



Drainage Strategy Report

Proposed housing development at
Accrington Road,
Whalley

on behalf of



Document Reference	CN 21315
Version	P09
Date Released	29th July 2026
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1 Introduction

1.1 Project Background

M & P Gadsden Consulting Engineers have been appointed by Oakmere Homes to undertake a Flood Risk Assessment in support of a full planning application for 17no family homes and 57no apartments at Accrington Road, Whalley, Lancashire.

The site will be accessed from two new junctions created on Accrington Road. One will be used to access 8 apartments and the other junction will give access to the remainder of the site. The new dwellings will be served by a mixture of tarmac and block paved highways. The site was previously used for agricultural purposes and there are no existing above ground structures on site.

The site currently has an extant planning approval (ref: 3/2012/0179) for 37 bungalows and 40 retirement apartments.

The purpose of this report is to discuss the proposed drainage strategy.

1.2 Surface Water Strategy

Current guidance commonly used for new development is the Local Authority SuDS Officer Organisation's (LASOO) "Non-statutory Technical Standards for Sustainable Drainage". This document is a best practice guidance document and covers the full spectrum of surface water drainage design from planning requirements, design criteria, flood risk and maintenance during the systems life.

The surface water drainage strategy for this site follows this guidance document wherever possible.

2 Existing Development Site

2.1 Site Characteristics

The site is located on the outskirts of Whalley and is currently vacant. To the north and west of the site are residential property, with agricultural land to the east. The River Calder borders the site to the south. The site is currently accessed off Accrington Road.

2.2 Existing Drainage Arrangements for the Site

There is currently no formal drainage network on most of the site itself.

United Utilities sewer records indicate that there are no existing sewers in Accrington Road to the north of the site. Further north along The Cloisters, there are both foul (150mm vitrified clay) and surface water (450mm concrete) sewers running from east to west. The foul then discharges into a combined sewer on Sydney Avenue.

The United Utilities sewer records can be seen in Appendix B.

2.3 Topography

The site is roughly square in shape and covers an area of approximately 2.87ha. The levels on site fall steeply from the north east corner to close to the middle of the site and then gently from east to west from that point. The high point of the site is at the north eastern corner at approximately 59.00m AOD and the low point is on the western boundary at 45.50m AOD.

The existing topographical survey can be viewed in Appendix A.

2.4 Hydrology

The River Calder runs from east to west directly to the south of the site. This forms part of the Ribble Catchment. The River Calder then discharges into the River Ribble further downstream. This river is classed as a main river and is the responsibility of the Environment Agency.

Mill Race watercourse is located approximately 85m to the west of the south western corner of the site. This runs from the River Calder upstream of Whalley Weir, through the Calder Vale area, and re-enters the River Calder again further downstream.

There is also an unnamed watercourse that runs from north to south along the eastern boundary of the site. The watercourse is culverted and discharges into the River Calder.

2.5 Contamination and Geology

Preliminary geological information has been sourced from bEk Enviro Preliminary Risk Assessment (Report Ref BEK-19545-1 April 2019) and the British Geological Survey website. A summary of this information is as follows:-

- Made Ground – no records of made ground on-site.
- Superficial geology – Glacio-fluvial deposits (sand & gravel), alluvium (clay, silt, sand & gravel) and Glacial Till (Boulder Clay).
- Bedrock – Bowland Shale formation in the north western corner of the site and the Pendle Grit Member in the south-east of the site.

3 Flood Risk Assessment

A Flood Risk Assessment was undertaken by JBA Consulting dated September 2022. The FRA states the following with regards to flooding:

- Fluvial: the site lies partially within Flood Zone 3 according to FMfP, however, updated modelling suggests that approximately 70% of the site is located Flood Zone 2 is a more appropriate classification (Medium Probability – land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding). The remainder of the site is within Flood Zone 1. The River Calder is shown to be the main risk of fluvial flooding according to hydraulic modelling
- Fluvial with climate change: with an allowance for climate change (+36% peak river flow), the predicted flood extent affects approximately 40% of the {} site (prior to proposed ground level changes);
- Surface water: Very low risk across the majority of the site. There is a localised area of low-high risk on the western boundary of the site which coincides with a topographic 'low'
- Reservoir breach: in the unlikely event that a breach of an upstream reservoir was to occur, the site could be at risk from reservoir flooding
- Groundwater: the results/observations reported following a ground investigation in 2019 suggest that the likelihood of groundwater emergence at the surface is low

4 Proposed Development & Future Flood Risk

4.1 Run Off Destination

Planning Policy guidance suggests the following hierarchy for surface water discharge: -

1. Into the ground (Infiltration)
2. To a surface water body;
3. To a surface water sewer;
4. To a combined sewer.

4.2 Runoff Assessment

The runoff rates have been calculated for the site for the pre-development and post development conditions at greenfield run off rate. The calculations have been undertaken for the 1 year, 30-year, 100 year and 100 year plus climate change events, which are based on the mean annual flood flow rate, QBAR (2.33-year event).

The total site area of the development is 2.90ha. Therefore, the site is less than 200ha and the greenfield calculations have been undertaken in accordance with methodology described in IoH 124 [11]. For catchments of less than 50ha the run-off rate is scaled according to the size of the catchment in relation to a 50ha site. As identified by reference to GEO Environmental Engineering PRA and BGS data, the site is expected to be underlain by low permeability clay. The soil index value has been estimated to reflect the expected in-situ ground conditions.

The runoff rate has been calculated using the area being proposed for development. Calculations can be seen in Appendix C and a summary of the results is included in Table 1 below:

Table 1 – Greenfield Runoff Rate Assessment

	<u>Runoff Calculations - Pre-Development</u>					
	Area (ha)	Qbar (l/s)	1year (l/s)	30year (l/s)	100year (l/s)	100year + cc (l/s)
Greenfield Pre-Development	1.80	15.36	13.36	26.11	31.95	47.93
Total	1.80	15.36	13.36	26.11	31.95	47.93

The post development runoff rates will be restricted to 1 year rate for the same return period and QBar for return periods up to 100 year plus 50% climate change with a 10% allowance for urban creep and a 35% allowance for the remaining greenfield areas. These measures will reduce flood risk downstream as the existing greenfield runoff rate will be matched for the 1 year event and Qbar will be matched for events up to the designed return period. This will provide an improvement for return periods above the 1 year event.

4.3 Proposed Scheme

It has been assumed that infiltration drainage is not suitable on this site as it is underlain by impermeable strata. The surface water from the development will be discharged into the River Calder. The discharge will be restricted to greenfield runoff rates.

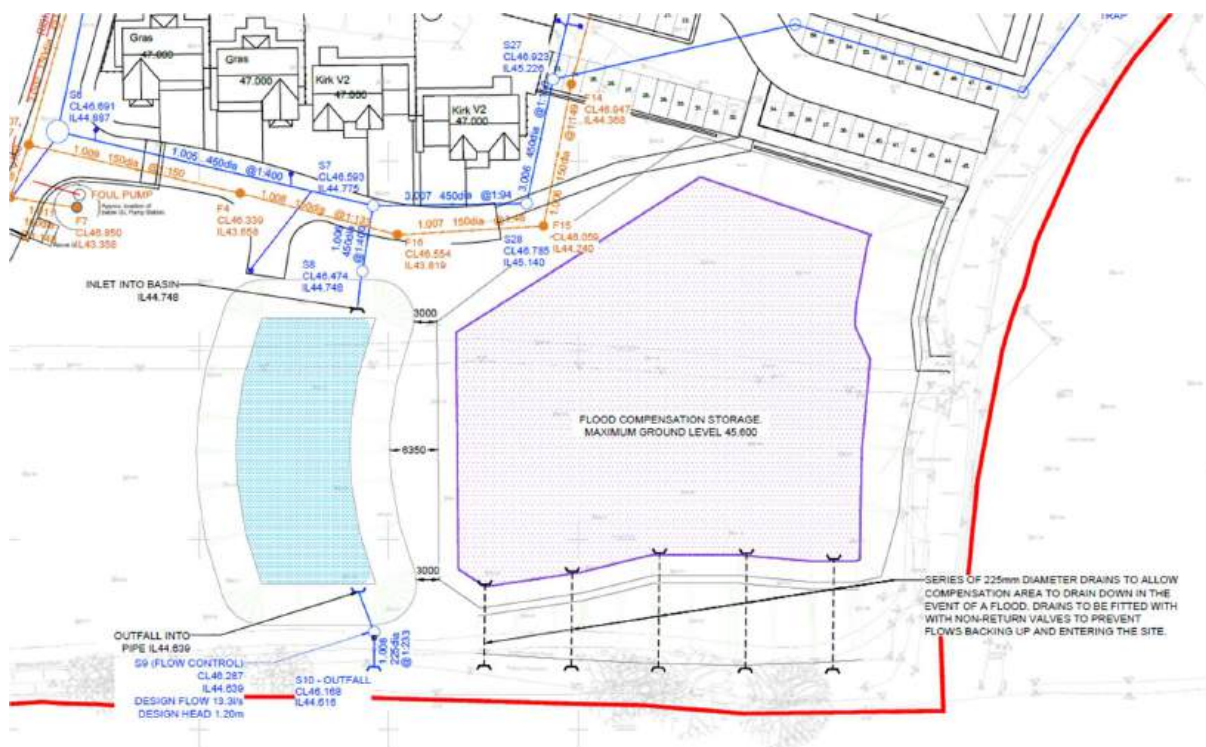
As part of the site falls within a functional floodplain, compensatory storage will be provided for the land raising within the 100 year + climate change allowance.

JBA Consulting modelled the compensatory storage with the information included in their report – Accrington Road, Whalley - FRA (Ref: OAKMERE-JBAU-XX-XX-RP-0002-S3-P06) dated December 2022. It states: *The proposed development causes no additional flood risk to other properties in the area. A sample of locations in adjacent residential areas were selected and comparisons were made for peak water levels before and after the proposed development. All locations showed either no change or reduced water levels following the proposed development.*

Modelled flood levels and flows for locations within watercourses downstream of the development site. The locations include downstream of Whalley Weir, Whalley Bridge and within the Mill Race near Calder Vale. There is no difference in water level between the existing/baseline and proposed development scenarios in the 1%AEP event plus 36% for climate change. The flows in the proposed scenario showed minor differences compared to the baseline but were within +/-0.1m³/s and do not affect flood levels, so flood risk remains unchanged.

The area for flood compensatory storage can be seen in the figure below (in purple), with the maximum ground level in this area being 45.600m AOD.

Figure 2 – Flood Compensatory Storage



The highways have been designed to follow the existing topography of the land where possible. All highway runoff will be collected by gullies and enter a piped network. Driveway runoff will be collected by aco (or similar) channel drains and enter a piped network.

The site will drain via a traditional gravity fed piped network with the flow restricted to the existing greenfield rate. The flow will be restricted via a Hydrobrake flow control unit and the storm water will be attenuated in the piped network and an attenuation basin. This basin has been designed for a 100 year return period + 50% climate change, a 10% allowance for urban creep and a 35% allowance for the remaining greenfield areas.

In addition to the SuDS treatments highlighted previously, back inlet gullies and silt trap manholes will also be provided to remove sediment/silt and therefore assisting with cleaning the water.

The foul drainage system will be a traditional gravity piped network to a low point to the east of the site, where there will be a pumping station that will pump the foul drainage to ultimately discharge into the existing combined sewer on Sydney Avenue.

The drainage design can be seen in Appendix D.

4.4 Future Flood Risk & Exceedance Routes

Flood risk to the new dwellings will be low. All finished floor levels will be lifted out of flood zone 3. In addition, all drainage attenuation features will be designed to a return period of 100 years plus 50% climate change, a 10% allowance for urban creep and a 35% allowance for the remaining greenfield areas.

A rill will be constructed along the western boundary of the site to protect the existing properties from any runoff from the raised levels within the application site. This will also protect the new properties from the existing surface water flood risk along that area.

A filter drain with a perforated pipe underneath will be installed along the bottom of the embankment to the north eastern and eastern boundary to protect the new properties from any overland flows from above. This drain will then connect into the main system on-site.

If a storm were to occur that is larger than the designed return period, flooding would first occur at the flow control manholes. Exceedance routes will need to be provided in order to guide the excess surface water away from new and existing property towards the River Calder.

4.5 Future Management

The developer will establish a management company that will be responsible for the maintenance and upkeep of the highways, attenuation basin and surface water drainage system. During the construction phase, the upkeep of the items listed will be the responsibility of the developer until they are formally handed over. See Appendix E for the management company maintenance pack and Appendix F for an example of a SuDS inspection checklist. The management company will also be responsible for the maintenance of the compensatory storage areas, see Appendix H for the maintenance plan.

A Section 104 agreement will be entered into with United Utilities for the adoption of the main foul drainage for the site.

Maintenance of driveways and roof water drainage will be the sole responsibility of the homeowners. A householder sustainable drainage maintenance plan will be included within the sales pack for each property making the homeowners aware of their responsibilities relating to surface water (see Appendix G).

5 Summary

This report provides a detailed strategy for the management of surface water from the proposed housing development at Accrington Road, Whalley. The strategy accounts for the following restrictions, measures and improvements:-

- Updated modelling suggests the site to be in flood zone 2 with the River Calder being the main risk to fluvial flooding
- Very low risk of surface water flooding for the majority of the site, with localised low-high risk
- In the unlikely event that a breach of an upstream reservoir was to occur, the site could be at risk from reservoir flooding
- Groundwater flooding is deemed to be a low risk
- Attenuation will be provided in the form of an attenuation basin.
- All attenuation features have been designed to attenuate flows up to the 100 year +50% climate change rainfall event with a 10% allowance for urban creep and a 35% allowance for the remaining greenfield areas.
- The proposed development run off rates will match or better the existing greenfield run off rates for all return periods, reducing flood risk.
- The proposed development run off rates are restricted to Qbar for all return periods.
- A flood compensatory storage area will be provided, this will be maintained by the management company.
- The highway will remain private and maintained by a management company.
- Surface water drainage will remain private and maintained by a management company.
- The main foul drainage and pumping station will be put up for adoption with United Utilities under a S104 agreement.
- Individual plot drainage will be maintained by the homeowners.

