



Avie Consulting Ltd
Unit 6 Killingbeck Court
Killingbeck Office Village
Killingbeck Drive
Leeds, LS14 6FD

Royd Moor Farm

Kingsman Homes

Flood Risk Assessment and Drainage Strategy Statement

June 2024



P4244

[illegible]



Avie Consulting Ltd
Unit 6 Killingbeck Court
Killingbeck Office Village
Killingbeck Drive
Leeds, LS14 6FD

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1 INTRODUCTION

Avie Consulting Ltd has been commissioned by Kingsman Homes to carry out a Flood Risk Assessment and Drainage Strategy report to support a Full Planning Application for a new residential development on land off Royd Moor Road, Thurlstone, Barnsley.

The aim of this report is to allow the Planning Authority to assess the site in accordance with the National Planning Policy Framework published by the Department of Communities and Local Government.

2 PROPOSED DEVELOPMENT

The site under consideration is brownfield development comprising the farmhouse, barns sheds and ancillary buildings for the current livestock/dairy farm that is in operation on the site and the fields surrounding it. The proposed end use is residential.

Please refer to Appendix A for Site Development Proposals.

The site is located some 500m north of the village of Millhouse Green and 1.25km northwest of Thurlstone at Ordnance Survey grid reference SE221401, with the nearest post code being S36 7RD.

The site is bounded as follows:

To the North – Royd Moor Road, open grazing land and the various buildings comprising Royd Moor Hall Farm.

To the East – Open grazing land and the village of Thurlstone.

To the South – Open grazing land giving way to the village of Millhouse Green.

To the West – Open grazing land.

Site levels vary from roughly 297m on the eastern site boundary and 286m AOD at the existing vehicular access from Royd Moor Road.

The site location plan is shown in Figure 1

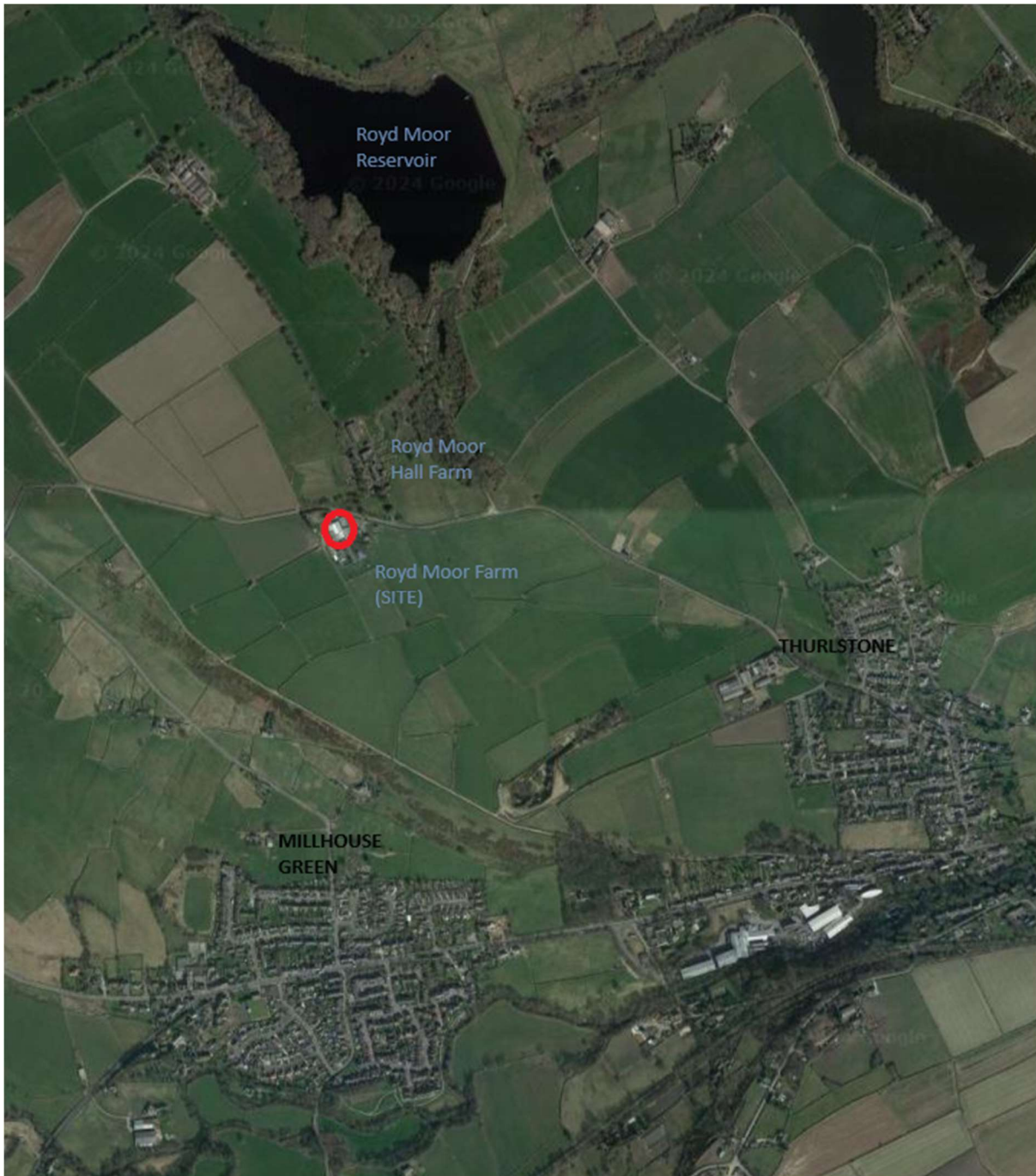


Figure 1 (Image courtesy of Google Maps)

3 FLOOD RISK ASSESSMENT CRITERIA

The EA flood data was obtained, the site under consideration is within Flood Zone 1 according to the latest version of the Indicative Floodplain Map produced by the Environment Agency.

Indicative Floodplain Map for the site is shown in figure 2 below.

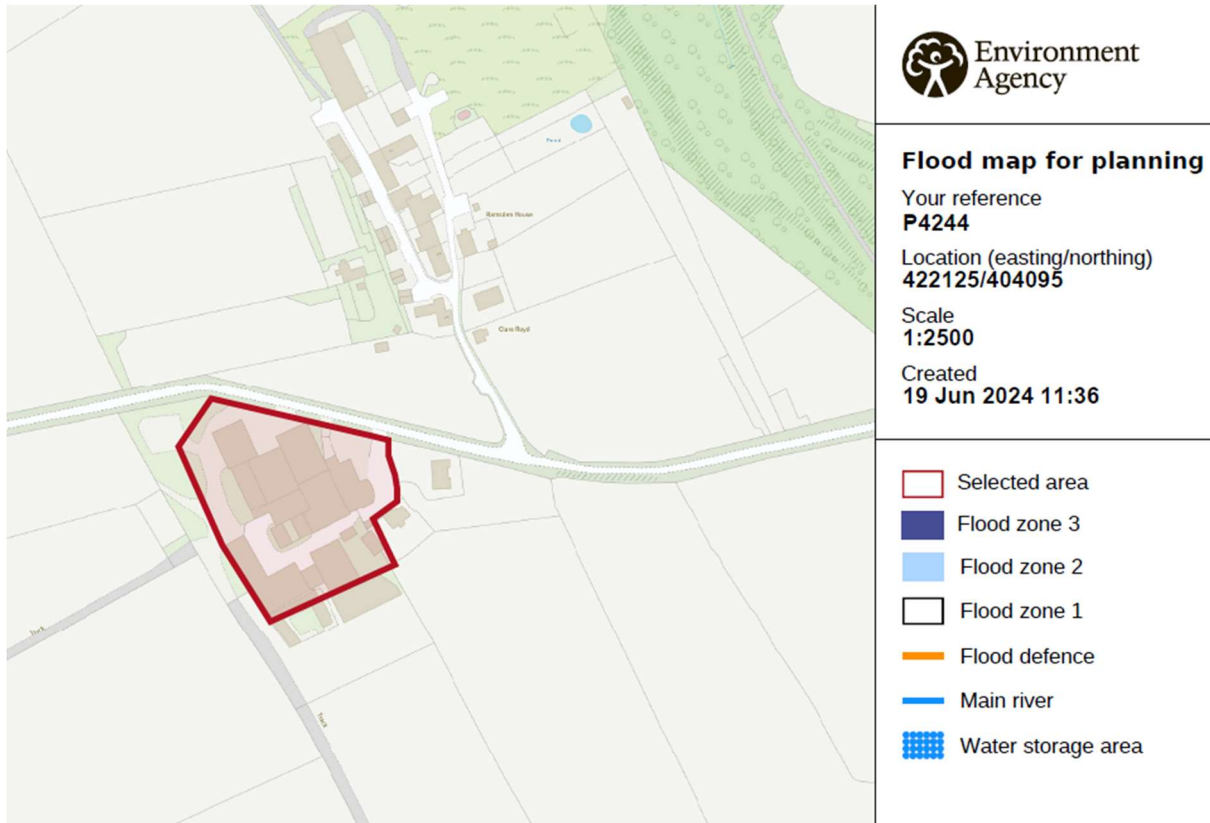


Figure 2 (approximate redline boundary shown)

