

Anzio Camp, Leek

Flood Risk Assessment & Drainage Strategy

December 2025

**Brownshore Management
Limited**

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1 INTRODUCTION

- 1.1.1 This Flood Risk Assessment (FRA) and Outline Drainage Strategy (DS) has been provided at the request of Brownshore Management Limited, hereafter referred to as “the client”, to assess the flood risks associated with the proposed development of Anzio Camp, Leek, hereafter referred to as “the site”.
- 1.1.2 The purpose of this FRA and DS is to:
- ▶ Identify the possible hazards posed from all major sources of flooding (fluvial, surface water, groundwater, infrastructural and coastal sources);
 - ▶ Provide a qualitative assessment of the probability of each potential flood hazard representing a constraint on the proposed development, based on the proposed land use type for the development and likelihood of flood occurrence;
 - ▶ Investigate and define any potential drainage impacts associated with the site;
 - ▶ Conceptually determine and define necessary surface water management controls to ensure no exacerbation of flood risk on the site or to external receptors due to any increase in surface water runoff; and
 - ▶ Recommend appropriate and necessary mitigation measures and additional assessments that may be required to progress the sustainable development of the site.
- 1.1.3 The FRA and DS comprises the following:
- ▶ A desktop review of publicly available information, including information from the Environment Agency (EA) and Staffordshire County Council who are the Lead Local Flood Authority (LLFA) for the proposed development area; and
 - ▶ An assessment and outline design of hydraulic controls and drainage requirements and drainage elements required to support the development of the site.
- 1.1.4 This report further details the methodologies employed within this study and provides recommendations as to any further work or investigations required to support the development of the site through the planning application process.

1.2 REGULATORY POLICY AND LEGISLATION

- 1.2.1 This assessment has been carried out in line with the current Government legislation, the National Planning Policy Framework (NPPF) 2024.
- 1.2.2 It has been assessed with reference to the following documents and legislative guidelines:
- ▶ CIRIA 753 The SUDS Manual V8 (2018);
 - ▶ DEFRA “Flood Risk Assessment Guidance for New Developments” (2006);
 - ▶ DEFRA “Surface Water Management Plan Technical Guidance” (2010);
 - ▶ BS 8533 2017 Assessing & Managing Flood Risk in Development Code of Practice (2017);
 - ▶ BS 8582:2013 Code of practice for surface water management for development Sites (2013);
 - ▶ National Planning Practice Guidance (2012 – updated 2022);
 - ▶ C624 Development and Flood Risk – Guidance for the Construction Industry’ (2004);
 - ▶ Sewage Sector Guidance (2022);
 - ▶ Planning Policy Guidance – Flood Risk and Climate Change (2014 – updated 2022).
- 1.2.3 In addition to the above, this report has also been informed by the following documents:
- ▶ Staffordshire Moorlands Local Plan 2020
 - ▶ Staffordshire Moorlands Level 1 Strategic Flood Risk Assessment 2015

1.3 SCOPE OF FLOOD RISK ASSESSMENT

- 1.3.1 The objective of this analysis and report is to provide an FRA in accordance with local and national guidance.
- 1.3.2 The detail and complexity of the FRA will reflect the level of risk to the site and consider the appropriateness of the proposed development type. This will also include assessment of potential risk to property and livelihoods, consideration of climate change, and the definition of appropriate flood risk mitigations required to satisfy the planning process.
- 1.3.3 Based on the assessment of requirements for a site-specific FRA as defined within NPPF 2024 technical guidance, the site is indicated as being located within Flood Zone 1, therefore it is necessary to provide a site-specific FRA. Flood Zone 1 refers to an area assessed as having less than 1 in 1,000 annual probability (<0.1%) of river or sea flooding in any one year.
- 1.3.4 Similarly, as the site is indicatively located in an area that may be subject to other assessable sources of flooding, such as pluvial (surface water) flooding, it is necessary to undertake a further site-specific assessment to verify the proposals for development.
- 1.3.5 Policy SD 5 of the Staffordshire Moorlands Local Plan states that all future development must ensure that:
 - ▶ The Council will follow a sequential approach to the management of flood risk. New development will be guided to the areas with the lowest risk of current and future flooding where this is viable and compatible with other policies aimed at achieving a sustainable pattern of development. The development of sites within areas at greater risk of flooding will only be considered where they are deemed acceptable due to national or other policies or material considerations.
 - ▶ All applicable development must be subject to a site-specific flood risk assessment which demonstrates that the development has been designed to be flood resilient and resistant and safe for its users for the lifetime of the development; in accordance with NPPF Policy. In addition, schemes in flood risk areas should demonstrate how the sequential approach has been used to locate the most vulnerable parts of the development in the areas of lowest flood risk. Where development sites are located in flood risk areas and/or affected by the presence of watercourses, the Council expects developers to undertake early discussions with the EA and the LLFA.
 - ▶ Where a watercourse is present on a development site, applicants will be expected to take opportunities to undertake river restoration and enhance natural river corridors where appropriate, in line with the Water Framework Directive, and to make space for water. The culverting of any watercourse will not normally be permitted and development should, wherever possible, open up any culverted watercourses to increase flood water storage and create a green corridor. More generally the Council will support the identification and implementation of natural flood management measures that will contribute towards delivering a reduction in local and catchment-wide flood risk and impacts of climate change and other multiple benefits.
 - ▶ All applicable developments should incorporate sustainable drainage measures (SuDS) to reduce the risk of flooding from surface water runoff and contribute to on-site flood alleviation, as well as contributing to wider Council objectives such as its emerging Green infrastructure Network; to enhancing biodiversity and recreation opportunities; landscape character etc. Developers should undertake early discussions with the LLFA to ensure that SuDs can be fully integrated into the final development layout.
 - ▶ Where appropriate suitable measures to deal with surface water arising from development proposals will be required to minimise the impact to and from new development. In such cases the Council will expect applicants to demonstrate how their proposals manage surface water run-off sustainably with discharge to the public sewer only being considered as a last resort, where, clear evidence must be demonstrated why alternative options are

not available. On greenfield sites developers should aim to not increase surface water runoff rates. On brownfield sites developers should aim to reduce surface water runoff to the greenfield rate wherever practical. Approved development proposals will be expected to be supplemented by appropriate maintenance and management regimes for surface water drainage. On larger sites involving phased development and/or involving multiple landowners the Council will where appropriate encourage applicants to engage in early discussion with utility providers and LLFA for the achievement of coordinated, holistic drainage strategies across the whole site over time.

- ▶ When considering planning applications, the Council will have regard to all relevant Catchment Flood Management Plans affecting the District. In all cases the Council will work with developers, stakeholders and landowners to encourage and promote implementation of natural flood risk management measures which will contribute towards flood risk reduction as well as achieve wider environmental benefits.