Appendix A



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Survey Operations Limited.

Note:

Orientation to Existing Site Grid.
All levels relate to Existing Site Datum.

Survey Control Markers established for
Mapping purposes only and should not be
used for Construction without the written
approval of Survey Operations Ltd.

SURVEY STATIONS			
Name	Easting	Northing	Height
S01	373450.89	435985.71	45.22
S02	373412.87	436005.20	45.37
S03	373455.74	436004.62	45.21
S04	373408.51	436006.30	45.29
S05	373423.87	435995.37	45.87
S06	373423.87	435995.37	45.87
S07	373521.80	435936.40	45.84
S08	373423.87	435935.22	46.50
S09	373454.24	436004.36	45.34

STANDARD REFERENCE & ABBREVIATIONS

ABT	Asbestos Waste	CL	Claret Level
AB	Asbestos	CP	Cable Pipe
AD	Asphalt	DB	Down Drain
AE	Asphalt	LE	Latrine Box
AF	Asphalt	LP	Lamp Post
AG	Asphalt	MB	Motor Bus
AI	Asphalt	MD	Motor Drive
AL	Asphalt	ME	Motor Engine
AM	Asphalt	MF	Motor Fuel
AN	Asphalt	MG	Motor Gas
AO	Asphalt	MH	Motor House
AP	Asphalt	MI	Motor Inlet
AQ	Asphalt	ML	Motor Level
AR	Asphalt	MR	Motor Road
AS	Asphalt	MS	Motor Sign
AT	Asphalt	MT	Motor Tank
AV	Asphalt	MU	Motor Unit
AW	Asphalt	MX	Motor X
AX	Asphalt	MY	Motor Y
AY	Asphalt	MZ	Motor Z
AZ	Asphalt	NA	North Arrow
BA	Asphalt	NB	North Boundary
BB	Asphalt	NC	North Corner
BC	Asphalt	ND	North Drain
BD	Asphalt	NE	North Edge
BE	Asphalt	NF	North Face
BF	Asphalt	NG	North Gate
BG	Asphalt	NH	North Hill
BH	Asphalt	NI	North Inlet
BI	Asphalt	NJ	North Junction
BJ	Asphalt	NK	North K
BK	Asphalt	NL	North Level
BL	Asphalt	NM	North Map
BM	Asphalt	NO	North Note
BN	Asphalt	NP	North Point
BO	Asphalt	NQ	North Quarter
BP	Asphalt	NR	North Road
BQ	Asphalt	NS	North Sign
BR	Asphalt	NT	North Tank
BS	Asphalt	NU	North Unit
BT	Asphalt	NV	North V
BU	Asphalt	NW	North W
BV	Asphalt	NX	North X
BW	Asphalt	NY	North Y
BX	Asphalt	NZ	North Z
BY	Asphalt	OA	Other Area
BZ	Asphalt	OB	Other Boundary
CA	Asphalt	OC	Other Corner
CB	Asphalt	OD	Other Drain
CC	Asphalt	OE	Other Edge
CD	Asphalt	OF	Other Face
CE	Asphalt	OG	Other Gate
CF	Asphalt	OH	Other Hill
CG	Asphalt	OI	Other Inlet
CH	Asphalt	OJ	Other Junction
CI	Asphalt	OK	Other K
CJ	Asphalt	OL	Other Level
CK	Asphalt	OM	Other Map
CL	Asphalt	ON	Other Note
CM	Asphalt	OO	Other Object
CN	Asphalt	OP	Other Point
CO	Asphalt	OQ	Other Quarter
CP	Asphalt	OR	Other Road
CQ	Asphalt	OS	Other Sign
CR	Asphalt	OT	Other Tank
CS	Asphalt	OU	Other Unit
CT	Asphalt	OV	Other V
CU	Asphalt	OW	Other W
CV	Asphalt	OX	Other X
CU	Asphalt	OY	Other Y
CO	Asphalt	OZ	Other Z

Survey OPERATIONS

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Client
Oakmere Hobes

Drawing Title
Topographical Survey of Land at
ACCRINGTON ROAD
INGHALLEY

Scale(s)	1:250	Surveyor	JD
Date	Nov 15	Drawn	AC
Job Number	15J270	Checked	SO

Sheet Size & Org Number & Revision
A0 15J270/001

Appendix B

TECHNICS GROUP
Technics House
Merrow Business Centre
Merrow Lane
Guildford
GU4 7WA

FAO:

Dear Sirs

Location: 1 WOODFIELD VIEW WHALLEY CLITHEROE BB7 9TB

I acknowledge with thanks your request for information on the location of our services.

Please find enclosed plans showing the approximate position of our apparatus known to be in the vicinity of this site. The enclosed plans are being provided to you subject to the United Utilities Terms and Conditions - Wastewater & Water Distribution Plans which are shown overleaf.

I also attach United Utilities' General Condition and Information sheets regarding United Utilities wastewater network and water distribution apparatus, which details contact numbers for additional services (i.e. new supplies, connections, diversions) which we are unable to deal with at this office. You should ensure that the Condition and Information sheets are made available to anyone carrying out any works which may affect our apparatus.

I trust the above meets with your requirements and look forward to hearing from you should you need anything further.

If you have any queries regarding this matter please telephone us on 0370 7510101.

Yours Faithfully,



Sue McManus
Operations Manager
Property Searches

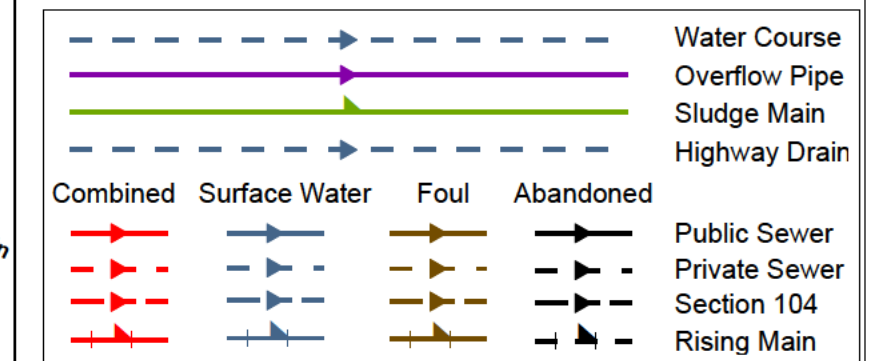
United Utilities Water Limited
Property Searches
Ground Floor Grasmere House
Lingley Mere Business Park
Great Sankey
Warrington
WA5 3LP
DX 715568 Warrington
Telephone 0370 751 0101

Property.searches@uu plc.co.uk

Your Ref: GRS00642
Our Ref: 14/ 1145619
Date: 8/10/2015

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LEGEND



**1 Woodfield View
Whalley
Clitheroe
BB7 9TB**

Printed By : Property Searches Date: 08/10/2015

DO NOT SCALE
Approximate Scale: 1:1250



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LEGEND

Proposed	Abandoned	Live	
			Distribution Main
			Trunk Main
			Comms Pipe
			Private Pipe
			Raw Water
			LDTM Raw Water
			LDTM Treated Water

**1 Woodfield View
Whalley
Clitheroe
BB7 9TB**

Printed By : Property Searches Date: 08/10/2015

DO NOT SCALE
Approximate Scale: 1:1250



Conditions and Information regarding wastewater network

These general conditions and precautions apply to the wastewater network of United Utilities

Please ensure that a copy of these conditions is passed to your representative and contractor on site.

- 1 United Utilities provides the approximate locations of its sewers according to its records. These records are not necessarily accurate or complete nor do they normally show the positions of every sewer culvert or drain, private connections from properties to the public sewers or the particulars of any private system. No person or company shall be relieved from liability for any damage caused by reason of the actual positions and/or depths being different from those indicated. The records do indicate the position of the nearest known public sewer from which the likely length of private connections can be estimated together with the need for any off site drainage rights or easements.
- 2 Special requirements relative to our sewers may be indicated. United Utilities employees or its contractors will visit any site at reasonable notice to assist in the location of its underground sewers and advise any precautions that may be required to obviate any damage. To arrange a visit or for further information regarding new supplies, connections, diversions, costing, or any notification required under these General Conditions, please call us on **0345 602 0406**.
- 3 Where public sewers are within a site which is to be developed and do not take any drainage from outside the area, they are from an operational viewpoint redundant. The developer must identify all redundant sewers affected by the development and apply to United Utilities in writing for these sewers to be formally closed. The developer shall bear all related costs of the physical abandonment work.
- 4 Public sewers within the site that are still live outside the area will be subject to a "Restricted Building zone". This would normally be a surface area equivalent to the depth of the sewer measured from the centre line of the sewer on either side. No construction will be permitted within that zone. The developer should also note that deep and wide rooted trees must not be planted in close proximity to live sewers. Access to public sewers must be maintained at all times and no interference to manholes will be permitted during construction work.
5. Where there is a public sewer along the line of a proposed development/building, arrangements shall be made by the developer at his cost to divert the sewer around the development. Where this is not possible and as a last resort, a "Building Over Agreement" will need to be completed under section 18 of the Building Act 1984. The developer shall design building foundations to ensure that no additional loading is transferred to the sewer and submit such details both to the Local Authority's Building Control Officer and to United Utilities for approval/acceptance. United Utilities on a rechargeable basis would normally undertake all aspects of design work associated with the diversion of any part of the operational wastewater network. For further advice please email wastewaterdeveloperservices@uuplc.co.uk
6. Where there is a non-main river watercourse/culvert passing through the site, the landowner has the responsibility of a riparian owner for the watercourse/culvert and is responsible for the maintenance of the fabric of the culvert and for all works involved in maintaining the unrestricted flow through it. Building over the watercourse/culvert is not recommended. The developer must contact the local authority before any works are carried out on the watercourse/culvert. Where it is necessary to discharge surface water from the site into the watercourse/culvert the developer shall make an assessment of the available capacity of the watercourse/culvert (based on a 1 in 50 year event) and ensure that the additional flow to be discharged into the watercourse/culvert will not cause any flooding. In appropriate cases, flooding may be prevented by on-site storage. The developer shall submit the relevant details required to substantiate his development proposals. Details of any outfall proposed shall also be submitted to the Environment Agency, PO Box 12, Richard Fairclough House, Knutsford Road, Warrington, Cheshire, WA4 1HT for their approval.
7. Where there is a main river watercourse/culvert passing through the site, the developer shall submit all proposals affecting the river to the Environment Agency at the address stated in paragraph 6 for approval/acceptance.

8. Your attention is drawn also to the following:

Private drains or sewers which may be within the site.

On 1 October 2011 all privately owned sewers and lateral drains which communicate with (that is drain to) an existing public sewer as at 1 July 2011 will become the responsibility of the sewerage undertaker. This includes private sewers upstream of pumping stations that have yet to transfer, but excludes lengths of sewer or drain that are the subject of an on-going appeal or which have been excluded from transfer as a result of an appeal or which are on or under land opted-out by a Crown body. The transfer specifically excludes sewers and lateral drains owned by a railway undertaker. Sewers upstream of such assets, however, are transferred. Such assets may not be recorded on the public sewer record currently as it was not a requirement to keep records of previously private sewers and drains.

Applications to make connections to the public sewer.

The developer must write to United Utilities requesting an application form that must be duly completed and returned. No works on the public sewer shall be carried out until a letter of consent is received from United Utilities.

Sewers for adoption If an agreement for the adoption of sewers under Section 104 of the Water Industry Act 1991 is being contemplated, a submission in accordance with "Sewers for Adoption", Seventh Edition, published by the Water Research Centre (2001) Plc, Henley Road, Medmenham, PO Box 16, Marlow, Buckinghamshire, SL7 2HD will be required, taking into consideration any departures from the general guide stipulated by United Utilities.

Further consultation with United Utilities.

Developers wishing to seek advice or clarification regarding sewer record information provided should contact United Utilities to arrange an appointment. A consultation fee may be charged, details of which will be made available at the time of making an appointment.

9. Combined sewers, foul sewers, surface water sewers, and pumped mains. These are shown separately in a range of colours or markings to distinguish them on our drawings, which are extracts from the statutory regional sewer map. A legend and key is provided on each extract for general use, although not all types of sewer will be shown on every extract.

Combined sewers shown coloured red carries both surface water and foul sewage, especially in areas where there is no separate surface water sewerage system.

Foul sewers coloured brown may also carry surface water and there may be no separate surface water system indicated in the immediate area. Both combined and foul sewers carry wastewater to our treatment works before it can safely be returned to the environment.

Surface water sewers coloured blue on our drawings are intended only to carry uncontaminated surface water (e.g. rainfall from roofs, etc) and they usually discharge into local watercourses. It is important for the protection of the environment and water quality that only uncontaminated surface water is connected to the surface water sewers. Improper connections to surface water sewers from sink wastes, washing machines and other domestic use of water can cause significant pollution of watercourses.

Pumped mains, rising mains and sludge mains will all be subject to pumping pressures and are neither suitable nor available for making new connections.

Highway drains, when included, show as blue and black dashed lines. Highway drains are not assets belonging to United Utilities and are the responsibility of local authorities.

