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Proposed Mixed-Use Development Land south of Station Road Market Bosworth Leicestershire CV13 0PD

Flood Risk Assessment and Drainage Strategy

Revision C: August 2024
R-FRA-26417-01-C

Registered office

NORTHAMPTON

Grand Union Works
Whilton Locks
Daventry, Northamptonshire
NN11 2NH
T: 01604 781811

T01-7

MILTON KEYNES

B2A, Denbigh Business Park
23 First Avenue
Denbigh
Milton Keynes | MK1 1DN
T: 01908 889433

POOLE

Suite 8 Branksome Park
Branksome Business Park
Bourne Valley Road | Poole
Dorset | BH12 1ED
T: 01202 540888



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PP Consulting Ltd., Grand Union Works, Whilton Locks, Daventry, Northamptonshire, NN11 2NH		
T: 01604 781811	E: mail@jppuk.net	W: jppuk.net
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Report Originators		
Prepared by		
	Josh Beverly Technician 	
Reviewed by		
	Katherine Rose BSc (Hons) MEnvSc MCIHT <u>Associate</u> 	

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1.0 Introduction

1.1 Background

1.1.1 This report is a Flood Risk Assessment and Drainage Strategy which has been prepared by JPP Consulting Limited on behalf of Miller Homes for a proposed residential development. The benefit of this report is to our instructing Client.

1.1.2 The proposed residential development is located at Station Road, Market Bosworth, as shown in Figure 1.1 below. Market Bosworth is located west of Leicester and north of Hinckley and Nuneaton. The National Grid Reference for the site is E439450 N302950. The proposed development has a total development area of approximately 4.4ha, of which approximately 3.5ha will be positively drained.

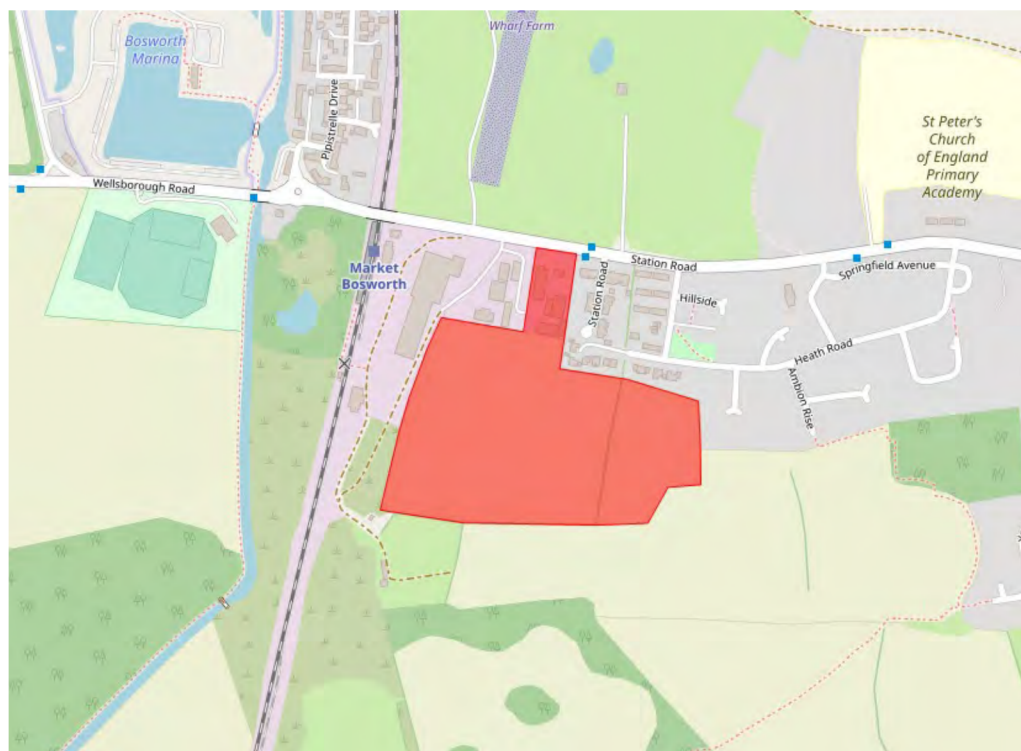


Figure 1.1 Site Location Plan

Source: OpenStreetMap

Obtained: 16/10/2023

1.2 Objectives

1.2.1 The objective of this report is to advise interested parties regarding the potential risk of flooding and the management of surface water run-off arising from the proposals.

1.2.2 This report has been prepared to support a planning application.

1.3 Reference documents

1.3.1 This report has been prepared with reference to the following publications:-

- Ministry of Housing, Communities and Local Government (March 2012, updated July 2021), National Planning Policy Framework
- Ministry of Housing, Communities and Local Government (March 2014, updated August 2021), Planning Practice Guidance 'Flood Risk and Coastal Change'
- Department for Environment, Food and Rural Affairs (March 2015), Non-statutory technical standards for sustainable drainage systems
- Environment Agency (September 2013), Climate Change Allowances for Planners: Guidance to support the National Planning Policy Framework
- Environment Agency (October 2013), Delivering benefits through evidence: Rainfall runoff management for developments
- HM Government (2010), The Building Regulations (2010), Drainage and Waste Disposal, Approved Document H, The NBS, Newcastle Upon Tyne
- Wilson, Bray, Cooper (2004), Sustainable drainage systems: Hydraulic, structural and water quality advise, C609, CIRIA, London
- Woods-Ballard et al (2015), The SUDS Manual, C753, CIRIA, London
- CIRIA Report C624 Development and flood risk
- National SUDS Working Group (2004), Interim Code of Practice for Sustainable Drainage Systems,
- Institute of Hydrology (1999), Flood Estimation Handbook, Institute of Hydrology, Wallingford
- BS EN 752:2008 Drain and sewer systems outside buildings. Hydraulic design and environmental considerations
- BS 8533:2011 Assessing and managing flood risk in development – Code of Practice
- CIRIA Report C635 Designing for exceedance in urban drainage – good practice
- Strategic Flood Risk Assessment for Hinckley and Bosworth Borough Council (July 2019)

1.4 Report History

1.4.1 This report has been revised (Revision C) to suit a new and updated drainage strategy layout. All changes and updates within the report are shown by the vertical line in the right-hand margin.

2.0 Description and history of the site and development proposals

2.1 Location and description of the site

- 2.1.1 The proposed mixed-use development is located at Station Road, Market Bosworth, as shown in Figure 1.1 above. The site is bound by existing residential dwellings to the north and north-east, agricultural fields to the east and south, and commercial units to the west with Market Bosworth railway station beyond.

2.2 History of the site

- 2.2.1 The site is currently agricultural fields, as shown on the topographical survey enclosed in **Appendix A**. We are not aware of any previous development on the site.
- 2.2.2 Aerial imagery dating back to December 2000 shows that the site was comparable at this time, see Figure 2.1 below.



*Figure 2.1 Aerial imagery dated December 2000
Obtained: Google Earth Pro 16/10/2023*

2.3 Proposed development

- 2.3.1 The proposed mixed-use development will comprise 140 residential dwellings and 0.55ha of employment use, along with landscaping, public open space, drainage infrastructure and a new access. The proposed development layout is shown on the plan enclosed in **Appendix B**.

2.4 Site topography

- 2.4.1 The topographical survey indicates that site levels fall from east (at approximately 107.0m) towards the south-west (lowest point of approximately 94.5m). The topographical survey is shown on the plan enclosed in **Appendix A**.

2.5 Existing drainage infrastructure

- 2.5.1 Severn Trent's asset plan is enclosed in **Appendix C**, which identifies surface water, combined water and foul water sewers.
- 2.5.2 A surface water sewer network is identified to the north-east of the site, associated with the dwellings along Heath Road. This network is shown to outfall at the northern site boundary, at the point where the topographical survey shows an existing ditch crossing the site. This follows the existing field boundary, which crosses the site in a north to south orientation. The ditch then turns west to follow the site's southern boundary.
- 2.5.3 It can be identified that a foul water sewer and a combined water sewer both run across the site. The combined sewer runs from the northern boundary of the site (MH4001) to the southern boundary of the site (MH3800), having a pipe diameter of 300mm. The foul water sewer crosses the site from the north-east and connects to the combined water sewer at MH4901; the foul water sewer starts at the northern boundary of the site at MH5006 having a pipe diameter of 150mm. A foul sewer also runs along the southern boundary of the site heading westbound, also connecting to MH3800, having a pipe diameter of 225mm. This foul water system connects to a foul water pumping station to the south-west of the site, from where a 225mm diameter pressure combined sewer is shown to the west of the site, heading northbound.

2.6 Geology of the site and ground investigation data

- 2.6.1 Inspection of the geological maps show that the superficial deposits at the site are Glaciofluvial Deposits comprising Sand and Gravel, Oadby Member and Bosworth Clay Member comprising Clay and Silt. The bedrock geology which underlies the site is Gunthorpe Member comprising Mudstone.
- 2.6.2 JPP Geotechnical and Environmental are undertaking a Phase 1 Desk Study for the site, which will be followed in due course by a Phase 2 Ground Investigation.

2.7 Development proposals and flood risk vulnerability

2.7.1 With reference to Annex 3 of the Flood Risk and Coastal Change Planning Practice Guidance (PPG) to the National Planning Policy Framework (NPPF), the proposed residential development would be classed as a More Vulnerable development, whilst the commercial area identified in the western area of the site would be classed as Less Vulnerable development.

2.7.2 An extract from Annex 3 of the PPG for Flood Risk and Coastal Change is replicated below in Table 2.1 with the proposed development type highlighted.

