Report Title	# Flood Risk Assessment and Drainage Report
Property Address	North Lane Haverigg Millom Cumbria
Client	PFK plc
Our Reference	22-111c001B
Date	June 2022
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Contents

Introduction

The purpose of this report is to present the design of the proposed surface water drainage design for a residential development at North Lane, Haverigg, Millom, LA18 4LX (thereafter referred to as 'The Site'). The report has been commissioned by owners, for the purposes of supporting a planning application and providing a flood risk assessment and a detailed drainage strategy for foul and surface water drainage on the site.

Research has been undertaken on the site and observations made regarding the existing site and its former history.

The report should be read in conjunction with the documents referenced to it, generally appended to this report, and all works has been designed in accordance with the following standards :

- CIRIA Publication C753 The SuDS Manual
- CIRIA Publication C768 Guidance on the Construction of SuDS

Calculations associated with the drainage have been performed using analysis packages and where appropriate copies of calculations are provided in this report.

Existing Site and Drainage

Site Description

The site is presently arable fields located to the south of North Lane, Haverigg. Residential properties are present to the east and north of the site, with the remaining boundaries are arable fields.

The site is flat and boundaries are either formed by man made dykes or streams and wire fences.

Superficial Deposits

The published superficial geology by The British Geological Survey shows the site comprises Raised Beach formation and Storm Beach deposits. Both are generally formed with sands and gravels with good natural drainage.

Solid Geology

The solid geology as published by the British Geological Survey shows the site to be underlain by St Bees Sandstone Formation consisting of Sandstones.

Surface Water

Formal surface water drainage is present locally around the fields of the site in the form of land drainage discharging directly to the ditches and watercourses present around the site. The principal watercourse is referred to as Stroup Dub Cut and discharges into Duddon Sands nearby.

Foul Water

There the site and nearby properties are not serviced by a public sewer. All nearby properties have individual septic tanks and all discharge to the open water courses around the site.

The public sewers operated by United Utilities are located at the junction of North Lane and Red Brow approx 175m from the site.

INITIAL FLOOD RISK

An initial flood risk assessment was undertaken adopting mapping available at https://flood-map-for-planning.service.gov.uk/ and this identified the area of the site to be within a Flood Zone 1.

Due to the presence of surface watercourses around the site, a detailed flood risk assessment shall be undertaken.

DETAILED FLOOD RISK ASSESSMENT

Flood Risk Assessment Criteria

A Flood Risk Assessment Report was requested from the Environment Agency and identified that the site is considered in a Flood Zone 1.

The Flood Zone classifications are as follows :

- Flood Zone 1 - land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

- Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year.

- Flood Zone 3 - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

In respect to the proposed development, this is classified as More Vulnerable and as such the flood risk assessment is required to address :

