



Flood Risk Assessment & Outline Drainage Strategy

**Land at Aston Flamville Road, Burbage,
Leicestershire, LE10 3AA**

Jelson Limited

June 2023

Preface

Site Address:	Land at Aston Flamville Road, Burbage, Leicestershire, LE10 3AA		
NGR:	E: 445090 N: 293300		
Site Use:	Agricultural land		
Proposed Use	Development of 343 dwellings with associated Public Open Space		
Site Area:	Site Area: Approximately 16 Hectares		
	Development Area: Approximately 9 Hectares		
Date of Inspection:	12 August 2022		
Avison Young Contact:	David Hoppe		
	DD:	0121 609 8228	Email: david.hoppe@avisonyoung.com
Instruction Number:	01C000075		
Report Control:	Status:		Date:
	Version 1		July 2021
	Version 2 - (Drainage Strategy revised by Geraldine Horner BEng Associate Director)		August 2022
	Version 3 – Report updated to take into account LLFA comments and revised scheme layout		June 2023
	Prepared By:		David Hoppe BSc MCIWEM C.WEM FRGS MEPS Flood Risk & Resilience Manager
	Prepared By:		Kazi Hasan BSc MSc CEng MICE Associate (Drainage and Infrastructure)
	Revised By:		Geraldine Horner BEng Associate Director
	Checked and Authorised By:		Gareth Condry BSc MSc PIEMA Director
	For and on behalf of Avison Young (UK) Limited		

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1. Scope of Instruction and Brief

Objectives

- 1.1 Instructions were received from Jelson (the Client) to undertake a Flood Risk Assessment and Outline Drainage Strategy to support a planning application for the development of 343 dwellings with associated Public Open Space.
- 1.2 A copy of the proposed Masterplan can be found in **Appendix I**.

Background

- 1.3 On the 21st April 2023, Leicestershire County Council as Lead Local Flood Authority reviewed version 1.0 of this Flood Risk Assessment and Outline Drainage Strategy and provided a detailed response which has been summarised below. The LLFA comments have been addressed accordingly throughout this report.

LLFA Key Observations and Advice

Observation / Advice	Comment / Solution
<i>1. British Geological Survey data indicates that infiltration will likely not be feasible. However, ground investigations will be needed to confirm this. As such, the Qbar rate should be used (as proposed) as there will be an increased run-off volume.</i>	Noted and we have used the QBar rate to calculate runoff rates for the site. Ground investigation will be completed prior to detailed design process commencing to confirm initial indications.
<i>2. The existing site is at risk of surface water flooding in the 1 in 100 year plus climate change event. It is noted that the 1 in 100 year plus 50% climate change event has been provided for the pre-development scenario, but only the 1 in 100 year plus 30% for the post development scenario. National guidance states that for development with a lifetime beyond 2100, flood risk assessments are required to assess the upper end allowances. The proposals fall within the Soar catchment for which the upper limit climate change allowance is 60%. Modelling should be updated to reflect this requirement for both the proposed and existing scenarios. It is advised that any modelling submitted to support a planning application must be checked and supported by the Environment Agency or an appropriately qualified third-party consultant.</i>	Up to date guidance on climate state that the central allowance for this catchment (Soar Management Catchment / Humber River Basin District) is 28% for the 2080s epoch (Link to Guidance). Finally, the 2080s epoch covers 2070 to 2125 (Link to Guidance). This will be confirmed as part of the third-party model review.
<i>3. It is not clear from the site plans if all the ditches into which the surface water is to be discharged is within land under the control of the developer. The applicant should provide evidence of developer control over each outfall or area</i>	The site plans now include a red line boundary (site development boundary) and a blue line boundary (site ownership boundary) to show where the developer has

Observation / Advice	Comment / Solution
<i>required to facilitate the surface water proposals, including the surface water flood compensation area.</i>	control of ditches; to demonstrate that outfall are located within the developer's ownership; and to show that the surface water flood compensation area and other surface water proposals fall wholly within the developer's ownership.
<i>4.No ditch levels have been provided and as such it is unclear if a gravity solution is viable. It is noted that the proposals will discharge via vortex flow controls. It is noted that modelling suggests that these outfalls are likely to be surcharged during a peak design event; this may impact on the scale of the proposed SuDS.</i>	The ditch levels are shown in pale grey as part of the topographical survey. We have reviewed the outfalls that show a surcharge in certain events and can confirm that the flow from each outfall does not exceed the allowable greenfield runoff rate in any instance. We have reviewed the SuDS features located just upstream of each outfall, to confirm there is sufficient volume in the detention basins / pipe network designed, to manage the surcharge situations. However such an outfall is so closely linked hydraulically, (in particular in proximity and in cover levels) to the upstream attenuation, water is most likely to backup in the attenuation rather than flood the outfall location. We have added to the table in Section 9.30 to show the volumes provided upstream of each outfall location to help clarify this matter. We have also added to the annotation for each detention basin to show the approximate total volume of storage available. NOTE: attenuation for Network 2 is provided within the pipe network.
<i>5.The proposals will require sections of watercourse to be culverted to allow for proposed road crossings. Note that the council's culverting policy requires culverting be kept to a minimum and where possible, existing culverts to be daylighted.</i>	Two existing culverts will be removed; one existing culvert will be removed and upgraded as part of the infrastructure works for the site; and one new culvert will be designed and installed to accommodate a new road crossing. These are now labelled on the Outline Drainage Strategy Layout. The design of new culverts required for the two new road crossings shown will be dealt with at the detailed design stage for the site and will adhere to all guidance and requirements to ensure no flooding is caused by any new structures.
<i>6.There is concern that there will be constrained maintenance access to existing watercourses on-site. The Council require that an easement of approximately 3m for a watercourse less than 2m in width and 4.5m for watercourses over 2m in</i>	Please refer to Maintenance Access Plan now attached at Appendix VI . This plan shows all ditch easements and easements for proposed culverts. It also identifies

Observation / Advice	Comment / Solution
<i>width. Whilst this is not stipulated within any legal byelaw the Council require this in order to safeguard access to the watercourse for essential maintenance and inspection purposes. If there are any potential culverts in the developable area then the Council would require an easement of 3m or greater to ensure no loading in the 45 degree zone from invert.</i>	points of access for future maintenance of these assets. The ditch easement widths have been amended to reflect the comments here and are now shown on the revised Outline Drainage Strategy Layout as well. See comments in next box below.

LLFA Recommendation

LLFA Recommendation	Solutions
<i>Leicestershire County Council as Lead Local Flood Authority (LLFA) advises the Local Planning Authority (LPA) that the application documents as submitted are insufficient for the LLFA to provide a substantive response at this stage. In order to provide a substantive response, the following information is required:</i>	
<i>A single plan showing the existing drainage regime of the site including (but not limited to):</i> <i>The site redline boundary;</i> <i>The site ownership boundary (where this differs);</i> <i>Labelled contours;</i> <i>Overland flow direction arrows;</i> <i>Existing sub-catchment boundaries and their associated size in ha.;</i> <i>All existing watercourses including associated culvert locations and direction of flow;</i> <i>Pre-development modelled 1 in 100 upper limit climate change surface water flood levels; and</i> <i>Any other surface water features on-site (or in close proximity to the boundary).</i>	This drawing has now been created and is titled Existing Catchment Area Plan. All requirements listed here have been incorporated into this drawing which is attached at Appendix VI.
<i>A single plan showing the proposed drainage regime of the site including (but not limited to):</i> <i>The site redline boundary;</i> <i>The site ownership boundary (where this differs);</i> <i>Labelled contours;</i> <i>Proposed developed catchment boundaries and their associated size in ha.;</i> <i>Indicative proposed development layout plan;</i> <i>All watercourses including associated existing and proposed culvert locations and direction of flow;</i> <i>Easement widths to all watercourses;</i> <i>Drainage strategy layout including indicative levels, SuDS depths and levels, outfall levels and flow control locations;</i> <i>Post-development modelled 1 in 100 plus upper limit climate change surface water flood levels for the flood compensation scenario; and</i>	The Outline Drainage Strategy Layout has now been shown on a single A0 sheet instead of the four A1 sheets originally submitted. All requirements listed here have been incorporated into this drawing which is attached at Appendix VI.

LLFA Recommendation	Solutions
Any other surface water features on-site (or in close proximity to the boundary).	
Evidence of developer control over all land required to deliver the proposed surface water drainage strategy.	All drawings show the redline site boundary and a further blue ownership boundary. Where the blue line boundary coincides with the red line boundary, the red line boundary denotes site ownership and the development boundary.
Third party review of the pre- and post-development surface water modelling.	HydroLand has been appointed to undertake a detailed review of the hydraulic flood model. The model review results are expected early July and these will be shared with the LLFA.
Consideration for the maintenance and management of SuDS features on site, including access for maintenance.	Please refer to Maintenance Access Plan now attached at Appendix VI .
Consideration of surcharged outfalls and the impact this will have on the scale of SuDS proposed.	See Comment / Solution number 4. above

Data Sources

- 1.4 This report is based upon a detailed review of the following readily available documentation:
- Hinckley and Bosworth Borough Council, Blaby District Council, Oadby & Wigston Borough Council Joint Strategic Flood Risk Assessment (SFRA), October 2014;
 - Hinckley and Bosworth Borough Council Level 2 Strategic Flood Risk Assessment, May 2020;
 - JBA Consulting, Hydraulic Modelling Study at Sherborne Road, Burbage, January 2021;
 - Leicestershire County Council Preliminary Flood Risk Assessment (June 2011);
 - Leicestershire County Council Local Flood Risk Management Strategy, (August 2015); and
 - Severn Trent Water Asset Maps.
- 1.5 Regulatory enquiries with the Environment Agency, Leicestershire County Council (Lead Local Flood Authority) and Severn Trent Water have been undertaken to obtain historic flood records and an understanding of the local flood risk (if any).
- 1.6 The findings and opinions conveyed in this report are based on information obtained from a variety of sources as detailed in the report and which Avison Young assumes to be reliable, but has not been

independently confirmed. Therefore, Avison Young cannot and does not guarantee the authenticity or reliability of third party information it has relied upon.

- 1.7 All Ordnance Survey Mapping contained within this report is © Crown Copyright. All rights reserved, licence number 100000795.

Report Preparation

- 1.8 Local Planning Authorities are advised by the Government's National Planning Policy Framework (NPPF) to consult the Environment Agency on development proposals in areas at risk of flooding and/or for sites greater than 1 hectare in area. In such circumstances the Environment Agency would require a Flood Risk Assessment to be submitted in support of the planning application for the proposed development.
- 1.9 In order to satisfy any potential concerns the Environment Agency may have with the proposed development at the site; this report has been prepared to assess the requirements of NPPF through:
- Assessing whether the proposed development is likely to be affected by flooding;
 - Assessing whether the proposed development is appropriate in the suggested location; and
 - Presenting measures necessary to mitigate any flood risk identified, to confirm that the proposed development and occupants would be safe, whilst ensuring that flood risk would not be increased elsewhere.

2. Site Location

2.1 The following site location plan and table provides a summary of the site's location and surrounding land uses.

Item	Description	
Site Location	The site is situated either side of Aston Flamville Road, which is accessed from the B4669 Sapcote Road to the immediate north of the site. The site is situated to the east of Burbage, which is a suburb of Hinckley and is located approximately 2.5km south east of Hinckley town centre. Site location and layout plans are provided below.	
Surrounding Land Uses	North	B4669 Sapcote Road with Aston Firs, Burbage Wood and agricultural land beyond. Hinckley railway line is located approximately 1.2km to the north.
	East	Woodside Garage and van rental company together with residential properties, agricultural land and M69 motorway beyond.
	South	Agricultural land, Burbage Cemetery and M69 motorway.
	West	Residential properties.

