Flood Risk Assessment & Outline Drainage Strategy

Cookson Way, Catterick, Richmond

White Acre Estates

August 2017

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CONTENTS

1.0 INTRODUCTION .......................................................................................................................... 1
2.0 POLICY & GUIDANCE .................................................................................................................. 3
3.0 EXISTING SITE ............................................................................................................................ 9
4.0 DEVELOPMENT PROPOSALS .................................................................................................... 14
5.0 SOURCES OF FLOOD RISK ..................................................................................................... 15
6.0 SURFACE WATER MANAGEMENT ............................................................................................. 18
7.0 FOUL WATER MANAGEMENT .................................................................................................... 26
8.0 MANAGEMENT MEASURES, OFF SITE IMPACTS AND RESIDUAL RISK ............................ 27
9.0 SUMMARY .................................................................................................................................. 29

APPENDICES

APPENDIX A – SITE LOCATION & CATCHMENT AREA PLAN
APPENDIX B – SCHEME MASTERPLAN
APPENDIX C - FLOOD SCREENING REPORT
APPENDIX D – TOPOGRAPHICAL SURVEY
APPENDIX E – RUN OFF CALCULATIONS
APPENDIX F – UTILITY REPORT
APPENDIX G – CORRESPONDENCE
1.0 INTRODUCTION

Appointment

1.1 SCP has been commissioned by White Acre Estates to provide a site specific Flood Risk Assessment and Outline Drainage Strategy to support the outline planning application for a new proposed development situated East of Cookson Way.

Proposed Development

1.2 The outline planning application proposes the construction of a residential development comprising up to a maximum of 107 dwellings with a total site area of approximately 4.19 hectares (ha). The site is currently undeveloped land and is located in a Flood Zone 1.

1.3 Proposed development plans are under development and approximate areas have been estimated based on the outline site plan provided by DGL Associates (1580WAE/CWC/SK02 Rev A)

1.4 The assumption has been made that the site will contain approximately 30% permeable area (1.26ha) and 70% impermeable area (2.93ha)

1.5 , which will be dedicated to houses and hard landscaping.

1.6 A plan showing the catchment area of the site can be found in Appendix A

Objective of Strategy

1.7 The objective of the strategy is to undertake a Flood Risk Assessment in accordance with the National Planning Policy Framework (NPPF) and to set out the Outline Drainage Strategy for the development.

1.8 The detail and complexity of a Flood Risk Assessment should reflect the level of risk to the site. The NPPF is the official document that regulates the assessment of flood risks and their appropriate mitigations to the planning process.

1.9 Section 9 to 19 of the 'Technical Guidance to the National Planning Policy Framework' provides requirements for a Site Specific FRA, which can be summarised as follows:

Be proportionate to the risk and appropriate to the scale, nature and location of the site;

Consider the risk of flooding arising from development in addition to the risk of flooding to the site;
Take the impacts of climate change into account;

Consider both the potential adverse and beneficial effects of flood risk management infrastructure including raised defences, flow channels, flood storage areas and other artificial features together with the consequences of their failure;

Consider the vulnerability of those that could occupy and use the site, taking account of the Sequential and Exception Tests and the vulnerability classification including arrangements for safe access/ egress;

Consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and identify flood risk reduction measures, so that assessments are fit for the purpose of the decisions being made;

Consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;

Include the assessment of the remaining (known as ‘residual’) risks after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development or land use;

Consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of development may affect drainage systems;

Be supported by appropriate data and information, including historical information on previous events.

1.10 This report therefore assesses flood risk to the site and any impact on flood risk to other land because of the development proposals.

1.11 To accompany the Outline Planning Application and this Flood Risk Assessment, an Outline Drainage Strategy has also been prepared as a part of this report.

1.12 In accordance with the National Planning Policy Framework there is a requirement that the drainage strategy should take into account climate change over the longer term of the development and give priority to the use of sustainable drainage systems.

- The existing surface water drainage systems within and in the vicinity of the site;
- Proposed surface water flows;
- Proposed surface water discharge points;
- Proposed surface water storage volumes;
- Proposed attenuation methods;
- Constraints imposed by regulatory bodies, including the Environment Agency, the local water, internal drainage board and highway authorities where applicable.

1.13 In accordance with the NPPF the drainage strategy takes account of climate change over the longer term of the development and gives priority to the use of sustainable drainage systems.

Limitations

1.14 This report has been prepared for exclusive use by White Acre Estates for the purpose of assisting them in evaluating the potential risk of flooding associated with the site and in making an Outline Planning Application. SCP 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 SCP. Any advice, opinions or recommendations within this document should be read and relied upon only in the context of the document as a whole.

1.15 SCP has endeavoured to assess all information provided to them during this appraisal and therefore this report has been compiled from a number of external sources.

1.16 The Flood Risk Assessment addresses the flood risk posed to and from the proposed development, the extent of which is outlined in Section 5.0 and will be shown on the masterplan and contained within Appendix B. 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.

1.17 A topographic survey of the proposed site has been produced and can be found in Appendix D.

2.0 POLICY & GUIDANCE

2.1 In carrying out our assessment and preparing this report, regard has been taken of the provisions of the development plan and a range of other material considerations. However, it is the Government’s National Planning Policy Framework, North Yorkshire County Council’s Strategic
Flood Risk Assessment (SFRA) and CIRIA document C624 which provide the most up to date and specific guidance on the Scope of Flood Risk Assessments.