- Surface water management

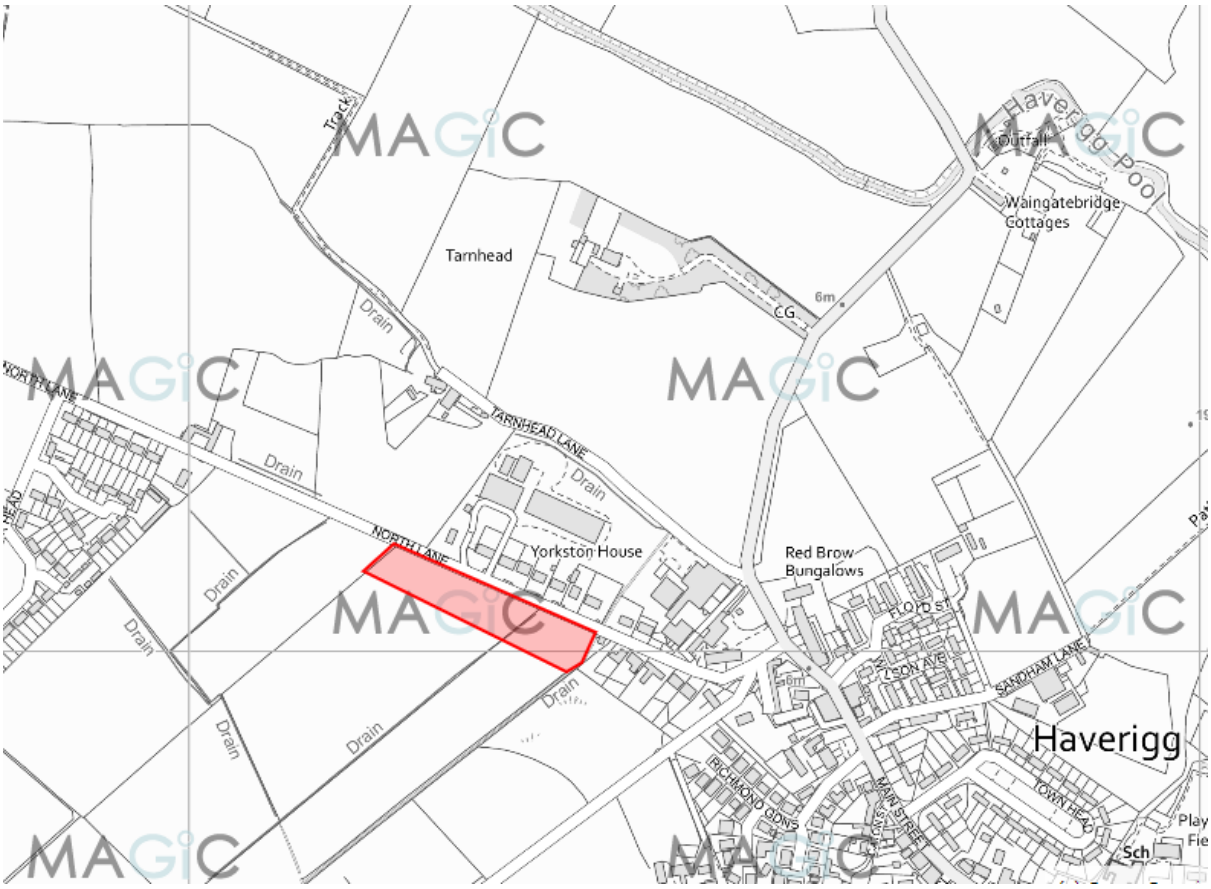
Sources of Flooding

As part of the risk assessment, consideration shall be given to the following sources of flooding and what effect these could have on the development:

Flooding from Rivers / Watercourses

There are a number of watercourses not by the Environment Agency as Main Rivers around the site. This includes the Stoup Dub Cut adjacent to the eastern boundary, and Haverigg Pool, approx 150m north of the site.

There are a number of other minor watercourses present which drain to the main rivers, some of which are identified on mapping, and it is considered that the developed / reclaimed nature of the ground around the site, these are man made.



Extract from DEFRA Magic Map

We consider that the drainage around the site including main rivers and minor watercourses are hydrologically connected to both the wider drainage network which shall be influenced by the coastal flooding, therefore, we consider the risk associated with flooding from rivers and watercourses to be **MODERATE to HIGH**.

Flooding from Reservoirs

Not applicable.

Flooding from the Sea

Not applicable.

Flooding from the Land

The area around the site is in part developed and areas around the site discharge to the engineered drainage around the site, therefore we consider the risk associated with flooding from the land to be **LOW**.

Flooding from Groundwater

The site has been developed over a number of years and any affect on groundwater would be negligible. Therefore, we consider the flood risk associated with groundwater to be LOW.

Flooding from Sewers

Sewers are located a significant distance from the site and therefore we consider that the flood risk to be LOW.

Summary

The following table indicates a summary of the risks and control measures required:

Source of Flooding	Risk	Control Measures
Rivers / Watercourses	Med / High	Mitigation measures regarding the construction of the facility
Reservoirs	n/a	
Sea	n/a	
Land	Low	As above
Groundwater	Low	As above
Sewers	Low	As above

Increase to Off Site Flooding

The proposed development in its nature is smaller in footprint than the historic structure present on the site. It is not proposed to enlarge this structure or modify the existing arrangements associated with the site to accommodate the new structure. It would be proposed therefore that the existing surface water runoff from the site would connect to the existing systems on the site and be no worse than existing.

Flood Risk Vulnerability

Assessment

The vulnerability of the proposed development is assessed in accordance with the Technical Guidance to the National Planning Policy Framework published by the Ministry of Housing, Communities and Local Government published on 27 March 2012 and updated on 19 February 2019.

The proposed development is for new dwellings and therefore classified as 'Minor Development'. From the NPPF, it considers that minor developments are unlikely to raise significant flood risk issues unless:

- They would have an adverse effect on a watercourse, floodplain or its flood defences;
- They would impede access to flood defence and management facilities, or;
- Where the cumulative impact of such developments would have a significant effect on local flood storage capacity or flood flows.

We consider that the proposed new dwellings would have no effect on the existing flood risk to the site and the wider area around the site.

Mitigation Measures

We consider that the development should consider the following mitigation measures associated with the management of the residual flood risk on the site.

- Flood resilience and resistance
- Emergency Access

Flood Resilience and Resistance

It would be anticipated that the detailed design of the proposed structure would include flood resilience and resistance measures. These may include :

- Management of potential pathways for water
- Raising of critical services and infrastructure
- Incorporation of suitable building materials and details.

Guidance published by CIRIA[1] should be adopted alongside the requirements to meet the Building Regulations associated with the adaption of the existing structure.

In addition, it is proposed that the floor levels of the new structure would be at 6.3m AOD, thus limiting the effect of water present within the building to approx 1.6m (based on the 1:200Y event incl calculated climate change).

Emergency Access

An emergency access plan should be adopted for the site and include the following procedures for the site.

- Roles and responsibilities
- Safe shut down of critical services
- Safe evacuation of the site for staff and visitors
- Process for site attendance post flood

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

Proposed Drainage Strategy

Surface Water

It is proposed that the surface water on the site is to be attenuated on each plot and released to the existing watercourses present on the site. Each plot shall restrict individual flows to a central surface water drain on the site and this will in turn discharge to the main drainage servicing the local area.

Soakways can be considered for each individual property but as the sites are limited in size, and its proposed that foul drainage soakaways are proposed for each plot, it would be impractical to achieve compliance with the Building Regulations and achieve two soakways within the rear gardens of the properties.

Surface Water Runoff Rates and Volumes

The surface water run off rates have been calculated using the Modified Rational Method and the IH124 Greenfield Runoff method. The rainfall catchment characteristics have been selected using tools available on UKSUDS.

In considering the requirements of the Cumbria County Council Design Guide[2], all surface water runoff should mimic the greenfield runoff rates for the development, the following table presents a summary of the sites, considering the site as two areas.