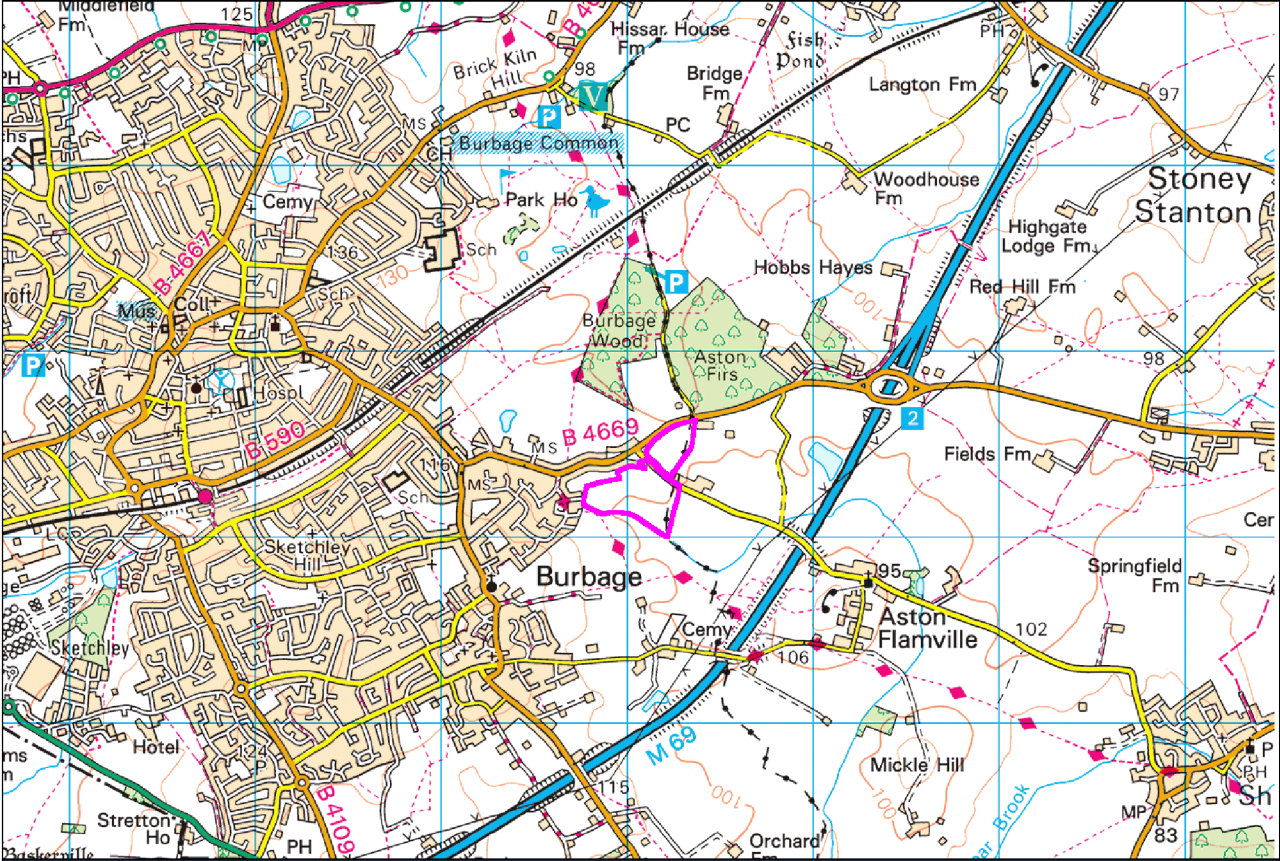
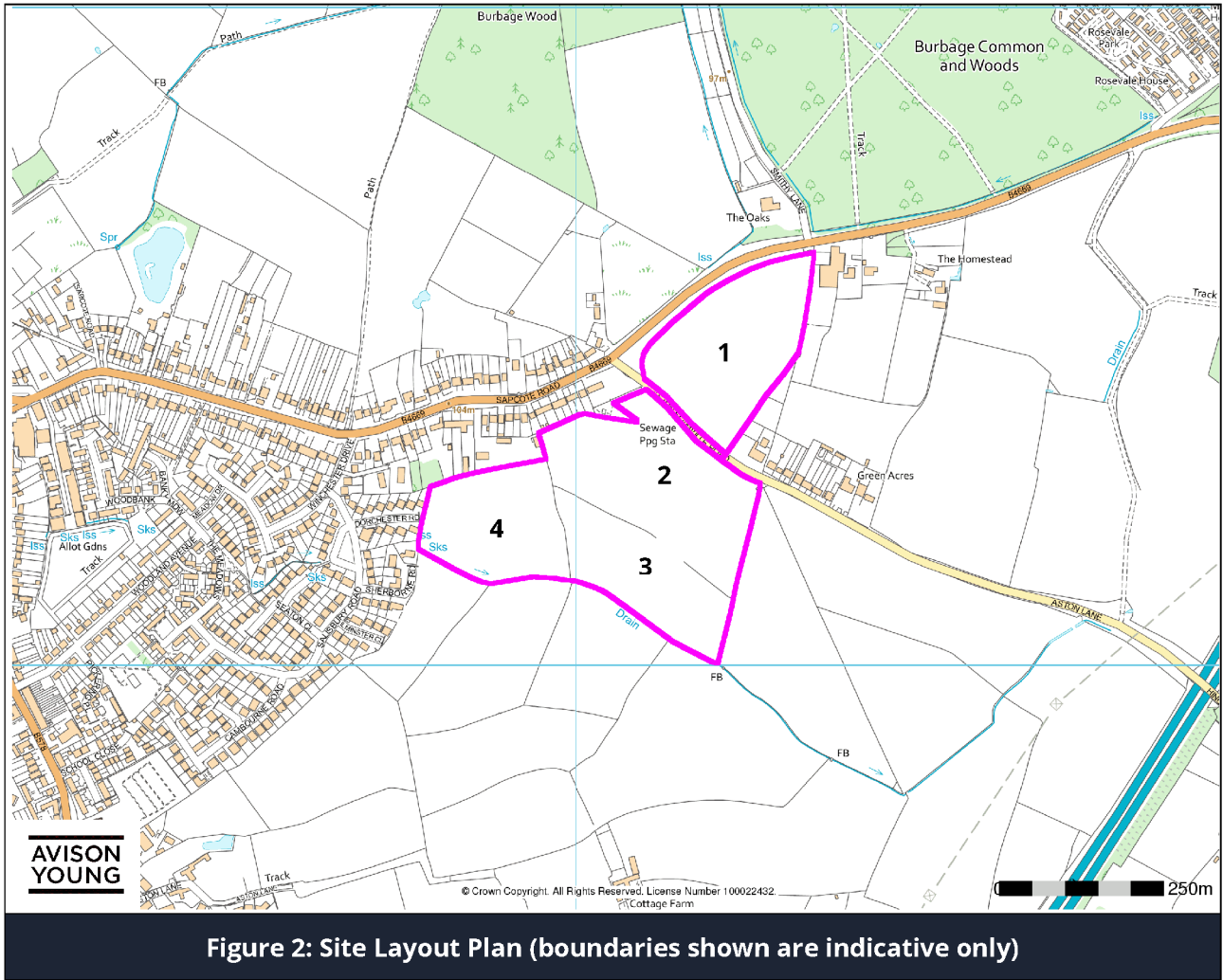


Figure 1: Site Location Plan (boundaries shown are indicative only)

3. Site Setting

3.1 The following site layout plan and table provides a summary of the site's condition and setting.



Item	Description
General Description	The site comprises approximately 16 hectares of agricultural farmland, which was laid entirely to pasture for the grazing of livestock. The fields are predominantly marked by hawthorn hedgerows with occasional mature ash and oak trees. Aston Flamville Road intersects Fields 1 and 2. A residential property, Burbage Dance Studio, Woodside Garage and a Van Rental Company are all located to the east of Field 1. The northern and western boundaries of Fields 2 and 4 are bound by residential properties, which are accessed from Sapcote Road, Dorchester Road and Sherborne Road. A rear access to a property off Sapcote Road was also noted in the north west of Field 2, with a concrete roadway bridging a field ditch. Overhead electricity cables trend north east to south west and from north west to south east across Field 1, with a further cable trending in a northerly direction to an off site property at the corner of Sapcote Road and Smithy Lane. Distribution

Item	Description												
General Description (continued)	transformers were noted in the northern and western corners of Field 1 associated with the overhead electricity cables. No electricity substations were noted on site.												
Topography	A topographical survey of the site has been carried out by Phoenix Survey Services Ltd in April 2013 (Ref S3396-01). Within Field 1, levels generally fall in a north-easterly direction from 102.00m AOD in the north-western corner of the site to 100.00m AOD in the north eastern corner of the site. The ground levels within Field 2 to 4 generally fall in a south-easterly direction. The highest ground is located in the south-western corner of Field 2 at approximately 102.20m AOD. The lowest ground level is located within the south eastern corner of Field 3 at 98.00m AOD. A copy of the Topographical Survey can be found in Appendix II.												
Geological Conditions	From a review of the British Geological Survey (BGS) Solid & Drift Sheet 169, Coventry at a scale of 1:50,000 and the online GeoIndex, the following geological succession has been identified at the site. <table><tr><th>Strata</th><th>Description</th><th>Approx. Thickness</th></tr><tr><td>Bosworth Clay Member of the Wolston Glaciogenic Formation</td><td>Pre Devensian glacial succession of the Midlands comprising glaciolacustrine muds (clay and silt).</td><td><5m</td></tr><tr><td>Wolston Sand and Gravel</td><td>Sand and gravel, locally with lenses of silt, clay or peat.</td><td><5m</td></tr><tr><td>Mercia Mudstone Group</td><td>Triassic aged dominantly red, less commonly grey green mudstone with subordinate siltstone and halite bearing units in some basinal areas. Thin beds of gypsum are widespread.</td><td>>100m</td></tr></table> The BGS do not map any artificial deposits across the site and limited Made Ground is anticipated given its agricultural land use. Localised areas of Made Ground to include brick and concrete is anticipated at field entrances, where rubble has been imported. No previous ground investigation reports are available for the site.	Strata	Description	Approx. Thickness	Bosworth Clay Member of the Wolston Glaciogenic Formation	Pre Devensian glacial succession of the Midlands comprising glaciolacustrine muds (clay and silt).	<5m	Wolston Sand and Gravel	Sand and gravel, locally with lenses of silt, clay or peat.	<5m	Mercia Mudstone Group	Triassic aged dominantly red, less commonly grey green mudstone with subordinate siltstone and halite bearing units in some basinal areas. Thin beds of gypsum are widespread.	>100m
Strata	Description	Approx. Thickness											
Bosworth Clay Member of the Wolston Glaciogenic Formation	Pre Devensian glacial succession of the Midlands comprising glaciolacustrine muds (clay and silt).	<5m											
Wolston Sand and Gravel	Sand and gravel, locally with lenses of silt, clay or peat.	<5m											
Mercia Mudstone Group	Triassic aged dominantly red, less commonly grey green mudstone with subordinate siltstone and halite bearing units in some basinal areas. Thin beds of gypsum are widespread.	>100m											
Catchment Hydrology	As shown below in Figure 3, two main land drains are present within the site boundary. For reference purposes within this report, we have titled these features as ‘Main Drain’ and ‘Drain’. These features generally trend and flow in a south easterly direction to the south of the site, and form part of the Soar Brook catchment.												

Item	Description
	The 'Main Drain' issues from a 1m diameter concrete culvert with brick headwall located on the south western site boundary of Field 4. The land drain flows in a vegetated channel approximately 1m wide and between 0.5m to 1m deep along the south western and southern boundary of Fields 4 and the south western boundary of Field 3. The 'Drain' flows between the eastern boundary of Field 4 and the western boundaries of Field 2 & 3. It then discharges into the 'Main Drain' in the south-eastern corner of Field 4. This feature is also between 0.5m to 1m wide and of similar depth. A smaller drain (referenced as Field Drain 1) is located along the north eastern boundary of Field 3. A second smaller drain (referenced as Field Drain 2) runs along the eastern boundaries of Fields 2 and 3. Field Drain 1 connects to Field Drain 2 in the north eastern corner of Field 3. Field Drain 2 connects into the Main Drain in the south eastern corner of Field 3. There are a number of culverted sections located along the drains to allow farm vehicles to cross between fields. Crossing 1 is located centrally in the south west boundary of Field 4. Crossing 2 is located centrally in the eastern boundary of Field 4, providing access into Field 3. Crossing 3 is located centrally in the north eastern boundary of Field 3, providing access into Field 2. With respect to Field 1, a ditch was present along the northern half of the eastern boundary (referenced Field Drain 3). An outfall culvert crossing Sapcote Road was noticed with water flowing from it, due north. Overland flow generated from the northern half of Field 1 flows to the north east and connects to the land drains located within Aston Firs woodland on the opposite side of Sapcote Road. The southern half flows to the south but no specific discharge point was noted. No ponds are present on site. The Soar Brook is located approximately 1.4km to the south of the site, which trends and flows in a general easterly direction, where it becomes the River Soar. The land drains on site are not classified as a Main River by the Environment Agency, however, the downstream section of the Soar Brook and River Soar are designated as Main Rivers.