1. For information regarding future proposals for construction of company apparatus please write to United Utilities, PO Box 453, Warrington, WA5 3QN.
2. For information regarding easements, deeds, grants or wayleaves please write to United Utilities Property Solutions, Coniston Buildings, Lingley Mere Business Park, Lingley Green Avenue, Great Sankey, Warrington, WA5 3UU
Tel: 01925 731 365

Conditions and Information regarding water distribution apparatus

These general conditions and precautions apply to the water distribution system of United Utilities

Please ensure that a copy of these conditions is passed to your representative and contractor on site.

1. United Utilities provides approximate locations of its water mains or apparatus according to its records. These records are not necessarily accurate or complete nor do they normally show the positions of private service pipes from the mains to properties. Where service pipes are shown, a blue broken line indicates their approximate position. No person or company shall be relieved from liability for any damage caused by reason of the actual positions and/or depths being different from those indicated.
2. Special requirements relative to our apparatus may be indicated. United Utilities employees will visit any site at reasonable notice to assist in the location of its underground water apparatus and advise any precautions that may be required to obviate any damage. To arrange a visit or for further information regarding new supplies, connections, diversions, costing, future proposals for construction of company apparatus or any notification required under these General Conditions, please telephone us on **0345 746 2200** or write to United Utilities, PO Box 453, Warrington, WA5 3QN.
3. In order to achieve safe working conditions adjacent to any water apparatus the following should be observed;
 - (a) All water apparatus should be located by hand digging prior to the use of mechanical excavation.
 - (b) During construction work where heavy plant may have to cross the line of a water main, and the main is not under a carriageway of adequate standard of construction, crossing points should be suitably reinforced with sleepers, steel plates or a specially constructed reinforced concrete raft as necessary. These crossing points should be clearly indicated and crossing the line of the water main at other places should be prevented. United Utilities employees will advise on the type of reinforcement necessary. This is particularly important on agricultural or open land, where tilling or erosion may have significantly reduced the original cover.

(c) No explosive should be used within 32 metres of any United Utilities apparatus without prior consultation with United Utilities.

(d) Where it is proposed to carry out piling within 15 metres of any water main United Utilities should be consulted so that the affected main may be surveyed.

4. During any excavation, it is important that measures should be taken to ensure continued support for any water main:

(a) Where excavation of trenches adjacent to any water main is likely to affect its support, the main must be supported to the satisfaction of United Utilities.

(b) Where a trench is excavated crossing or parallel to the line of a water main, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the main. In special cases it may be necessary to provide permanent support to a main which has been exposed over the length of the excavation before back-filling and reinstatement is carried out. No back-filled concrete should contact the main.

5. No other apparatus should be laid over and along the line of a water main irrespective of clearance. A minimum clearance of 450 millimetres should be allowed between any plant being installed and an existing main, to facilitate maintenance and repair, whether the adjacent plant is parallel to or crossing the main. No manhole, chamber, or other obstruction should be built over or around a water main.

6. Where a water main is coated with special wrapping and the wrapping is damaged, even to a minor extent, United Utilities must be notified, and the excavation must be left open for ready access so that repairs can be made. In case of any material damage to the main itself causing leakage, or weakening of the mechanical strength of the pipe, the person or body responsible should immediately notify United Utilities in order that the necessary remedial work can be carried out. The full cost of the necessary remedial work will be charged to the person or body responsible for the damage.

1. If you propose to change existing levels over water mains you will need to inform us. We will need specific locations to be identified together with precise details as to the scale of the proposed changes to existing ground levels. Changes to existing levels may require the diversion of our apparatus at your cost. However, in certain circumstances we may wish to leave our apparatus where it is. On these occasions you will usually be required to protect our apparatus by means of a concrete raft and either raise or lower any surface boxes affected.
2. Under no circumstances should our surface boxes be either buried or left in a situation where they are raised above finished ground levels. You should reuse and re-set any surface boxes affected by your works into the new surface so that they align over the water apparatus below. You will be responsible for the cost of repairing any damage to our apparatus as a result of your works.
3. Where proposals involve resurfacing, you must notify United Utilities if your excavation will be greater than 750mm in the highway and 300mm in a footpath, verge or other location.
4. For information regarding easements, deeds, grants, licences or wayleaves, please write to United Utilities Property Solutions, Coniston Buildings, Lingley Mere Business Park, Lingley Green Avenue, Great Sankey, Warrington WA5 3UU (Tel 01925 731 365).

Tree planting restrictions over water mains

a) Poplar and willow trees have extensive root systems and should not be planted within 10 metres of any water main.

b) The following trees and those of a similar size, whether they are deciduous or evergreen, should not be planted within six metres of any water main:

- Ash, beech, birch, elm, horse chestnut, lime, oak, sycamore;
- Apple trees and pear trees;
- Most conifers.

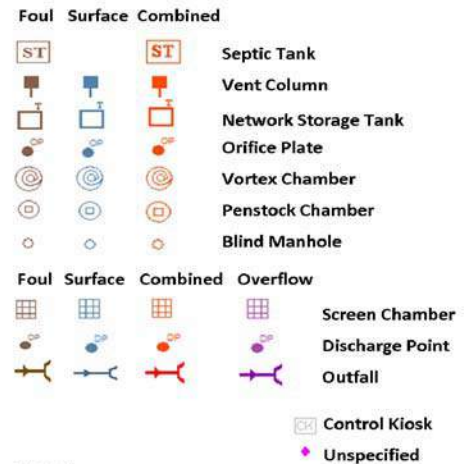
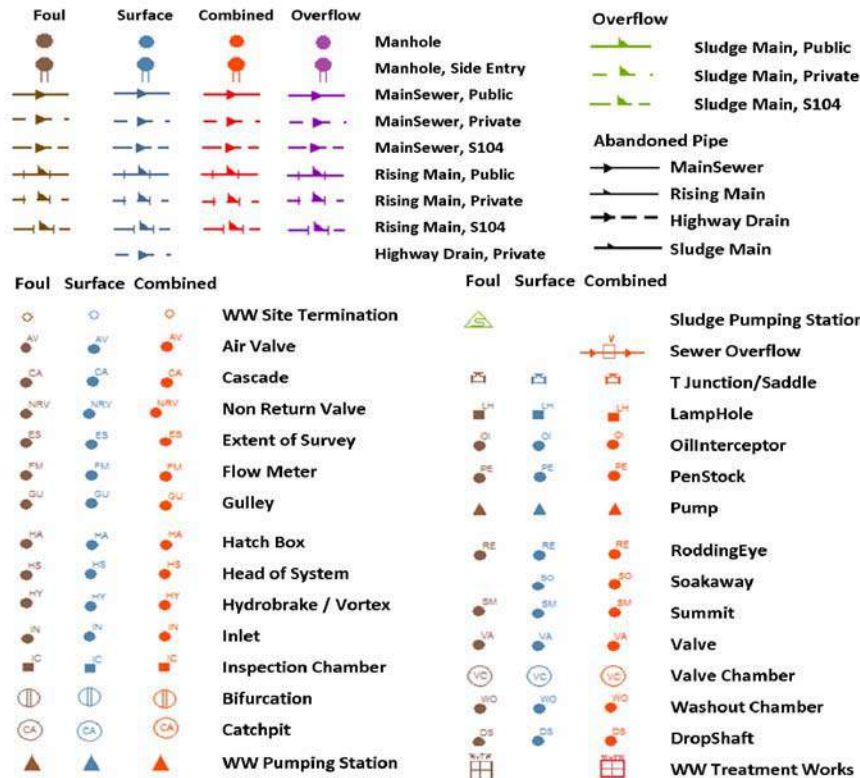
c) United Utilities requires access to the route of its mains at all times to inspect for leaks and carry out surveys. We recommend that no shrubs or bushes which might obstruct or interfere with our access should be planted within one metre of the centre line of any water main.

d) There may be instances when both United Utilities and the landowner will wish to plant shrubs or bushes close to the water main for screening or other purposes. The following shallow rooting shrubs would be suitable for this purpose:

- Blackthorn, broom, cotoneaster, elder;
- Hazel, laurel, privet, quickthorn, snowberry;
- Most ornamental flowering shrubs.

e) In areas where soft fruit is grown, blackcurrant, raspberries and gooseberries may be planted close to the main, provided that a path is left clear for inspection access and surveys. United Utilities can give additional advice where required in particular circumstances.

WASTE WATER SYMBOLOGY



Legend			
MANHOLE FUNCTION		SEWER SHAPE	
FO	Foul	CI	Circular
SW	Surface Water	EG	Egg
CO	Combined	OV	Oval
OV	Overflow	FT	Flat Top
		RE	Rectangular
		SQ	Square
		TR	Trapezoidal
		AR	Arch
		BA	Barrel
		HO	HorseShoe
		UN	Unspecified
SEWER MATERIAL			
AC	Asbestos Cement	DI	Ductile Iron
BR	Brick	VC	Vitrified Clay
CO	Concrete	PP	Polypropylene
CSB	Concrete Segment	PF	Pitched Fibre
CSU	Concrete Segment	MA	Masonry, Coursed
CC	Concrete Box Culverted	MA	Masonry, Random
PSC	Plastic / Steel	RP	Reinforced Plastic
GR	Glass Reinforced	CI	Cast Iron
GRP	Glass Reinforced	SI	Spun Iron
PVC	Polyvinyl Chloride	ST	Steel
PE	Polyethylene	U	Unspecified

CLEAN WATER SYMBOLOGY

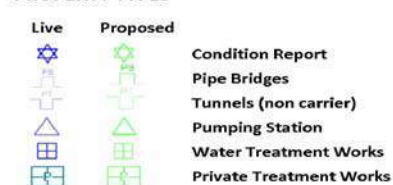
PIPE WORK



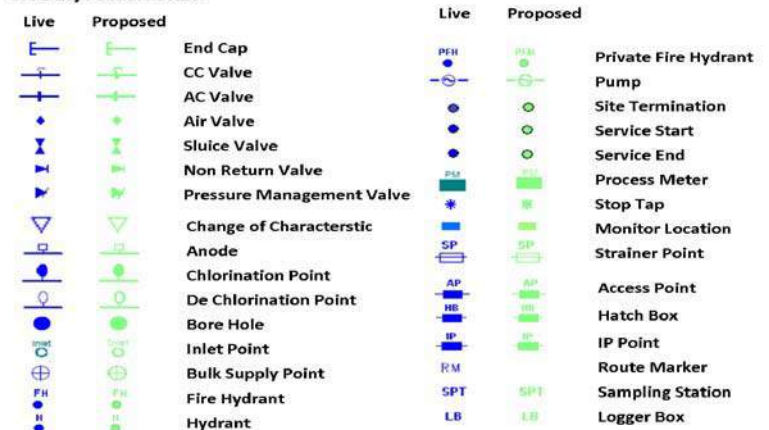
ABANDONED PIPE



PROPERTY TYPES



NODES/FURNITURES



Legend	
MATERIAL TYPES	LINING TYPES
AC ASBESTOS CEMENT	CL CEMENT LINING
CI CAST IRON	TB TAR OR BITUMEN
CU COPPER	ERL EPOXY RESIN
CO CONCRETE	
DI DUCTILE IRON	INSERTION TYPES
GI GALVANISED IRON	DD DIE DRAWN
GR GREY IRON	DR DIRECTIONAL DRILLING
OT OTHERS	MO MOLING
PB LEAD	PI PIPELINE
PV UPVC	SL SLIP LINED
SI SPUN IRON	
ST STEEL	
UN UNKNOWN	
PE POLYETHYLENE	

TERMS AND CONDITIONS - WASTERWATER & WATER DISTRIBUTION PLANS

These provisions apply to the public sewerage, water distribution and telemetry systems (including sewers which are the subject of an agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the agreement for the self construction of water mains) (UUWL apparatus) of United Utilities Water Limited "(UUWL)".

TERMS AND CONDITIONS:

1. This Map and any information supplied with it is issued subject to the provisions contained below, to the exclusion of all others and no party relies upon any representation, warranty, collateral contract or other assurance of any person (whether party to this agreement or not) that is not set out in this agreement or the documents referred to in it.
2. This Map and any information supplied with it is provided for general guidance only and no representation, undertaking or warranty as to its accuracy, completeness or being up to date is given or implied.
3. In particular, the position and depth of any UUWL apparatus shown on the Map are approximate only. UUWL strongly recommends that a comprehensive survey is undertaken in addition to reviewing this Map to determine and ensure the precise location of any UUWL apparatus. The exact location, positions and depths should be obtained by excavation trial holes.
4. The location and position of private drains, private sewers and service pipes to properties are not normally shown on this Map but their presence must be anticipated and accounted for and you are strongly advised to carry out your own further enquiries and investigations in order to locate the same.
5. The position and depth of UUWL apparatus is subject to change and therefore this Map is issued subject to any removal or change in location of the same. The onus is entirely upon you to confirm whether any changes to the Map have been made subsequent to issue and prior to any works being carried out.
6. This Map and any information shown on it or provided with it must not be relied upon in the event of any development, construction or other works (including but not limited to any excavations) in the vicinity of UUWL apparatus or for the purpose of determining the suitability of a point of connection to the sewerage or other distribution systems.
7. No person or legal entity, including any company shall be relieved from any liability howsoever and whensoever arising for any damage caused to UUWL apparatus by reason of the actual position and/or depths of UUWL apparatus being different from those shown on the Map and any information supplied with it.
8. If any provision contained herein is or becomes legally invalid or unenforceable, it will be taken to be severed from the remaining provisions which shall be unaffected and continue in full force and affect.
9. This agreement shall be governed by English law and all parties submit to the exclusive jurisdiction of the English courts, save that nothing will prevent UUWL from bringing proceedings in any other competent jurisdiction, whether concurrently or otherwise.

