Greater Norwich Level 2 Strategic Flood Risk Assessment

Final Report

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Greater Norwich Authorities

JBA Project Manager

Hannah Coogan
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
B46 3AD

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Contract

This report describes work commissioned by Samuel Walker, on behalf of the Greater Norwich Authorities, by an email dated 9th July 2020. Hannah Coogan, Thomasin Sayers, Chris Smith, James Jones, Edmund Mumford, Hannah Booth and Helen Dawson Of JBA Consulting carried out this work.

Prepared by ..... Thomasin Sayers BA Hons
Analyst

Edmund Mumford BSc MSc
Analyst

Helen Dawson BSc
Assistant Analyst

Reviewed by ..... Hannah Coogan BSc FCIWEM C.WEM

Technical Director

Purpose

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JBA Consulting has no liability regarding the use of this report except to Greater Norwich Authorities.

Acknowledgements

JBA would like to acknowledge the assistance of the Greater Norwich Authorities in producing this report.

Carbon Footprint

JBA is aiming to reduce its per capita carbon emissions.

Executive Summary

Introduction and Context

This Level 2 Strategic Flood Risk Assessment (SFRA) document undertakes a Level 2 assessment of site options identified by the Greater Norwich Authorities. It builds upon the Level 1 SFRAs completed in December 2017 for Greater Norwich, Great Yarmouth, King's Lynn and West Norfolk, and North Norfolk areas.

This Level 2 SFRA involves the assessment of 26 proposed development sites. In addition, since the previous SFRA was published, there have been updates to national and local planning policy, including the release of updated SFRA guidance in August 2019. This 2021 Level 2 SFRA has updated information on flood data, flood risk policy and has recommendations for the cumulative impact of development.

SFRA Objectives

The Planning Practice Guidance (PPG) advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- **Level One:** where flooding is not a major issue in relation to potential development sites and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- **Level Two**: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the National Planning Policy Framework (NPPF) Exception Test. In these circumstances, the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

Level 2 SFRA Outputs

The Level 2 assessment includes detailed assessments of the proposed site options. These include:

- An assessment of all sources of flooding including fluvial flooding, tidal flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increase in fluvial flood risk due to climate change.
- Reporting on current conditions of flood defence infrastructure, where applicable.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff.
- Advice on whether the sites are likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA.

As part of the Level 2 SFRA, detailed site summary tables have been produced for the proposed sites, covering the above. To accompany each site summary table, there is an Interactive Geo-PDF map, with all the mapped flood risk outputs.

Summary of the Level 2 SFRA

The Greater Norwich Authorities determined the sites which required a Level 2 assessment, based on the information from the Level 1 SFRA and proximity of the sites to watercourses and known flood risk areas.

Of the 32 sites initially proposed for Level 2 assessment in Greater Norwich, 8 of the sites are no longer progressing to allocation at this time, 1 additional site was added and 1 site was divided into two. Of the 26 undergoing a Level 2 assessment, all sites required additional modelling to understand fluvial risk.

- 15 sites required climate change uplifts on the River Wensum
- 3 sites required climate change uplifts on the River Wensum and River Yare, including extreme H++ climate change scenario
- 3 sites required climate change uplifts on the River Yare, including the extreme H++ climate change scenario for 1 site
- 1 site required climate change uplifts on the River Waveney
- 1 site required climate change uplifts on the Spixworth Beck
- 3 sites required new 2D strategic modelling to inform the fluvial risk to site

Each site-specific summary table produced sets out the flood risk to each site based on a range of flood risk datasets and the strategic modelling completed as part of this study. Each table sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. A broadscale assessment of suitable Sustainable Drainage Systems (SuDS) options has been provided, giving an indication where there may be constraints to certain types of SuDS techniques.

To accompany each site summary table, there is an Interactive GeoPDF map, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow easy navigation of the data.