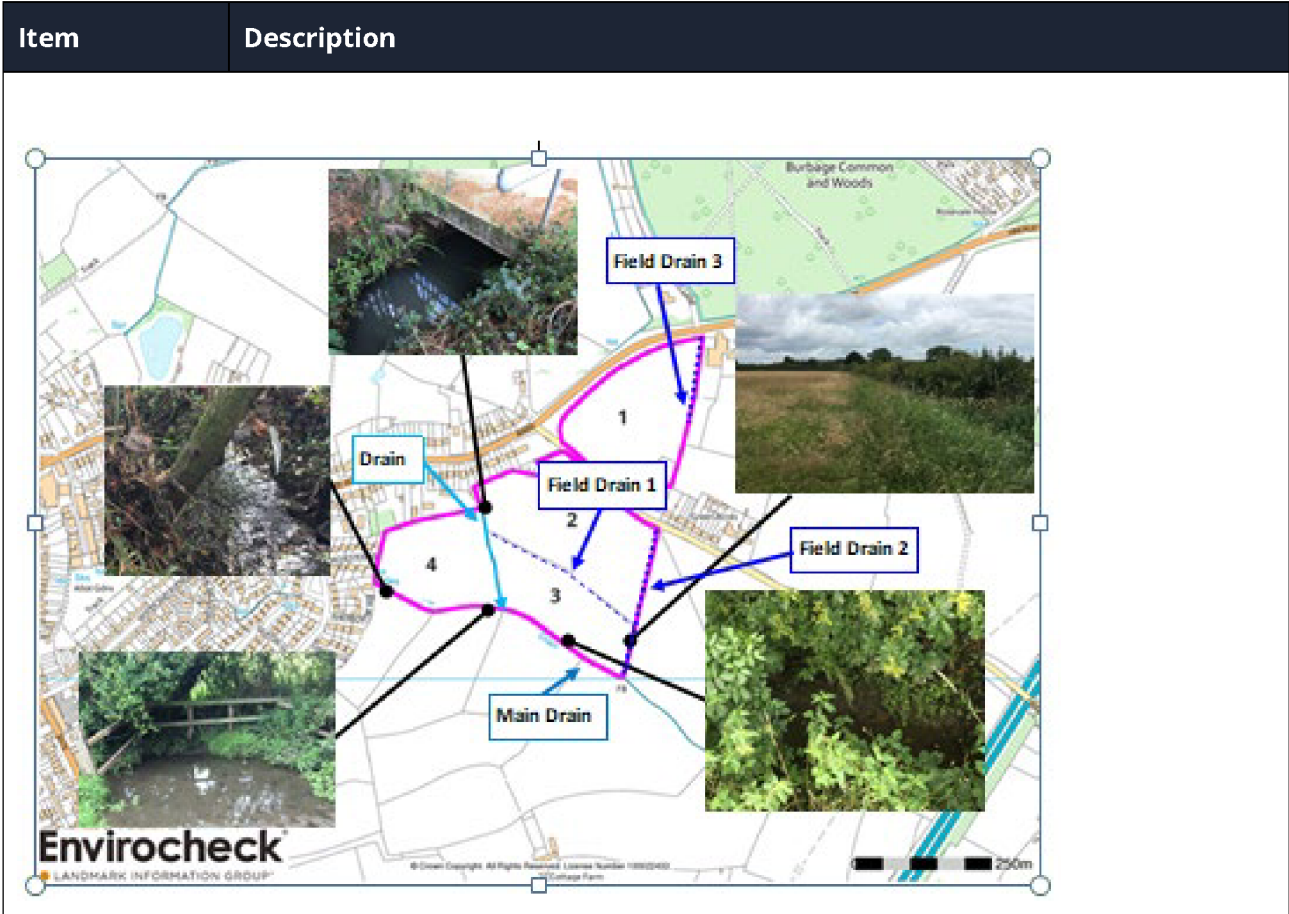


Figure 3 – Existing Drainage Ditches

Catchment Hydrogeology	According to the Envirocheck Report, the following aquifer designations are assigned to the geological units beneath the site. <table><tr><th>Geological Unit</th><th>Aquifer Designation</th></tr><tr><td>Bosworth Clay Member of the Wolston Glacigenic Formation</td><td>Unproductive Strata with low permeability and have negligible significance for water supply or for the supply of base flow to streams and rivers.</td></tr><tr><td>Wolston Sand and Gravel</td><td>Secondary A Aquifer with permeable layers capable of supporting water supplies and base flow to rivers on a local scale.</td></tr><tr><td>Mercia Mudstone Group</td><td>Secondary B Aquifer with predominantly lower permeability layers which may store limited amounts of groundwater.</td></tr></table> Regional groundwater flow is considered to be to the south / south east towards the Soar Brook. The Environment Agency's Groundwater Vulnerability maps show the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties of the local area. The site is shown to be located in an area where the superficial deposits have a low groundwater vulnerability, which means that groundwater resources are of low	Geological Unit	Aquifer Designation	Bosworth Clay Member of the Wolston Glacigenic Formation	Unproductive Strata with low permeability and have negligible significance for water supply or for the supply of base flow to streams and rivers.	Wolston Sand and Gravel	Secondary A Aquifer with permeable layers capable of supporting water supplies and base flow to rivers on a local scale.	Mercia Mudstone Group	Secondary B Aquifer with predominantly lower permeability layers which may store limited amounts of groundwater.
Geological Unit	Aquifer Designation								
Bosworth Clay Member of the Wolston Glacigenic Formation	Unproductive Strata with low permeability and have negligible significance for water supply or for the supply of base flow to streams and rivers.								
Wolston Sand and Gravel	Secondary A Aquifer with permeable layers capable of supporting water supplies and base flow to rivers on a local scale.								
Mercia Mudstone Group	Secondary B Aquifer with predominantly lower permeability layers which may store limited amounts of groundwater.								

Item	Description
Catchment Hydrogeology (continued)	priority with a high degree of natural protection. The risk of pollution from spillages at the surface is therefore low to groundwater but the risk of pollution runoff to surface watercourse could be increased and activities should be managed. The site is not located within a Groundwater Source Protection Zone.
Existing Site Drainage	The site is considered as greenfield in drainage terms. Sewer records obtained from Severn Trent Water show that a Sewage Pumping Station is located off site centrally along the northern boundary of Field 2, which serves the local residential properties. The sewer record shows that a 300mm diameter public foul water sewer trends from Dorchester Road in a north easterly direction across Field 4. It then continues around the north west perimeter of Field 2 until it enters the pumping station. Manhole covers associated with the public foul sewer are located in both Fields 4 and 2. The manhole cover in Field 4 was raised above its surroundings and was surrounded by Heras fencing. This appeared to have had recent repair completed. A pressurised foul sewer exits the Pumping Station and trends in a southerly direction across Fields 2 and 3. An abandoned pipe also runs parallel with the pressurised foul sewer. It is understood that there has been some surcharging of the foul sewers in the past leading to odour issues. The manhole cover observed in the northeast corner of Field 2 does not appear to be part of the public sewer network following a review of the Severn Trent Water Asset Plan. A second, but smaller, Severn Trent Water Pumping Station is located to the north of Field 1 adjacent to Sapcote Road. This serves Woodside Garage, the Van Rental company to the east and residential properties along Sapcote Road. A pressurised public combined sewer runs immediately beyond the north western site boundary of Field 1 feeding into the larger pumping station at Field 2. A further pressurised combined sewer is also laid within the carriageway of Aston Flamville Road which serves the residential properties to the south east of Field 1. This pressurised combined sewer also connects to the larger pumping station north of Field 2 via a section of 300mm diameter gravity combined sewer located in the access road to this pumping station. Surface water from the site is currently captured by a series of field ditches located at the field boundaries, which then feed into the main land drain as described above. A review of the Severn Trent Water Asset Plan confirms public surface water sewers discharge into the land drain from the north, south and west. A private surface water pipe was noted to discharge into the field ditch in the north west corner of Field 2. Copies of the Severn Trent Water Sewer Plans can be found in Appendix III.

Site Photographs

3.2 A selection of site photographs taken on 5 August 2022 is presented below.



Photo 1: View looking west across Field 1 towards junction of Sapcote Road and Aston Flamville Road



Photo 2: View looking to the north west across Field 2 towards housing and sewage pumping station



Photo 3: View looking east across Field 3



Photo 4: View looking west across Field 4 and fenced manhole in centre of field



Photo 5: View of manhole in centre of - Field 4



Photo 6: Leicestershire Round Public Footpath located off site to the south



Photo 7: View of Surface Water Sewer entering land drain in south west corner of Field 4



Photo 8: Main Drain, downstream culvert in the northern corner of Field 4



Photo 9: Manhole cover in north east corner of Field 2



Photo 10: View of Severn Trent Water Sewage Pumping Station north of Field 2



Photo 11: Severn Trent Sewage Pumping Station north of Field 2



Photo 12: Northern boundary of Field 1, opposite the STW pumping station

4. Development Proposals

4.1 The proposed development comprises up to 343 residential dwellings at an average net density of 35 dwellings per hectare, including 20% affordable housing, public open space and associated infrastructure with all matters reserved except for access.

4.2 In summary, it is proposed that the scheme would deliver:

- up to 343 dwellings (including a mix of dwelling types from 2 - 5 bedroom properties) at an average net density of circa 35 dph;
- 20% affordable housing (including affordable rent and shared ownership);
- a new vehicular and pedestrian access taken from Aston Flamville Road into both the northern and southern parcels of land;
- pedestrian access point from Dorchester Road;
- improvements to the pedestrian and cycle infrastructure;
- a network of green infrastructure (circa 6.15 hectares) interspersed throughout the site;
- a potential link to the existing Public Right of Way to the south of the site;
- an equipped play area;
- the retention and addition of structural landscaping; and
- new sensitively designed sustainable drainage system (SuDs).

4.3 A copy of the detailed site plans can be found in **Appendix I**.

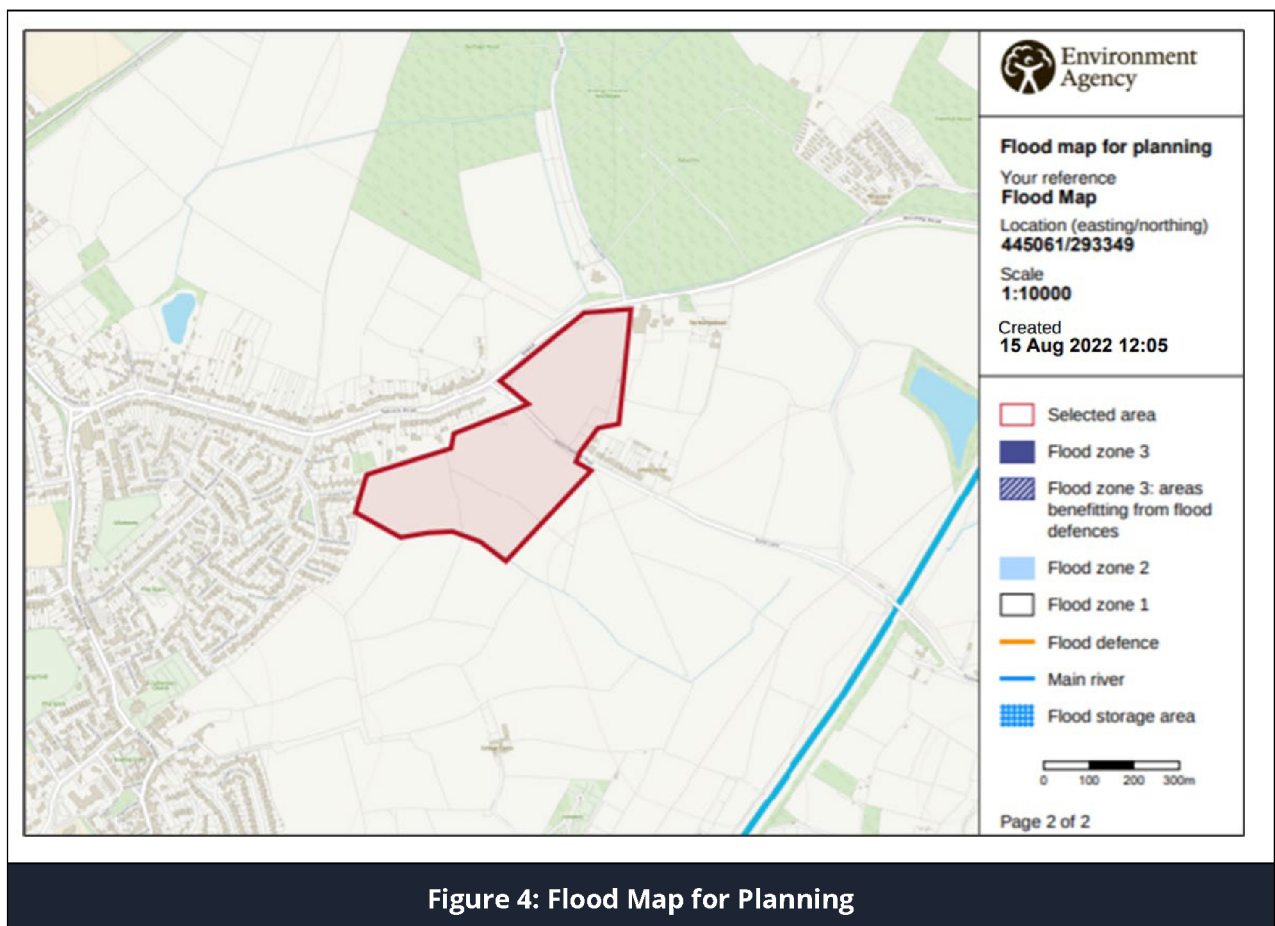
5. Flood Risk

- 5.1 This section identifies what potential sources of flooding could affect the site and includes further details on how flooding might occur.

Fluvial

Environment Agency Flood Maps

- 5.2 According to the publicly available Environment Agency Flood Map for Planning, the entire site is located within Environment Agency Flood Zone 1 (land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year).
- 5.3 Upon review of the Environment Agency's Long-Term Flood Risk Map, the site is at 'Very Low' risk of flooding with an annual probability of river or sea flooding of less than 1 in 1,000.