Appendix C

Calculated by: Rob Bruce

Site name: ACCRINGTON ROAD

Site location: WHALLEY

Site Details

Latitude: 53.81972° N

Longitude: 2.40268° W

Reference: 3863048619

Date: Oct 28 2022 09:30

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.

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 1.8

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):	1139	1139
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 $SPR/SPRHOST \leq 0.3$?

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):	15.36	15.36
1 in 1 year (l/s):	13.36	13.36
1 in 30 years (l/s):	26.11	26.11
1 in 100 year (l/s):	31.95	31.95
1 in 200 years (l/s):	36.4	36.4

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.

Appendix D

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.500
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.073	5.00	48.646	1200	373579.669	436076.937	1.350
2	0.131	5.00	47.857	1200	373574.622	436055.014	1.507
3	0.091	5.00	47.579	1200	373553.423	436059.839	1.509
11	0.118	5.00	47.109	3000	373522.844	436080.478	1.726
12	0.128	5.00	47.961	3000	373542.195	436074.493	2.727
4	0.069	5.00	47.458	3000	373544.597	436055.593	2.345
5	0.069	5.00	47.428	3000	373540.747	436047.898	2.358
6	0.158	5.00	46.691	3000	373531.367	436003.860	1.804
26	0.236	5.00	48.097	1500	373605.848	436047.500	2.044
27	0.253	5.00	46.923	1500	373596.676	436010.732	1.697
28	0.000	5.00	46.785	1500	373593.195	435994.385	1.670
7	0.152	5.00	46.593	1500	373572.955	435994.085	1.818
8	0.000		46.474	1500	373571.516	435985.437	1.726
9	0.000		46.474	1500	373573.098	435937.872	1.835
10			46.168	1500	373573.032	435932.522	1.552

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)
1.000	1	2	22.496	0.600	47.296	46.350	0.946	23.8	150	5.18	50.0
1.001	2	3	21.741	0.600	46.350	46.070	0.280	77.6	300	5.38	50.0
1.002	3	4	9.794	0.600	46.070	45.383	0.687	14.3	300	5.42	50.0
2.000	11	12	20.255	0.600	45.383	45.234	0.149	135.9	450	5.19	50.0
2.001	12	4	19.052	0.600	45.234	45.113	0.121	157.5	450	5.39	50.0
1.003	4	5	8.604	0.600	45.113	45.070	0.043	200.1	450	5.52	50.0
1.004	5	6	45.026	0.600	45.070	44.887	0.183	246.0	450	6.10	50.0
1.005	6	7	42.721	0.600	44.887	44.780	0.107	400.0	450	6.81	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)
1.000	2.073	36.6	9.9	1.200	1.357	0.073	0.0
1.001	1.786	126.2	27.6	1.207	1.209	0.204	0.0
1.002	4.185	295.8	40.0	1.209	1.775	0.295	0.0
2.000	1.742	277.0	16.0	1.276	2.277	0.118	0.0
2.001	1.617	257.2	33.3	2.277	1.895	0.246	0.0
1.003	1.433	228.0	82.7	1.895	1.908	0.610	0.0
1.004	1.291	205.4	92.0	1.908	1.354	0.679	0.0
1.005	1.010	160.7	113.4	1.354	1.363	0.837	0.0

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)
3.005	26	27	37.895	0.600	46.053	45.376	0.677	56.0	300	5.30	50.0
3.006	27	28	16.714	0.600	45.226	45.115	0.111	150.0	450	5.47	50.0
3.007	28	7	20.242	0.600	45.140	44.925	0.215	94.1	450	5.63	50.0
1.006	7	8	8.767	0.600	44.775	44.753	0.022	400.0	450	6.95	50.0
1.007	8	9	47.591	0.600	44.748	44.639	0.109	436.6	450	7.77	50.0
1.008	9	10	5.350	0.600	44.639	44.616	0.023	232.6	225	7.88	50.0

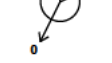
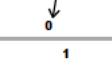
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
3.005	2.105	148.8	32.0	1.744	1.247	0.236	0.0
3.006	1.657	263.6	66.3	1.247	1.220	0.489	0.0
3.007	2.095	333.2	66.3	1.195	1.218	0.489	0.0
1.006	1.010	160.7	200.3	1.368	1.271	1.478	0.0
1.007	0.966	153.7	200.3	1.276	1.385	1.478	0.0
1.008	0.853	33.9	200.3	1.610	1.327	1.478	0.0

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)
1.000	22.496	23.8	150	Circular_Default Sewer Type	48.646	47.296	1.200	47.857	46.350	1.357
1.001	21.741	77.6	300	Circular_Default Sewer Type	47.857	46.350	1.207	47.579	46.070	1.209
1.002	9.794	14.3	300	Circular_Default Sewer Type	47.579	46.070	1.209	47.458	45.383	1.775
2.000	20.255	135.9	450	Circular_Default Sewer Type	47.109	45.383	1.276	47.961	45.234	2.277
2.001	19.052	157.5	450	Circular_Default Sewer Type	47.961	45.234	2.277	47.458	45.113	1.895
1.003	8.604	200.1	450	Circular_Default Sewer Type	47.458	45.113	1.895	47.428	45.070	1.908
1.004	45.026	246.0	450	Circular_Default Sewer Type	47.428	45.070	1.908	46.691	44.887	1.354
1.005	42.721	400.0	450	Circular_Default Sewer Type	46.691	44.887	1.354	46.593	44.780	1.363
3.005	37.895	56.0	300	Circular_Default Sewer Type	48.097	46.053	1.744	46.923	45.376	1.247
3.006	16.714	150.0	450	Circular_Default Sewer Type	46.923	45.226	1.247	46.785	45.115	1.220
3.007	20.242	94.1	450	Circular_Default Sewer Type	46.785	45.140	1.195	46.593	44.925	1.218
1.006	8.767	400.0	450	Circular_Default Sewer Type	46.593	44.775	1.368	46.474	44.753	1.271
1.007	47.591	436.6	450	Circular_Default Sewer Type	46.474	44.748	1.276	46.474	44.639	1.385
1.008	5.350	232.6	225	Circular_Default Sewer Type	46.474	44.639	1.610	46.168	44.616	1.327

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.002	3	1200	Manhole	Adoptable	4	3000	Manhole	Adoptable
2.000	11	3000	Manhole	Adoptable	12	3000	Manhole	Adoptable
2.001	12	3000	Manhole	Adoptable	4	3000	Manhole	Adoptable
1.003	4	3000	Manhole	Adoptable	5	3000	Manhole	Adoptable
1.004	5	3000	Manhole	Adoptable	6	3000	Manhole	Adoptable
1.005	6	3000	Manhole	Adoptable	7	1500	Manhole	Adoptable
3.005	26	1500	Manhole	Adoptable	27	1500	Manhole	Adoptable
3.006	27	1500	Manhole	Adoptable	28	1500	Manhole	Adoptable
3.007	28	1500	Manhole	Adoptable	7	1500	Manhole	Adoptable
1.006	7	1500	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.007	8	1500	Manhole	Adoptable	9	1500	Manhole	Adoptable
1.008	9	1500	Manhole	Adoptable	10	1500	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
1	373579.669	436076.937	48.646	1.350	1200		0	1.000	47.296	150
2	373574.622	436055.014	47.857	1.507	1200		1	1.000	46.350	150
							0	1.001	46.350	300
3	373553.423	436059.839	47.579	1.509	1200		1	1.001	46.070	300
							0	1.002	46.070	300
11	373522.844	436080.478	47.109	1.726	3000		0	2.000	45.383	450
12	373542.195	436074.493	47.961	2.727	3000		1	2.000	45.234	450
							0	2.001	45.234	450
4	373544.597	436055.593	47.458	2.345	3000		1	2.001	45.113	450
							2	1.002	45.383	300
							0	1.003	45.113	450
5	373540.747	436047.898	47.428	2.358	3000		1	1.003	45.070	450
							0	1.004	45.070	450
6	373531.367	436003.860	46.691	1.804	3000		1	1.004	44.887	450
							0	1.005	44.887	450
26	373605.848	436047.500	48.097	2.044	1500		0	3.005	46.053	300
27	373596.676	436010.732	46.923	1.697	1500		1	3.005	45.376	300
							0	3.006	45.226	450
28	373593.195	435994.385	46.785	1.670	1500		1	3.006	45.115	450
							0	3.007	45.140	450
7	373572.955	435994.085	46.593	1.818	1500		1	3.007	44.925	450
							2	1.005	44.780	450
							0	1.006	44.775	450
8	373571.516	435985.437	46.474	1.726	1500		1	1.006	44.753	450
							0	1.007	44.748	450

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
9	373573.098	435937.872	46.474	1.835	1500	1  0	1	1.007	44.639	450
10	373573.032	435932.522	46.168	1.552	1500	1 	1	1.008	44.616	225

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	✓
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.300	Check Discharge Rate(s)	✓
Summer CV	0.750	Check Discharge Volume	✓
Winter CV	0.840	100 year 360 minute (m³)	
Analysis Speed	Detailed		

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 %)
1	0	0	0
30	40	0	0
100	50	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 10 Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		
Applies to All storms					

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	1.000	54	1.000	108	1.000	162	1.000	216	1.000	270	1.000
1	1.000	55	1.000	109	1.000	163	1.000	217	1.000	271	1.000
2	1.000	56	1.000	110	1.000	164	1.000	218	1.000	272	1.000
3	1.000	57	1.000	111	1.000	165	1.000	219	1.000	273	1.000
4	1.000	58	1.000	112	1.000	166	1.000	220	1.000	274	1.000
5	1.000	59	1.000	113	1.000	167	1.000	221	1.000	275	1.000
6	1.000	60	1.000	114	1.000	168	1.000	222	1.000	276	1.000
7	1.000	61	1.000	115	1.000	169	1.000	223	1.000	277	1.000
8	1.000	62	1.000	116	1.000	170	1.000	224	1.000	278	1.000
9	1.000	63	1.000	117	1.000	171	1.000	225	1.000	279	1.000
10	1.000	64	1.000	118	1.000	172	1.000	226	1.000	280	1.000
11	1.000	65	1.000	119	1.000	173	1.000	227	1.000	281	1.000
12	1.000	66	1.000	120	1.000	174	1.000	228	1.000	282	1.000
13	1.000	67	1.000	121	1.000	175	1.000	229	1.000	283	1.000
14	1.000	68	1.000	122	1.000	176	1.000	230	1.000	284	1.000
15	1.000	69	1.000	123	1.000	177	1.000	231	1.000	285	1.000
16	1.000	70	1.000	124	1.000	178	1.000	232	1.000	286	1.000
17	1.000	71	1.000	125	1.000	179	1.000	233	1.000	287	1.000
18	1.000	72	1.000	126	1.000	180	1.000	234	1.000	288	1.000
19	1.000	73	1.000	127	1.000	181	1.000	235	1.000	289	1.000
20	1.000	74	1.000	128	1.000	182	1.000	236	1.000	290	1.000
21	1.000	75	1.000	129	1.000	183	1.000	237	1.000	291	1.000
22	1.000	76	1.000	130	1.000	184	1.000	238	1.000	292	1.000
23	1.000	77	1.000	131	1.000	185	1.000	239	1.000	293	1.000
24	1.000	78	1.000	132	1.000	186	1.000	240	1.000	294	1.000
25	1.000	79	1.000	133	1.000	187	1.000	241	1.000	295	1.000
26	1.000	80	1.000	134	1.000	188	1.000	242	1.000	296	1.000
27	1.000	81	1.000	135	1.000	189	1.000	243	1.000	297	1.000
28	1.000	82	1.000	136	1.000	190	1.000	244	1.000	298	1.000
29	1.000	83	1.000	137	1.000	191	1.000	245	1.000	299	1.000
30	1.000	84	1.000	138	1.000	192	1.000	246	1.000	300	1.000
31	1.000	85	1.000	139	1.000	193	1.000	247	1.000	301	1.000
32	1.000	86	1.000	140	1.000	194	1.000	248	1.000	302	1.000
33	1.000	87	1.000	141	1.000	195	1.000	249	1.000	303	1.000
34	1.000	88	1.000	142	1.000	196	1.000	250	1.000	304	1.000
35	1.000	89	1.000	143	1.000	197	1.000	251	1.000	305	1.000
36	1.000	90	1.000	144	1.000	198	1.000	252	1.000	306	1.000
37	1.000	91	1.000	145	1.000	199	1.000	253	1.000	307	1.000
38	1.000	92	1.000	146	1.000	200	1.000	254	1.000	308	1.000
39	1.000	93	1.000	147	1.000	201	1.000	255	1.000	309	1.000
40	1.000	94	1.000	148	1.000	202	1.000	256	1.000	310	1.000
41	1.000	95	1.000	149	1.000	203	1.000	257	1.000	311	1.000
42	1.000	96	1.000	150	1.000	204	1.000	258	1.000	312	1.000
43	1.000	97	1.000	151	1.000	205	1.000	259	1.000	313	1.000
44	1.000	98	1.000	152	1.000	206	1.000	260	1.000	314	1.000
45	1.000	99	1.000	153	1.000	207	1.000	261	1.000	315	1.000
46	1.000	100	1.000	154	1.000	208	1.000	262	1.000	316	1.000
47	1.000	101	1.000	155	1.000	209	1.000	263	1.000	317	1.000
48	1.000	102	1.000	156	1.000	210	1.000	264	1.000	318	1.000
49	1.000	103	1.000	157	1.000	211	1.000	265	1.000	319	1.000
50	1.000	104	1.000	158	1.000	212	1.000	266	1.000	320	1.000
51	1.000	105	1.000	159	1.000	213	1.000	267	1.000	321	1.000
52	1.000	106	1.000	160	1.000	214	1.000	268	1.000	322	1.000
53	1.000	107	1.000	161	1.000	215	1.000	269	1.000	323	1.000

