

Highfield House, Manchester Road, Heywood, Rochdale OL10 2AN

Discharge of Condition Report

Technical Note – Foul and Surface Water Drainage

Project ref: 5852 – Highfield House, Manchester Road, Heywood, Rochdale
Prepared by: Geoff Waite BSc CEng C.WEM MICE MCIWEM *Consultant*
Approved by: Tim Brook BSc (Hons) *Technical Director*
Date: 28 June 2023
Version: Final v1.0

Introduction

1. Weetwood Services Ltd ('Weetwood') has been instructed by Highfield House Care Home (Heywood) Ltd to prepare a Technical Note in association with the proposed redevelopment of Highfield House, Manchester Road, Heywood OL10 2AN. The site is presently a care home and is located at Ordnance Survey National Grid Reference SD 861 100 as shown in **Figure 1**.
2. Planning permission was granted by Rochdale Borough Council on 17 February 2021 (reference 17/00886/FUL) for the demolition of an existing single storey rear extension and the erection of a new two storey rear extension to provide 40 bedrooms. It should be noted that application reference 17/00886/FUL was a resubmission of a previous application under reference 15/01457/FUL.
3. Details of the proposed development are provided in **Annex 1**.

Drainage Information submitted to support the Planning Application and Consultation Responses

4. The planning application appears to have been supported by a Flood Risk Assessment (FRA) dated 21 August 2017. This document has not been reviewed because it is not available on the planning portal. It is presumed that the FRA may have been produced by Mike Lambert Associates because there is subsequent drainage related correspondence from this company in January 2018.
5. United Utilities (UU) provided a consultation response to the planning application on 15 September 2017 (see **Annex 2**). The key points from this response were as follows:
 - Foul Water: Foul and surface water shall be drained on separate systems.
 - Surface Water: The surface water scheme must be in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015). This means that the surface water disposal hierarchy must be followed. UU stated that in the event that surface water drains to the public sewer the flow rate must be restricted to 6.5 l/s.
6. A copy of UU's sewer records is provided in **Annex 3**. The records indicate that the site is served by a 375 mm diameter public combined sewer located in Manchester Road. The sewer runs in a northerly direction. There are no public surface water sewers in the vicinity of the site apart from a 150 mm diameter public surface water sewer in Isherwood Street to the north which is remote from the site. This surface water sewer subsequently discharges into a 300 mm diameter public combined sewer.
7. It is presumed that the FRA referred to in **paragraph 4** was deemed to be unsatisfactory. Mike Lambert Associates prepared a further submission dated 11 January 2018 addressing sustainable drainage (see details in **Annex 4**). This further submission was informed by infiltration testing and supporting calculations. A CCTV sewer survey is also referred to but there are no details of this survey available.
8. The infiltration testing was carried out in two trial pits located to the rear of the property. The pit dimensions were 1.2 m long, 0.6 m wide and 1.5 m deep. The report indicates that water fell evenly at a rate of 2 inches (50.8 mm) per hour. The infiltration rate was estimated as 2.9×10^{-6} m/sec (equivalent to 0.01 m/hr). It should be noted that the water level measurements in the test pits were not fully in accordance with BRE365.

9. It is assumed that the Mike Lambert Associates correspondence dated 11 January 2018 was deemed acceptable from a drainage perspective because there is no further correspondence available and planning permission was granted on 17 February 2021. The permission included two conditions relating to foul and surface water drainage:

Condition 5: *'Prior to the commencement of any development, a surface water drainage scheme, based on the hierarchy of drainage options in the National Planning Practice Guidance (NPPG) with evidence of an assessment of the site conditions shall be submitted to and approved in writing by the Local Planning Authority.*

'The surface water drainage scheme must be in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards and unless otherwise agreed in writing by the Local Planning Authority, no surface water shall discharge to the public sewerage system either directly or indirectly.'

Reason for pre-commencement condition: *'This application proposes to develop the site. The condition would ensure appropriate drainage of the site in the interest of future occupiers.'*

Condition 10: *'Foul and surface water shall be drained on separate systems, at least to the exit point(s) from the site. The drainage connection details shall be approved by United Utilities.'*

Reason: *'To ensure the appropriate disposal of foul and surface waters and to manage the risk of flooding and pollution in accordance with Policy G8 of the adopted Rochdale Core Strategy and the National Planning Policy Framework.'*

Previous Application to Discharge Conditions 5 and 10 – October 2022

10. An application to discharge conditions 5 and 10 was made in October 2022 (reference 22/01320/DOC) but this was rejected both by UU¹ and Rochdale Borough Council². UU objected to the discharge of Condition 5 on the grounds that the condition states that surface water must not discharge into the public sewer and that insufficient details on the proposed drainage arrangements were provided. UU requested further information with regard to finished floor levels, manhole cover/invert levels and details of a proposed discharge rate/flow control arrangement in the event of surface water discharging into the public sewer.
11. Rochdale Borough Council's Drainage Engineer agreed with UU and added that there is no indication that infiltration testing in accordance with BRE365 has been undertaken on site.

Application to Discharge Conditions 5 and 10 – Additional Information

12. This Technical Note provides additional details and information to support an application to discharge Conditions 5 and 10. The details provided include a proposed drainage layout and full hydraulic calculations which take account of:
- Further correspondence with Rochdale Borough Council post December 2022
 - Reference to UU sewer records
 - Reference to the infiltration potential at the site
13. It was not clear from earlier correspondence whether the drainage engineer at Rochdale Borough Council had previously reviewed the details produced by Mike Lambert Associates dated 11 January 2018. This information was provided to the drainage engineer on 29 March 2023 and the engineer responded by email³. The drainage engineer referenced that the timing for the fall of water levels within the test pits and supporting calculations were missing but he did state that he is *'.... happy to assume that there is permeability capacity in the soil, because the tester mentioned sand in the report. My reasoning:- the soakaway will reduce discharge to the combined sewer, because your proposal is to build the soakaway and only the overflow from the soakaway will discharge to the combined sewer.'*

¹ United Utilities letter to Rochdale Borough Council, 31 October 2022, Reference DC/22/3658

² Rochdale Council Refusal Notice, 1 December 2022, Reference 22/1320/DOC

³ Email from Rochdale Borough Council Drainage Engineer, 5 April 2023

‘You can progress with your drainage design and send your final proposals to Planning and myself.’

14. It is therefore proposed to progress the designs using an infiltration rate of 0.01 m/hr with an overflow into the public combined sewer. It is, however, recommended that the infiltration tests are repeated prior to finalising the detailed drainage designs because:
 - The earlier infiltration tests were carried out in test pits to the rear of the property. There is no space post development to accommodate infiltration components at the rear of the property because of the close proximity of building foundations.
 - Surface water runoff will be directed to the front of the property where there is space in the car park to accommodate attenuation storage with infiltration potential.
15. UU’s sewer records indicate a 375 mm diameter public combined sewer in Manchester Road running from south to north. The nearest manhole to the site is located at the junction of Manchester Road and Stamford Street. It should be noted that there are no cover or invert levels provided on the sewer records. Ordnance Survey mapping indicates a spot height of 137.20 m Above Ordnance Datum (m AOD) a short distance to the south of Stamford Street. Assuming a depth of cover from ground level to the soffit of the sewer of 1.20 m, the invert level of the 375 mm diameter sewer at the junction with Stamford Street would be 135.625 m AOD. Ground levels at the site entrance are 137.40 m AOD meaning that a gravity connection to the public combined sewer is feasible. It is also likely that the site is served by an existing connection to the 375 mm diameter sewer and this connection could be reused if levels are favourable.

Foul Drainage Design

16. Pipe sizes, materials and gradients have been designed in compliance with the “small developments” requirements in Sewers for Adoption⁴.

Surface Water Drainage Design

17. The existing site discharges surface water at unrestricted flow rates into the public combined sewer in Manchester Road. The existing site comprises 0.152 hectares (ha) of impermeable surfaces and the runoff rates from these surfaces have been calculated using the Modified Rational Method. Details of the input parameters and the output results are provided in **Annex 5**. The runoff rates from the existing site are presented in **Table 1**.

Table 1: Existing Site Runoff Rates

AEP of Rainfall Event	Peak discharge for 0.152 ha impermeable area (l/s)
1 in 1	22.8
1 in 2	29.2
1 in 30	53.1
1 in 100	67.0

18. The proposed foul and surface water drainage layout is provided in **Annex 6** and supporting hydraulic calculations are provided in **Annex 7**.
19. The design includes an online cellular infiltration tank located in the car park to the front of the property. The tank is located a minimum distance of 5.90 m from the existing Highfield House and a minimum distance on 5.0 m from the site boundary. The tank has a plan area of 130 m², an invert level of 136.25 m and is 0.8 m deep. There is 1.10 m of cover from ground level to the soffit of the tank.
20. The total impermeable area draining to the tank is 0.187 ha which includes all existing impermeable areas that will remain post development.
21. The design is based upon an infiltration rate of 0.01 m/hr and the rate of overflow to the public sewer is controlled by a Hydro-Brake. The invert level of the Hydro-Brake is set at 136.65 m which is 0.4 m above the

⁴ Sewers for Adoption 7th Edition, Water UK, 2012

invert level of the tank. This maximises the infiltration potential of the tank whilst minimising flood risk at the site during extreme events.

