LAND WEST OF RATCLIFFE ROAD, SILEBY

Drainage Technical Note

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Drainage Technical Note
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Quality Management

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Prepared by:

RPS

20 Farringdon Street
London, EC4A 4AB

Prepared for:

Redrow Homes

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1 INTRODUCTION AND SITE SETTING

1.1 RPS was commissioned to undertake a Drainage Technical Note in relation to the promotion of Land West of Ratcliffe Road, Sileby which is being pursued for a development of c. 665 homes, a local centre and a school. A Concept Plan for Phase 1 is included in Appendix A.

1.2 The aim of this Technical Note is to provide initial advice with respect to the existing drainage infrastructure in the locality of the site, suitable surface water outfall locations and Sustainable Drainage Systems (SuDS) techniques, as well as consideration of a potential connection point to the foul sewer network.

Site Description

1.3 The site is located between Cossington and Sileby, at National Grid Reference SK 61320 14505 and occupies an area of approximately 45 hectares (ha). It is bounded to the north by residential housing and a watercourse, to the northeast by Ratcliffe Road, to the south by agricultural land and to the west by a railway line. The site location is presented in Figure 1.

1.4 The site is currently occupied by agricultural land, with two watercourses present within the western part of the site and a pond in the central part of the site.

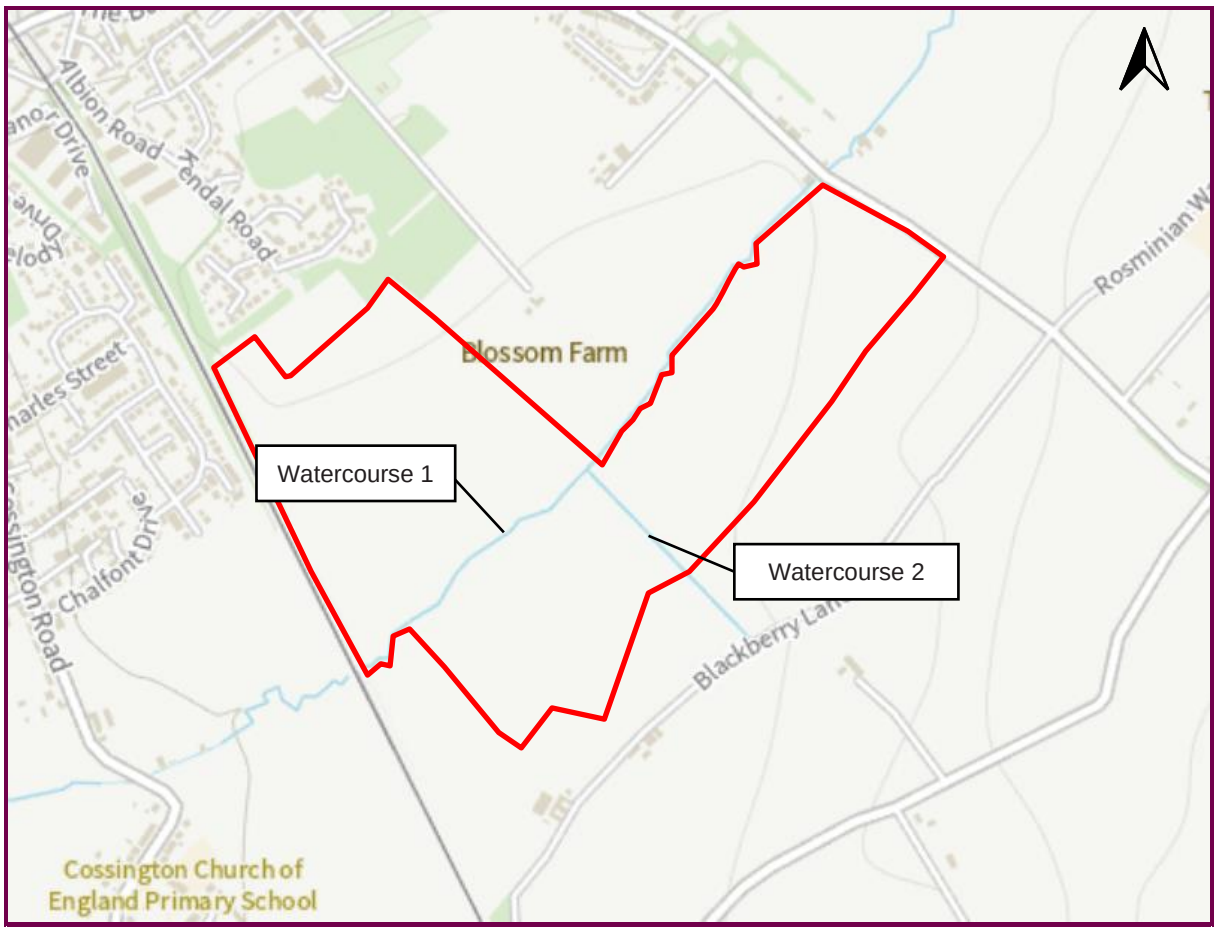


Figure 1. Site Location
Approximate site boundary indicated red, for location purposes only