**National Planning Policy Framework & Planning Policy Statement 25**

2.2 The National Planning Policy Framework (NPPF) was published in England in March 2012. As a result, all previous Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs) were superseded. This included PPS25: Development and Flood Risk, along with its supplement on Development and Coastal Change.

2.3 One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

2.4 It advises that where new development is necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible should reduce flood risk overall.

2.5 The NPPF’s flood risk advice is set out in paragraphs 100-103 of the Framework document. It is also accompanied by a Technical Guidance document which contains more details of carrying out development with regard to flood risk.

2.6 A comparison of the new NPPF Technical Guidance and the PPS25 documents reveals that the technical approach to the FRA process is largely unchanged with the presumption for development in Flood Zone 1.

2.7 Notable topics that have been retained from PPS25 within NPPF and its Technical Guidance include:

- The same Flood Zone definitions and vulnerability classifications of development are retained.
- The Sequential & Exceptions tests tie in more closely with NPPF’s principle to promote the most sustainable development.
- Climate Change and Sea Level rise are key considerations in the assessment.
- Management of Residual Risk discusses matters of Flood Risk Management and Mitigation, including Flood Resistance and Resilience. This clearly allows for development opportunities in areas where prospective sites are in Flood Zones 2 and 3, as long as flood ingress, impact, rate of onset etc are understood and mitigated.
Flood and Water Management Act 2010

2.8 The Flood and Water Management Act 2010 received Royal Assent on 8th April 2010. This Act provides duties on the Environment Agency, Local Authorities, Developers and other bodies to manage flood risks. The Act has significant planning and design implications for Developers.

2.9 It should be noted that these standards and procedures are being reviewed by the respective regulatory bodies and third parties against the requirements imposed by the Flood and Water Management Act 2010. The advice and recommendations provided may change when associated regulations have been issued in order to implement the full scope of the Act.

2.10 The main areas affecting Developers are:

- Lead Local Flood Authority (LLFA) to adopt sustainable urban drainage systems (SUDS). The LLFA may be either a Unitary or County Council;

- Approval fees and non-performance bonds to be standardised;

- A National Standard for SUDS design, construction, maintenance and operation to be issued. This guidance will emphasise the preference for surface SUDS features and the need to incorporate green corridors into the masterplan. A DRAFT version of this document was issued for consultation in December 2011. The final version was expected to be issued in 2014 however, DEFRA reported a delay and to date have not advised when the revised issue date is likely to be.

- Changes to the rights to connect to sewers will restrict automatic connection rights to only Section 104 sewer schemes or approved SUDS schemes constructed to a new national sewer or new SUDS standard respectively;

- Two options for the SUDS approval process. Either directly to the SUDS Approval Body or as a combined application to the Planning Authority as part of the Planning Application.

North Yorkshire County Council Strategic Flood Risk Assessment (SFRA)

2.11 Local Planning Authorities are required to produce Local Development Frameworks, which are a portfolio of Local Development Documents (LDD) that collectively deliver the spatial planning strategy for the Authority area. The LDDs undergo a Sustainability Appraisal which assists Planning Authorities in ensuring their policies fulfil the principles of sustainability. Strategic Flood Risk Assessments are one of the documents to be used as the evidence base for planning
decisions and are a component of the Sustainability Appraisal process. Therefore, SFRAs should be used in the review or production of LDDs.

2.12 SFRAs assess the risk associated with all types of flooding and provide the information required to identify the amount of development permitted in an area; how the drainage systems in the area should function and also how the risks in vulnerable areas can be reduced and/or mitigated. The National Planning Policy Framework states that Regional Planning Bodies (RPBs) or Local Planning Authorities (LPAs) should prepare SFRAs in consultation with the Environment Agency.

2.13 North West Yorkshire County Council in partnership with JBA, produced the Level 1 SFRA for the area in 2010.

2.14 The SFRA did not identify the area as being at risk of flooding nor did it report any historic flooding therefore there are no specific risks to the site area indicated within the SFRA. The SFRA does highlight that the River Swale (north of site) and Brough Beck (south of site) are both within Flood Zone 3 and shows historic flooding within Catterick. However in relation to the site location there is no fluvial risk of either watercourse with respect to flooding considering the topographic nature of the site.

**North Yorkshire County Council SUDS Design Guidance**

2.15 With reference to the local authorities guidance on SUDs design there is a requirement that flooding does not occur on any part of the site for a 1 in 30 year rainfall event. Any calculations undertaken will need to take into consideration of urban creep and climate change in accordance with NPPF.

2.16 The guidance also stats that green field run off is to be determined using the Institute of Hydrology (IH) Report 124 or Flood Estimation Handbook (FEH) methods and that for a whole or part brownfield site; greenfield runoff rate and/or 70% of demonstrable existing positively drained runoff rate for those rainfall events will be permitted however greenfield runoff rate should be achieved where possible.