22. The peak rate discharged into the public sewer is controlled by the Hydro-Brake to a maximum of 6.5 l/s. This is the peak flow rate as set out in UU's planning application consultation response dated 15 September 2017. The results are discussed in more detail below and it should be noted that the rate of 6.5 l/s only occurs during the more extreme rainfall events.
23. The proposed surface water network has been analysed using the Causeway Flow software. The tank has been sized to accommodate the 1 in 100 annual exceedance probability (AEP) event including a 45% increase in rainfall intensity to take account of climate change (see **Annex 7**). Results are also provided for the 1 in 1 AEP event, the 1 in 2 AEP event and the 1 in 30 AEP event plus 40% climate change. All results are summarised in **Table 2**.

Table 2: Causeway Flow Results

AEP Event	Peak Flow Rate to Public Sewer (l/s)	Water Level in Tank (m AOD)	Depth of Water in Tank (m)
1 in 1	0.0	136.610	0.360
1 in 2	0.3	136.672	0.422
1 in 30 plus 40%	6.3	136.835	0.585
1 in 100 plus 45%	6.5	137.020	0.770

24. The results shown that no flow is discharged into the public sewer for the 1 in 1 AEP event because the water level in the tank is always below the invert level of the Hydro-Brake. The maximum flow rate discharged for the 1 in 2 AEP event is 0.3 l/s. This provides betterment for these events when compared to the existing situation.

Exceedance Flow Routes, Pollution Control and Maintenance

25. Flows resulting from rainfall in excess of the 1 in 100 AEP rainfall event including an allowance for climate change will be managed in exceedance routes. The overland flow routes are indicated on the drainage layout in **Annex 6**. Flows would be directed away from built development into the car park at the front of the property and then onto the public highway.
26. Pollution control will be provided in catch pit manholes. This will minimise the amount of silt discharged into the cellular infiltration tank.
27. The foul and surface water pipe networks at the site will serve one property. All drainage assets will be private and maintained by the property owner. An indicative maintenance schedule is provided in **Table 3**.

Table 3: Maintenance Requirements

Schedule	Required action	Frequency
Geo-cellular infiltration/attenuation tank		
Regular maintenance	Inspect and identify any areas that are not operating correctly	Monthly for 3 months, then annually
	Remove debris from the catchment surface	Monthly
	Remove sediment from internal forebays	Annually, or as required
Remedial action	Repair inlet/outlet and vents	As required
	Reconstruct infiltration structure and/or replace void fill, if performance deteriorates or failure occurs	
	Replacement of clogged geotextile (will require reconstruction)	
Monitoring	Inspect catchpit manholes and note rate of sediment accumulation	Monthly in the first year and then annually
	Inspect inlet/outlet and vents to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years, or as required
	Check infiltration tank to ensure emptying is occurring	Annually

Schedule	Required action	Frequency
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years, or as required
Flow Control Unit		
Routine maintenance	Remove litter and debris and inspect for sediment accumulation	Six Monthly
	Remove sediment from sump	As necessary – Indicated by system inspections
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six Monthly
	Inspect flow control unit and establish appropriate replacement frequencies	Six Monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first year of operation, then every six months

Summary and Conclusions

28. This Technical Note has been prepared to accompany an application to discharge conditions 5 and 10 of planning permission reference 17/00886/FUL.
29. Foul water and surface water is to be drained in separate systems as far as the site entrance from where there will be a connection into the public combined sewer.
30. There is the potential to infiltrate surface water runoff at the site. Percolation tests were previously carried out to the rear of the property. The test measurements were not fully in accordance with the requirements of BRE365 but calculations suggest the rate of infiltration is 2.9×10^{-6} m/sec (0.01 m/hr). It is recommended that further BRE365 tests are carried out in the car park at the front of the property prior to finalising the drainage designs.
31. It is proposed to use an online geocellular infiltration tank to collect and infiltrate surface water. There is an overflow to the combined sewer with flows controlled by a Hydro-Brake.
32. The peak flow rate discharged into the public combined sewer is 6.5 l/s for the extreme rainfall events. All the runoff from the 1 in 1 AEP event and the majority of runoff from the 1 in 2 AEP event is retained on site to be infiltrated. The peak flow discharged into the public combined sewer for the 1 in 2 AEP event is 0.3 l/s. This provides significant betterment during these two events in comparison with the existing situation.

This document has been prepared solely as a Technical Note for Highfield House Care Home (Heywood) Ltd and is confidential to Highfield House Care Home (Heywood) Ltd. Weetwood Services Ltd accepts no responsibility or liability for any use that is made of this document other than by Highfield House Care Home (Heywood) Ltd for the purposes for which it was originally commissioned and prepared.

FIGURES



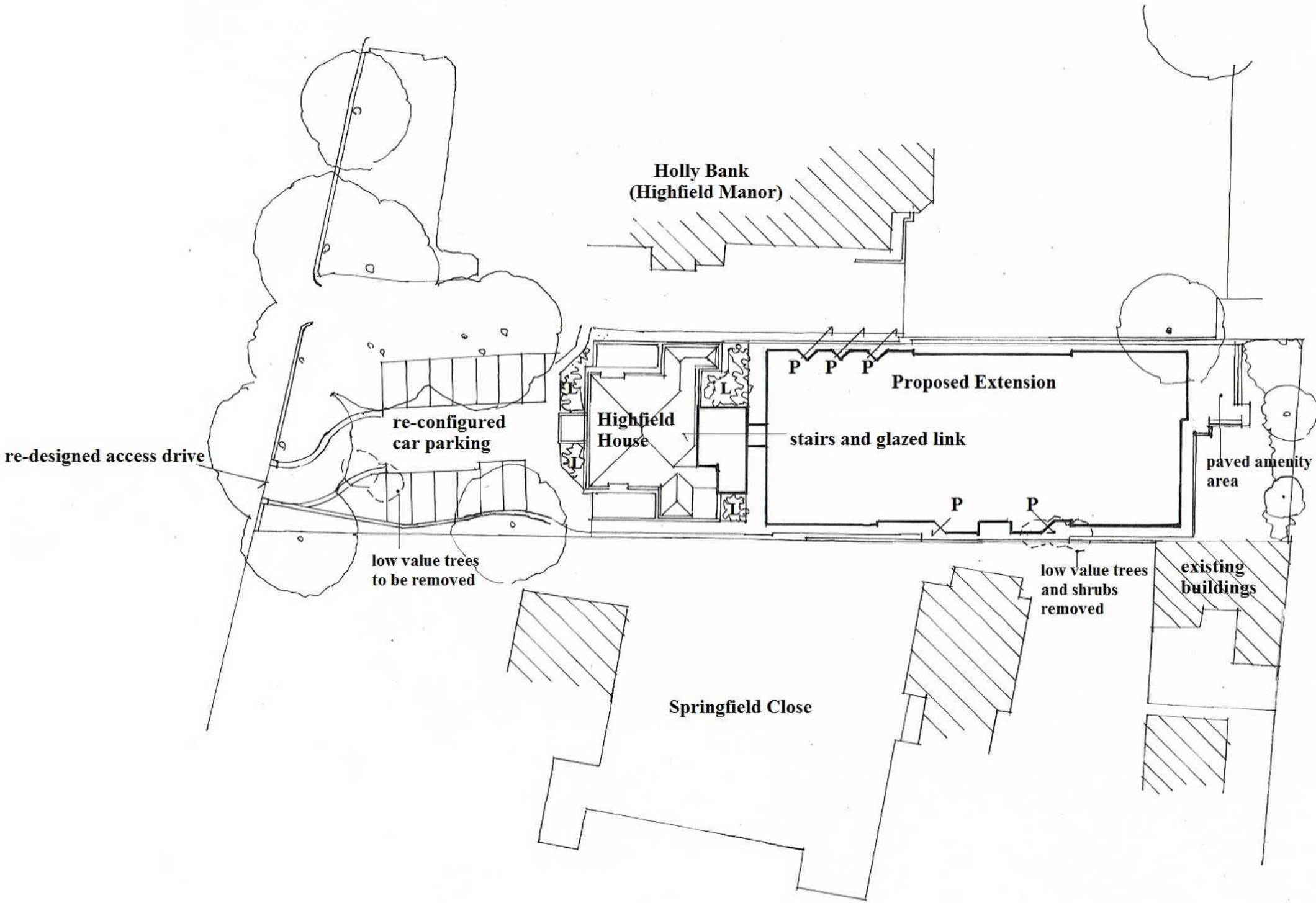
Figure 1: Site Location

ANNEX 1

Development Proposals

Proposed Rear Extension
Highfield House
Manchester Road
Heywood

Proposed Site Layout
reference HH01/0717/01
scale 1:500@A3



- key
- L landscaping
 - P prospect

ANNEX 2

United Utilities Planning Consultation Response 15 September 2017



**United Utilities Water Limited
Developer Services & Planning**
Warrington North WWTW
Barnard Street off Old Liverpool Road
Gatewarth Industrial Estate
Sankey Bridges
Warrington
WA5 1DS