Topography

1.5 Topographic data indicates that the site is generally located between approximately 64m AOD and 49m AOD. The site generally slopes down towards the south west and also down towards Watercourse 1.

1.6 To the north of Watercourse 1 in the west of the site (see Figure 1), levels range approximately from 64m AOD at the northern-most part to 49m AOD at Watercourse 1.

1.7 To the east of Watercourse 2, site levels range approximately from 64m AOD in the eastern-most part adjacent to Ratcliffe Road to 54m AOD in proximity to the watercourse. West of Watercourse 2, levels range approximately from 57m AOD to 51m AOD adjacent to Watercourse 1. There does not appear to be as defined a valley associated with Watercourse 2 as there is for Watercourse 1.

1.8 The topographic data was a LiDAR Digital Terrain Model (DTM) to 1m resolution, obtained from Defra's open data platform.

2 ENVIRONMENTAL SETTING

Hydrology

2.1 OS mapping indicates that two unnamed ordinary watercourses are present on site. Lead local flood authorities, district councils and internal drainage boards will carry out flood risk management work on ordinary watercourses. The first ('Watercourse 1') flows partially along the northern boundary of the site and then bisects the western part of the site, flowing through in a south westerly direction. It is a tributary of the River Soar, an Environment Agency (EA) designated 'main river', of which the confluence is located 1.45km south west of the site. The EA is responsible for the maintenance, improvement, or construction to manage flood risk associated with any 'main river'.

2.2 The second watercourse ('Watercourse 2') flows through the centre of the site in a north westerly direction and flows into Watercourse 1. A pond is located in the central part of the site and does not appear to be hydraulically connected to either of the watercourses.

2.3 No other significant watercourses or waterbodies are located within 500m of the site.

Fluvial / Tidal Flood Risk Classification

2.4 The EA Flood Map for Planning, which is available online, indicates that the site is located predominantly within Flood Zone 1, whereby the annual probability of flooding from fluvial or tidal sources is classified as less than 1 in 1,000. An area along Watercourse 1 in the west of the site is indicated to be located within Flood Zone 3 whereby the annual probability of fluvial flooding is greater than 1 in 100. There are limited areas of Flood Zone 2 - annual probability of fluvial flooding is greater than 1 in 1,000 but less than 1 in 100 – surrounding this. The EA Flood Map for Planning is provided in Figure 2.