Area	Plots	Area [Ha}	Greenfield Runoff {l/sec]	Greenfield Volume [cuM]
Area A	6, 7 & 8	0.2952	0.90	53
Area B	1, 2, 3, 4 & 5	0.5162	1.5	93
		TOTAL	**2.40**	**146**

[2] https://cumbria.gov.uk/elibrary/Content/Internet/544/3887/43115144751.PDF

We have reviewed the surface water runoff rates from the site using UK SUDS, and the following table presents a summary of the peak flow rates from the site.

Sustainable Urban Drainage [SUDS]

The requirements for Sustainable Urban Drainage shall be include :

The following recommendations are considered appropriate for the site :

Rainwater Harvesting - Considered suitable for use on site from rooves. Harvested rainwater may be suitable for use in toilet flushing.

Permeable Paving - Suitable for parking areas, and would allow storage within the depth of the paving prior to discharge to the surface water system.

Sub Surface Storage - Suitable on site with appropriate management arrangements for maintenance.

Rooves

It is proposed that the rooves discharge to the surface water network installed on the site. Calculations for the roof areas of each plot entering the surface water network shall be calculated and used in a detailed model to be produced for the site.

All roof drainage and arrangements shall be constructed in accordance with the Building Regulations.

Parking and Paved Surfaces

It is proposed that paved surfaces on the site including parking areas, footways and roads shall have formal drainage present and discharge via the surface water network. An overall reduction in the areas of paved surfaces from the present areas of the site shall be achieved with incorporation of amenity areas on the site.

Gardens

It is proposed that amenity areas on the site shall be created including planting and landscaping.

These areas replace former areas of hardstanding or at locations of buildings. It is proposed that these areas will discharge naturally to the underlying ground conditions.

Foul Drainage

Due to the complex nature of the existing public sewers and achieving a connection to them at the end of North Lane, it is proposed that each property shall adopt its own packaged treatment plant and discharge via a soakaway to the rear of the properties.

Hydraulic Design

Foul Drainage

A preliminary scheme for the foul drainage at each plot has been performed considering a 4 bedroom property.

It would be proposed that the following be adopted for each plot.

Packaged Treatment Plant	Marsh Ensign 8P or similar
Soakaway Field Size	7m length - 600mm wide trench

Soakaway calculations are based on an average percolation value of 2.1 sec / mm obtained from percolation testing undertaken on the site. The percolation test results and calculations for the above field size are enclosed with this report.

The final position of the packaged plant and soakaway shall be in accordance with the requirements of the Building Regulations which include distances from habitable rooms, boundaries and distance between access and the tank.

Drawing 22-111 DWG001 indicates provisional locations for tanks and soakaways for each plot.

Surface Water Drainage

Principally the surface water drainage has been calculated on the impermeable areas of the development and it is proposed that outline modelling shall consider the two areas separately with individual design for each plot being undertaken once final plot design has been undertaken.

Modelling has been conducted on the following rainfall events:

- 1 in 10 years
- 1 in 30 years
- 1 in 100 years plus 40 % increase due to climate change over a 6 hour period

An assessment of the proposed network has been undertaken to identify the requirements of each property and requirements for the attenuation of water on each plot to ensure that runoff from the site does not exceed the limits of Qbar (approx 1 in 2 year rainfall event) based on the ratio of impermeable areas of each site and the overall area..

The following parameters were adopted in the analysis. These were obtained from UK SUDS based on the site location and data held by HR Wallingford.

Area A and B

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	10 year (l/s)	2.2
Summer CV	0.750	30 year (l/s)	3.0
Winter CV	0.840	100 year (l/s)	3.9
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year 360 minute (m³)	53

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0
30	0	0	0
100	40	0	0

The following rates and volumes have been calculated for the predevelopment discharge and volumes from the site.

Area A

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.99
Greenfield Method	IH124	Growth Factor 100 year	2.57
Positively Drained Area (ha)	0.295	Betterment (%)	0
SAAR (mm)	1048	QBar	0.9
Soil Index	2	Q 10 year (l/s)	1.3
SPR	0.30	Q 30 year (l/s)	1.7
Region	4	Q 100 year (l/s)	2.2
Growth Factor 10 year	1.49		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	0.295	Storm Duration (mins)	360
Soil Index	2	Betterment (%)	0
SPR	0.30	PR	0.329
CWI	125.120	Runoff Volume (m^3)	53

Area B

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.99
Greenfield Method	IH124	Growth Factor 100 year	2.57
Positively Drained Area (ha)	0.516	Betterment (%)	0
SAAR (mm)	1048	QBar	1.5
Soil Index	2	Q 10 year (l/s)	2.2
SPR	0.30	Q 30 year (l/s)	3.0
Region	4	Q 100 year (l/s)	3.9
Growth Factor 10 year	1.49		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	0.516	Storm Duration (mins)	360
Soil Index	2	Betterment (%)	0
SPR	0.30	PR	0.329
CWI	125.120	Runoff Volume (m^3)	93

Detailed Engineering

The detailed model presented in this report adopts the following engineering aspects specific to the areas of the site.

Area A

Impermeable Areas

The following table presents a summary of the plot areas and the ratio of each area to be used in the storage calculations.