- 1.3.6 Potential flood risk at the site has been assessed against the site layout plan, which has been provided as [Appendix A](#) to this report. Significant changes to the site's developable area may necessitate a further review of this document to ensure that risk of flooding is not exacerbated and has been satisfactorily addressed within the development proposal.

1.4 SCOPE OF OUTLINE DRAINAGE STRATEGY

- 1.4.1 Surface water runoff must be effectively managed to ensure that there is no exacerbation of potential surface water flooding issues on the site, or at any external receptors, due to any potential increases in surface water runoff rates and volumes.
- 1.4.2 The drainage hierarchy will be applied in determining the most suitable type and point of discharge of surface waters runoff from impermeable areas on the site. This will ensure that surface water is sustainably managed on the site, and that there is no exacerbation of flood risk elsewhere as a result of undertaking the development. This will be undertaken in accordance with industry best practice principles and guidance, such as the C753 SUDS Manual (2016), Design and Construction Guidance for Sewage Sector (DCGSS) (2020) and applicable sections of the Planning Policy Guidance (PPG).
- 1.4.3 Any increase in surface water runoff rate associated with the development of the site must also be managed in accordance with the guidelines set by LPA, the LLFA for the area.
- 1.4.4 The outline DS will identify potential opportunities and locations for attenuation infrastructure, as well as potential connection points and provide calculations of permissible discharge rates for runoff generated on site.
- 1.4.5 The outline DS therefore aims to provide surety that any drainage provided as part of the project development can safely and appropriately convey all flows from the site to appropriate discharge locations. This is to ensure sustainable and safe operation within the site, as well as ensuring sustainable operation of any receiving infrastructure. These assessments have been undertaken in accordance with prescribed best practice and building codes, including prioritising the incorporation of SuDS, where appropriate and practicable for the management of surface water.
- 1.4.6 Following the completion of a final site masterplan the drainage scheme proposed within this report should be reassessed to ensure surface water runoff and foul water drainage can be appropriately managed in accordance with best practise and local and national standard requirements.

2 METHODOLOGY

2.1 INTRODUCTION

- 2.1.1 This report aims to demonstrate that the proposed development is sustainable and will not be impacted by or exacerbate flood risk elsewhere through the development of the site. This assessment will account for the effects of climate change, as well as identifying further opportunities to reduce the probability and consequences of flooding within the site locality.
- 2.1.2 This report aims to identify constraints and opportunities for the site based on the development proposals provided by the client ([Appendix A](#)) and provide recommendations for the sustainable provision of drainage and mitigation of any potential flood risk for the site.
- 2.1.3 The assessment methodology is as follows:
- ▶ Desktop review of the geology, hydrology, and other pertinent environmental characteristics of the site, and how these affect flood risk of the proposed development and site drainage.
 - ▶ Obtain and review existing baseline flood risk and drainage guidance information from relevant environmental authorities (EA, LLFA, etc.) as to site specific flood risk from all applicable sources.
 - ▶ Review the findings from the above and advise on the suitability of developing the site for the proposed development in consideration of the applicable flood risk and comment on limitations and opportunities for the site, with recommendations of further mitigation where applicable and appropriate.
 - ▶ Produce indicative design calculations for the Outline DS to determine the requirements for developing the site's surface water drainage and providing adequate storage in line with local planning policy and guidance. This will include the presentation of drawings with an indicative layout for any additional drainage and attenuation infrastructure located on the site.
 - ▶ Review the findings from the above and advise on the suitability of developing the site for the proposed development in consideration of the applicable flood risk and drainage and comment on limitations and opportunities for the site, with recommendations of further mitigation where applicable and appropriate.

3 PROJECT BACKGROUND

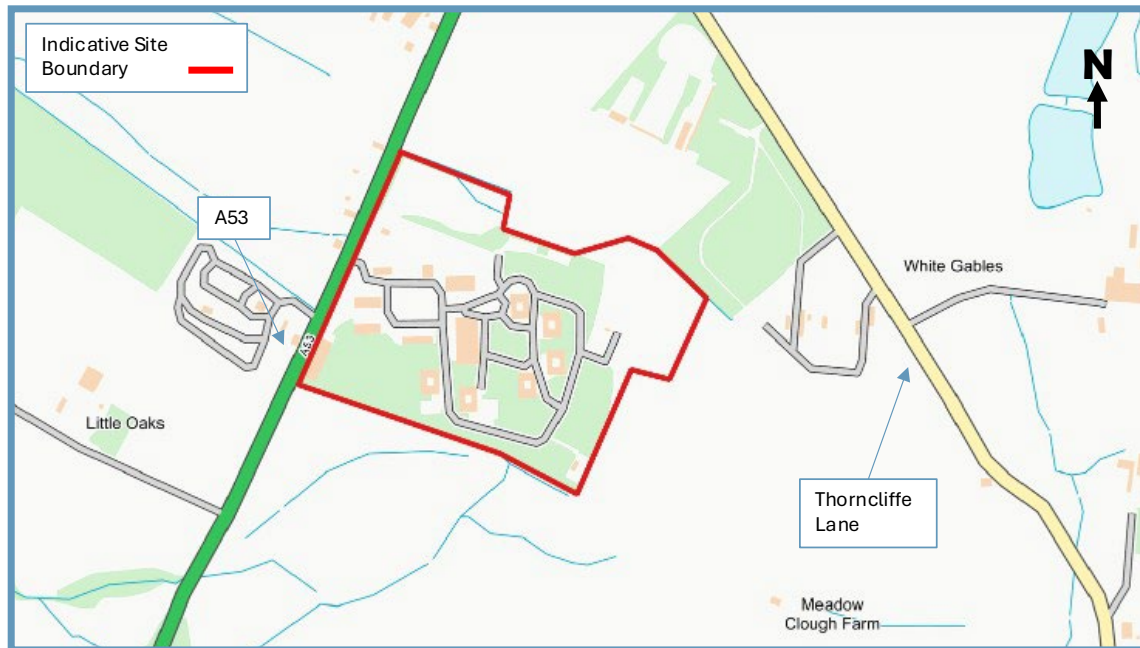
3.1 DEVELOPMENT DESCRIPTION AND LOCATION

- 3.1.1 Andrew Moseley Associates (AMA) was appointed by Brownshore Management Limited to provide a Flood Risk Assessment and Drainage Strategy in support of the redevelopment of the Anzio site, located at Anzio Camp, Blackshaw Moor, Leek, ST13 8TL at NGR: SK 00655 59067.
- 3.1.2 The proposed development is located in the area of Leek, approximately 12 miles northeast of Stoke-on-Trent. Proposals for the site are for mixed use, consisting of 282 residential units and supporting retail development, with associated hardstanding, landscaping and infrastructure. A site layout can be found in [Appendix A](#).
- 3.1.3 The Local Planning Authority for this development is Staffordshire Moorlands District Council, and the Lead Local Flood Authority for the area is Staffordshire County Council.
- 3.1.4 This report has been prepared in accordance with the National Planning Policy Framework (NPPF) and the accompanying technical guidance to assess all forms of flooding including the management of surface water on-site.
- 3.1.5 The site is referenced in [Table 3-1](#) and [Figure 3-1](#) below.

