



DRAINAGE ASSESSMENT REPORT

Land to South of Helme Lane, Meltham

Commissioned by Acumen Architects

Report 17902-L-RP-002 R2

8th April 2021

Notation

DIA	Drainage Impact Assessment
EA	Environment Agency
FRA	Flood Risk Assessment
IDB	Internal Drainage Board
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

DRAINAGE ASSESSMENT REPORT

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ISSUE LOG FOR REPORT 17902-L-RP-002

<i>Rev</i>	<i>Date</i>	<i>Description</i>	<i>Author</i>	<i>Checked</i>
R0	October 2019	FIRST ISSUE	BW	GS
R1	March 2021	Revised to suit new pumping arrangement	BW	GS
R2	8 th April 2021	Revised to suit LLFA comments	BW	LB

Issuing office: Mason Clark (Leeds). Refer to final page for full office details.

1 INTRODUCTION

Mason Clark Associates (MCA) has been commissioned by Acumen Architects to compile a drainage assessment report for the proposed redevelopment of land off Helme Lane, Meltham, HD9 5RU.

This report has been carried out to provide a preliminary assessment of flooding at the site and an initial feasibility assessment for suitable methods for discharge of surface and foul water from the proposed development.

2 PROPOSED DEVELOPMENT

The proposed residential development is located off Helme Lane, Maltham. An approximate post code is HD9 5RU and coordinates are (410250, 411100). An indicative site plan is included in Appendix A. The proposed development is for the construction of 20 residential properties, comprising of 8 detached and 12 semi-detached buildings with proposed access road through the adjacent Barratt Homes development (Planning Application: 2018/92937) which was approved in April 2019.

Levels across the site generally fall from NW to SE. LiDAR topographical information indicates that levels across the site are in the region of 182.69m AOD – 172.93m AOD with approximate gradients of the site being 1:22 NW to SE.

3 FLOOD RISK

The Environment Agency Flood Map for Planning (Appendix B) indicates that the site lies within Flood Zone 1. Flood Zone 1 is defined in the National Planning Practice Guidance for Flood Risk and Coastal Change as a site with low annual probability of flooding. The zone comprises of land assessed as having less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

The Kirklees Council Level 1 SFRA (2016) Flood Zone Map L indicates that the site lies outside of Flood Zone 2, thus in Flood Zone 1 (though does not specifically use this term). A separate Flood Risk Assessment by Mason Clark Associates has been submitted for this application.

4 SURFACE WATER DRAINAGE STRATEGY

Building Regulations Part H states that the priority for discharging surface water runoff from a development is as follows; (1st) Infiltration into the ground, (2nd) discharge into a watercourse, (3rd) discharge into a sewer.

Infiltration

A site investigation has not yet been carried out however British Geological Survey records suggest the site would not be suitable for infiltration due to the depth of impermeable clays. Surrounding developments connected to alternative outlets also support the unsuitability of infiltration methods.

Watercourse

An unnamed watercourse is present adjacent to the northern site boundary, site levels generally fall north to south therefore discharging to the watercourse via gravity would not be feasible.

Meltham Dike is located approximately 200m south of the proposed development, Yorkshire water sewer records indicate that surface water from the neighbouring developments ultimately discharge to this watercourse.

Public Sewers

As a last resort following the hierarchy of surface water disposal, discharge to the public sewer system can be considered.

With infiltration systems considered unfeasible for the site, surface water attenuation systems should be utilised to ensure the flows from the site to a public surface water sewer, are reduced to as close as practicable to the greenfield runoff rate or as otherwise agreed with the Water Authority. A minimum discharge rate of 3 l/s will be assumed for the purpose of this report to ensure that surface water storage may be accommodated on site for this worst case scenario. Flows lower than 3 l/s are likely to require an infeasibly small orifice and are thus prone to blockage.

Yorkshire Water sewer records (Appendix C) indicate there are public sewers located in Mean Lane and Pavilion Way directly south of the site. Due to the topography of the site and the distance to the public sewers, discharge from the site may require pumping. Surface water shall discharge via gravity towards an on-site pump compound in the southern area of site before discharging to the public sewers in Pavilion Way. The exact point of connection is to be confirmed at detailed design stage. Further investigation is to be carried out to assess the possibility of discharging surface water from the site via gravity however, this report will

assume a pumped solution is required until this information is available. For surface and foul water to discharge towards the pump compound, the sewer shall pass through private gardens and land owned by Dathan Tools with a 6-meter easement. This easement is shown on the Drainage Layout (Appendix D).

Proposed Impermeable Areas

From the indicative site layout plan, an estimation of the development area has been calculated as 3,530m² or 0.353ha.

Proposed impermeable areas from roofs and external impermeable areas of the development are as follows:

Roof Areas = 1,080m²

Road Areas = 1,840

Private Driveways = 610m²

A plan showing Impermeable areas can be found in Appendix D.

Discharge to public sewers:

Using the MicroDrainage Source Control Quick Storage Estimate for the proposed impermeable areas shown above during the 1:100 year storm event including 30% factor for climate change approximately 212m³ - 328m³ of attenuation would be required. The use of a flow control device would be required to attenuate flows to the restricted discharge rate which is assumed to be 3 l/s.

A more detailed analysis of the attenuation required is included in Appendix E and is summarised below. Please note that one pipe feature was modelled for first just the road areas to get an accurate reflection of the oversized pipe required. Then the roof and driveway areas were added to see the impact on volume whilst maintaining one common outfall. The additional pipe volume from this calculation will alternatively be provided as storage within permeable driveways.

Estimated attenuation required	30Yr Return Period	100 Yr Return Period +30% cc
Roof Areas and Driveways	67m ³	141m ³
Road Areas	42m ³	89m ³

A schematic drainage layout can be found in Appendix D which shows the 140m length of oversized pipe required. Additionally, hatching indicates the permeable paving areas. The average depth across all paving areas (674m²) to achieve the maximum 141m³ volume is 600mm of voided stone. The exact depths will be subject to assessment of levels at detailed design stage.

Where possible, Sustainable drainage (SuDS) systems/techniques should be used to drain the site of surface water runoff. These could be in the form of permeable paving, rainwater harvesting, ponds and other above ground green systems. Swales could also be incorporated into the layout to convey surface runoff rather than below ground pipes (which tend to have a higher velocity).

Sustainable Drainage (Overview)

Drainage systems can contribute to sustainable development and improve urban design, by balancing the different issues that influence the development of communities. Approaches to manage surface water that take account of water quantity (flooding), water quality (pollution) and amenity issues are collectively referred to as Sustainable Drainage Systems (SuDS).

SuDS mimic nature and typically manage rainfall close to where it falls. SuDS can be designed to slow water down (attenuate) before it enters streams, rivers and other watercourses, they provide areas to store water in natural contours and can be used to allow water to soak (infiltrate) into the ground or evaporated from surface water and lost or transpired from vegetation (known as evapotranspiration).

SuDS are technically regarded a sequence of management practices, control structures and strategies designed to efficiently and sustainably drain surface water, while minimising pollution and managing the impact on water quality of local water bodies.

SuDS are more sustainable than traditional drainage methods because they:

- Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding
- Protect or enhance water quality (reducing pollution from runoff)
- Protect natural flow regimes in watercourses
- Are sympathetic to the environment and the needs of the local community
- Provide an attractive habitat for wildlife in urban watercourses
- Provide opportunities for evapotranspiration from vegetation and surface water
- Encourage natural groundwater/aquifer recharge (where appropriate)
- Create better places to live, work and play.