As the site lies entirely within Flood Zone 1 the flood risk assessment needs to consider the following:

- Flooding from other sources such as rivers, tidal, sewers and overland flooding
- The potential for the development to increase flooding elsewhere through the addition of hard surfaces
- The effect of the new development on surface water run-off

4 EXISTING FLOOD DEFENCES

The site does not benefit from any flood defences, nor does it require any.

5 SOURCES OF FLOODING

As part of the flood risk assessment consideration should be given to the following sources of flooding and what effect these could have on the development.

5.1 Flooding from Rivers / Watercourses

The indicative floodplain map extract shown in figure 2 shows the site to lie entirely within Flood Zone 1. The closest watercourse is some 250m northeast of the site and some 11m lower in elevation.

The risk of flooding from rivers and watercourses is considered to be **LOW**.

5.2 Flooding from the Sea

The site is more 75km from the nearest tidal waters, as such the risk of flooding from this source is considered to be **LOW**.

5.3 Flooding from Land

The effect of intense rainfall needs to be considered and the local Topography of the land assessed.

The site is currently developed with a range of roofed agricultural structures and a residential dwelling. All of these buildings are positively drained to ground level with collection of surface water at ground level by overland flow to low points within the site (generally on the Royd Moor Road boundary) where collected surface waters are piped through the wall and discharge into the ditch alongside Royd Moor Road. Whilst there may be some overland flows entering the site in the current drainage regime, it is difficult to determine where and how much due to the steeply sloping site and current ground level surface water collection system. Given that there is no historic record of surface water flooding this is deemed not to be an issue that affects the site. The risk of flooding from land is considered to be **LOW**.

The long-term flood maps obtained from the GOV.UK website (see figure 3) show that the site is not known to be at risk of surface water flooding.

It is recommended that plot FFLs are raised 150mm above general site levels to ensure that any overland flows that may occur within the proposed development do not adversely affect the plots.

As such the risk of flooding from this source is considered to be **LOW**.

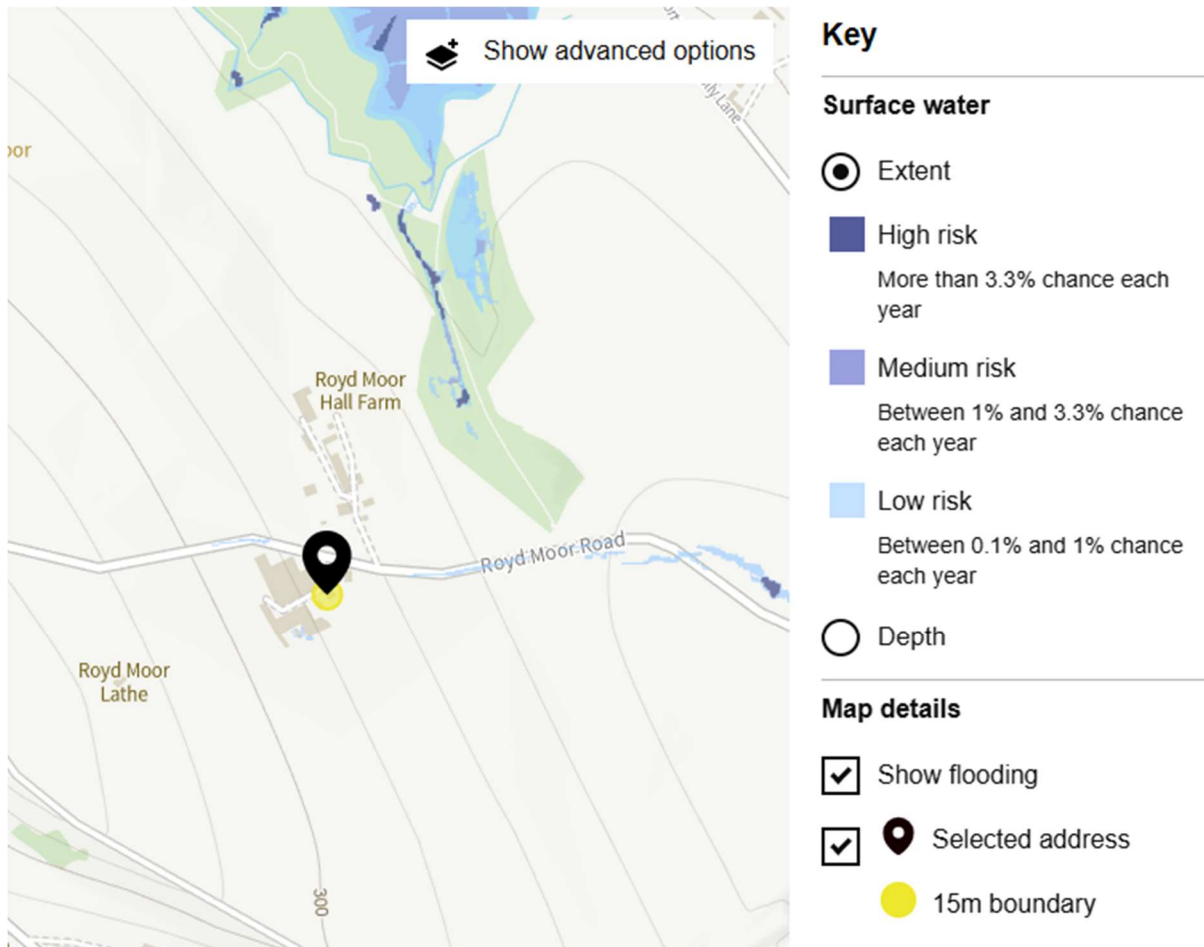


Figure 3

5.4 Flooding from Groundwater

Groundwater flooding occurs when water levels in the ground rise above surface elevations, particularly in low lying areas. On the basis that the geology in the area is understood to comprise clay soils overlying sandstone, groundwater flooding is not expected to be an issue.

As such the risk of flooding from this source is considered to be **LOW**.