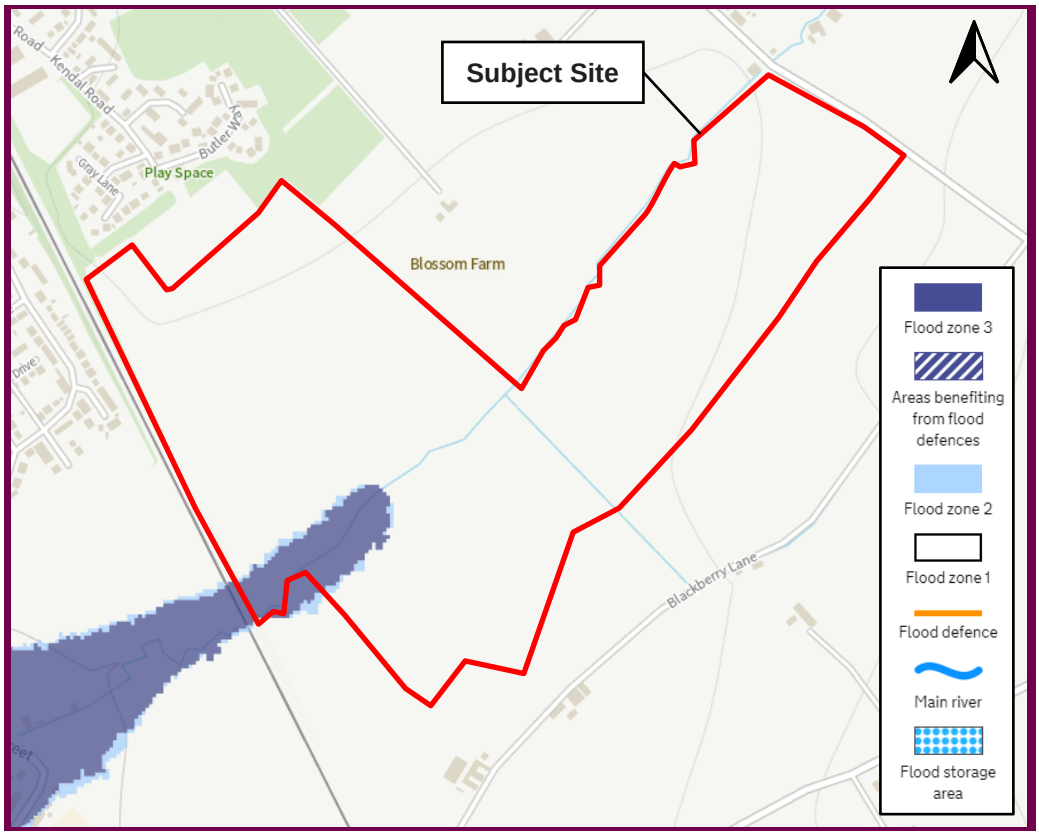


Figure 2. EA Flood Map for Planning
Approximate site boundary indicated red, for location purposes only

Surface Water Flood Risk Classification

2.5 The EA's updated Flood Map for Surface Water, which is available online, indicates that the majority of the site is at 'very low' risk, whereby the annual probability of flooding is less than 1 in 1,000. Land surrounding Watercourse 1, as well as other limited parts of the site, is indicated to be at a low risk of flooding. This corresponds with an annual probability of flooding that is greater than 1 in 1,000 but less than 1 in 100. There are additional limited parts of the site, mainly adjacent to Watercourse 1 on the western boundary of the site, that are at 'medium' and 'high' risk of flooding. The probabilities are greater than 1 in 100 but less than 1 in 30 and greater than 1 in 30 respectively. The updated Flood Map for Surface Water is presented in Figure 3.

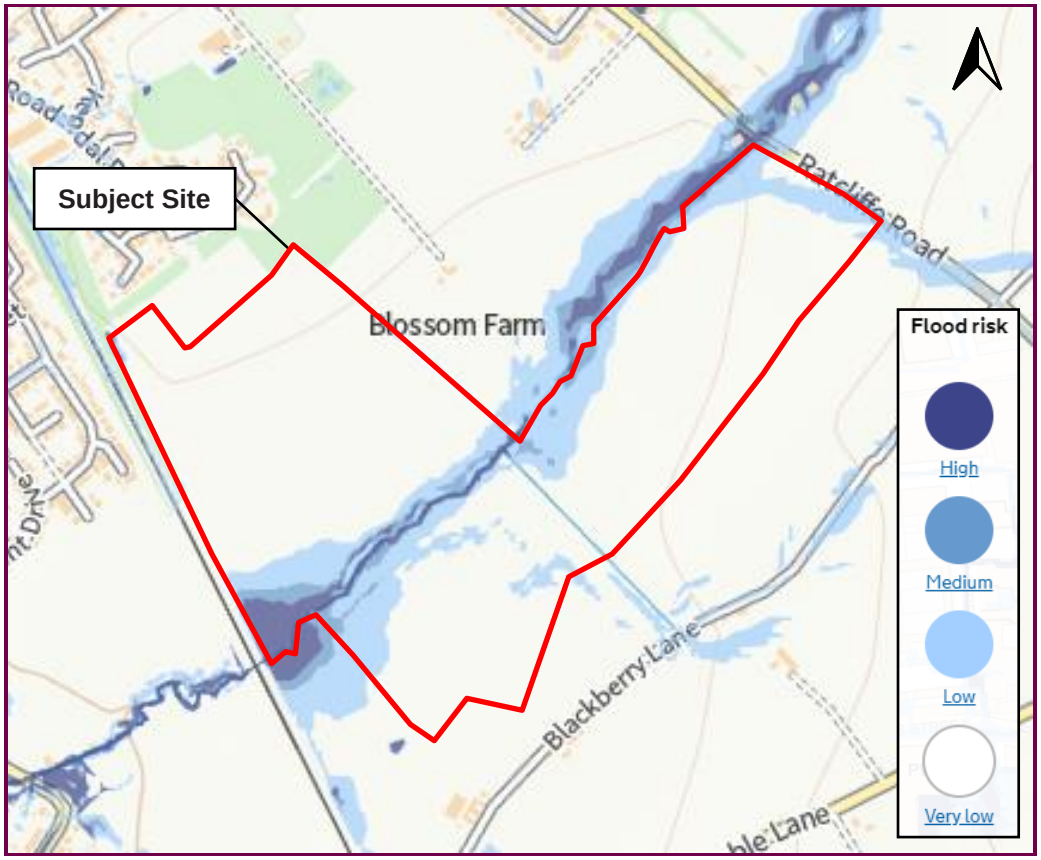


Figure 3. Updated Flood Map for Surface Water
Approximate site boundary indicated red, for location purposes only