Flood Risk Vulnerability Classification	
Vulnerability	Development Types
More Vulnerable	Hospitals.
	Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
	Buildings used for dwelling houses , student halls of residence, drinking establishments, nightclubs and hotels.
	Non-residential uses for health services, nurseries and educational establishments.
	Landfill and site used for waste management facilities for hazardous waste.
Less Vulnerable	Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
	Police, ambulance and fire stations which are not required to be operational during flooding.
	Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution ; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure.
	Land and buildings used for agriculture and forestry.
	Waste treatment (except landfill and hazardous waste facilities).
	Minerals working and processing (except for sand and gravel working).
	Water treatment works which do not need to remain operational during times of flood.
	Sewage treatment works, if adequate measures to control pollution and manage sewage during flood events are in place.
Source: National Planning Policy Framework - 2012	

Table 2.1 Flood Risk Vulnerability Classification

3.0 Flood risk

3.1 Fluvial / Tidal flooding

- 3.1.1 An extract of the Environment Agency's Flood Map for Planning (Rivers and Sea) is provided below in Figure 3.1. The flood map was extracted from the GOV.UK website on 16/10/2023. The approximate application site boundary is shown in red. The map indicates that the development site is located within Flood Zone 1 (Low Probability) and as such, the report considers the development to be in Flood Zone 1 and at a low risk of flooding from rivers or the sea.



Figure 3.1 Flood Map for Planning (Rivers and Sea)
Source: GOV.UK website - 16/10/2023

3.1.2 Table 3.1 below is a copy of Table 1 from Planning Practice Guidance for '*Flood Risk and Coastal Change*' to the National Planning Policy Framework which defines Flood Zones. The proposed development, which is located within Flood Zone 1, is defined as having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Flood Zone Definitions	
Flood Zone	Definition
Zone 1: Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding.
Zone 2: Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.
Zone 3a: High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding.
Zone 3b: The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.
Source: Planning Practice Guidance - 2014	

Table 3.1 Flood Zone Definitions

3.2 Flooding from surface water

- 3.2.1 An extract of the Environment Agency map 'Risk of Flooding from Surface Water' is provided below in Figure 3.2. The approximate application site boundary is shown in red. The majority of the site is shown to be located at a very low (less than 1 in 1000) risk of surface water flooding in a given year.
- 3.2.2 A surface water flow route is shown to cross the site at a low (1 in 100 to 1 in 1000) and medium (1 in 30 to 1 in 100) risk of surface water flooding in a given year. This route is shown to flow from north-east to south-west. This route is considered to be associated with the existing watercourse that crosses the site, as discussed in Section 2.5 above.
- 3.2.3 A surface water flow route is shown to the south of the site, flowing from east to west. This route is shown to be at a low, medium and high (greater than 1 in 30) risk of surface water flooding in a given year.

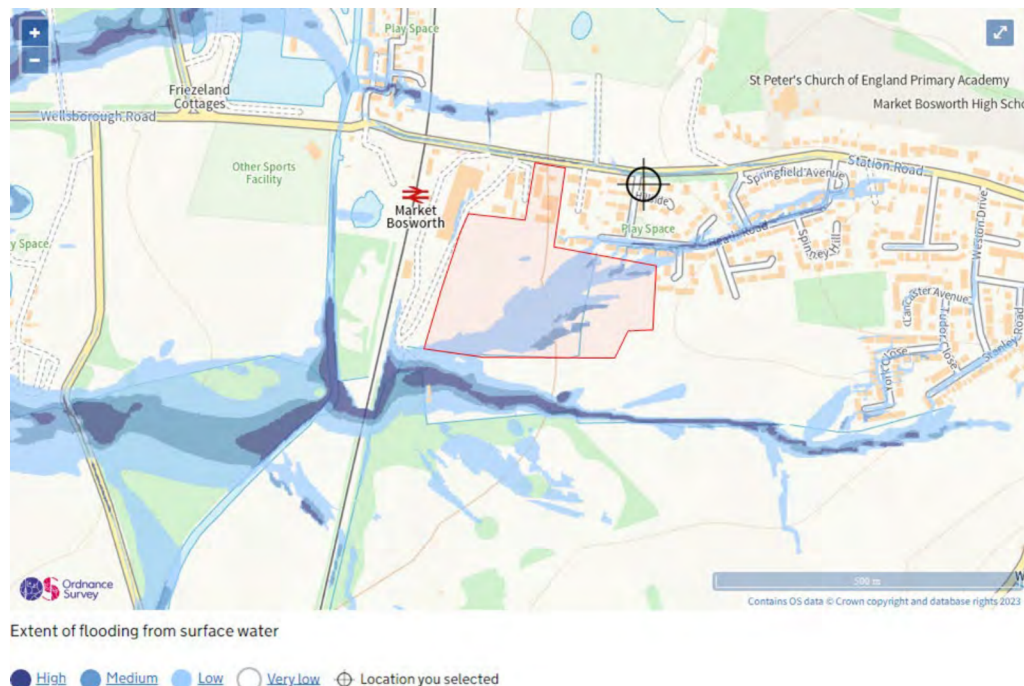


Figure 3.2 Risk of Flooding from Surface Water
Source: GOV.UK website – 16/10/2023

- 3.2.4 It should be noted that this map is generated using a broad methodology applied at the national scale. The model utilises generalised information on infiltration, sewerage infrastructure, rainfall events and catchment topography to route rainfall over a ground surface model. As such, the analysis does not take account of site-scale factors / characteristics that may exert an influence upon surface water flood depths and extents. The map therefore only provides a guide regarding the areas that may be vulnerable to this source of flooding.

3.2.5 The existing watercourse that crosses the site from north to south will be retained post-development. The watercourse will be culverted where required to facilitate the proposed internal road.

3.2.6 The levels of the site will be designed such that the dwellings are not at risk of surface water flooding.

3.3 Flooding from groundwater

3.3.1 The Strategic Flood Risk Assessment (SFRA) for Hinckley and Bosworth Borough Council has been reviewed with regards to groundwater flooding. The Areas Susceptible to Groundwater Flooding Map shows *“the proportion of each 1km grid square where geological and hydrogeological conditions shown that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring”*.

3.3.2 As shown on the map extract enclosed in **Appendix D**, the majority of the site is shown to be located within a 1km grid square within the “25% to 50%” category. The northern-most part of the site, adjacent to Station Road, is shown to be located within a 1km grid square within the “less than 25%” category.

3.3.3 The information available at the time of preparing this report, and the nature of the underlying geology, suggests that groundwater emergence at the surface is unlikely, such that groundwater flood risk does not constitute a constraint in this instance.

3.4 Flooding from sewers

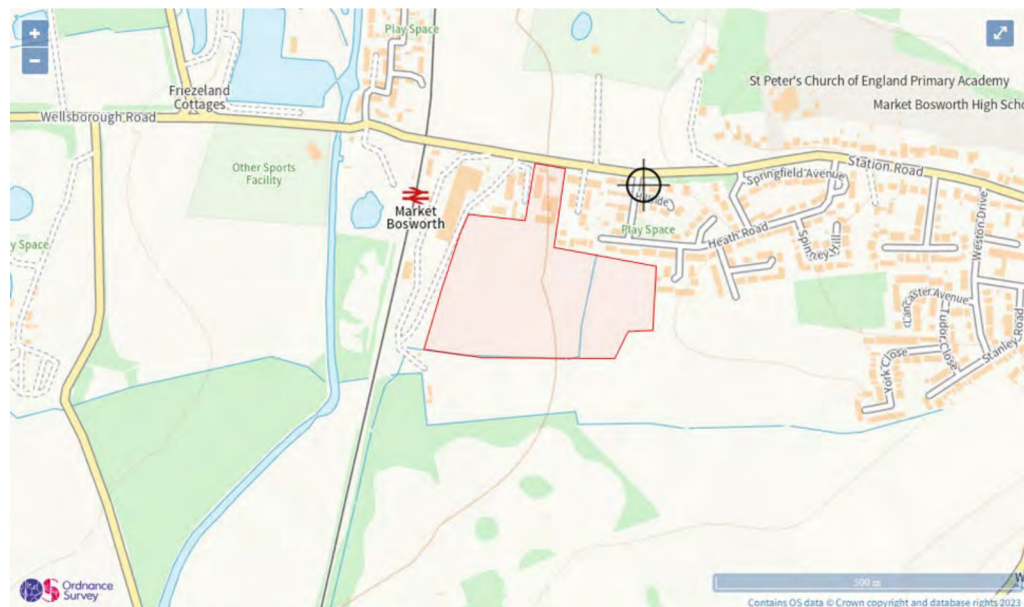
3.4.1 Severn Trent’s asset plan is enclosed in **Appendix C**. There are existing sewers identified within a near to the site, details for which are set out in Section 2.4.1 above.

3.4.2 We do not have any records of sewer flooding within the vicinity of the proposed development.

3.4.3 We therefore do not consider the risk of flooding from sewers to be a significant risk to the proposed development.

3.5 Flooding from reservoirs, canals and other artificial sources

- 3.5.1 We are not aware of any canals or artificial water sources that may result in flooding of this site.
- 3.5.2 The EA provides maps (<https://flood-warning-information.service.gov.uk/long-term-flood-risk/>) showing the area that may be affected by flooding as a result of a breach of a large, raised reservoir (i.e. capable of storing over 25,000 cubic metres of water above the natural level of any part of the surrounding land).
- 3.5.3 An extract of the Environment Agency map 'Risk of Flooding from Reservoirs' is provided below in Figure 3.3. It can be seen that the proposed development site, shown in red, is not at a risk of flooding from reservoirs.



Maximum extent of flooding from reservoirs:

● when river levels are normal ● when there is also flooding from rivers ● Location you selected

Figure 3.3 Risk of Flooding from Reservoirs

Source: GOV.UK website - 16/10/2023

- 3.5.4 It can therefore be concluded that the risk of flooding from reservoirs and other artificial sources is low.

3.6 Historic flooding

3.6.1 With reference to the SFRA for Hinckley and Bosworth Borough Council, Figure 5-2 of the report displays a map of the historical flood incidents within Hinckley and Bosworth Borough, in the following categories:

- Separate
- 09/03/2016
- 14-15/01/2014
- 15-16/06/2016
- 22-23/01/2018
- 27/07/2013

3.6.2 One record is identified within Market Bosworth, within the 15-16/06/2016 category. The location of this flood incident is not shown within the vicinity of the site. This map is enclosed in **Appendix E**.

3.6.3 Shown below in Figure 3.4 is a historical flood map data set that has been collated by the Environment Agency. As demonstrated, there are no notified historic flooding events within or around the proposed site development area, including the whole of Market Bosworth.