SuDS principles

Sustainable drainage is a departure from the traditional approach to draining sites. There are some key principles that influence the planning and design process enabling SuDS to mimic natural drainage by:

- storing runoff and releasing it slowly (attenuation)
- allowing water to soak into the ground (infiltration)
- Slowly transporting (conveying) water on the surface
- filtering out pollutants
- allowing sediments to settle out by controlling the flow of the water

The above was taken from www.susdrain.org

SUDS Technique	Can they be feasibly incorporated into the site?	Comments
Green Roofs	✗	The proposed development could not be designed to incorporate a green-roof design
Basins and Ponds	✗	The proposed development could not be designed to incorporate these elements due to site constraints.
Filter Strips, Swales and Bio-Retention	✗	The proposed development could not be designed to incorporate these elements due to site constraints.
Infiltration techniques	✗	Ground conditions suggest infiltration techniques would not be suitable.
Permeable surfaces and tree pits	✓	Permeable roads and/or driveways may be possible subject to agreement with the LLFA and the Water Authority.
Rainwater Harvesting	✗	The proposed development could not be designed to incorporate these elements.
Tanked Systems	✓	Attenuation storage could be provided.

SuDS Maintenance

On-site SuDS systems will be privately managed rather than put forward for adoption by the local Water Authority. Exact details of the drainage systems will be determined during detailed design stage.

The below table shows an indicative maintenance schedule for a typical permeable paving system.

Schedule	Required Action	Frequency
Regular Maintenance	Inspect and Identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, Annually thereafter.
	Remove sediment from pre-treatment structures and/or internal forbays.	Annually, or as required.
Remedial Action	If ponding is occurring, joints shall be unblocked by sweeping or vacuuming the areas affected. Contaminated aggregate to be removed and replaced.	As required.
	Remove any vegetation growing in the joints or treat with a glyphosate-based weed killer.	As required.
Monitoring	Inspect/check all inlets, Outlets and vents.	Annually

6 FOUL WATER DRAINAGE STRATEGY

Yorkshire Water sewer records (Appendix C) indicate there are public sewers located in Mean Lane and Pavilion Way directly south of the site. Records also show a foul water manhole approximately 20-30m south west of the site in third party land. The chamber appears to serve the Dathan Tools building owned by the client.

It is recommended that further investigation is carried out on this chamber to assess the possibility of discharging to the chamber via gravity. Until this information is available, it should be assumed that a pumped solution is required. Foul water shall discharge via gravity towards an on-site pump compound in the southern area of site. For surface and foul water to discharge towards the pump compound, the sewer shall pass through land owned by Dathan Tools with a 6-meter easement.

All below ground foul water drainage is to be designed and constructed to the current Building Regulations standards or where drainage is to be adopted by the local water authority, Sewers for Adoption 7th Edition.

7 CONCLUSIONS

- The site is located on Flood zone 1 and is therefore defined as low annual probability of flooding.
- The unsuitable ground conditions therefore mean that infiltration via soakaways are not a viable option.
- The nearest watercourse to the site lies directly north of the site however due to levels this watercourse would not provide a feasible point of discharge for surface water. Meltham Dike is located to the south of site, the surface water from the site will eventually discharge to this watercourse via Yorkshire water sewers.
- It is therefore recommended that surface water is pumped into the existing Yorkshire Water sewers south of the site at a restricted rate of 3 litres/second. A Drainage Layout can be found in Appendix D.
- The required storage volume for the roof and driveways for a 1 in 100 year event plus 30% climate change is approximately 141m³. It is recommended to store all surface water from these impermeable areas within voided stone beneath the permeable paving. Based on a total permeable paving area of 674m² and a void ratio of 30%, approximately 600mm of voided stone would be required beneath each of the driveways. Storage Calculations can be found in Appendix E.
- The required storage volume for the road areas for a 1 in 100 year event plus 30% climate change is approximately 89m³. It is recommended to store all surface water from these impermeable areas within oversized pipes beneath the roads. Based on 900mm diameter pipework at a shallow gradient, approximately 140m of pipework would be required. Storage Calculations can be found in Appendix E.
- Foul water from the site should be pumped into the existing Yorkshire Water sewers located south of the site subject to agreement with Yorkshire Water.
- Further investigation is required to assess the possibility of discharging both the surface and foul water from the site to public sewers via gravity.

8 LIMITATIONS

All comments and proposals contained in this report, including any conclusions, are based on information available to Mason Clark Associates during investigations. The conclusions drawn by Mason Clark Associates could therefore differ if the information is found to be inaccurate or misleading. Mason Clark Associates accepts no liability should this be the case, nor if additional information exists or becomes available with respect to this scheme.

Where we have undertaken preliminary infiltration rate tests on site on your behalf this is for indicative purposes only to enable preliminary designs to progress. Where any subsequent designs rely upon infiltration and/or these test results then you should undertake further infiltration rate tests in accordance with accepted industry standard guidelines as detailed in Building Research Establishment publication BRE Digest 365.

Except as otherwise requested by the client, Mason Clark Associates is not obliged to and disclaims any obligation to update the report for events taking place after: -

- (i) The date on which this assessment was undertaken, and*
- (ii) The date on which the final report is delivered*

Mason Clark Associates makes no representation whatsoever concerning the legal significance of its findings or the legal matters referred to in the report.

All Environment Agency mapping data is used under special license. Data is current as of October 2019 and is subject to change.

The information presented and conclusions drawn are based on statistical data and are for guidance purposes only. The study provides no guarantee against flooding of the study site or elsewhere, nor of the absolute accuracy of water levels, flow rates and associated probabilities.

This report has been prepared for the use of Acumen Architects. No other third parties may rely upon or reproduce the contents of this report without the written permission of Mason Clark Associates. If any unauthorised third party comes into possession of this report, they rely on it at their own risk and the authors do not owe them any Duty of Care or Skill.

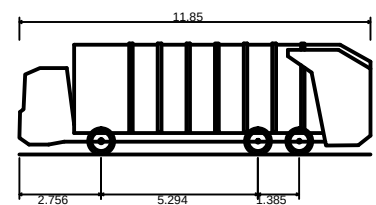
APPENDIX A
INDICATIVE SITE PLAN



Only figured dimensions should be used.

Scaled dimensions should be checked with the Architect.

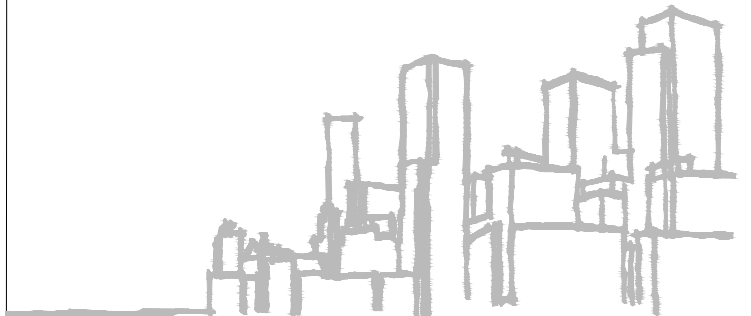
This drawing together with the design, is the property and copyright of the Architect and must not be reproduced without written permission



11.85m Refuse Vehicle
Overall Length 11.850m
Overall Width 2.500m
Overall Body Height 3.751m
Min Body Ground Clearance 0.304m
Track Width 2.500m
Lock to Lock Time 4.00s
Kerb to Kerb Turning Radius 9.850m

C	Layout amended following drainage and highways comments.	JF	JC	07/04/2021
F	Tracking for 11.5m bin lorry added. Turning heads amended.	JF	JC	31/03/2021
E	Pumping station added to south. Plot 21 omitted.	JF	JC	08/03/2021
D	Adjacent site levels added, pedestrian link width drawn as 2M.	JF	JC	21/02/2020
C	Separate pedestrian path added to south link.	JF	JC	16/01/2020
B	Spot levels added, rumble strip to west site, KC bollard added.	JF	JC	10/12/19
A	Vehicle restriction note added to pedestrian link	JF	JC	28/10/19
rev	description	drawn	auth	date

DO NOT SCALE OFF THIS DRAWING



acumen
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Headrow House, Old Leeds Road, Huddersfield, HD1 1SG

Client DATHAN TOOL & GAUGE CO LTD.			
Project LAND OFF MEAN LANE, MELTHAM			
Project No 2620	Drawing No 03	Rev G	
Description INDICATIVE SITE PLAN			
Scale 1:500@ A1	Date Drawn OCT '19	Drawn By JF	Authorised By JC
No Comments Found View All Comments View Comments Add Comment			
Purpose of Issue Planning ☒ Building Regs ☐ Tender ☐ Comment ☐ Approval ☐ Construction ☐			

APPENDIX B

FLOOD MAP FOR PLANNING

Flood map for planning

Your reference
17902-L

Location (easting/northing)
410306/411103

Created
16 Mar 2021 10:10

Your selected location is in flood zone 1, an area with a low probability of flooding.