2.17 There is a requirement that the greenfield runoff rate is to be restricted to a maximum of 1.4 l/s/ha unless modelling conclusively demonstrates greenfield runoff to be greater than this in accordance with CIRIA C753 – The SUDs Manual– Chapter 3. This requirement will be addressed as part of the drainage strategy.
CIRIA Guidance

2.18 The CIRIA publication ‘C624 Development and Flood Risk – Guidance for the Construction Industry’, define three levels of FRA which can be undertaken:
Table 1 - Flood Risk Assessment Levels

<table>
<thead>
<tr>
<th>FRA Level</th>
<th>Description/Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
<td>Screening Study to identify whether there are any flooding or surface water management issues related to a development site that may warrant further consideration. This should be based on readily available existing information, including the SFRA, Environment Agency Flood Map and Standing Advice. The Screening Study will ascertain whether a FRA is required.</td>
</tr>
</tbody>
</table>
| **Level 2** | Scoping Study to be undertaken if the Level 1 FRA indicates that the site may lie within an area that is at risk of flooding or that the site may increase flood risk due to increased run-off. This Study should confirm the sources of flooding which may affect the site and should include the following:  
  - An appraisal of the availability and adequacy of existing information;  
  - A qualitative appraisal of the flood risk posed to the site, and potential impact of the development on flood risk elsewhere;  
  - An appraisal of the scope of possible measures to reduce the flood risk to acceptable levels.  
  The Scoping Study may identify that sufficient quantitative information is already available to complete a FRA appropriate to the scale and nature of the development. |
| **Level 3** | Detailed Study to be undertaken if the Level 2 FRA concludes that further quantitative analysis is required to assess flood risk issues related to the development site. The Study should include:  
  - Quantitative appraisal of the potential flood risk to the development;  
  - Quantitative appraisal of the potential impact of development site on flood risk elsewhere;  
  - Quantitative demonstration of the effectiveness of any proposed mitigation measures. |

2.19 This report will follow the format of a Level 2 qualitative study.
3.0 **EXISTING SITE**

**Site Location**

3.1 The site is located on land east of Cookson Way, Catterick.

3.2 An approximate postcode for the site is DL9 4XG and OS Co-ordinates 421180E, 498725N.

3.3 A site location plan can be found in Appendix A.

**Table 2 - Site Description**

<table>
<thead>
<tr>
<th>Area</th>
<th>The gross site area is approximately 4.19 hectares.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing Surfacing</td>
<td>The existing site is currently greenfield</td>
</tr>
<tr>
<td>General Topography</td>
<td>The whole site has a gradual fall from the south west corner of the site through to the north east corner with a change in level of approximately 82m to 79m AOD</td>
</tr>
<tr>
<td>Current Use</td>
<td>The site is currently used as pasture land</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boundaries</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>Pasture lands</td>
</tr>
<tr>
<td>East</td>
<td>Cookson Way and Barratt York residential development and amenities</td>
</tr>
<tr>
<td>South</td>
<td>Pasture lands and Catterick Road</td>
</tr>
<tr>
<td>West</td>
<td>Pasture land</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Access</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vehicular</td>
<td>There is currently no direct public road access to the site however as part of the Barrett York development (west of the site) there is a roundabout on Cookson Way which has space allowances for a future leg to be constructed to the east.</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>Access to the site can be achieved via Cookson Way</td>
</tr>
</tbody>
</table>

**Existing Public Sewers**

3.4 Yorkshire Water sewer records show that there is an existing 150mm dia. VC foul sewer running south along Churchill Dr, servicing the Barrett York development. The foul sewer connects to a pumping station, south of the Cookson Way roundabout, and discharges via a 100mm dia. foul sewer rising main which runs south along Cookson Way.
3.5 Constructed as part the Barrett York development, there is also an existing 225mm dia. surface water sewer which flows northward along the west site boundary before discharging into a local watercourse.

3.6 Yorkshire Water advised that the existing sewer system was under development ownership at the time of consultation (May, 2017). The Yorkshire Water plans depict the sewers as publicly owned; it is assumed that Yorkshire Water will take ownership in the near future.

3.7 See Appendix F for Yorkshire Water Utility Report.

**Existing Private Drainage**

3.8 There is currently no on-site drainage, as indicated by Yorkshire Water.

**Watercourses, Land Drainage and other Waterbodies**

3.9 Environment Agency river mapping suggests that the nearest major water courses to the site are the River Swale and Brough Beck. It is understood that the River Swale is the designated Main River and falls within the Environment Agency’s jurisdiction.

3.10 River Swale is designated as a primary river and its closest point is situated approximately 700m north east of the site, however this is separated from the site by topography. Brough Beck, which is not designated by the Environment Agency as a main river is situated approximately 700m south of the site and is regulated by the Lead Local Flood Authority (LLFA), North Yorkshire County Council.

3.11 Google Maps and Yorkshire Water mapping indicates a minor watercourse along the northern site boundary running easterly. The Landmark Envirocheck Flood Screening report (Appendix C) supports this assumption, showing surface water depths, velocity and direction in this area.

3.12 The Land Registry Current Title Plan (Title Number NYK421702) suggests that the minor watercourse is within land also owned by the development site owner.

**Existing Flood Defences and Other Structures**

3.13 The LLFA has not indicated the presence of any flood defences within close proximity to the proposed development during consultation. Aerial photography of the site, EA mapping and local topographical survey also suggests that there are no flood defences within close proximity.
Historical Land Use

3.14 The site itself has been historically used for agricultural purposes.

Historical Flood Records

3.15 The table below summarises the historical flood records obtained through consultation with the various bodies contacted as part of this study.