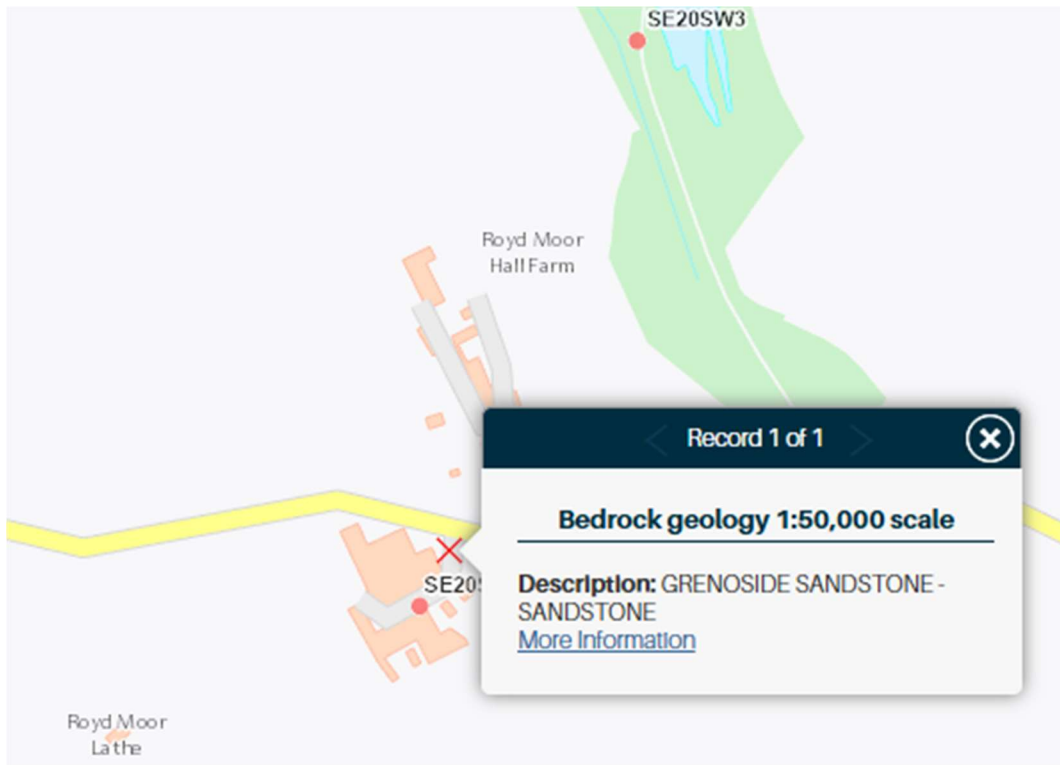


Figure 4

5.5 Flooding from Sewers

There are no public sewers in proximity to the site, so flooding from sewers will not affect the site. A copy of the Yorkshire Water sewer asset plan for the area is contained in Appendix B.

The risk of flooding from this source is **LOW**.

6 FLOOD RISK SUMMARY

Sources of Flooding	Risk			Control Measures
	High	Medium	Low	
Rivers:			X	None
Sea			X	None
Land			X	Plot FFL's to be 150mm above existing ground levels
Groundwater			X	None
Existing sewers			X	None

7 INCREASE TO OFFSITE FLOODING

The surface water drainage strategy has been developed to offer an improvement over the existing uncontrolled surface water flows from site and to include consideration of climate change allowances for peak rainfall intensity as well as urban creep. The proposed development represents a significant reduction on the existing impermeable roofed/positively drained area for the site. The reduction in discharge rate and the attenuation of collected surface waters for more severe storm events means that the site will discharge at a lower rate to assist with reducing the peak volume associated with storm events downstream, thereby reducing flood risk downstream of the site.

8 FLOOD RISK VULNERABILITY

The vulnerability of the proposed development is assessed in accordance with the Technical Guidance to the National Planning Policy Framework published by the Department for Communities and Local Government in March 2012.

The report should consider if the development is acceptable for the Flood Zone Classification in accordance with Annexe 3 within the NPPF.

The proposed development is Residential and is classified as **“More vulnerable”** according to the NPPF.

The site is indicated on the flood maps to be in Flood Zone 1.

Table 3: Flood Risk Vulnerability and Flood Zone ‘Compatibility’

Flood Risk Vulnerability Classification (from Table 2)		Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test required	✓	✓
	Zone 3a	Exception Test required	✓	✗	Exception Test required	✓
	Zone 3b	Exception Test required	✓	✗	✗	✗

✓ Development is appropriate

✗ Development should not be permitted.

Utilising the Flood Zone Compatibility Table above, the development is deemed appropriate for the site and flood risk classification Flood Zone 1

As part of the assessment the following development constraints require consideration and recommendation made as to how to mitigate any flood risk appropriately.

8.1 Finished Floor Levels

The flood map extracts obtained from the GOV.UK website indicate that the site is in Flood Zone 1 and therefore at negligible risk of flooding from rivers or the sea, surface water or reservoir failure.

To mitigate against localised flooding caused by heavy / intense rainfall events, it is recommended that the internal ground floor level of the plots is set a minimum of 150 mm above external levels to ensure that any short-term surface water issues are prevented from causing damage to the dwellings.

8.2 Existing Flood Volumes

No loss of existing flood volume will occur as a result of the proposed development as it is within flood zone 1 according to the indicative flood maps and level information.

8.3 Flood Routing

Flood Routing paths are to be maintained on site by ensuring that proposed levels allow flows to move through the site without affecting properties. This is expected to be mainly along the proposed development infrastructure as the plots will be raised above the existing ground levels to afford them protection from the passage of surface water through the site.

8.4 Emergency Access

The site is in flood zone 1 according to the flood maps reviewed and as such, emergency access is not anticipated to be an issue and no specific route is required to be identified.

9 CLIMATE CHANGE ALLOWANCES

The EA have published revised climate change allowances for rainfall intensity, such as the climate change allowance as follows in Table 2.

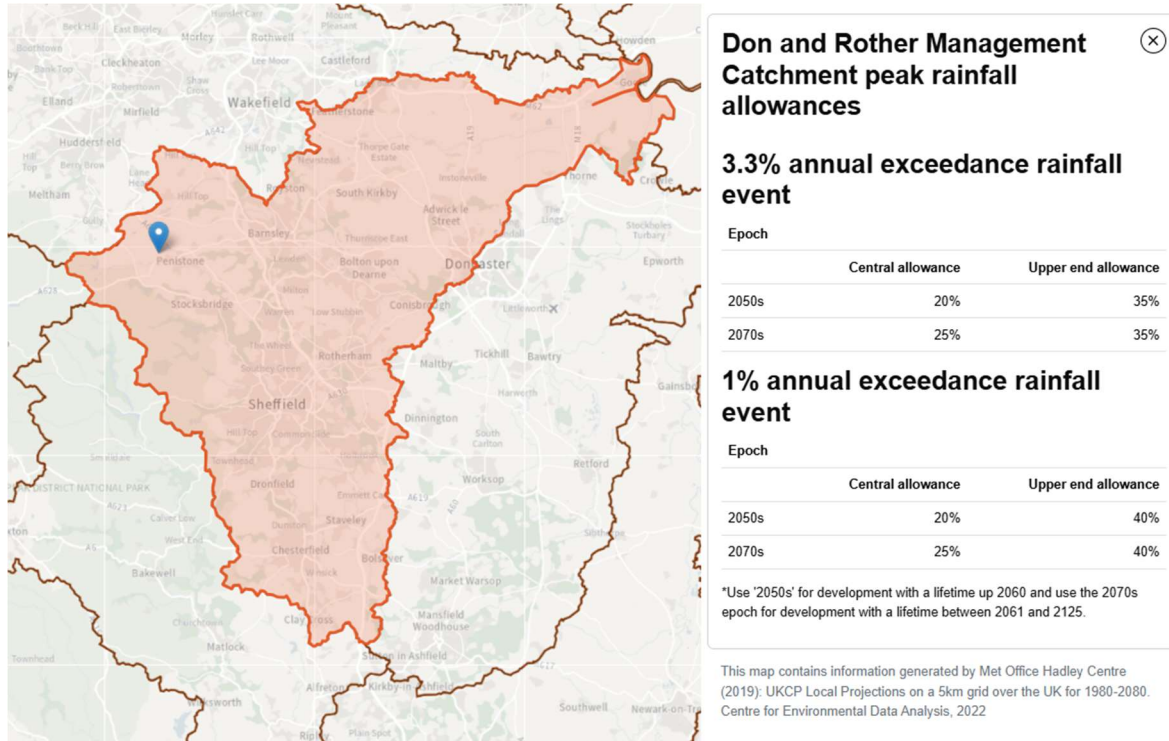


Table 2.

The proposed surface water drainage and attenuation systems will need to be designed to accommodate a 40% climate change allowance.

10 PROPOSED DRAINAGE STRATEGY

10.1 Surface Water

The Lead Local Flood Authority (LLFA) for the Thurlstone area is Barnsley Metropolitan Borough Council. The Surface Water drainage proposals for the site is currently proposed to discharge surface water to the ditch running along the side of Royd Moor Road. The surface water drainage system for the new development will be designed to consider severe storm events up to and including 1in100 year return period events with additional allowances for Climate Change (40%) and urban creep (10%). The provision of a rigorous treatment train will need to be included in the detailed design of the surface water drainage system in accordance with best practice and council policies.

Discharge to Ground

The superficial soils on site are not expected to be suitable to accept the collected surface waters but the BGS Geo-index identifies the bedrock geology in the area as sandstone. The depth to sandstone will need to be determined as part of the intrusive geotechnical investigations and the infiltration rate for the sandstone should be tested at the same time – or sooner - to determine whether a surface water discharge to ground would be viable.