The following points summarise the Level 2 assessment:

- The majority of the sites assessed as part of this Level 2 SFRA are at fluvial flood risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site. Sites significantly affected by fluvial flooding will require more detailed investigations to inform a sequential approach to site layouts, SuDS possibilities, safe access and egress etc, as part of a site-specific Flood Risk Assessment taken forward by a developer.
- The majority of sites at fluvial risk are also at risk from surface water flooding, with areas of ponding in the higher return period events across some sites and the access roads surrounding them. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. For example, Site R38 presents very little present-day fluvial risk, although has a significant surface water through path through the west of the site. The impact of surface water flooding at sites such as this will need more detailed investigations undertaken as part of a site-specific Flood Risk Assessment at a later stage.
- Climate change allowances were applied to the existing watercourse models and 2D strategic models completed as part of this SFRA. For the 5%, 1% and 0.1% AEP events, the 2080s period was used, and all three allowance categories were modelled (25%, 35% & 65%). Modelling indicates that flood extents will increase as a result of climate change and therefore, the depths, velocities and hazard of flooding are also seen to increase. Some sites are more sensitive to climate change increases than others. Site-specific Flood Risk Assessments (FRAs) should confirm the impact of climate change using latest guidance.
- Sites in the Level 2 assessment are likely to be unaffected by a coastal breach scenario and tidal flooding, even with climate change increase, although a site-specific FRA should investigate the impact further for the sites in the east of Norwich.

- For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles. Where there is no safe access of egress, shelter in situ should be provided.
- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken to understand which SuDS option would be best.
- Sites which have areas designated by the Environment Agency as being a historic landfill site will require site ground investigations to determine the extent of the contamination and the impact this may have on SuDS.
- The Cumulative Impact Assessment (CIA) identified three catchments as at a high risk of increased risk as a result of development in the future. These are:
    - The River Wensum, through Norwich
    - The River Yare, from Tiffey to Wensum
    - The River Tiffey, Upstream of Wymondham

  The full CIA is in Appendix D and a summary is included in Section 6.3.
- To enable development in the East Norwich Regeneration Area, a carefully considered flood risk and sustainable drainage strategy covering sites GNLP0360, GNLP0353 and R10 must support early master planning and feasibility work. This will involve sacrificing some areas as functional floodplain and increasing flood storage to allow other areas of sites to be defended against fluvial flooding. There should be no overall loss of floodplain storage and the risk of flooding should not be increased up or downstream of the sites. The most suitable site in flood risk terms is GNLP0353.

  Major reprofiling, flood defences and sustainable drainage work would be required to bring forward such as high flood risk site. This will again involve sacrificing some areas as functional floodplain and increasing flood storage to allow other areas of the site to be defended against fluvial flooding. This is likely to affect the amount of land available for development. Areas of functional floodplain should be safeguarded from future development but may be appropriate for green infrastructure and open space uses

At the planning application stage and as part of an FRA, developers will need to undertake detailed hydrological and hydraulic assessments of watercourses and tidal flooding, to verify flood extent, depth, velocity and hazard (including considering the latest **climate change allowances**), inform development zoning within the site and prove, if required, whether the Exception Test can be passed.

For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriately flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

It is recommended that as part of the early discussions relating to development proposals, developers discuss requirements relating to site-specific FRA and drainage strategies with both the Local Planning Authority and the LLFA, to identify any potential issues that may arise from the development proposals.

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Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability
AStGWf	Areas Susceptible to Groundwater flooding
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CIA	Cumulative Impact Assessment
DTM	Digital Terrain Model
EA	Environment Agency
Exception Test	Set out in the NPPF, the Exception Test is used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
Flood defence	Infrastructure used to protect an area against floods, such as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
Flood risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a River.
FRA	Flood Risk Assessment - A site-specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
Greenfield	Undeveloped parcel of land
GNLP	Greater Norwich Local Plan
Ha	Hectare
IH124	A hydrology methodology produced by the Institute of Hydrology to assess the runoff from small catchments.
JBA	Jeremy Benn Associates
JFlow	2D generalised hydrodynamic modelling software.
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management.
Main Watercourse	Main rivers are designated by the Environment Agency and are usually larger rivers and streams. It consults with other risk management authorities and the public before making these decisions. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk and their powers to carry out flood defence work apply to main rivers only.
m AOD	metres Above Ordnance Datum
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRD	National Receptor Database
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility for maintenance.

Term	Definition
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity.
ReFH	Revitalised Flood Hydrograph
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
RoFSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW))
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
SFRA	Strategic Flood Risk Assessment
SPZ	(Groundwater) Source Protection Zone
Stakeholder	A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
URBEXT	Urban extent catchment descriptor, describing the level of urbanisation in a catchment.

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

The following text is taken from the National Planning Policy Framework, paragraph 156:

"Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards.".

This Strategic Flood Risk Assessment (SFRA) 2021 document provides a Level 2 assessment of strategic sites identified for potential allocation within Greater Norwich.

1.2 Levels of SFRA

The **Planning Practice Guidance**[1] (PPG) advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- **Level 1**: where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the Sequential Test.
- **Level 2**: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all necessary development, creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

This report fulfils the requirements of a **Level 2** SFRA.