This means:

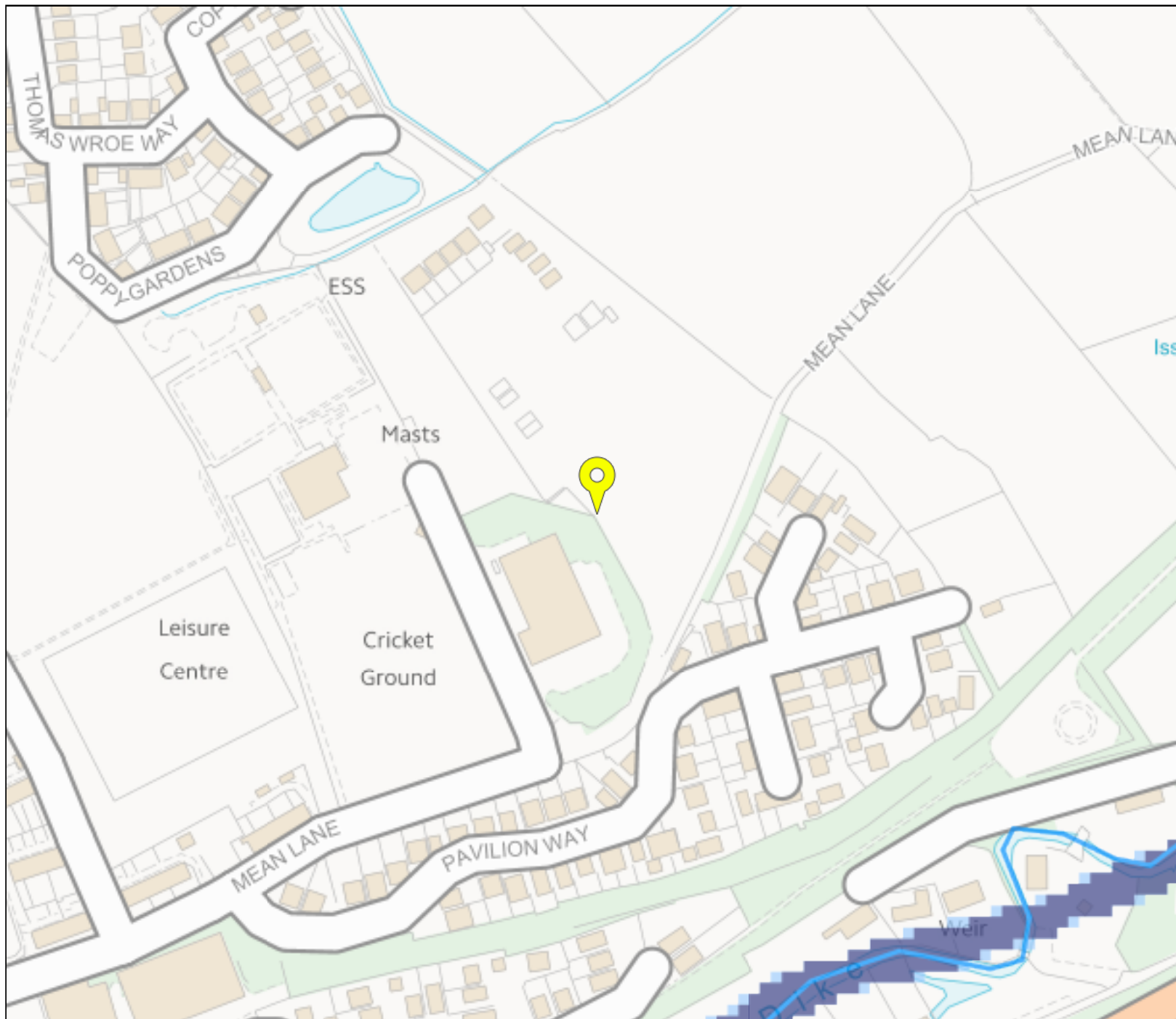
- you don't need to do a flood risk assessment if your development is smaller than 1 hectare and not affected by other sources of flooding
- you may need to do a flood risk assessment if your development is larger than 1 hectare or affected by other sources of flooding or in an area with critical drainage problems

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

The Open Government Licence sets out the terms and conditions for using government data.
<https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>



Flood map for planning

Your reference

17902-L

Location (easting/northing)

410306/411103

Scale

1:2500

Created

16 Mar 2021 10:10

-  Selected point
-  Flood zone 3
-  Flood zone 3: areas benefiting from flood defences
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Flood storage area