Plot	House Area [sqM]	Uplift 40%	Total	% Ratio of Impermeable Areas
6	250	100	350	37%
7	225	90	315	33%
8	200	80	280	30%
		Total Area A	**945**	

Attenuation

A total attenuation of 72 cuM is required for Area A. In consideration of the above ratio, we have calculated the following attenuation and flow rates required on each plot to achieve a controlled greenfield runoff rate of 0.9 l/sec for Area A.

Plot	Attenuation [cuM]	Flow Rate [l/s]
6	26.7	0.333
7	23.76	0.297
8	21.6	0.27

Each plot shall attenuate individually and release via a hydrobrake to the main drainage servicing the site.

Area B

Impermeable Areas

The following table presents a summary of the plot areas and the ratio of each area to be used in the storage calculations.

Plot	House Area [sqM]	Uplift 40%	Total	% Ratio
1	250	100	350	21%
2	225	90	315	19%
3	225	90	315	19%
4	225	90	315	19%
5	270	108	378	23%
		Total Area B	**1673**	

Attenuation

A total attenuation of 110 cuM is required for Area B. In consideration of the above ratio, we have calculated the following attenuation and flow rates required on each plot to achieve a controlled greenfield runoff rate of 1.5 l/sec for Area A.

Plot	Attenuation [cuM]	Flow Rate [l/s]
1	23.1	0.315
2	21	0.285
3	21	0.285
4	21	0.285
5	25.3	0.345

Each plot shall attenuate individually and release via a hydrobrake to the main drainage servicing the site.

Maintenance of Drainage

Operation and Maintenance Requirements

As with all traditional drainage systems, SuDS need to be inspected and maintained regularly to ensure that they operate correctly and efficiently. If SuDS are not properly maintained then there is a risk that the systems will become overloaded during periods of prolonged heavy rainfall, potentially resulting in localised flooding of the development. Recommendations for the SuDS maintenance activities for the privately maintained areas are detailed below.

All maintenance activities should be detailed in the Health and Safety Plan and a risk assessment should be undertaken in accordance with CDM regulations.

Inlets, Outlets, Controls and Inspection Chambers

- Inlets and outlets structures may be surface structures or conveyance pipes with guards or headwalls. They must be free from obstruction at all times.
- SuDS flow control structures can be protected orifices, slots weirs or other controls at or near the surface to be accessible and easy to maintain. They may be in baskets, in small chambers or in the open.
- Inspection Chambers and rodding eyes are used on bends or where pipes come together and allow cleaning of the system if necessary. They should be designed out of the system where possible.

Inlets, Outlets, Controls and Inspection Chambers	Frequency
Regular Maintenance ● Inspect surface structures removing obstructions and silt as necessary. ● Check there is no physical damage. ● Strim vegetation 1m min. surround structures and keep hard aprons free from silt and debris. ● Remove cover and inspect ensuring water is flowing freely and that the exit route for water is unobstructed. ● Remove debris and silt. ● Undertake inspection after leaf fall in autumn	Monthly

Occasional Tasks Check topsoil levels are 20mm above edges of manholes and chambers to avoid mower damage	Annual
Remedial Works Monitor effectiveness of the system and advise / inspect / clean and test if water is standing in the system. This may require specialist cleaning.	As Required

Appendices

Percolation Test Results

PERCOLATION TESTS

Project : North Lane, Haverigg
Project No : 22-111
Test Date : 15/3/22
Weather : Damp following period of wet weather.

Equipment **Auger / Hand Dug**
250 mm

Hole No.	Test	Depth (mm)	Fill Time	TIME @ 75%	TIME @ 25%	Finish	TIME 75-25 (sec)	Volume m3	Area m2	Infiltration Rate m/sec	Percolation Rate (sec/mm)
1	1	**1250**					**1380**	**3.07E-02**	**5.40E-01**	**4.12E-05**	**2.2**
1	2	**1250**					**1020**	**3.07E-02**	**5.40E-01**	**5.57E-05**	**1.6**
1	3	**1250**					**1260**	**3.07E-02**	**5.40E-01**	**4.51E-05**	**2.0**
2	1	**1250**					**1250**	**3.07E-02**	**5.40E-01**	**4.55E-05**	**2.0**
2	2	**1250**					**1400**	**3.07E-02**	**5.40E-01**	**4.06E-05**	**2.2**
2	3	**1250**					**1350**	**3.07E-02**	**5.40E-01**	**4.21E-05**	**2.2**

Detailed Foul Water Calculations

SOAKAWAY SIZES - FOUL

Project : North Lane, Haverigg

Project No : 22-111

Date 15/3/22

Description Soakaway discharge for individual 4 Bed Units from packaged treatment plant

No of Properties :

Occupancy	Bedrooms	Occupancy	Volume (litres per day)
Typical Plot	4	8	1200
	TOTALS	**8**	**1200 litres**

Percolation Value (Secs/mm) **2.1 sec / mm**

Soakaway Area **4.2 m2**

SOAKAWAY LENGTH

with 300mm TRENCH	14 metres
with 600mm TRENCH	7 metres
with 900mm TRENCH	5 metres

Detailed Surface Water Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	40	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	17.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	0.650
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
6	0.035	4.00	100.000	450	361.100	435.350	0.800
7	0.032	4.00	100.000	450	377.080	427.740	1.021
8	0.028	4.00	100.000	450	391.013	421.540	1.212
OUTFALL_A			100.000	1200	404.230	413.800	1.403
1	0.035	4.00	101.000	450	245.370	484.300	0.750
2	0.032	4.00	101.000	450	270.930	472.900	1.271
3	0.032	4.00	100.500	450	290.870	464.000	1.063
4	0.032	4.00	100.500	450	309.880	455.500	1.186
5	0.038	4.00	100.000	450	327.600	447.600	0.875
OUTFALL_B			100.000	1200	333.600	444.900	0.914