Table 3-1 Site Context

Site Name	Anzio Camp
Location	Leek
NGR (approx..)	SK 00655 59067
Application Site Area (ha)	12.0
General Locality	The site is located on a former military facility and borders undeveloped land to the north, east and south, and the A53 to the west. Pedestrian and vehicular access to the site is provided via the A53, which is located along the western boundary of the site.
Development Type	Mixed Use
EA Flood Zone	Flood Zone 1
Local Planning Authority	Staffordshire Moorlands District Council

Figure 3-1 Site Location Plan



3.2 TOPOGRAPHY

- 3.2.1 A topographic survey provided by the client and undertaken by Corporate Architecture Limited Chartered Architects (ref: 3262/SM/11/0002) shows ground levels at the site to be in the region of 95.5 to 121.2 m Above Ordnance Datum (m AOD). The topographic survey can be seen in [Appendix B](#).
- 3.2.2 Further review of topographical data shows site levels to be lowest in the southwest of the site, while greatest levels are located in the northeast. A general fall in gradient from northeast to southwest is observed across the site.
- 3.2.3 As indicated by aerial imagery, the previously developed site consists of areas of hardstanding which make up approximately 50% of the site, with the remainder consisting of grass land consisting of medium density vegetation.

3.3 GEOLOGY AND GROUND CONDITIONS

- 3.3.1 British Geological Survey (BGS) Open Geoscience website indicates that the entire site is underlain by Morridge Formation – Mudstone, siltstone and sandstone, with overlying superficial deposits of Till, Devensian - Diamicton.
- 3.3.2 The BGS website information indicates that there is a borehole record (ref: SK05NW20) located adjacent to the site frontage to the west however, the record is not available.
- 3.3.3 Information obtained from the Cranfield University's Soilscape website indicates that the northwest of the site is located in an area classified as being Soilscape 19, which is defined as having slowly permeable wet very acid upland soils with a peaty surface. The southeast of the site is located in an area classified as being Soilscape 17, which is defined as having slowly permeable seasonally wet acid loamy and clayey soils.

3.4 HYDROGEOLOGY

- 3.4.1 According to the Department for Environment, Food and Rural Affairs (DEFRA) MAGIC map, the site is indicated as not being located in a Groundwater Source Protection Zone (SPZ), as defined by the Environment Agency (EA) for the protection of a potable groundwater supply.

- 3.4.2 The site is located as being in an area of low to medium groundwater vulnerability and located above a Secondary A bedrock aquifer and a Secondary superficial drift aquifer.

3.5 HYDROLOGY

- 3.5.1 As shown in [Figure 3-2](#), there are a number of unnamed watercourses within the vicinity of the site, including one located along the northeast and northwest boundaries of the site, 10m west of the site, and in the southeast corner of the site. An additional watercourse can also be seen through the north of the site within the topographic survey in [Appendix B](#), as well as along the western boundary of the site. These watercourses all appear to flow west towards the Tittlesworth Reservoir, which is located approximately 1.3 km west of the site.
- 3.5.2 The EA's Catchment Data Explorer website indicates that the site resides within the Churnet Rivers and Lakes operational catchment and the Churnet from Meerbrook to Leekbrook sub catchment.

Figure 3-2 Watercourse Location



4 POTENTIAL FLOOD RISK

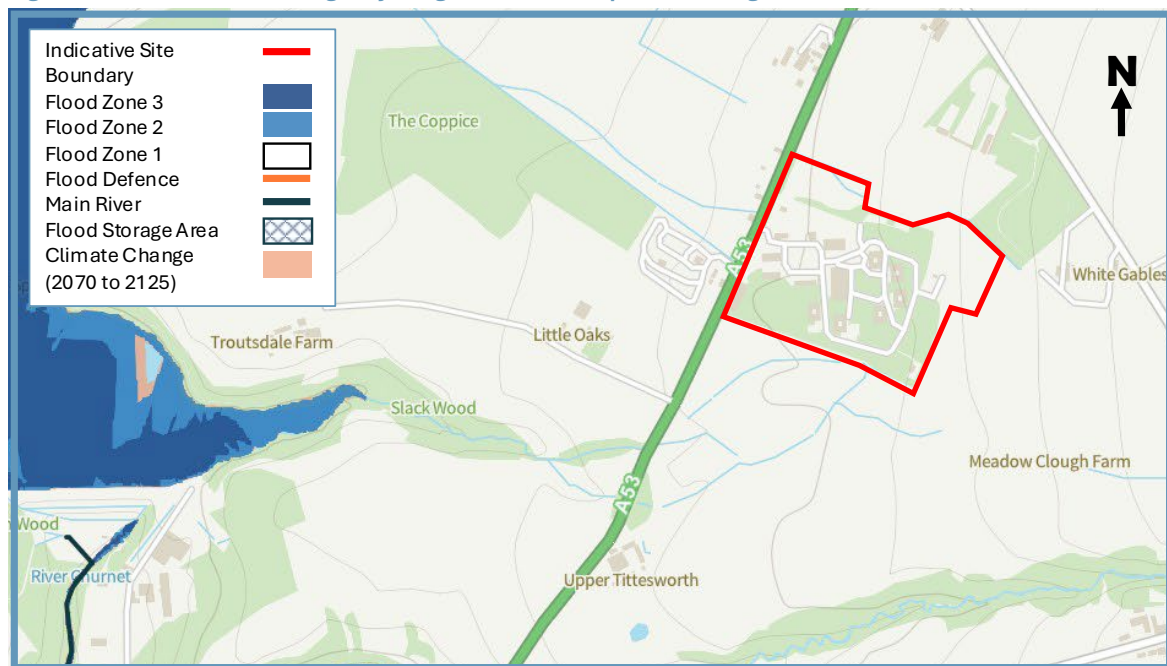
4.1 SOURCES OF FLOODING

- 4.1.1 This report is to consider flood risk from all potential sources. [Section 5](#) then discusses in further detail the probability of flooding, any potential impacts and necessary mitigation, where required.

4.2 ENVIRONMENT AGENCY FLOOD ZONES

- 4.2.1 The EA Flood Map for Planning shows the site is located within Flood Zone 1, which is designated as land having less than a 1 in 1000 probability of river or sea flooding.
- 4.2.2 This potential fluvial/coastal flood risk to the site has been illustrated in [Figure 4-1](#).