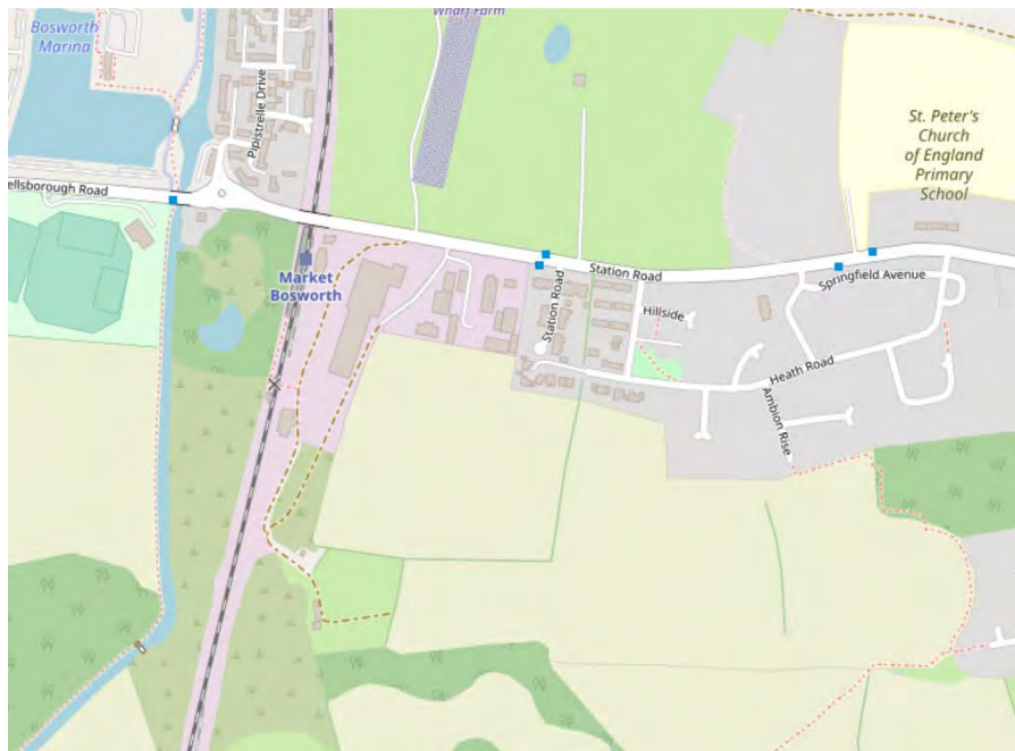


Figure 3.4 Historical Flooding Map
Source: QGIS data (Environment Agency)
Obtained: 16/10/2023

3.7 Flood risk vulnerability and flood zone compatibility

- 3.7.1 Based on the above assessment of the site being located within Flood Zone 1 and classified as a More Vulnerable development, and with reference to Table 3.2 below (Planning Practice Guidance for 'Flood Risk and Coastal Change' to the National Planning Policy Framework, Table 2), the proposed development of this site would be considered "appropriate". A copy of Table 2 is presented below highlighting the above. Neither a Sequential Test or an Exception Test are required.

Table 2 – Flood Risk Vulnerability and Flood Zone Compatibility					
Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatibility	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	X	Exception test required	✓
Zone 3b	Exception test required	✓	X	X	X
✓ = Development is appropriate			X = Development should not be permitted		
Source: Planning Practice Guidance - 2014					

Table 3.2 Flood Risk Vulnerability and Flood Zone Compatibility

3.8 Flood compensation

- 3.8.1 Flood compensation measures will not be required for this site as it is located within Flood Zone 1.

3.9 Access and egress

- 3.9.1 Access and egress to and from this site in the event of flooding will be via the proposed development's access road which will allow residents of the development to move to higher ground.

4.0 Management of surface water

4.1 Current conditions

- 4.1.1 The site is currently open with no existing development, and is therefore considered a greenfield site with no existing drainage. Therefore, greenfield run-off calculations shall be used to derive the allowable run off rate from the site.

4.2 Surface water drainage outfalls

- 4.2.1 It is a requirement of The Building Regulations (2010), Drainage and Waste Disposal, Approved Document H, to dispose of surface water collected by a development in accordance with the following, listed in order of priority:-

1. Infiltration systems where ground condition permit
2. To watercourses
3. To sewers

- 4.2.2 Each of these is considered separately below:

4.2.3 Infiltration systems

- 4.2.3.1 The geology of the site is described in Section 2.6 above. Underlying ground conditions suggest soakaways are not a viable method for managing surface water at the site.

4.2.4 Watercourses / Main River

- 4.2.4.1 A watercourse is located along the site's southern boundary. Therefore, surface water from the proposed development will drain to this watercourse.

4.2.5 Sewers

- 4.2.5.1 Draining the site to an existing watercourse is a viable option therefore the use of surface water sewers will not be considered further.

4.3 Surface water drainage strategy

- 4.3.1 Surface water discharge rates will be restricted to greenfield equivalent run-off rates to ensure that the rate of surface water run-off from the site does not increase as a result of the proposed development.
- 4.3.2 The proposed drainage strategy will comprise a piped network with an outfall to the watercourse located along the site's southern boundary. Attenuation for the site will be provided in an online detention basin in the south-western corner, which will include a low flow channel and micropool.
- 4.3.3 Surface water associated with the commercial element of the proposals will be attenuated within that parcel of the development, and outfall to the online detention basin, prior to a single outfall to the watercourse located along the site's southern boundary.
- 4.3.4 An indicative surface water layout plan is enclosed in **Appendix F**. The drawing shows that surface water attenuation can be accommodated on the site and the method of discharge on the basis that infiltration techniques are not viable. The detailed design parameters of the drainage are described below.

4.4 SUDS assessment

4.4.1 We have considered the suitability of SUDS for use on the development site. The review is set out in below Table 4.1.

SUDS Assessment		
SUDS Technique	Suitability	Justification
Rain Water Harvesting	Maybe	Use will only mitigate a small proportion of the increase in volume of run-off created by the proposed development. Rainwater butts can be used to reduce potable water requirements.
Green Roofs	No	Green roofs are generally only viable on flat roofs. We understand that the proposed dwellings are to have pitched roofs.
Infiltration	No	Underlying geology unviable.
Filter Strips / Filter Drains	No	Underlying geology unviable.
Swales	No	Underlying geology unviable.
Bioretention Systems	No	No open spaces
Trees	Yes	A number of existing trees will be retained, plus new landscaped areas are proposed.
Pervious Pavements	No	The online detention basin will offer suitable treatment of surface water.
Attenuation Tanks	No	Surface water will be attenuated above ground within an online detention basin.
Detention Basin	Yes	Surface water will be attenuated via an online detention basin, to include low flow channel and micropool.
Ponds and Wetlands	No	A detention basin will be used for the attenuation of surface water.
Trapped Drainage	No	A sufficient level of water treatment will be provided through the online detention basin, which will include a low flow channel and micropool.

Table 4.1 SUDS Assessment

4.5 Water quality

- 4.5.1 Chapter 26 of The SuDS Manual 2015 (CIRIA 753) provides guidance on the methods that should be used to design SuDS to meet the water quality design criteria and good practice design standards. Based on the simple index approach, the pollution hazard indices for different land use classifications are listed in Table 26.2, Chapter 26 of the SuDS Manual. Table 4.2 below summarises the pollution hazard indices that are applicable for residential land use development.

Pollution Hazard Indices for Different Land Use Classifications				
Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydro-carbons
Residential Roofs	Very low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg school, offices) ie <300 traffic movements/day	Low	0.5	0.4	0.4
Source: Table 26.2 of The SuDS Manual				

Table 4.2 Pollution Hazard Indices for Different Land Use Classifications

- 4.5.2 Surface water run-off from the development will pass through a detention basin.
- 4.5.3 Table 26.3 of The SuDS Manual shows the mitigation indices for a range of SuDS components for discharges to surface waters. An extract of this is provided in Table 4.3 below for the components relevant to the proposed development. As the detention basins will be online features, to include low-flow channel and micropool, they are considered to be ponds for the assessment of water quality.

Indicative SuDS Mitigation Indices for Discharges to Surface Waters			
Type of SuDS Component	Mitigation Indices		
	TSS	Metals	Hydro-carbons
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Source: Table 26.3 of The SuDS Manual			

Table 4.3 Indicative SuDS Mitigation Indices for Discharges to Surface Waters

- 4.5.4 As set out in The SuDS Manual, where two or more components are utilised, “a factor of 0.5 is used to account for the reduced performance of the secondary or tertiary components”. This will therefore need to be considered where multiple SUDS components are proposed.
- 4.5.5 Based on the information and assessment set out above, the range of proposed SuDS features are considered to provide sufficient water treatment for the development proposals.

4.6 Surface water drainage design and management

- 4.6.1 Proposals are to design the surface water drainage system to accommodate storms up to the 1 in 100-year event plus an allowance of 40% for climate change. The design life of a residential development is considered to be greater than 60 years. The Environment Agency's guidance 'Flood risk assessments: climate change allowances' to support the National Planning Policy Framework, which defines the climate change allowances. Table 4.4 below sets out the peak rainfall allowances for the Tame Anker & Mease Management Catchment.

Peak Rainfall Intensity Allowance: Tame Anker & Mease Management Catchment			
Rainfall Event	Epoch	Central Allowance	Upper End Allowance
3.3%	2050's	+20%	+35%
	2070's	+25%	+35%
1%	2050's	+20%	+40%
	2070's	+25%	+40%
Source: Environment Agency - 2016			

Table 4.4 Peak Rainfall Intensity Allowance

4.7 Existing run-off rates

- 4.7.1 To reflect the changes in the near surface geology across the site the greenfield run-off rates have been calculated. The method used to calculate the greenfield run-off rates is the ICP SUDS and the calculations are presented in **Appendix G**.

- 4.7.2 The greenfield run off rate, for the application site, is:

Soil type	= 0.450 – obtained from HR Wallingford online tool
SAAR	= 700mm – obtained from the FEH parameters
Urban	= 0.000
Region number	= 4
Developable area	= 4.816ha
Q ₁	= 17.6 l/s
Q _{bar}	= 21.2 l/s
Q ₃₀	= 41.5 l/s
Q ₁₀₀	= 54.4 l/s

- 4.7.3 Surface water run-off from the proposed development will be limited to the greenfield equivalent rate of 21.2 l/s via a vortex flow control device.