Telephone: 01925 679345
Planning.liaison@uuplc.co.uk

Rochdale MBC
PO Box 32 Telegraph House, Baillie Street
Rochdale
OL16 1JH

Your ref: 17/00886/ful
Our ref: DC/17/3462
Date: 15-SEP-17

Dear Sir/Madam,

Location: Highfield House Manchester Road Heywood OL10 2AN

Proposal: Demolish existing extension & erection of new three storey rear extension to provide 60 bedrooms

Drainage Conditions

United Utilities will have no objection to the proposed development provided that the following conditions are attached to any approval:

Foul Water

Condition 1

Foul and surface water shall be drained on separate systems.

Reason: To secure proper drainage and to manage the risk of flooding and pollution.

Surface Water

Condition 2

Prior to the commencement of any development, a surface water drainage scheme, based on the hierarchy of drainage options in the National Planning Practice Guidance with evidence of an assessment of the site conditions shall be submitted to and approved in writing by the Local Planning Authority.

The surface water drainage scheme must be in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015) or any subsequent replacement national standards. In the event of surface water draining to the combined public sewer, the pass forward flow rate to the public sewer must be restricted to 6.5l/s.

Reason: To promote sustainable development, secure proper drainage and to manage the risk of flooding and pollution. This condition is imposed in light of policies within the NPPF and NPPG.

The applicant can discuss any of the above with Developer Engineer, **Will Harrison**, by email at wastewaterdeveloperservices@uuplc.co.uk.

Management and Maintenance of Sustainable Drainage Systems

Without effective management and maintenance, sustainable drainage systems can fail or become ineffective. As a provider of wastewater services, we believe we have a duty to advise the Local Planning Authority of this potential risk to ensure the longevity of the surface water drainage system and the service it provides to people. We also wish to minimise the risk of a sustainable drainage system having a detrimental impact on the public sewer network should the two systems interact. We therefore recommend the Local Planning Authority include a condition in their Decision Notice regarding a management and maintenance regime for any sustainable drainage system that is included as part of the proposed development.

For schemes of 10 or more units and other major development, we recommend the Local Planning Authority consults with the Lead Local Flood Authority regarding the exact wording of any condition. You may find the below a useful example.

Example condition

Prior to occupation of the development a sustainable drainage management and maintenance plan for the lifetime of the development shall be submitted to the local planning authority and agreed in writing. The sustainable drainage management and maintenance plan shall include as a minimum:

- a. Arrangements for adoption by an appropriate public body or statutory undertaker, or, management and maintenance by a resident's management company; and*
- b. Arrangements for inspection and ongoing maintenance of all elements of the sustainable drainage system to secure the operation of the surface water drainage scheme throughout its lifetime.*

The development shall subsequently be completed, maintained and managed in accordance with the approved plan.

Reason: To ensure that management arrangements are in place for the sustainable drainage system in order to manage the risk of flooding and pollution during the lifetime of the development.

Please note, United Utilities cannot provide comment on the design, management and maintenance of an asset that is not in our ownership and therefore should the suggested condition be included in the Decision Notice, we will not be involved in discharging this condition.

Water Comments

Any necessary disconnection or diversion of the private main must have the approval of the pipeline owner and be carried out to our standards at the applicant's expense.

Our records show that there is a private water main within the site.

The applicant must undertake a complete soil survey, as and when land proposals have progressed to a scheme design i.e. development, and results submitted along with an application for water. This will aid in our design of future pipework and materials to eliminate the risk of contamination to the local water supply.

Water pressure in this area is regulated to around 2 bar. This should be taken into account when designing the internal plumbing.

Pump fed storage of 24 hours capacity is advised for developments of three stories and over.

A domestic water supply can be made available to the proposed development.

The level of cover to the water mains and sewers must not be compromised either during or after construction.

A separate metered supply to each unit will be required at the applicant's expense and all internal pipe work must comply with current water supply (water fittings) regulations 1999.

Should this planning application be approved, the applicant should contact United Utilities on 03456 723 723 regarding connection to the water mains or public sewers.

General comments

It is the applicant's responsibility to demonstrate the exact relationship between any United Utilities' assets and the proposed development. United Utilities offer a fully supported mapping service and we recommend the applicant contact our Property Searches Team on Property.Searches@uuplc.co.uk to obtain maps of the site.

Due to the public sewer transfer, not all sewers are currently shown on the statutory sewer records, if a sewer is discovered during construction; please contact a Building Control Body to discuss the matter further.

Supporting information

United Utilities wishes to draw attention to the following as a means to facilitate sustainable development within the region.

Site drainage

In accordance with the National Planning Policy Framework (NPPF) and the National Planning Practice Guidance (NPPG), the site should be drained on a separate system with foul water draining to the public sewer and surface water draining in the most sustainable way.

The NPPG clearly outlines the hierarchy to be investigated by the developer when considering a surface water drainage strategy. We would ask the developer to consider the following drainage options in the following order of priority:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer.

The comments made in this letter regarding site drainage reflect this approach.

If the applicant intends to offer wastewater assets forward for adoption by United Utilities, the proposed detailed design will be subject to a technical appraisal by an Adoptions Engineer as we need to be sure that the proposal meets the requirements of Sewers for adoption and United Utilities' Asset Standards. The proposed design should give consideration to long term operability and give United Utilities a cost effective proposal for the life of the assets. Therefore, should this application be approved and the applicant wishes to progress a Section 104 agreement, we strongly recommend that no construction commences until the detailed drainage design, submitted as part of the Section 104 agreement, has been assessed and accepted in writing by United Utilities. Any works carried out prior to the technical assessment being approved is done entirely at the developers own risk and could be subject to change.

Justification for Pre-commencement condition

If a 'Pre-commencement' condition has been requested in this correspondence, please consider the following information as justification of this request.

In accordance with the Town and Country Planning (Development Management Procedure) (England) Order 2015 Part 6, we have been asked to provide written justification for any pre-commencement condition we may have recommended to you in respect of surface water disposal.

The purpose of the planning system is to help achieve sustainable development. This includes securing the most sustainable approach to surface water disposal in accordance with the surface water hierarchy.

It is important to explain that the volume arising from surface water flows can be many times greater than the foul flows from the same development. As a result they have the potential to use up a significant volume of capacity in our infrastructure. If we can avoid and manage surface water flows entering the public sewer, we are able to significantly manage the impact of development on wastewater infrastructure and, in accordance with Paragraph 103 of the NPPF, minimise the risk of flooding. Managing the impact of surface water on wastewater infrastructure is also more sustainable as it reduces the pumping and treatment of unnecessary surface water and retains important capacity for foul flows.

As our powers under the Water Industry Act are limited, it is important to ensure explicit control over the approach to surface water disposal in any planning permission that you may grant.

Our reasoning for recommending this as a pre-commencement condition is further justifiable as drainage is an early activity in the construction process. It is in the interest of all stakeholders to ensure the approach is agreed before development commences.

Further information regarding Developer Services and Planning, can be found on our website at <http://www.unitedutilities.com/builders-developers.aspx>.

Yours faithfully

Jill Walker
United Utilities
Developer Services and Planning

ANNEX 3

United Utilities Sewer Records

Extract from Map of Public Sewers

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.

United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown. Crown copyright and database rights [2016] Ordnance Survey 100022432.

United Utilities Water Limited 2014

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Manchester Road Heywood OL10 2AN

Printed By: Property Searches Date: 23/08/2017

DO NOT SCALE

Approximate Scale: 1:1250

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ANNEX 4

Mike Lambert Associates Letter/Report/Enclosures 11 January 2018

MICHAEL LAMBERT ASSOCIATES

M.E.Lambert B.Sc.,C.Eng.,M.I.C.E.

Consultant- A.G.Morris B.Sc.,C.Eng.,M.I.C.E.,M.C.I.W.E.M.

Pear Tree House
1 Partridge Close
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Cheshire
CW7 1PY
T/F 01606 862373

Chorlton Planning
61 Nudger Green
Dobcross
Oldham OL3 5AW

B2036
11/1/18
FAO Caroline Tamworth

Dear Madam

Eagle Care Homes- Highfield House, Heywood- sustainable drainage.