Discharge to a Surface Water Body

The local sewerage authority (Yorkshire Water) records have been obtained for the site and its immediate surrounds. These records show that there are no surface water sewers in proximity to the site. As a discharge to the ditch adjacent to Royd Moor Road is available, a discharge to surface water sewer has been discounted.

Discharge to Surface Water Sewer

The local sewerage authority (Yorkshire Water) records have been obtained for the site and its immediate surrounds. These records show that there are no surface water sewers in proximity to the site. As a discharge to the ditch adjacent to Royd Moor Road is available, a discharge to surface water sewer has been discounted.

Discharge to Combined Sewer

The local sewerage authority (Yorkshire Water) records have been obtained for the site and its immediate surrounds. These records show that there are no combined sewers in proximity to the site. As a discharge to the ditch adjacent to Royd Moor Road is available, a discharge to combined sewer has been discounted.

The development's new foul flows are proposed to be treated on site using package treatment plants (one per plot) prior to discharging to the ditch running along the side of Royd Moor Road or, should it prove to be feasible, to ground on site.

11 PROPOSED DRAINAGE SCHEME

The proposed surface water drainage network has followed the hierarchy of discharge as described above and concluded that the collected surface waters should be attenuated on site and discharged to the ditch running alongside Royd Moor Road unless a discharge to ground is proven to be feasible, in which case, collected surface water will be discharged to ground in the first instance as this would be a more preferable location according to the hierarchy of discharge.

The proposed surface water drainage strategy for the development will provide a betterment on the existing discharge rate (calculated by the Modified Rational Method) area has been assessed as 1558m² (including an additional 10% Urban creep allowance for roof areas). The plan in Appendix C shows the proposed impermeable areas created by the development and how they are proposed to be divided and drained and attenuated prior to discharge to the ditch running alongside Royd Moor Road.

Volume of Runoff

The volume of surface water run-off will be reduced as the proposed development contains less impermeable area than the existing site establishment. The rate of runoff from the site will also be reduced by the use of flow controls to provide a betterment over the existing free discharge rates and the provision of attenuation to balance the flow of collected surface water with the restricted discharge will spread this reduced peak rate of discharge over a longer period whilst the reduction in impermeable area will reduce the overall volume of water discharged by the development. Should the bedrock beneath the site prove suitable for infiltrating captured

12 DRAINAGE IMPACT

The site currently collects surface water and discharges it to the ditch running alongside Royd Moor Road in an uncontrolled manner (no formal attenuation facilities and multiple piped discharges to the ditch) for all storm events. This is proposed to be mitigated by a reduction on the drained area by the reduction in development density and by discharging surface waters at a reduced rate whilst storing the balance of the collected runoff within the site until it can be discharged at the reduced rate.

13 GENERAL REMARKS

This report is for the sole use of Kingsman Homes and their immediate advisors in connection with the development of the subject site for residential use. It shall not be reproduced in whole or in part or relied upon by third parties for any use whatsoever without the express permission of Avie Consulting Ltd. Avie Consulting Ltd shall have no liability for any use of this report other than for the purposes for which it was originally prepared.

14 RECOMMENDATIONS / CONCLUSIONS

- The site under consideration is located in Flood Zone 1 according to the Indicative Floodplain Map on the GOV.UK website, as such in Flood Risk terms, the proposed development is appropriate for the site.
- Residential Development is classified as “More Vulnerable” and is appropriate under the National Planning Policy Framework on this site in terms of Flood Risk in flood zone 1.
- It is recommended that finished floor levels are set at a minimum of 150mm above the lowest proposed ground level.
- Flood Routing paths are to be maintained on site by ensuring levels allow flows to move through the site without affecting properties.
- Foul water is proposed to be collected on each plot, conveyed to a package treatment plant on each plot with the treated effluent proposed to be discharged to the existing ditch running alongside Royd Moor Road – or to ground should this prove to be feasible.

APPENDIX A
Site Development Proposals

NOTE: ALL DIMENSIONS SHOWN ARE PROVISIONAL DIMENSIONS ONLY & SHOULD NOT BE READ AS EXACT MEASUREMENTS. THESE MAY NEED TO BE ALTERED DUE TO SITE CONSTRAINTS/ INSPECTION

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DRAWING DESCRIPTION	
PROPOSED SITE PLAN PLOTS 1-8	
JOB TITLE	
ROYD MOOR FARM, ROYD MOOR ROAD THURLSTONE	
CLIENT	
KINGSMAN HOMES	
DRAWN BY	SCALE 1:250 @ A1
DATE JUNE 2022	DRAWING NO. 2036- 00-03
CHECKED	REVISION I



L'Arche Developments (Yorkshire) Ltd
3 The Studio
The Old Brickworks
HD4 6UY
mail@larchedevelopments.co.uk
Company Reg:0145534 VATReg: 141626355
Claire Parker-Hagill 07787226469 & Emma Hanks 0777927444

APPENDIX B
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 (Diversionary 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.

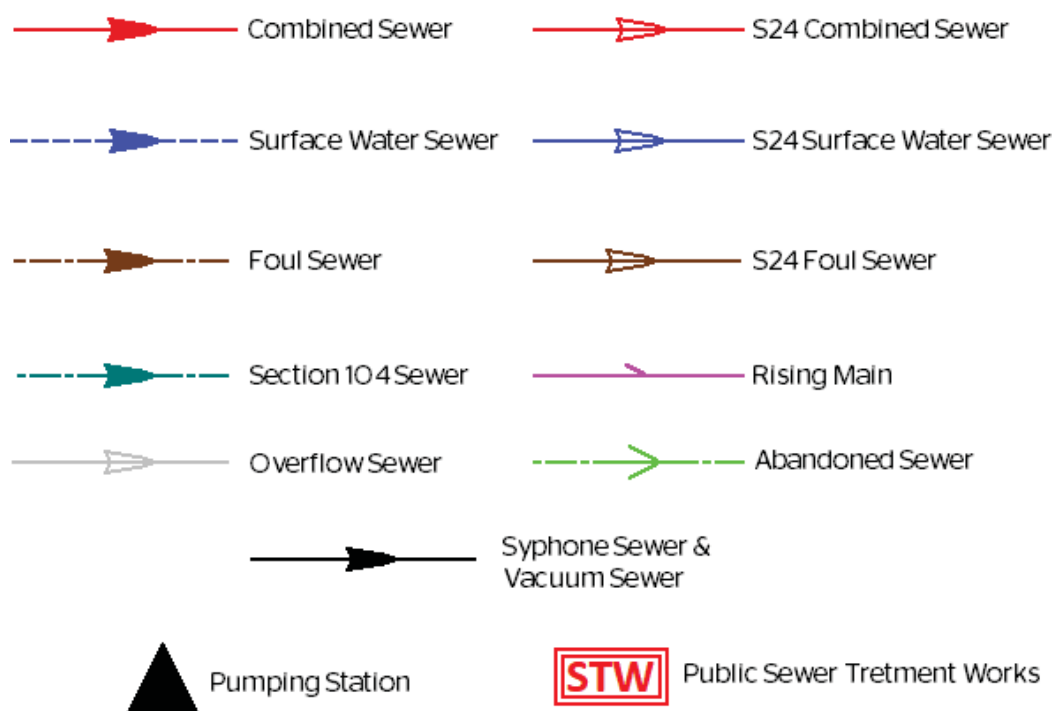
Private pumping stations will also transfer during the period 1 October 2011 – 1 Oct 2016. Records of these assets may not yet be shown on the existing mains record drawing(s). If you encounter any of these assets you must inform Yorkshire Water Services Ltd (YWS).

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 0845 124 24 24.