Hinckley and Bosworth Borough Council Level 2 Strategic Flood Risk Assessment (May 2020)

- 5.4
- The recently revised Hinckley and Bosworth Borough Council Level 2 Strategic Flood Risk Assessment (SFRA) (May 2020) included flood maps covering the subject site¹. The results show that the central and south-eastern portion of the site is at flood risk from the Main Drain and Drain which run through the site. This modelling shows that approximately 19% of the land within the redline below (which is smaller than the development redline boundary) is within Flood Zone 3b (land that would flood with an annual probability of 1 in 20 years).
- 5.5
- The SFRA modelling was carried out by JBA Consulting. A copy of the flood map is shown below.

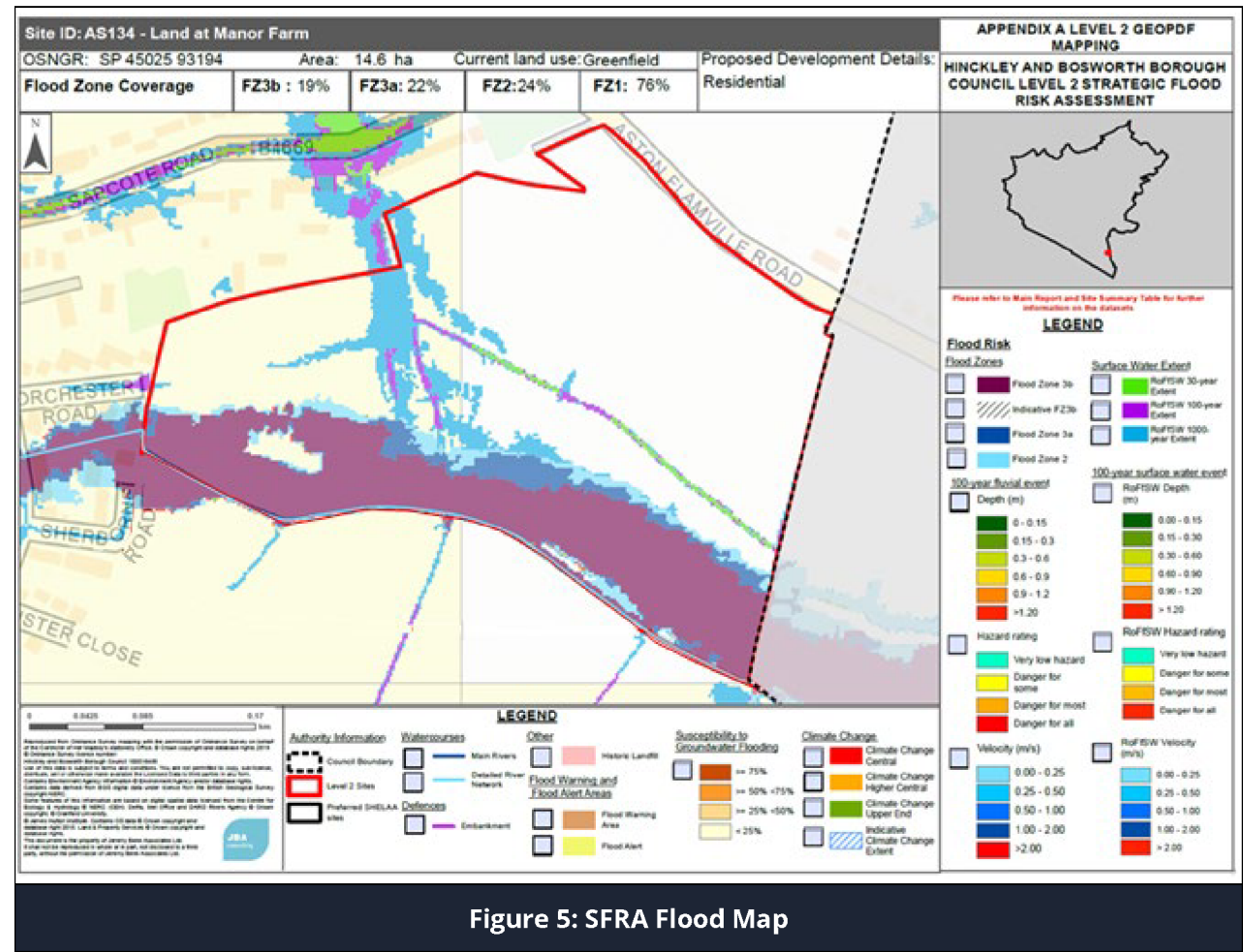


Figure 5: SFRA Flood Map

- 5.6
- In accordance with the SFRA Section 5.5.3 fluvial recommendations, a detailed hydraulic flood modelling study was undertaken to further understand flood risk associated with the above Unnamed Watercourse and to identify mitigation measures required to reduce flood risk to the development area.

¹ SFRA site reference – AS134_

- 5.7 JBA Consulting, who completed the SFRA modelling were commissioned to model the watercourse to develop an understanding of the flood risk associated with the ordinary watercourse. Once the baseline scenarios were known, a number of post-development scenarios were tested to reduce flood risk to the site without increasing flood risk elsewhere. The scenario testing is discussed within Section 7 of this report.

Model Build

- 5.8 A 1D-2D hydraulic model was developed using Flood Modeller-TUFLOW to represent the changing depth, velocity and hazard at the site. A channel survey was carried out by Grantham Coates Survey in July 2020 which consisted of 12 cross section along the watercourse and at key hydraulic structures such as access bridges across the channel and culverted sections of the watercourse.
- 5.9 The existing floodplain topography was represented by combining a site-specific topography survey undertaken by Phoenix Survey Services in July 2020 and LiDAR DTM Topographical survey data to understand the site levels.
- 5.10 The hydraulic model represents the ordinary watercourse flowing approximately west to east in the southern part of the site (Main Drain) and the main tributary (Drain) which runs through the centre of the site. The extent of the model in the 1D and 2D domains is shown in Figure 6 below.

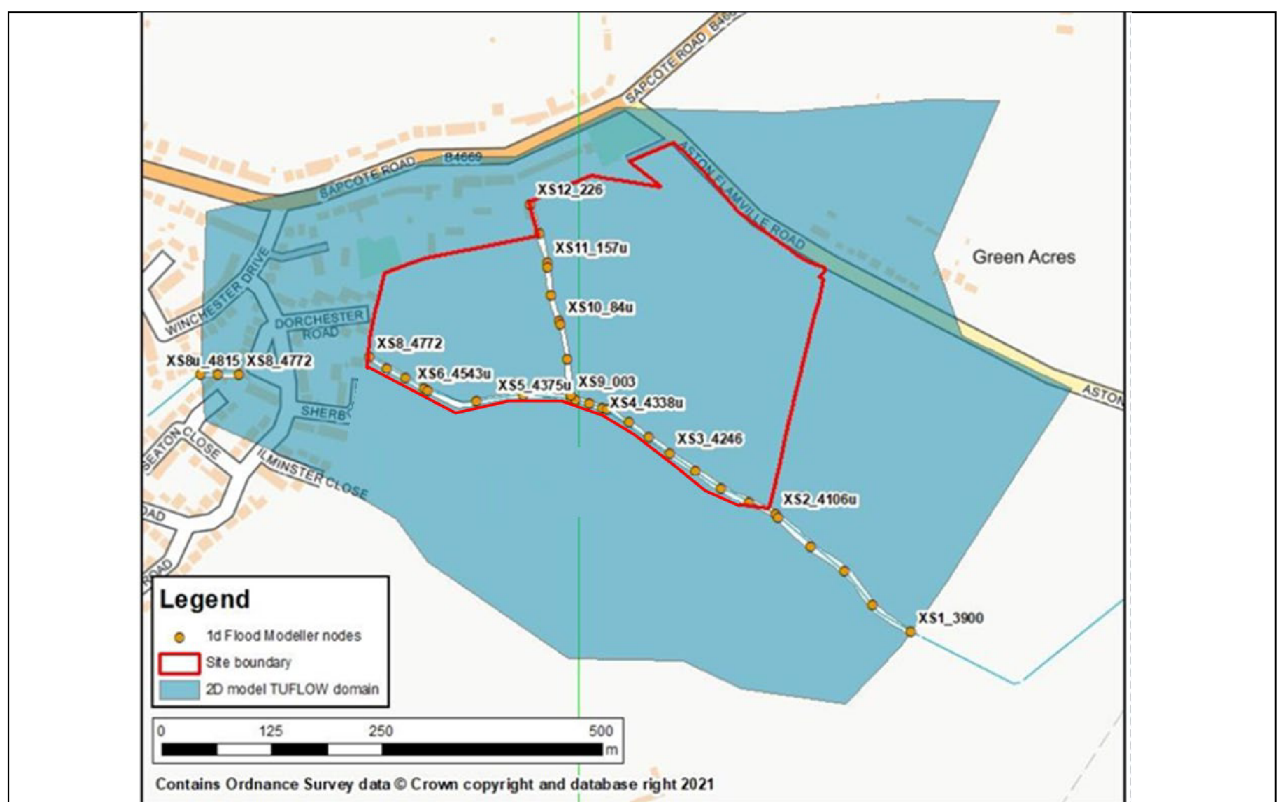


Figure 6: Model Extent

Model Results

- 5.11 The hydraulic model was run for 20-year, 100-year, 100-year plus climate change (30% and 50%) and for the 1,000-year fluvial scenarios.
- 5.12 The modelling work was undertaken in 2021 and since the report was issued, the climate change requirements for the area has reduced from 30% to 28%. Because this offers a betterment to the modelling undertaken by JBA Consulting, we have not at this time updated the modelling.
- 5.13 Results from the baseline hydraulic modelling results show that flooding occurs in all modelled events due to the lack of capacity of the channel and undersized culverts which act to constrict flows and hinder the conveyance of flood water downstream.
- 5.14 The baseline extents which exclude climate change are shown in Figure 7 below. When factoring in climate change, the flood extent of the 1 in 100-year only increases slightly due to relatively shallow depths.
- 5.15 The flood extent is similar to the SFRA. However, when comparing the SFRA with the detailed modelling there is a significant reduction in flood risk across Field 4, removing the central and south western areas from Flood Zone 3b.

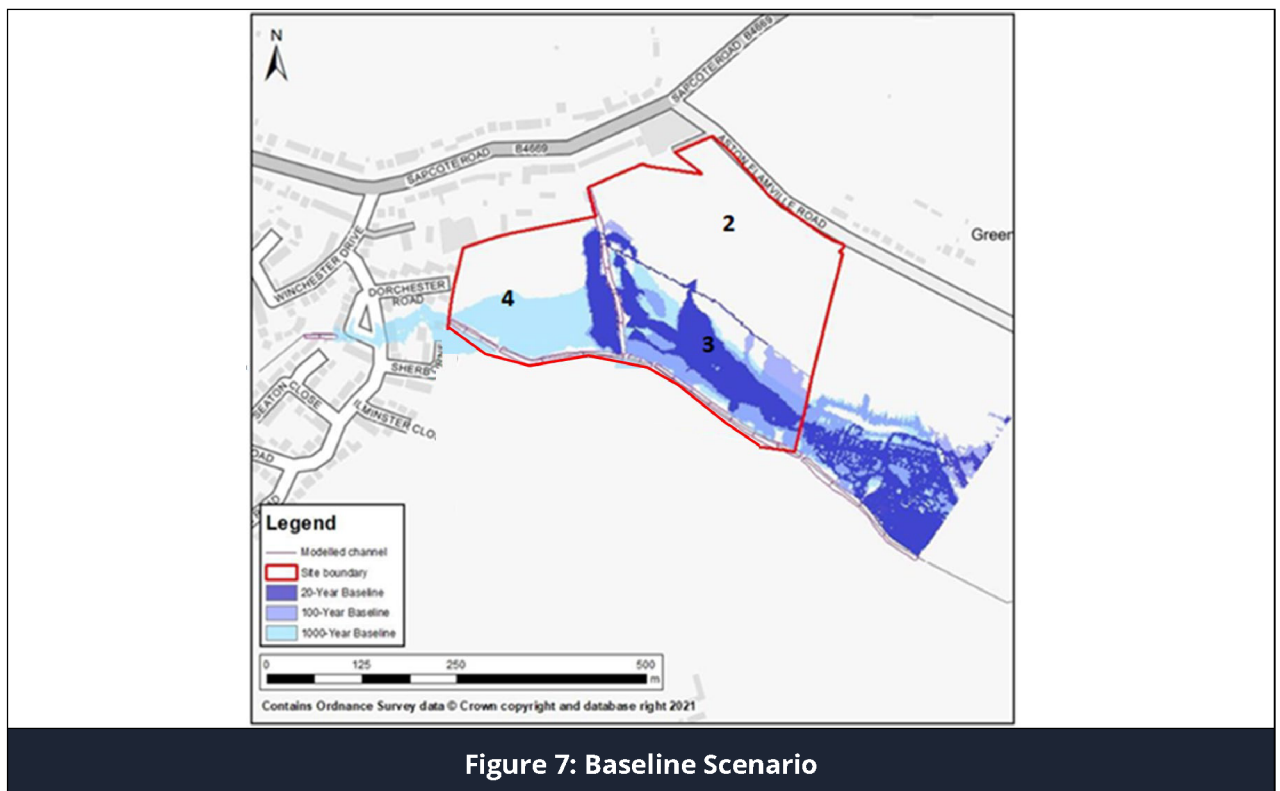


Figure 7: Baseline Scenario

- 5.16 As shown below in Figure 8, flood depths within the site during the 1 in 100-year plus 30% climate change event are generally shallow at 0cm to 5cm. However, along the eastern boundary of Field 4 and within the southern portion of Field 3, depths of up to 0.15m are shown. Within the south-eastern corner of Field 4, at the confluence of the two drains, flood depths of up to 0.25m is shown.