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
324	1.000	378	1.000	432	1.000	486	1.000	540	1.000	594	1.000
325	1.000	379	1.000	433	1.000	487	1.000	541	1.000	595	1.000
326	1.000	380	1.000	434	1.000	488	1.000	542	1.000	596	1.000
327	1.000	381	1.000	435	1.000	489	1.000	543	1.000	597	1.000
328	1.000	382	1.000	436	1.000	490	1.000	544	1.000	598	1.000
329	1.000	383	1.000	437	1.000	491	1.000	545	1.000	599	1.000
330	1.000	384	1.000	438	1.000	492	1.000	546	1.000	600	1.000
331	1.000	385	1.000	439	1.000	493	1.000	547	1.000	601	1.000
332	1.000	386	1.000	440	1.000	494	1.000	548	1.000	602	1.000
333	1.000	387	1.000	441	1.000	495	1.000	549	1.000	603	1.000
334	1.000	388	1.000	442	1.000	496	1.000	550	1.000	604	1.000
335	1.000	389	1.000	443	1.000	497	1.000	551	1.000	605	1.000
336	1.000	390	1.000	444	1.000	498	1.000	552	1.000	606	1.000
337	1.000	391	1.000	445	1.000	499	1.000	553	1.000	607	1.000
338	1.000	392	1.000	446	1.000	500	1.000	554	1.000	608	1.000
339	1.000	393	1.000	447	1.000	501	1.000	555	1.000	609	1.000
340	1.000	394	1.000	448	1.000	502	1.000	556	1.000	610	1.000
341	1.000	395	1.000	449	1.000	503	1.000	557	1.000	611	1.000
342	1.000	396	1.000	450	1.000	504	1.000	558	1.000	612	1.000
343	1.000	397	1.000	451	1.000	505	1.000	559	1.000	613	1.000
344	1.000	398	1.000	452	1.000	506	1.000	560	1.000	614	1.000
345	1.000	399	1.000	453	1.000	507	1.000	561	1.000	615	1.000
346	1.000	400	1.000	454	1.000	508	1.000	562	1.000	616	1.000
347	1.000	401	1.000	455	1.000	509	1.000	563	1.000	617	1.000
348	1.000	402	1.000	456	1.000	510	1.000	564	1.000	618	1.000
349	1.000	403	1.000	457	1.000	511	1.000	565	1.000	619	1.000
350	1.000	404	1.000	458	1.000	512	1.000	566	1.000	620	1.000
351	1.000	405	1.000	459	1.000	513	1.000	567	1.000	621	1.000
352	1.000	406	1.000	460	1.000	514	1.000	568	1.000	622	1.000
353	1.000	407	1.000	461	1.000	515	1.000	569	1.000	623	1.000
354	1.000	408	1.000	462	1.000	516	1.000	570	1.000	624	1.000
355	1.000	409	1.000	463	1.000	517	1.000	571	1.000	625	1.000
356	1.000	410	1.000	464	1.000	518	1.000	572	1.000	626	1.000
357	1.000	411	1.000	465	1.000	519	1.000	573	1.000	627	1.000
358	1.000	412	1.000	466	1.000	520	1.000	574	1.000	628	1.000
359	1.000	413	1.000	467	1.000	521	1.000	575	1.000	629	1.000
360	1.000	414	1.000	468	1.000	522	1.000	576	1.000	630	1.000
361	1.000	415	1.000	469	1.000	523	1.000	577	1.000	631	1.000
362	1.000	416	1.000	470	1.000	524	1.000	578	1.000	632	1.000
363	1.000	417	1.000	471	1.000	525	1.000	579	1.000	633	1.000
364	1.000	418	1.000	472	1.000	526	1.000	580	1.000	634	1.000
365	1.000	419	1.000	473	1.000	527	1.000	581	1.000	635	1.000
366	1.000	420	1.000	474	1.000	528	1.000	582	1.000	636	1.000
367	1.000	421	1.000	475	1.000	529	1.000	583	1.000	637	1.000
368	1.000	422	1.000	476	1.000	530	1.000	584	1.000	638	1.000
369	1.000	423	1.000	477	1.000	531	1.000	585	1.000	639	1.000
370	1.000	424	1.000	478	1.000	532	1.000	586	1.000	640	1.000
371	1.000	425	1.000	479	1.000	533	1.000	587	1.000	641	1.000
372	1.000	426	1.000	480	1.000	534	1.000	588	1.000	642	1.000
373	1.000	427	1.000	481	1.000	535	1.000	589	1.000	643	1.000
374	1.000	428	1.000	482	1.000	536	1.000	590	1.000	644	1.000
375	1.000	429	1.000	483	1.000	537	1.000	591	1.000	645	1.000
376	1.000	430	1.000	484	1.000	538	1.000	592	1.000	646	1.000
377	1.000	431	1.000	485	1.000	539	1.000	593	1.000	647	1.000

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
648	1.000	702	1.000	756	1.000	810	1.000	864	1.000	918	1.000
649	1.000	703	1.000	757	1.000	811	1.000	865	1.000	919	1.000
650	1.000	704	1.000	758	1.000	812	1.000	866	1.000	920	1.000
651	1.000	705	1.000	759	1.000	813	1.000	867	1.000	921	1.000
652	1.000	706	1.000	760	1.000	814	1.000	868	1.000	922	1.000
653	1.000	707	1.000	761	1.000	815	1.000	869	1.000	923	1.000
654	1.000	708	1.000	762	1.000	816	1.000	870	1.000	924	1.000
655	1.000	709	1.000	763	1.000	817	1.000	871	1.000	925	1.000
656	1.000	710	1.000	764	1.000	818	1.000	872	1.000	926	1.000
657	1.000	711	1.000	765	1.000	819	1.000	873	1.000	927	1.000
658	1.000	712	1.000	766	1.000	820	1.000	874	1.000	928	1.000
659	1.000	713	1.000	767	1.000	821	1.000	875	1.000	929	1.000
660	1.000	714	1.000	768	1.000	822	1.000	876	1.000	930	1.000
661	1.000	715	1.000	769	1.000	823	1.000	877	1.000	931	1.000
662	1.000	716	1.000	770	1.000	824	1.000	878	1.000	932	1.000
663	1.000	717	1.000	771	1.000	825	1.000	879	1.000	933	1.000
664	1.000	718	1.000	772	1.000	826	1.000	880	1.000	934	1.000
665	1.000	719	1.000	773	1.000	827	1.000	881	1.000	935	1.000
666	1.000	720	1.000	774	1.000	828	1.000	882	1.000	936	1.000
667	1.000	721	1.000	775	1.000	829	1.000	883	1.000	937	1.000
668	1.000	722	1.000	776	1.000	830	1.000	884	1.000	938	1.000
669	1.000	723	1.000	777	1.000	831	1.000	885	1.000	939	1.000
670	1.000	724	1.000	778	1.000	832	1.000	886	1.000	940	1.000
671	1.000	725	1.000	779	1.000	833	1.000	887	1.000	941	1.000
672	1.000	726	1.000	780	1.000	834	1.000	888	1.000	942	1.000
673	1.000	727	1.000	781	1.000	835	1.000	889	1.000	943	1.000
674	1.000	728	1.000	782	1.000	836	1.000	890	1.000	944	1.000
675	1.000	729	1.000	783	1.000	837	1.000	891	1.000	945	1.000
676	1.000	730	1.000	784	1.000	838	1.000	892	1.000	946	1.000
677	1.000	731	1.000	785	1.000	839	1.000	893	1.000	947	1.000
678	1.000	732	1.000	786	1.000	840	1.000	894	1.000	948	1.000
679	1.000	733	1.000	787	1.000	841	1.000	895	1.000	949	1.000
680	1.000	734	1.000	788	1.000	842	1.000	896	1.000	950	1.000
681	1.000	735	1.000	789	1.000	843	1.000	897	1.000	951	1.000
682	1.000	736	1.000	790	1.000	844	1.000	898	1.000	952	1.000
683	1.000	737	1.000	791	1.000	845	1.000	899	1.000	953	1.000
684	1.000	738	1.000	792	1.000	846	1.000	900	1.000	954	1.000
685	1.000	739	1.000	793	1.000	847	1.000	901	1.000	955	1.000
686	1.000	740	1.000	794	1.000	848	1.000	902	1.000	956	1.000
687	1.000	741	1.000	795	1.000	849	1.000	903	1.000	957	1.000
688	1.000	742	1.000	796	1.000	850	1.000	904	1.000	958	1.000
689	1.000	743	1.000	797	1.000	851	1.000	905	1.000	959	1.000
690	1.000	744	1.000	798	1.000	852	1.000	906	1.000	960	1.000
691	1.000	745	1.000	799	1.000	853	1.000	907	1.000	961	1.000
692	1.000	746	1.000	800	1.000	854	1.000	908	1.000	962	1.000
693	1.000	747	1.000	801	1.000	855	1.000	909	1.000	963	1.000
694	1.000	748	1.000	802	1.000	856	1.000	910	1.000	964	1.000
695	1.000	749	1.000	803	1.000	857	1.000	911	1.000	965	1.000
696	1.000	750	1.000	804	1.000	858	1.000	912	1.000	966	1.000
697	1.000	751	1.000	805	1.000	859	1.000	913	1.000	967	1.000
698	1.000	752	1.000	806	1.000	860	1.000	914	1.000	968	1.000
699	1.000	753	1.000	807	1.000	861	1.000	915	1.000	969	1.000
700	1.000	754	1.000	808	1.000	862	1.000	916	1.000	970	1.000
701	1.000	755	1.000	809	1.000	863	1.000	917	1.000	971	1.000

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
972	1.000	1026	1.000	1080	1.000	1134	1.000	1188	1.000	1242	1.000
973	1.000	1027	1.000	1081	1.000	1135	1.000	1189	1.000	1243	1.000
974	1.000	1028	1.000	1082	1.000	1136	1.000	1190	1.000	1244	1.000
975	1.000	1029	1.000	1083	1.000	1137	1.000	1191	1.000	1245	1.000
976	1.000	1030	1.000	1084	1.000	1138	1.000	1192	1.000	1246	1.000
977	1.000	1031	1.000	1085	1.000	1139	1.000	1193	1.000	1247	1.000
978	1.000	1032	1.000	1086	1.000	1140	1.000	1194	1.000	1248	1.000
979	1.000	1033	1.000	1087	1.000	1141	1.000	1195	1.000	1249	1.000
980	1.000	1034	1.000	1088	1.000	1142	1.000	1196	1.000	1250	1.000
981	1.000	1035	1.000	1089	1.000	1143	1.000	1197	1.000	1251	1.000
982	1.000	1036	1.000	1090	1.000	1144	1.000	1198	1.000	1252	1.000
983	1.000	1037	1.000	1091	1.000	1145	1.000	1199	1.000	1253	1.000
984	1.000	1038	1.000	1092	1.000	1146	1.000	1200	1.000	1254	1.000
985	1.000	1039	1.000	1093	1.000	1147	1.000	1201	1.000	1255	1.000
986	1.000	1040	1.000	1094	1.000	1148	1.000	1202	1.000	1256	1.000
987	1.000	1041	1.000	1095	1.000	1149	1.000	1203	1.000	1257	1.000
988	1.000	1042	1.000	1096	1.000	1150	1.000	1204	1.000	1258	1.000
989	1.000	1043	1.000	1097	1.000	1151	1.000	1205	1.000	1259	1.000
990	1.000	1044	1.000	1098	1.000	1152	1.000	1206	1.000	1260	1.000
991	1.000	1045	1.000	1099	1.000	1153	1.000	1207	1.000	1261	1.000
992	1.000	1046	1.000	1100	1.000	1154	1.000	1208	1.000	1262	1.000
993	1.000	1047	1.000	1101	1.000	1155	1.000	1209	1.000	1263	1.000
994	1.000	1048	1.000	1102	1.000	1156	1.000	1210	1.000	1264	1.000
995	1.000	1049	1.000	1103	1.000	1157	1.000	1211	1.000	1265	1.000
996	1.000	1050	1.000	1104	1.000	1158	1.000	1212	1.000	1266	1.000
997	1.000	1051	1.000	1105	1.000	1159	1.000	1213	1.000	1267	1.000
998	1.000	1052	1.000	1106	1.000	1160	1.000	1214	1.000	1268	1.000
999	1.000	1053	1.000	1107	1.000	1161	1.000	1215	1.000	1269	1.000
1000	1.000	1054	1.000	1108	1.000	1162	1.000	1216	1.000	1270	1.000
1001	1.000	1055	1.000	1109	1.000	1163	1.000	1217	1.000	1271	1.000
1002	1.000	1056	1.000	1110	1.000	1164	1.000	1218	1.000	1272	1.000
1003	1.000	1057	1.000	1111	1.000	1165	1.000	1219	1.000	1273	1.000
1004	1.000	1058	1.000	1112	1.000	1166	1.000	1220	1.000	1274	1.000
1005	1.000	1059	1.000	1113	1.000	1167	1.000	1221	1.000	1275	1.000
1006	1.000	1060	1.000	1114	1.000	1168	1.000	1222	1.000	1276	1.000
1007	1.000	1061	1.000	1115	1.000	1169	1.000	1223	1.000	1277	1.000
1008	1.000	1062	1.000	1116	1.000	1170	1.000	1224	1.000	1278	1.000
1009	1.000	1063	1.000	1117	1.000	1171	1.000	1225	1.000	1279	1.000
1010	1.000	1064	1.000	1118	1.000	1172	1.000	1226	1.000	1280	1.000
1011	1.000	1065	1.000	1119	1.000	1173	1.000	1227	1.000	1281	1.000
1012	1.000	1066	1.000	1120	1.000	1174	1.000	1228	1.000	1282	1.000
1013	1.000	1067	1.000	1121	1.000	1175	1.000	1229	1.000	1283	1.000
1014	1.000	1068	1.000	1122	1.000	1176	1.000	1230	1.000	1284	1.000
1015	1.000	1069	1.000	1123	1.000	1177	1.000	1231	1.000	1285	1.000
1016	1.000	1070	1.000	1124	1.000	1178	1.000	1232	1.000	1286	1.000
1017	1.000	1071	1.000	1125	1.000	1179	1.000	1233	1.000	1287	1.000
1018	1.000	1072	1.000	1126	1.000	1180	1.000	1234	1.000	1288	1.000
1019	1.000	1073	1.000	1127	1.000	1181	1.000	1235	1.000	1289	1.000
1020	1.000	1074	1.000	1128	1.000	1182	1.000	1236	1.000	1290	1.000
1021	1.000	1075	1.000	1129	1.000	1183	1.000	1237	1.000	1291	1.000
1022	1.000	1076	1.000	1130	1.000	1184	1.000	1238	1.000	1292	1.000
1023	1.000	1077	1.000	1131	1.000	1185	1.000	1239	1.000	1293	1.000
1024	1.000	1078	1.000	1132	1.000	1186	1.000	1240	1.000	1294	1.000
1025	1.000	1079	1.000	1133	1.000	1187	1.000	1241	1.000	1295	1.000

Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)	Time (mins)	Depth (m)
1296	1.000	1321	1.000	1346	1.000	1371	1.000	1396	1.000	1421	1.000
1297	1.000	1322	1.000	1347	1.000	1372	1.000	1397	1.000	1422	1.000
1298	1.000	1323	1.000	1348	1.000	1373	1.000	1398	1.000	1423	1.000
1299	1.000	1324	1.000	1349	1.000	1374	1.000	1399	1.000	1424	1.000
1300	1.000	1325	1.000	1350	1.000	1375	1.000	1400	1.000	1425	1.000
1301	1.000	1326	1.000	1351	1.000	1376	1.000	1401	1.000	1426	1.000
1302	1.000	1327	1.000	1352	1.000	1377	1.000	1402	1.000	1427	1.000
1303	1.000	1328	1.000	1353	1.000	1378	1.000	1403	1.000	1428	1.000
1304	1.000	1329	1.000	1354	1.000	1379	1.000	1404	1.000	1429	1.000
1305	1.000	1330	1.000	1355	1.000	1380	1.000	1405	1.000	1430	1.000
1306	1.000	1331	1.000	1356	1.000	1381	1.000	1406	1.000	1431	1.000
1307	1.000	1332	1.000	1357	1.000	1382	1.000	1407	1.000	1432	1.000
1308	1.000	1333	1.000	1358	1.000	1383	1.000	1408	1.000	1433	1.000
1309	1.000	1334	1.000	1359	1.000	1384	1.000	1409	1.000	1434	1.000
1310	1.000	1335	1.000	1360	1.000	1385	1.000	1410	1.000	1435	1.000
1311	1.000	1336	1.000	1361	1.000	1386	1.000	1411	1.000	1436	1.000
1312	1.000	1337	1.000	1362	1.000	1387	1.000	1412	1.000	1437	1.000
1313	1.000	1338	1.000	1363	1.000	1388	1.000	1413	1.000	1438	1.000
1314	1.000	1339	1.000	1364	1.000	1389	1.000	1414	1.000	1439	1.000
1315	1.000	1340	1.000	1365	1.000	1390	1.000	1415	1.000	1440	1.000
1316	1.000	1341	1.000	1366	1.000	1391	1.000	1416	1.000		
1317	1.000	1342	1.000	1367	1.000	1392	1.000	1417	1.000		
1318	1.000	1343	1.000	1368	1.000	1393	1.000	1418	1.000		
1319	1.000	1344	1.000	1369	1.000	1394	1.000	1419	1.000		
1320	1.000	1345	1.000	1370	1.000	1395	1.000	1420	1.000		

Node 9 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	44.639	Product Number	CTL-SHE-0163-1330-1200-1330
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	13.3	Min Node Diameter (mm)	1500

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	44.748
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	525.0	0.0	1.725	1115.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.79%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	47.348	0.052	9.4	0.1140	0.0000	OK
15 minute winter	2	10	46.448	0.098	26.1	0.2806	0.0000	OK
15 minute winter	3	10	46.148	0.078	37.4	0.1820	0.0000	OK
1440 minute winter	11	1470	45.461	0.078	1.2	0.6607	0.0000	OK
1440 minute winter	12	1470	45.461	0.227	2.5	1.8201	0.0000	OK
1440 minute winter	4	1470	45.461	0.348	6.1	2.6666	0.0000	OK
1440 minute winter	5	1470	45.461	0.391	6.8	2.9947	0.0000	OK
1440 minute winter	6	1470	45.461	0.574	8.4	5.0651	0.0000	SURCHARGED
15 minute winter	26	10	46.146	0.093	30.3	0.3790	0.0000	OK
1440 minute winter	27	1470	45.461	0.235	5.0	1.1172	0.0000	OK
1440 minute winter	28	1470	45.461	0.346	5.0	0.6121	0.0000	OK
1440 minute winter	7	1470	45.461	0.686	14.3	2.3603	0.0000	SURCHARGED
1440 minute winter	8	1470	45.461	0.713	13.9	462.7325	0.0000	SURCHARGED
1440 minute winter	9	1470	45.461	0.822	0.6	1.4533	0.0000	SURCHARGED
15 minute summer	10	1	45.616	1.000	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	9.3	1.061	0.253	0.1969	
15 minute winter	2	1.001	3	25.7	1.497	0.203	0.3739	
15 minute winter	3	1.002	4	37.0	2.718	0.125	0.1335	
15 minute winter	11	2.000	12	14.6	0.698	0.053	0.4303	
15 minute winter	12	2.001	4	30.3	0.619	0.118	0.9567	
15 minute winter	4	1.003	5	75.7	1.065	0.332	0.6113	
15 minute winter	5	1.004	6	84.3	0.972	0.410	4.0336	
15 minute winter	6	1.005	7	98.4	0.807	0.612	5.3036	
15 minute winter	26	3.005	27	29.5	1.630	0.198	0.6872	
15 minute winter	27	3.006	28	61.1	1.180	0.232	0.8654	
15 minute winter	28	3.007	7	61.1	1.418	0.183	1.1294	
15 minute winter	7	1.006	8	171.7	1.394	1.069	1.0749	
15 minute winter	8	1.007	9	17.3	0.481	0.112	3.3090	
15 minute summer	9	Hydro-Brake®	10	0.0				0.0

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.79%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	47.406	0.110	32.1	0.2444	0.0000	OK
15 minute winter	2	10	46.554	0.204	89.2	0.5855	0.0000	OK
15 minute winter	3	12	46.417	0.347	128.4	0.8111	0.0000	SURCHARGED
15 minute winter	11	13	46.296	0.913	120.4	7.7014	0.0000	SURCHARGED
15 minute winter	12	13	46.291	1.057	93.5	8.4647	0.0000	SURCHARGED
15 minute winter	4	12	46.272	1.159	206.3	8.8761	0.0000	SURCHARGED
15 minute winter	5	12	46.209	1.139	209.1	8.7211	0.0000	SURCHARGED
15 minute winter	6	12	45.979	1.092	255.7	9.6310	0.0000	SURCHARGED
15 minute winter	26	11	46.242	0.189	103.7	0.7697	0.0000	OK
1440 minute winter	27	1050	45.978	0.752	13.4	3.5719	0.0000	SURCHARGED
1440 minute winter	28	1050	45.978	0.863	13.1	1.5251	0.0000	SURCHARGED
1440 minute winter	7	1050	45.978	1.203	38.3	4.1372	0.0000	SURCHARGED
1440 minute winter	8	1050	45.978	1.230	38.2	906.3356	0.0000	SURCHARGED
1440 minute winter	9	1050	45.977	1.338	13.3	2.3637	0.0000	SURCHARGED
15 minute summer	10	1	45.616	1.000	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	31.7	1.870	0.864	0.3544	
15 minute winter	2	1.001	3	88.4	1.988	0.700	1.2114	
15 minute winter	3	1.002	4	119.2	3.371	0.403	0.6897	
15 minute winter	11	2.000	12	-71.6	0.779	-0.259	3.2093	
15 minute winter	12	2.001	4	90.2	0.654	0.351	3.0187	
15 minute winter	4	1.003	5	191.0	1.205	0.838	1.3632	
15 minute winter	5	1.004	6	217.3	1.372	1.058	7.1341	
15 minute winter	6	1.005	7	267.0	1.685	1.662	6.7689	
15 minute winter	26	3.005	27	102.6	2.033	0.689	2.2191	
15 minute winter	27	3.006	28	198.1	1.489	0.751	2.6482	
15 minute winter	28	3.007	7	196.8	1.497	0.591	3.2072	
15 minute winter	7	1.006	8	491.6	3.103	3.060	1.3788	
15 minute winter	8	1.007	9	37.9	0.579	0.247	7.5368	
1440 minute winter	9	Hydro-Brake®	10	13.3				665.3

Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.79%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	12	48.234	0.938	44.5	2.0746	0.0000	SURCHARGED
15 minute winter	2	12	47.343	0.993	112.8	2.8500	0.0000	SURCHARGED
15 minute winter	3	13	47.153	1.083	156.3	2.5309	0.0000	SURCHARGED
15 minute winter	11	13	47.003	1.620	122.2	13.6702	0.0000	FLOOD RISK
15 minute winter	12	13	46.995	1.761	106.2	14.1026	0.0000	SURCHARGED
15 minute winter	4	13	46.969	1.856	244.9	14.2121	0.0000	SURCHARGED
15 minute winter	5	13	46.864	1.794	262.3	13.7287	0.0000	SURCHARGED
15 minute winter	6	12	46.484	1.597	322.0	14.0863	0.0000	FLOOD RISK
15 minute winter	26	11	46.950	0.897	143.7	3.6572	0.0000	SURCHARGED
15 minute winter	27	11	46.336	1.110	273.6	5.2703	0.0000	SURCHARGED
1440 minute winter	28	1110	46.316	1.201	17.6	2.1219	0.0000	SURCHARGED
1440 minute winter	7	1110	46.316	1.541	52.0	5.2989	0.0000	FLOOD RISK
1440 minute winter	8	1110	46.316	1.568	51.8	1245.9090	0.0000	FLOOD RISK
1440 minute winter	9	1110	46.315	1.676	13.4	2.9609	0.0000	FLOOD RISK
15 minute summer	10	1	45.616	1.000	0.0	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	34.9	1.982	0.952	0.3960	
15 minute winter	2	1.001	3	104.1	2.001	0.825	1.5310	
15 minute summer	3	1.002	4	148.8	3.326	0.503	0.6897	
15 minute winter	11	2.000	12	-66.1	0.781	-0.239	3.2093	
15 minute winter	12	2.001	4	104.1	0.657	0.405	3.0187	
15 minute winter	4	1.003	5	240.7	1.519	1.056	1.3632	
15 minute winter	5	1.004	6	276.6	1.746	1.347	7.1341	
15 minute winter	6	1.005	7	337.1	2.128	2.099	6.7689	
15 minute winter	26	3.005	27	128.3	2.030	0.862	2.6685	
15 minute winter	27	3.006	28	266.4	1.682	1.011	2.6482	
15 minute winter	28	3.007	7	263.9	1.666	0.792	3.2072	
15 minute winter	7	1.006	8	641.7	4.051	3.995	1.3891	
15 minute winter	8	1.007	9	47.3	0.617	0.308	7.5405	
180 minute winter	9	Hydro-Brake®	10	13.3				243.4

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.500
Ratio-R	0.300	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.073	5.00	48.646	1200	373579.669	436076.937	1.350
2	0.131	5.00	47.857	1200	373574.622	436055.014	1.507
3	0.091	5.00	47.579	1200	373553.423	436059.839	1.509
11	0.118	5.00	47.109	3000	373522.844	436080.478	1.726
12	0.128	5.00	47.961	3000	373542.195	436074.493	2.727
4	0.069	5.00	47.458	3000	373544.597	436055.593	2.345
5	0.069	5.00	47.428	3000	373540.747	436047.898	2.358
6	0.158	5.00	46.691	3000	373531.367	436003.860	1.804
26	0.236	5.00	48.097	1500	373605.848	436047.500	2.044
27	0.253	5.00	46.923	1500	373596.676	436010.732	1.697
28	0.000	5.00	46.785	1500	373593.195	435994.385	1.670
7	0.152	5.00	46.593	1500	373572.955	435994.085	1.818
8	0.000		46.474	1500	373571.516	435985.437	1.726
9	0.000		46.474	1500	373573.098	435937.872	1.835
10			46.168	1500	373573.032	435932.522	1.552