Flood Risk Mapping Summary

2.6 RPS notes that it appears unlikely that the areas of Flood Zone 2 and 3 have been derived from detailed modelling and therefore may not accurately represent fluvial flood risk. The area of fluvial flood risk at the site may be greater than the Flood Zone 2 and 3 extents on Figure 2. Detailed hydraulic modelling is likely to be required to support a planning application at the site. This can be undertaken early on in the masterplanning process to clarify the level of fluvial flood risk and inform the layout and design.

2.7 In the interim, as a precautionary approach, it is advised that as a minimum the 'low' risk surface water flood extent which is associated with the watercourse is taken as an *indication* for the 1 in 100 year plus climate change fluvial flood extent and used to inform the design process. Detailed modelling may result in an increase in developable area from the current, conservative estimate.

Hydrogeology

2.8 British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the site is situated on superficial deposits as follows:

- Alluvium – comprising clay, silt, sand and gravel – in the immediate vicinity of Watercourse 1;
- Head – comprising clay, silt, sand and gravel – parallel to the Alluvium deposits and covering much of the site
- Wanlip Member – comprising sand and gravel – in the south west of the site;
- Birstall Member – comprising sand and gravel – in the north western corner of the site; and
- Very limited areas of both the Thrussington Member – comprising diamicton – and Glaciofluvial Deposits – comprising sand and gravel –in the north west of the site.
- No superficial deposits were recorded in limited peripheral areas in the east of the site and the north west.

2.9 The site as a whole is underlain by bedrock geology of the Edwalton Member, comprising mudstone.

2.10 One BGS borehole log was available within the site boundary, reference SK61SW53, excavated in the west of the site, 30m south of Watercourse 1 and indicated to be located on Alluvium. The borehole was to 1.2m depth and did not encounter groundwater.

2.11 The soils are described as 'slightly acid loamy and clayey soils with impeded drainage' by the National Soils Research Institute.

2.12 According to the EA's Aquifer Designation Mapping, the Alluvium, Wanlip Member, Birstall Member and Glaciofluvial Deposits are all classified as Secondary A Aquifers. These formations are formed of permeable layers capable of supporting water supplies at a local scale, in some cases forming an important source of base flow to rivers. The Head deposits and Thrussington Member are classified as Secondary (undifferentiated) Aquifers. These formations have varying characteristics in different locations.

2.13 The Edwalton Member is classified as a Secondary B Aquifer. These formations are generally formed of lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

2.14 EA online groundwater Source Protection Zone (SPZ) mapping indicates that the site is not located within a groundwater SPZ.

2.15 There are no designated sensitive areas (e.g. Special Area of Conservation (SAC), Special Protection Area (SPA) or Site of Special Scientific Interest (SSSI)) within close proximity to the site. However, the site is located within a Nitrate Vulnerable Zone.

Existing Drainage Infrastructure

2.16 Severn Trent Water plans of public sewers, included as Appendix B, indicates that there are no public sewers on-site or adjacent. The nearest public surface water and foul sewers are located beneath Gray Lane 60m to the north of the western part of the site, associated with residential properties. These pipes are indicated to have a diameter of 150mm and flow in a northerly direction.

2.17 Foul and surface water sewers, likely of 225mm diameter but not possible to fully ascertain from the mapping, are located beneath Charles Street, 70m west of the site, on the opposite side of the railway line.

2.18 Based on site topography it is likely surface water from the site currently flows unrestricted into Watercourse 1, some initially via Watercourse 2.

3 SURFACE WATER MANAGEMENT

Introduction

3.1 Development at this site is likely to result in an increase in the impermeable area and this will need to be appropriately mitigated. Based on a residential development lifespan of 100 years, a 40% increase in peak rainfall intensity has been included as a climate change allowance in the following calculations, which covers the potential increase up to the year 2115.