4.8 Attenuation requirements

- 4.8.1 Surface water will discharge into the existing watercourse and will be attenuated to a Q_{bar} greenfield run-off rate of 21.2 l/s. To achieve this, surface water will be attenuated onsite to accommodate a 1 in 100-year event plus an allowance of 40% for climate change.

- 4.8.2 The commercial area of the development has an associated drained area of 0.485ha. A surface water outfall restricted to 5.0 l/s will be provided to the detention basin. As such, an attenuation volume of 301.8m³ is required to accommodate the 1 in 100 year plus 40% climate change event. This attenuation will be provided within the commercial parcel of the development. Calculations are enclosed in **Appendix H**.
- 4.8.3 The residential area of the development has an associated drained area of 2.431ha. Based on a surface water flow restriction of 21.2 l/s, an attenuation volume of 1,615.0m³ is required to accommodate the 1 in 100 year plus 40% climate change event. Calculations enclosed in **Appendix I**.
- 4.8.4 Additional calculations have been undertaken to allow for the 5.0 l/s outfall from the commercial parcel into the detention basin, based on the following parameters. As such, a total attenuation volume of 1,736.2 m³ is required to accommodate the 1 in 100 year plus 40% climate change event. Calculations enclosed in **Appendix J**.
- 4.8.5 The attenuation requirements for Catchment 1 have been calculated based on the following parameters, obtained with the use of FSR rainfall data. Full calculations are enclosed in **Appendix J**.
- | | |
|--|-------------------------|
| Rainfall data | = FSR |
| Return period | = 100 year |
| Climate change | = 40% |
| Total drained area | = 2.916ha |
| Limiting flow to existing water course | = 21.2 l/s |
| Control | = Vortex flow control |
| Total storage required | = 1,736.2m ³ |
- 4.8.6 Attenuation will be accommodated within a single detention basin in the south-west corner of the development. This arrangement is shown on the plan enclosed in **Appendix H**.
- 4.8.7 Allowances for urban creep will be accommodated within the proposed freeboard of the detention basin. These requirements will be assessed and confirmed as part of the detailed drainage design.

4.9 Overland flows

- 4.9.1 Proposals are to design the surface water drainage to accommodate the 1 in 100-year storm event taking into account the predicted future effects of climate. Clearly there is a risk of this storm event being exceeded, albeit this risk is considered very low. In such an event the proposed drainage systems will become overwhelmed and overland flows could occur. Overland flows will be directed to follow the path that overland flows currently follow.

5.0 Foul water drainage strategy

- 5.1 Severn Trent's asset plan is enclosed in **Appendix C**, which identifies the existing and combined water sewers in the vicinity of the site.
- 5.2 The proposed foul water drainage strategy will require a diversion of the existing foul water sewer that crosses the site. The diversion proposals are indicated on the drainage drawing enclosed in **Appendix F**.
- 5.3 It is proposed that foul water from the site will outfall to the existing foul water sewer that is identified along the site's southern boundary.
- 5.4 The foul water proposals are subject to consultation with Severn Trent.

6.0 Maintenance

6.1 Surface water drainage maintenance

- 6.1.1 The drainage system will be designed to minimise maintenance requirements, however, a full maintenance scheme will be established for those elements not being offered for adoption. The various areas will be maintained as set out in Table 6.1 below.

Maintenance Areas – Surface Water	
Aspect	Maintainer
Private Drains	Home owner
SUDS – Private	Home owner
SUDS – Communal	SUDS Adoption Authority / Management Company
Adopted Sewers	Severn Trent Water

Table 6.1 Maintenance Areas – Surface Water

6.2 Foul water drainage maintenance

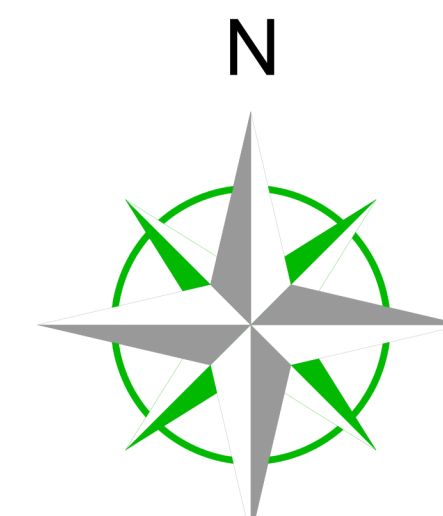
- 6.2.1 The drainage system will be designed to minimise maintenance requirements, however, a full maintenance scheme will be established for those elements not being offered for adoption. The various areas will be maintained as set out in Table 6.2 below.

Maintenance Areas – Foul Water	
Aspect	Maintainer
Private Drains	Home owner
Adopted Sewers	Severn Trent Water

Table 6.2 Maintenance Areas – Foul Water



Appendix A
Topographical Survey
Greenhatch Group drawing no. 47186_T



Station Information:

Station	Easting (m)	Northing (m)	Level (m)
GH3	439638.058	302891.928	103.594
GH6	439894.887	302724.087	104.190
GH8	439465.891	303078.204	99.213
GH9	439468.039	303141.169	99.163
GH10	439491.872	303088.537	99.564
GH11	439473.814	303090.497	99.395
GH12	439438.061	303167.339	97.710
GH13	439526.150	303160.279	100.595

OS Note

This survey has been oriented to the Ordnance Survey (O.S.) National Grid OSG836(15) via Global Navigation Satellite Systems (GNSS) and the O.S. Active Network (OS Net).

A true OSG836 coordinate has been established near to the site centre via a transformation using the OSTN15GB & OSGM15GB transformation models.

The survey has been correlated to this point and a further one or more OSG836 (15) points established to create a true O.S. bearing for angle orientation.

No scale factor has been applied to the survey therefore the coordinates shown are arbitrary & not true O.S. Coordinates which have a scale factor applied.
Please refer to Survey Station Table to enable establishment of the on-site grid and datum.

Some services may have been omitted due to parked vehicles.

Legend:

[illegible]

Rev	Date	Description	Drawn	Q. Re
-----	------	-------------	-------	-------



Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044
admin@greenhatch-group.co.uk
www.greenhatch-group.co.uk

St Albans Unit B, The Courtyard Alban Park St Albans Hertfordshire AL4 0LA t. (01727) 854481	Newcastle 24 Riverside Studios Armetynst Road Newcastle Bus. Park Newcastle-U-Tyne NE4 7YL t. (01912) 736391	London 27, Cornwall Terrace Mer Regents Park London NW1 5LL t. (02072) 241806
--	--	--

CLIENT

**Miller Homes
(East Midlands) Ltd**

PROJE

**Station Road
Market Bosworth
Leicestershire CV13 0ND**

Topographical Survey

SCALE A0@ 1: 1000	DATE SURVEYED 09.05.23
DRAWN DH	QUALITY REF GH16987

Level datum	See note
Grid orientation	See note

Drawing No.	Rev.
47186_T	0

Comments

This plan should only be used for its original purpose. Greenhatch Group accepts no responsibility for this plan if supplied to any party other than the original client.

All dimensions should be checked on site prior to design and construction.

Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.



Appendix B
Technical Planning Layout
Miller Homes drawing no. n2258-008-01A



Key

- Application boundary
- Employment zone (Outline element of the application)
- Affordable rented dwelling
- Affordable shared ownership dwelling

Code	House Type Name	Bedrooms	Number
Affordable (Shared Ownership)			
AL1 HAS	HASTING	1	2
AL22 SHE	SHERMONT	2	6
AL30 HAY	HAYTON	3	4
AL40 TAY	TAYWOOD	4	2
Sub-Total		14	25%
Affordable (Rented)			
AL1 HAS	HASTING	1	8
AL22 SHE	SHERMONT	2	17
AL30 HAY	HAYTON	3	14
AL40 TAY	TAYWOOD	4	2
Sub-Total		41	75%
Affordable Total		55	40%
Market Housing			
L253 RED	REDMONT	1	1
L255 DEL	DELMONT	2	19
L353 CAL	CALBERTON	2	10
L360 CHI	CHILTON	3	7
L362 CLY	CLAYTON	3	1
AL25 BRI	BRIXTON	3	1
L363 HAM	HAMPTON	3	11
L365 LIN	LINTON	3	7
L461 FOR	FORDWOOD	3	10
L467 BEA	BEAUWOOD	4	5
L466 CHA	CHARLESWOOD	4	4
L470 BRW	BRIARWOOD	4	2
L472 CRO	CROSSWOOD	4	2
L474 FAV	FAVERWOOD	4	3
Sub-Total		83	60%
Overall Site Total		138	