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
2.000	6	7	17.700	0.600	99.200	98.979	0.221	80.0	150	4.26	50.0
2.001	7	8	15.250	0.600	98.979	98.788	0.191	80.0	150	4.49	50.0
2.002	8	OUTFALL_A	15.317	0.600	98.788	98.597	0.191	80.0	150	4.72	50.0
1.000	1	2	27.987	0.600	100.250	99.779	0.471	59.4	100	4.47	50.0
1.001	2	3	21.836	0.600	99.729	99.512	0.217	100.6	150	4.83	50.0
1.002	3	4	20.824	0.600	99.437	99.314	0.123	169.3	225	5.18	50.0
1.003	4	5	19.401	0.600	99.314	99.125	0.189	102.7	225	5.43	50.0
1.004	5	OUTFALL_B	6.580	0.600	99.125	99.086	0.039	168.7	225	5.54	50.0

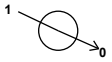
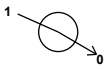
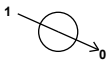
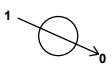
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
2.000	1.125	19.9	6.6	0.650	0.871	0.035	0.0	59	1.012
2.001	1.125	19.9	12.7	0.871	1.062	0.067	0.0	87	1.191
2.002	1.125	19.9	18.0	1.062	1.253	0.095	0.0	112	1.271
1.000	1.001	7.9	6.6	0.650	1.121	0.035	0.0	71	1.122
1.001	1.001	17.7	12.7	1.121	0.838	0.067	0.0	94	1.087
1.002	1.002	39.8	18.8	0.838	0.961	0.099	0.0	109	0.987
1.003	1.290	51.3	24.9	0.961	0.650	0.131	0.0	110	1.280
1.004	1.004	39.9	32.1	0.650	0.689	0.169	0.0	153	1.113

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
2.000	17.700	80.0	150	Circular	100.000	99.200	0.650	100.000	98.979	0.871
2.001	15.250	80.0	150	Circular	100.000	98.979	0.871	100.000	98.788	1.062
2.002	15.317	80.0	150	Circular	100.000	98.788	1.062	100.000	98.597	1.253
1.000	27.987	59.4	100	Circular	101.000	100.250	0.650	101.000	99.779	1.121
1.001	21.836	100.6	150	Circular	101.000	99.729	1.121	100.500	99.512	0.838
1.002	20.824	169.3	225	Circular	100.500	99.437	0.838	100.500	99.314	0.961
1.003	19.401	102.7	225	Circular	100.500	99.314	0.961	100.000	99.125	0.650
1.004	6.580	168.7	225	Circular	100.000	99.125	0.650	100.000	99.086	0.689

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
2.000	6	450	Manhole	Adoptable	7	450	Manhole	Adoptable
2.001	7	450	Manhole	Adoptable	8	450	Manhole	Adoptable
2.002	8	450	Manhole	Adoptable	OUTFALL_A	1200	Manhole	Adoptable
1.000	1	450	Manhole	Adoptable	2	450	Manhole	Adoptable
1.001	2	450	Manhole	Adoptable	3	450	Manhole	Adoptable
1.002	3	450	Manhole	Adoptable	4	450	Manhole	Adoptable
1.003	4	450	Manhole	Adoptable	5	450	Manhole	Adoptable
1.004	5	450	Manhole	Adoptable	OUTFALL_B	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
6	361.100	435.350	100.000	0.800	450	 0	2.000	99.200	150
7	377.080	427.740	100.000	1.021	450	1  0	2.000 2.001	98.979 98.979	150 150
8	391.013	421.540	100.000	1.212	450	1  0	2.001 2.002	98.788 98.788	150 150
OUTFALL_A	404.230	413.800	100.000	1.403	1200	1 	2.002	98.597	150
1	245.370	484.300	101.000	0.750	450	 0	1.000	100.250	100
2	270.930	472.900	101.000	1.271	450	1  0	1.000 1.001	99.779 99.729	100 150
3	290.870	464.000	100.500	1.063	450	1  0	1.001 1.002	99.512 99.437	150 225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
4	309.880	455.500	100.500	1.186	450	1	1.002	99.314	225
						0	1.003	99.314	225
5	327.600	447.600	100.000	0.875	450	1	1.003	99.125	225
						0	1.004	99.125	225
OUTFALL_B	333.600	444.900	100.000	0.914	1200	1	1.004	99.086	225

Simulation Settings

Rainfall Methodology	FSR	Drain Down Time (mins)	240
FSR Region	England and Wales	Additional Storage (m³/ha)	0.0
M5-60 (mm)	17.000	Check Discharge Rate(s)	✓
Ratio-R	0.400	10 year (l/s)	1.3
Summer CV	0.750	30 year (l/s)	1.7
Winter CV	0.840	100 year (l/s)	2.2
Analysis Speed	Normal	Check Discharge Volume	✓
Skip Steady State	x	100 year 360 minute (m³)	53