 0 20 40 60m

APPENDIX C

YORKSHIRE WATER SEWER RECORDS

YORKSHIRE WATER PROTECTION OF MAINS AND SERVICES

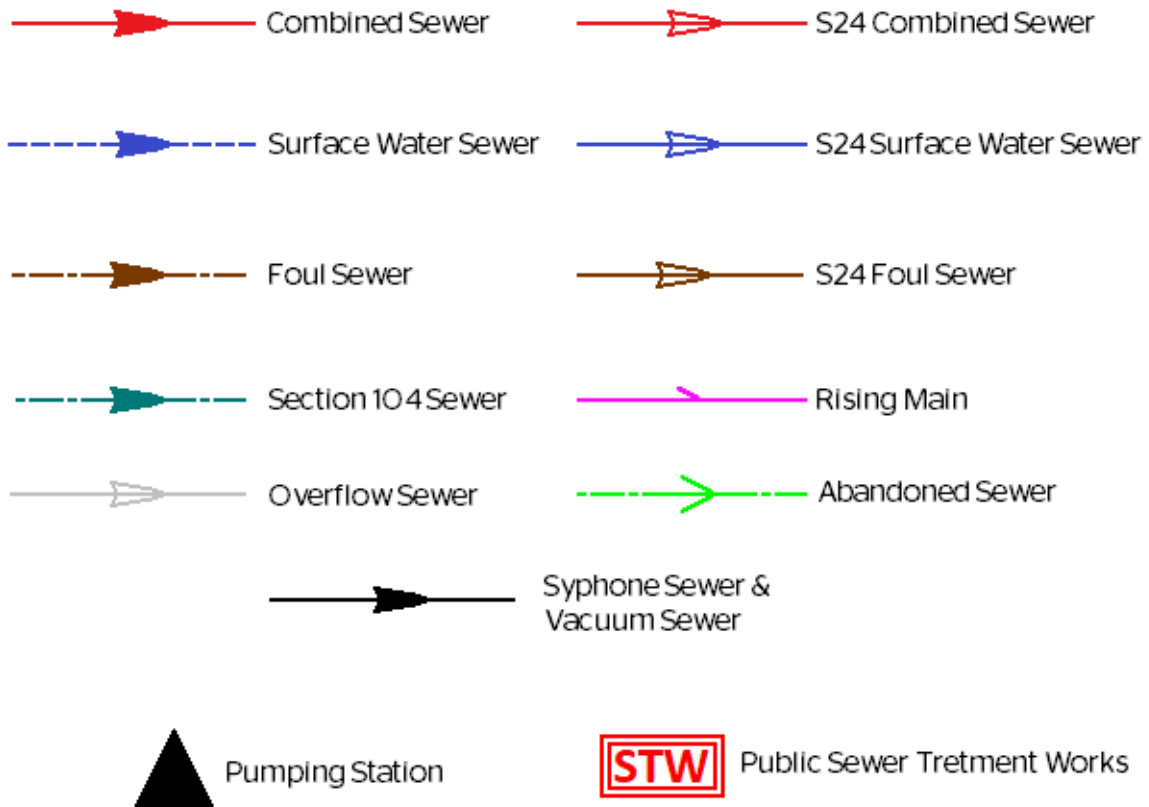
1. The position of Yorkshire Water Services Ltd (YWS) apparatus shown on the existing mains record drawing(s) indicates the **general** position and nature of our apparatus and the accuracy of this information cannot be guaranteed. Any damage to YWS apparatus as a result of your works may have serious consequences and you will be held responsible for all costs incurred. Prior to commencing major works, the exact location of apparatus must be determined on site, if necessary by excavating trial holes. The actual position of such apparatus and that of service pipes which have not been indicated must be established on site by contacting the Customer Helpline on 0845 124 24 24 for both water and sewerage.
2. The public sewer and water network is lawfully retained in its existing position and the sewerage and water undertaker is entitled to have it remain so without any disturbance. The provisions of section 159 of the Water Industry Act 1991 provides that the undertaker may "inspect, maintain, adjust, repair or alter" the network. Those rights are given to enable the undertaker to perform its statutory duties. Any development of the land or any other action that unacceptably hindered the exercise of those rights would be unlawful. The provisions contained in Section 185 of the Water Industry Act 1991 state that where it is reasonable to do so, a person may require the water supply undertaker to alter or remove a pipe where it is necessary to enable that person to carry out a proposed change of use of the land. The provisions contained in Section 185 also require the person making the request to pay the full cost of carrying out the necessary works.
3. Ground levels over existing YWS apparatus are to be maintained. Sewers in highways will **generally** be laid to give 1200mm of cover from finished ground level working to kerb races, other permanent identification of the limits of the road or to an agreed line and level. Substantial increases or decreases to this 1200mm depth of cover will result in the sewer being re-laid at your expense. Water mains and services will **generally** be laid with a minimum of 750mm depth of cover however some mains and services usually those installed over 50 years ago may have less ground cover.
4. If surface levels are to be decreased / increased significantly the effects on existing water supply apparatus will be carefully considered and if any alterations are necessary, the costs of the alterations will be recharged to you in full. Outlets on fire hydrants must be no more than 300mm below the new levels and all surface boxes must be adjusted as part of the scheme.
5. To enable future repair works to be carried out without hindrance; any pipe, cable, duct, etc. installed parallel to a water main or service pipe should not be installed directly over or within 300mm of a water main or service pipe or 1000mm of a waste water asset. Where a pipe, cable, duct, etc. crosses a main or service it should preferably cross perpendicular or at an angle of no less than 45° and with a minimum clearance of 150mm. These requirements apply to activities within an existing highway and are relevant to the installation of pipes, cables, ducts, etc. up to and including 250mm in diameter (*see illustration below*). Necessary protection measures for installations greater than 250mm in diameter and/or in private land will need to be agreed on an individual basis. Installations within a new development site must comply with the National Joint Utilities Group publication Volume 2: NJUG Guidelines On The Positioning Of Underground Utilities Apparatus For New Development Sites.
6. All excavation works near to YW apparatus should be by hand digging only.
7. Backfilling with a suitable material to a minimum 300mm above YW apparatus is required.
8. Adequate support must be provided where any works pass under YW apparatus.
9. Jointing chambers, lighting columns and other structures must be installed in such a way that future repair or maintenance works to YW apparatus will not be hindered.
10. Apparatus such as; railings, sign posts, etc. must not be placed in such a way that they prevent access to or full operation of controlling valves, hydrants or similar apparatus. YWS surface boxes must not be covered or buried. Any adjustment, alteration or replacement of manhole covers must be agreed on site prior to the commencement of the works with a YWS Inspector who may be contacted via our Call Centre on 0845 124 24 24.
11. Explosives shall not be used within 100 metres of any Yorkshire Water Services apparatus or installations.
12. Vibrating plant should not be used directly over any apparatus. Movement or operation by vehicles or heavy plant is not to be permitted in the immediate vicinity of YWS plant or apparatus unless there has been prior consultation and, if necessary, adequate protection provided without cost to YWS.
13. **Under no circumstances** should thrust boring or similar trenchless techniques commence until the actual position of the Company's mains/services along the proposed route have been confirmed by trial holes.
14. Any alterations to the highway should be notified following the procedures outlined in the New Road and Street Works Act 1991 Code of Practice; Measures Necessary Where Apparatus Is Affected By Major Works (Diversions Works).
15. You will be held responsible for any damage or loss to YWS apparatus during and after completion of work, caused by yourselves, your servant or agent. Any damage caused or observed to YWS plant or apparatus should be immediately reported to YWS. Should YW incur any costs as a result of non-compliance with the above, all costs will be rechargeable in full.
16. You should ensure that nothing is done on the site to prejudice the safety or operation of YWS employees, plant or apparatus.

17. In accordance with the New Roads and Street Works Act 1991, Chapter 22, Part 3, Section 80. The location of any identified YW asset "*which is not marked, or is wrongly marked, on the records made available* " should be communicated back to Yorkshire Water. The location of the apparatus should be identified on copies of the supplied plans which should be returned to Yorkshire Water (Asset Records Team) with photographic supporting evidence where possible.
18. The Government has decided that responsibility for private sewers serving two or more properties and lateral drains (the section of pipe beyond the boundary of a single property, connecting it to the public sewer) will be transferred to the water companies on Oct 1 2011. Private pumping stations will also transfer during the period 1 October 2011 – 1 Oct 2016. Records of these assets may not yet be shown on the existing mains record drawing(s). If you encounter any of these assets you must inform Yorkshire Water Services Ltd (YWS).
19. Please note that the information supplied on the enclosed plans is reproduced from Ordnance Survey material with the permission of the Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office, © Crown Copyright. Unauthorised reproduction infringes Crown Copyright and may lead to prosecution or civil proceedings. Licence Number 1000019559.
20. This information is for guidance only and the position and depth of any YW apparatus is approximate only. Likewise, the nature and condition of any YW apparatus cannot be guaranteed. YW has no responsibility for recording the locations of privately owned apparatus. As of 1 October 2011, there may be some lateral drains and/or public sewers which are not documented on YW records but may still be present. For the avoidance of doubt, this information is not a substitute for appropriate professional and/or legal advice. YW accepts no responsibility for any inaccuracy or omissions in this information. The actual position of YW apparatus must be determined on site by excavating trial holes by hand. YW requires a minimum of two working days' written notice of the intention to excavate any trial holes before any excavation can be undertaken. If there are any queries in this respect please contact Yorkshire Water on 0345 124 24 24.