<table>
<thead>
<tr>
<th>Information Source</th>
<th>Flood Records/Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment Agency</td>
<td>Maps from the Environment Agency (viewed 20th April 2017) have indicated that the site is not at risk of flooding.</td>
</tr>
<tr>
<td>North Yorkshire County Council</td>
<td>The response from NYCC was that they did not hold any records of flooding at the site. Review of the North West Yorkshire Strategic Flood Risk Assessment (SFRA)(^1) indicated a historical flood event occurred at the River Swale, flooding the northern edge of Catterick, however this did not affect the site in question.</td>
</tr>
<tr>
<td>Yorkshire Water</td>
<td>At the time of writing a consultation response was awaited from Yorkshire Water indicating any history of surcharge and therefore details will be entered into the final version of this report when received.</td>
</tr>
</tbody>
</table>

\(^1\) North West Yorkshire Strategic Flood Risk Assessment - Volume II: Technical Report
**Flood Mapping**

**Envirocheck Flood Screening Report**

3.16 The Envirocheck Flood Screening Report indicates that the proposed development site is located in Flood Zone 1 (low risk). The River Swale (approx. 700m north of the site), nominated as a main river by the Environment Agency, is within Zone 2 and 3 and is at high risk of flooding, as indicated by the report. However due to the topography of the surrounding area, does not directly present a fluvial flooding risk to the site.

3.17 The Colburn beck, which feeds into the River Swale, splits into a minor watercourse approximately 1km north west of the site and flows towards the site and discharges into Brough Beck. Brough Beck (approx. 700m south of the site) is within Zone 2 and 3 but is downstream of the site and hence does not present a pluvial or fluvial flood risk.

3.18 This is land designated as having a less than 0.1% annual probability of flooding from rivers or the sea in any year (less than a 1 in 1000 annual probability of flooding).

3.19 Flood zone designation ignores the presence of any flood defences and only considers flooding from fluvial and tidal sources.

3.20 The flood screening report data specific to the site area shows a low pluvial depth (0.1m-0.3m) and a low surface water hazard rating for a 1000 year return. The report can be found in Appendix C.

**EA Reservoir Flood Map**

3.21 The Environment Agency website does not locate the site within an area at risk from reservoir flooding.

**EA Groundwater Map**

3.22 The Environment Agency Groundwater map highlights the site as being within a ‘Secondary A’ area for Bedrock Designation and ‘Secondary (undifferentiated)’ area for Superficial Deposits Designation. ‘Secondary A’ classification, as described by the Environment Agency (EA)\(^2\), represents an area with permeable layers capable of supporting water supplies at a local rather than strategic scale. These are generally aquifers formerly classified as minor aquifers. ‘Secondary (undifferentiated)’ classification is given to areas where it has not been possible to

\(^2\) Environment Agency: Aquifers – Understanding the British Geological Survey Aquifer Designation maps
attribute either category A or B to a rock type. In most case, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type. This suggests that infiltration may be possible at this site however an intrusive site investigation for the development should carried out prior to detailed design in order to properly assess soil conditions.

**British Geological Survey Flood Data**

3.23 The BGS Flood Data Map website indicates that the site contains no inland geological indicators of flooding, however there is potential for groundwater flooding to occur at the surface.
4.0 DEVELOPMENT PROPOSALS

Nature of the Development

4.1 The proposed development comprises of the construction of 107 residential houses with associated highways and hard and soft landscaping.

4.2 Proposed development plans are under development and approximate areas have been estimated based on the outline site plan provided by DGL Associates (1580WAE/CWC/SK02 Rev -)

4.3 The assumed site areas based on this plan have been broken down as:

- Permeable Area – Embankments and landscaped areas which will be re-levelled and positively drained within the site: 30% - approx. **1.26 Hectares**.

- Impermeable Area – Car Parks, Buildings and Access Routes which are positively drained: 70% - approx. **2.93 Hectares**.

4.4 The total area of the proposed development is approximately **4.19 hectares** which is assumed to be 30% permeable by area.
5.0 SOURCES OF FLOOD RISK

Table 4 - Sources of Flood Risk Summary

<table>
<thead>
<tr>
<th>Source</th>
<th>Likelihood</th>
</tr>
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<tbody>
<tr>
<td>Fluvial</td>
<td>Low</td>
</tr>
<tr>
<td>Coastal - Sea</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Coastal - Estuarine</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Pluvial</td>
<td>Low</td>
</tr>
<tr>
<td>Sewer – SWS, FWS, CS, CSO</td>
<td>Low</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Low</td>
</tr>
<tr>
<td>Other Sources</td>
<td>Low</td>
</tr>
</tbody>
</table>

Fluvial Flood Risk

5.1 Information relating to flood risk at the site has been obtained via Envirocheck Flood Screening report (Appendix C) and also the Environment Agency’s online flood mapping tool.

5.2 Examination of the flood maps show that the site is located within an area classified as Flood Zone 1 and the risk of flooding from Rivers or the Sea is considered to be ‘low’. Both Brough Beck and River Swale are local to the proposed site and it is understood that they fall under the jurisdiction of the Lead Local Flood Authority and Environment Agency, respectively. Given that the site is uphill from both main rivers it would suggest the likelihood of fluvial flooding is low.