Greenfield Runoff Rates and Attenuation Volume Requirements

3.2 At this initial stage it has been estimated that a proposed development could result in approximately 60% of the site being covered with impermeable surfacing, comprising building footprint or external hardstanding. As such, initial drainage calculations have been undertaken based on an indicative impermeable area of 27ha.

3.3 The equivalent greenfield runoff rate for the proposed impermeable areas have been calculated using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) Method. The greenfield rates are presented in Table 1 below.

Table 1. Equivalent greenfield runoff rates

Return Period (years)	Runoff Rate (l/s)
1 in 1	98.4
Q_{BAR}	118.6
1 in 30	232.4
1 in 100	304.8

Q_{BAR} = mean annual flood low
l/s = litres per second

3.4 Surface water runoff would likely be required to be restricted to the QBAR greenfield runoff rate. In order to achieve this restriction a Quick Storage Estimate (QSE) indicates that it could be necessary to provide between 17,393 m^3 and 23,433 m^3 of attenuation for the 1 in 100 year plus 40% climate change event. This calculation has been undertaken on the basis that managing surface water using infiltration is not viable. The ICP SuDS calculations and the MicroDrainage QSE Assessment are included as Appendix C.

Consideration of Drainage Hierarchy

3.5 The PPG advises of the following hierarchy for the discharge of surface water;

1. Infiltration;
2. To a surface water body;
3. To a surface water sewer, highway drain or another drainage system; or
4. To a combined sewer.

3.6 Based on the superficial geology at the site – as summarised in paragraphs 2.9 and 2.13 above - infiltration could potentially provide a viable means for the discharge of surface water in parts of the site which are underlain by gravel-rich Secondary A Aquifers. Such areas total approximately 25% of the site. Soakaway testing in accordance with BRE 365 should be undertaken to investigate the

feasibility of infiltration across the site and determine how this relates to the proposed layout requirements.

3.7 Should infiltration not prove viable, or should it not be suitable as the sole means for discharge of surface water, then in line with the drainage hierarchy discharge should be via a restricted outfall to Watercourse 1. Given the topography of the site it should be feasible to direct surface water to several outfall locations along the length of Watercourse 1, within the red line boundary.

3.8 There are no public sewer networks adjacent to the site and in line with the Drainage Hierarchy, infiltration and / or discharge to watercourse should be pursued.

Consideration of Sustainable Drainage Systems

3.9 Given the reported geology conditions beneath the site (paragraphs 2.9 to 2.15), it is considered that soakaways or other infiltration-based SuDS techniques could provide a feasible method for the discharge of surface water runoff in some parts of the site.

3.10 On the basis that the site is currently a greenfield site, it will be necessary to prioritise open storage features such as attenuation ponds as part of a proposed development. Conveyance features such as swales could be staggered in a terrace arrangement to slow flows across the slope of the site and provide an additional stage of water quality treatment. The use of permeable paving is likely to be suitable on footpaths and in car parking areas.

3.11 The provision of open storage features would offer benefits in terms of water quality by slowing the flow and enabling filtration and settlement of particles. This is of particular importance as the site is located within a Nitrate Vulnerable Zone (NVZ) and therefore the ability of nitrates from agricultural (and urban) pollution to enter the underlying aquifers or watercourse should be minimised. Wetland areas (of which swales and detention basins could potentially contribute) have been demonstrated to reduce nitrate concentrations in receiving watercourses.

3.12 Green roofs and rainwater harvesting systems could also be considered for the school or, if proposed, apartment blocks. These techniques can all provide wider sustainability benefits in addition to surface water attenuation.

3.13 The main SuDS attenuation features should be located in topographically low areas of the site and therefore close to Watercourse 1, whilst remaining outside both the fluvial and the key surface water flood risk areas, see paragraph 2.7. SuDS should not be located within the 1 in 100 year plus climate change flood extent as this area needs to remain functional during a fluvial flood event. At this stage, in the absence of detailed hydraulic modelling, it is recommended that SuDS features are avoided in area of 'low' surface water flood risk which are hydraulically connected to the watercourses. SuDS conveyance features, such as swales, can link higher, developed parts of the site to the lower areas where the attenuation features are located.

3.14 Based on the maximum value in the QSE in paragraph 3.4, an average water depth of 1m in the basins and accounting for a 300mm freeboard, it is estimated that approximately 2 hectares of land would be required for the provision of suitable above ground surface water attenuation. This area may increase slightly depending on the number of attenuation ponds that are proposed and does not include the associated maintenance strips or earthworks areas. If significant areas of permeable paving could be incorporated then the area of land required for surface water storage may reduce. This estimate is on the basis that all run-off would be attenuated and discharged to the watercourses, it does not include any allowance for infiltration, which could reduce the land take required for SuDS.