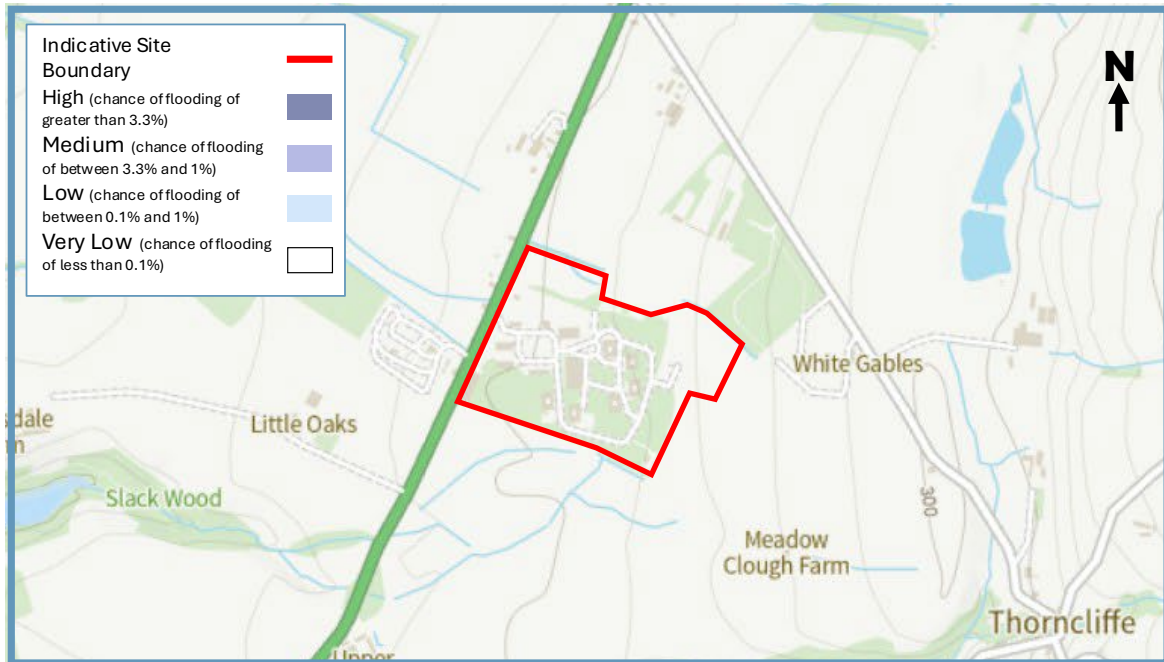
Figure 4-1 Environment Agency Long Term Flood Map for Planning



4.3 FLUVIAL AND COASTAL FLOODING

- 4.3.1 It is necessary to consider the risk of fluvial and coastal flooding at the site during both present times and with the impacts of climate change. Therefore, the EA Long Term Flood Risk Map for fluvial and coastal flooding between the years 2036 and 2069 has been presented below in [Figure 4-2](#). This figure indicates that the site is at very low risk of fluvial and/or coastal flooding.

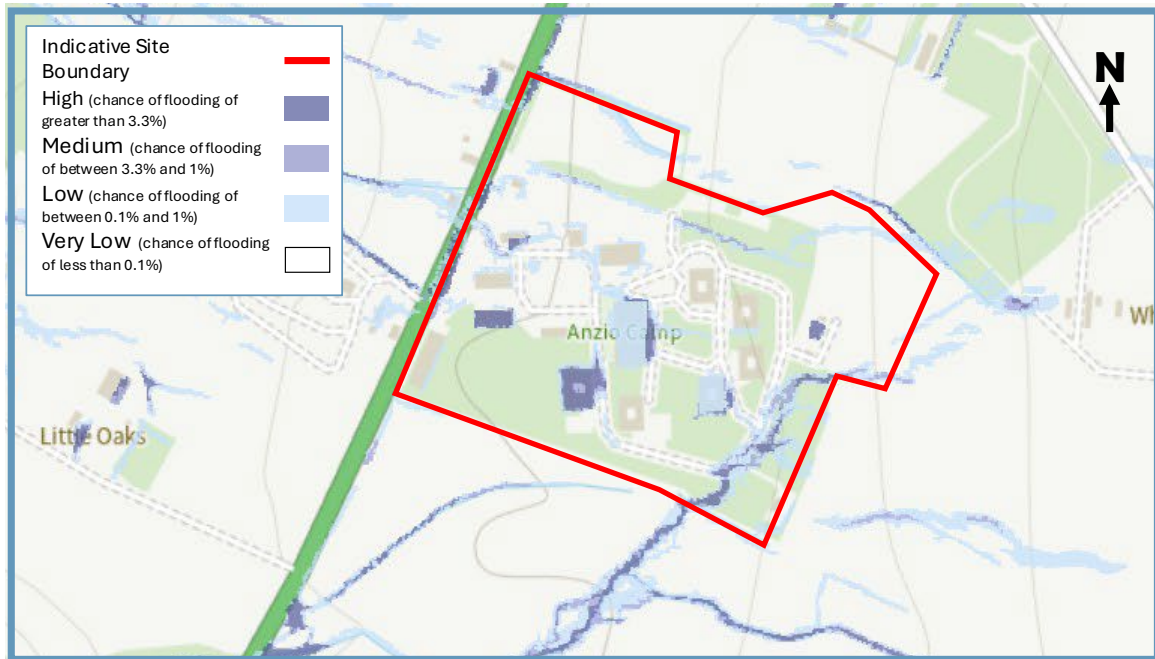
Figure 4-2 Environment Agency Long Term Flood Map – Rivers and Sea – Yearly Chance of Flooding between 2036 and 2069



4.4 PLUVIAL (SURFACE WATER) FLOODING

- 4.4.1 Similarly to that discussed in [Section 4.3](#), the impacts of climate change on the potential for surface water flooding should be considered within the assessment of the flood risk at the site. The EA Long Term Flood Risk Map for surface water flooding between the years 2040 and 2060 is shown below in [Figure 4-3](#). This figure shows that the majority of the site is located in an area at very low risk of surface water flooding, with a number of areas throughout the site being at low to high risk of surface water flooding.
- 4.4.2 Potential flood depths vary across the site, with a maximum of 0.90m in the far east of the site. Upon comparison to the site layout plan, this is identified as being an area of open space within the proposed development.
- 4.4.3 There are minor areas in the south and centre of the site which are at low risk of experiencing flood depths of 0.60m. There are wider areas spread across the site at a low to high risk of experiencing flood depths of 0.30m.
- 4.4.4 In order to further understand the potential impact of surface water flooding on the proposed development, the extent of surface water flooding at 0.30m depth has been overlaid with the site layout plan and provided in [Appendix C](#). This shows that there are very few plots within the site which are at risk of experiencing surface water flooding. Recommended mitigation measures are further discussed in [Section 6](#) of this report.
- 4.4.5 As the proposed development of the site may potentially reduce the overall site permeability and potentially increase surface water run-off rates and volumes, the surface water discharge controls must ensure that any proposal for drainage, or discharge, does not adversely impact upon downstream drainage infrastructure or offsite receptors.
- 4.4.6 The site is therefore considered to have medium potential risk of flooding from pluvial sources.