We refer to this site and to our FRA report version 01 of 21/8/17. The rear of the site has had percolation testing carried out by Holroyd and the ground has some soakage potential with a percolation value of 2.9×10 to the minus 6 metres per sec indicating fine sandy conditions. The site has combined drainage which has been checked by a CCTV survey and which drains to the public combined sewer system in Manchester Road. An extension of the existing building is proposed and our in principle design consists of a 15m length rear soakaway to take 96m² of new roof with the rest of the new roof runoff draining separate system to cellular storage units under the front carpark with a vortex flow limiter outlet manhole set at a limiting flow rate of 5 l/sec. New surface water flows will then connect to the existing site combined drainage.

The soakage calculations are attached and comply with BRE 365. We also attach an in principle new drainage plan which post consent will be part of the detail design instructions for the architectural detail design.

We trust this will comply with sustainable drainage requirements and also Critical Drainage Area policy. We do apologise for the delay which has been beyond ours or Chorlton Planning's control and has been between the CCTV contractor and Eagle Care Homes.

Yours faithfully

M. E. L. L.

M.E.Lambert

Attached

Percolation test photos and results from Holroyd
A3 plans plus soakage calculations table.

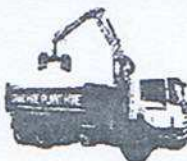
CONSULTING CIVIL ENGINEERS

VAT reg 674 6275 04 Emails- floodriskengineer@gmail.com

sudsengineers@sky.com
Roads/rivers/river modelling/sustainable drainage/attenuation/ wetlands/ development infrastructure/feasibility

Workcentres at Winsford & Waterfoot

HOLROYD Skip Hire Ltd



DIGGER & TRACKED MACHINE HIRE • CRUSHED BRICK • CONCRETE & SOIL SUPPLIES

Holes ARE 600 WIDE 1500 DEEP
& PICTURES.

Little End Farm
Moorside
Oldham
OL4 2NB

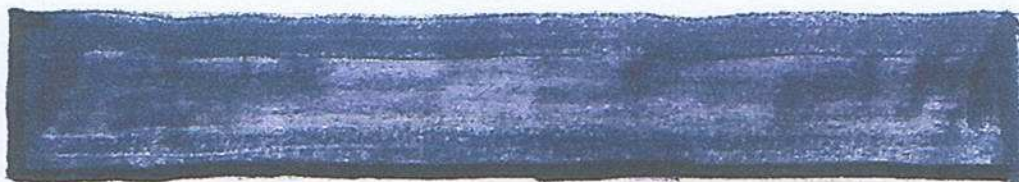
Tel: 0161 624 1118

Fax: 0161 627 1911

E-mail: dawn@holroydskiphire.co.uk

Website: www.holroydskiphire.co.uk

①



460

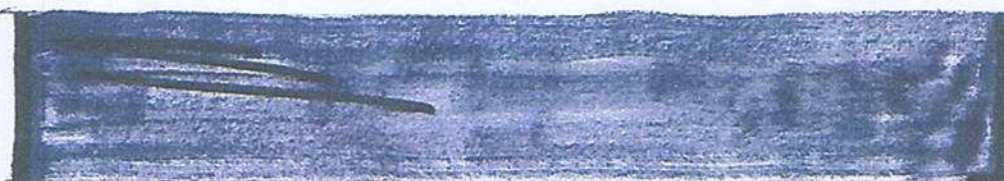
600

1500

300

140

②



460

1500

1040



Site Location Map 11200

- ① 1.8" SOIL
2' SAND
1 GRAVELLY SUBGRADE
THEN SAND
- ② 18 SOIL
THEN SAND
FOR 5'
UP TO DEPTH

1.5m depth bed-pit & permeation test

General Notes

Hingham, Haverhill, Canton, St. Paul, DE
Civic 2.4m

Wakefield, MA 02154

wake

limited



9 PICTURES

HOLES $2' \times 4' = 8$ SQUARE FEET

WATER FELL EVENLY 2" PER HOUR
ON BOTH HOLES



Extract from Map of Public Sewers

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

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Approximate Scale: 1:1250



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Table 1 Values of Factor Z1 for rainfall duration D and ratio r

r	Rainfall duration D				Hours					
	Minutes				1	2	4	6	10	24
0.12	0.22	0.34	0.45	0.67	1.00	1.48	2.17	2.75	3.70	6.00
0.15	0.25	0.38	0.48	0.69	1.00	1.42	2.02	2.46	3.23	4.90
0.18	0.27	0.41	0.51	0.71	1.00	1.36	1.86	2.25	2.86	4.30
0.21	0.29	0.43	0.54	0.73	1.00	1.33	1.77	2.12	2.62	3.60
0.24	0.31	0.46	0.56	0.75	1.00	1.30	1.71	2.00	2.40	3.35
0.27	0.33	0.48	0.58	0.76	1.00	1.27	1.64	1.88	2.24	3.10
0.30	0.34	0.49	0.59	0.77	1.00	1.25	1.57	1.78	2.12	2.84
0.33	0.35	0.50	0.61	0.78	1.00	1.23	1.53	1.73	2.04	2.60
0.36	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
0.39	0.37	0.52	0.63	0.80	1.00	1.21	1.46	1.62	1.82	2.28
0.42	0.38	0.53	0.64	0.81	1.00	1.20	1.42	1.57	1.74	2.16
0.45	0.39	0.54	0.65	0.82	1.00	1.19	1.38	1.51	1.68	2.03

Table 2 Growth factor Z2 for M10 rainfalls from M5 rainfalls

M5 rainfall mm	M10 growth factor Z2	
	England and Wales	Scotland and N Ireland
5	1.19	1.17
10	1.22	1.19
15	1.24	1.20
20	1.24	1.19
25	1.24	1.18
30	1.22	1.18
40	1.19	1.17
50	1.17	1.16
75	1.14	1.14
100	1.13	1.13

- the outflow from the soakaway is under-estimated; higher infiltration rates occur at greater depths of storage in practice than are adopted in design, and because the outflow is calculated on the basis of the rainfall duration rather than the run-off duration. The latter may be considerably longer, depending on the length of drains.

Soil infiltration rate

Excavate a soakage trial pit to the same depth as anticipated in the full-size soakaway; for run-off from 100 m² this will be 1 to 1.5 m below the invert level of the drain discharging to the soakaway. Overall depths of excavation will be typically 1.5 to 2.5 m for permeable areas up to 100 m² draining to the soakaway.

The trial pit should be 0.3 to 1 m wide and 1 to 3 m long. It should have vertical sides trimmed square and, if necessary for stability, should be filled with granular material. When granular fill is used, a full-height, perforated, vertical observation tube should be positioned in the pit so that water levels can be monitored with a dip tape. It should be possible to construct a suitably dimensioned pit with a backhoe loader or mini-excavator. Narrow, short pits use less water for the soakage tests but may be more difficult to trim and clean prior to testing. Measure the pit carefully before trials.

For safety reasons do not enter the pit.

A lot of water will be used to determine the soil infiltration rate so a water bowser may be needed. The inflow should be rapid so that the pit can be filled to its maximum effective depth in a short time, ie to the design invert level of the drain to the soakaway. Take care that the inflow does not cause the walls of the pit to collapse.

Fill the pit and allow it to drain three times to near empty; each time record the water level and time from filling, at intervals sufficiently close to clearly define water level versus time (Figure 2). The three fillings should be on the same or consecutive days.

Calculate the soil infiltration rate from the time taken for the water level to fall from 75% to 25% effective storage depth in the pit, using the lowest f value of the three test results for design:

where:

$$\text{Soil infiltration rate, } f = \frac{V_{p75-25}}{a_{p50} \times t_{p75-25}}$$

V_{p75-25} = the effective storage volume of water in the trial pit between 75% and 25% effective depth

a_{p50} = the internal surface area of the trial pit up to 50% effective depth and including the base area

t_{p75-25} = the time for the water level to fall from 75% to 25% effective depth.

If the test pit is deeper than about 3 m, it may be difficult to supply sufficient water for a full-depth soakage test. Tests may be conducted at less than full depth but determinations of the soil infiltration rate may be lower than those from the full-depth test. This is because relationships between depth of water in the soakage pit, the effective area of outflow and the infiltration rate can vary with depth, even when soil conditions themselves do not vary. The variation in infiltration rate with the depth at which the determination is made may be as much as a factor of two. From the results of a soakage trial in Figure 2, the calculated infiltration rate based upon a fall of water level from:

- 75% to 50% effective depth is 5.1×10^{-5} m/s
- 50% to 25% effective depth is 2.9×10^{-5} m/s.