3.15 The provision of attenuation should be split between several basins, both north and south of Watercourse 1, in addition to utilising other SuDS techniques within the development parcels and as above-ground conveyance features. Overall, it is considered that the required attenuation can be achieved within the site, taking into account the topography and potential flood risk areas.

3.16 Consideration will ultimately be given to the SuDS treatment train to ensure the appropriate water treatment is achieved, given the site is located within an NVZ. Further drainage analysis can be undertaken on a sub-catchment basis to inform locations and sizing of these features.

Consideration of Foul Drainage

3.17 With respect to foul drainage, the information available indicates 2 potential options.

3.18 Whilst the closest sewer is located beneath Gray Lane to the north, this is at a higher elevation than the site itself and therefore would require installation of one or more foul pumping stations to achieve the outfall.

3.19 As the site slopes down towards the west, a connection westward of the railway line may be more appropriate. This connection to the west would require consultation with Network Rail (NR) given the likely requirement to instal foul drainage infrastructure beneath NR assets.

3.20 Consultation through a Pre-Development Enquiry will be required with Severn Trent Water (STW) to determine the capacity of the local networks and available connection points. STW will indicate if their existing infrastructure may need to be upgraded and if so, the proposed development may need to be phased in accordance with this.

4 SUMMARY AND CONCLUSIONS

4.1 This initial Drainage Technical Note has established the following:

- Hydraulic modelling is likely to be required to accurately determine the fluvial floodplain associated with Watercourse 1. The required Climate Change Allowances would be considered as part of this modelling;
- The majority of the site is located outside of the potential area of flood risk and therefore initial assessment indicates that it is feasible for a residential-led development to be located at the site away from the identified fluvial flood extent and areas of 'low' surface water flood risk;
- Infiltration could be a feasible means of surface water disposal for some parts of the site and soakaway testing to BRE365 should be undertaken to determine the feasibility to inform detailed design;
- Surface water discharge to Watercourse 1 is a viable alternative – or additional – option. This can be achieved within the red line boundary;
- Open storage features such as attenuation basins, ponds and swales will be prioritised, with permeable paving also likely to be a suitable technique. Such features would provide wider benefits in terms of biodiversity, amenity and water quality, in addition to surface water attenuation;
- At least 2 ha of land is likely to be required for the provision of above ground surface water attenuation on the basis that no infiltration is feasible. This can be achieved and is illustrated in the current concept plan;
- All surface water attenuation features have been located outside of the 'low' surface water flood risk extent that is connected to Watercourse 1, until detailed fluvial hydraulic modelling is undertaken;
- Consideration will be given to quality of surface water prior to discharge, given the site is located within a Nitrate Vulnerable Zone. The incorporation of open storage features, such as those illustrated on the concept plan, will assist with this; and
- With respect to foul drainage, consultation will be undertaken with Severn Trent Water to determine a suitable outfall location with adequate capacity for the site. Two potential outfall locations have been identified within close proximity of the site. Should any upgrade works to the foul sewer network be required, these would not preclude development at the site and can be phased in accordance with construction.

APPENDICES

Appendix A

Concept Plan

Planning | Design | Environment | Economics | Heritage
East Midlands

Land West of Ratcliffe Road, Sileby - **Concept Plan**

| Drawn by: LJE | Approved by: PS | Date: 23/08/21 | Scale: 1:5000 @ A3 | DRG: P21-2418 003 Sheet No: 1 Rev: D | Client: Redrow Homes |

Pegasus Group

Appendix B

Severn Trent Water Sewer Plans

(c) Crown copyright and database rights 2021 Ordnance Survey 100031673

Date: 10/08/21

Scale: 1:1250

Map Centre: 461311,314398

Data updated: 14/07/21

Our Ref: 619798 - 1

Wastewater Plan A0

Do not scale off this Map. This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. It is particularly this plan does not imply any interest in the land and that in the event of any development or any works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems. On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011. Transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not ossess complete records of these assets. These assets may not be displayed on the map. Reproduction by permission of Ordnance Survey on behalf of HMSO. © Crown Copyright and database right 2004. All rights reserved. Ordnance Survey licence number: 100031673. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.

rachel.shepherd@rpsgroup.com

Sileby 1

SEVERN TRENT

SEVERN TRENT

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.

b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.

d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.

e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).