ALSO REFER TO TECHNICAL PLANNING LAYOUT

20m

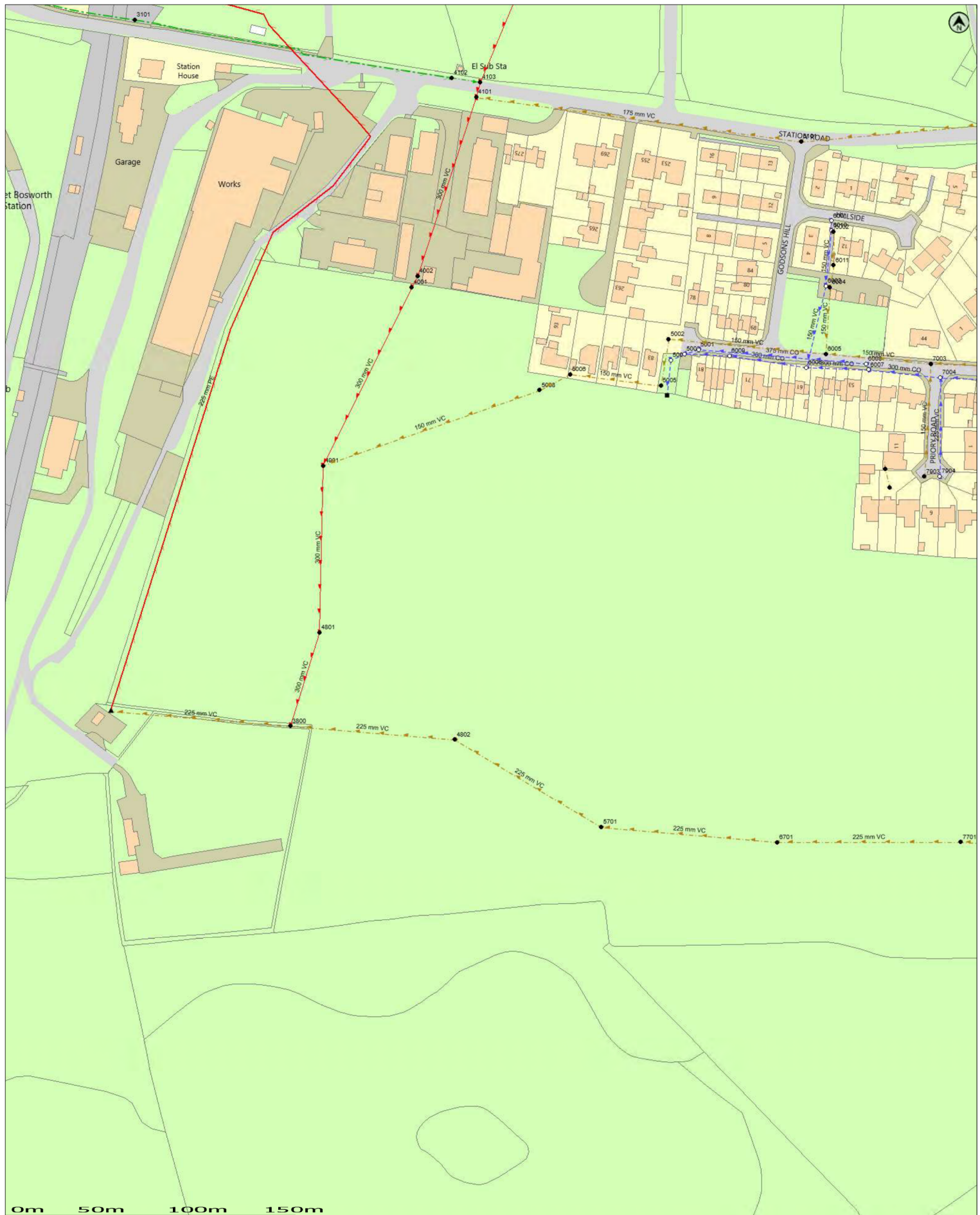
millerhomes

nineteen47
CHARTERED TOWN PLANNERS & URBAN DESIGNERS

Project: Station Road, Market Bosworth
Drawing No: 008-01
Drawing Scale: 1:500 @ A0



Appendix C
Severn Trent Asset Plan



(c) Crown copyright and database rights 2023 Ordnance Survey 100031673
Data updated: 14/03/23

Scale: 1:1250
Map Centre: 439492.302894

Date: 24/03/23
Our Ref: 1120257 - 3

Wastewater Plan A2
Powered by digdat

Public Foul Gravity/Lateral Drain	Highway Drain	Manhole Foul
Public Combined Gravity/Lateral Drain	Overflow Pipe	Manhole Surface
Public Surface Water Gravity/Lateral Drain	Disposal Pipe	Abandoned Pipe
Pressure Foul	Culverted Water Course	Chamber
Pressure Combined	Pumping Station	
Pressure Surface Water	Fitting	

miaf@igl.co.uk

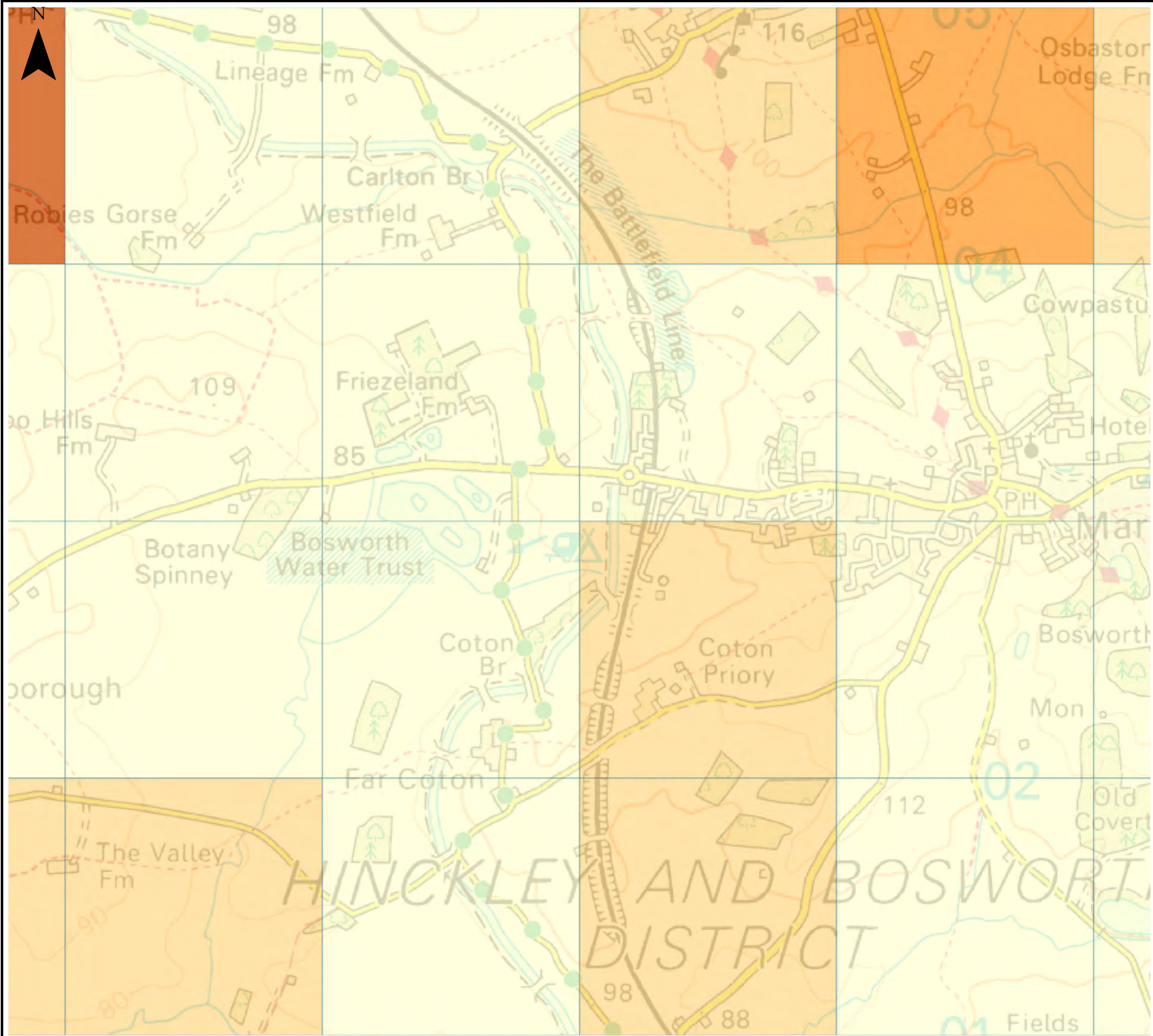
5019



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Appendix D
Groundwater Flood Risk
Hinckley & Bosworth Borough Council SFRA: Appendix G Map 15 of 44



Notes

The Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGWF data should be used only in combination with other information, for example local data or historic data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

Key Plan



Legend



Joint SFRA area

Areas Susceptible to Groundwater Flooding

Classification

- ≥ 75%
- ≥ 50% < 75%
- ≥ 25% < 50%
- < 25%

Note:
Absence of values for any grid square means that no part of that square is identified as being susceptible to groundwater emergence.



REF	Date	Comments
A	Aug 2014	Draft
B	Sept 2014	Final
C		

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HBBC, BDC and OWBC JOINT SFRA APPENDIX G

GROUNDWATER FLOOD MAPS

Sheet No: 15 of 44

Index Number: JSFRA_15

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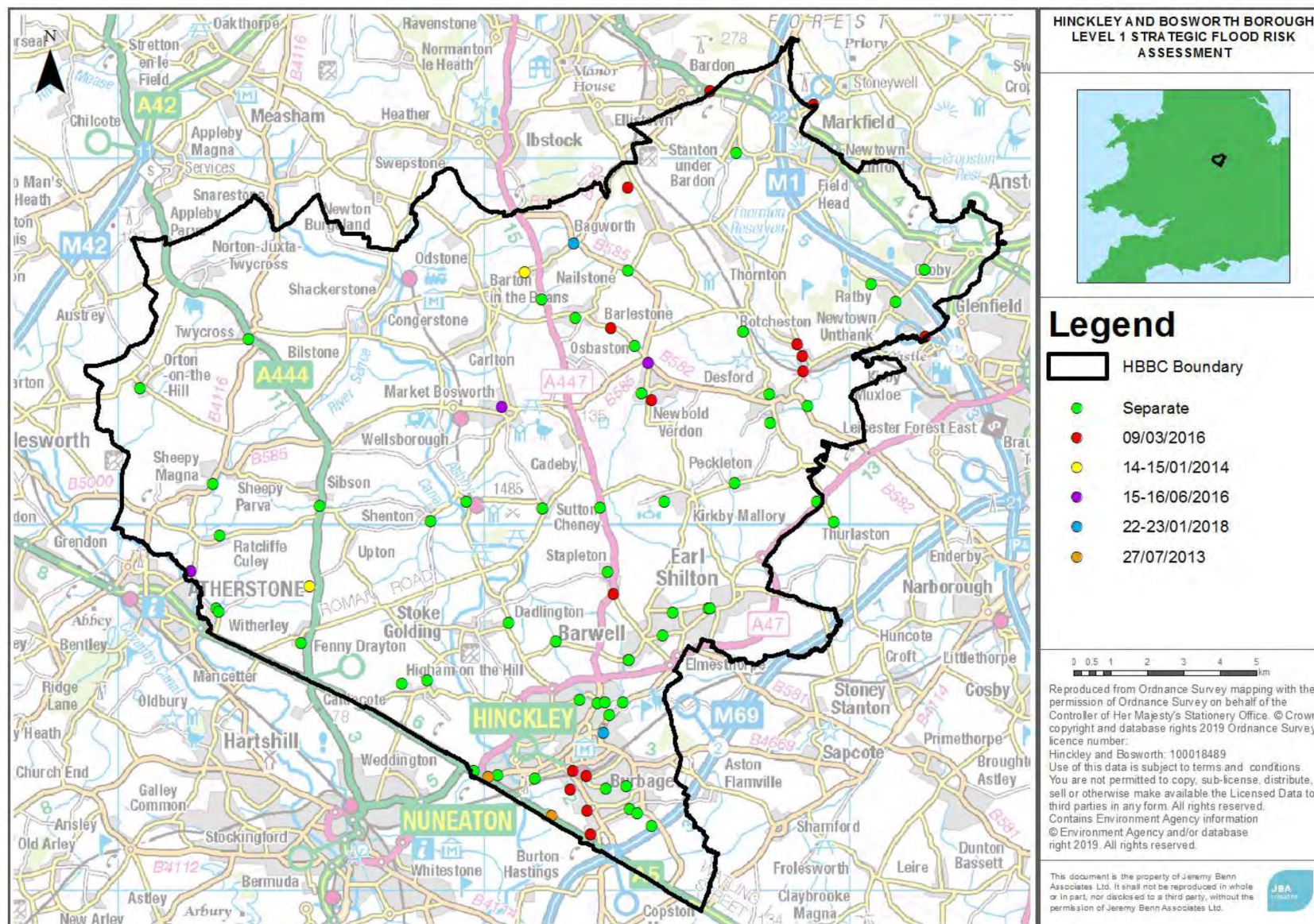