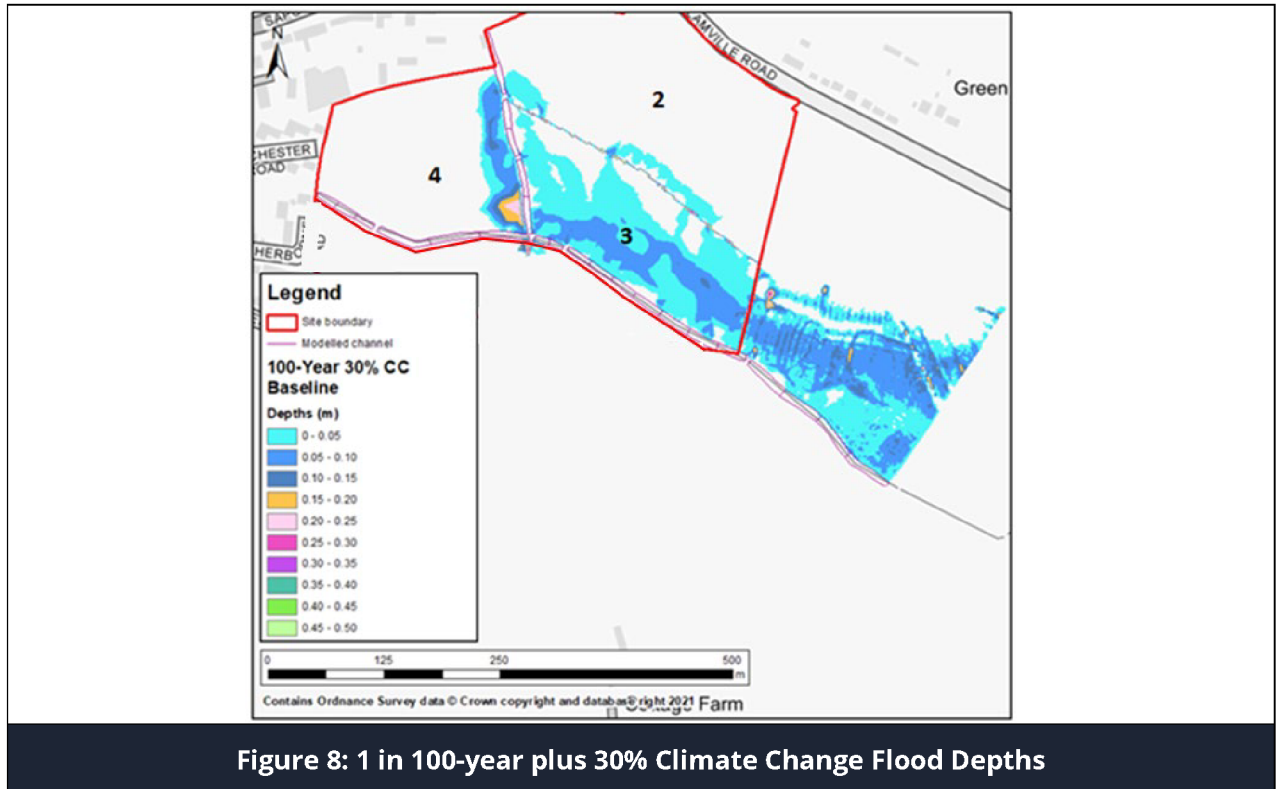


Figure 8: 1 in 100-year plus 30% Climate Change Flood Depths

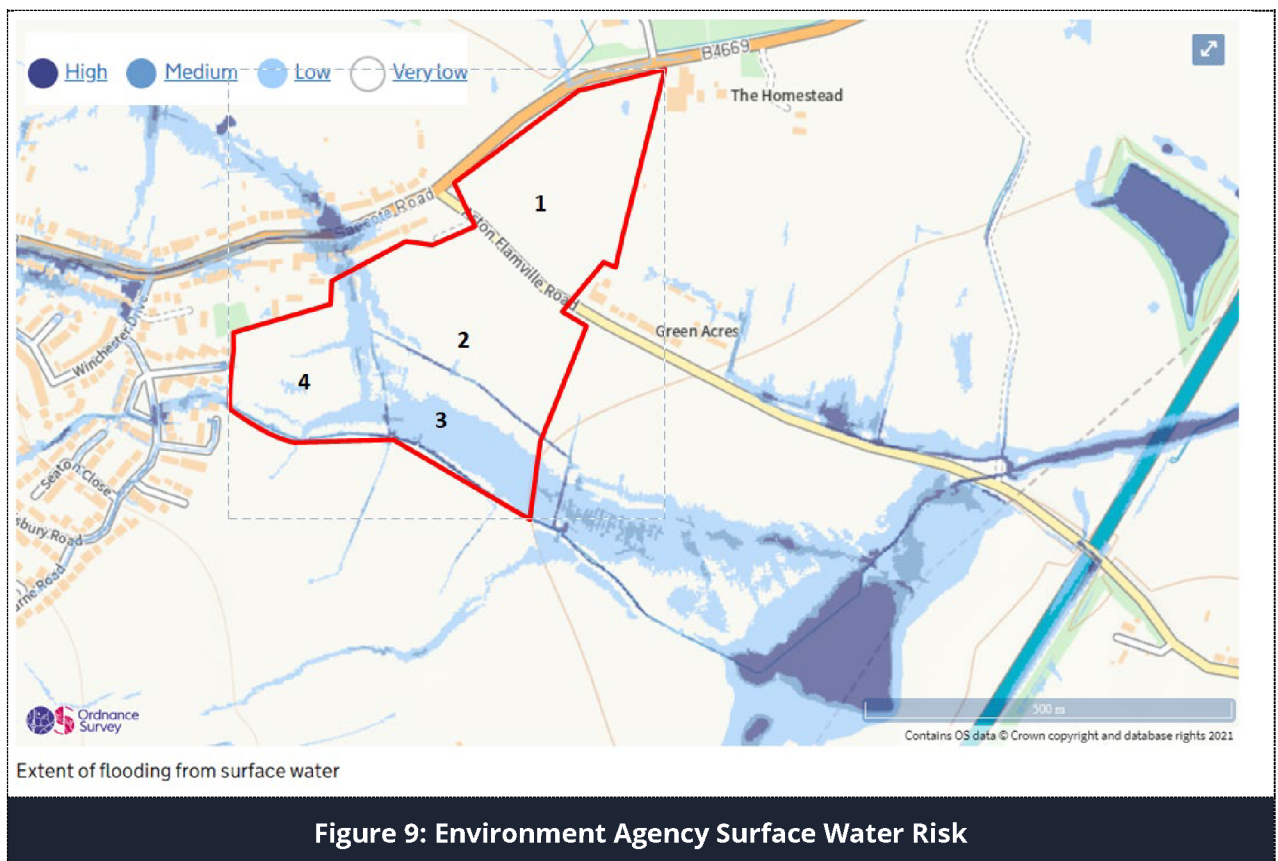
- 5.17 In summary, the flood modelling has shown that there is a risk of flooding across the central and south-eastern portion of the site. However, the flood depths are generally shallow between 0cm to 5cm. When comparing the SFRA flood outlines against the detailed modelling study, the main difference is the western portion of the site is not shown to flooding during 1 in 100-year plus cc event, however, the flood extent across the central and south-eastern corner is similar.
- 5.18 To reduce the flood extent across the development area, various flood mitigation options have been tested to reduce flood risk without increasing flooding risk elsewhere. These options have been discussed within **Section 7**.
- 5.19 The risk of flooding from fluvial sources is considered to be **'low to medium'**.

Surface Water

- 5.20 The Environment Agency Surface Water Flood Maps indicate that the majority of the site is at 'very low' risk of surface water flooding, with an annual chance of flooding of less than 1 in 1,000. However,

there is a 'low' risk of surface water flooding, with an annual chance of flooding between 1 in 1,000 and 1 in 100, associated with Field 3 and the eastern and southern parts of Field 4.

- 5.21 The channels of the land drain and field ditches are indicated to be at 'medium' risk of surface water flooding with an annual chance of flooding between 1 in 100 and 1 in 30 and 'high' risk of surface water flooding with an annual chance of flooding of greater than 1 in 30.
- 5.22 No records of surface water flooding are held by the Environment Agency. The site owner has no records of the site having been affected by surface water flooding.



- 5.23 The risk of surface water flooding to the site is considered as '**low**'.

Groundwater

- 5.24 From a review of the British Geological Survey 'Groundwater Flooding Susceptibility Map' and based on the anticipated geological conditions of the site, groundwater flooding is not considered to be a significant risk.
- 5.25 The risk of groundwater flooding is considered to be '**low**'.

Sewer

- 5.26 There are no public surface water sewers located within the site. However, there are several public foul water sewers including a pressurised foul water main and a 300mm diameter public foul water sewer located within the site. Therefore, there is a risk of sewer flooding caused by bursting of pressurised sewers or when the capacities of the gravity sewers are overwhelmed.
- 5.27 However, to reduce this risk, the layout of the site has been carefully designed so that these sewers are contained within the access roads and no property is located within 5m of any public sewer.
- 5.28 Any flood water caused by sewer flooding will be intercepted by the new highway drainage system which will be installed to serve the development, hence the risk of damages to residents and properties is low.
- 5.29 Therefore, the risk of sewer flooding (post development) to the site is considered **'low'**.

Reservoirs

- 5.30 The Environment Agency Reservoir Flood Map shows that the site is not at risk from reservoir flooding.
- 5.31 The risk of flooding from reservoirs is considered **'negligible'**.

Artificial Sources

- 5.32 There are no canals in close proximity (1km) to the subject site.
- 5.33 The risk of flooding from artificial sources is considered **'negligible'**.

6. Flood Risk Classification

- 6.1 This section identifies if the site is suitable for development in line with the 2021 National Planning Policy Framework.

Sequential Test

- 6.2 The risk based sequential test is a planning tool found within the National Planning Policy Framework. It is used to steer new development to areas at the lowest probability of flooding, known as Flood Zone 1 (1 in 1,000 annual probability of river or sea flooding). The Flood Zones are the starting point for the sequential test is summarised below.

Flood Zone	Associated Flood Risk
Zone 1	This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year.
Zone 2	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding or between 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.
Zone 3a	This zone comprises land assessed as having a 1 in 100 or greater probability of river flooding or a 1 in 200 or greater probability of flooding from the sea in any year.
Zone 3b	This zone comprises of the functional floodplain. This land comprises land where water has to flow or be stored in times of flood.

- 6.3 According to the Environment Agency flood maps the site is located within **Flood Zone 1**.
- 6.4 It is acknowledged that the SFRA places a large portion of the site within Flood Zone 3b where development is not appropriate. However, the detailed flood modelling exercise has reduced the extent of functional floodplain and modelling shows that flood depths are generally low between 0 to 15cm. Proposed mitigation measures result in the development platform being located outside of the floodplain.

Vulnerability Table

- 6.5 National Planning Policy Framework groups development types into different vulnerability classifications:

- Essential Infrastructure such as essential utility infrastructure;
- Highly Vulnerable such as residential caravans and basement dwellings;
- More Vulnerable such as dwelling houses, short stay holiday caravans and educational establishments;
- Less Vulnerable such as offices, shops, restaurants and cafes; and
- Water Compatible such as water treatment plants and amenity open space.

6.6 Dwelling house developments are classed as **'More Vulnerable'**.

6.7 For each Flood Zone within the Technical Guidance, the table below sets out whether development of the different vulnerability classifications are appropriate.

Flood Zone	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	✗	Exception Test required	✓	✓
Zone 3b	Exception Test required	✗	✗	✗	✓
✓ Development is appropriate ✗ Development is not appropriate					

6.8 The site is located within Flood Zone 1 and in accordance with the National Planning Policy, development is deemed appropriate.

Exception Test

6.9 The Exception Test, as set out in paragraph 164 of the 2021 National Planning Policy Framework, is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available.

6.10 In accordance with National Planning Policy Framework, an Exception Test is not required for the proposed site.

7. Flood Mitigation

Optioneering Work

- 7.1 During the modelling exercise, four post-development options were tested to reduce flood risk across Fields 2, 3 and 4 without increasing flood risk elsewhere.
- 7.2 The optioneering work has been based on the 1 in 100-year plus 30% climate change flood level. The modelling work was undertaken in 2021 and since the report was issued, the climate change requirements for the area has reduced from 30% to 28%. Because this offers a betterment to the modelling undertaken by JBA Consulting, we have not at this time updated the modelling.
- 7.3 The following 3 Options have been discounted due to increased flood risk downstream of the site. For further details and associated figures showing the detrimental increase in flood risk, please see Section 4 of JBA Consulting's Hydraulic Modelling report which can be found in **Appendix IV**.
- **Option 1:** Two culverts were removed along the channel.
 - **Option 2:** Removal of the culverts plus raising bank heights by 300mm along the length of the tributary channel. Along the main channel, 1m increase in channel width with bank heights increased by 300mm.
 - **Option 3:** The culverts along the tributary channel were removed as per Option 1. The existing orifice reduced in diameter from 1.1m to 0.48m to maintain flood leaving the site to its pre-development value. Directly upstream of this throttled culvert, the channel was widened by 5 times and the height of the banks increased in order to contain the throttled flood within the channel. Additionally, bank heights along the modelled tributary channel (flowing from north to south through the site) and along parts of the main watercourse were increased by heights of up to 2.93m in order to contain flood water within the channel. In areas where an increase in bank height is required, a low flow channel has been maintained.