Property Identifier

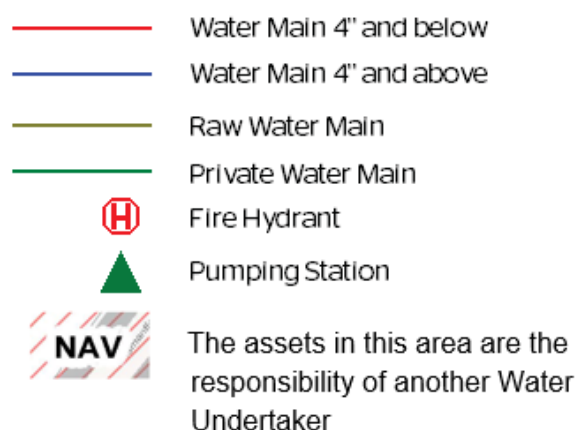


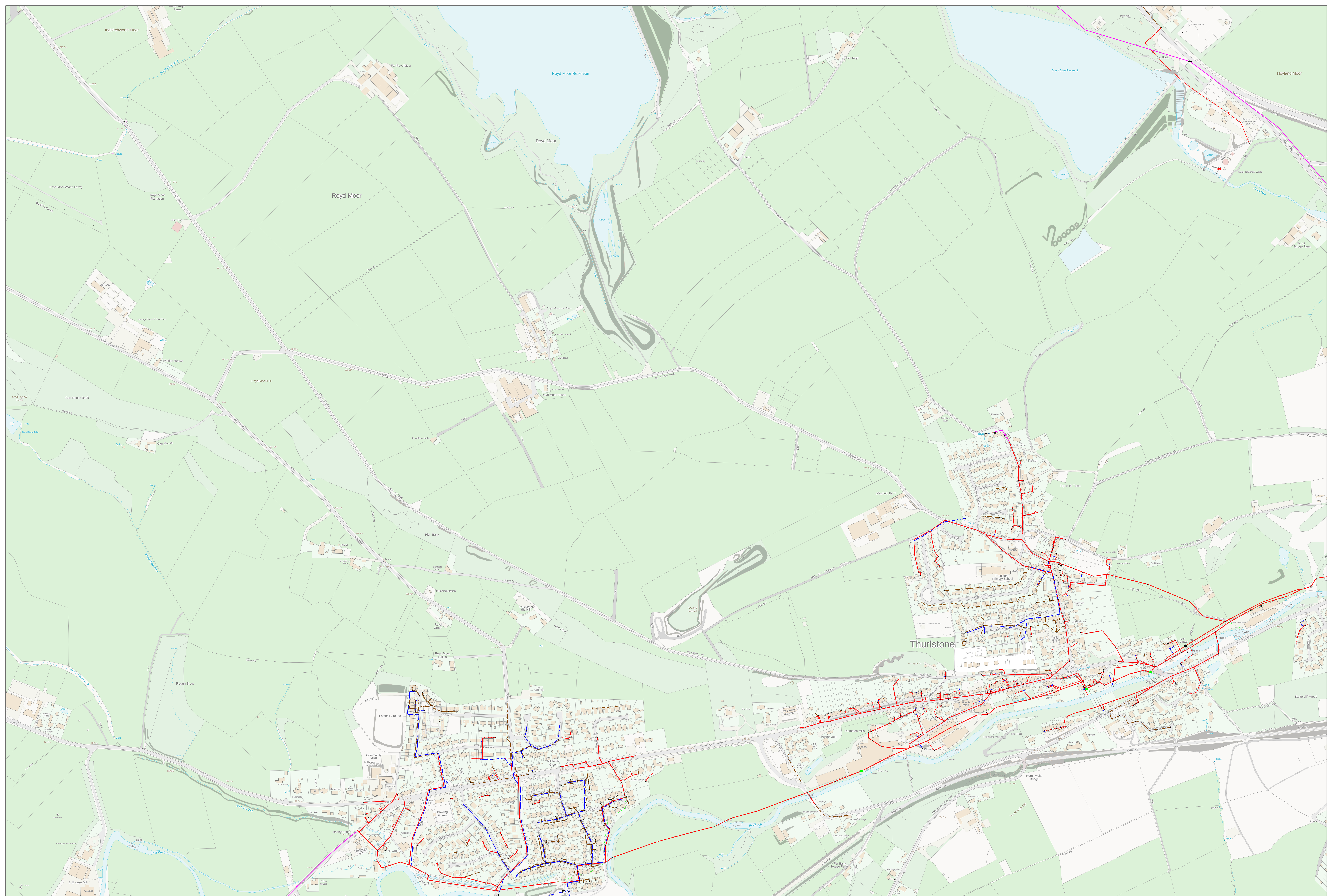
Sewer Legend



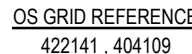
Please note that the direction of flow arrows may not always appear depending on the scale of the map.

Water Legend





APPENDIX C
Existing and Proposed Impermeable Areas



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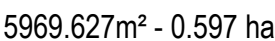
All dimensions are in millimetres unless noted otherwise

DO NOT SCALE THIS DRAWING - IF IN DOUBT ASK

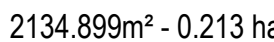
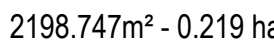
- All dimensions & levels to be checked by the contractor prior to commencement of work, any discrepancy shall be reported immediately to Ave Consulting Ltd
- All work shall be carried out in accordance with Local Authority, statutory authority, health & safety requirements and regulations.
- The drawings shall be read in accordance with all other contract documents relevant at that time of issue and during the period of the contract.
- The contractor must ensure the overall stability of the works is adequate at all stages of the construction.
- No allowance has been made for cutouts, holes, notches, etc. for services. All of these are to be agreed prior to the start of the works.



Area m² - ha



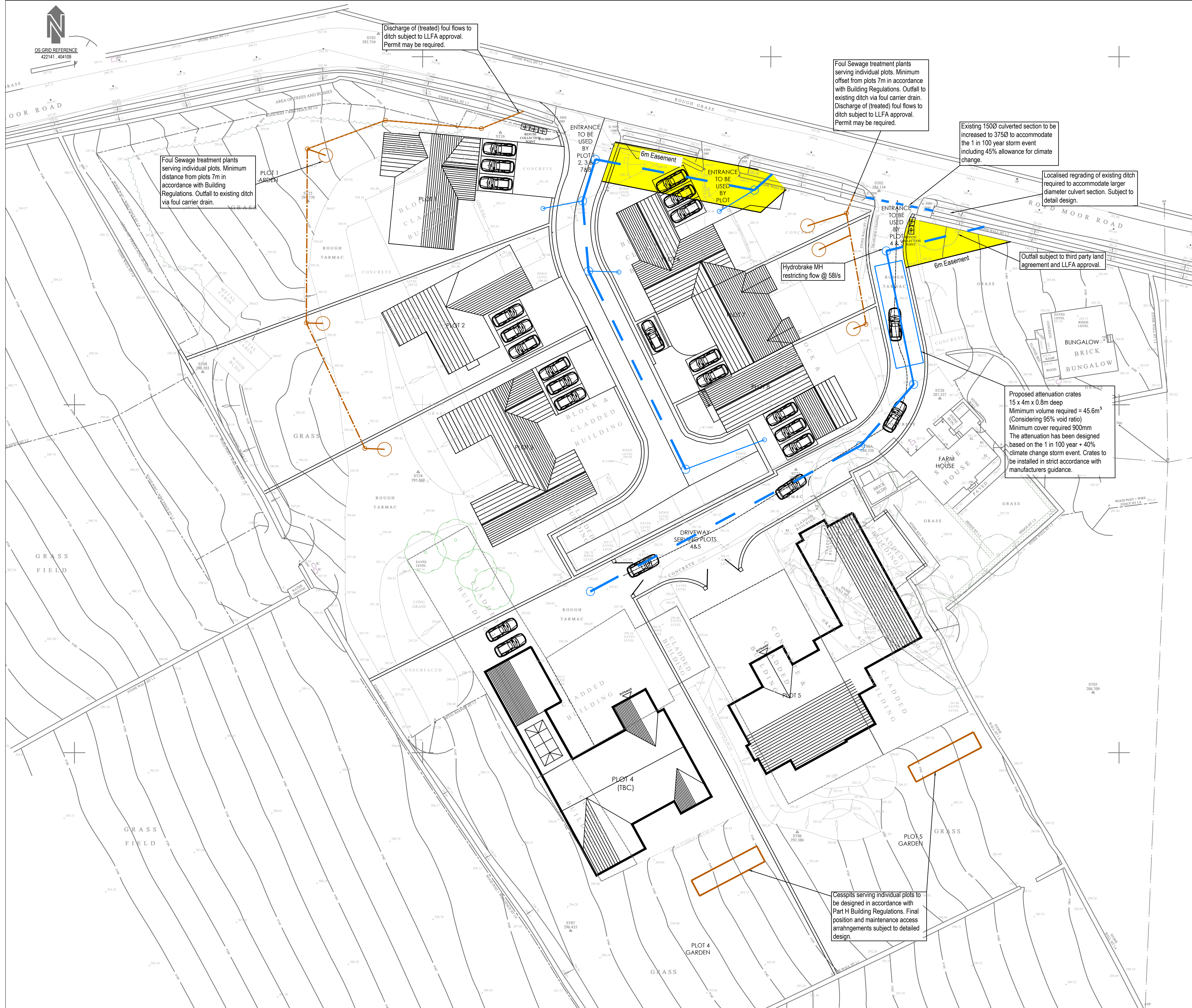
Area m² - ha



Total: 4333.646m² - 0.433 ha

2	Initial issue	S.T.P.	S.A.B.	24.06.2024
Rev	Details	By	Chk	Date
		6 Killingbeck Court, Killingbeck Office Village, Killingbeck Drive, Leeds LS14 6FD. Tel: 0113 249 7416 www.avie-consulting.co.uk		
Client:				
Kingsman Homes				
Project:				
Royd Moor Farm Thurlstone				
Offer:				
Existing & Proposed Impermeable Areas				
Drawn:	Checked:	Date	Scale:	Original dwg size
S.T.P.	S.A.B.	June 2024	1:500	A1
Drawing Number:				Rev.
P4244-02				Ø