1.3 SFRA Objectives

The objectives of the Level 2 SFRA are to:

1. Undertake site-specific flood risk analysis for the site identified using the latest available flood risk data, thereby assisting the Council in applying the Exception Test to its proposed site options in preparation of its Local Plan.
2. Using available data, provide information and a comprehensive set of maps presenting flood risk from all sources for each site option.
3. Where the Exception Test is required, provide recommendations for making the site safe throughout its lifetime.
4. Take into account most recent policy and legislation in the NPPF, PPG and LLFA Developer Guidance.
5. Undertake strategic analysis of the catchments within the Greater Norwich Local Plan area.

[1] Planning Practice Guidance – Flood Risk and Coastal Change - Paragraph: 012 Reference ID: 7-012-20140306

1.4 Context of the Level 2 Assessment

The **Greater Norwich Area SFRA Level 1** was undertaken by JBA Consulting and published in December 2017. This report appraised flood risk from all sources in the Greater Norwich Area.

Currently, the Joint Core Strategy, adopted in November 2014, sets out the strategy for regeneration and growth in the Greater Norwich area (comprising Norwich, Broadland and South Norfolk Districts) up to 2026. The Council is currently developing a Local Plan and the Plan is set to be adopted in September 2022. The Greater Norwich Development Partnership board sets out the programme for preparing the Greater Norwich Local Plan (GNLP), which will be the principal statutory development plan document for the area.

JBA Consulting were provided with a list of sites for Level 2 assessment from the Greater Norwich Authorities. In total, 26 sites have been assessed for this Level 2 SFRA.

1.5 Consultation

SFRAs should be prepared in consultation with other Risk Management Authorities (RMAs). The following parties, external to the Greater Norwich Local Plan team, have been consulted during the preparation of the Level 2 SFRA:

- Greater Norwich Planning Policy
- Environment Agency
- Water Management Alliance group of six Internal Drainage Boards
- Broads Authority
- Norfolk County Council Lead Local Flood Authority
- Anglian Water

1.6 How to Use this Report

Table 1-1 SFRA User Guide

Section	Contents	How to use
1. Introduction	Outlines the purpose and objectives of the Level 2 SFRA.	For general information and context.
2. The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.	Users should refer to this section for any relevant policy which may underpin strategic or site-specific assessments.
3. Planning policy for flood risk management	Provides an overview of both national and existing Local Plan policy on flood risk management.	Users should use this section to understand and follow the steps required for the Sequential and Exception Tests.
4. Impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA. Sets out how developers should apply the guidance to inform site-specific Flood Risk Assessments.	This section should be used to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development.
5. Sources of information used in preparing the Level 2 SFRA	Summarises the data used in the Level 2 assessments and GeoPDF mapping.	Users should refer to this section in conjunction with the summary tables and GeoPDF mapping to understand the data presented. Developers should refer back to this section when understanding requirements for a site-specific FRA.
6. Level 2 Assessment Methodology	Summarises the sites requiring Level 2 assessment and the outputs produced for each of these sites.	This section should be used in conjunction with the site summary tables and GeoPDF mapping to understand the data presented.
7. Flood risk management requirements for developers	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Refers to relevant sections in the L1 SFRA for mitigation guidance.	Developers should use this section to understand requirements for FRAs and what conditions/ guidance documents should be followed. Developers should also refer to the L1 SFRA for further information on flood mitigation options.
8. Surface water management and SuDS	An overview of any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority, Anglian Water and the water sector. Refers back to relevant sections in the L1 SFRA for information on SuDS and surface water management.	Developers should use this section to understand what national, regional and local SuDS standards are applicable. Hyperlinks are provided. Developers should also refer to the L1 SFRA for further information on types of SuDS, the hierarchy and management trains information.
9. Summary of Level 2 assessment and recommendations	Summarises the results and conclusions of the Level 2 assessment, and signposts to the L1 SFRA for planning policy recommendations.	Developers and planners should use this section to provide an overview of the Level 2 assessment. Planners should use this section to identify which potential site allocations have the least risk of flooding. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.

