
Flush-Flo™	0.330	2.6
Kick-Flo®	0.672	2.1
Mean Flow over Head Range	-	2.5

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.6	1.800	3.3	4.500	5.0	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	5.9		

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3

Unit Reference	MD-SHE-0089-5000-2299-5000
Design Head (m)	2.299
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	60.684
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.299	5.0
Flush-Flo™	0.384	3.8
Kick-Flo®	0.790	3.1
Mean Flow over Head Range	-	3.8

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	2.7	0.300	3.8	0.500	3.8	0.800	3.1
0.200	3.6	0.400	3.8	0.600	3.7	1.000	3.4

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	3.7	2.400	5.1	5.000	7.2	8.000	9.0
1.400	4.0	2.600	5.3	5.500	7.5	8.500	9.3
1.600	4.2	3.000	5.7	6.000	7.8	9.000	9.5
1.800	4.5	3.500	6.1	6.500	8.1	9.500	9.8
2.000	4.7	4.000	6.5	7.000	8.4		
2.200	4.9	4.500	6.8	7.500	8.7		

Storage Structures for 180518 SW1.SWS

Cellular Storage Manhole: 1, DS/PN: 1.000

Invert Level (m) 63.655 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) 64.360 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	207.0	0.0	0.521	0.0	0.0
0.520	207.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 1.003

Invert Level (m) 62.074 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) 61.568 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) 61.415 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Cellular Storage Manhole: 7, DS/PN: 1.006

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) 62.776 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) 61.983 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, DS/PN: 2.002

Invert Level (m) 61.594 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	103.6	0.0	0.521	0.0	0.0
0.520	103.6	0.0			

Cellular Storage Manhole: 11, DS/PN: 2.003

Invert Level (m) 61.428 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	181.4	0.0	0.521	0.0	0.0
0.520	181.4	0.0			

Cellular Storage Manhole: 12, DS/PN: 2.004

Invert Level (m) 60.868 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) 60.783 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: 16, DS/PN: 3.000

Invert Level (m) 61.323 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) 60.684 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			

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) 0.750
M5-60 (mm) 18.600 Cv (Winter) 0.840

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	1440 Winter	2	+0%					64.129
1.001	2	180 Winter	2	+0%					64.413
1.002	3	60 Winter	2	+0%	2/15 Summer				64.449
1.003	4	60 Winter	2	+0%					62.138
1.004	5	60 Winter	2	+0%					61.811
1.005	6	60 Winter	2	+0%					61.659
1.006	7	1440 Winter	2	+0%					61.639
2.000	8	60 Summer	2	+0%					62.838
2.001	9	720 Winter	2	+0%					62.052
2.002	10	720 Winter	2	+0%	2/120 Winter				62.046
2.003	11	1440 Winter	2	+0%					61.641
2.004	12	1440 Winter	2	+0%					61.639
2.005	13	1440 Winter	2	+0%	2/1440 Winter				61.639
1.007	14	1440 Winter	2	+0%	2/1440 Winter				61.639
1.008	15	1440 Winter	2	+0%	2/960 Winter				61.639
3.000	16	1440 Winter	2	+0%					61.639
1.009	17 HB	1440 Winter	2	+0%	2/30 Summer				61.639
1.010	18	120 Winter	2	+0%					60.658