Pluvial Flood Risk

5.3 Pluvial flooding is defined as flooding resulting from rainfall-generated overland flow, before runoff enters any watercourse or sewer.

5.4 It is usually associated with high intensity rainfall events but can also occur with low intensity rainfall or melting snow where ground is saturated, frozen, developed or otherwise has low permeability resulting in overland flow and ponding in depressions in the topography. Large catchment areas are particularly prone to this type of flooding.

5.5 Surface water flood maps can be found in Appendix C. They demonstrate that after a 1 in 1000 year rainfall event the site is prone to very low levels of flooding. However this mapping will be based on coarse level data and can be considered indicative only. Furthermore, site levels will
be re-engineered to ensure that there is no risk of surface water flooding to the proposed development.

5.6 The topography of the site and surrounding area means that there is little likelihood of significant flows impacting on the proposed development or on land and property adjacent to the development. The only flows that are likely to be present on site are from direct rainfall on areas of hardstanding.

5.7 The proposed new development will be served by a new surface water drainage network and surface attenuation which will be designed to accommodate surface water flows within the site for up to and including the 100 year plus climate change storm event.

**Sewer Flood Risk**

5.8 Given that the site has no existing surface and foul water network there is no risk of flooding as a result of a surcharge.

5.9 There is a foul water network within the adjacent development, Barret York. This includes surface and foul water pipes, a pumping station and a rising main which runs south along Cookson Way west of the site. Given the existing proposed development site is lower than the adjacent development and its associated sewer infrastructure, there is a risk that, should the system fail and surcharge, flooding will impact on the proposed development.

5.10 Therefore it is considered that the risk of flooding to the site from surcharged sewers is low.

**Groundwater Flood Risk**

5.11 In general terms groundwater flooding can occur from three main sources, raised water tables, seepage and percolation, and groundwater recovery or rebound.

5.12 If groundwater levels are naturally close to the surface then this can present a flood risk during intense rainfall. Having reviewed groundwater flood maps from Environment Agency and the British Geological Survey it indicates that the site contains no inland geological indicators of flooding however the site does have potential for groundwater flooding to occur at the surface. The site is situated over a Secondary A type aquifer which suggests the ground is permeable.

5.13 With reference to BGS drift maps, the composition of the ground is predominately Till and Millstone. This suggests the ground has semi-permeable properties and hence a potential of groundwater flooding. An intrusive investigation should be undertaken at detailed design stage to
establish exact ground water levels. However, based on current available information it is considered that the likelihood of flooding from this source is low.

**Flooding from Other Sources**

5.14 Non-natural or artificial sources of flooding can include reservoirs, lakes and canals.

5.15 No other potential sources of flood risk have been identified in the vicinity of the site.

**Historical and Anecdotal Flooding Information**

5.16 Review of North Yorkshire County Council’s SFRA indicated that the River Swale has historically experienced flooding in the North Catterick area. The Environment Agency issues flood warnings for Catterick Bridge (approximately 1.8km north east of the site) and for the Brompton area (approximately 1.3km north west of the site).

5.17 There is no evidence the proposed site itself has any history of flooding.

**Flood Risk Vulnerability Classification**

5.18 The proposed development is residential and can be considered to be classified as ‘more vulnerable’ within Table 2: Flood Risk Vulnerability Classification of the NPPF. Therefore this type of development would be wholly appropriate for Flood Zone 1.

**Figure 1 - Flood Risk Vulnerability Classification**

<table>
<thead>
<tr>
<th>Flood risk vulnerability classification (see table 2)</th>
<th>Essential infrastructure</th>
<th>Water compatible</th>
<th>Highly vulnerable</th>
<th>More vulnerable</th>
<th>Less vulnerable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Zone 2</td>
<td>✓</td>
<td>✓</td>
<td>Exception Test required</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Zone 3a</td>
<td>Exception Test required</td>
<td>✓</td>
<td>✓</td>
<td>Exception Test required</td>
<td>✓</td>
</tr>
<tr>
<td>Zone 3b functional floodplain</td>
<td>Exception Test required</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

**Key:** ✓ Development is appropriate. ✗ Development should not be permitted.
6.0 SURFACE WATER MANAGEMENT

Introduction

6.1 The National Planning Policy Framework (NPPF)\(^3\) and accompanying Planning Practice Guidance\(^4\) indicate surface water run-off should be controlled as near to its source as possible through a sustainable drainage approach to surface water management.

6.2 Consideration should therefore firstly be given to using sustainable urban 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 (2010)\(^5\) sets out a hierarchy for the disposal of surface water which encourages a SUDS approach, as detailed in Section 2.0.

Climate Change

6.3 There are indications that the climate in the UK is changing significantly and it is widely believed that the nature of climate change will vary greatly by region. Current expert opinion indicates the likelihood that future climate change would produce more frequent short duration and high intensity rainfall events with the addition of more frequent periods of long duration rainfall.