**Appendix E
Historic Flooding
Hinckley & Bosworth Borough Council SFRA: Figure 5-2**



Figure 5-2: Map of historical flood incidents within Hinckley and Bosworth borough grouped by the time period of significant flood events





Appendix F
Drainage Strategy Layout
JPP Consulting drawing no. 26417-101C



This drawing has been based/developed using the following external drawings					
Type	Company	Drawing date	Drawing title	Date received	Rev
Site Layout	Miller Homes	N/A	DWG "Market Bosworth Sketch Layout 2023 Part 1 Increased area"	04.10.2023	-
Topographical survey	Greenhatch Group	09.05.2023	DWG Title - "Topographical Survey" Drawing Number - 47385_T_REV0	04.10.2023	-
OS Data	Miller Homes	N/A	DWG "OS_Detail_Vector"	04.10.2023	-

General Notes

- This drawing is to be used in conjunction with all relevant drawings, specifications and details.
- All dimensions are in metres unless noted otherwise.
- Do not scale from this drawing.

Drawing Key

Site Boundary - Taken from Architects' layout referenced

- Boundary of Development (Excluding open space used to calculate Q&B rural runoff)
- Proposed Section 104 Adoptable Foul Sewer
- Proposed Section 104 Adoptable Storm Sewer
- Existing Severn Trent Water Foul Sewer
- Existing Severn Trent Water Storm Sewer
- Existing Severn Trent Water Combined Drainage
- Proposed Section 38 Highway Drainage
- Proposed Section 185 Sewer Diversion
- Proposed Cellular Storage
- Proposed Private Surface Water Headwall
- Proposed Culvert Works
- Proposed Section 104 Adoptable Headwall
- Tree Protection Area - Taken from FPCR drawing titled "Tree Survey Plan West" Ref: 11637-T-01 dated September 2023
- Existing Contour
- Extent of Proposed Basins
- Proposed Banking Works (Max 1:3)
- Existing Foul Sewer to be Diverted

Detention basin operation & maintenance requirements		
Maintenance Schedule	Required Action	Recommended Frequency
Regular maintenance	Litter and debris removal	Monthly
	Grass cutting - for pathways and access routes	Monthly (during growing season) or as required
	Grass cutting - meadow grass in and around basin	Half yearly (spring - before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (as start then as required)
	Tidy all dead growth before start of growing season	Annually
	Remove sediments from inlets, outlet and forebay	Annually (or as required)
Occasional maintenance	Manage wetlands plants in outlet pool - where provided	Annually
	Re-seed area of poor vegetation growth	Annually (or as required)
	Prune and trim trees and remove cuttings	2 years, (or as required)
	Remove sediments from forebay, when 50% full and from micropools if volume is reduced by >25%	3-10 years, (or as required)
Remedial actions	Repair of erosion or other damage by re-seeding or re-lifting	As required
	Re-alignment of rip-rap	As required
Monitoring	Repair/rehabilitation of inlets, outlets and overflows	As required
	Re-level uneven surfaces and reinstatement design levels	As required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly/after large storms
	Inspect bankside, structures and pipework, etc for evidence of physical damage	Monthly/after large storms
Monitoring	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Half yearly
	Check penstocks and other mechanical devices	Half yearly

Operation and maintenance requirements for pipes, gullies and manholes		
Maintenance Schedule	Required action	Record frequency
Regular maintenance	Inspect and identify areas that are not operating correctly. If required, take remedial action	Monthly for first 3 months and then six monthly
	Debris removal from catchment surface (where may cause risk to performance)	Monthly
	Remove sediment from pre-treatment structures (e.g. gullies)	Annually or as required
	Cleaning/jetting of annually, or as required, pipes and manholes	As required

Operation & Maintenance: Private Drainage			
Pipe systems, inspection chambers, manholes and hydro-rails. Inspection chambers are provided at regular intervals, changes in direction, change in gradient and changes in pipe diameter. Access for maintenance is provided at inspection chambers/manhole positions.			
Maintenance Schedule	Required Action	Recommended Frequency	Maintaining Company
Regular maintenance	Inspect and identify areas that are not operating correctly. If required, take remedial action	Monthly (for the first 3 months) then six monthly	Private
	Debris removal from catchment surface (where may cause risk to performance)	Monthly	
	Remove sediment from pre-treatment structures (e.g. gullies)	Annually or as required	
	Cleaning/jetting annually, or as required, pipes, gullies and manholes	As required	
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly	
	Check any penstocks and other mechanical devices	Annually	
Monitoring	Inspect/check all part of pipes system, inspection chambers and hydro-rails to ensure that they are in good condition and operating as required	Annually and after large storms	Private
Remedial actions	Repair/rehabilitation of inlets, outlets and overflows	As required	Private

Water Quality Management				
Water quality management in accordance with document E26 of SUDs manual				
Total SUDs mitigation index = mitigation index x 0.5 (mitigation index)				
Network 1 - Residential Parcel				
Pollution hazard indices for different land use classifications (E2.2)	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Individual property driveways: residential car parks, low traffic roads (eg car de-lais, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) < 300 traffic movements/day	Low	0.5	0.4	0.4

Indicative SUDs mitigation indices for discharges to surface waters 26.3			
Types of SUDs Components	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Road	0.7	0.7	0.5
Permeable Paving	0.7	0.6	0.7

Total SUDs mitigation index = 2 pollution hazard index therefore SUDs mitigation is appropriate as per in accordance with document E26 of SUDs manual

Rev C Drawing amended to suit new site layout By JCB Checked TL 02.08.2024

Rev B Drawing amended to suit new site layout By JCB Checked TL 24.05.2024

Rev A Existing foul drainage route amended to suit drainage survey By RF Checked TL 18.03.2024

jpp Northampton
Grand Union Works, Whilton Locks, Daventry
Northamptonshire, NN11 2NH
T: 01604 781811
P: 01604 781811
E: mail@jppuk.net W: jppuk.net

Client Miller Homes

Project Proposed Mixed Use Development Station Road Market Bosworth

Title Drainage Strategy Layout

Scale at A0 1:500 Drawn by SF Checked by TL Date October 2023

Status PRELIMINARY Project ref 26417 Drawing no. 101 Revision C

DRAFT ISSUE FOR COMMENT ONLY
SUBJECT TO FOUL SURVEY AND
PRE-DEVELOPMENT ENQUIRY TO
CONFIRM FOUL OUTFALL

Drawing is not to be used for construction until status is CONSTRUCTION



Appendix G

Greenfield Run-off Calculations

JPP Consulting Ltd		Page 1																								
Cedar Barn White Lodge Walgrave Northampton NN6 9PY																										
Date 24/05/2024 10:52 File Pond Sizing (Sketch Sch...	Designed by Tom.Leatherland Checked by																									
XP Solutions																										
Source Control 2020.1																										
<u>ICP SUDS Mean Annual Flood</u> Input <table><tr><td>Return Period (years)</td><td>100</td><td>Soil</td><td>0.450</td></tr><tr><td>Area (ha)</td><td>4.816</td><td>Urban</td><td>0.000</td></tr><tr><td>SAAR (mm)</td><td>700</td><td>Region Number</td><td>Region 4</td></tr></table> Results l/s <table><tr><td>QBAR Rural</td><td>21.2</td></tr><tr><td>QBAR Urban</td><td>21.2</td></tr><tr><td>Q100 years</td><td>54.4</td></tr><tr><td>Q1 year</td><td>17.6</td></tr><tr><td>Q30 years</td><td>41.5</td></tr><tr><td>Q100 years</td><td>54.4</td></tr></table>			Return Period (years)	100	Soil	0.450	Area (ha)	4.816	Urban	0.000	SAAR (mm)	700	Region Number	Region 4	QBAR Rural	21.2	QBAR Urban	21.2	Q100 years	54.4	Q1 year	17.6	Q30 years	41.5	Q100 years	54.4
Return Period (years)	100	Soil	0.450																							
Area (ha)	4.816	Urban	0.000																							
SAAR (mm)	700	Region Number	Region 4																							
QBAR Rural	21.2																									
QBAR Urban	21.2																									
Q100 years	54.4																									
Q1 year	17.6																									
Q30 years	41.5																									
Q100 years	54.4																									
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Appendix H
Drainage Calculations
Commercial Parcel: 1 in 100 year + 40% CC