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	-0.876	0.000	0.00			0.0	OK	
1.001	2	-0.172	0.000	0.03		60	2.7	OK	
1.002	3	1.380	0.000	0.04			3.0	SURCHARGED	
1.003	4	-0.161	0.000	0.18			8.5	OK	
1.004	5	-0.233	0.000	0.11			10.6	OK	
1.005	6	-0.209	0.000	0.20		47	12.3	OK	
1.006	7	-0.151	0.000	0.03		349	5.3	OK	
2.000	8	-0.088	0.000	0.36		26	6.3	OK	
2.001	9	-0.156	0.000	0.13		234	5.9	OK	
2.002	10	0.152	0.000	0.04		415	2.6	SURCHARGED	
2.003	11	-0.162	0.000	0.03		345	3.5	OK	
2.004	12	-0.029	0.000	0.01		856	3.3	OK	
2.005	13	0.004	0.000	0.01			3.0	SURCHARGED	
1.007	14	0.041	0.000	0.01			6.5	SURCHARGED	
1.008	15	0.089	0.000	0.01		892	6.0	SURCHARGED	
3.000	16	-0.509	0.000	0.00		447	1.0	OK	
1.009	17 HB	0.730	0.000	0.11		1038	3.8	SURCHARGED	
1.010	18	-0.170	0.000	0.14			3.8	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	0.420	99.9	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	53.639	1.516	35.4	0.083	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.512	0.770	40.9	0.096	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.255	100.0	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.177	100.0	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	18.982	0.077	245.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	13.655	0.192	71.1	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	71.706	0.718	99.9	0.095	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	37.730	0.314	120.2	0.195	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	22.253	0.091	245.0	0.078	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	33.218	0.136	245.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.033	400.0	0.062	0.00	0.0	0.600	o	825	Pipe/Conduit	
2.005	14.105	0.035	400.0	0.042	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.007	24.092	0.048	501.9	0.021	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.008	21.726	0.041	529.9	0.029	0.00	0.0	0.600	o	825	Pipe/Conduit	
3.000	15.459	0.039	400.0	0.070	5.00	0.0	0.600	o	825	Pipe/Conduit	
1.009	13.858	0.082	170.0	0.000	0.00	0.0	0.600	o	225	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	5.70	64.855	0.049	0.0	0.0	0.0	1.01	17.8	0.0
1.001	0.00	6.10	64.360	0.132	0.0	0.0	0.0	2.21	87.7	0.0
1.002	0.00	6.36	62.844	0.228	0.0	0.0	0.0	2.05	81.5	0.0
1.003	0.00	6.68	62.074	0.332	0.0	0.0	0.0	1.31	52.0	0.0
1.004	0.00	6.87	61.744	0.367	0.0	0.0	0.0	1.57	111.1	0.0
1.005	0.00	7.19	61.568	0.395	0.0	0.0	0.0	1.00	70.7	0.0
1.006	0.00	7.29	61.415	0.424	0.0	0.0	0.0	2.15	237.6	0.0
2.000	0.00	6.19	62.776	0.095	0.0	0.0	0.0	1.01	17.8	0.0
2.001	0.00	6.72	61.983	0.290	0.0	0.0	0.0	1.19	47.4	0.0
2.002	0.00	7.09	61.594	0.368	0.0	0.0	0.0	1.00	70.7	0.0
2.003	0.00	7.57	61.428	0.433	0.0	0.0	0.0	1.15	127.4	0.0
2.004	0.00	7.72	60.843	0.495	0.0	0.0	0.0	1.48	790.2	0.0
2.005	0.00	7.88	60.809	0.537	0.0	0.0	0.0	1.48	790.2	0.0
1.007	0.00	8.18	60.773	0.982	0.0	0.0	0.0	1.32	704.7	0.0
1.008	0.00	8.46	60.725	1.011	0.0	0.0	0.0	1.28	685.7	0.0
3.000	0.00	5.17	61.323	0.070	0.0	0.0	0.0	1.48	790.2	0.0
1.009	0.00	8.69	60.684	1.081	0.0	0.0	0.0	1.00	39.8	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
1.010	4.168	0.025	170.0	0.000	0.00	0.0	0.600	o	225	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)
1.010	0.00	8.76	60.603	1.081	0.0	0.0	0.0	1.00	39.8	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	60.578	60.578	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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.223		

Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 5.0

Unit Reference	MD-SHE-0075-3400-2049-3400
Design Head (m)	2.049
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	62.844
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.049	3.4
Flush-Flo™	0.327	2.5
Kick-Flo®	0.667	2.0
Mean Flow over Head Range	-	2.6