f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.
2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).
3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.
4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.
5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.
6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.
7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.
8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.
9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.
10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.
11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.
12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.
13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,
14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.
16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.
17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014
18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.
19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
5402	F	57.54	56.08	1.46
5405	F	60.63	0	0
5407	F		0	0
5808	F	60.85	0	0
6703	F		0	0
6704	F	61.21	57.45	3.76
6705	F	61.45	58.12	3.33
6717	F	64.18	62.07	2.11
6718	F	63.75	61.99	1.76
6719	F	63.17	61.99	1.18
6722	F	60.28	57.85	2.43
6724	F	61.67	58.16	3.51
6804	F		0	0
6806	F		0	0
6807	F		0	0
6809	F	62.1	0	0
7711	F	66.95	64.56	2.39
7712	F	66.68	64.31	2.37
7713	F	65.96	63.66	2.3
7714	F	65.3	62.81	2.49
7715	F	65.07	62.46	2.61
7716	F	64.69	62.42	2.27
7717	F		0	0
7801	F		0	0
7802	F	67.38	65.19	2.19
7806	F	67.14	65.16	1.98
7809	F	67.21	64.87	2.34
5404	S	57.41	55.75	1.66
5806	S		0	0
6602	S	61.05	59.05	2
6401	S	57.41	55.91	1.5
6701	S	60.06	0	0
6702	S		0	0
6708	S	61.33	58.06	3.27
6709	S	61.17	58.45	2.72
6710	S	61.05	58.2	2.85
6711	S	61.31	57.18	4.13
6712	S	63.96	60.33	3.63
6713	S	63.93	60.69	3.24
6714	S	63.62	60.67	2.95
6715	S	63.16	60.61	2.55
6716	S	63.13	60.37	2.76
6720	S		0	0
6721	S	62.17	60.17	2
6723	S	60.58	58.1	2.48
6725	S	61.66	58.56	3.1
6803	S		0	0
6805	S	62.18	0	0
6808	S		0	0
7703	S	66.61	64.78	1.83
7704	S	66.99	64.85	2.14
7705	S	65.97	64.76	1.21
7706	S	64.9	62.87	2.03
7707	S	65.19	64.06	1.13
7709	S	64.53	60.97	3.56
7710	S		0	0
7802	S		0	0
7803	S	67.75	66.09	1.66
7804	S	67.41	65.99	1.42
7805	S	67.16	65.3	1.86
7806	S	67.29	65.28	2.01
7810	S	67.15	65.01	2.14