APPENDIX D
Proposed Drainage Strategy



Notes-

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All dimensions are in millimetres unless noted otherwise

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1. All dimensions & levels to be checked by the contractor prior to commencement of work, any discrepancy shall be reported immediately to Ave Consulting Ltd
2. All work shall be carried out in accordance with Local Authority, statutory authority, health & safety requirements and regulations.
3. The drawings shall be read in accordance with all other contract documents relevant at that time of issue and during the period of the contract.
4. The contractor must ensure the overall stability of the works is adequate at all stages of the construction.
5. No allowance has been made for cutouts, holes, notches, etc. for services. All of these are to be agreed prior to the start of the works.

DRAINAGE KEY:

- PPIC PROPOSED SURFACE WATER
SEWER/DRAIN/INSPECTION CHAMBER/MANHOLE
- PPIC PROPOSED FOUL WATER
DRAIN/INSPECTION CHAMBER/MANHOLE
- PROPOSED FOUL PACKAGED TREATMENT
PLANT
- PROPOSED CESSPOOL/CESSPIT

Ø	Initial issue	T.C.	09/04/2024	
Rev	Details	By	Chk Date	
		6 Killingbeck Court, Killingbeck Office Village, Killingbeck Drive, Leeds LS14 6FD. Tel: 0113 249 7416 www.avie-consulting.co.uk		
Client: Kingsman Homes				
Project: Royd Moor Farm Thurstone				
Title: Foul and Surface Water Drainage Strategy				
Drawn:	Checked:	Date:	Scale:	Original dwg size
T.C.	T.C.	April 2024	As Stated	A1
Drawing Number:			Rev:	Ø
P4244-01				

APPENDIX E

Outline Attenuation Calculations

Avie Consulting Ltd					Page 1	
6 Killingbeck Court Killingbeck Drive Leeds LS14 6FD						
Date 26/06/2024 13:45 File PIPE MAIN SITE.SRCX		Designed by ShanePlunkett Checked by				
Micro Drainage			Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+45%)</u>						
Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer		287.574	0.524	67.8	1.2	O K
30 min Summer		287.655	0.605	74.2	1.4	O K
60 min Summer		287.610	0.560	70.7	1.3	O K
120 min Summer		287.434	0.384	55.1	0.8	O K
180 min Summer		287.352	0.302	44.4	0.6	O K
240 min Summer		287.317	0.267	37.1	0.5	O K
360 min Summer		287.276	0.226	28.7	0.4	O K
480 min Summer		287.251	0.201	23.6	0.3	O K
600 min Summer		287.234	0.184	20.3	0.3	O K
720 min Summer		287.219	0.169	17.9	0.3	O K
960 min Summer		287.195	0.145	14.5	0.2	O K
1440 min Summer		287.172	0.122	10.7	0.2	O K
2160 min Summer		287.158	0.108	7.9	0.1	O K
2880 min Summer		287.146	0.096	6.3	0.1	O K
4320 min Summer		287.131	0.081	4.7	0.1	O K
5760 min Summer		287.123	0.073	3.8	0.1	O K
7200 min Summer		287.118	0.068	3.2	0.1	O K
8640 min Summer		287.113	0.063	2.8	0.1	O K
10080 min Summer		287.109	0.059	2.5	0.1	O K
15 min Winter		287.687	0.637	76.5	1.5	O K
30 min Winter		287.742	0.692	80.4	1.6	O K
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer		127.702	0.0	52.4	14	
30 min Summer		87.939	0.0	72.2	22	
60 min Summer		57.831	0.0	95.0	36	
120 min Summer		36.592	0.0	120.2	66	
180 min Summer		27.473	0.0	135.4	96	
240 min Summer		22.297	0.0	146.5	126	
360 min Summer		16.614	0.0	163.7	186	
480 min Summer		13.457	0.0	176.8	248	
600 min Summer		11.416	0.0	187.5	306	
720 min Summer		9.973	0.0	196.6	366	
960 min Summer		8.049	0.0	211.5	486	
1440 min Summer		5.936	0.0	234.0	726	
2160 min Summer		4.365	0.0	258.1	1080	
2880 min Summer		3.504	0.0	276.2	1468	
4320 min Summer		2.568	0.0	303.7	2204	
5760 min Summer		2.063	0.0	325.3	2856	
7200 min Summer		1.741	0.0	343.2	3536	
8640 min Summer		1.516	0.0	358.6	4368	
10080 min Summer		1.349	0.0	372.3	5088	
15 min Winter		127.702	0.0	58.7	14	
30 min Winter		87.939	0.0	80.9	22	
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Avie Consulting Ltd					Page 2	
6 Killingbeck Court Killingbeck Drive Leeds LS14 6FD						
Date 26/06/2024 13:45 File PIPE MAIN SITE.SRCX		Designed by ShanePlunkett Checked by				
Micro Drainage			Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+45%)</u>						
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	
60 min Winter	287.556	0.506	66.3	1.1	O K	
120 min Winter	287.358	0.308	45.5	0.6	O K	
180 min Winter	287.306	0.256	34.7	0.5	O K	
240 min Winter	287.275	0.225	28.5	0.4	O K	
360 min Winter	287.240	0.190	21.5	0.3	O K	
480 min Winter	287.215	0.165	17.4	0.3	O K	
600 min Winter	287.197	0.147	14.8	0.2	O K	
720 min Winter	287.185	0.135	13.0	0.2	O K	
960 min Winter	287.171	0.121	10.5	0.2	O K	
1440 min Winter	287.157	0.107	7.8	0.1	O K	
2160 min Winter	287.140	0.090	5.7	0.1	O K	
2880 min Winter	287.130	0.080	4.6	0.1	O K	
4320 min Winter	287.120	0.070	3.4	0.1	O K	
5760 min Winter	287.112	0.062	2.7	0.1	O K	
7200 min Winter	287.107	0.057	2.4	0.1	O K	
8640 min Winter	287.104	0.054	2.1	0.1	O K	
10080 min Winter	287.100	0.050	1.8	0.1	O K	
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)		
60 min Winter	57.831	0.0	106.4	36		
120 min Winter	36.592	0.0	134.6	66		
180 min Winter	27.473	0.0	151.6	96		
240 min Winter	22.297	0.0	164.1	126		
360 min Winter	16.614	0.0	183.4	184		
480 min Winter	13.457	0.0	198.0	248		
600 min Winter	11.416	0.0	210.0	306		
720 min Winter	9.973	0.0	220.2	372		
960 min Winter	8.049	0.0	236.9	478		
1440 min Winter	5.936	0.0	262.1	742		
2160 min Winter	4.365	0.0	289.1	1096		
2880 min Winter	3.504	0.0	309.4	1452		
4320 min Winter	2.568	0.0	340.2	2148		
5760 min Winter	2.063	0.0	364.4	2872		
7200 min Winter	1.741	0.0	384.4	3616		
8640 min Winter	1.516	0.0	401.7	4480		
10080 min Winter	1.349	0.0	417.0	4984		
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6 Killingbeck Court Killingbeck Drive Leeds LS14 6FD		
Date 26/06/2024 13:45 File PIPE MAIN SITE.SRCX	Designed by ShanePlunkett Checked by	
Micro Drainage		Source Control 2020.1.3

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.303	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.219