Figure 4-3 Environment Agency Long Term Flood Risk Map – Pluvial (Surface Water) Flooding – Yearly Chance of Flooding between 2040 and 2060



4.5 GROUNDWATER FLOODING

- 4.5.1 Ground conditions in the northwest of the site is located in an area classified as being Soilscape 19, which is defined as having slowly permeable wet very acid upland soils with a peaty surface. The southeast of the site is located in an area classified as being Soilscape 17, which is defined as having slowly permeable seasonally wet acid loamy and clayey soils, therefore the propensity for groundwater emergence at the site is considered to be medium, and the potential risk of groundwater emergence affecting the site development is considered to be low.
- 4.5.2 However, given the impermeable nature of the proposed site's hardstanding areas subsequent to development, potential elevation of groundwater or groundwater emergence within the superficial geology causing flooding within the site post-development will be largely eliminated.
- 4.5.3 According to the Staffordshire Moorlands Level 1 SFRA, there is no major problems identified within the area with regard to groundwater flooding, and only one incident of potential groundwater flooding has been recorded. The Areas Susceptible to Groundwater Flooding map provided in [Appendix D](#) shows the north of the site as being over 75% susceptible to groundwater flooding, and the south as being between 25% and 50% susceptible to groundwater flooding, likely due to the sites proximity to the Tittesworth Reservoir.
- 4.5.4 During long periods of heavy rainfall, the water table within an area can rise above the natural ground level, resulting in groundwater flooding.
- 4.5.5 Site specific investigations should be able to prove the presence of ground water and propose remedial mitigation where required. Flood risk to the proposed development due to groundwater emergence is therefore considered to be low.
- 4.5.6 Flood risk to the proposed development due to groundwater emergence is considered to be low provided that all reasonable and practicable mitigation measures for any subsurface construction associated with the development are adhered to.

4.6 FLOODING FROM ARTIFICIAL SOURCES

- 4.6.1 In accordance with information taken from the EA Long Term Flood Risk information, the site and its surroundings are unlikely to experience flooding from artificial sources such as dam or canal failure. In

addition, reservoirs and canals are regularly maintained by relevant local authorities and failure is extremely unlikely. Therefore, the potential risk of flooding from reservoir and/or canal failure is considered to be negligible.

4.7 FLOODING FROM SEWERS

- 4.7.1 As the site is previously developed, it is assumed that there is existing drainage infrastructure within the site. There is no evidence of historic sewer flooding within the site following review of the Staffordshire Moorlands Level 1 SFRA Sewer Flood Event map provided in [Appendix E](#).
- 4.7.2 The site is therefore considered to have very low potential risk of flooding from sewer flooding.

4.8 HISTORIC FLOODING

- 4.8.1 The EA historic flood map shows the site to not have experienced historic flooding.
- 4.8.2 A review of the Staffordshire Moorlands Level 1 SFRA Historic Flood Events map provided in [Appendix F](#), confirms the EA historic flood mapping and indicates that the site has not experienced any historic flooding.

5 FLOOD RISK ASSESSMENT

5.1 FLOOD RISK PLANNING POLICY

National Planning Policy Framework

- 5.1.1 The National Planning Policy Framework (NPPF) sets out the Government's national policies on different aspects of land use planning in England in relation to flood risk. Planning Practice Guidance is also available online.
- 5.1.2 The Planning Practice Guidance sets out the vulnerability to flooding of different land uses. It encourages development to be located in areas of lower flood risk where possible and stresses the importance of preventing increases in flood risk off site to the wider catchment area.
- 5.1.3 The Planning Practice Guidance also states that alternative sources of flooding, other than fluvial (river flooding), should also be considered when preparing a Flood Risk Assessment.
- 5.1.4 This Flood Risk Assessment is written in accordance with the NPPF and the Planning Practice Guidance.
- 5.1.5 The EA Flood Map for Planning locates the site within Flood Zone 1, i.e. land assessed as having less than 1 in 1,000 annual probability (<0.1%) of river or sea flooding in any one year.
- 5.1.6 The flood map extents indicated on this map show the potential for flooding from fluvial and coastal sources, and although they are indicative, they are a key tool in defining the appropriateness of a development type or the requirement for further assessment.
- 5.1.7 Under the NPPF (2024), Flood Zone 1 is defined as having a low probability flood risk. The proposed development includes of 282 residential units and supporting retail development, with associated hardstanding, landscaping and infrastructure, which are defined within Table 2 of the NPPF technical guidance as being 'More Vulnerable'. Therefore, according to the criteria in Table 3 of the NPPF Technical Guidance (Flood Risk Vulnerability and Flood Zone 'Compatibility'), the proposed development may be deemed as 'Appropriate'.

5.2 SEQUENTIAL AND EXCEPTION TEST

- 5.2.1 Both the NPPG and the SFRA require the 'Sequential Test' to be applied to ensure that proposed developments are carried out in area that are at the least risk of flooding, before considering development in areas that are at risk of flooding. The proposed site falls within Flood Zone 1 and is considered to come under the 'More Vulnerable' category as a mixed use development.
- 5.2.2 Based on Table 3 in the National Planning Practice Guidance for Flood Risk and Coastal Change, the proposed use of the site is acceptable due to it being located in Flood Zone 1 and an Exception Test is not required.

Table 5-1 Development Appropriateness Based on Vulnerability and Flood Zones

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	✓	Exception test required	✓	✓
Flood Zone 3a	Exception test required	✓	x	Exception test required	✓
Flood Zone 3b	Exception test required	✓	x	x	x

5.3 CONCLUSION

- 5.3.1 In light of this assessment against the sites applicable flood zone (Flood Zone 1), further assessment against the sequential or exception test is not required.
- 5.3.2 **Table 5-2** summarises the pre mitigation flood risk associated with the site as well as the impacts of the flood risk on the wider catchment prior to mitigation. The mitigation measures proposed to address flood risk issues and ensure the development is appropriate for its location are discussed within **Section 6**.

Table 5-2 Pre-Mitigation Flood Risk Summary

Sources	Probability of Flood Risk	Impacts	Description
Tidal	N/A	N/A	The site is located inland and therefore, is not tidally influenced.
Fluvial	Very Low	Very Low	The site is not shown to be located in an area susceptible to fluvial flooding.
Surface Water (Pluvial)	Medium	Low	Review of information from multiple sources (EA, LLFA) reveals evidence of surface water flooding across the site, with maximum flood depths of 0.60m in the developable areas, and 0.90m within open space of the proposed development.
Groundwater	Medium	Low	The site is shown to be at risk of groundwater flooding; however, given the hardstanding nature of the site following development, groundwater emergence at the site will be limited.
Artificial Sources	Very Low	Very Low	Review of information from multiple sources (EA, LLFA) reveals no evidence of flooding from reservoirs or canals.
Sewers	Very Low	Very Low	The risk of flooding from the surcharging of sewers is considered to be low.
Effect of development on wider catchment	Low	Low	The impermeable area of the site is being altered.