Storm Durations

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

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0
30	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.99
Greenfield Method	IH124	Growth Factor 100 year	2.57
Positively Drained Area (ha)	0.295	Betterment (%)	0
SAAR (mm)	1048	QBar	0.9
Soil Index	2	Q 10 year (l/s)	1.3
SPR	0.30	Q 30 year (l/s)	1.7
Region	4	Q 100 year (l/s)	2.2
Growth Factor 10 year	1.49		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	0.295	Storm Duration (mins)	360
Soil Index	2	Betterment (%)	0
SPR	0.30	PR	0.329
CWI	125.120	Runoff Volume (m³)	53

Node OUTFALL_A Online Head/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 98.597

Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
0.010	0.900	1.200	0.900

Node OUTFALL_B Online Head/Flow Control

Flap Valve x | Replaces Downstream Link ✓ | Invert Level (m) 99.086

Head (m)	Flow (l/s)	Head (m)	Flow (l/s)
0.010	1.500	0.900	1.500

Node OUTFALL_A Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	98.597	Depth (m)	1.200
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Inf Depth (m)	
Safety Factor	1.0	Pit Width (m)	12.000	Number Required	1
Porosity	1.00	Pit Length (m)	5.000		

Node OUTFALL_B Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	99.086	Depth (m)	0.900
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)		Inf Depth (m)	
Safety Factor	1.0	Pit Width (m)	20.000	Number Required	1
Porosity	1.00	Pit Length (m)	6.000		

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Approval Settings

Node Size	✓	Minimum Full Bore Velocity (m/s)	
Node Losses	✓	Maximum Full Bore Velocity (m/s)	3.000
Link Size	✓	Proportional Velocity	✓
Minimum Diameter (mm)	150	Return Period (years)	
Link Length	✓	Minimum Proportional Velocity (m/s)	0.750
Maximum Length (m)	100.000	Maximum Proportional Velocity (m/s)	3.000
Coordinates	✓	Surcharged Depth	✓
Accuracy (m)	1.000	Return Period (years)	
Crossings	✓	Maximum Surcharged Depth (m)	0.100
Cover Depth	✓	Flooding	✓
Minimum Cover Depth (m)		Return Period (years)	30
Maximum Cover Depth (m)	3.000	Time to Half Empty	x
Backdrops	✓	Discharge Rates	✓
Minimum Backdrop Height (m)		Discharge Volume	✓
Maximum Backdrop Height (m)	1.500	100 year 360 minute (m^3)	
Full Bore Velocity	✓		

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
10 year 15 minute summer	179.310	50.739	30 year 360 minute summer	26.939	6.932
10 year 15 minute winter	125.832	50.739	30 year 360 minute winter	17.511	6.932
10 year 30 minute summer	115.897	32.795	30 year 480 minute summer	20.981	5.545
10 year 30 minute winter	81.331	32.795	30 year 480 minute winter	13.940	5.545
10 year 60 minute summer	77.042	20.360	30 year 600 minute summer	17.039	4.661
10 year 60 minute winter	51.185	20.360	30 year 600 minute winter	11.642	4.661
10 year 120 minute summer	46.688	12.338	30 year 720 minute summer	15.093	4.045
10 year 120 minute winter	31.019	12.338	30 year 720 minute winter	10.143	4.045
10 year 180 minute summer	35.513	9.139	30 year 960 minute summer	12.278	3.233
10 year 180 minute winter	23.084	9.139	30 year 960 minute winter	8.133	3.233
10 year 240 minute summer	27.879	7.368	30 year 1440 minute summer	8.788	2.355
10 year 240 minute winter	18.522	7.368	30 year 1440 minute winter	5.906	2.355
10 year 360 minute summer	21.070	5.422	100 year +40% CC 15 minute summer	408.473	115.584
10 year 360 minute winter	13.696	5.422	100 year +40% CC 15 minute winter	286.647	115.584
10 year 480 minute summer	16.473	4.353	100 year +40% CC 30 minute summer	268.775	76.054
10 year 480 minute winter	10.944	4.353	100 year +40% CC 30 minute winter	188.614	76.054
10 year 600 minute summer	13.418	3.670	100 year +40% CC 60 minute summer	180.954	47.821
10 year 600 minute winter	9.168	3.670	100 year +40% CC 60 minute winter	120.222	47.821
10 year 720 minute summer	11.912	3.193	100 year +40% CC 120 minute summer	110.370	29.168
10 year 720 minute winter	8.006	3.193	100 year +40% CC 120 minute winter	73.327	29.168
10 year 960 minute summer	9.726	2.561	100 year +40% CC 180 minute summer	83.953	21.604
10 year 960 minute winter	6.442	2.561	100 year +40% CC 180 minute winter	54.572	21.604
10 year 1440 minute summer	6.999	1.876	100 year +40% CC 240 minute summer	65.765	17.380
10 year 1440 minute winter	4.704	1.876	100 year +40% CC 240 minute winter	43.693	17.380
30 year 15 minute summer	226.195	64.005	100 year +40% CC 360 minute summer	49.370	12.705
30 year 15 minute winter	158.733	64.005	100 year +40% CC 360 minute winter	32.092	12.705
30 year 30 minute summer	147.452	41.724	100 year +40% CC 480 minute summer	38.291	10.119
30 year 30 minute winter	103.475	41.724	100 year +40% CC 480 minute winter	25.439	10.119
30 year 60 minute summer	98.615	26.061	100 year +40% CC 600 minute summer	30.992	8.477
30 year 60 minute winter	65.517	26.061	100 year +40% CC 600 minute winter	21.176	8.477
30 year 120 minute summer	59.946	15.842	100 year +40% CC 720 minute summer	27.387	7.340
30 year 120 minute winter	39.827	15.842	100 year +40% CC 720 minute winter	18.406	7.340
30 year 180 minute summer	45.598	11.734	100 year +40% CC 960 minute summer	22.191	5.844
30 year 180 minute winter	29.640	11.734	100 year +40% CC 960 minute winter	14.700	5.844
30 year 240 minute summer	35.759	9.450	100 year +40% CC 1440 minute summer	15.789	4.232
30 year 240 minute winter	23.758	9.450	100 year +40% CC 1440 minute winter	10.611	4.232