JPP Consulting Ltd				Page 1	
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		26417 - Market Bosworth 1 in 100 Year + 40% CC Commercial Storage Required			
Date 29/05/2024 15:34 File Pond Sizing (Employment...		Designed by SF Checked by TL			
XP Solutions		Source Control 2020.1			
Summary of Results for 100 year Return Period (+40%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.459	0.459	5.0	160.6	O K
30 min Summer	99.531	0.531	5.0	185.7	O K
60 min Summer	99.608	0.608	5.0	212.7	O K
120 min Summer	99.684	0.684	5.0	239.4	O K
180 min Summer	99.721	0.721	5.0	252.5	Flood Risk
240 min Summer	99.741	0.741	5.0	259.4	Flood Risk
360 min Summer	99.753	0.753	5.0	263.7	Flood Risk
480 min Summer	99.747	0.747	5.0	261.6	Flood Risk
600 min Summer	99.738	0.738	5.0	258.3	Flood Risk
720 min Summer	99.727	0.727	5.0	254.5	Flood Risk
960 min Summer	99.697	0.697	5.0	243.8	O K
1440 min Summer	99.631	0.631	5.0	220.9	O K
15 min Winter	99.515	0.515	5.0	180.2	O K
30 min Winter	99.597	0.597	5.0	208.9	O K
60 min Winter	99.685	0.685	5.0	239.8	O K
120 min Winter	99.773	0.773	5.0	270.4	Flood Risk
180 min Winter	99.817	0.817	5.0	285.9	Flood Risk
240 min Winter	99.842	0.842	5.0	294.7	Flood Risk
360 min Winter	99.862	0.862	5.0	301.8	Flood Risk
480 min Winter	99.862	0.862	5.0	301.6	Flood Risk
600 min Winter	99.850	0.850	5.0	297.6	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	180.605	0.0	160.8	19	
30 min Summer	105.807	0.0	188.6	33	
60 min Summer	61.987	0.0	223.9	64	
120 min Summer	36.315	0.0	262.5	122	
180 min Summer	26.561	0.0	288.1	182	
240 min Summer	21.275	0.0	307.7	242	
360 min Summer	15.561	0.0	337.6	360	
480 min Summer	12.464	0.0	360.5	458	
600 min Summer	10.493	0.0	379.4	510	
720 min Summer	9.116	0.0	395.5	572	
960 min Summer	7.252	0.0	419.3	700	
1440 min Summer	5.253	0.0	455.2	978	
15 min Winter	180.605	0.0	180.3	19	
30 min Winter	105.807	0.0	211.4	33	
60 min Winter	61.987	0.0	250.9	62	
120 min Winter	36.315	0.0	294.1	120	
180 min Winter	26.561	0.0	322.7	178	
240 min Winter	21.275	0.0	344.7	236	
360 min Winter	15.561	0.0	378.2	350	
480 min Winter	12.464	0.0	403.9	460	
600 min Winter	10.493	0.0	425.0	564	
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JPP Consulting Ltd				Page 2	
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		26417 - Market Bosworth 1 in 100 Year + 40% CC Commercial Storage Required			
Date 29/05/2024 15:34 File Pond Sizing (Employment...		Designed by SF Checked by TL			
XP Solutions		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
720 min Winter	99.833	0.833	5.0	291.7	Flood Risk
960 min Winter	99.796	0.796	5.0	278.6	Flood Risk
1440 min Winter	99.711	0.711	5.0	249.0	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
720 min Winter	9.116	0.0	443.0	608	
960 min Winter	7.252	0.0	469.6	742	
1440 min Winter	5.253	0.0	509.5	1054	

JPP Consulting Ltd		Page 3																																								
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Commercial Storage Required																																									
Date 29/05/2024 15:34 File Pond Sizing (Employment...	Designed by SF Checked by TL																																									
XP Solutions																																										
Source Control 2020.1																																										
Rainfall Details <table><tr><td>Rainfall Model</td><td>FEH</td></tr><tr><td>Return Period (years)</td><td>100</td></tr><tr><td>FEH Rainfall Version</td><td>1999</td></tr><tr><td>Site Location</td><td>439400 302750 SK 39400 02750</td></tr><tr><td>C (1km)</td><td>-0.029</td></tr><tr><td>D1 (1km)</td><td>0.362</td></tr><tr><td>D2 (1km)</td><td>0.338</td></tr><tr><td>D3 (1km)</td><td>0.281</td></tr><tr><td>E (1km)</td><td>0.309</td></tr><tr><td>F (1km)</td><td>2.369</td></tr><tr><td>Summer Storms</td><td>Yes</td></tr><tr><td>Winter Storms</td><td>Yes</td></tr><tr><td>Cv (Summer)</td><td>0.750</td></tr><tr><td>Cv (Winter)</td><td>0.840</td></tr><tr><td>Shortest Storm (mins)</td><td>15</td></tr><tr><td>Longest Storm (mins)</td><td>1440</td></tr><tr><td>Climate Change %</td><td>+40</td></tr></table> Time Area Diagram Total Area (ha) 0.485 <table><tr><th>Time (mins)</th><th>Area</th></tr><tr><th>From:</th><th>To: (ha)</th></tr><tr><td>0</td><td>4 0.485</td></tr></table>			Rainfall Model	FEH	Return Period (years)	100	FEH Rainfall Version	1999	Site Location	439400 302750 SK 39400 02750	C (1km)	-0.029	D1 (1km)	0.362	D2 (1km)	0.338	D3 (1km)	0.281	E (1km)	0.309	F (1km)	2.369	Summer Storms	Yes	Winter Storms	Yes	Cv (Summer)	0.750	Cv (Winter)	0.840	Shortest Storm (mins)	15	Longest Storm (mins)	1440	Climate Change %	+40	Time (mins)	Area	From:	To: (ha)	0	4 0.485
Rainfall Model	FEH																																									
Return Period (years)	100																																									
FEH Rainfall Version	1999																																									
Site Location	439400 302750 SK 39400 02750																																									
C (1km)	-0.029																																									
D1 (1km)	0.362																																									
D2 (1km)	0.338																																									
D3 (1km)	0.281																																									
E (1km)	0.309																																									
F (1km)	2.369																																									
Summer Storms	Yes																																									
Winter Storms	Yes																																									
Cv (Summer)	0.750																																									
Cv (Winter)	0.840																																									
Shortest Storm (mins)	15																																									
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Climate Change %	+40																																									
Time (mins)	Area																																									
From:	To: (ha)																																									
0	4 0.485																																									
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JPP Consulting Ltd		Page 4
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Commercial Storage Required	
Date 29/05/2024 15:34 File Pond Sizing (Employment...	Designed by SF Checked by TL	
XP Solutions	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	350.0	1.000	350.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0105-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	105
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.0
Flush-Flo™	0.296	5.0
Kick-Flo®	0.637	4.1
Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.4	3.000	8.4	7.000	12.5
0.200	4.8	1.400	5.8	3.500	9.0	7.500	12.9
0.300	5.0	1.600	6.2	4.000	9.6	8.000	13.3
0.400	4.9	1.800	6.6	4.500	10.1	8.500	13.7
0.500	4.7	2.000	6.9	5.000	10.6	9.000	14.1
0.600	4.3	2.200	7.2	5.500	11.1	9.500	14.5
0.800	4.5	2.400	7.5	6.000	11.6		
1.000	5.0	2.600	7.8	6.500	12.1		



Appendix I
Drainage Calculations
Residential Parcel: 1 in 100 year + 40% CC

JPP Consulting Ltd				Page 1	
Cedar Barn White Lodge Walgrave Northampton NN6 9PY		26417 - Market Bosworth 1 in 100 Year + 40% CC Residential Storage Required			
Date 29/05/2024 15:35 File Pond Sizing (Sketch Sch...		Designed by SF Checked by TL			
XP Solutions		Source Control 2020.1			
<u>Summary of Results for 100 year Return Period (+40%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.465	0.465	21.1	808.9	O K
30 min Summer	99.539	0.539	21.1	938.4	O K
60 min Summer	99.620	0.620	21.1	1079.6	O K
120 min Summer	99.704	0.704	21.1	1225.5	Flood Risk
180 min Summer	99.751	0.751	21.1	1306.3	Flood Risk
240 min Summer	99.779	0.779	21.1	1355.1	Flood Risk
360 min Summer	99.806	0.806	21.1	1403.1	Flood Risk
480 min Summer	99.813	0.813	21.1	1415.4	Flood Risk
600 min Summer	99.810	0.810	21.1	1410.2	Flood Risk
720 min Summer	99.806	0.806	21.1	1402.7	Flood Risk
960 min Summer	99.787	0.787	21.1	1368.7	Flood Risk
1440 min Summer	99.741	0.741	21.1	1289.7	Flood Risk
15 min Winter	99.521	0.521	21.1	907.2	O K
30 min Winter	99.606	0.606	21.1	1053.7	O K
60 min Winter	99.698	0.698	21.1	1214.6	O K
120 min Winter	99.795	0.795	21.1	1382.4	Flood Risk
180 min Winter	99.847	0.847	21.1	1474.3	Flood Risk
240 min Winter	99.880	0.880	21.1	1531.5	Flood Risk
360 min Winter	99.915	0.915	21.1	1592.4	Flood Risk
480 min Winter	99.928	0.928	21.1	1614.4	Flood Risk
600 min Winter	99.928	0.928	21.1	1615.0	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	180.605	0.0	768.5	19	
30 min Summer	105.807	0.0	903.5	34	
60 min Summer	61.987	0.0	1103.4	64	
120 min Summer	36.315	0.0	1295.0	122	
180 min Summer	26.561	0.0	1421.7	182	
240 min Summer	21.275	0.0	1518.7	242	
360 min Summer	15.561	0.0	1666.3	360	
480 min Summer	12.464	0.0	1779.0	480	
600 min Summer	10.493	0.0	1871.2	550	
720 min Summer	9.116	0.0	1949.5	608	
960 min Summer	7.252	0.0	2064.1	732	
1440 min Summer	5.253	0.0	2230.8	996	
15 min Winter	180.605	0.0	863.3	19	
30 min Winter	105.807	0.0	1013.1	33	
60 min Winter	61.987	0.0	1237.6	62	
120 min Winter	36.315	0.0	1451.9	120	
180 min Winter	26.561	0.0	1593.5	180	
240 min Winter	21.275	0.0	1702.1	238	
360 min Winter	15.561	0.0	1867.0	352	
480 min Winter	12.464	0.0	1992.9	464	
600 min Winter	10.493	0.0	2095.6	572	
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JPP Consulting Ltd		Page 2
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Residential Storage Required	
Date 29/05/2024 15:35 File Pond Sizing (Sketch Sch...	Designed by SF Checked by TL	
XP Solutions	Source Control 2020.1	