The design method adopts the result determined from 75% to 25% effective depth of 3.3×10^{-5} m/s (see the box on page 5).

If it is impossible to carry out a full-depth soakage test, soil infiltration rate calculation should be based on the time

Design examples

Design a soakaway to receive stormwater from 95 m² impermeable surface for a site near Southampton

Find the rainfall ratio from Figure 1 ($r = 0.35$) and calculate the storm rainfalls for a range of storm durations (Table 3).

Table 3 Rainfall results for a range of storm durations

Storm duration D min	M5-D min = 20 mm × Z1	Z2	M10-D min = R mm
10	10.2	1.22	12.4
15	12.4	1.23	15.3
30	15.8	1.24	19.6
60	20.0	1.24	24.8
120	24.4	1.24	30.3
240	30.0	1.22	36.6
360	33.8	1.21	40.9
600	39.0	1.19	46.6

Assuming the results from a soakage trial pit (Figure 2) were obtained at the site, they can be used to design a soakaway which will be filled with granular material having 30% free volume. The percentage void space of any granular fill material must be pre-determined for use in the design method.

Take the soakaway dimensions as:

2.4 m long × 2.5 m deep × 1.5 m effective storage depth, so that the soakage trial pit can form part of the full-scale soakaway.

Calculate the design width of the soakaway:

Volume equation $I - O = S$

Inflow to soakaway I

$$I = A \times R$$

= impermeable surface area × M10-D min rainfall eg for 10 min storm duration, M10-10 min = 12.4 mm = 0.0124 m

$$I = 95 \times 0.0124$$

$$= 1.178 \text{ m}^3$$

Outflow from soakaway O

$$O = a_{s50} \times f \times D$$

= internal surface area of soakaway pit to 50% storage depth (excluding base area) × soil percolation rate × storm duration

For rectangular pit 2.4 m long × 1.5 m effective depth × W m wide:

$$a_{s50} = 2 \times (2.4 + W) \times (1.5 \div 2)$$

$$= 3.6 + 1.5 W \text{ m}^2$$

$$f = 3.3 \times 10^{-5} \text{ m/s from soakage trial}$$

$$O = (3.6 + 1.5 W) \times (3.3 \times 10^{-5}) \times (D \times 60) \text{ m}^3$$

Soakaway storage volume S

S = effective volume of soakaway with 30% free volume

$$= 2.4 \times 1.5 \times W \times 0.3$$

$$= 1.08 W \text{ m}^3$$

For satisfactory storage of the M10-10 min run-off.

$$I - O = S$$

$$1.178 - (3.6 + 1.5 W) \times (3.3 \times 10^{-5}) \times (10 \times 60) = 1.08 W$$

Required soakaway width $W = 1 \text{ m}$

Repeat the calculation for a range of M10-D min storms and determine the maximum width. Results are summarised in Table 4.

Table 4 Rainfall results for a range of M10-D min storms

Storm duration D – min	Required soakaway width W – m
10	1.00
15	1.20
30	1.41
60	1.53
120	1.41
240	0.99

A soakaway 2.4 m long × 1.5 m effective depth × 1.53 m wide would be suitable with the critical storm duration around 1 hour for 10-year events. The design may be suitable for the site layout but, if not, alternative shapes could be investigated. For example, if a narrow soakaway was necessary similar to the soakage trial pit (0.6 m wide × 1.5 m effective depth), calculations show that it must be 5.1 m long, with the critical storm duration around 30 min.

Check on time of emptying half storage volume, t_{s50}

$$t_{s50} = \frac{S \times 0.5}{a_{s50} \times f} = \frac{(1.08 \times 1.53) \times 0.5}{(3.6 + [1.5 \times 1.53]) \times (3.3 \times 10^{-5})} \text{ seconds}$$

$$t_{s50} = 1.2 \text{ hours}$$

This design is clearly satisfactory but with soil infiltration rates of about 10^{-7} it may take days for the soakaway to half empty so the performance would be unsuitable.

VERSION	FEH CD-R Version	3	exported a	14:35:44	GMT	Mon	21-Aug-17		B2037
Parameters				Heywood rain data			mel		
Calculation	Design rainfall								
Calculation	Typical point in catchment								
Calculation	Catchment GB	386200	410650	SD 86200	10650				
Catchment	2	km**2							
Duration=	6	1 (hours)							
Fixed dura no									
Return per	100	1 (years)							
Annual ma yes									
c	d1	d2	d3	e	f				
	-0.026	0.34881	0.43574	0.3748	0.30322	2.45372			
An areal reduction factor of 0.974 has been applied to a point rainfall of 70.8 mm to yield a catchment design rainfall of 68.9 mm.									
No warning(s) or note(s) were present for this calculation.									
The data in the following table have been computed using sliding durations.									
			10	20	50	100	200	500	
Duration	Duration	Duration	year rainfa	year rainfa	year rainfa	year rainfa	year rainfa	year rainfall	
minutes	hours	days	mm	mm	mm	mm	mm	mm	
15	0.25	0.010417	14.09	17.99	24.68	31.28	39.6	54.07	
30	0.5	0.020833	17.59	22.17	29.91	37.43	46.8	62.85	
45	0.75	0.03125	19.98	24.99	33.38	41.47	51.48	68.46	
60	1	0.041667	21.86	27.19	36.06	44.57	55.03	72.69	
75	1.25	0.052083	23.42	29.01	38.27	47.1	57.93	76.11	
90	1.5	0.0625	24.77	30.58	40.16	49.27	60.39	79	
105	1.75	0.072917	25.97	31.96	41.83	51.17	62.55	81.52	
120	2	0.083333	27.05	33.21	43.32	52.87	64.47	83.76	
135	2.25	0.09375	28.04	34.35	44.68	54.41	66.21	85.78	
150	2.5	0.104167	28.95	35.4	45.93	55.82	67.8	87.61	
165	2.75	0.114583	29.8	36.38	47.08	57.13	69.26	89.31	
180	3	0.125	30.6	37.29	48.16	58.34	70.63	90.88	
195	3.25	0.135417	31.35	38.15	49.18	59.49	71.91	92.34	
210	3.5	0.145833	32.06	38.96	50.13	60.56	73.11	93.72	
225	3.75	0.15625	32.74	39.73	51.04	61.58	74.24	95.02	
240	4	0.166667	33.38	40.46	51.9	62.54	75.31	96.24	
255	4.25	0.177083	34	41.16	52.72	63.46	76.34	97.41	
270	4.5	0.1875	34.59	41.83	53.5	64.34	77.31	98.52	
285	4.75	0.197917	35.16	42.47	54.25	65.18	78.25	99.58	
300	5	0.208333	35.7	43.09	54.98	65.98	79.14	100.6	
315	5.25	0.21875	36.23	43.69	55.67	66.76	80	101.57	
330	5.5	0.229167	36.74	44.27	56.34	67.51	80.83	102.51	
345	5.75	0.239583	37.24	44.83	56.99	68.23	81.63	103.41	
360	6	0.25	37.71	45.37	57.62	68.93	82.4	104.29	
375	6.25	0.260417	38.18	45.89	58.23	69.6	83.15	105.13	
390	6.5	0.270833	38.63	46.4	58.82	70.26	83.87	105.94	
405	6.75	0.28125	39.07	46.89	59.39	70.9	84.57	106.73	
420	7	0.291667	39.5	47.38	59.95	71.51	85.25	107.5	
435	7.25	0.302083	39.92	47.84	60.49	72.11	85.91	108.24	
450	7.5	0.3125	40.32	48.3	61.02	72.7	86.56	108.97	
465	7.75	0.322917	40.72	48.75	61.53	73.27	87.19	109.67	
480	8	0.333333	41.11	49.18	62.04	73.82	87.8	110.35	
495	8.25	0.34375	41.49	49.61	62.53	74.37	88.39	111.02	
510	8.5	0.354167	41.86	50.03	63.01	74.9	88.97	111.67	
525	8.75	0.364583	42.23	50.44	63.48	75.42	89.54	112.31	
540	9	0.375	42.58	50.84	63.94	75.92	90.1	112.93	
555	9.25	0.385417	42.93	51.23	64.39	76.42	90.64	113.54	
570	9.5	0.395833	43.28	51.61	64.83	76.9	91.17	114.13	
585	9.75	0.40625	43.61	51.99	65.26	77.38	91.7	114.71	
600	10	0.416667	43.94	52.36	65.68	77.85	92.21	115.28	
615	10.25	0.427083	44.27	52.72	66.1	78.3	92.71	115.84	
630	10.5	0.4375	44.59	53.08	66.51	78.75	93.2	116.38	
645	10.75	0.447917	44.9	53.43	66.91	79.19	93.68	116.92	
660	11	0.458333	45.21	53.77	67.3	79.63	94.15	117.45	
675	11.25	0.46875	45.51	54.11	67.69	80.05	94.62	117.96	
690	11.5	0.479167	45.81	54.44	68.07	80.47	95.07	118.47	
705	11.75	0.489583	46.11	54.77	68.44	80.88	95.52	118.97	
720	12	0.5	46.4	55.09	68.81	81.28	95.96	119.46	
735	12.25	0.510417	46.77	55.51	69.3	81.83	96.57	120.15	
750	12.5	0.520833	47.13	55.92	69.78	82.37	97.17	120.84	
765	12.75	0.53125	47.49	56.33	70.25	82.89	97.76	121.51	
780	13	0.541667	47.85	56.73	70.72	83.42	98.34	122.18	
795	13.25	0.552083	48.2	57.13	71.18	83.93	98.91	122.84	
810	13.5	0.5625	48.55	57.52	71.64	84.44	99.48	123.48	
825	13.75	0.572917	48.89	57.91	72.09	84.94	100.04	124.12	