- 5.3.3 Based on the assessable information presented, the site is considered to meet the requirements of the NPPF, given the assessed potential flood risk posed from all applicable sources, the means of adopting suitable mitigation measures to prevent increase in the potential for flood risk and based on the vulnerability of the development type. Further consideration of necessary surface water run-off

mitigation measures will be provided, so as to address the potential for increase of surface water arising from the proposed development of the site.

6 FLOOD RISK MITIGATION

6.1 INTRODUCTION

- 6.1.1 **Section 4** has identified the sources of flooding which could potentially pose a risk to the site and the proposed development. This section of the FRA sets out the mitigation measures which are to be considered within the proposed development detail design to address and reduce the risk of flooding to within acceptable levels.

6.2 EFFECT OF DEVELOPMENT ON WIDER CATCHMENT

Development Drainage

- 6.2.1 The current site is considered to be brownfield. The amount of impermeable area will be altered. Therefore, the existing drainage systems will not be suitable to discharge the surface water from the site alongside the additional run-off from the proposed development. A sufficient drainage strategy will be therefore provided by AMA.

6.3 SITE ARRANGEMENTS

Sequential Arrangement

- 6.3.1 The Flood Zone mapping shows the site to be located within Flood Zone 1. Therefore, a Sequential Test has not been completed for this site.

Finished Floor Levels

- 6.3.2 Given the site's location within Flood Zone 1, there are no specific requirements for finished floor levels with regard to flood risk. However, it is recommended that an FFL of 0.15m is set for the proposed development.
- 6.3.3 As discussed, there are a number of plots identified as being at risk of surface water flooding within the site. As such, the plots identified as being at risk within **Appendix C** of this report should have an FFL of at least 0.30m above adjacent ground level.

7 FOUL WATER DRAINAGE

7.1 INTRODUCTION

- 7.1.1 It is proposed to install a new foul drainage system to serve the proposed mixed use development.
- 7.1.2 The foul water system will be designed and constructed in accordance with the current Building Regulations, BS EN:752 'Drainage and Sewer Systems Outside Buildings', the Local Authority Building Control specifications and requirements, Sewers for Adoption 8th Edition and the Civil Engineering Specification for the Water Industry.

7.2 EXISTING SEWERS

- 7.2.1 AMA attained a Severn Trent Water pre-development enquiry which can be seen in [Appendix G](#). The sewer map provided by Severn Trent Water does not show any public sewers located within the site.
- 7.2.2 As the site is brownfield, it is assumed that there is existing drainage infrastructure within the site. This should be confirmed via a CCTV drainage survey.

7.3 FOUL WATER DISCHARGE RATES

- 7.3.1 The estimate design Dry Weather Flow (DWF) generated by the proposed development, based on a gravity system, has been calculated as 13.1 litres per second.
- 7.3.2 This figure is based on 282 dwellings at 4,000 litres per dwelling as prescribed in Sewers for Adoption, as well as retail facilities based on an estimate of 15 full time day staff at 90 litres per person per day as prescribed in British Water Flows and Loads.

7.4 FOUL WATER CAPACITY AND POINT OF CONNECTION

- 7.4.1 Severn Trent Water have advised that foul water can discharge to the existing 150mm foul water sewer located adjacent to the west of the site, located within the A53. They have not advised of any known capacity issues with the public sewer network in the area which would hinder development at the site.
- 7.4.2 No depth/level information is available for these sewers and therefore further survey work in the form of a drainage CCTV and tracing survey will be required to confirm whether a gravity connection will be feasible.
- 7.4.3 Any proposed connection onto the public recorded sewers will require a S106 connection application.

8 SURFACE WATER DRAINAGE STRATEGY

8.1 INTRODUCTION

- 8.1.1 The National Planning Policy Framework (NPPF) and accompanying Technical Guidance indicate that surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management.
- 8.1.2 Consideration should therefore firstly be given to using sustainable drainage (SuDS) techniques including soakaways, infiltration trenches, permeable pavements, grassed swales, ponds and wetlands to reduce flood risk by attenuating the rate and quantity of surface water run-off from a site. This approach can also offer other benefits in terms of promoting groundwater recharge, water quality improvement and amenity enhancements. Approved document Part H of the Building Regulations (2015) sets out a hierarchy for the disposal of surface water which encourages a SuDS approach.

8.2 OVERVIEW AND CONCEPT

- 8.2.1 As detailed in [Section 3.1](#), development proposals for the site consist of mixed use, consisting of consisting of 282 residential units and supporting retail development, with associated hardstanding, landscaping and infrastructure. The site plan shows the developable area of the site to be restricted to the red line boundary, as shown in [Appendix A](#), with an approximate total developable area of 12 ha.
- 8.2.2 Review of the site plan shows proposals to consist of an approximate total impermeable area of 7.32 ha, which equates to approximately 61% of the total proposed developable area ([Table 8-1](#)).
- 8.2.3 It is considered that green open space and landscaped areas will not produce or contribute run-off to the surface water management infrastructure proposed as part of this strategy. This has been taken into account when deriving the impermeable area for the site.

Table 8-1 Contributing Surface Water Drainage Areas

Drainage Area	Area (ha)	% Impermeable	Contributing area
Green open spaces and landscape areas	4.68	0	0
Access Roads	2.56	100	2.56
Dwellings	4.60	100	4.60
Retail	0.16	100	0.16
Totals	12.0	-	7.32

8.3 PRE-DEVELOPMENT SURFACE WATER RUN-OFF

Brownfield

- 8.3.1 As the site is a previously developed, brownfield site, with existing structures pre-development surface water drainage will be based upon the Modified Rational Method (MRM). Based on the redevelopment to the existing structure, it is noted that there may be requirements to improve the surface water drainage to effectively drain the site.
- 8.3.2 As discussed previously in this report the total site area marked out by the red line boundary found in [Appendix A](#) is 12 ha with a total impermeable area of 7.32 ha. The pre-development surface water run-off will be based upon the existing impermeable area 2.76 ha. Therefore:
- ▶ The total impermeable area (Pre-Development) of the site is 2.76 ha.
 - ▶ The estimated peak flow rate for the site for a 50 mm / event is defined below using the Modified Rational Equation method.

8.3.3 $Q = C i A$

8.3.4 Where:

- ▶ Q = Flow rate in m^3/sec
- ▶ C = site impermeability or run-off coefficient = estimated as 100% or 1
- ▶ i = rainfall intensity = 50 mm/hr
- ▶ A = impermeable site area producing run-off = 2.76 ha or 27,600 m^2

8.3.5 The peak run-off rate using the above defined equation would therefore be:

- ▶ $Q = 1.00 \times 50 \times 2.76$ (impermeable area in ha) $\times 2.78 = 383.64$ l/s

8.3.6 As shown above the peak run-off rate for the site using the modified rational method is estimated to be 383.64 l/s.