Appendix A: Level 2 Assessment - Site Summary Tables	Provides a detailed summary of flood risk for sites requiring a more detailed assessment. The section considers flood risk, emergency planning, climate change, broadscale assessment of possible SuDS, exception test requirements and requirements for site-specific FRAs.	Planners should use this section to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these tables to understand flood risk, access and egress requirements, climate change, SuDS and FRA requirements for site-specific assessments.
Appendix B: Mapping	Mapping for each Level 2 assessed site showing flood risk at and around the site.	Planners and developers should use these maps in conjunction with the site summary tables to understand the nature and location of flood risk.
Appendix C: Modelling summary	Provides a summary of the modelling work undertaken to inform the flood risk to sites.	For technical background information.
Appendix D: Cumulative impact of development and strategic solutions	Makes policy recommendations regarding the cumulative impact of development on flood risk for the catchments within the GNLP area.	Planners should use this section to help develop policy recommendations for the sites specified. Developers should use this section to understand the potential storage requirements and betterment opportunities for the sites assessed.

1.7 SFRA Study Area

The Greater Norwich area is approximately 150,269ha and has a population of approximately 412,000[2].

Greater Norwich is located in central Norfolk. The study area is comprised of three lower-tier local authorities; Broadland District to the north, Norwich City District as the central urban district, and South Norfolk District to the south.

The Level 2 SFRA covers the Districts of Norwich, Broadland and South Norfolk Councils.

The map below, Figure 1-1, shows the Greater Norwich study area location in the context of the UK and also surrounded by neighbouring authorities; Breckland District, East Suffolk District, Great Yarmouth District, Mid Suffolk District and North Norfolk District.

The main rivers in the Greater Norwich area are the Rivers Wensum, Yare, Waveney and Bure. The Spixworth Beck, a tributary of the River Bure, has also been modelled in this Level 2 assessment. The map below, Figure 1-2, shows the locations of these rivers and wider network in the Greater Norwich area.

The River Wensum rises in northeast Norfolk and passes through Norwich City Centre, it is a tributary of the River Yare of which the confluence is situated in east Norwich. The Yare rises to the east of Norwich and flows south easterly around the urban perimeter of Norwich, and out to the Broads where it is tidally influenced. The River Waveney passes through South Norfolk and the Bure passes north of Norwich before both flow into the Tidal Broads.

2 Office for National Statistics. Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland. Mid-2019: April 2020 Local Authority District Codes. https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland

Figure 1-1 Overview Map of Study Area and Neighbouring Authorities

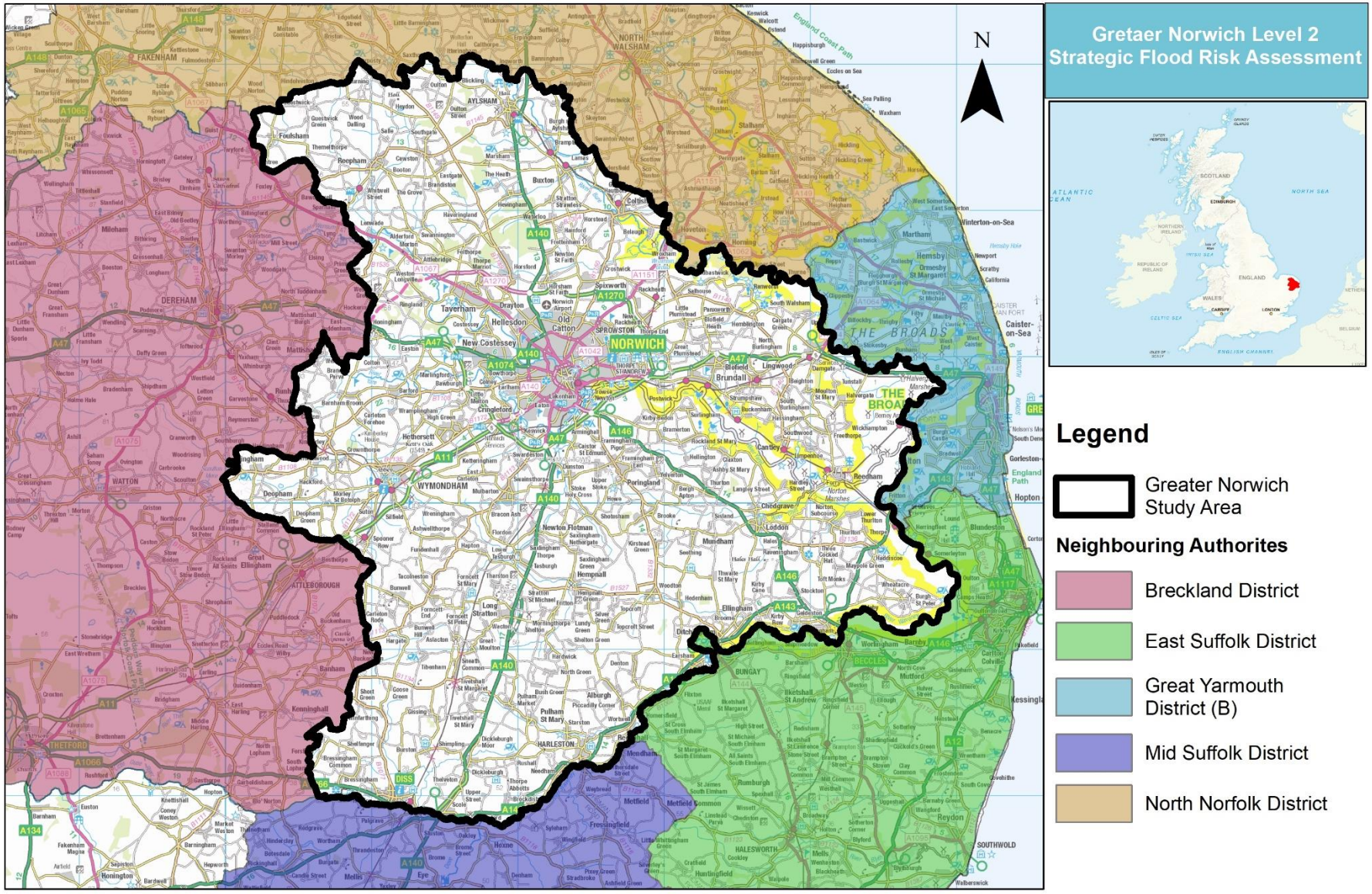
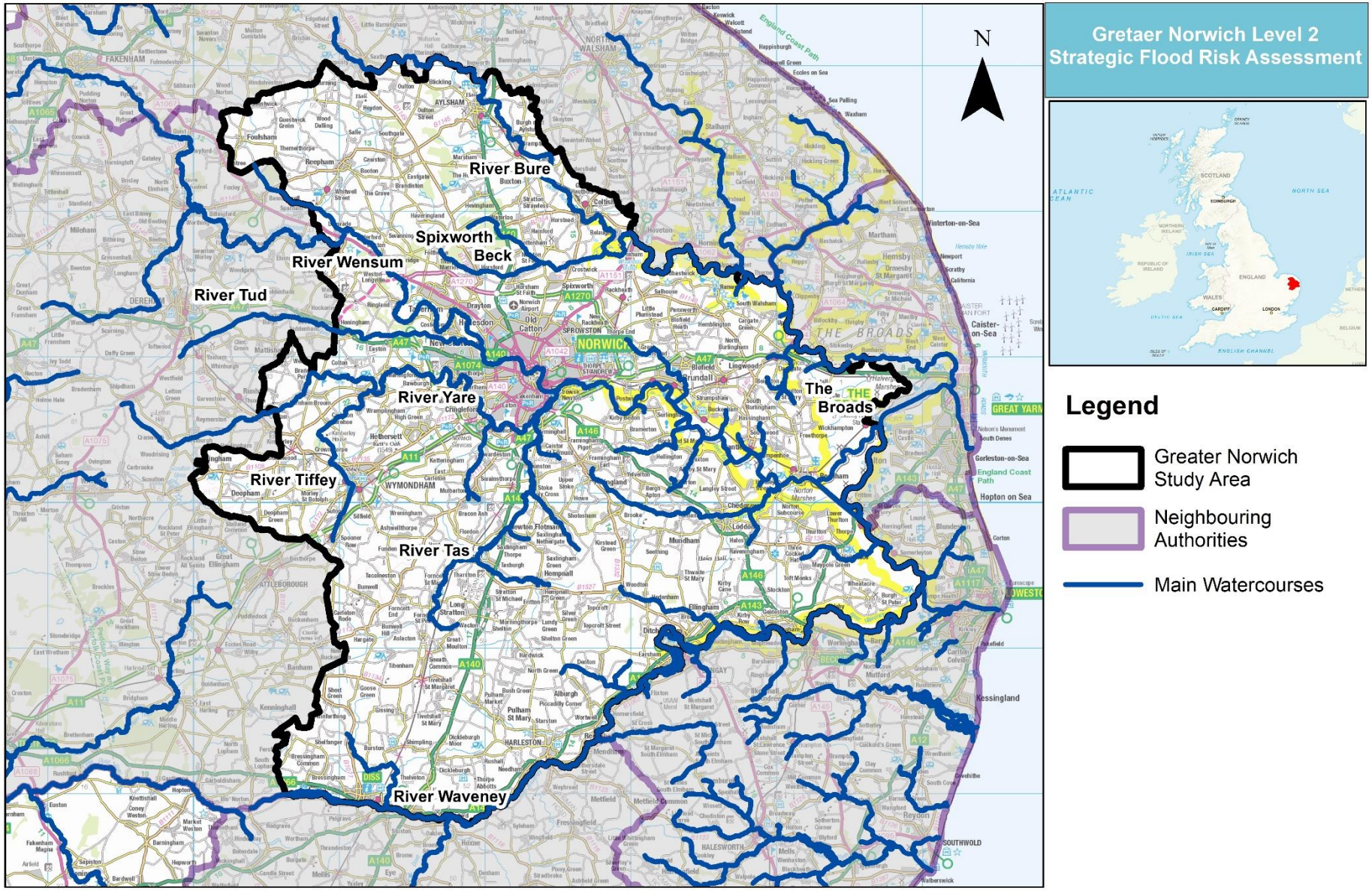