Preferred Option

7.4 The preferred Option 4 proposes:

- The removal of three undersized culverts (locations shown on Figure 10 below);
- Raising the bank levels of the Main Drain and Drain (levels range from 0.01m to 1m);
- Creating a flood storage area (bank heights range from 0m to 1m) with a flow control structure (0.70m diameter) at the southern end of the site (location shown on Figure 10 below); and
- A 1m deep low flow channel running alongside the Flood Storage Area with a lowered left-hand bank to allow excess water to spill directly into the Flood Storage Area.

7.5 The proposed Option 4 is shown in Figure 10 below. This figure includes the recommended heights required to raise bank levels and create the flood storage area and the location of the proposed culvert removals. Option 4 has also been included within Outline Drainage Strategy drawing (**Appendix VI**), which shows the location of the flood storage area and 1m deep low flow channel.

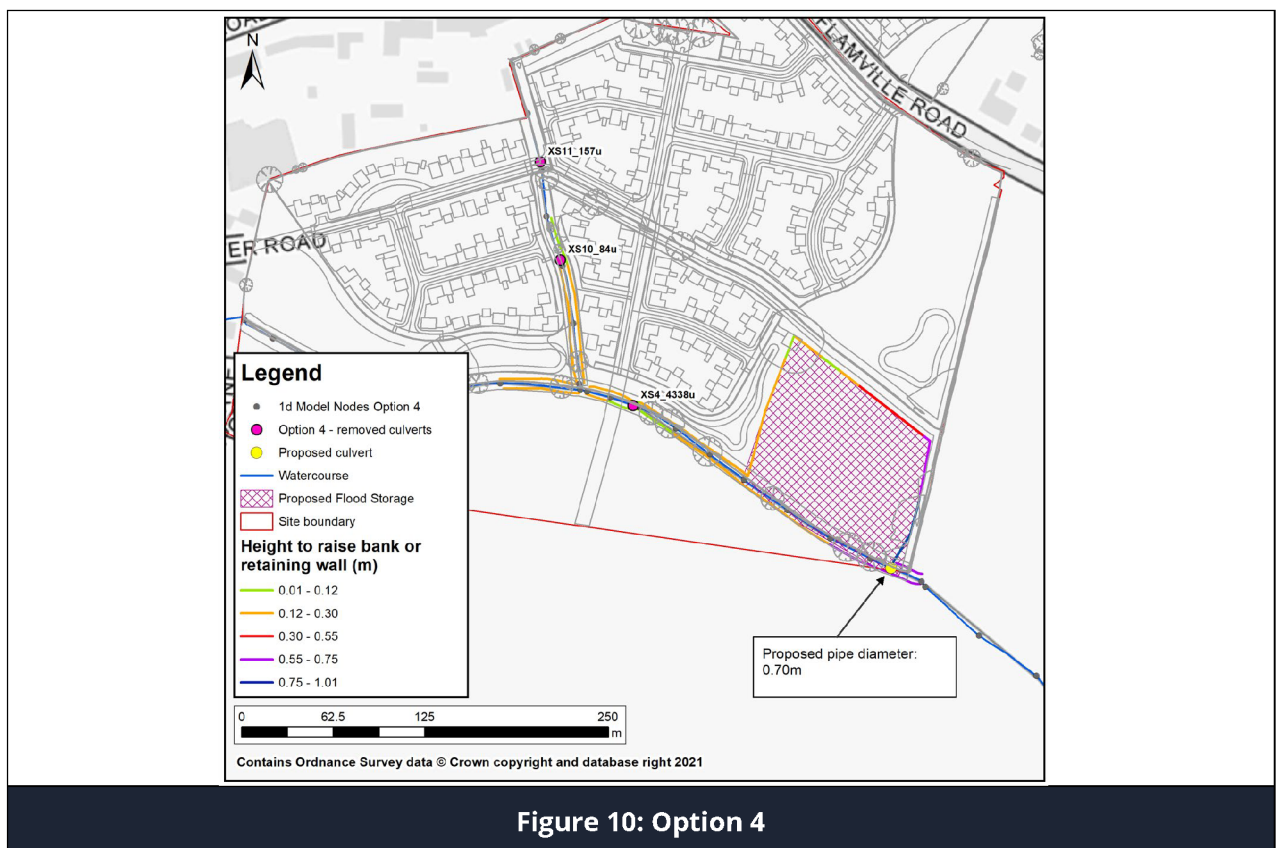
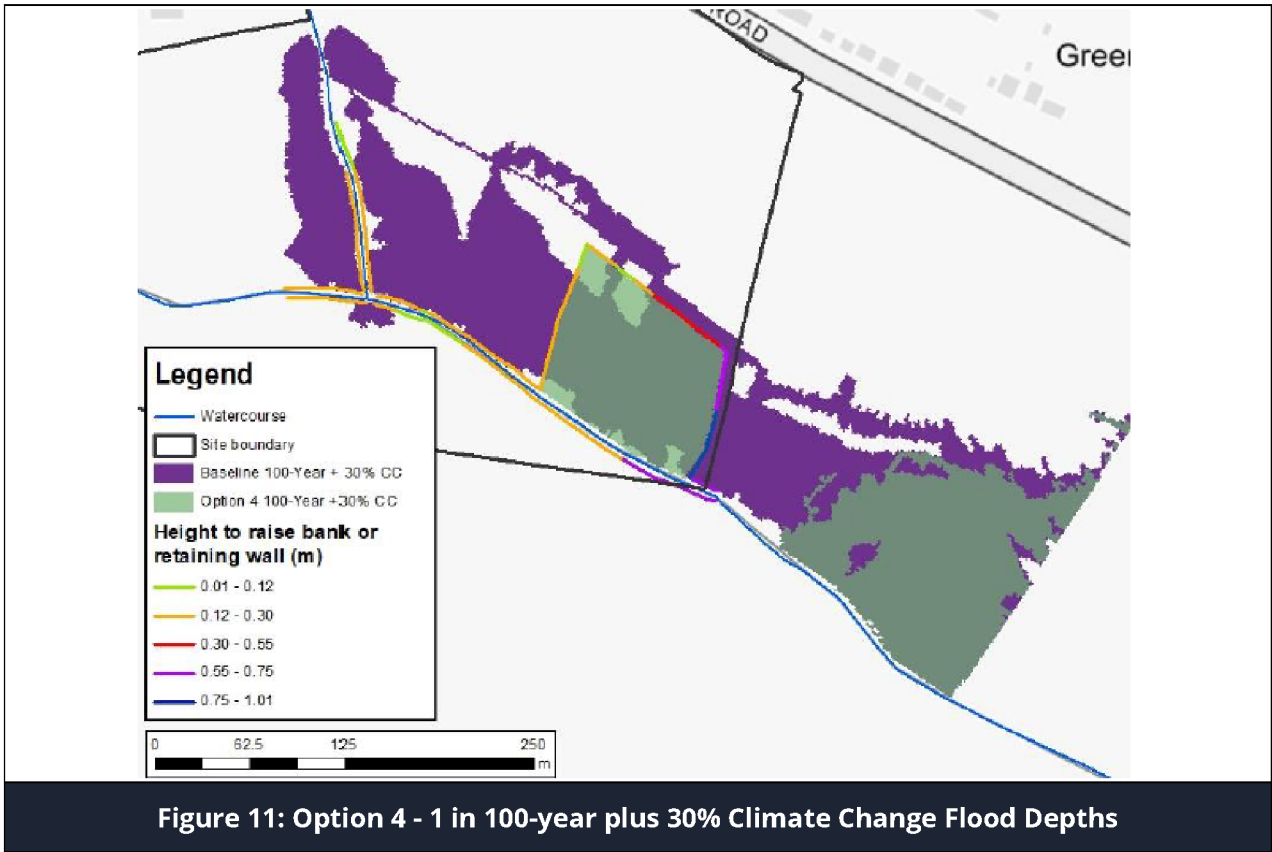
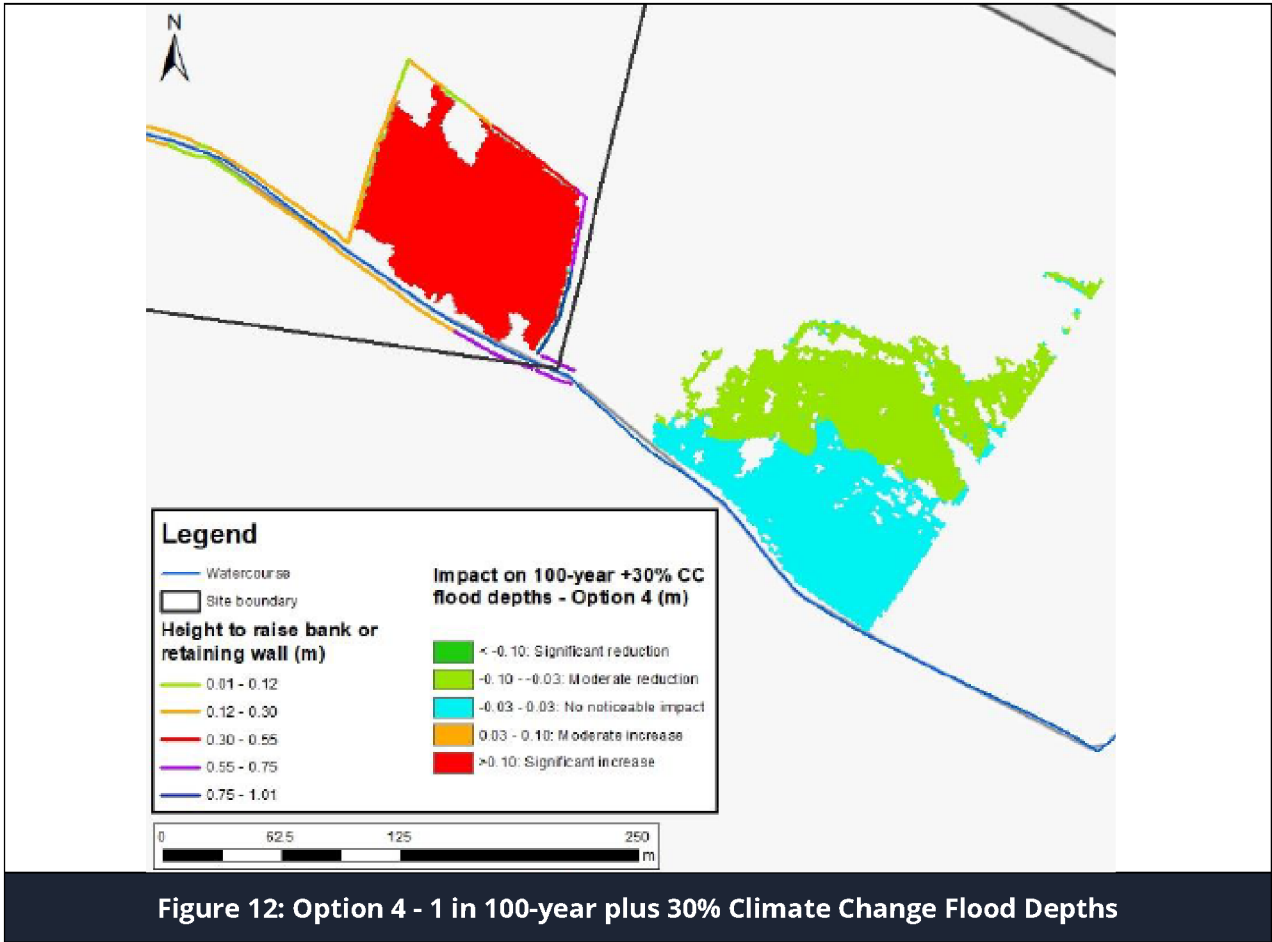


Figure 10: Option 4

7.6 As shown below in Figure 11, when Option 4 is implemented flood water (Green extent) is contained within the channel and within the Flood Storage Area. The flood extent is also reduced downstream of the site.



7.7 As shown in Figure 12, Option 4 will generally reduce flood depths downstream by up to 10cm.



Summary

- 7.8 A number of post development options were tested to reduce flood risks across the site without increasing flood risk to third party land. Option 4 has been chosen as the preferred option and this will prevent flood water from overtopping the channel of the Main Drain and Drain without increasing flood risk elsewhere. Full details of the supporting flood modelling can be found in **Appendix IV** within JBA Consulting Hydraulic Modelling Report.