Time (mins) Area			Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)	From:	To:	(ha)
0	4	0.073	4	8	0.073	8	12	0.073

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6 Killingbeck Court Killingbeck Drive Leeds LS14 6FD		
Date 26/06/2024 13:45 File PIPE MAIN SITE.SRCX	Designed by ShanePlunkett Checked by	
Micro Drainage		Source Control 2020.1.3
<u>Model Details</u> Storage is Online Cover Level (m) 324.977 <u>Pipe Structure</u> Diameter (m) 0.226 Length (m) 71.000 Slope (1:X) 40.000 Invert Level (m) 287.050 <u>Pipe Outflow Control</u> Diameter (m) 0.225 Entry Loss Coefficient 0.500 Slope (1:X) 40.0 Coefficient of Contraction 0.600 Length (m) 3.500 Upstream Invert Level (m) 287.050 Roughness k (mm) 0.600		
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6 Killingbeck Court Killingbeck Drive Leeds LS14 6FD																																																																																																																																																																																																																																																																																								
Date 26/06/2024 13:46 File TANK 60 L_S.SRCX			Designed by ShanePlunkett Checked by																																																																																																																																																																																																																																																																																					
Micro Drainage			Source Control 2020.1.3																																																																																																																																																																																																																																																																																					
Summary of Results for 100 year Return Period (+45%) Half Drain Time : 5 minutes. <table><tr><th>Storm Event</th><th>Max Level (m)</th><th>Max Depth (m)</th><th>Max Infiltration (l/s)</th><th>Max Control (l/s)</th><th>Max Outflow (l/s)</th><th>Max Volume (m³)</th><th>Status</th></tr><tr><td>15 min Summer</td><td>285.223</td><td>0.303</td><td>0.0</td><td>55.9</td><td>55.9</td><td>17.6</td><td>O K</td></tr><tr><td>30 min Summer</td><td>285.276</td><td>0.356</td><td>0.0</td><td>57.2</td><td>57.2</td><td>20.6</td><td>O K</td></tr><tr><td>60 min Summer</td><td>285.257</td><td>0.337</td><td>0.0</td><td>56.8</td><td>56.8</td><td>19.5</td><td>O K</td></tr><tr><td>120 min Summer</td><td>285.190</td><td>0.270</td><td>0.0</td><td>50.2</td><td>50.2</td><td>15.7</td><td>O K</td></tr><tr><td>180 min Summer</td><td>285.154</td><td>0.234</td><td>0.0</td><td>41.3</td><td>41.3</td><td>13.6</td><td>O K</td></tr><tr><td>240 min Summer</td><td>285.130</td><td>0.210</td><td>0.0</td><td>35.1</td><td>35.1</td><td>12.2</td><td>O K</td></tr><tr><td>360 min Summer</td><td>285.100</td><td>0.180</td><td>0.0</td><td>27.3</td><td>27.3</td><td>10.4</td><td>O K</td></tr><tr><td>480 min Summer</td><td>285.081</td><td>0.161</td><td>0.0</td><td>22.6</td><td>22.6</td><td>9.3</td><td>O K</td></tr><tr><td>600 min Summer</td><td>285.068</td><td>0.148</td><td>0.0</td><td>19.4</td><td>19.4</td><td>8.6</td><td>O K</td></tr><tr><td>720 min Summer</td><td>285.058</td><td>0.138</td><td>0.0</td><td>17.1</td><td>17.1</td><td>8.0</td><td>O K</td></tr><tr><td>960 min Summer</td><td>285.043</td><td>0.123</td><td>0.0</td><td>13.9</td><td>13.9</td><td>7.1</td><td>O K</td></tr><tr><td>1440 min Summer</td><td>285.025</td><td>0.105</td><td>0.0</td><td>10.4</td><td>10.4</td><td>6.1</td><td>O K</td></tr><tr><td>2160 min Summer</td><td>285.009</td><td>0.089</td><td>0.0</td><td>7.6</td><td>7.6</td><td>5.1</td><td>O K</td></tr><tr><td>2880 min Summer</td><td>284.999</td><td>0.079</td><td>0.0</td><td>6.1</td><td>6.1</td><td>4.6</td><td>O K</td></tr><tr><td>4320 min Summer</td><td>284.987</td><td>0.067</td><td>0.0</td><td>4.5</td><td>4.5</td><td>3.9</td><td>O K</td></tr><tr><td>5760 min Summer</td><td>284.980</td><td>0.060</td><td>0.0</td><td>3.6</td><td>3.6</td><td>3.5</td><td>O K</td></tr><tr><td>7200 min Summer</td><td>284.975</td><td>0.055</td><td>0.0</td><td>3.1</td><td>3.1</td><td>3.2</td><td>O K</td></tr><tr><td>8640 min Summer</td><td>284.971</td><td>0.051</td><td>0.0</td><td>2.6</td><td>2.6</td><td>3.0</td><td>O K</td></tr><tr><td>10080 min Summer</td><td>284.968</td><td>0.048</td><td>0.0</td><td>2.4</td><td>2.4</td><td>2.8</td><td>O K</td></tr><tr><td>15 min Winter</td><td>285.269</td><td>0.349</td><td>0.0</td><td>57.1</td><td>57.1</td><td>20.2</td><td>O K</td></tr></table> <table><tr><th>Storm Event</th><th>Rain (mm/hr)</th><th>Flooded Volume (m³)</th><th>Discharge Volume (m³)</th><th>Time-Peak (mins)</th></tr><tr><td>15 min Summer</td><td>127.702</td><td>0.0</td><td>51.0</td><td>18</td></tr><tr><td>30 min Summer</td><td>87.939</td><td>0.0</td><td>70.2</td><td>26</td></tr><tr><td>60 min Summer</td><td>57.831</td><td>0.0</td><td>92.4</td><td>40</td></tr><tr><td>120 min Summer</td><td>36.592</td><td>0.0</td><td>116.9</td><td>70</td></tr><tr><td>180 min Summer</td><td>27.473</td><td>0.0</td><td>131.6</td><td>100</td></tr><tr><td>240 min Summer</td><td>22.297</td><td>0.0</td><td>142.4</td><td>130</td></tr><tr><td>360 min Summer</td><td>16.614</td><td>0.0</td><td>159.2</td><td>190</td></tr><tr><td>480 min Summer</td><td>13.457</td><td>0.0</td><td>172.0</td><td>250</td></tr><tr><td>600 min Summer</td><td>11.416</td><td>0.0</td><td>182.3</td><td>310</td></tr><tr><td>720 min Summer</td><td>9.973</td><td>0.0</td><td>191.2</td><td>370</td></tr><tr><td>960 min Summer</td><td>8.049</td><td>0.0</td><td>205.7</td><td>490</td></tr><tr><td>1440 min Summer</td><td>5.936</td><td>0.0</td><td>227.5</td><td>734</td></tr><tr><td>2160 min Summer</td><td>4.365</td><td>0.0</td><td>251.0</td><td>1100</td></tr><tr><td>2880 min Summer</td><td>3.504</td><td>0.0</td><td>268.6</td><td>1448</td></tr><tr><td>4320 min Summer</td><td>2.568</td><td>0.0</td><td>295.4</td><td>2152</td></tr><tr><td>5760 min Summer</td><td>2.063</td><td>0.0</td><td>316.4</td><td>2936</td></tr><tr><td>7200 min Summer</td><td>1.741</td><td>0.0</td><td>333.8</td><td>3632</td></tr><tr><td>8640 min Summer</td><td>1.516</td><td>0.0</td><td>348.8</td><td>4336</td></tr><tr><td>10080 min Summer</td><td>1.349</td><td>0.0</td><td>362.1</td><td>5056</td></tr><tr><td>15 min Winter</td><td>127.702</td><td>0.0</td><td>57.1</td><td>18</td></tr></table>								Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status	15 min Summer	285.223	0.303	0.0	55.9	55.9	17.6	O K	30 min Summer	285.276	0.356	0.0	57.2	57.2	20.6	O K	60 min Summer	285.257	0.337	0.0	56.8	56.8	19.5	O K	120 min Summer	285.190	0.270	0.0	50.2	50.2	15.7	O K	180 min Summer	285.154	0.234	0.0	41.3	41.3	13.6	O K	240 min Summer	285.130	0.210	0.0	35.1	35.1	12.2	O K	360 min Summer	285.100	0.180	0.0	27.3	27.3	10.4	O K	480 min Summer	285.081	0.161	0.0	22.6	22.6	9.3	O K	600 min Summer	285.068	0.148	0.0	19.4	19.4	8.6	O K	720 min Summer	285.058	0.138	0.0	17.1	17.1	8.0	O K	960 min Summer	285.043	0.123	0.0	13.9	13.9	7.1	O K	1440 min Summer	285.025	0.105	0.0	10.4	10.4	6.1	O K	2160 min Summer	285.009	0.089	0.0	7.6	7.6	5.1	O K	2880 min Summer	284.999	0.079	0.0	6.1	6.1	4.6	O K	4320 min Summer	284.987	0.067	0.0	4.5	4.5	3.9	O K	5760 min Summer	284.980	0.060	0.0	3.6	3.6	3.5	O K	7200 min Summer	284.975	0.055	0.0	3.1	3.1	3.2	O K	8640 min Summer	284.971	0.051	0.0	2.6	2.6	3.0	O K	10080 min Summer	284.968	0.048	0.0	2.4	2.4	2.8	O K	15 min Winter	285.269	0.349	0.0	57.1	57.1	20.2	O K	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	15 min Summer	127.702	0.0	51.0	18	30 min Summer	87.939	0.0	70.2	26	60 min Summer	57.831	0.0	92.4	40	120 min Summer	36.592	0.0	116.9	70	180 min Summer	27.473	0.0	131.6	100	240 min Summer	22.297	0.0	142.4	130	360 min Summer	16.614	0.0	159.2	190	480 min Summer	13.457	0.0	172.0	250	600 min Summer	11.416	0.0	182.3	310	720 min Summer	9.973	0.0	191.2	370	960 min Summer	8.049	0.0	205.7	490	1440 min Summer	5.936	0.0	227.5	734	2160 min Summer	4.365	0.0	251.0	1100	2880 min Summer	3.504	0.0	268.6	1448	4320 min Summer	2.568	0.0	295.4	2152	5760 min Summer	2.063	0.0	316.4	2936	7200 min Summer	1.741	0.0	333.8	3632	8640 min Summer	1.516	0.0	348.8	4336	10080 min Summer	1.349	0.0	362.1	5056	15 min Winter	127.702	0.0	57.1	18
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status																																																																																																																																																																																																																																																																																	
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5760 min Summer	284.980	0.060	0.0	3.6	3.6	3.5	O K																																																																																																																																																																																																																																																																																	