Table 11.1
Permeability and Drainage Characteristics of Soils*

Coefficient of Permeability k in cm per sec (log scale)															
		10^2	10^1	1.0	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}		
		Good					Poor			Practically Impervious					
Drainage	Clean gravel	Clean sands, clean sand and gravel mixtures					Very fine sands, organic and inorganic silts, mixtures of sand silt and clay, glacial till, stratified clay deposits, etc.					"Impervious" soils, e.g., homogeneous clays below zone of weathering			
	Soil types						"Impervious" soils modified by effects of vegetation and weathering								
Direct determination of k	Direct testing of soil in its original position—pumping tests. Reliable if properly conducted. Considerable experience required														
	Constant-head permeameter. Little experience required														
Indirect determination of k	Falling-head permeameter. Reliable. Little experience required						Falling-head permeameter. Unreliable. Much experience required					Falling-head permeameter. Fairly reliable. Considerable experience necessary			
	Computation from grain-size distribution. Applicable only to clean cohesionless sands and gravels											Computation based on results of consolidation tests. Reliable. Considerable experience required			

ANNEX 5

Existing Site Runoff Rates

The peak discharge rates of surface water runoff from the impermeable areas at the existing site have been calculated based on the Modified Rational Method⁵. The following parameters have been obtained from the maps in the Wallingford Procedure:

M5-60 minute rainfall depth:	20.0 mm
Ratio of M5-60 to M5-2 day rainfall:	0.3
Average Annual Rainfall:	1,100 mm
Winter Rain Acceptance Potential/ Soil Type:	0.4/Type 3
The Urban Catchment Wetness Index (UCWI) value:	120

A time of concentration of 5 minutes has been used comprising a time of entry of 4 minutes and a time of flow of 1 minute.

A rainfall estimation calculation has been carried out to convert the M5-60 minute rainfall to the 5-minute duration rainfall for the 1 in 1, 1 in 2, 1 in 30 and 1 in 100 annual exceedance probability (AEP) rainfall events. The calculated rainfall intensities for these events are 50.9, 65.1, 118.6 and 149.5 mm/hr respectively.

The flow rate as given by the Modified Rational Method is:

$$Q = 2.78 \times C_v \times C_r \times \text{rainfall intensity} \times \text{impermeable area}$$

where:

C_v is the volumetric runoff coefficient = $P_r/PIMP = 0.82$

where P_r is Percentage Runoff and PIMP is Percentage Impermeable Area

C_r is the routing coefficient = 1.3

Impermeable Area = 0.152 ha

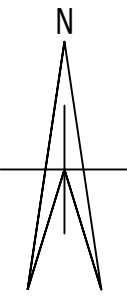
The peak discharges of surface runoff from impermeable areas of the existing site are shown in the table below:

AEP of Rainfall Event	Peak discharge for 0.152 ha impermeable area (l/s)
1 in 1	22.8
1 in 2	29.2
1 in 30	53.1
1 in 100	67.0

⁵ The Wallingford Procedure, Volume 4, 1981

ANNEX 6

Proposed Drainage Layout



KEY

EXISTING PUBLIC COMBINED SEWER

PROPOSED SURFACE WATER SEWER

PROPOSED FOUL SEWER

PROPOSED COMBINED SEWER

EXISTING PUBLIC COMBINED MANHOLE

PROPOSED SURFACE WATER MANHOLE

PROPOSED FOUL MANHOLE

PROPOSED COMBINED MANHOLE

PROPOSED GEO-CELLULAR STORAGE

SITE BOUNDARY

OVERLAND FLOW ROUTE

PROPOSED MANHOLE COVER LEVELS
ARE INDICATIVE ONLY AND ARE
SUBJECT TO FINAL PROPOSED GROUND
LEVELS (DESIGNED BY OTHERS)

PROPOSED RUNOFF RATES
1:1 AEP = 0.0 l/s
1:2 AEP = 0.3 l/s
1:30 AEP +40% C.C = 6.3 l/s
1:100 AEP +45% C.C= 6.5 l/s

TOTAL SITE AREA = 0.245 ha (APPROX.)
TOTAL IMPERMEABLE AREA = 0.187 ha

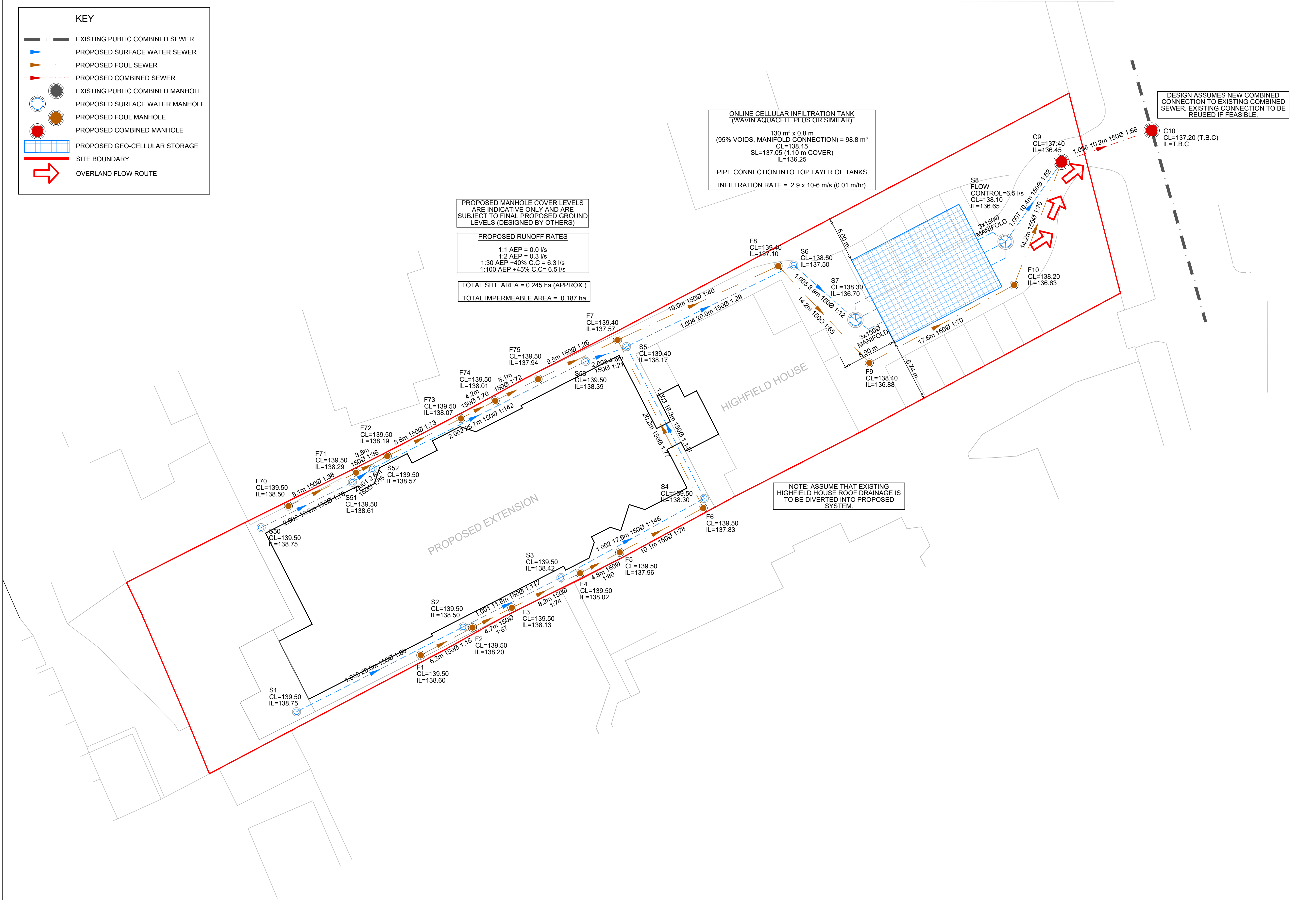
ONLINE CELLULAR INFILTRATION TANK
(WAVIN AQUACELL PLUS OR SIMILAR)

130 m² x 0.8 m
(95% VOIDS, MANIFOLD CONNECTION) = 98.8 m³
CL=138.15
SL=137.05 (1.10 m COVER)
IL=136.25

PIPE CONNECTION INTO TOP LAYER OF TANKS
INFILTRATION RATE = 2.9 x 10-6 m/s (0.01 m/hr)

DESIGN ASSUMES NEW COMBINED
CONNECTION TO EXISTING COMBINED
SEWER. EXISTING CONNECTION TO BE
REUSED IF FEASIBLE.