Appendix C

MicroDrainage Modelling Assessment

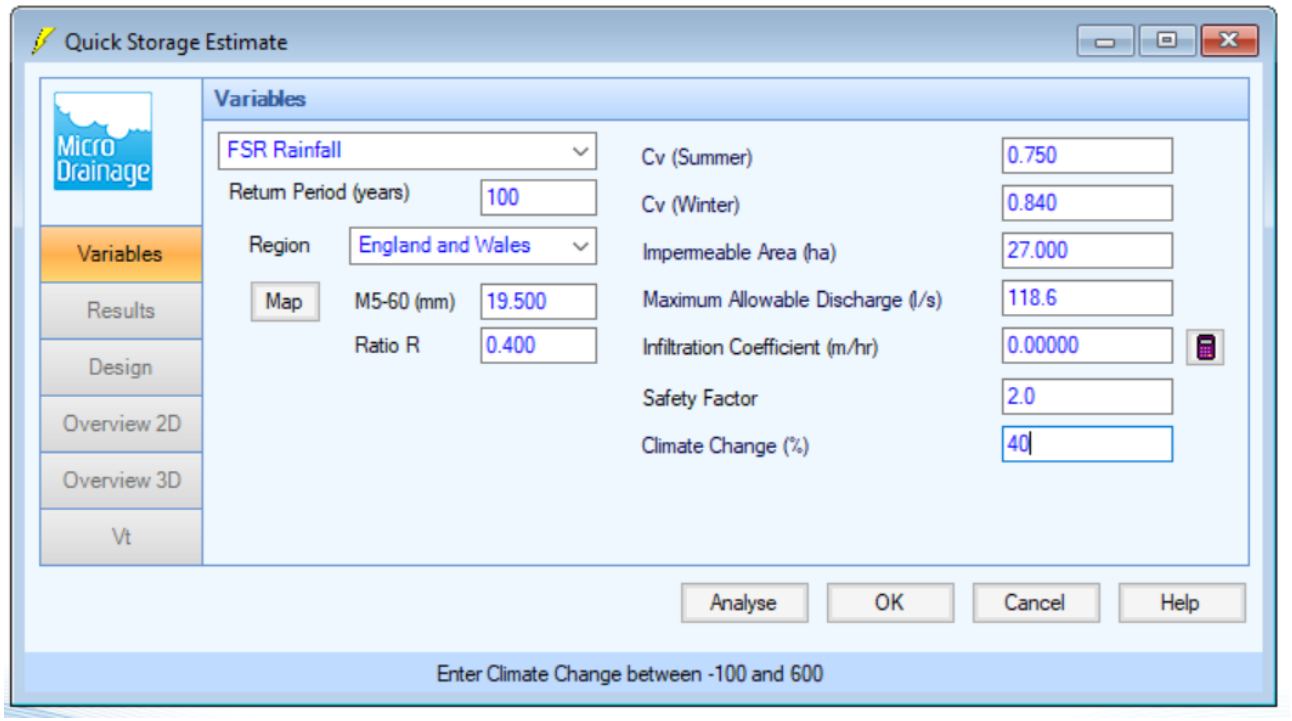
ICP SUDS Mean Annual Flood

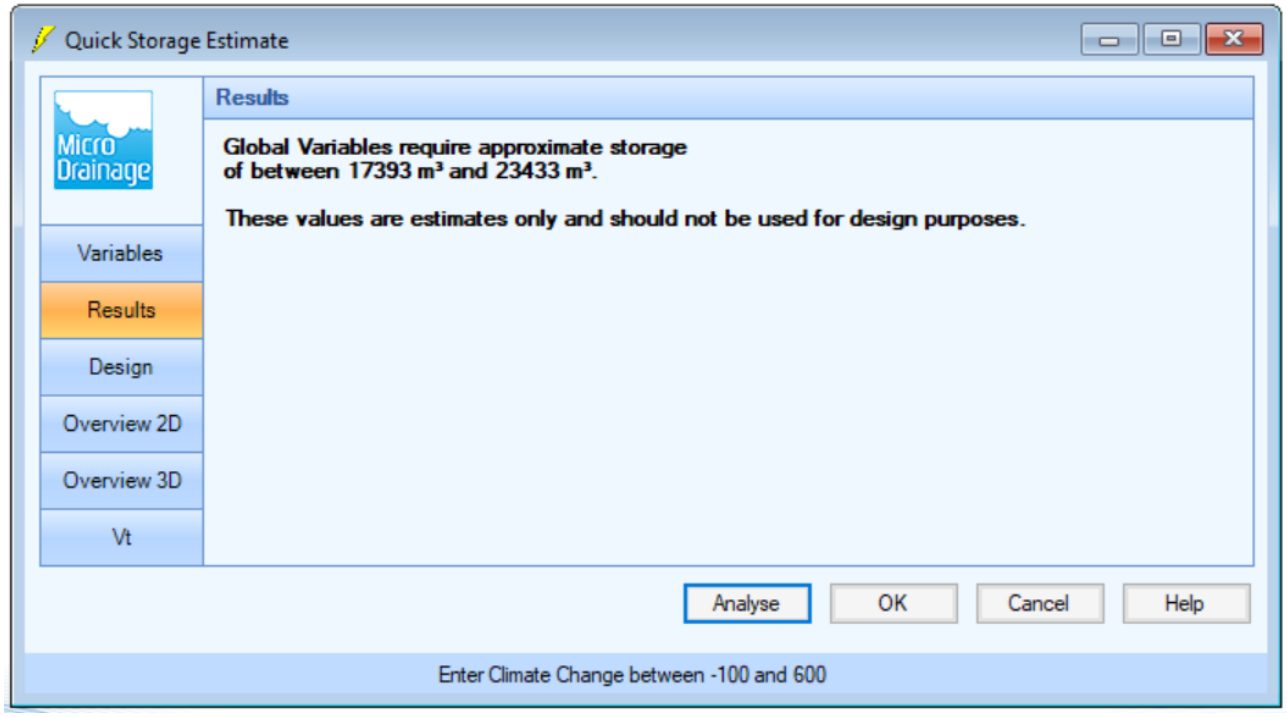
Input

Return Period (years)	2	Soil	0.450
Area (ha)	27.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results l/s

QBAR Rural	118.6
QBAR Urban	118.6
Q2 years	106.3
Q1 year	98.4
Q30 years	232.4
Q100 years	304.8


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FSR Rainfall
Return Period (years) 100
Region England and Wales
Map
M5-60 (mm) 19.500
Ratio R 0.400
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 27.000
Maximum Allowable Discharge (l/s) 118.6
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 40
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage of between 17393 m³ and 23433 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Climate Change between -100 and 600