6.4 The NPPF Technical Guidance Table 5 states that the recommended national precautionary sensitivity ranges for increase of peak rainfall intensity is 30% until 2115. However, The Environment Agency (EA) issued new advice which updated previous climate change allowances outlined in the NPPF. The table below, extracted from the Guidance for Flood risk Assessment: Climate Change Allowances (Table 2)\(^6\) shows anticipated changes in extreme rainfall intensity in small and urban catchments. For Flood Risk Assessments and Strategic Flood Risk Assessments, The Environment Agency recommend both the central and upper end allowances are assessed to understand the range of impact.

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\(^3\) Department for Communities and Local Government 2012 – National Planning Policy Framework

\(^4\) Department for Communities and Local Government 2016– Planning Practice Guidance

\(^5\) HM Government Building Regulations 2010 – Approved Document part H

\(^6\) ENVIRONMENT AGENCY 2016 FLOODING AND COASTAL CHANGE –FLOOD RISK ASSESSMENTS: CLIMATE CHANGE ALLOWANCES TABLE 2
Figure 2 - Table 2 from NPPF - https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

<table>
<thead>
<tr>
<th>Humber River Basin District</th>
<th>Total potential change anticipated for the ‘2020s’ (2015 to 2039)</th>
<th>Total potential change anticipated for the ‘2050s’ (2040 to 2069)</th>
<th>Total potential change anticipated for the ‘2080s’ (2070 to 2115)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper end</td>
<td>20%</td>
<td>30%</td>
<td>50%</td>
</tr>
<tr>
<td>Central</td>
<td>10%</td>
<td>15%</td>
<td>20%</td>
</tr>
</tbody>
</table>

6.5 As recommended by the EA, both the central and upper end allowances have been considered for the purpose of surface water drainage strategy and assessment of exceedance flow pathways.

**Pre-development Surface Water Runoff**

6.6 For the purpose of determining the existing rate of surface water runoff, the proposed developable area is considered 100% permeable as it is undeveloped greenfield land. The total area of the proposed development site is circa **4.19 hectares (ha)**.

**IH124 Method for Runoff Rates**

6.7 The runoff rates from the permeable (Greenfield) areas of the site have been initially calculated using the HR Wallingford Sustainable Drainage Tool (http://www.uksuds.com/greenfieldrunoff_js.htm) which utilises either the Institute of Hydrology Report 124 Method or the FEH Statistics Method.

6.8 The IH124 publication provides the essential design elements for determining the estimated Greenfield runoff rate which is based on the site area, soil type, and average annual rainfall, which is influenced by the location of the site within the United Kingdom. This methodology is recommended within R&D Technical Report W5-074/A/TR/1 ‘Preliminary Rainfall Runoff Management for Developments’ (2012).
6.9 The IH 124 equation to calculate runoff is:

\[ Q_{\text{bar}} = 0.00108 \times 0.89 \times \text{SAAR}^{1.17} \times \text{SOIL}^{2.17} \]

Where:

- \( Q_{\text{bar}} \) = Mean Annual Flood \((m^3/s)\). A return period in the region of 2.3 years.
- \( \text{SAAR} \) = Standard Average Annual Rainfall (mm)
- \( A \) = Area (ha) of the catchment.
- \( \text{SOIL} \) = Soil index value obtained from soil maps in the Flood Studies Report or the WRAP map of the Wallingford Procedure.

6.10 The SAAR value for the site and soil value were obtained automatically through the HR Wallingford website. The analysis for determining the peak Greenfield discharge rate uses 50 ha in the formula and linearly interpolates the flow rate value based on the ratio of the development to 50 ha.

6.11 The Standard Percentage Runoff coefficient (SPR) values are determined by the SOIL category. These SOIL categories range from 1 to 5 with 1 being sandy highly permeable materials and 5 (rarely used) being exposed rock. Information from BGS has indicated a semi-permeable strata and hence a SOIL value of 2 with a corresponding SPR value of 0.3 has been used.

6.12 As mentioned above, the \( Q_{\text{bar}} \) values represent a return period of 2.3 years. A regional growth factor can be applied to determine the peak runoff rate for other return periods including the 1 in 30 year and 1 in 100 year events. The growth factors are obtained from the tables in the Flood Studies Research FSSR 14 as shown below. The site is located in Region 3, Northeast/ North Yorkshire.

| Growth Curve Factors for Hydrological Region 3 |
|-----------------|--------|
| 1 year          | 0.86   |
| 10 year         | 1.45   |
| 30 year         | 1.75   |
| 100 year        | 2.08   |
Figure 3: FSSR 14 Hydrological Map and Growth curve table

6.13 The table below summaries the existing Greenfield runoff rates generated by the site for a range of storm return periods using the IH124 method.

Table 5: Existing Development Runoff – IH124 Method

<table>
<thead>
<tr>
<th>Site Area</th>
<th>Qbar (l/s)</th>
<th>Peak Runoff 1 in 1 year (l/s)</th>
<th>Peak Runoff 1 in 30 years (l/s)</th>
<th>Peak Runoff 1 in 100 year (l/s)</th>
<th>Peak Runoff 1 in 100 year + 20% CC (l/s)</th>
<th>Peak Runoff 1 in 100 year +50% CC (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.19ha</td>
<td>7.39</td>
<td>6.36</td>
<td>12.94</td>
<td>15.38</td>
<td>18.46</td>
<td>23.07</td>
</tr>
</tbody>
</table>

FEH Statistical Method for Runoff Rates

6.14 The second method of calculating existing runoff from a site is utilising the Flood Estimation Handbook Statistics for rainfall. This method is normally preferred by some Lead Local Flood Authorities and the Environment Agency as the method uses a wider statistical base and can take into account the minutiae of catchment and soil characteristics which the IH124 method does not.