NOTE: ASSUME THAT EXISTING
HIGHFIELD HOUSE ROOF DRAINAGE IS
TO BE DIVERTED INTO PROPOSED
SYSTEM.



NOTES

1. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT WEETWOOD DRAWINGS.

2. PROPOSED SITE LAYOUT TAKEN FROM P A DUST CHARTERED ARCHITECTS 'PROPOSED NEW DRAINAGE PLAN' DRAWING (REF: HH02/1922/PL01).

3. EXISTING DRAINAGE LOCATION TAKEN FROM UNITED UTILITIES RECORD DRAWING RECEIVED FROM UNITED UTILITIES DATED 01/06/23 AND ARE INDICATIVE ONLY AND TO BE CONFIRMED.

4. INFILTRATION RATE TAKEN FROM REPORT BY MICHAEL LAMBERT ASSOCIATES DATED 11/1/18 REFERENCE B2036.

P1

27.06.23

INITIAL ISSUE

DSH

GW

REV

DATE

DESCRIPTION

DRAWN

CHECK

Client

MR ALAN SPENCER

Drawing Status

PLANNING

Project

HIGHFIELD HOUSE
MANCHESTER ROAD
HEYWOOD

Title

PROPOSED DRAINAGE
LAYOUT

Date

JUNE 2023

Scale (A1)

1:200

Drawn

DSH

Checked

GW

Project No

4852

Drawing No

100

Revision

P1

Park House, Ffordd
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Tel 01352 700045
info@weetwood.net
www.weetwood.net

Development • Planning • Environment

THIS DRAWING MUST BE READ IN CONJUNCTION WITH THE SPECIFICATION AND ALL OTHER RELEVANT DRAWINGS. DO NOT SCALE FROM THIS DRAWING.

ANNEX 7

Hydraulic Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	1	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)	0.200
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	x

Adoptable Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	749	1500
499	1350	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100 | 150

Nodes

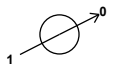
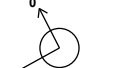
Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.009	5.00	139.500	600	159.278	-17.063	0.750
2	0.017	5.00	139.500	600	177.161	-7.946	1.000
3	0.015	5.00	139.500	600	187.677	-2.640	1.080
4	0.014	5.00	139.500	600	203.070	5.855	1.200
50	0.013	5.00	139.500	600	155.477	2.717	0.750
51			139.500	600	165.281	7.604	0.890
52	0.018	5.00	139.500	600	167.397	9.042	0.930
53	0.019	5.00	139.500	600	190.337	20.586	1.110
5	0.007	5.00	139.400	600	194.718	22.174	1.230
6			138.500	600	212.694	30.928	1.000
7	0.020	5.00	138.300	1200	219.301	25.046	1.600
8	0.056	5.00	138.100	1200	235.424	33.447	1.450
9			137.400	1200	241.445	42.029	0.950
10			137.200	1200	251.111	45.393	0.900

Pipeline Schedule

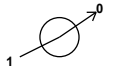
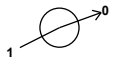
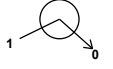
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	20.073	80.3	150	Circular	139.500	138.750	0.600	139.500	138.500	0.850
1.001	11.779	147.2	150	Circular	139.500	138.500	0.850	139.500	138.420	0.930
1.002	17.582	146.5	150	Circular	139.500	138.420	0.930	139.500	138.300	1.050
1.003	18.332	141.0	150	Circular	139.500	138.300	1.050	139.400	138.170	1.080
2.000	10.955	78.2	150	Circular	139.500	138.750	0.600	139.500	138.610	0.740
2.001	2.558	64.0	150	Circular	139.500	138.610	0.740	139.500	138.570	0.780
2.002	25.681	142.7	150	Circular	139.500	138.570	0.780	139.500	138.390	0.960
2.003	4.660	21.2	150	Circular	139.500	138.390	0.960	139.400	138.170	1.080
1.004	19.994	29.8	150	Circular	139.400	138.170	1.080	138.500	137.500	0.850
1.005	8.846	12.2	150	Circular	138.500	137.500	0.850	138.300	136.775	1.375
1.006	18.180	363.6	225	Circular	138.300	136.700	1.375	138.100	136.650	1.225
1.007	10.483	52.4	150	Circular	138.100	136.650	1.300	137.400	136.450	0.800
1.008	10.235	68.2	150	Circular	137.400	136.450	0.800	137.200	136.300	0.750

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	600	Manhole	Adoptable	2	600	Manhole	Adoptable
1.001	2	600	Manhole	Adoptable	3	600	Manhole	Adoptable
1.002	3	600	Manhole	Adoptable	4	600	Manhole	Adoptable
1.003	4	600	Manhole	Adoptable	5	600	Manhole	Adoptable
2.000	50	600	Manhole	Adoptable	51	600	Manhole	Adoptable
2.001	51	600	Manhole	Adoptable	52	600	Manhole	Adoptable
2.002	52	600	Manhole	Adoptable	53	600	Manhole	Adoptable
2.003	53	600	Manhole	Adoptable	5	600	Manhole	Adoptable
1.004	5	600	Manhole	Adoptable	6	600	Manhole	Adoptable
1.005	6	600	Manhole	Adoptable	7	1200	Manhole	Adoptable
1.006	7	1200	Manhole	Adoptable	8	1200	Manhole	Adoptable
1.007	8	1200	Manhole	Adoptable	9	1200	Manhole	Adoptable
1.008	9	1200	Manhole	Adoptable	10	1200	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
1	159.278	-17.063	139.500	0.750	600				
						0	1.000	138.750	150
2	177.161	-7.946	139.500	1.000	600		1	1.000	138.500
						0	1.001	138.500	150
3	187.677	-2.640	139.500	1.080	600		1	1.001	138.420
						0	1.002	138.420	150
4	203.070	5.855	139.500	1.200	600		1	1.002	138.300
						0	1.003	138.300	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
50	155.477	2.717	139.500	0.750	600				
						0	2.000	138.750	150
51	165.281	7.604	139.500	0.890	600				
						1	2.000	138.610	150
						0	2.001	138.610	150
52	167.397	9.042	139.500	0.930	600				
						1	2.001	138.570	150
						0	2.002	138.570	150
53	190.337	20.586	139.500	1.110	600				
						1	2.002	138.390	150
						0	2.003	138.390	150
5	194.718	22.174	139.400	1.230	600				
						1	2.003	138.170	150
						2	1.003	138.170	150
						0	1.004	138.170	150
6	212.694	30.928	138.500	1.000	600				
						1	1.004	137.500	150
						0	1.005	137.500	150
7	219.301	25.046	138.300	1.600	1200				
						1	1.005	136.775	150
						0	1.006	136.700	225
8	235.424	33.447	138.100	1.450	1200				
						1	1.006	136.650	225
						0	1.007	136.650	150
9	241.445	42.029	137.400	0.950	1200				
						1	1.007	136.450	150
						0	1.008	136.450	150
10	251.111	45.393	137.200	0.900	1200				
						1	1.008	136.300	150

Simulation Settings

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

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
2	0	0	0
30	40	0	0
100	45	0	0

Node 8 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	136.650	Product Number	CTL-SHE-0119-6500-1000-6500
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	6.5	Min Node Diameter (mm)	1200

Node 8 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.01000	Safety Factor	2.0	Invert Level (m)	136.250
Side Inf Coefficient (m/hr)	0.01000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	130.0	130.0	0.800	130.0	166.8	0.801	0.0	166.8