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)
1.000	1	2	22.496	0.600	47.296	46.350	0.946	23.8	150	5.18	50.0
1.001	2	3	21.741	0.600	46.350	46.070	0.280	77.6	300	5.38	50.0
1.002	3	4	9.794	0.600	46.070	45.383	0.687	14.3	300	5.42	50.0
2.000	11	12	20.255	0.600	45.383	45.234	0.149	135.9	450	5.19	50.0
2.001	12	4	19.052	0.600	45.234	45.113	0.121	157.5	450	5.39	50.0
1.003	4	5	8.604	0.600	45.113	45.070	0.043	200.1	450	5.52	50.0
1.004	5	6	45.026	0.600	45.070	44.887	0.183	246.0	450	6.10	50.0
1.005	6	7	42.721	0.600	44.887	44.780	0.107	400.0	450	6.81	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)
1.000	2.073	36.6	9.9	1.200	1.357	0.073	0.0
1.001	1.786	126.2	27.6	1.207	1.209	0.204	0.0
1.002	4.185	295.8	40.0	1.209	1.775	0.295	0.0
2.000	1.742	277.0	16.0	1.276	2.277	0.118	0.0
2.001	1.617	257.2	33.3	2.277	1.895	0.246	0.0
1.003	1.433	228.0	82.7	1.895	1.908	0.610	0.0
1.004	1.291	205.4	92.0	1.908	1.354	0.679	0.0
1.005	1.010	160.7	113.4	1.354	1.363	0.837	0.0

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)
3.005	26	27	37.895	0.600	46.053	45.376	0.677	56.0	300	5.30	50.0
3.006	27	28	16.714	0.600	45.226	45.115	0.111	150.0	450	5.47	50.0
3.007	28	7	20.242	0.600	45.140	44.925	0.215	94.1	450	5.63	50.0
1.006	7	8	8.767	0.600	44.775	44.753	0.022	400.0	450	6.95	50.0
1.007	8	9	47.591	0.600	44.748	44.639	0.109	436.6	450	7.77	50.0
1.008	9	10	5.350	0.600	44.639	44.616	0.023	232.6	225	7.88	50.0

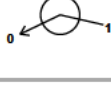
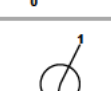
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
3.005	2.105	148.8	32.0	1.744	1.247	0.236	0.0
3.006	1.657	263.6	66.3	1.247	1.220	0.489	0.0
3.007	2.095	333.2	66.3	1.195	1.218	0.489	0.0
1.006	1.010	160.7	200.3	1.368	1.271	1.478	0.0
1.007	0.966	153.7	200.3	1.276	1.385	1.478	0.0
1.008	0.853	33.9	200.3	1.610	1.327	1.478	0.0

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)
1.000	22.496	23.8	150	Circular_Default Sewer Type	48.646	47.296	1.200	47.857	46.350	1.357
1.001	21.741	77.6	300	Circular_Default Sewer Type	47.857	46.350	1.207	47.579	46.070	1.209
1.002	9.794	14.3	300	Circular_Default Sewer Type	47.579	46.070	1.209	47.458	45.383	1.775
2.000	20.255	135.9	450	Circular_Default Sewer Type	47.109	45.383	1.276	47.961	45.234	2.277
2.001	19.052	157.5	450	Circular_Default Sewer Type	47.961	45.234	2.277	47.458	45.113	1.895
1.003	8.604	200.1	450	Circular_Default Sewer Type	47.458	45.113	1.895	47.428	45.070	1.908
1.004	45.026	246.0	450	Circular_Default Sewer Type	47.428	45.070	1.908	46.691	44.887	1.354
1.005	42.721	400.0	450	Circular_Default Sewer Type	46.691	44.887	1.354	46.593	44.780	1.363
3.005	37.895	56.0	300	Circular_Default Sewer Type	48.097	46.053	1.744	46.923	45.376	1.247
3.006	16.714	150.0	450	Circular_Default Sewer Type	46.923	45.226	1.247	46.785	45.115	1.220
3.007	20.242	94.1	450	Circular_Default Sewer Type	46.785	45.140	1.195	46.593	44.925	1.218
1.006	8.767	400.0	450	Circular_Default Sewer Type	46.593	44.775	1.368	46.474	44.753	1.271
1.007	47.591	436.6	450	Circular_Default Sewer Type	46.474	44.748	1.276	46.474	44.639	1.385
1.008	5.350	232.6	225	Circular_Default Sewer Type	46.474	44.639	1.610	46.168	44.616	1.327

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	1200	Manhole	Adoptable	2	1200	Manhole	Adoptable
1.001	2	1200	Manhole	Adoptable	3	1200	Manhole	Adoptable
1.002	3	1200	Manhole	Adoptable	4	3000	Manhole	Adoptable
2.000	11	3000	Manhole	Adoptable	12	3000	Manhole	Adoptable
2.001	12	3000	Manhole	Adoptable	4	3000	Manhole	Adoptable
1.003	4	3000	Manhole	Adoptable	5	3000	Manhole	Adoptable
1.004	5	3000	Manhole	Adoptable	6	3000	Manhole	Adoptable
1.005	6	3000	Manhole	Adoptable	7	1500	Manhole	Adoptable
3.005	26	1500	Manhole	Adoptable	27	1500	Manhole	Adoptable
3.006	27	1500	Manhole	Adoptable	28	1500	Manhole	Adoptable
3.007	28	1500	Manhole	Adoptable	7	1500	Manhole	Adoptable
1.006	7	1500	Manhole	Adoptable	8	1500	Manhole	Adoptable
1.007	8	1500	Manhole	Adoptable	9	1500	Manhole	Adoptable
1.008	9	1500	Manhole	Adoptable	10	1500	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
1	373579.669	436076.937	48.646	1.350	1200		0	1.000	47.296	150
2	373574.622	436055.014	47.857	1.507	1200		1	1.000	46.350	150
							0	1.001	46.350	300
3	373553.423	436059.839	47.579	1.509	1200		1	1.001	46.070	300
							0	1.002	46.070	300
11	373522.844	436080.478	47.109	1.726	3000		0	2.000	45.383	450
12	373542.195	436074.493	47.961	2.727	3000		1	2.000	45.234	450
							0	2.001	45.234	450
4	373544.597	436055.593	47.458	2.345	3000		1	2.001	45.113	450
							2	1.002	45.383	300
							0	1.003	45.113	450
5	373540.747	436047.898	47.428	2.358	3000		1	1.003	45.070	450
							0	1.004	45.070	450
6	373531.367	436003.860	46.691	1.804	3000		1	1.004	44.887	450
							0	1.005	44.887	450
26	373605.848	436047.500	48.097	2.044	1500		0	3.005	46.053	300
27	373596.676	436010.732	46.923	1.697	1500		1	3.005	45.376	300
							0	3.006	45.226	450
28	373593.195	435994.385	46.785	1.670	1500		1	3.006	45.115	450
							0	3.007	45.140	450
7	373572.955	435994.085	46.593	1.818	1500		1	3.007	44.925	450
							2	1.005	44.780	450
							0	1.006	44.775	450
8	373571.516	435985.437	46.474	1.726	1500		1	1.006	44.753	450
							0	1.007	44.748	450

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)	
9	373573.098	435937.872	46.474	1.835	1500	1  0	1	1.007	44.639	450
10	373573.032	435932.522	46.168	1.552	1500	1 	1	1.008	44.616	225

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	✓
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.300	Check Discharge Rate(s)	✓
Summer CV	0.750	Check Discharge Volume	✓
Winter CV	0.840	100 year 360 minute (m³)	
Analysis Speed	Detailed		

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 %)
1	0	0	0
30	40	0	0
100	50	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	IH124	Growth Factor 100 year	2.48
Positively Drained Area (ha)		Betterment (%)	0
SAAR (mm)		QBar	
Soil Index	1	Q 1 year (l/s)	
SPR	0.10	Q 30 year (l/s)	
Region	1	Q 100 year (l/s)	
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)		Storm Duration (mins)	360
Soil Index	1	Betterment (%)	0
SPR	0.10	PR	
CWI		Runoff Volume (m³)	

Node 9 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	44.639	Product Number	CTL-SHE-0163-1330-1200-1330
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	13.3	Min Node Diameter (mm)	1500

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	44.748
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	525.0	0.0	1.725	1115.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	47.348	0.052	9.4	0.1140	0.0000	OK
15 minute winter	2	10	46.448	0.098	26.1	0.2806	0.0000	OK
15 minute winter	3	10	46.148	0.078	37.4	0.1820	0.0000	OK
15 minute winter	11	10	45.452	0.069	15.1	0.5840	0.0000	OK
15 minute winter	12	11	45.337	0.103	31.0	0.8220	0.0000	OK
15 minute winter	4	11	45.325	0.212	75.6	1.6210	0.0000	OK
15 minute winter	5	11	45.272	0.202	84.0	1.5445	0.0000	OK
15 minute winter	6	12	45.190	0.303	103.4	2.6748	0.0000	OK
15 minute winter	26	10	46.146	0.093	30.3	0.3790	0.0000	OK
15 minute winter	27	10	45.388	0.162	61.9	0.7709	0.0000	OK
15 minute winter	28	11	45.281	0.166	61.1	0.2926	0.0000	OK
15 minute winter	7	12	45.136	0.361	171.5	1.2428	0.0000	OK
240 minute winter	8	184	45.006	0.258	46.6	147.4825	0.0000	OK
240 minute winter	9	184	45.005	0.366	14.1	0.6473	0.0000	SURCHARGED
15 minute summer	10	1	44.616	0.000	12.9	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	9.3	1.061	0.253	0.1969	
15 minute winter	2	1.001	3	25.7	1.497	0.203	0.3739	
15 minute winter	3	1.002	4	37.0	2.718	0.125	0.1335	
15 minute winter	11	2.000	12	14.6	0.698	0.053	0.4303	
15 minute winter	12	2.001	4	30.3	0.619	0.118	0.9567	
15 minute winter	4	1.003	5	75.7	1.065	0.332	0.6113	
15 minute winter	5	1.004	6	84.3	0.972	0.410	4.0336	
15 minute winter	6	1.005	7	98.4	0.807	0.612	5.3036	
15 minute winter	26	3.005	27	29.5	1.630	0.198	0.6872	
15 minute winter	27	3.006	28	61.1	1.180	0.232	0.8654	
15 minute winter	28	3.007	7	61.1	1.418	0.183	1.1294	
15 minute winter	7	1.006	8	171.7	1.394	1.069	1.0749	
30 minute summer	8	1.007	9	23.9	0.513	0.155	3.4901	
180 minute winter	9	Hydro-Brake®	10	13.3				226.3

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	47.406	0.110	32.1	0.2444	0.0000	OK
15 minute winter	2	10	46.554	0.204	89.2	0.5855	0.0000	OK
15 minute winter	3	12	46.417	0.347	128.4	0.8111	0.0000	SURCHARGED
15 minute winter	11	13	46.296	0.913	120.4	7.7014	0.0000	SURCHARGED
15 minute winter	12	13	46.291	1.057	93.5	8.4647	0.0000	SURCHARGED
15 minute winter	4	12	46.272	1.159	206.3	8.8761	0.0000	SURCHARGED
15 minute winter	5	12	46.209	1.139	209.1	8.7211	0.0000	SURCHARGED
15 minute winter	6	12	45.979	1.092	255.7	9.6310	0.0000	SURCHARGED
15 minute winter	26	11	46.242	0.189	103.7	0.7697	0.0000	OK
15 minute winter	27	11	45.850	0.624	213.8	2.9645	0.0000	SURCHARGED
15 minute winter	28	11	45.747	0.632	198.1	1.1162	0.0000	SURCHARGED
480 minute winter	7	456	45.697	0.922	82.7	3.1724	0.0000	SURCHARGED
480 minute winter	8	456	45.697	0.949	81.9	654.0464	0.0000	SURCHARGED
480 minute winter	9	456	45.696	1.057	14.1	1.8682	0.0000	SURCHARGED
15 minute summer	10	1	44.616	0.000	13.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute winter	1	1.000	2	31.7	1.870	0.864	0.3544	
15 minute winter	2	1.001	3	88.4	1.988	0.700	1.2114	
15 minute winter	3	1.002	4	119.2	3.371	0.403	0.6897	
15 minute winter	11	2.000	12	-71.6	0.779	-0.259	3.2093	
15 minute winter	12	2.001	4	90.2	0.654	0.351	3.0187	
15 minute winter	4	1.003	5	191.0	1.205	0.838	1.3632	
15 minute winter	5	1.004	6	217.3	1.372	1.058	7.1341	
15 minute winter	6	1.005	7	267.0	1.685	1.662	6.7689	
15 minute winter	26	3.005	27	102.6	2.033	0.689	2.2191	
15 minute winter	27	3.006	28	198.1	1.489	0.751	2.6482	
15 minute winter	28	3.007	7	196.8	1.497	0.591	3.2072	
15 minute winter	7	1.006	8	491.6	3.103	3.060	1.3750	
15 minute winter	8	1.007	9	50.0	0.660	0.325	7.5183	
15 minute summer	9	Hydro-Brake®	10	13.3				194.0

Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.84%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	12	48.234	0.938	44.5	2.0746	0.0000	SURCHARGED
15 minute winter	2	12	47.343	0.993	112.8	2.8500	0.0000	SURCHARGED
15 minute winter	3	13	47.153	1.083	156.3	2.5309	0.0000	SURCHARGED
15 minute winter	11	13	47.003	1.620	122.2	13.6702	0.0000	FLOOD RISK
15 minute winter	12	13	46.995	1.761	106.2	14.1026	0.0000	SURCHARGED
15 minute winter	4	13	46.969	1.856	244.9	14.2121	0.0000	SURCHARGED
15 minute winter	5	13	46.864	1.794	262.3	13.7287	0.0000	SURCHARGED
15 minute winter	6	12	46.484	1.597	322.0	14.0863	0.0000	FLOOD RISK
15 minute winter	26	11	46.950	0.897	143.7	3.6572	0.0000	SURCHARGED
15 minute winter	27	11	46.336	1.110	273.6	5.2703	0.0000	SURCHARGED
15 minute winter	28	12	46.152	1.037	266.4	1.8330	0.0000	SURCHARGED
600 minute winter	7	570	46.056	1.281	96.1	4.4041	0.0000	SURCHARGED
600 minute winter	8	570	46.055	1.307	95.7	980.7833	0.0000	SURCHARGED
600 minute winter	9	570	46.054	1.415	14.4	2.5003	0.0000	SURCHARGED
15 minute summer	10	1	44.616	0.000	13.3	0.0000	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	1	1.000	2	34.9	1.982	0.952	0.3960	
15 minute winter	2	1.001	3	104.1	2.001	0.825	1.5310	
15 minute summer	3	1.002	4	148.8	3.326	0.503	0.6897	
15 minute winter	11	2.000	12	-66.1	0.781	-0.239	3.2093	
15 minute winter	12	2.001	4	104.1	0.657	0.405	3.0187	
15 minute winter	4	1.003	5	240.7	1.519	1.056	1.3632	
15 minute winter	5	1.004	6	276.6	1.746	1.347	7.1341	
15 minute winter	6	1.005	7	337.1	2.128	2.099	6.7689	
15 minute winter	26	3.005	27	128.3	2.030	0.862	2.6685	
15 minute winter	27	3.006	28	266.4	1.682	1.011	2.6482	
15 minute winter	28	3.007	7	263.9	1.666	0.792	3.2072	
15 minute winter	7	1.006	8	641.7	4.051	3.995	1.3891	
15 minute summer	8	1.007	9	56.1	0.690	0.365	7.5405	
600 minute winter	9	Hydro-Brake®	10	14.4				622.6

Appendix E



Sustainable Drainage Maintenance & Management Plan

Housing Development Accrington Road, Whalley

1.0 Introduction

Sustainable drainage systems or SuDS are an environmentally friendly approach to managing rainfall that uses the landscape. SuDS aim to: -

- Control the flow, volume and frequency of water leaving a development site
- Prevent pollution by intercepting silt and cleaning runoff from hard surfaces
- Provide attractive surroundings for the community
- Create opportunities for wildlife

2.0 SuDS at Accrington Road, Whalley

Management and maintenance of the elements outlined in this document will be the responsibility of the management company. The management company that will be responsible until the development is complete are as follows:

Oakmere Homes (Northwest) Ltd
Helm Bank,
Natland, Kendal,
Cumbria. LA9 7PS

Upon completion of the development, the management and maintenance responsibilities will be passed over to a further management company, the details of which are as follows:

Trinity Property Group
Vantage Point
23 Mark Road
Hemel Hempstead
Hertfordshire
HP2 7DN

The management company will provide financial management through service charges paid by residents of the development. This will cover the routine maintenance outlined in this document, along with ensuring funding is available to replace major components when they reach the end of their design life.

The management company will also be responsible for the management and maintenance of the flood compensatory storage. A separate document is available for

The SuDS are designed to prevent flooding of the housing development and control the flow of water from the site. This site utilises attenuation in the form of an attenuation basin, along with a vortex flow control unit to slowly discharge surface water into the existing watercourse. The maintenance of the drainage network and attenuation features will be the responsibility of the management company once it has been handed over from the developer post construction.

The highway serving the site is constructed using a mixture of bituminous macadam and impermeable pavements. The maintenance of the main carriageways will be the responsibility of the management company.

Private shared access driveways are also constructed using impermeable pavements. The maintenance of these private shared access driveways will be the responsibility of the management company.

3.0 Managing the SuDS

The day-to-day surface water drainage and SuDS requiring management and maintenance for this site are summarised in Table 1 with the basin management in Table 2 and the compensatory storage in Table 3: -

Table 1 – Maintenance Schedule

	Maintenance Item	Action	Regularity
1	Monitoring Generally	Initial inspection of everything below to ensure the system is working effectively	After large storms and quarterly during first year
2	Impermeable Pavements	Brushing/sweeping of surface area to clear litter, grass cuttings, leaves and other debris	Once per year after Autumn leaf fall and as required
3	Impermeable Pavements	Removal of weeds using glyphosphate applied directly into weeds using an applicator	Annually and/or as required
4	Impermeable Pavements	Remedial work to depressions and cracked or broken block pavers. Replace blocks and replace jointing material	As required
5	Manholes, Geocellular Tanks, Pipes etc	Lift manhole covers, visual inspection. If debris/silt has built up arrange jetting. Arrange CCTV survey if performance deteriorates.	Annually and/or as required
6	Flow Control (Hydro-Brake)	Lift manhole cover, clear silt from silt trap, inspect Hydro-brake for blockages	Annually
8	Inlets and Outlets	Inspect and remove silt, litter and debris. Strim for 1m around	Monthly

Table 2 – Attenuation Basin Maintenance Schedule

	Maintenance Item	Action	Regularity
1	Litter Management	Pick up all litter in SuDS and landscape areas and remove from site	Monthly
2	Grass Maintenance	Cut grass to side slopes and surrounding areas at 100mm	As required or monthly
3	Basin Vegetation Maintenance	Monitor basin vegetation and cut 30% of edge at 100mm each year if necessary in September-November	Annually
4	Inlet & Outlets	Inspect and remove silt, litter and debris. Strim for 1m around	Monthly
5	Silt Management	a)Inspect base of basin for silt accumulation	Annually
		b)Excavate silt taking care not to damage basin integrity. Set a side silt and allow to dry within 10m of SuDS feature. Spread, rake and overseed.	As necessary
6	Basin Monitoring	Check and reinstate design levels. Check for ponding and inspect for structural issues, repairing as required.	Within first 12 months and then as necessary
7	Outlets	Inspect and remove silt, litter and debris. Strim for 1m around	Monthly

A record of all inspections and maintenance undertaken at the site should be recorded. This should be kept as part of the health and safety file. A template to record the items listed above can be seen on the next page of this document. Access to the maintenance file will be available upon request and electronically forwarded to the Local Planning Authority.

Appendix F

Table 1: SuDS Maintenance Inspection Checklist

GENERAL INFORMATION			
Site ID			
Site Location and co-ordinates (GIS if appropriate)			
Elements forming the SuDS scheme		Approved Drawing Reference(s)	
Inspection frequency		Approved Specification Reference	
Type of development		Specific purpose of any parts of the scheme (e.g. biodiversity, wildlife and visual aspects)	

	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
GENERAL INSPECTION ITEMS								
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?								
Is there any evidence of accidental spillages, oils, poor water quality, odours, nuisance insects?								
Have any health and safety risks been identified to either the public or maintenance operatives?								
Is there any deterioration in the surface of permeable or porous surfaces (e.g. rutting, spreading of blocks or signs of ponding water)?								

	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
SILT/SEDIMENT ACCUMULATION								
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If yes, state depth (mm) and extent Is removal required? If yes, state waste disposal requirements and confirm all waste management requirements have been complied with (consult Environment Agency or SEPA).								
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (e.g. under-drained swale or infiltration basin)?								
Does permeable or porous surfacing require sweeping to remove silt?								
SYSTEM BLOCKAGES / LITTER BUILD UP								
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?								
Is there any evidence of any other clogging/blockage of outlets or drainage paths?								
VEGETATION								

	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
Is the vegetation condition satisfactory (density, weed growth, coverage etc.)? (Check against approved planting regime.)								
Does any part of the system require weeding / pruning / mowing? (Check against maintenance frequency stated in approved design.)								
Is there any evidence of invasive species becoming established? If yes, state action required.								
INFRASTRUCTURE								
Are any check dams or weirs in good condition?								
Is there evidence of any accidental damage to the system (e.g. wheel ruts?)								
Is there any evidence of cross connections or other unauthorised inflows?								
Is there any evidence of tampering with the flow controls?								
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)								
OTHER OBSERVATIONS								
Information appended (e.g. photos)								

	Inspection date				Inspection date			
	Details	Y/N	Action required	Date Completed	Details	Y/N	Action required	Date Completed
SUITABILITY OF CURRENT MAINTENANCE REGIME								
Continue as current								
Increase maintenance								
Decrease maintenance								
NEXT INSPECTION								
Proposed date for next inspection								

Appendix G



Householder Sustainable Drainage Maintenance Plan

Housing Development Accrington Road, Whalley

1.0 Introduction

Sustainable drainage systems or SuDS are aimed to: -

- Control the flow, volume and frequency of water leaving a development site
- Prevent pollution by intercepting silt and cleaning runoff from hard surfaces

2.0 Surface water drainage & SuDS serving this property

House roof and impermeable driveway surfaces are served by an attenuation basin. A management company is responsible for the maintenance and upkeep of this basin.

As the property owner you are responsible for maintenance and upkeep of the system serving your house and impermeable driveways until it discharges into the public sewer. Silt traps and trapped gullies protect the system from silting and blocking up as well as enhancing water quality. These features are key to ensuring the systems longevity.

SuDS features should not be interfered with in any fashion without the prior approval of the Lead Local Flood Authority (Lancashire County Council).

3.0 Management & Maintenance

The surface water drainage and SuDs requiring management and maintenance for this property are summarised in Table 1 below: -

Table 1 – Householder Maintenance Schedule

Maintenance Item	Regularity	Action	Purpose	Diagram
ACO or similar channel to driveway	Monthly	Remove litter, grass cuttings and other vegetation from the surface of the grills	Prevent grills becoming blocked allowing water to get away	
ACO or similar channel to driveway	Annually	Remove debris, grass cuttings etc from inside the channel itself. This can be easily done by lifting the lid to the corner unit and cleaning out the sump by hand wearing a suitable pair of gloves	Prevent the silt trap filling up and debris entering the tank	 Corner unit Sump unit
Gullies to downspouts	Monthly	Remove litter, grass cuttings and other vegetation from the gulley grate	Prevent grate/cover becoming blocked allowing water to get away	
Gullies to downspouts	Annually	Remove debris, grass cuttings etc from inside the gulley itself. This can be easily done by lifting the cover and cleaning out the gulley by hand wearing a suitable pair of gloves	Prevent the trap filling up and debris entering the tank	
Inspection Chambers	Annually	-Remove silt from base of silt trap manhole	Prevent inspection chamber blocking up and affecting the performance of the system	

Appendix H



Compensatory Storage Maintenance & Management Plan

Housing Development Accrington Road, Whalley

1.0 Purpose

The purpose of this maintenance plan is to ensure that the compensatory flood storage areas remain operational and provide the designed flood storage volume by preventing loss of capacity due to siltation, vegetation encroachment, erosion, or obstruction.

2.0 Asset Description

Asset: Compensatory flood storage basin and outfall pipes

Function: To provide replacement floodplain storage and maintain flood flow conveyance by offsetting any loss of flood storage resulting from development.

3.0 Access

Permanent access shall be maintained to all compensatory storage areas to allow routine inspection, vegetation management, sediment removal and emergency maintenance works.

The development site is served by a network of highways including a road which runs up to the north-west corner of the attenuation basin. This road features a turning head which will provide ample space for vehicles to park and load/unload any maintenance plant/equipment.

Any access into the basin should be from the western edge where the slope height is at it's lowest. Pedestrian access around the entire basin is available and should be maintained at all times.

4.0 Maintenance Responsibilities

Management and maintenance of the elements outlined in this document will be the responsibility of the management company.

The management company that will be responsible until the development is complete are as follows:

Oakmere Homes (Northwest) Ltd
Helm Bank,
Natland, Kendal,
Cumbria. LA9 7PS

Upon completion of the development, the management and maintenance responsibilities will be passed over to a further management company, the details of which are as follows:

Trinity Property Group
Vantage Point
23 Mark Road
Hemel Hempstead
Hertfordshire
HP2 7DN

Contact details shall be updated and retained throughout the life of the development.

The management company will provide financial management through service charges paid by residents of the development. This will cover the routine maintenance outlined in this document, along with ensuring funding is available for major works as and when required.

5.0 Inspection Requirements

Activity	Frequency
Visual inspection of storage areas	Twice yearly
Inspection following significant flood events	Within 14 days
Check for accumulation of debris	Twice yearly
Check for excessive sediment build-up	Annually
Check for erosion, scour or bank instability	Annually
Survey storage levels and capacity	Every 5 years

6.0 Routine Maintenance

Activity	Frequency
Remove litter and debris	Twice yearly and after flood events
Cut grass and control vegetation as required	1-3 times annually
Remove invasive species	As required
Clear blocked flow paths and inlets/outlets	Twice yearly
Repair minor erosion and damaged ground surfaces	As required
Reinstate access routes for maintenance vehicles	As required

7.0 Sediment Management

- Sediment accumulation shall be monitored during annual inspections.
- Where sediment deposition reduces storage capacity or impedes flow, material shall be removed and disposed of in accordance with relevant regulations.
- Removed material shall not be stockpiled within the floodplain where it could reduce storage volume.

8.0 Vegetation Management

- Vegetation shall be managed to maintain storage capacity and allow free movement of floodwater.
- Trees and scrub shall not be permitted to establish where they could displace flood storage or obstruct flow.
- Existing ecological features shall be retained where compatible with flood storage requirements.

9.0 Remedial Works

Where inspections identify defects, the following response times shall apply

Defect	Actionable Timescale
Blocked flow routes	Within 1 month
Significant erosion/scour	Within 3 months
Loss of storage capacity	Within 6 months
Structural defects affecting function	Immediate assessment and repair

10.0 Record Keeping

A record of all inspections and maintenance undertaken at the site should be recorded. This should be kept as part of the health and safety file. A template to record the items listed above can be seen on the next page of this document. Access to the maintenance file will be available upon request and electronically forwarded to the Local Planning Authority or Environment Agency.

11.0 Review

Where inspections recommend changes to the maintenance and management plan, the document should be updated accordingly.

The maintenance plan shall be reviewed every five years or following a significant flood event to ensure the compensatory storage areas continue to operate as designed.