Figure 1-2 Key watercourses in the Greater Norwich study area



2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is considered at every stage of the planning process. This section of the Level 2 SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities, given the changes since the Level 1 Norfolk Authorities SFRA and updated guidance. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and considered.

SFRAs contain information that should be referred to in responding to the Flood Risk Regulations and the formulation of local flood risk management strategies and plans. SFRAs are also linked to the preparation of Catchment Flood Management Plans (CFMPs), Surface Water Management Plans (SWMPs) and Water Cycle Strategies (WCSs).

2.2 Roles and Responsibilities for Flood Risk Management

There are a number of different organisations in and around Greater Norwich that have responsibilities for flood risk management, known as Risk Management Authorities (RMAs). These are shown below in Table 2-1, with a summary of their responsibilities.

It is important to note that land and property owners are responsible for the maintenance of watercourses either on or next to their properties. Property owners are also responsible for the protection of their properties from flooding. More information can be found in the Environment Agency publication **Owning a Watercourse** (2018).

When it comes to undertaking works to reduce flood risk, the Environment Agency and Norfolk County Council as LLFA do have powers, but limited resources must be prioritised and targeted to where they can have the greatest effect.

Table 2-1 Roles and Responsibilities for Flood Risk Management

Risk Management Authority	Strategic Level	Operational Level	Planning Role
Environment Agency	• Strategic overview for all sources of flooding • National Strategy • Reporting and general supervision	• Main rivers • Reservoirs	• Statutory consultee for development in Flood Zones 2 and 3 for coastal and fluvial extents
Norfolk County Council - Lead Local Flood Authority (LLFA)	• Preliminary Flood Risk Assessment • Local Flood Risk Management Strategy	• Surface Water • Groundwater • Ordinary Watercourses (consenting and enforcement) • Ordinary watercourses (works)	• Statutory consultee for all major developments
Broadland District Council, Norwich City Council, South Norfolk Council - Local Planning Authority (LPA)	• Local Plans as Local Planning Authorities	• Determination of Planning Applications as Local Planning Authorities • Managing open spaces under Council ownership	• As left

Risk Management Authority	Strategic Level	Operational Level	Planning Role
Broads Authority	• Local Planning Authority • Conservation and area promotion	• Maintain waterways • Determination of Planning Applications as Local Planning Authorities	• Determination of Planning Applications as Local Planning Authorities • Managing open spaces under Council ownership
Water Management Alliance – Broads and Norfolk Rivers Internal Drainage Boards	• Water level management and environmental conservation	• Permissive powers for water level management	• Non-statutory consultee • Other statutory powers to determine development suitability
Water Companies: Anglian Water	• Asset Management Plans supported by Periodic Reviews (business cases) • Develop Drainage and Wastewater management plans	• Public sewers	• Non-statutory consultee for all major developments. Also provides comments below this threshold where a specific request is received from Council' • Adoption of SuDS under Sewerage Sector Guidance
Highways Authorities: Highways England - motorways and trunk roads Norfolk County Council, Local Highway Authority – Other adopted roads	• Highway drainage policy and planning	• Highway drainage • Local Highway Authority is able to adopt some highway drainage features	• Internal planning consultee regarding highways and design standards and options

2.3 Relevant Legislation

The following legislation is relevant to development and flood risk in Greater Norwich:

- **Flood Risk Regulations (2009)** transpose the EU Floods Directive (2000) into UK law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments (PFRAs) and identify where there are nationally significant Flood Risk Areas. For the Flood Risk Areas, detailed flood maps and a Flood Risk Management Plan are produced. This is a six-year cycle of work and the second cycle started in 2017.
- **Town and County Planning Act (1990)**, **Water Industry Act (1991)**, **Land Drainage Act (1991)**, Environment Act (2005) and **Flood and Water Management Act (2010)** – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have FRM role.
- **Land Drainage Act (1991)** and **Environmental Permitting Regulations (2016)** define where developers need to apply for additional permission (and Planning Permission) to undertake works to an ordinary watercourse or Main River.