8.3.7 Provision of suitable controls for the management of the on-site surface water run-off may be developed in conjunction with the future masterplan and existing site levels, especially if the footprints of development change meaning an increase in impermeable areas. Additional investigation would then need to be undertaken to determine if the site required betterment and attenuation.

8.4 GROUNDWATER PROTECTION

8.4.1 The proposed development site is not identified as being within a groundwater source protection zone (SPZ), as such no special measures are required to prevent risk to drinking water supplies.

8.5 METHODS OF SURFACE WATER MANAGEMENT

8.5.1 There are three methods that have been reviewed for the management and discharge of surface water which are detailed below; these may be applied individually or collectively to form a complete strategy. They should be applied in the order of priority as listed:

- ▶ Discharge via Infiltration
- ▶ Discharge to a Watercourse
- ▶ Discharge to Surface Water Sewer or Highway Drain
- ▶ Discharge to Public Sewer

8.6 INFILTRATION

8.6.1 Any impermeable areas that can drain to a soakaway or an alternative method of infiltration would significantly improve the sustainability of any surface water systems.

8.6.2 The British Geological Society (BGS) Geology of Britain Viewer indicates that the entire site is underlain by Morridge Formation – Mudstone, siltstone and sandstone, with overlying superficial deposits of Till, Devensian - Diamicton.

8.6.3 Information obtained from the Cranfield University's Soilscape website indicates that the northwest of the site is located in an area classified as being Soilscape 19, which is defined as having slowly permeable wet very acid upland soils with a peaty surface. The southeast of the site is located in an area classified as being Soilscape 17, which is defined as having slowly permeable seasonally wet acid loamy and clayey soils.

8.6.4 From a desktop review of the geology and soil at the site, it is believed that infiltration would not be an acceptable way of discharging surface water from the site.

8.6.5 Percolation testing has not yet been carried out on this site. It is recommended that infiltration testing to BRE 365 digest is undertaken as part of any future site investigations works at the site so that this can be used as satisfactory evidence for the LLFA or Severn Trent as necessary. The results of a percolation test will also be required to produce infiltration/soakaway designs.

8.7 WATERCOURSE

- 8.7.1 As discussed in [Section 3.5](#) there are a number of unnamed watercourses within the vicinity of the site, including one located along the northeast and northwest boundaries of the site, 10m west of the site, and in the southeast corner of the site. An additional watercourse can also be seen through the north of the site within the topographic survey in [Appendix B](#), as well as along the western boundary of the site. These watercourses all appear to flow west towards the Tittlesworth Reservoir, which is located approximately 1.3 km west of the site.
- 8.7.2 As the site is in close proximity to a number of watercourses, it would be possible to discharge surface water from the site into a watercourse.
- 8.7.3 AMA contacted the LLFA regarding a potential outfall to one of the watercourses surrounding the site however, at the time of writing this report, no response has been received. This correspondence can be found in [Appendix H](#).
- 8.7.4 It can be seen within the topographic survey in [Appendix B](#) that there are a number of existing outfalls from the site to the watercourse located along the western boundary of the site. As such, an existing outfall could be utilised within the proposed drainage strategy for the site, subject to confirmation of condition of the existing outfalls. Further investigation into the capacity and condition of the ditch will be required.

8.8 PUBLIC SEWERS

- 8.8.1 As a last resort and following the hierarchy of surface water, disposal discharge to the public sewer system may need to be considered.
- 8.8.2 In the Severn Trent Water pre development enquiry ([Appendix G](#)) they state that the SuDS hierarchy should be followed, and in the event that soakaways are unfeasible for the development then discharging to a surrounding watercourse should be confirmed. Severn Trent Water state that though flows are to be agreed with the LLFA, the flows should be in line with greenfield rates of 5 l/s/ha.
- 8.8.3 Additionally, the sewer map provided by Severn Trent Water does not show a surface water or combined sewer in close proximity to the site that would be able to accept surface water flows from the site.
- 8.8.4 Therefore, it would not be possible to discharge surface water from the site into a public sewer.

8.9 PROPOSED DISCHARGED RATES

- 8.9.1 Surface water from the site will be discharged via an outfall to the watercourse along the western boundary of the site.
- 8.9.2 As the site will be drained by discharging surface water into the watercourse, surface water will be restricted to 60 l/s, based on 5 l/s/ha as the greenfield rate for the site.

8.10 ATTENUATION REQUIREMENTS

- 8.10.1 As discussed earlier the site will be drained into a watercourse at a restricted discharge rate of l/s. Therefore, attenuation will have to be provided.
- 8.10.2 Causeway Flow drainage design software has been used to estimate the maximum storage volume required on-site for the 100-year storm event plus 40% (30% allowance for climate change and 10% for urban creep). The results of these calculations can be found in [Appendix I](#).

Total Impermeable Area

- 8.10.3 This volume is based on providing attenuation to discharge surface water at a rate of 60 l/s. The attenuation volume required can be found in [Table 8-2](#) below.

Table 8-2 Attenuation Volume

Gross Area (ha)	Max Discharge (l/s)	Imp. Area (ha)	Q100+40% Volume (m ³)
12.0	60.0	7.32	6420

8.11 DRAINAGE NETWORK

- 8.11.1 The final surface water drainage network servicing the site should ideally consist of permeable paving to limit the run-off from any paved areas, whilst extending time of concentration for discharge to the accompanying drainage network.
- 8.11.2 For any portion of the network crossing a highway or an area to be trafficked by heavy grade vehicles (HGV's), a minimum cover requirement of 1.20 m below cover level should be provided where practically possible for the internal drainage network to satisfy Sewers for Adoption standards.
- 8.11.3 Proposals for the drainage network are to discharge to the unnamed ditch located along the western boundary of the site through an existing outfall.

9 SUSTAINABLE DRAINAGE SYSTEMS

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

9.2 SUSTAINABLE DRAINAGE (OVERVIEW)

- 9.2.1 Drainage systems can contribute to sustainable development and improve urban design, by balancing the different issues that influence the development of communities. Approaches to manage surface water that take account of water quantity (flooding), water quality (pollution) and amenity issues are collectively referred to as Sustainable Drainage Systems (SuDS).
- 9.2.2 SuDS mimic nature and typically manage rainfall close to where it falls. SuDS can be designed to slow water down (attenuate) before it enters streams, rivers, and other watercourses, they provide areas to store water in natural contours and can be used to allow water to soak (infiltrate) into the ground or evaporated from surface water and lost or transpired from vegetation (known as evapotranspiration).
- 9.2.3 SUDS are technically regarded as a sequence of management practices, control structures and strategies designed to drain surface water efficiently and sustainably, while minimising pollution and managing the impact on water quality of local water bodies.
- 9.2.4 SuDS are more sustainable than traditional drainage methods because they:
- ▶ Manage runoff volumes and flow rates from hard surfaces, reducing the impact of urbanisation on flooding,
 - ▶ Protect or enhance water quality (reducing pollution from runoff),
 - ▶ Protect natural flow regimes in watercourses,
 - ▶ Are sympathetic to the environment and the needs of the local community,
 - ▶ Provide an attractive habitat for wildlife in urban watercourses,
 - ▶ Provide opportunities for evapotranspiration from vegetation and surface water,
 - ▶ Encourage natural groundwater/aquifer recharge (where appropriate),
 - ▶ Create better places to live, work and play.