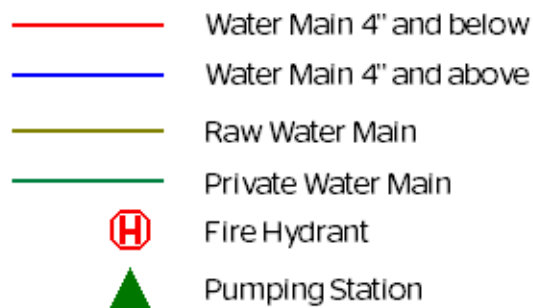
Property Identifier

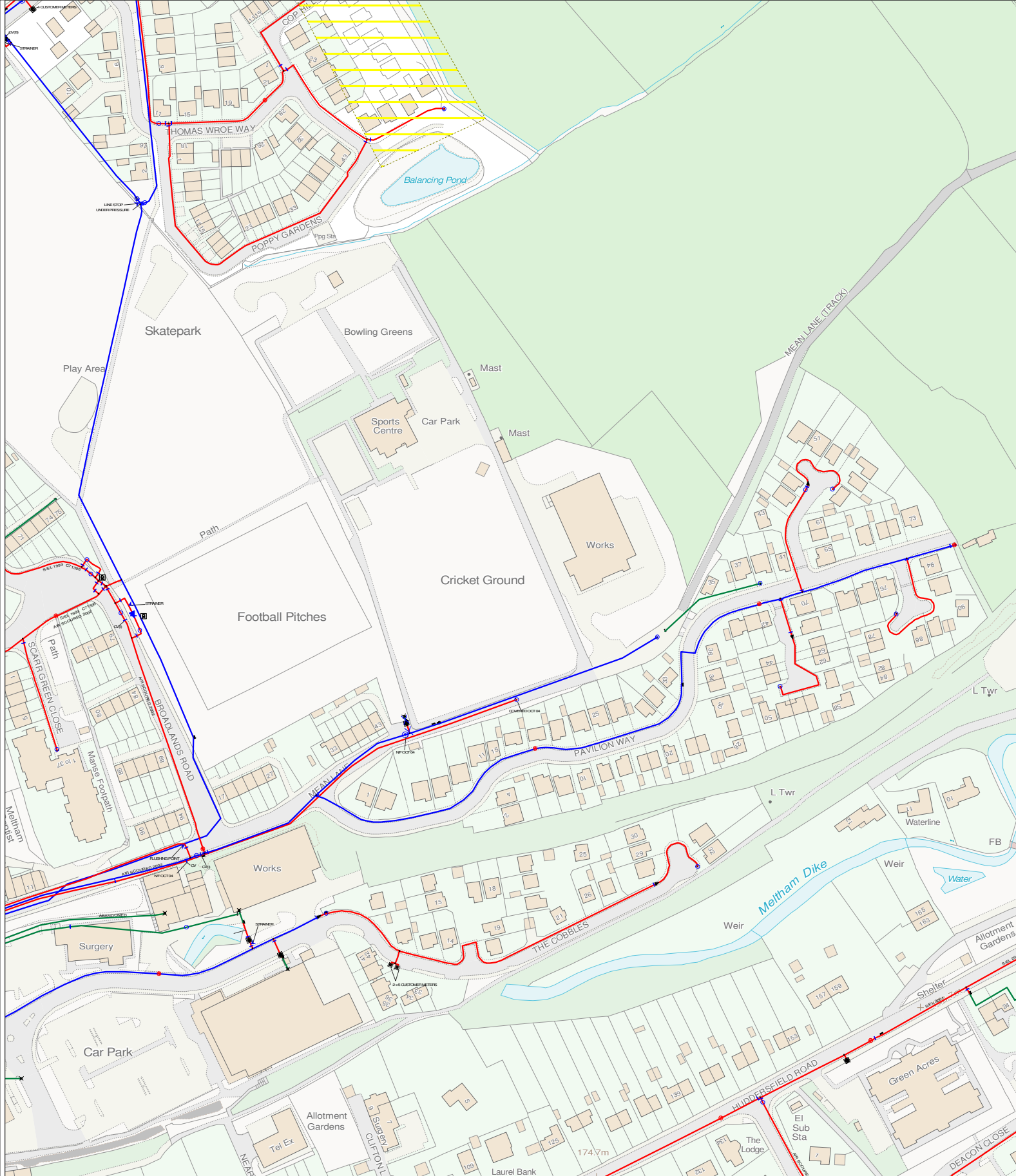


Sewer Legend

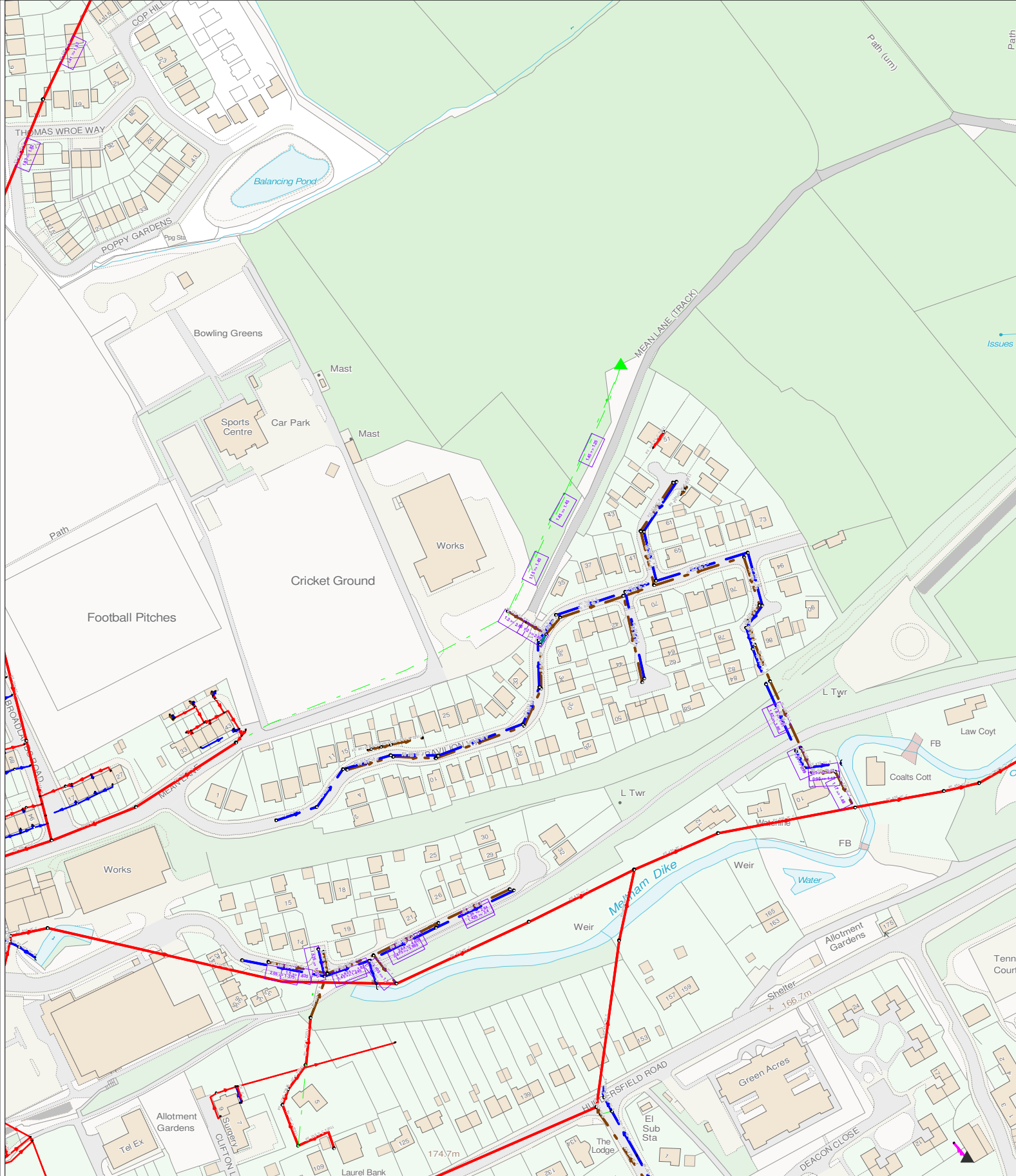


Water Legend





410003 : 410757	Map Name : SE0910NE	Title	
 YorkshireWater	Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Sarah Chamberlain Contact Tel :	Notes	
		Partial Key	The position and depths of apparatus shown on this plan are approximate only. The exact positions and depths should be obtained by excavation trial holes.
		Water mains up to 4" in diameter	
		Water mains over 4" in diameter	
		Raw water mains	
		Private water mains	Scale : 1:2500
(Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432		Drg No :	Maris No :
Registered Office, Yorkshire Water Services Limited, Western House, Halifax Road, Bradford BD6 2SZ, Registered In England and Wales No. 2366682		Date Req : 02/10/2019, 09:47:42	Date Gen : 02/10/2019, 09:47:59
		Source : Water Network Enquiry	 A part of Yorkshire Water