- **Water Environment Regulations (2017)** transpose the European Water Framework Directive (2000) into law, requiring the Environment Agency to produce River Basin Management Plans (RBMPs). These aim to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands reach 'good status'.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014) and Strategic Environmental Assessment Directive (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.
- Note that secondary UK legislation implementing EU Directives such as the Flood Risk Regulations and Water Environment Regulations are subject to repeal/ amendment following the UK exit from the EU. At the time of publishing this report the references here were correct.

2.4 Relevant Flood Risk Policy and Strategy Documents

Table 2-2 summarises some of the relevant national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. There are hyperlinks to the documents in the table. These documents may:

- Provide useful and specific local information to inform flood risk assessments within the local area.
- Set the strategic policy and direction for Flood Risk Management (FRM) and drainage – they may contain policies and action plans that set out what future mitigation and climate change adaptation plans may affect a development site. A developer should seek to contribute in all instances to the strategic vision for FRM and drainage in Greater Norwich.
- Provide guidance and/ or standards that informs how a developer should assess flood risk and/ or design flood mitigation and SuDS.

Table 2-2 National, Regional and Local Flood Risk Guidance, Policy and Strategy Documents

Level	Document, lead author and date	Information	Policy and Measures	Development Design Requirements	Next Update Due
National	**Flood and Coastal Management Strategy** (Environment Agency) 2020	No	Yes	No	Due to be reviewed in 2026
National	**National Planning Policy Framework and Guidance** (MCHLG) 2018/2015	No	No	Yes	
National	**Building Regulations Part H** (MCHLG) 2010	No	No	Yes	-
National	**Sewerage Section Guidance** (UK Water) 2020	Yes	no	Yes	
Regional	**Anglian river basin district river basin management plan** (Environment Agency) 2015	No	Yes	No	Due to be reviewed in 2021
Regional	**Climate Change Guidance for Flood Risk Assessment** (Environment Agency) 2020	No	No	Yes	Due to be reviewed in 2021
Regional	**SuDS Design Manual** (Anglian Water)	Yes	No	Yes	
Local	**Greater Norwich Level 1 Strategic Flood Risk Assessment** (JBA Consulting) 2017	Yes	No	No	-
Local	**Greater Norwich Joint Core Strategy** Broadland District Council, Norwich City Council, South Norfolk Council, Norfolk County Council (2011)	Yes	Yes	Yes	Due to be reviewed in 2026
Local	**Preliminary Flood Risk Assessment Report** Norfolk County Council (2017)	Yes	No	No	Due to be reviewed in 2023
Local	**Norfolk Local Flood Risk Management Strategy** Norfolk County Council 2015	Yes	Yes	Yes	Update to be published Spring 2021

Level	Document, lead author and date	Information	Policy and Measures	Development Design Requirements	Next Update Due
Local	**Norwich Surface Water Management Plan** Norfolk County Council 2014 **South Norfolk Surface Water Management Plan** Norfolk County Council 2016	Yes	Yes	No	-
Local	**Norfolk County Council Lead Local Flood Authority Statutory Consultee for Planning Guidance Document**	Yes	Yes	Yes	Update to be published in 2021

2.5 Relevant Flood Risk Management Studies and Documents

2.5.1 National Flood and Coastal Erosion Risk Management Strategy for England (2020)

The **National Flood and Coastal Erosion Risk Management Strategy** (FCERM) for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. The new Strategy has been in preparation since 2018. The Environment Agency brought together a wide range of stakeholders to develop the strategy collaboratively. The Strategy is much more ambitious than the previous one from 2011 and looks ahead to 2100 and the action needed to address the challenge of climate change.