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	2.0	1.200	2.7	3.000	4.1	7.000	6.0
0.200	2.4	1.400	2.8	3.500	4.4	7.500	6.2
0.300	2.5	1.600	3.0	4.000	4.6	8.000	6.4
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.6
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.8
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.6		
1.000	2.4	2.600	3.8	6.500	5.8		

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Unit Reference	MD-SHE-0075-3100-1610-3100
Design Head (m)	1.610
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	61.594
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.610	3.1
Flush-Flo™	0.330	2.6
Kick-Flo®	0.672	2.1
Mean Flow over Head Range	-	2.5

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.6	1.800	3.3	4.500	5.0	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	5.9		

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3

Unit Reference	MD-SHE-0089-5000-2299-5000
Design Head (m)	2.299
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	60.684
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.299	5.0
Flush-Flo™	0.384	3.8
Kick-Flo®	0.790	3.1
Mean Flow over Head Range	-	3.8

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	2.7	0.300	3.8	0.500	3.8	0.800	3.1
0.200	3.6	0.400	3.8	0.600	3.7	1.000	3.4

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	3.7	2.400	5.1	5.000	7.2	8.000	9.0
1.400	4.0	2.600	5.3	5.500	7.5	8.500	9.3
1.600	4.2	3.000	5.7	6.000	7.8	9.000	9.5
1.800	4.5	3.500	6.1	6.500	8.1	9.500	9.8
2.000	4.7	4.000	6.5	7.000	8.4		
2.200	4.9	4.500	6.8	7.500	8.7		

Storage Structures for 180518 SW1.SWS

Cellular Storage Manhole: 1, DS/PN: 1.000

Invert Level (m) 63.655 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) 64.360 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	207.0	0.0	0.521	0.0	0.0
0.520	207.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 1.003

Invert Level (m) 62.074 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) 61.568 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) 61.415 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Cellular Storage Manhole: 7, DS/PN: 1.006

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) 62.776 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) 61.983 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, DS/PN: 2.002

Invert Level (m) 61.594 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	103.6	0.0	0.521	0.0	0.0
0.520	103.6	0.0			

Cellular Storage Manhole: 11, DS/PN: 2.003

Invert Level (m) 61.428 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	181.4	0.0	0.521	0.0	0.0
0.520	181.4	0.0			

Cellular Storage Manhole: 12, DS/PN: 2.004

Invert Level (m) 60.868 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) 60.783 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: 16, DS/PN: 3.000

Invert Level (m) 61.323 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) 60.684 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			

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) 0.750
M5-60 (mm) 18.600 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	1440 Winter	30	+0%					64.876
1.001	2	240 Winter	30	+0%					64.535
1.002	3	30 Winter	30	+0%	30/15 Summer				64.684
1.003	4	1440 Winter	30	+0%					62.269
1.004	5	1440 Winter	30	+0%	30/720 Winter				62.263
1.005	6	1440 Winter	30	+0%	30/600 Winter				62.261
1.006	7	1440 Winter	30	+0%	30/480 Winter				62.258
2.000	8	30 Winter	30	+0%					62.877
2.001	9	1440 Winter	30	+0%	30/360 Winter				62.292
2.002	10	1440 Winter	30	+0%	30/30 Winter				62.289
2.003	11	1440 Winter	30	+0%	30/480 Winter				62.257
2.004	12	1440 Winter	30	+0%	30/360 Summer				62.257
2.005	13	1440 Winter	30	+0%	30/240 Winter				62.257
1.007	14	1440 Winter	30	+0%	30/240 Winter				62.257
1.008	15	1440 Winter	30	+0%	30/180 Winter				62.257
3.000	16	1440 Winter	30	+0%	30/960 Winter				62.257