8. Developer Recommendations

Option 4 - Development outside of 1 in 100-year plus 30% flood extent

- 8.1 Avison Young has worked closely with the Project Architect to ensure that the proposed development including houses and SuDS attenuation ponds are located outside of the modelled 1 in 100-year plus 30% fluvial flood extent. The modelling work was undertaken in 2021 and since the report was issued, the climate change requirements for the area has reduced to 28%. Because this offers a betterment to the modelling undertaken by JBA Consulting, we have not at this time updated the modelling.
- 8.2 As discussed within Section 7, Option 4 will be implemented to reduce flood risk across the site ensuring the proposed development falls outside of the modelled 1 in 100-year plus 30% climate change flood extent. Option 4 includes:
- The removal of three undersized culverts;
 - Raising the bank levels of the Main Drain and Drain;
 - Creating a flood storage area with a flow control structure at the southern end of the site; and
 - A 1m deep low flow channel running alongside the Flood Storage Area with a lowered left-hand bank to allow excess water to spill directly into the Flood Storage Area.
- 8.3 As shown below in Figure 13, all development has been allocated outside of the JBA Consulting's 1 in 100-year plus 30% flood outline.

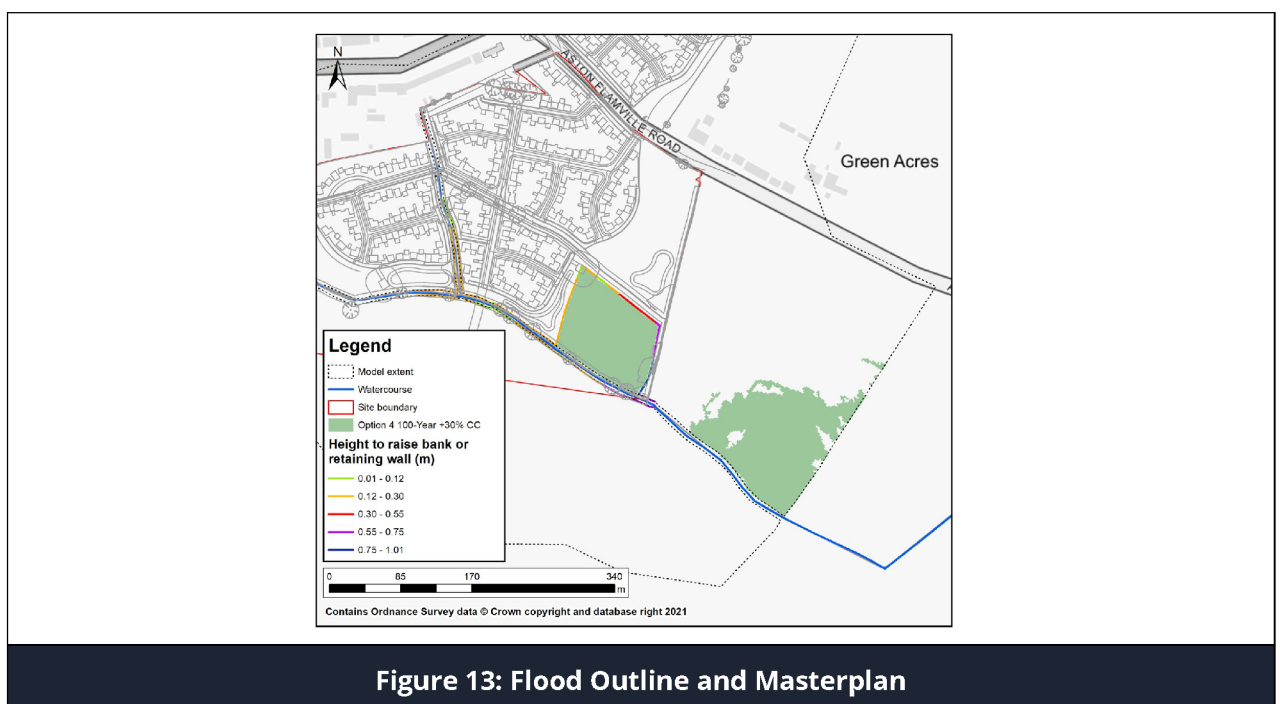


Figure 13: Flood Outline and Masterplan

Option 4 -Detailed Design

- 8.4 Detailed design will be required to support the design of the Flood Storage Area with the flow control structure, 1m deep low flow channel running alongside the Flood Storage Area and raising of the bank levels.

Finished Floor Levels

- 8.5 Option 4 shows no flooding across the development areas during a 1 in 100-year plus 30% climate change event. However, to mitigate any residual risk of flooding, we recommend that the finished floor level of the dwellings are set 300mm above ground level where they fall within the baseline scenario extent (Figure 8). This includes all dwellings within Field 3 and eastern boundary of Field 4 and the land immediately adjacent to the confluence of the Main Drain and Drain.

Ditch clearance and maintenance

- 8.6 We recommend that the Main Drain, Drain and Field Drain are cleared of dense vegetation. This work will increase the capacity of the channel and assist with the conveyance of flood water.

Culvert Removal

- 8.7 As discussed in Section 7, it is recommended that three existing culverts are removed to help with the conveyance of water. The location of the proposed culvert removal is shown in Figure 10 above.

Proposed Roads – crossing the Field Drain

- 8.8 There is a proposed access road which will cross the Field Drain (northern boundary of Field 3). It is important that this crossing does not impact the natural flow of surface water. The crossing will require a correctly sized culvert to ensure that natural flows are maintained.

Soakaway Tests

- 8.9 The drainage strategy has been designed to discharge into the network of drains, under the assumption that the soil permeability is not suitable for infiltration to discharge surface water into the ground.
- 8.10 To confirm the permeability of the soil, soakaway tests are recommended prior to the detailed design stage.

Sewer Easements

- 8.11 A minimum of a 5m easement on either side from the centre line of the existing 300mm gravity foul water sewer and pressurised public foul water sewers has been incorporated in the masterplan.

Ordinary Watercourse (Main Drain, Drain and Field Drain) Easements

- 8.12 A minimum of a 4.5m easement from the top of bank of the existing drains (Main Drain, Drain and Field Drain) has been incorporated into the masterplan.

SuDS Features

- 8.13 All SuDS features have been located outside of the 1 in 100 year plus 30% flood extent (Option 4).
- 8.14 The Flood Storage Area does not form part of the surface water drainage management.

Application for Ordinary Watercourse Land Drainage Consent

- 8.15 An application for Ordinary Watercourse Land Drainage Consent must be submitted to Leicestershire County Council to review the proposed works including the proposed drainage ditch clearance, culvert removal, installation of the culvert / bridge crossing, Flood Storage Area and any surface water outfalls. This should be done at the detailed design stage.

9. Outline Surface Water Drainage Strategy

9.1 An outline surface water drainage strategy has been prepared following the local and national guidance on sustainable drainage systems (SuDS).

9.2 In summary, the strategy proposes:

- Five individual networks to serve the development;
- The surface water drainage networks discharge into nearest drains;
- Four on-site surface water attenuation basins to limit peak discharge rates from the new drainage scheme to greenfield runoff rates; and
- The drainage scheme incorporates a combination of traditional drainage and SuDS features.

Guidance

9.3 This outline drainage strategy has been developed in accordance with the following national standards for guidance:

- Building Regulations 2010, Part H, Drainage and Waste Disposal;
- CIRIA C753, The Sustainable Drainage Systems (SuDS) Manual, 2015;
- Defra, Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage system, March 2015 (this document is regarded as the National Standards for SuDS);
- Environment Agency, Report – SC030219, Rainfall runoff management for developments, 2013; and
- Leicestershire County Council Interim LLFA Guidance Note: Planning and Development in Leicestershire; October 2018.

SuDS Design Criteria

Water Quantity

9.4 The National Standards for SuDS considers that any proposed surface water drainage system should consider flood risk to the development in the following flood events:

- The 1 in 30 year event – water should be stored in areas designated to hold and/or convey water;
- The 1 in 100 year event - flooding should not occur within any part of a building or utility plant susceptible to water unless in an area designated to hold and/or convey water; and

- Exceedance flow – events exceeding the 1 in 100 year event – so far as is reasonably practicable, flows are managed in exceedance routes that minimise the risks to people and property.

Discharge Hierarchy

9.5 The proposed surface water drainage system should follow the 'discharge hierarchy' as stated in the Buildings Regulations (Part H). The surface run-off should be disposed of as high up the hierarchy as is reasonably practicable:

- Infiltration and reuse
- Surface water body
- Surface water sewer, highway drain, or another drainage system
- Combined sewer

Water Quality

9.6 The pollution indices approach for discharge to surface water as outlined in Chapter 26 of the CIRIA SuDS Manual (C753) has been used to select suitable SuDS components to ensure water quality of the surface water discharge effluents.

9.7 Based on the Table 26.2 CIRIA SuDS Manual (C753), the pollution hazard indices for residential roofs are 'very low' and for the access roads and driveways are considered as 'low' (see table below).

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Individual property driveways, general access roads	Low	0.5	0.4	0.4

9.8 Based on the above, the recommendations included in the Table 26.3 in Chapter 26 of the CIRIA SuDS Manual (C753), the following SuDS components are considered suitable to ensure water quality of the surface water run-off from the roads:

- Swale/vegetated channels;
- Bio-retention system;
- Permeable pavement;
- Detention basin;

- Pond; and
- Wetland.

Amenity and Biodiversity

- 9.9 Any SuDS scheme should be integrated with the landscape plan of the development to enhance amenity value. In addition, SuDS should be designed to improve biodiversity whenever possible.

Basis of Design

- 9.10 The strategy has been designed, taking into account the following:

Permeable / Impermeable Areas

- 9.11 The total site area is 16ha, with a developable area of 9.85ha. The proposals will introduce an impermeable area that is approximately 40% of the 9.85ha developable area. Therefore, impermeable areas will total approximately 4.0ha. This will increase both the rate and volume of surface water run-off compared with its existing condition. This additional surface water needs to be managed through the use of SuDS, so that it does not exacerbate or create new flood risk elsewhere during the intended lifetime of the development.

Overland Flow Risk

- 9.12 The slightly elevated topography, compared to surrounding areas, of Field 1 restricts overland flow entering this field. The Environment Agency Surface Water Flood Map does not show any surface water flow entering the site from surrounding land.
- 9.13 However, the Environment Agency Surface Water Flood Map shows surface water overland flow in Field 4 entering from the west and in Field 2 and 3 entering from the north. These overland flow routes follow the channels of the existing drains. The development retains these drains as open channels with proposed modification to improve the existing drainage capacity.
- 9.14 Therefore, this outline drainage strategy has been developed to manage surface water generated from the proposed development only.

Proposed Flood Storage Area

- 9.15 The drainage strategy takes into consideration the location and details of the proposed flood storage area. The surface water drainage scheme proposes separate surface water attenuation basins to minimise impact on the proposed flood mitigation/improvement measures.

Preferred Option for Surface Water Discharge

- 9.16 No ground investigation or soakaway tests have been carried out at this outline stage to confirm the soil permeability rates. However, as discussed in Section 3, the geology of the site is likely to be underlain by Bosworth Clay Member and Mudstone at greater depth. Therefore, the option of infiltration to discharge surface water into the ground is unlikely to be feasible. However, beneath the Bosworth Clay Member, sand and gravel is likely to be present which may provide opportunities for use of soakaways at a smaller scale, although this strata may contain groundwater limiting its effectiveness for soakaways. It is recommended that soakaway tests are carried out during the detailed design stage to identify soil infiltration rate and depth to groundwater. Should the tests prove successful, the option of surface water discharge into the ground via infiltration should be considered as the preferred surface water discharge option.
- 9.17 At this stage, it is proposed that surface water from the proposed development is discharged into the existing drains with on-site attenuation to limit peak discharge rate to greenfield runoff rates.

Urban Creep

- 9.18 Leicestershire County Council Interim LLFA Guidance Note: Planning and Development in Leicestershire; October 2018 recommends using a 10% allowance in hydraulic calculation for urban creep. Therefore, in the hydraulic calculations and shown on the new Catchment Area Plan, the drainage catchment area has been increased by 10%.

Estimation of Greenfield Rates

- 9.19 Based on the topography of the site, the overall development area is divided into 5 drainage catchments with individual outfalls into the nearby drains. For the ease of reference, these networks are numbered as Network 1, 2, 3, 4 and 5. Networks 1 and 2 cover the development areas proposed in Field 4 (western development parcel), whilst Networks 3 and 4 represent drainage catchment areas for Fields 2 and 3 (the central development parcel). Network 5 covers the development parcel in Field 1 (north).
- 9.20 The mean annual greenfield peak flow rates (Q_{bar}) for the individual catchments have been estimated based on the proposed impermeable areas (within each catchment) using MicroDrainage design software based on Interim Code of Practice (ICP) SuDS. For smaller catchments where the estimate Q_{bar} is less than 5l/s, a minimum value of 5l/s is used to avoid frequent blockages in flow control devices. This is in line with the recommendations in the Leicestershire County Council Interim LLFA Guidance Note: Planning and Development in Leicestershire; October 2018. The following table shows

the estimated allowable peak discharge rates. The estimated impermeable areas include a 10% allowance for urban creep.