6.15 The soil categorisation for the site is classified as a slowly permeable seasonally wet acid loamy and clayey soil. This has been taken from the LandIS database and the Soilscape mapping tool provided by the Cranfield University and sponsored by the Department for the Environment, Farming and Rural Affairs. This output is shown in Figure 4 below.
As with the IH124 method above, the HR Wallingford website provides an online tool which allows for the automatic calculation for the SAAR for the site.

The table below summarises the existing Greenfield runoff rates generated by the site for a range of storm return periods using the FEH Statistical method.

**Table 6: Existing Development Runoff – FEH Statistical Method**

<table>
<thead>
<tr>
<th>Site Area</th>
<th>Qbar (l/s)</th>
<th>Peak Runoff 1 in 1 year (l/s)</th>
<th>Peak Runoff 1 in 30 years (l/s)</th>
<th>Peak Runoff 1 in 100 year (l/s)</th>
<th>Peak Runoff 1 in 100 year + 20%CC (l/s)</th>
<th>Peak Runoff 1 in 100 year +50% CC (l/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.19ha</td>
<td>8.34</td>
<td>7.17</td>
<td>14.59</td>
<td>17.34</td>
<td>20.81</td>
<td>26.01</td>
</tr>
</tbody>
</table>
Proposed Restricted Discharge Rates

6.18 To comply with local and national drainage and planning policy, discharge from the development would be restricted to the existing Greenfield runoff rate which will be agreed by the lead flood authority. This would ensure that surface water runoff from the proposed development does not exceed the existing scenario.

6.19 The table above provides the existing Greenfield runoff rates and it is proposed that the post development runoff be limited to these rates calculated. An outline drainage strategy has been included as part of this strategy to demonstrate that a sustainable surface water management system is achievable.

Methods of Surface Water Management

6.20 The nearest watercourse to the site is a land drain which flows easterly along the north of the site. The location of the watercourse is directly adjacent the north boundary of the proposed development and is deemed to be a suitable outfall location for the site, and therefore will be used as part of the drainage solution for the development.

6.21 An detention basin has been proposed to the north of the site with an estimated surface area of 2000m², this can be appropriately sized in depth to suit the storm event attenuation required as detailed in section 6.32 below.

6.22 Consultation with the LLFA (Stuart Edwards – 8th May 2017) has indicated no restrictions beyond the normal SUDs Guidelines. The watercourse is within land owned by the development site owner, the accurate location and ownership is still to be confirmed. At this stage ownership approval to discharge into the watercourse has been assumed and will need validating.

6.23 Alternatively, 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.

6.24 At the time of writing, no intrusive investigation has been undertaken within the site. However infiltration may be a suitable method of surface water disposal given the indication of permeable soil strata via BGS drift maps and the LandIS soilscape map.

6.25 Soakaway testing should be carried out in accordance with BRE365 to determine whether any infiltration solution can potentially be applied as a feasible method of surface water management.

6.26 This testing would be undertaken as part of a normal intrusive site investigation process. If favourable infiltration rates are returned from the site investigation, further design work should be
undertaken to establish whether some form of infiltration based drainage solution could be applied within the confines of the development.

6.27 Outfall to existing Yorkshire Water sewers is not being considered as part of the proposed development.

**Attenuation Requirements**

6.28 The proposed restricted discharge rate, 8.35l/s, and calculated post-development runoff rates generate a storage requirement during periods of intense rainfall.

6.29 The Microdrainage ‘Quick Storage Estimate’ module has been used to estimate the storage volume required for both a 1 in 30 year and 1 in 100 year storm event plus a 50% allowance for climate change. These volumes are detailed in the table below and are based on the assumption that no infiltration is possible and all surface water discharge will be restricted as indicated.

6.30 This is validated by a second calculation undertaken using the HR Wallingford Storage Calculator which is used as a check.

**Table 7 – Storage Volume Required on Site**

<table>
<thead>
<tr>
<th>Permissible Discharge (l/s)</th>
<th>Impermeable Area (ha)</th>
<th>$Q_{30}$ Volume (m$^3$)</th>
<th>$Q_{100}$ Volume (m$^3$)</th>
<th>$Q_{100+50%}$ Volume (m$^3$)</th>
<th>HR Wallingford $Q_{100+50%}$ Volume (m$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.34</td>
<td>2.93</td>
<td>1134-1653</td>
<td>1555-2161</td>
<td>2617-3597</td>
<td>4845</td>
</tr>
</tbody>
</table>

These volumes are indicative only and are subject to confirmation at detailed design stage.
Outline Surface Water Drainage Strategy

6.31 The general principle of the surface water drainage strategy for this site is to collect the runoff from the private driveways, carriageways, footways, and roof areas, and then convey this to an attenuation area located within the north east area of the site, and subsequently discharging into the watercourse to the north of the site at a restricted rate.

6.32 An detention basin has been proposed to the north of the site with an estimated surface area of 2000m², this can be appropriately sized in depth to suit the storm event attenuation required as detailed in table 7 above.