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	-0.129	0.000	0.05			0.8	OK	
1.001	2	-0.050	0.000	0.04		138	3.0	OK	
1.002	3	1.615	0.000	0.04			3.2	FLOOD RISK	
1.003	4	-0.030	0.000	0.11		291	5.4	OK	
1.004	5	0.219	0.000	0.06			6.2	SURCHARGED	
1.005	6	0.393	0.000	0.11		988	6.8	SURCHARGED	
1.006	7	0.468	0.000	0.04		1451	7.4	SURCHARGED	
2.000	8	-0.049	0.000	0.78		15	13.7	OK	
2.001	9	0.084	0.000	0.12		488	5.6	SURCHARGED	
2.002	10	0.395	0.000	0.04		1074	2.6	SURCHARGED	
2.003	11	0.454	0.000	0.03		1445	4.0	SURCHARGED	
2.004	12	0.589	0.000	0.01			4.2	SURCHARGED	
2.005	13	0.622	0.000	0.01			3.7	SURCHARGED	
1.007	14	0.659	0.000	0.02			9.4	SURCHARGED	
1.008	15	0.707	0.000	0.02			8.6	SURCHARGED	
3.000	16	0.109	0.000	0.00		1653	1.5	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)
1.009	17 HB	1440 Winter	30	+0%	30/15 Summer				62.257
1.010	18	1440 Winter	30	+0%					60.661

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
1.009	17 HB	1.348	0.000	0.12			4.2	SURCHARGED	
1.010	18	-0.167	0.000	0.15			4.2	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	0.420	99.9	0.049	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	53.639	1.516	35.4	0.083	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	31.512	0.770	40.9	0.096	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	25.483	0.255	100.0	0.104	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	17.652	0.177	100.0	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	18.982	0.077	245.0	0.028	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	13.655	0.192	71.1	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.000	71.706	0.718	99.9	0.095	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	37.730	0.314	120.2	0.195	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.002	22.253	0.091	245.0	0.078	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.003	33.218	0.136	245.0	0.065	0.00	0.0	0.600	o	375	Pipe/Conduit	
2.004	13.246	0.033	400.0	0.062	0.00	0.0	0.600	o	825	Pipe/Conduit	
2.005	14.105	0.035	400.0	0.042	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.007	24.092	0.048	501.9	0.021	0.00	0.0	0.600	o	825	Pipe/Conduit	
1.008	21.726	0.041	529.9	0.029	0.00	0.0	0.600	o	825	Pipe/Conduit	
3.000	15.459	0.039	400.0	0.070	5.00	0.0	0.600	o	825	Pipe/Conduit	
1.009	13.858	0.082	170.0	0.000	0.00	0.0	0.600	o	225	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	5.70	64.855	0.049	0.0	0.0	0.0	1.01	17.8	0.0
1.001	0.00	6.10	64.360	0.132	0.0	0.0	0.0	2.21	87.7	0.0
1.002	0.00	6.36	62.844	0.228	0.0	0.0	0.0	2.05	81.5	0.0
1.003	0.00	6.68	62.074	0.332	0.0	0.0	0.0	1.31	52.0	0.0
1.004	0.00	6.87	61.744	0.367	0.0	0.0	0.0	1.57	111.1	0.0
1.005	0.00	7.19	61.568	0.395	0.0	0.0	0.0	1.00	70.7	0.0
1.006	0.00	7.29	61.415	0.424	0.0	0.0	0.0	2.15	237.6	0.0
2.000	0.00	6.19	62.776	0.095	0.0	0.0	0.0	1.01	17.8	0.0
2.001	0.00	6.72	61.983	0.290	0.0	0.0	0.0	1.19	47.4	0.0
2.002	0.00	7.09	61.594	0.368	0.0	0.0	0.0	1.00	70.7	0.0
2.003	0.00	7.57	61.428	0.433	0.0	0.0	0.0	1.15	127.4	0.0
2.004	0.00	7.72	60.843	0.495	0.0	0.0	0.0	1.48	790.2	0.0
2.005	0.00	7.88	60.809	0.537	0.0	0.0	0.0	1.48	790.2	0.0
1.007	0.00	8.18	60.773	0.982	0.0	0.0	0.0	1.32	704.7	0.0
1.008	0.00	8.46	60.725	1.011	0.0	0.0	0.0	1.28	685.7	0.0
3.000	0.00	5.17	61.323	0.070	0.0	0.0	0.0	1.48	790.2	0.0
1.009	0.00	8.69	60.684	1.081	0.0	0.0	0.0	1.00	39.8	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
1.010	4.168	0.025	170.0	0.000	0.00	0.0	0.600	o	225	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)
1.010	0.00	8.76	60.603	1.081	0.0	0.0	0.0	1.00	39.8	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	60.578	60.578	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	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.223		