410080 : 410757	Map Name : SE1010NW	Title
 Yorkshire Water, PO Box 500, Halifax Road, Bradford BD6 2LZ Contact Name : Sarah Chamberlain Contact Tel : (Ody) COPYRIGHT STATEMENTS: Reproduced by permission of Ordnance Survey on behalf of HMSO © Crown copyright and database 2014. All rights reserved Ordnance Survey Licence number 100022432 Registered Office, Yorkshire Water Services Limited, Western House, Halifax Road, Bradford BD6 2SZ, Registered in England and Wales No. 2366682	Notes Partial Key Foul Sewer = F Combined Sewer = C Surface Water Sewer = SW Trade Sewer = TD Partially Separate = PS Date Req : 02/10/2019, 09:48:55 Source : Sewer Network Enquiry	This plan is furnished as a general guide only and no warranty as to its correctness is given or implied. This plan must not be relied upon in the event of excavations or other works made in the vicinity of public sewers. No house or property connections are shown.  Date Gen : 02/10/2019, 09:48:58

APPENDIX D

DRAINAGE LAYOUT AND IMPERMEABLE AREAS PLAN



Notes

1. This drawing is subject to copyright and must not be reproduced, stored or transmitted in any form without prior permission from Mason Clark Associates.
2. This drawing is not to be scaled. All dimensions are to be checked on site by the contractor. Any discrepancies are to be notified to Mason Clark Associates. Obtain instructions prior to works commencing.
3. This drawing is to be read in conjunction with all the relevant contract drawings and specifications.
4. All dimensions are in millimetres and all levels are in metres AOD unless noted otherwise.
5. All work shall be carried out in accordance with Local Authority, Statutory Authority and Health & Safety Regulations.
6. Mason Clark Associates are not responsible for determining the appropriate fire period, fire boundary conditions or the associated design of fire protection or inherent fire resistance to any elements of structure, including all frames, posts, beams, joists, roof members and secondary structural elements such as inlets. Refer to the Architect or Project Manager for this information.

Key (Private Drainage)

- Approximate Site Boundary
- Surface Water
- Foul Water
- SMH Surface Water Manhole
- SWPIC Surface Water Polypropylene Inspection Chamber 4500
- FWPPIC Foul Water Polypropylene Inspection Chamber 4500
- Surface Water Storage - Oversized pipe
- Permeable Paved Driveway - Voided Stone Attenuation
- Easement

Storage Requirements:

See source control calculations in Appendix E for storage requirements.

Storage requirements subject to change, actual volumes to be confirmed at detailed design stage.

Storage Available:

Permeable paving

Area = 674m²
Void Ratio = 30%
Depth of Voided Stone = 600mm
Storage Volume = 141m³

Oversized Pipes

Pipe Diameter = 900mm
Length = 140m
Storage Volume = 89m³

P3	Revised to suit LLFA comments	BW	08.04.2021		
P2	Revised to suit pumping arrangement	BW	12.03.2021		
P1	Preliminary Issue - For Comment	BW	24.10.2019		
Rev	Details	By	Date		
		Hull	+44 (0) 1482 345797		
		Leeds	+44 (0) 113 277 9542		
		York	+44 (0) 1904 438005		
		www.masonclark.co.uk			
masonclarkassociates					
civil and structural engineering consultants					
Client: Acumen Architects					
Project: Helme Lane, Meltham					
Title: Drainage Layout					
Drawn: BW		Checked: GS		Date: Oct '19	
Scale @ A1: 1:250					
Drawing No: 17902-L-DR-200			Rev: P3		