6.33 The surface water system is proposed to outfall into the nearest watercourse to the site which is a land drain which flows easterly along the north of the site; this is located directly adjacent the north boundary of the proposed.

6.34 Consultation with the LLFA (Stuart Edwards – 8th May 2017) has indicated no restrictions beyond the normal SUDs Guidelines. The watercourse is within land owned by the development site owner, the accurate location and ownership is still to be confirmed. At this stage ownership approval to discharge into the watercourse has been assumed and will need validating.
7.0 FOUL WATER MANAGEMENT

Introduction

7.1 It is proposed to construct a new foul water drainage system to serve the development which will connect into the public foul sewer network situated in Cookson Way to the west of the site.

7.2 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 7th Edition and the Civil Engineering Specification for the Water Industry 7th Edition.

7.3 As the proposed housing site design is still in development, a general principle foul water management strategy has been outlined below.

Foul Water Capacity and Point of Connection

7.4 The proposed outfall connection discharges into an existing 150mm dia. VC pipe north of the existing pumping station on the Cookson Way roundabout as shown on the Yorkshire Water Sewer plan attached as Appendix F.

7.5 The preferred method for foul water management is a gravity system with a connection to the existing sewer network on Cookson Way. This will require the redesign of site levels to drain westwards, towards Barrett York site.

7.6 Further investigation work will be required on-site to establish exact invert levels prior to the commencement of any detailed design or construction work. Should pumping be required then any pumping station will be designed in accordance with the current Building Regulations, British Standards and Sewers for Adoption 7th Edition, all in consultation with Yorkshire Water.

7.7 Furthermore, a feasibility study will be required by Yorkshire Water to determine the exact connection point, and any works required to prepare their system for the additional flow of foul water.
8.0 MANAGEMENT MEASURES, OFF SITE IMPACTS AND RESIDUAL RISK

Flood Risk Management Measures

8.1 The surface water drainage strategy for the new development site aims to restrict the peak flows to the existing greenfield rates with attenuation for the flows from extreme events.

8.2 The new private and adoptable drainage systems will be designed in accordance with current design guidance and standards. Attenuation will be provided for up to the 100 year return period storm event with an allowance for climate change.

8.3 The use of SUDs site control measures, with controlled release of surface water to the watercourse will minimise the flood risk impact.

8.4 Finished site levels will be engineered to provide positive drainage where required and prevent ponding. The accumulation of standing water will therefore not occur and thus not pose a risk.

8.5 Gradients of the hardstanding areas, where possible, will be designed to fall away from buildings such that any overland flow resulting from extreme events would be channelled away from entrances.

8.6 As the site and surrounding areas are located within Flood Zone 1, it is considered that access and egress should not be affected during flooding.

Off Site Impacts

8.7 To ensure that the proposed development will not increase flood risk elsewhere, a positive drainage system will be provided which will discharge into the existing water course at a limited rate agreed with the LLFA. This restricted discharge in conjunction with surface water attenuation on site will militate against flood risk to other land.

8.8 By reducing the pre-development peak runoff prior to its point of discharge into the public sewer system, the potential for surface water flooding on the downstream network and watercourse is reduced.

Residual Risks

8.9 The development and its drainage system will be designed to cope with the intense storm events up to and included the 100 year return period rainfall event with an allowance for climate change. If an extreme rainfall event exceeds the design criteria for the drainage network it is likely that there will be some overland flows which are unable to enter the system. It is therefore important
that these potential overland flows are catered for within the proposed planning layout in the event that the capacity of the drainage system is exceeded.

8.10 Any overland flows generated by the proposed development must be directed away from any adjacent existing properties surrounding the site and towards the highway network where it can follow natural flow paths.

8.11 As with any drainage system, blockages within the surface water system have potential to cause flooding or disruption. It is important that any drainage systems not being offered for adoption to either the Water Company or the Local Authority has an appropriate maintenance regime scheduled which would be advised to prospective property owners where appropriate.
9.0 SUMMARY

9.1 The proposed development comprises the construction of a 107 house residential development with associated hard and soft landscaping. The masterplan/proposed housing site design is currently under development.

9.2 The site is in an area identified as having a ‘low’ probability of flooding on the Environment Agency Flood Map and is located in Flood Zone 1.

9.3 NPPF requires that planning applications for development proposals of 1 hectare or greater in Flood Zone 1 should be accompanied by a Flood Risk Assessment.

9.4 The Flood Risk Assessment (FRA) has reviewed all sources of flood risk to both the proposed development and to existing adjacent developments as a result of the proposals, including fluvial, tidal, pluvial, groundwater, sewers and flooding from artificial sources.

9.5 The primary option for surface water disposal is via attenuation and discharge into a water course at a restricted discharge rate of 8.34 l/s.

9.6 It is the intention that the foul water may be discharged to the public foul sewer network situated along Cookson Way. This will be subject to detailed design of a developed masterplan and agreement with Yorkshire Water through a feasibility study.

9.7 The development is accessible for emergency access and egress during times of extreme flooding as the flood plain does not extend into the area proposed for development.

9.8 The Flood Risk Assessment is considered to be commensurate with the development proposals and in summary, the development can be considered appropriate for Flood Zone 1 in accordance with the NPPF.