Online Controls for 180518 SW1.SWS

Hydro-Brake® Optimum Manhole: 3, DS/PN: 1.002, Volume (m³): 5.0

Unit Reference	MD-SHE-0075-3400-2049-3400
Design Head (m)	2.049
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	62.844
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	2.049	3.4
Flush-Flo™	0.327	2.5
Kick-Flo®	0.667	2.0
Mean Flow over Head Range	-	2.6

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	2.0	1.200	2.7	3.000	4.1	7.000	6.0
0.200	2.4	1.400	2.8	3.500	4.4	7.500	6.2
0.300	2.5	1.600	3.0	4.000	4.6	8.000	6.4
0.400	2.5	1.800	3.2	4.500	4.9	8.500	6.6
0.500	2.4	2.000	3.4	5.000	5.2	9.000	6.8
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.6		
1.000	2.4	2.600	3.8	6.500	5.8		

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Unit Reference	MD-SHE-0075-3100-1610-3100
Design Head (m)	1.610
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	61.594
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: 10, DS/PN: 2.002, Volume (m³): 3.8

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.610	3.1
Flush-Flo™	0.330	2.6
Kick-Flo®	0.672	2.1
Mean Flow over Head Range	-	2.5

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.5	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.6	1.800	3.3	4.500	5.0	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.6	5.500	5.5	9.500	7.1
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.9	6.500	5.9		

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3

Unit Reference	MD-SHE-0089-5000-2299-5000
Design Head (m)	2.299
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	60.684
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.299	5.0
Flush-Flo™	0.384	3.8
Kick-Flo®	0.790	3.1
Mean Flow over Head Range	-	3.8

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	2.7	0.300	3.8	0.500	3.8	0.800	3.1
0.200	3.6	0.400	3.8	0.600	3.7	1.000	3.4

Hydro-Brake® Optimum Manhole: 17 HB, DS/PN: 1.009, Volume (m³): 30.3

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
1.200	3.7	2.400	5.1	5.000	7.2	8.000	9.0
1.400	4.0	2.600	5.3	5.500	7.5	8.500	9.3
1.600	4.2	3.000	5.7	6.000	7.8	9.000	9.5
1.800	4.5	3.500	6.1	6.500	8.1	9.500	9.8
2.000	4.7	4.000	6.5	7.000	8.4		
2.200	4.9	4.500	6.8	7.500	8.7		

Storage Structures for 180518 SW1.SWS

Cellular Storage Manhole: 1, DS/PN: 1.000

Invert Level (m) 63.655 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) 64.360 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	207.0	0.0	0.521	0.0	0.0
0.520	207.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 1.003

Invert Level (m) 62.074 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) 61.568 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) 61.415 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Cellular Storage Manhole: 7, DS/PN: 1.006

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) 62.776 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) 61.983 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, DS/PN: 2.002

Invert Level (m) 61.594 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	103.6	0.0	0.521	0.0	0.0
0.520	103.6	0.0			

Cellular Storage Manhole: 11, DS/PN: 2.003

Invert Level (m) 61.428 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	181.4	0.0	0.521	0.0	0.0
0.520	181.4	0.0			

Cellular Storage Manhole: 12, DS/PN: 2.004

Invert Level (m) 60.868 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) 60.783 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: 16, DS/PN: 3.000

Invert Level (m) 61.323 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) 60.684 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			

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) 0.750
M5-60 (mm) 18.600 Cv (Winter) 0.840