7200 min Summer	284.975	0.055	0.0	3.1	3.1	3.2	O K																																																																																																																																																																																																																																																																																	
8640 min Summer	284.971	0.051	0.0	2.6	2.6	3.0	O K																																																																																																																																																																																																																																																																																	
10080 min Summer	284.968	0.048	0.0	2.4	2.4	2.8	O K																																																																																																																																																																																																																																																																																	
15 min Winter	285.269	0.349	0.0	57.1	57.1	20.2	O K																																																																																																																																																																																																																																																																																	
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360 min Summer	16.614	0.0	159.2	190																																																																																																																																																																																																																																																																																				
480 min Summer	13.457	0.0	172.0	250																																																																																																																																																																																																																																																																																				
600 min Summer	11.416	0.0	182.3	310																																																																																																																																																																																																																																																																																				
720 min Summer	9.973	0.0	191.2	370																																																																																																																																																																																																																																																																																				
960 min Summer	8.049	0.0	205.7	490																																																																																																																																																																																																																																																																																				
1440 min Summer	5.936	0.0	227.5	734																																																																																																																																																																																																																																																																																				
2160 min Summer	4.365	0.0	251.0	1100																																																																																																																																																																																																																																																																																				
2880 min Summer	3.504	0.0	268.6	1448																																																																																																																																																																																																																																																																																				
4320 min Summer	2.568	0.0	295.4	2152																																																																																																																																																																																																																																																																																				
5760 min Summer	2.063	0.0	316.4	2936																																																																																																																																																																																																																																																																																				
7200 min Summer	1.741	0.0	333.8	3632																																																																																																																																																																																																																																																																																				
8640 min Summer	1.516	0.0	348.8	4336																																																																																																																																																																																																																																																																																				
10080 min Summer	1.349	0.0	362.1	5056																																																																																																																																																																																																																																																																																				
15 min Winter	127.702	0.0	57.1	18																																																																																																																																																																																																																																																																																				
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Micro Drainage				Source Control 2020.1.3			
<u>Summary of Results for 100 year Return Period (+45%)</u>							
Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max E Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	285.319	0.399	0.0	57.7	57.7	23.1	O K
60 min Winter	285.243	0.323	0.0	56.5	56.5	18.7	O K
120 min Winter	285.161	0.241	0.0	43.0	43.0	14.0	O K
180 min Winter	285.124	0.204	0.0	33.4	33.4	11.8	O K
240 min Winter	285.101	0.181	0.0	27.4	27.4	10.5	O K
360 min Winter	285.073	0.153	0.0	20.6	20.6	8.9	O K
480 min Winter	285.056	0.136	0.0	16.8	16.8	7.9	O K
600 min Winter	285.045	0.125	0.0	14.3	14.3	7.2	O K
720 min Winter	285.036	0.116	0.0	12.6	12.6	6.7	O K
960 min Winter	285.023	0.103	0.0	10.1	10.1	6.0	O K
1440 min Winter	285.008	0.088	0.0	7.5	7.5	5.1	O K
2160 min Winter	284.995	0.075	0.0	5.5	5.5	4.3	O K
2880 min Winter	284.987	0.067	0.0	4.4	4.4	3.9	O K
4320 min Winter	284.977	0.057	0.0	3.2	3.2	3.3	O K
5760 min Winter	284.971	0.051	0.0	2.6	2.6	2.9	O K
7200 min Winter	284.967	0.047	0.0	2.2	2.2	2.7	O K
8640 min Winter	284.964	0.044	0.0	1.9	1.9	2.5	O K
10080 min Winter	284.961	0.041	0.0	1.7	1.7	2.4	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)			
30 min Winter	87.939	0.0	78.6	26			
60 min Winter	57.831	0.0	103.4	40			
120 min Winter	36.592	0.0	130.9	70			
180 min Winter	27.473	0.0	147.4	100			
240 min Winter	22.297	0.0	159.5	130			
360 min Winter	16.614	0.0	178.3	190			
480 min Winter	13.457	0.0	192.6	252			
600 min Winter	11.416	0.0	204.2	310			
720 min Winter	9.973	0.0	214.1	370			
960 min Winter	8.049	0.0	230.4	492			
1440 min Winter	5.936	0.0	254.9	736			
2160 min Winter	4.365	0.0	281.1	1104			
2880 min Winter	3.504	0.0	300.9	1460			
4320 min Winter	2.568	0.0	330.8	2204			
5760 min Winter	2.063	0.0	354.4	2840			
7200 min Winter	1.741	0.0	373.8	3552			
8640 min Winter	1.516	0.0	390.6	4400			
10080 min Winter	1.349	0.0	405.6	5112			
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.700	Shortest Storm (mins)	15
Ratio R	0.303	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.213

Time (mins) Area			Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)	From:	To:	(ha)
0	4	0.071	4	8	0.071	8	12	0.071

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Micro Drainage Source Control 2020.1.3		

Model Details

Storage is Online Cover Level (m) 286.620

Cellular Storage Structure

Invert Level (m) 284.920 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	61.0	0.0	0.401	0.0	0.0
0.400	61.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0316-5800-0800-5800
Design Head (m)	0.800
Design Flow (l/s)	58.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	316
Invert Level (m)	284.920
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	58.0
Flush-Flo™	0.443	57.9
Kick-Flo®	0.679	53.6
Mean Flow over Head Range	-	44.0

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	9.5	1.200	70.5	3.000	110.1	7.000	166.6
0.200	32.4	1.400	76.0	3.500	118.7	7.500	172.3
0.300	55.8	1.600	81.1	4.000	126.7	8.000	177.9
0.400	57.8	1.800	85.9	4.500	134.2	8.500	181.7
0.500	57.7	2.000	90.4	5.000	141.3	9.000	187.1
0.600	56.1	2.200	94.7	5.500	148.1	9.500	192.3
0.800	58.0	2.400	98.8	6.000	154.5		
1.000	64.6	2.600	102.7	6.500	160.7		

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