9.3 SUDS PRINCIPALS

- 9.3.1 Sustainable drainage is a departure from the traditional approach to draining sites. There are some key principles that influence the planning and design process enabling SuDS to mimic natural drainage by:
- ▶ Storing runoff and releasing it slowly (attenuation)
 - ▶ Allowing water to soak into the ground (infiltration)
 - ▶ Slowly transporting (conveying) water on the surface
 - ▶ Filtering out pollutants
 - ▶ Allowing sediments to settle out by controlling the flow of the water

- 9.3.2 The above was replicated from www.susdrain.org.

9.4 SUDS TECHNIQUES

- 9.4.1 The following table is a list of SuDS features that may/may not be feasible for the proposed site.

Table 9-1 SuDS Feasibility Table

SuDS Technique	Can they be feasibly incorporated into the site?	Comments
Green Roofs	✗	The sloping roofs of the proposed development would not permit a green roof design.
Basins and Ponds	✓	The proposed development could be designed to incorporate these elements due to site constraints such as the topography.
Filter Strips, Swales and Bio-Retention	✓	The proposed development could be designed to incorporate these elements due to site constraints.
Infiltration Techniques	✗	Desktop review of the available data indicate that infiltration would not be feasible at the site.
Permeable Surfaces and Tree Pits	✓	Surfacing of the external areas could be in a permeable material, such as permeable paved access roads and driveways.
Rainwater Harvesting	✓	New roofs could be directed to rainwater harvesting tanks for reuse.

10 SUMMARY

- 10.1.1 The proposals for the site are for mixed use, consisting of 282 residential units and supporting retail development, with associated hardstanding, landscaping and infrastructure.
- 10.1.2 The site is in an area identified as having a low probability of flooding on the EA Flood Map and is located in Flood Zone 1.
- 10.1.3 Review of information from multiple sources (EA, LLFA) reveals evidence of surface water flooding across the site, with maximum flood depths of 0.60m in the developable areas, and 0.90m within open space of the proposed development.
- 10.1.4 The site is shown to be at risk of groundwater flooding; however, given the hardstanding nature of the site following development, groundwater emergence at the site will be limited.
- 10.1.5 The site is identified as not being at risk of tidal, fluvial, artificial source or sewer flooding.
- 10.1.6 It is recommended that FFLs of dwellings not affected by surface water flooding are set at a minimum of 0.15m above adjacent ground level, and dwellings located in an area at risk of surface water flooding should have an FFL of at least 0.30m above adjacent ground level.
- 10.1.7 As with any drainage system, blockages within the surface water sewer systems constructed to serve the development has the potential to cause flooding or disruption. Any drainage systems which are not to be offered for adoption to either the Water Company or the Local Authority will have a suitable maintenance regime scheduled, and an appropriate management company appointed to carry out the works.
- 10.1.8 The primary option for surface water disposal is to use outfall to a watercourse.
- 10.1.9 From a desktop review of ground conditions at the site, infiltration methods have been deemed unsuitable in draining surface water from the site.
- 10.1.10 There is a suitable watercourse in the vicinity of the site which could be utilised to dispose of surface water from the site. It is proposed that surface water will discharge through an outfall to the unnamed watercourse located along the western boundary of the site.
- 10.1.11 There is not a suitable public sewer in the vicinity of the site which could be utilised to dispose of the surface water as Severn Trent Water has stated that there are no surface water or combined water sewers in close proximity to the site to accept surface water flows.
- 10.1.12 Attenuation is required as the means of surface water disposal is through an outfall to a watercourse. Furthermore, there will be a restricted discharge limit of 60 l/s based on 5 l/s/ha.
- 10.1.13 There is a formal point of connection into a Severn Trent Water public foul water sewer in close proximity to the site. Foul water domestic waste can discharge to the 150mm diameter public foul sewer recorded in the A53, at a point to the west of the site

11 LIMITATIONS

- 11.1.1 This report has been prepared for exclusive use by Brownshore Management Limited for the purpose of assisting them in evaluating the potential constraints imposed by flood risk and drainage in making a Planning Application.
- 11.1.2 AMA accepts no liability for any use of this document other than by its client and only for the purposes, stated in the document, for which it was prepared and provided. No person other than the client may copy (in whole or in part) use or rely on the contents of this document, without the prior written permission of AMA. Any advice, opinions or recommendations within this document should be read and relied upon only in the context of the document as a whole.
- 11.1.3 AMA has endeavoured to assess all information provided to them during this appraisal. The report summarises from several external sources and cannot offer any guarantees or warranties for the completeness or accuracy of information relied upon.
- 11.1.4 This report has been undertaken with the assumption that the site will be developed in accordance with the above proposals without significant change. The conclusions resulting from this study are not necessarily indicative of future conditions or operating practices at or adjacent to the site.
- 11.1.5 A topographic survey has been completed for the site and was supplied to AMA by the client. AMA accepts no liability for the accuracy of this survey, and it is recommended that it is verified on-site prior to the commencement of any construction work.
- 11.1.6 Existing drainage information is based on third party survey data and record information which is considered to be incomplete. It is therefore recommended that a FULL drainage investigation survey is commissioned to establish the precise alignment, level, and condition of ALL existing drainage within the development site to inform the masterplan and future detailed design proposals.

APPENDICES

Appendix A Proposed Site Layout

Appendix B Topographic Survey

Appendix C Surface Water Flood Extent

Appendix D Staffordshire Moorlands Level 1 SFRA Areas Susceptible to Groundwater Flooding Map

Appendix E Staffordshire Moorlands Level 1 SFRA Sewer Flood Event Map

Appendix F Staffordshire Moorlands Level 1 SFRA Historic Flood Event Map

Appendix G Severn Trent Water Pre-Development Enquiry

Appendix H Correspondence with the LLFA

Appendix I Causeway Flow Calculations



Appendix A
Proposed Site Layout



Appendix B
Topographic Survey



Appendix C
Surface Water Flood Extent

Appendix D
Staffordshire Moorlands Level 1 SFRA
Areas Susceptible to Groundwater
Flooding Map

Appendix E
Staffordshire Moorlands Level 1 SFRA
Sewer Flood Event Map

Appendix F
Staffordshire Moorlands Level 1 SFRA
Historic Flood Event Map



Appendix G
Severn Trent Water Pre-Development
Enquiry



Appendix H
Correspondence with the LLFA



Appendix I
Causeway Flow Calculations



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