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 (%) 40

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	240 Winter	100	+40%				
1.001	2	360 Winter	100	+40%	100/60 Summer			
1.002	3	15 Winter	100	+40%	100/15 Summer	100/15 Summer		
1.003	4	360 Winter	100	+40%	100/240 Winter			
1.004	5	360 Winter	100	+40%	100/180 Winter			
1.005	6	360 Winter	100	+40%	100/180 Summer			
1.006	7	360 Winter	100	+40%	100/120 Winter			
2.000	8	360 Winter	100	+40%	100/15 Winter			
2.001	9	360 Winter	100	+40%	100/60 Winter			
2.002	10	360 Winter	100	+40%	100/15 Summer			
2.003	11	360 Winter	100	+40%	100/120 Winter	100/360 Winter		
2.004	12	360 Winter	100	+40%	100/120 Summer			
2.005	13	360 Winter	100	+40%	100/120 Summer			
1.007	14	360 Winter	100	+40%	100/120 Summer			
1.008	15	360 Winter	100	+40%	100/60 Winter			
3.000	16	360 Winter	100	+40%	100/180 Winter			
1.009	17 HB	360 Winter	100	+40%	100/15 Summer			

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

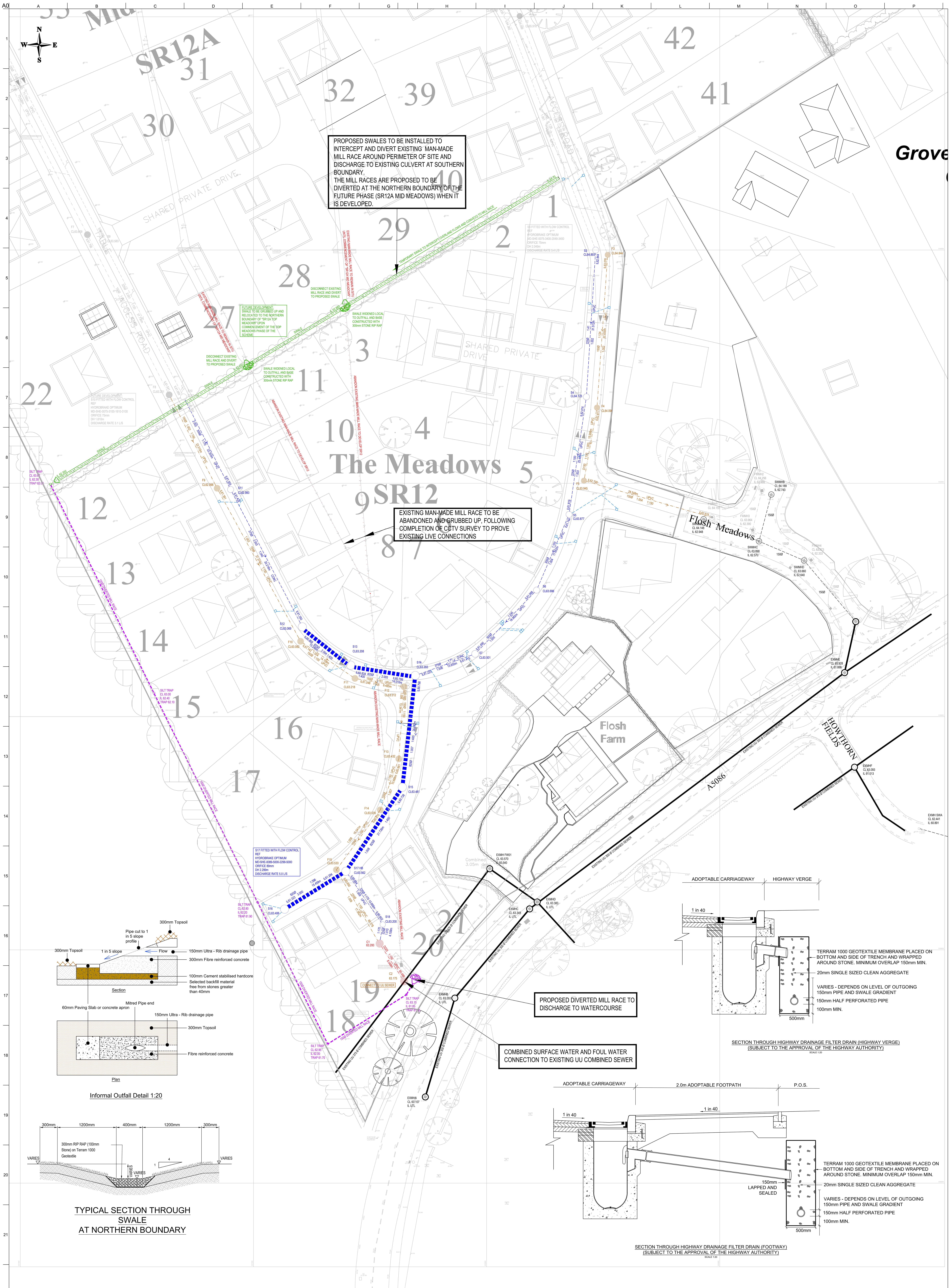
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1	64.905	-0.100	0.000	0.23			4.0	OK
1.001	2	64.872	0.287	0.000	0.04		283	3.2	SURCHARGED
1.002	3	64.894	1.825	0.727	0.04			3.4	FLOOD
1.003	4	63.005	0.706	0.000	0.28			13.6	SURCHARGED
1.004	5	62.996	0.952	0.000	0.18			17.1	SURCHARGED
1.005	6	62.992	1.125	0.000	0.32			19.8	SURCHARGED
1.006	7	62.988	1.198	0.000	0.12			21.3	SURCHARGED
2.000	8	63.085	0.159	0.000	0.55		187	9.5	SURCHARGED
2.001	9	63.095	0.887	0.000	0.34			15.2	SURCHARGED
2.002	10	63.092	1.198	0.000	0.04			2.6	FLOOD RISK
2.003	11	62.984	1.180	0.622	0.07			7.9	FLOOD
2.004	12	62.986	1.318	0.000	0.02			9.0	FLOOD RISK
2.005	13	62.986	1.352	0.000	0.02			8.4	FLOOD RISK
1.007	14	62.986	1.388	0.000	0.05			23.2	SURCHARGED
1.008	15	62.986	1.436	0.000	0.04			18.7	SURCHARGED
3.000	16	62.986	0.838	0.000	0.01			5.8	SURCHARGED
1.009	17 HB	62.986	2.077	0.000	0.14			5.0	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	1	
1.001	2	
1.002	3	3
1.003	4	
1.004	5	
1.005	6	
1.006	7	
2.000	8	
2.001	9	
2.002	10	
2.003	11	1
2.004	12	
2.005	13	
1.007	14	
1.008	15	
3.000	16	
1.009	17 HB	