Network	Impermeable area (ha)	Actual Qbar (l/s)	Maximum peak greenfield rates (l/s)
1	1.12	4.9	5
2	0.076	0.8	5
3	1.16	5.1	5.1
4	1.03	4.5	5
5	1.26	5.5	5.5
TOTAL	4.64	20.80	25.6

9.21 A copy of the MicroDrainage greenfield run-off calculations are included in **Appendix V**.

Proposed of Surface Water Drainage System

- 9.22 The proposed surface water system comprises a combination of a traditional pipe network and various SuDS features to ensure surface water run-off from the impermeable areas of the development is properly managed.
- 9.23 Rainwater that falls on the roofs of the houses will initially be collected in high level rainwater gutters and then drained by rainwater pipes. The rainwater pipes will discharge to the main below ground carrier drain which will be located within the access roads.
- 9.24 The access roads will be drained by traditional kerb and gully arrangements. The road gullies will be connected to the main carrier drains. Main carrier drains will convey the surface water into the proposed SuDS attenuation basins located towards lower part of the respective catchments.
- 9.25 Peak discharges from the above SuDS ponds will be controlled in flow control chambers by Hydrobrakes or similar vortex flow control devices.
- 9.26 It is recommended that following site-specific soakaway test results, permeable paving is considered for private access roads and driveways which will allow partial infiltration of surface water into the ground and this will also provide source control and water quality improvement. In addition to permeable paving, it is recommended that rainwater harvesting in the form of water butts should be used for individual houses.

9.27 A layout of the proposed Surface Water Drainage Strategy has been included in **Appendix VI**.

Attenuation Storage Estimate

9.28 The proposed below ground surface water drainage networks have been modelled using MicroDrainage drainage design software. A climate change allowance of 40% for peak rainfall intensity has been used for estimating surface water attenuation for the 1 in 100 year storm event. This is based on the recommendation available online.²

9.29 In accordance with the National Standards for SuDS, the MicroDrainage model confirms that the proposed surface water drainage does not surcharge during a 1 year storm, no surface flooding occurs during a 30 year storm event, and flood water is contained in the SuDS ponds during a 100 year storm events (plus 40% climate change allowance) with storm durations from 15 minutes to 1440 minutes. However, for the highest intensity rainfall event, some temporary localised flooding is expected towards the lower parts of the catchments. This flooding will be contained within the highway corridor or will be allowed to runoff directly into the local ditch network without impacting on any dwellings.

9.30 The required and provided surface water attenuation volumes for a 1 in 100 year plus 40% climate change event for the individual networks are presented in the following table.

Network reference	Impermeable area drained (including 10% for Urban Creep) (ha)	Allowable Peak discharge rates (l/s)	Attenuation Volume Required (m ³)	Attenuation Volume Provided (m ³)
Network 1	1.23	5	841	1186
Network 2	0.084	5	11.28	23.3*
Network 3	1.23	5.1	650	850
Network 4	1.13	5	789	2549
Network 5	1.39	5.5	1072	1638

*Attenuation for Network 2 is provided in the pipe network.

9.31 Copies of the MicroDrainage model results are included in **Appendix V**.

² <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

Design for Exceedance

- 9.32 The surface water drainage strategy has taken into consideration the potential for 'exceedance flows' in its formulation. Flood events up to the 100 year plus 40% climate change event will be drained by the proposed drainage system reducing the hazard to people and risk of property flooding.
- 9.33 Should exceedance of the drainage system occur in an event greater than the design envisaged or in the case of a blockage, the finished ground levels will be carefully designed to route overland flows away from the proposed houses. Overland flows should be directed towards the access roads, which should route flows towards the SuDS attenuation basins and finally discharging into the existing drains.
- 9.34 The exceedance flow routes are shown in the proposed Drainage Strategy layout drawing included in **Appendix VI**. Please note that flooding may be shown as occurring along pipe lengths where additional storage will be created in upstream pipe work that will be designed during the detailed design stage of the development.

Water Quality - SuDS Treatment Train

- 9.35 The pollution potential from residential development is low. The proposed SuDS attenuation basins will improve the quality of surface water run-off prior to discharging into the existing drains.
- 9.36 During construction, mitigation measures will need to be implemented to prevent pollution to the land drains. The guidance within the CIRIA environmental good practice on site guide should be used together with standard pollution prevention measures.

Amenity and Biodiversity

- 9.37 The proposed SuDS attenuation basins are integrated with the proposed landscaped plan and have been developed in liaison with the project landscape architect.
- 9.38 The above will improve amenity and biodiversity. The drainage layout is carefully designed to avoid existing and proposed extent of tree canopies to ensure minimum disruption to trees during construction and operational period of the proposed drainage scheme.

SuDS Maintenance Requirements

- 9.39 The new surface water drainage system should be detailed to reduce the need for maintenance as far as is reasonably practicable. To facilitate maintenance and repair of drainage features, the main drainage carrier drains are sited either within highway corridors or public open space.

- 9.40 The proposed surface water drainage network will be offered to Severn Trent Water for adoption. The maintenance of the above ground SuDS attenuation basins and private sewers will be maintained by a management company to ensure that they are maintained throughout the lifetime of the development.
- 9.41 The following maintenance regime should be implemented for all on-site private drainage structures/sewers.
- Gutters, rainwater pipes, outlets and gullies should be inspected and thoroughly cleaned once a year;
 - All manholes should be inspected once a year and where necessary cleaned out at the same time. Any defects to the brickworks or benching cover to frame should be made good. Attention should be made to the Confined Spaces Regulations 1997 and the provisions contained therein for access to confined spaces. Details for entering manholes are contained in the above legislation; and
 - The flow control device should be inspected and maintained as per the recommendations of the manufacturers. In addition, a regular visual inspection is recommended monthly to assess the performance and frequent cleaning undertaken (if required).

Health and Safety Requirements

- 9.42 The details of the new surface water drainage system will be designed with consideration to minimise health and safety risk to the public and to maintenance staff.
- 9.43 All access points to the below ground drainage structures, sewers, inlet, outlets and outfalls will be designed to be easily accessible and in accordance with the relevant standards to minimise risks to the public and the maintenance personnel.
- 9.44 The side slopes of the SuDS attenuation basins will be designed with a side slope of 1 in 3 or flatter. Due to relatively flat topography of the site, the maximum depth of the basins are kept to 1.25m. In addition, access to these basins by the public will be protected by timber fences around the perimeter. A maintenance strip of 2m will be provided around the basins.

The Lead Local Flood Authority (LLFA) Requirements

- 9.45 The proposed outfalls into the existing ditch network will require Land Drainage Consents from the LLFA.

9.46 Access for the LLFA and their contractors for maintenance of all the ditches, proposed and existing culverts on the site will have to be available at all times. The Maintenance Access Plan attached at **Appendix VI** identifies points of access that should be provided.

10. Outline Foul Water Drainage Strategy

- 10.1 Foul water from the proposed residential dwellings will be drained by a separate foul water drainage system. This foul water drainage system will discharge into the existing public foul water sewers located within or in close proximity of the site.
- 10.2 Due to the topography and location of public foul water sewers, three separate foul water drainage networks are proposed. The network proposed to serve the residential houses to the west of the development (Field 4) will discharge into the 300mm diameter public foul water sewer located towards the northern part of this parcel. Due to the topography of the site, a foul water pumping station will be required to drain the lower part of the site. This pumping station is proposed to be located to the south of the development parcel in Field 4.
- 10.3 Foul water from residential houses in the central parcel of land (Fields 2 and 3) will also discharge into the above 300mm diameter public foul water sewer but at a downstream manhole. A second foul water pumping station is proposed at the lower part of this area to make the proposed connection.
- 10.4 Foul water from residential houses in the north-eastern parcel of land (Field 1) will discharge into the 300mm diameter public combined sewer in Aston Flamville Road. Similar to the above two networks, third foul water pumping station will be required to make the proposed connection into the public sewer. However, it may be possible to connect by gravity directly into the existing Severn Trent Water pumping station off Sapcote Road, which is located immediately north of Field 2.
- 10.5 A pre-development enquiry response (**Appendix VII**) from Severn Trent Water has confirmed that the existing sewerage network has adequate capacity to serve the proposed residential development. Severn Trent Water has not commented on the provision of a direct connection into the existing pumping station in Sapcote Road. It is recommended that further liaison with Severn Trent Water is undertaken to investigate the feasibility of this option. Should this be acceptable, the proposed foul water pumping station for this parcel of development will not be required.
- 10.6 The new foul water drainage scheme will be offered to Severn Trent Water for adoption under Section 104 of the Water Industry Act 1991.
- 10.7 The proposed foul water connections into the public foul water sewers will require an application to Severn Trent Water under Section 106 of the Water Industry Act 1991.
- 10.8 A copy of the proposed foul water drainage strategy layout is included in **Appendix VI**.

Health and Safety Requirements

- 10.9 The details of the new foul water drainage system will be designed with consideration to minimise health and safety risk to the public and to maintenance staff.
- 10.10 The depth of the foul water sewer will be designed as shallow as reasonably practicable and to comply with Severn Trent Water adoptable standard. All access points to the below ground drainage structures/sewers shall be designed to be easily accessible and in accordance with the relevant standards to minimise risks to the public and the operation personnel.

11. Conclusion

- 11.1 Avison Young was instructed by Jelson Limited (the Client) to undertake a Flood Risk Assessment and Outline Drainage Strategy to support a planning application for residential development.
- 11.2 The Flood Risk Assessment and Outline Drainage Strategy has been prepared in accordance with the National Planning Policy Framework and national and local policies on SuDS in respect of the proposed scheme of development.

Flood Risk

- 11.3 Following the completion of this assessment, the following conclusions can be drawn:
- The Environment Agency Flood Maps show that the site is located within 'Flood Zone 1' and is at 'Very Low Risk' of flooding. In accordance with National Planning Policy Framework 'more vulnerable' development types are deemed appropriate within Flood Zone 1.
 - A small network of land drains run through the site. The recently revised Hinckley and Bosworth Borough Council Level 2 Strategic Flood Risk Assessment (May 2020) has provided high level flood modelling which has included flood risk from the Main Drain and Drain located on site. The results show that the central and south-eastern portion of the site is at flood risk. In accordance with the SFRA and to help understand the risk associated with the watercourses, JBA Consulting was commissioned to undertake a detailed hydraulic flood modelling study to further understand flood risk associated with the above land drains and to identify mitigation measures required to reduce flood risk to the development area.
 - The detailed modelling results show that the flood extent is similar to the SFRA, however, flood depths are generally shallow, ranging from 1cm to 15cm.
 - To reduce the flood extent across the development area, various flood mitigation options have been tested to reduce flood risk without increasing flooding risk elsewhere. A solution has been identified which includes:
 - The removal of three undersized culverts;
 - Raising the bank levels of the Main Drain and Drain;
 - Creating a flood storage area with a flow control structure at the southern end of the site; and

- A 1m deep low flow channel running alongside the Flood Storage Area with a lowered left-hand bank to allow excess water to spill directly into the Flood Storage Area.
- Post development modelling shows that by incorporating the above measures, all development falls outside of the 1 in 100-year plus 30% flood outline and flood risk is reduced downstream.
- We have made a number of flood risk developer recommendations which can be found in Section 8.
- In terms of other forms of flooding there is a low or very low flood risk to the whole site from surface water , groundwater, artificial sources and sewer flooding.

Surface Water Drainage Strategy

- 11.4 The surface water drainage strategy proposes a separate surface water drainage system that discharges to the existing ditches with peak flow limited to greenfield flow rates by attenuating surface water run-off within SuDS attenuation basins.
- 11.5 The proposed surface water drainage system comprises a combination of traditional pipe network and various SuDS features to ensure surface water run-off from the impermeable areas of the development is properly managed and treated.
- 11.6 To minimise flood risk to the site and elsewhere, surface water attenuation basins and flow control devices have been proposed to manage surface water run-off within the site for storm events up to 1 in 100 year plus 40% allowance for climate change events.
- 11.7 The development proposes to retain the existing drains as open channels with recommendations for mitigation measures to improve existing drainage conditions.
- 11.8 We consider that the proposed SuDS scheme will not increase risk of surface water flooding to the site and elsewhere.
- 11.9 The proposed outfalls into the existing drains will require land drainage consents from the LLFA.

Foul Water Drainage Strategy

- 11.10 The foul water drainage strategy proposes a separate foul water drainage network that discharges to the existing public foul water and combined sewers located within and in close proximity of the site subject to formal agreement with Severn Trent Water under the Water Industry Act 1991. Due to the topography of the site, pumping of foul water will be required to discharge foul water into public sewers.

11.11 A pre-development enquiry response from Severn Trent Water has confirmed that the existing sewerage network has adequate capacity to serve the proposed residential development. For the development parcel of land to the north (Field 1), it is recommended that further consultation with Severn Trent Water is undertaken to investigate the option of a gravity connection directly into their foul water pumping station in Sapcote Road.

Contact Details

Enquiries

Paul Nixon BSc MSc LLM - Director

0121 609 8226

paul.nixon@avisonyoung.com

Visit us online

avisonyoung.co.uk