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	138.775	0.025	1.2	0.0129	0.0000	OK
15 minute winter	2	11	138.549	0.049	3.4	0.0303	0.0000	OK
15 minute winter	3	11	138.482	0.062	5.2	0.0349	0.0000	OK
15 minute winter	4	11	138.374	0.074	6.9	0.0382	0.0000	OK
15 minute winter	50	10	138.780	0.030	1.7	0.0190	0.0000	OK
15 minute winter	51	10	138.638	0.028	1.7	0.0078	0.0000	OK
15 minute winter	52	11	138.625	0.055	3.9	0.0368	0.0000	OK
15 minute winter	53	11	138.431	0.041	6.2	0.0254	0.0000	OK
15 minute winter	5	11	138.244	0.074	13.9	0.0292	0.0000	OK
15 minute winter	6	11	137.557	0.057	13.9	0.0162	0.0000	OK
15 minute winter	7	11	136.829	0.129	16.3	0.1776	0.0000	OK
1440 minute winter	8	1110	136.610	-0.040	2.0	46.7720	0.0000	OK
15 minute summer	9	1	136.450	0.000	0.0	0.0000	0.0000	OK
15 minute summer	10	1	136.300	0.000	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	1.2	0.350	0.058	0.0683	
15 minute winter	2	1.001	3	3.3	0.559	0.226	0.0696	
15 minute winter	3	1.002	4	5.2	0.663	0.352	0.1367	
15 minute winter	4	1.003	5	6.9	0.798	0.461	0.1581	
15 minute winter	50	2.000	51	1.7	0.705	0.083	0.0261	
15 minute winter	51	2.001	52	1.6	0.420	0.074	0.0103	
15 minute winter	52	2.002	53	3.9	0.808	0.263	0.1245	
15 minute winter	53	2.003	5	6.2	1.025	0.160	0.0290	
15 minute winter	5	1.004	6	13.9	1.892	0.427	0.1476	
15 minute winter	6	1.005	7	13.9	2.361	0.272	0.0522	
15 minute winter	7	1.006	8	16.2	0.778	0.598	0.3777	
15 minute summer	8	Hydro-Brake®	9	0.0				
1440 minute winter	8	Infiltration		0.2				
15 minute summer	9	1.008	10	0.0	0.000	0.000	0.0000	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	10	138.778	0.028	1.5	0.0144	0.0000	OK
15 minute winter	2	10	138.556	0.056	4.3	0.0347	0.0000	OK
15 minute winter	3	10	138.492	0.072	6.7	0.0402	0.0000	OK
15 minute winter	4	11	138.387	0.087	8.8	0.0448	0.0000	OK
15 minute winter	50	10	138.784	0.034	2.2	0.0216	0.0000	OK
15 minute winter	51	11	138.642	0.032	2.2	0.0090	0.0000	OK
15 minute winter	52	11	138.633	0.063	5.1	0.0420	0.0000	OK
15 minute winter	53	10	138.437	0.047	8.1	0.0296	0.0000	OK
15 minute winter	5	11	138.257	0.087	18.0	0.0346	0.0000	OK
15 minute winter	6	11	137.564	0.064	18.1	0.0181	0.0000	OK
15 minute winter	7	11	136.851	0.151	21.2	0.2091	0.0000	OK
1440 minute winter	8	1110	136.672	0.022	2.3	54.8853	0.0000	OK
1440 minute winter	9	1110	136.463	0.013	0.3	0.0141	0.0000	OK
1440 minute winter	10	1110	136.312	0.012	0.3	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	1.5	0.368	0.074	0.0819	
15 minute winter	2	1.001	3	4.2	0.590	0.287	0.0838	
15 minute winter	3	1.002	4	6.6	0.700	0.451	0.1656	
15 minute winter	4	1.003	5	8.9	0.838	0.594	0.1939	
15 minute winter	50	2.000	51	2.2	0.750	0.107	0.0315	
15 minute winter	51	2.001	52	2.1	0.443	0.095	0.0124	
15 minute winter	52	2.002	53	5.0	0.855	0.337	0.1506	
15 minute winter	53	2.003	5	8.1	1.075	0.208	0.0358	
15 minute winter	5	1.004	6	18.1	2.038	0.554	0.1775	
15 minute winter	6	1.005	7	18.1	2.356	0.354	0.0715	
15 minute winter	7	1.006	8	21.0	0.839	0.778	0.4546	
1440 minute winter	8	Hydro-Brake®	9	0.3				
1440 minute winter	8	Infiltration		0.2				
1440 minute winter	9	1.008	10	0.3	0.430	0.014	0.0071	2.7

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	13	138.936	0.186	4.6	0.0972	0.0000	SURCHARGED
15 minute winter	2	12	138.929	0.429	11.4	0.2674	0.0000	SURCHARGED
15 minute winter	3	12	138.902	0.482	13.4	0.2704	0.0000	SURCHARGED
15 minute winter	4	12	138.801	0.501	17.1	0.2587	0.0000	SURCHARGED
15 minute winter	50	10	138.806	0.056	5.7	0.0353	0.0000	OK
15 minute winter	51	12	138.778	0.168	5.6	0.0476	0.0000	SURCHARGED
15 minute winter	52	12	138.775	0.205	13.5	0.1375	0.0000	SURCHARGED
15 minute winter	53	12	138.674	0.284	20.9	0.1776	0.0000	SURCHARGED
15 minute winter	5	12	138.609	0.439	35.9	0.1743	0.0000	SURCHARGED
15 minute winter	6	12	137.597	0.097	34.8	0.0273	0.0000	OK
15 minute winter	7	11	136.977	0.277	42.4	0.3827	0.0000	SURCHARGED
360 minute winter	8	248	136.835	0.185	13.9	76.4417	0.0000	SURCHARGED
360 minute winter	9	248	136.508	0.058	6.3	0.0660	0.0000	OK
360 minute winter	10	248	136.355	0.055	6.3	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	4.3	0.433	0.217	0.3534	
15 minute summer	2	1.001	3	9.6	0.649	0.654	0.2074	
30 minute summer	3	1.002	4	12.6	0.765	0.864	0.3095	
15 minute winter	4	1.003	5	16.5	1.101	1.105	0.3227	
15 minute winter	50	2.000	51	5.6	0.826	0.281	0.1237	
15 minute winter	51	2.001	52	5.6	0.486	0.250	0.0450	
15 minute summer	52	2.002	53	13.0	0.956	0.875	0.4521	
15 minute winter	53	2.003	5	18.1	1.168	0.465	0.0820	
15 minute winter	5	1.004	6	34.8	2.184	1.063	0.2959	
15 minute winter	6	1.005	7	34.8	2.308	0.679	0.1309	
15 minute winter	7	1.006	8	42.0	1.090	1.556	0.6572	
360 minute winter	8	Hydro-Brake®	9	6.3				
360 minute winter	8	Infiltration		0.2				
360 minute winter	9	1.008	10	6.3	1.024	0.291	0.0625	60.9

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1	13	139.416	0.666	5.3	0.3481	0.0000	FLOOD RISK
15 minute winter	2	13	139.406	0.906	13.2	0.5644	0.0000	FLOOD RISK
15 minute winter	3	13	139.363	0.943	17.1	0.5292	0.0000	FLOOD RISK
15 minute winter	4	13	139.213	0.913	21.4	0.4709	0.0000	FLOOD RISK
15 minute winter	50	13	139.153	0.403	7.7	0.2534	0.0000	SURCHARGED
15 minute winter	51	13	139.143	0.533	7.4	0.1508	0.0000	SURCHARGED
15 minute winter	52	13	139.138	0.568	13.3	0.3808	0.0000	SURCHARGED
15 minute winter	53	13	139.012	0.622	21.0	0.3887	0.0000	SURCHARGED
15 minute winter	5	13	138.932	0.762	41.8	0.3025	0.0000	SURCHARGED
15 minute winter	6	13	137.622	0.122	41.0	0.0344	0.0000	OK
15 minute winter	7	12	137.040	0.340	49.6	0.4701	0.0000	SURCHARGED
360 minute winter	8	256	137.020	0.369	18.6	100.7375	0.0000	SURCHARGED
120 minute winter	9	126	136.510	0.060	6.5	0.0674	0.0000	OK
120 minute winter	10	90	136.356	0.056	6.5	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)
30 minute summer	1	1.000	2	4.6	0.440	0.233	0.3534	
15 minute winter	2	1.001	3	9.5	0.657	0.649	0.2074	
15 minute winter	3	1.002	4	14.9	0.844	1.016	0.3095	
15 minute winter	4	1.003	5	19.9	1.133	1.337	0.3227	
15 minute winter	50	2.000	51	7.4	0.830	0.367	0.1929	
15 minute winter	51	2.001	52	6.9	0.462	0.312	0.0450	
30 minute summer	52	2.002	53	13.4	0.949	0.907	0.4521	
15 minute winter	53	2.003	5	19.0	1.184	0.489	0.0820	
15 minute winter	5	1.004	6	41.0	2.365	1.254	0.3290	
15 minute winter	6	1.005	7	41.1	2.371	0.802	0.1456	
15 minute winter	7	1.006	8	49.7	1.266	1.840	0.6800	
120 minute winter	8	Hydro-Brake®	9	6.5				
360 minute winter	8	Infiltration		0.2				
120 minute winter	9	1.008	10	6.5	1.034	0.301	0.0643	59.2

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