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)
1.010	18	360 Winter	100	+40%					60.667

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
1.010	18	-0.161	0.000	0.18			5.0	OK	



LEGEND

- EXISTING UU SEWERS
- PROPOSED UU COMBINED WATER SEWER
- PROPOSED UU FOUL WATER SEWER
- PROPOSED UU SURFACE WATER SEWER
- PROPOSED HIGHWAY DRAINAGE

LEGEND

- PROPOSED DIVERSION OF MILL RACE MAINTAINED BY MANAGEMENT CO
- PROPOSED FILTER DRAINS, MAINTAINED BY MANAGEMENT CO

Issue	Date	Description	By	Chkd	Appd
P7	13-07-22	Filter drains removed	RH	RH	PL
P6	07-06-22	Updated to reflect client comments	RH	RH	PL
P5	30-05-22	Updated to reflect LLFA comments	RH	RH	PL
P4	09-12-21	Updated to reflect client comments	RH	RH	PL
P3	19-05-21	Updated to reflect client comments	RH	RH	PL
P2	23-04-21	Updated to reflect client comments	RH	RH	PL

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Client: MR R.W. MULHOLLAND

Job Title: FLOSH MEADOWS SR12 CUMBRIA

Drawing Title: PROPOSED DRAINAGE

Scale at A0: 1:250

Drawing Status: PRELIMINARY

Job No: 1842 | Drawing No: 202 | Issue: P7

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