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
720 min Winter	99.921	0.921	21.1	1602.5	Flood Risk
960 min Winter	99.892	0.892	21.1	1552.9	Flood Risk
1440 min Winter	99.832	0.832	21.1	1448.5	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
720 min Winter	9.116	0.0	2182.8	674
960 min Winter	7.252	0.0	2309.8	768
1440 min Winter	5.253	0.0	2491.1	1070

JPP Consulting Ltd		Page 3																																											
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Residential Storage Required																																												
Date 29/05/2024 15:35 File Pond Sizing (Sketch Sch...	Designed by SF Checked by TL																																												
XP Solutions																																													
Source Control 2020.1																																													
Rainfall Details <table><tr><td>Rainfall Model</td><td>FEH</td></tr><tr><td>Return Period (years)</td><td>100</td></tr><tr><td>FEH Rainfall Version</td><td>1999</td></tr><tr><td>Site Location</td><td>439400 302750 SK 39400 02750</td></tr><tr><td>C (1km)</td><td>-0.029</td></tr><tr><td>D1 (1km)</td><td>0.362</td></tr><tr><td>D2 (1km)</td><td>0.338</td></tr><tr><td>D3 (1km)</td><td>0.281</td></tr><tr><td>E (1km)</td><td>0.309</td></tr><tr><td>F (1km)</td><td>2.369</td></tr><tr><td>Summer Storms</td><td>Yes</td></tr><tr><td>Winter Storms</td><td>Yes</td></tr><tr><td>Cv (Summer)</td><td>0.750</td></tr><tr><td>Cv (Winter)</td><td>0.840</td></tr><tr><td>Shortest Storm (mins)</td><td>15</td></tr><tr><td>Longest Storm (mins)</td><td>1440</td></tr><tr><td>Climate Change %</td><td>+40</td></tr></table> Time Area Diagram Total Area (ha) 2.431 <table><tr><th colspan="2">Time (mins)</th><th>Area</th></tr><tr><th>From:</th><th>To:</th><th>(ha)</th></tr><tr><td>0</td><td>4</td><td>2.431</td></tr></table>			Rainfall Model	FEH	Return Period (years)	100	FEH Rainfall Version	1999	Site Location	439400 302750 SK 39400 02750	C (1km)	-0.029	D1 (1km)	0.362	D2 (1km)	0.338	D3 (1km)	0.281	E (1km)	0.309	F (1km)	2.369	Summer Storms	Yes	Winter Storms	Yes	Cv (Summer)	0.750	Cv (Winter)	0.840	Shortest Storm (mins)	15	Longest Storm (mins)	1440	Climate Change %	+40	Time (mins)		Area	From:	To:	(ha)	0	4	2.431
Rainfall Model	FEH																																												
Return Period (years)	100																																												
FEH Rainfall Version	1999																																												
Site Location	439400 302750 SK 39400 02750																																												
C (1km)	-0.029																																												
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E (1km)	0.309																																												
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Summer Storms	Yes																																												
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Cv (Winter)	0.840																																												
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Climate Change %	+40																																												
Time (mins)		Area																																											
From:	To:	(ha)																																											
0	4	2.431																																											
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JPP Consulting Ltd		Page 4
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Residential Storage Required	
Date 29/05/2024 15:35 File Pond Sizing (Sketch Sch...	Designed by SF Checked by TL	
XP Solutions	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1740.0	1.000	1740.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0204-2120-1000-2120
Design Head (m)	1.000
Design Flow (l/s)	21.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	204
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	21.2
Flush-Flo™	0.345	21.1
Kick-Flo®	0.721	18.1
Mean Flow over Head Range	-	17.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.0	1.200	23.1	3.000	35.9	7.000	54.0
0.200	19.4	1.400	24.9	3.500	38.6	7.500	55.9
0.300	21.0	1.600	26.5	4.000	41.2	8.000	57.7
0.400	21.0	1.800	28.1	4.500	43.6	8.500	59.4
0.500	20.7	2.000	29.5	5.000	45.9	9.000	61.1
0.600	20.1	2.200	30.9	5.500	48.1	9.500	62.7
0.800	19.1	2.400	32.2	6.000	50.1		
1.000	21.2	2.600	33.5	6.500	52.1		



Appendix J
Drainage Calculations
Combined Network: 1 in 100 year + 40% CC

JPP Consulting Ltd		Page 1
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Storage Required	
Date 24/05/2024 12:22 File Cascade File.CASX	Designed by SF Checked by TL	
XP Solutions		Source Control 2020.1

Cascade Summary of Results for Pond Sizing (Sketch Scheme).SRCX

Upstream Structures	Outflow To	Overflow To
Pond Sizing (Employment Land).SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.467	0.467	21.1	812.6	O K
30 min Summer	99.543	0.543	21.1	945.1	O K
60 min Summer	99.628	0.628	21.1	1092.4	O K
120 min Summer	99.719	0.719	21.1	1250.2	Flood Risk
180 min Summer	99.772	0.772	21.1	1342.8	Flood Risk
240 min Summer	99.806	0.806	21.1	1403.3	Flood Risk
360 min Summer	99.847	0.847	21.1	1473.9	Flood Risk
480 min Summer	99.866	0.866	21.1	1507.2	Flood Risk
600 min Summer	99.873	0.873	21.1	1519.2	Flood Risk
720 min Summer	99.872	0.872	21.1	1517.6	Flood Risk
960 min Summer	99.858	0.858	21.1	1493.8	Flood Risk
1440 min Summer	99.827	0.827	21.1	1439.0	Flood Risk
15 min Winter	99.524	0.524	21.1	911.0	O K
30 min Winter	99.609	0.609	21.1	1060.3	O K
60 min Winter	99.705	0.705	21.1	1227.0	Flood Risk
120 min Winter	99.809	0.809	21.1	1407.4	Flood Risk
180 min Winter	99.869	0.869	21.1	1511.8	Flood Risk
240 min Winter	99.909	0.909	21.1	1581.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	180.605	0.0	920.0	19
30 min Summer	105.807	0.0	1079.4	34
60 min Summer	61.987	0.0	1323.8	64
120 min Summer	36.315	0.0	1553.1	124
180 min Summer	26.561	0.0	1704.3	182
240 min Summer	21.275	0.0	1820.1	242
360 min Summer	15.561	0.0	1995.8	362
480 min Summer	12.464	0.0	2129.6	480
600 min Summer	10.493	0.0	2238.5	600
720 min Summer	9.116	0.0	2330.6	700
960 min Summer	7.252	0.0	2463.3	800
1440 min Summer	5.253	0.0	2644.2	1054
15 min Winter	180.605	0.0	1032.0	19
30 min Winter	105.807	0.0	1207.6	33
60 min Winter	61.987	0.0	1484.4	62
120 min Winter	36.315	0.0	1740.4	122
180 min Winter	26.561	0.0	1909.4	180
240 min Winter	21.275	0.0	2038.6	238

JPP Consulting Ltd		Page 2
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Storage Required	
Date 24/05/2024 12:22 File Cascade File.CASX	Designed by SF Checked by TL	
XP Solutions		Source Control 2020.1

Cascade Summary of Results for Pond Sizing (Sketch Scheme).SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
360 min Winter	99.957	0.957	21.1	1665.5	Flood Risk
480 min Winter	99.983	0.983	21.1	1709.6	Flood Risk
600 min Winter	99.994	0.994	21.1	1730.4	Flood Risk
720 min Winter	99.998	0.998	21.2	1736.2	Flood Risk
960 min Winter	99.981	0.981	21.1	1706.2	Flood Risk
1440 min Winter	99.937	0.937	21.1	1630.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
360 min Winter	15.561	0.0	2234.4	354
480 min Winter	12.464	0.0	2382.9	468
600 min Winter	10.493	0.0	2503.3	580
720 min Winter	9.116	0.0	2604.4	690
960 min Winter	7.252	0.0	2747.6	896
1440 min Winter	5.253	0.0	2922.9	1112

JPP Consulting Ltd		Page 3
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Storage Required	
Date 24/05/2024 12:22 File Cascade File.CASX	Designed by SF Checked by TL	
XP Solutions	Source Control 2020.1	

Cascade Rainfall Details for Pond Sizing (Sketch Scheme).SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	439400 302750 SK 39400 02750
C (1km)	-0.029
D1 (1km)	0.362
D2 (1km)	0.338
D3 (1km)	0.281
E (1km)	0.309
F (1km)	2.369
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	1440
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.431

Time (mins) Area
From: To: (ha)

0 4 2.431

JPP Consulting Ltd		Page 4
Cedar Barn White Lodge Walgrave Northampton NN6 9PY	26417 - Market Bosworth 1 in 100 Year + 40% CC Storage Required	
Date 24/05/2024 12:22 File Cascade File.CASX	Designed by SF Checked by TL	
XP Solutions		
Source Control 2020.1		

Source Control 2020.1

Cascade Model Details for Pond Sizing (Sketch Scheme).SRCX

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1740.0	1.000	1740.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0204-2120-1000-2120
Design Head (m)	1.000
Design Flow (l/s)	21.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	204
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	21.2
Flush-Flo™	0.345	21.1
Kick-Flo®	0.721	18.1
Mean Flow over Head Range	-	17.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.0	1.200	23.1	3.000	35.9	7.000	54.0
0.200	19.4	1.400	24.9	3.500	38.6	7.500	55.9
0.300	21.0	1.600	26.5	4.000	41.2	8.000	57.7
0.400	21.0	1.800	28.1	4.500	43.6	8.500	59.4
0.500	20.7	2.000	29.5	5.000	45.9	9.000	61.1
0.600	20.1	2.200	30.9	5.500	48.1	9.500	62.7
0.800	19.1	2.400	32.2	6.000	50.1		
1.000	21.2	2.600	33.5	6.500	52.1		