APPENDIX E

MICRODRAINAGE STORAGE CALCULATIONS

Mason Clark Associates Ltd					Page 1
Church House 44 Newland Park Kingston upon Hull, HU5 2DW					
Date 08/04/2021 14:31 File 30 Storage Roads.SRCX		Designed by laura.barlow Checked by			
Innovyze		Source Control 2019.1			
Summary of Results for 30 year Return Period					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	97.900	0.400	3.0	19.0	O K
30 min Summer	97.975	0.475	3.0	25.6	O K
60 min Summer	98.041	0.541	3.0	31.5	O K
120 min Summer	98.077	0.577	3.0	34.8	O K
180 min Summer	98.078	0.578	3.0	34.9	O K
240 min Summer	98.074	0.574	3.0	34.5	O K
360 min Summer	98.059	0.559	3.0	33.2	O K
480 min Summer	98.039	0.539	3.0	31.3	O K
600 min Summer	98.015	0.515	3.0	29.2	O K
720 min Summer	97.991	0.491	3.0	27.0	O K
960 min Summer	97.941	0.441	3.0	22.6	O K
1440 min Summer	97.849	0.349	3.0	14.9	O K
15 min Winter	97.931	0.431	3.0	21.7	O K
30 min Winter	98.017	0.517	3.0	29.4	O K
60 min Winter	98.099	0.599	3.0	36.7	O K
120 min Winter	98.155	0.655	3.0	41.8	O K
180 min Winter	98.158	0.658	3.0	42.0	O K
240 min Winter	98.148	0.648	3.0	41.1	O K
360 min Winter	98.122	0.622	3.0	38.8	O K
480 min Winter	98.083	0.583	3.0	35.3	O K
600 min Winter	98.041	0.541	3.0	31.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	65.814	0.0	22.7	23	
30 min Summer	45.484	0.0	31.4	37	
60 min Summer	30.183	0.0	41.7	64	
120 min Summer	19.401	0.0	53.5	118	
180 min Summer	14.761	0.0	61.1	150	
240 min Summer	12.123	0.0	66.9	182	
360 min Summer	9.172	0.0	75.9	250	
480 min Summer	7.514	0.0	82.9	318	
600 min Summer	6.431	0.0	88.7	386	
720 min Summer	5.660	0.0	93.7	452	
960 min Summer	4.623	0.0	102.1	580	
1440 min Summer	3.470	0.0	114.9	824	
15 min Winter	65.814	0.0	25.4	24	
30 min Winter	45.484	0.0	35.1	37	
60 min Winter	30.183	0.0	46.7	64	
120 min Winter	19.401	0.0	60.0	120	
180 min Winter	14.761	0.0	68.4	174	
240 min Winter	12.123	0.0	74.9	200	
360 min Winter	9.172	0.0	85.1	276	
480 min Winter	7.514	0.0	92.9	350	
600 min Winter	6.431	0.0	99.4	420	
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Mason Clark Associates Ltd					Page 2
Church House 44 Newland Park Kingston upon Hull, HU5 2DW					
Date 08/04/2021 14:31 File 30 Storage Roads.SRCX		Designed by laura.barlow Checked by			
Innovyze		Source Control 2019.1			
<u>Summary of Results for 30 year Return Period</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
720 min Winter	97.998	0.498	3.0	27.7	O K
960 min Winter	97.916	0.416	3.0	20.5	O K
1440 min Winter	97.775	0.275	3.0	9.2	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
720 min Winter	5.660	0.0	105.0	488	
960 min Winter	4.623	0.0	114.3	616	
1440 min Winter	3.470	0.0	128.7	842	
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Mason Clark Associates Ltd		Page 3																																										
Church House 44 Newland Park Kingston upon Hull, HU5 2DW																																												
Date 08/04/2021 14:31 File 30 Storage Roads.SRCX	Designed by laura.barlow Checked by																																											
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From: To:	(ha)	From: To:	(ha)	From: To:	(ha)																																							
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Mason Clark Associates Ltd		Page 4																																																																								
Church House 44 Newland Park Kingston upon Hull, HU5 2DW																																																																										
Date 08/04/2021 14:31 File 30 Storage Roads.SRCX	Designed by laura.barlow Checked by																																																																									
Innovyze																																																																										
Source Control 2019.1																																																																										
Model Details Storage is Online Cover Level (m) 100.000 Pipe Structure Diameter (m) 0.900Length (m) 100.000 Slope (1:X) 500.000Invert Level (m) 97.500 Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0082-3000-1000-3000 Design Head (m) 1.000 Design Flow (l/s) 3.0 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 82 Invert Level (m) 97.500 Minimum Outlet Pipe Diameter (mm) 100 Suggested Manhole Diameter (mm) 1200 Control PointsHead (m)Flow (l/s) Design Point (Calculated) 1.000 3.0 Flush-Flo™ 0.297 3.0 Kick-Flo® 0.623 2.4 Mean Flow over Head Range - 2.6 The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated <table><tr><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td><td>Depth (m)</td><td>Flow (l/s)</td></tr><tr><td>0.100</td><td>2.4</td><td>1.200</td><td>3.3</td><td>3.000</td><td>5.0</td><td>7.000</td><td>7.4</td></tr><tr><td>0.200</td><td>2.9</td><td>1.400</td><td>3.5</td><td>3.500</td><td>5.4</td><td>7.500</td><td>7.7</td></tr><tr><td>0.300</td><td>3.0</td><td>1.600</td><td>3.7</td><td>4.000</td><td>5.7</td><td>8.000</td><td>7.9</td></tr><tr><td>0.400</td><td>2.9</td><td>1.800</td><td>3.9</td><td>4.500</td><td>6.0</td><td>8.500</td><td>8.2</td></tr><tr><td>0.500</td><td>2.8</td><td>2.000</td><td>4.1</td><td>5.000</td><td>6.3</td><td>9.000</td><td>8.4</td></tr><tr><td>0.600</td><td>2.5</td><td>2.200</td><td>4.3</td><td>5.500</td><td>6.6</td><td>9.500</td><td>8.6</td></tr><tr><td>0.800</td><td>2.7</td><td>2.400</td><td>4.5</td><td>6.000</td><td>6.9</td><td></td><td></td></tr><tr><td>1.000</td><td>3.0</td><td>2.600</td><td>4.7</td><td>6.500</td><td>7.2</td><td></td><td></td></tr></table>			Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	2.4	1.200	3.3	3.000	5.0	7.000	7.4	0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7	0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9	0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2	0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4	0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6	0.800	2.7	2.400	4.5	6.000	6.9			1.000	3.0	2.600	4.7	6.500	7.2		
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
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Mason Clark Associates Ltd					Page 1
Church House 44 Newland Park Kingston upon Hull, HU5 2DW					
Date 08/04/2021 14:25 File 30 Storage Full Area.SRCX		Designed by laura.barlow Checked by			
Innovyze		Source Control 2019.1			
Summary of Results for 30 year Return Period					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.020	0.520	2.8	39.8	O K
30 min Summer	98.118	0.618	2.8	54.4	O K
60 min Summer	98.224	0.724	2.8	70.1	O K
120 min Summer	98.325	0.825	2.8	84.2	O K
180 min Summer	98.369	0.869	2.8	89.9	O K
240 min Summer	98.389	0.889	2.8	92.2	O K
360 min Summer	98.394	0.894	2.8	92.8	O K
480 min Summer	98.390	0.890	2.8	92.4	O K
600 min Summer	98.384	0.884	2.8	91.6	O K
720 min Summer	98.375	0.875	2.8	90.6	O K
960 min Summer	98.355	0.855	2.8	88.1	O K
1440 min Summer	98.304	0.804	2.8	81.5	O K
15 min Winter	98.056	0.556	2.8	45.1	O K
30 min Winter	98.168	0.668	2.8	61.8	O K
60 min Winter	98.292	0.792	2.8	79.9	O K
120 min Winter	98.432	0.932	2.8	96.8	O K
180 min Winter	98.526	1.026	2.8	104.1	O K
240 min Winter	98.606	1.106	2.8	107.6	O K
360 min Winter	98.715	1.215	2.9	109.3	O K
480 min Winter	98.625	1.125	2.8	108.2	O K
600 min Winter	98.586	1.086	2.8	107.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	65.814	0.0	43.6	25	
30 min Summer	45.484	0.0	60.2	39	
60 min Summer	30.183	0.0	79.9	68	
120 min Summer	19.401	0.0	102.7	126	
180 min Summer	14.761	0.0	117.2	184	
240 min Summer	12.123	0.0	128.4	242	
360 min Summer	9.172	0.0	145.7	328	
480 min Summer	7.514	0.0	159.1	390	
600 min Summer	6.431	0.0	170.3	456	
720 min Summer	5.660	0.0	179.8	522	
960 min Summer	4.623	0.0	195.8	662	
1440 min Summer	3.470	0.0	220.5	944	
15 min Winter	65.814	0.0	48.8	25	
30 min Winter	45.484	0.0	67.4	39	
60 min Winter	30.183	0.0	89.5	68	
120 min Winter	19.401	0.0	115.1	124	
180 min Winter	14.761	0.0	131.3	180	
240 min Winter	12.123	0.0	143.8	236	
360 min Winter	9.172	0.0	163.2	344	
480 min Winter	7.514	0.0	178.2	402	
600 min Winter	6.431	0.0	190.7	474	
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Church House 44 Newland Park Kingston upon Hull, HU5 2DW					
Date 08/04/2021 14:25 File 30 Storage Full Area.SRCX		Designed by laura.barlow Checked by			
Innovyze		Source Control 2019.1			
<u>Summary of Results for 30 year Return Period</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
720 min Winter	98.550	1.050	2.8	105.4	O K
960 min Winter	98.484	0.984	2.8	101.3	O K
1440 min Winter	98.373	0.873	2.8	90.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
720 min Winter	5.660	0.0	201.4	554	
960 min Winter	4.623	0.0	219.3	712	
1440 min Winter	3.470	0.0	246.9	1024	
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Mason Clark Associates Ltd		Page 3																																										
Church House 44 Newland Park Kingston upon Hull, HU5 2DW																																												
Date 08/04/2021 14:25	Designed by laura.barlow																																											
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Mason Clark Associates Ltd		Page 4
Church House 44 Newland Park Kingston upon Hull, HU5 2DW		
Date 08/04/2021 14:25	Designed by laura.barlow	
File 30 Storage Full Area.SRCX	Checked by	
Innovyze	Source Control 2019.1	
Model Details Storage is Online Cover Level (m) 100.000 Pipe Structure Diameter (m) 0.900Length (m) 170.000 Slope (1:X) 500.000Invert Level (m) 97.500 Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0078-3000-1300-3000 Design Head (m) 1.300 Design Flow (l/s) 3.0 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 78 Invert Level (m) 97.500 Minimum Outlet Pipe Diameter (mm) 100 Suggested Manhole Diameter (mm) 1200 Control PointsHead (m)Flow (l/s) Design Point (Calculated) 1.300 3.0 Flush-Flo™ 0.341 2.8 Kick-Flo® 0.695 2.2 Mean Flow over Head Range - 2.5 The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated Depth (m)Flow (l/s)Depth (m)Flow (l/s)Depth (m)Flow (l/s)Depth (m)Flow (l/s) 0.100 2.21.200 2.93.000 4.47.000 6.6 0.200 2.71.400 3.13.500 4.77.500 6.8 0.300 2.81.600 3.34.000 5.08.000 7.0 0.400 2.81.800 3.54.500 5.38.500 7.2 0.500 2.72.000 3.75.000 5.69.000 7.4 0.600 2.62.200 3.85.500 5.99.500 7.6 0.800 2.42.400 4.06.000 6.1 1.000 2.72.600 4.16.500 6.3		
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Church House 44 Newland Park Kingston upon Hull, HU5 2DW					
Date 08/04/2021 14:33 File 100 +30% Storage Roads....		Designed by laura.barlow Checked by			
Innovyze		Source Control 2019.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	97.973	0.473	3.0	34.2	O K
30 min Summer	98.051	0.551	3.0	47.2	O K
60 min Summer	98.130	0.630	3.0	60.7	O K
120 min Summer	98.193	0.693	3.0	71.8	O K
180 min Summer	98.211	0.711	3.0	74.9	O K
240 min Summer	98.212	0.712	3.0	75.1	O K
360 min Summer	98.205	0.705	3.0	73.9	O K
480 min Summer	98.197	0.697	3.0	72.5	O K
600 min Summer	98.187	0.687	3.0	70.8	O K
720 min Summer	98.176	0.676	3.0	68.8	O K
960 min Summer	98.151	0.651	3.0	64.4	O K
1440 min Summer	98.088	0.588	3.0	53.5	O K
15 min Winter	98.001	0.501	3.0	38.8	O K
30 min Winter	98.089	0.589	3.0	53.7	O K
60 min Winter	98.180	0.680	3.0	69.5	O K
120 min Winter	98.259	0.759	3.0	83.1	O K
180 min Winter	98.286	0.786	3.0	87.6	O K
240 min Winter	98.294	0.794	3.0	88.9	O K
360 min Winter	98.286	0.786	3.0	87.6	O K
480 min Winter	98.270	0.770	3.0	85.0	O K
600 min Winter	98.255	0.755	3.0	82.5	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	110.471	0.0	38.1	25	
30 min Summer	77.202	0.0	53.3	39	
60 min Summer	51.576	0.0	71.2	68	
120 min Summer	33.108	0.0	91.4	124	
180 min Summer	25.017	0.0	103.6	182	
240 min Summer	20.428	0.0	112.8	240	
360 min Summer	15.331	0.0	126.9	302	
480 min Summer	12.479	0.0	137.8	366	
600 min Summer	10.625	0.0	146.6	432	
720 min Summer	9.310	0.0	154.2	502	
960 min Summer	7.547	0.0	166.6	644	
1440 min Summer	5.599	0.0	185.4	910	
15 min Winter	110.471	0.0	42.7	25	
30 min Winter	77.202	0.0	59.7	39	
60 min Winter	51.576	0.0	79.7	68	
120 min Winter	33.108	0.0	102.3	124	
180 min Winter	25.017	0.0	116.0	180	
240 min Winter	20.428	0.0	126.3	236	
360 min Winter	15.331	0.0	142.2	340	
480 min Winter	12.479	0.0	154.3	386	
600 min Winter	10.625	0.0	164.2	464	
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Church House 44 Newland Park Kingston upon Hull, HU5 2DW					
Date 08/04/2021 14:33 File 100 +30% Storage Roads....		Designed by laura.barlow Checked by			
Innovyze		Source Control 2019.1			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
720 min Winter	98.238	0.738	3.0	79.5	O K
960 min Winter	98.198	0.698	3.0	72.6	O K
1440 min Winter	98.099	0.599	3.0	55.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
720 min Winter	9.310	0.0	172.7	542	
960 min Winter	7.547	0.0	186.6	696	
1440 min Winter	5.599	0.0	207.7	988	
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Date 08/04/2021 14:29 File 100 +30% Storage Full A...		Designed by laura.barlow Checked by			
Innovyze		Source Control 2019.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	97.643	0.643	2.4	69.9	O K
30 min Summer	97.746	0.746	2.4	97.2	O K
60 min Summer	97.852	0.852	2.4	127.6	O K
120 min Summer	97.964	0.964	2.4	158.3	O K
180 min Summer	98.027	1.027	2.4	173.4	O K
240 min Summer	98.070	1.070	2.4	182.7	O K
360 min Summer	98.122	1.122	2.5	193.1	O K
480 min Summer	98.145	1.145	2.5	197.1	O K
600 min Summer	98.147	1.147	2.5	197.5	O K
720 min Summer	98.140	1.140	2.5	196.3	O K
960 min Summer	98.123	1.123	2.5	193.3	O K
1440 min Summer	98.091	1.091	2.4	187.0	O K
15 min Winter	97.678	0.678	2.4	78.8	O K
30 min Winter	97.789	0.789	2.4	109.5	O K
60 min Winter	97.911	0.911	2.4	144.1	O K
120 min Winter	98.056	1.056	2.4	179.6	O K
180 min Winter	98.148	1.148	2.5	197.7	O K
240 min Winter	98.221	1.221	2.6	209.2	O K
360 min Winter	98.339	1.339	2.7	222.8	O K
480 min Winter	98.427	1.427	2.8	229.1	O K
600 min Winter	98.477	1.477	2.8	231.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	110.471	0.0	73.1	26	
30 min Summer	77.202	0.0	102.2	41	
60 min Summer	51.576	0.0	136.5	70	
120 min Summer	33.108	0.0	175.3	128	
180 min Summer	25.017	0.0	198.7	188	
240 min Summer	20.428	0.0	216.3	246	
360 min Summer	15.331	0.0	243.5	364	
480 min Summer	12.479	0.0	264.3	482	
600 min Summer	10.625	0.0	281.3	600	
720 min Summer	9.310	0.0	295.8	662	
960 min Summer	7.547	0.0	319.7	782	
1440 min Summer	5.599	0.0	355.7	1044	
15 min Winter	110.471	0.0	81.9	26	
30 min Winter	77.202	0.0	114.5	40	
60 min Winter	51.576	0.0	152.9	68	
120 min Winter	33.108	0.0	196.3	126	
180 min Winter	25.017	0.0	222.5	184	
240 min Winter	20.428	0.0	242.3	242	
360 min Winter	15.331	0.0	272.8	356	
480 min Winter	12.479	0.0	296.0	470	
600 min Winter	10.625	0.0	315.1	578	
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Sewer requisitions and diversions
Section 98 and 185 Agreements