Results for 10 year Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	6	10	99.268	0.068	8.5	0.0109	0.0000	OK
15 minute summer	7	11	99.137	0.158	16.3	0.0251	0.0000	SURCHARGED
15 minute summer	8	10	99.011	0.223	21.1	0.0354	0.0000	SURCHARGED
120 minute winter	OUTFALL_A	116	98.820	0.223	6.8	13.6365	0.0000	OK
15 minute winter	1	10	100.345	0.095	8.5	0.0151	0.0000	OK
15 minute winter	2	10	99.847	0.118	16.0	0.0187	0.0000	OK
15 minute winter	3	10	99.569	0.132	23.7	0.0210	0.0000	OK
15 minute winter	4	7	99.449	0.135	31.4	0.0215	0.0000	OK
15 minute winter	5	7	99.418	0.293	40.3	0.0466	0.0000	SURCHARGED
120 minute winter	OUTFALL_B	118	99.289	0.203	12.1	24.6480	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	6	2.000	7	8.5	0.804	0.428	0.2246	
15 minute summer	7	2.001	8	15.1	0.873	0.759	0.2685	
15 minute summer	8	2.002	OUTFALL_A	21.4	1.656	1.076	0.2301	
120 minute winter	OUTFALL_A	Head/Flow		0.9				18.7
15 minute winter	1	1.000	2	8.2	1.111	1.038	0.2112	
15 minute winter	2	1.001	3	15.9	1.104	0.896	0.3135	
15 minute winter	3	1.002	4	23.6	0.963	0.592	0.5108	
15 minute winter	4	1.003	5	31.0	1.071	0.604	0.6278	
15 minute winter	5	1.004	OUTFALL_B	40.5	1.905	1.015	0.1474	
120 minute winter	OUTFALL_B	Head/Flow		1.5				31.0

Results for 30 year Critical Storm Duration. Lowest mass balance: 99.24%

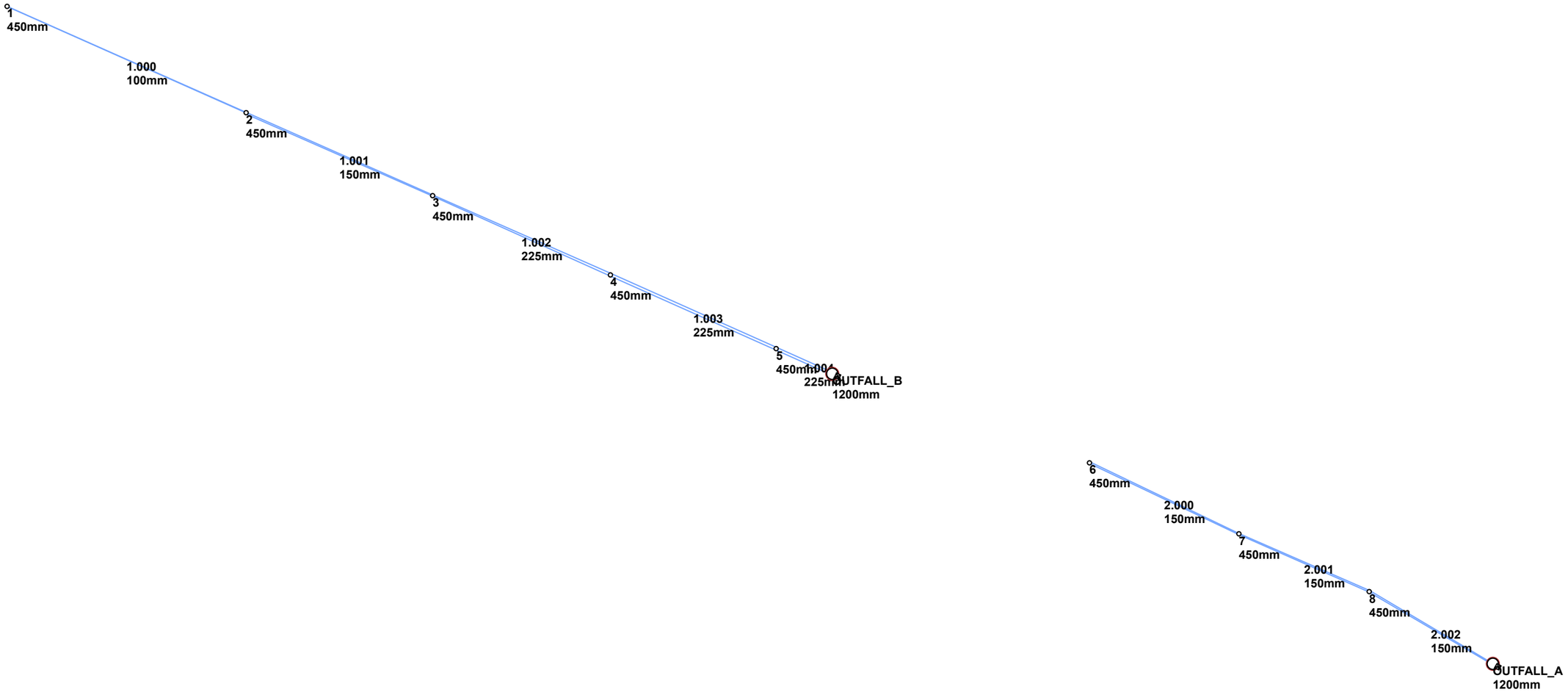
Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	6	11	99.391	0.191	10.8	0.0304	0.0000	SURCHARGED
15 minute winter	7	11	99.329	0.350	20.3	0.0557	0.0000	SURCHARGED
15 minute winter	8	11	99.131	0.343	25.7	0.0546	0.0000	SURCHARGED
120 minute winter	OUTFALL_A	118	98.905	0.308	8.8	18.8486	0.0000	OK
15 minute winter	1	11	100.594	0.344	10.8	0.0547	0.0000	SURCHARGED
15 minute winter	2	11	99.880	0.151	18.8	0.0240	0.0000	SURCHARGED
15 minute winter	3	10	99.586	0.149	28.0	0.0237	0.0000	OK
15 minute winter	4	10	99.469	0.155	37.8	0.0246	0.0000	OK
15 minute winter	5	6	99.426	0.301	49.2	0.0478	0.0000	SURCHARGED
180 minute winter	OUTFALL_B	172	99.369	0.283	11.4	34.2611	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	6	2.000	7	10.4	0.818	0.523	0.3116	
15 minute winter	7	2.001	8	18.1	1.031	0.913	0.2685	
15 minute winter	8	2.002	OUTFALL_A	25.8	1.670	1.298	0.2697	
120 minute winter	OUTFALL_A	Head/Flow		0.9				18.8
15 minute winter	1	1.000	2	9.2	1.177	1.171	0.2190	
15 minute winter	2	1.001	3	18.1	1.120	1.025	0.3614	
15 minute winter	3	1.002	4	27.9	0.981	0.702	0.5948	
15 minute winter	4	1.003	5	37.6	1.117	0.732	0.6597	
15 minute winter	5	1.004	OUTFALL_B	49.4	1.955	1.239	0.1854	
180 minute winter	OUTFALL_B	Head/Flow		1.5				36.2