Flood Risk Assessments
Coastal erosion flood breach analysis
Flood risk management / prevention schemes

Underground drainage design
Stormwater attenuation
SUDS
Ponds, lakes and balancing ponds

PROJECT MANAGEMENT
QUANTITY SURVEYING & CONTRACT ADVICE
CDM SERVICES
BUILDING SURVEYING SERVICES

Design, Remedial Repair / Improvement Schemes
Contract Administration
Building Surveys
Professional Opinion Reports
Condition Surveys & Schedules of Condition
Measured Surveys
Dilapidation Claims
Party Wall etc. Act Representation
Disabled Adaptations
Disabled adaptations

STRUCTURAL ENGINEERING

Residential and commercial building structures
Education and healthcare facilities
Heavy industrial development
Feasibility studies for development sites
Building Regulations and Planning Applications

Access and maintenance gantries
Modular building design
Blast design

Subsidence management and resolution
Temporary works design and specification
Site and soils investigation
Sulphate attack specialists
Confined spaces assessments

CONSERVATION ENGINEERING

Engineer Accredited in Building Conservation CARE
Registered Engineer
Heritage and conservation engineering
Listed Building refurbishment
Historic Parks and Gardens
Scheduled Ancient Monuments
Monitoring and investigations
Liaison with Local Conservation Officers
Buildings at Risk and Managed Ruins

EXPERT WITNESS SERVICES

Civil & Structural engineering disputes
Project Disputes
Building Surveying
Health and Safety Regulations