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.24%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	6	10	100.000	0.800	19.5	0.1272	1.3321	FLOOD
15 minute winter	7	10	99.977	0.998	30.4	0.1587	0.0000	FLOOD RISK
15 minute winter	8	10	99.633	0.845	39.7	0.1344	0.0000	SURCHARGED
240 minute winter	OUTFALL_A	236	99.278	0.681	9.6	41.6341	0.0000	OK
15 minute winter	1	9	101.000	0.750	19.5	0.1193	2.0725	FLOOD
15 minute winter	2	10	100.487	0.758	26.6	0.1206	0.0000	SURCHARGED
15 minute winter	3	10	100.005	0.568	41.9	0.0903	0.0000	SURCHARGED
15 minute winter	4	10	99.840	0.526	58.8	0.0837	0.0000	SURCHARGED
240 minute winter	5	236	99.709	0.584	16.7	0.0929	0.0000	FLOOD RISK
240 minute winter	OUTFALL_B	236	99.709	0.623	16.5	75.4842	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	6	2.000	7	12.6	0.807	0.634	0.3116	
15 minute winter	7	2.001	8	24.1	1.372	1.215	0.2685	
15 minute winter	8	2.002	OUTFALL_A	39.4	2.242	1.984	0.2697	
240 minute winter	OUTFALL_A	Head/Flow		0.9				25.1
15 minute winter	1	1.000	2	10.3	1.313	1.306	0.2190	
15 minute winter	2	1.001	3	24.5	1.394	1.386	0.3844	
15 minute winter	3	1.002	4	41.2	1.035	1.034	0.8282	
15 minute winter	4	1.003	5	58.2	1.464	1.135	0.7716	
240 minute winter	5	1.004	OUTFALL_B	16.5	0.992	0.413	0.2617	
240 minute winter	OUTFALL_B	Head/Flow		1.5				41.8



Drawings

Brookfield

Stable Hill

NORTH LANE

PERC TEST 1

PERC TEST 2

01 02 03 04 05 06 07 08

AREA B
0.5162 HA

SURFACE WATER
MAIN DRAINAGE

OUTFALL B

TYPICAL FOUL PTP
AND SOAKAWAY

AREA A
0.2952 HA

SURFACE WATER
MAIN DRAINAGE

OUTFALL A

Stroup Dub Cut

OVERALL SITE PLAN
SCALE 1:500

ENGINEER

KINGMOOR CONSULTING

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CLIENT

PROJECT
PROPOSED RESIDENTIAL DEVELOPMENT
NORTH LANE, HAVERIGG, LA18 4LX

TITLE
OVERALL DRAINAGE PLAN

SCALE	STATUS	
1:500	FOR PLANNING APPLICATION	
PAPER SIZE	DRAWN BY	CHECKED AND APPROVED
A1	C AIMERS	C AIMERS
PROJECT PHASE	DATE	DATE
PLANNING	MAR 2022	MAR 2022

DRAWING NUMBER
22-111-DWG001

REVISION
A