The emphasis of The Strategy is on developing resilient places and communities. The Strategy has been split into three high level ambitions: climate resilient places, today's growth and infrastructure resilient in tomorrow's climate, and a nation ready to respond and adapt to flooding and coastal change. Measures include:

- updating the national river, coastal and surface water flood risk mapping and the understanding of long term investment needs for flood and coastal infrastructure,
- trialling new and innovative funding models,
- flood resilience pilot studies,
- developing an adaptive approach to the impacts of climate change,
- seeking nature based solutions towards flooding and erosion issues,
- integrating natural flood management into the new Environmental Land Management scheme, considering long term adaptive approaches in Local Plans,
- maximising the opportunities for flood and coastal resilience as part of contributing to environmental net gain for development proposals,
- investing in flood risk infrastructure that supports sustainable growth, aligning long term strategic planning cycles for flood and coastal work between stakeholders,
- mainstreaming property flood resilience measures and 'building back better' after flooding, consistent approaches to asset management and record keeping,
- updating guidance on managing high risk reservoirs in light of climate change,
- critical infrastructure resilience, education, skills, and capacity building,
- research, innovation and sharing of best practise,
- supporting communities to plan for flood events,
- developing world leading ways of reducing the carbon and environmental impact from the construction and operation of flood and coastal defences,
- development of digital tools to communicate flood risk and transforming the flood warning service and increasing flood response and recovery support.

The Strategy was completed in 2020 and published alongside a New National Policy Statement for Flood and Coastal Erosion Risk Management. The statement sets out five key commitments which will accelerate progress to better protect and better prepare the country for the coming years:

1. Upgrading and expanding flood defences and infrastructure across the country,
2. Managing the flow of water to both reduce flood risk and manage drought,
3. Harnessing the power of nature to not only reduce flood risk, but deliver benefits for the environment, nature, and communities,
4. Better preparing communities for when flooding and erosion does occur, and
5. Ensuring every area of England has a comprehensive local plan for dealing with flooding and coastal erosion.

2.6 LLFAs, Surface Water and SuDS

The 2019 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). When considering planning applications, local planning authorities should consult the LLFA on the management of surface water in order to satisfy that:

- The proposed minimum standards of operation are appropriate
- Through the use of planning conditions or planning obligations there are clear arrangements for on-going maintenance over the development's lifetime

Norfolk County Council's SuDS requirements for new developers are set out in the **Norfolk County Council Lead Local Flood Authority Statutory Consultee for Planning Guidance Document**.

The 2019 NPPF states that flood risk should be managed "using opportunities provided by new development to reduce causes and impacts of flooding". As such, Norfolk County Council expects SuDS to be incorporated on minor development as well as major development. Masterplans should be designed to ensure that space is made for above ground SuDS features. Underground tanks should only be used on sites as a last resort.

2.7 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in an area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments. There are SWMPS for Norwich and South Norfolk in the GNLP area, which will be used to inform prioritisation of future flood management actions.

2.8 Updated Strategic Flood Risk Assessment Guidance

There was an update to the **'How to prepare a Strategic Flood Risk Assessment guidance'** in August 2019, which had some key additions to both Level 1 and Level 2 assessments. The Level 2 assessment is undertaken in accordance with this guidance.

3 Planning Policy for Flood Risk Management

3.1 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (**NPPF**) was published in February 2019, replacing the 2012 version. The NPPF sets out Government's planning policies for England. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF states that:

"Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards"

Planning Practice Guidance on flood risk was published in March 2014 and sets out how the policy should be implemented. **Diagram 1 in the NPPG** sets out how flood risk should be considered in the preparation of Local Plans.

3.2 The Risk Based Approach

The NPPF takes a risk-based approach to development in flood risk areas. A risk-based approach sets out requirements in a way that is proportionate to the risk present. Therefore, in the context of a strategic flood risk assessment, recommendations made are proportionate to the level of risk present on site. This risk-based approach informs the Sequential test set out in 3.4 below.

3.3 The Flood Zones

The definition of the Flood Zones is provided below in Table 3-1. The Flood Zones described in the table below depict the flooding from rivers and the sea. The Flood Zones do not consider defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

The Flood Zones do not consider surface water, sewer or groundwater flooding or the impacts of canal or reservoir failure. They do not consider climate change. Hence there could still be a risk of flooding from other sources and that the level of flood risk will change over time during the lifetime of a development.

Table 3-1 Flood Zone Summary – Flooding from Rivers and Sea

Zone	Probability	Description
Zone 1	Low	• This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding in any year (<0.1% AEP). • All land uses are appropriate in this zone. • For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
Zone 2	Medium	• This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1% AEP) or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1% – 0.5% AEP) in any year. • Essential infrastructure, water compatible infrastructure, less

Zone	Probability	Description
		vulnerable and more vulnerable land uses (as set out by NPPF) as appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test. • All developments in this zone require an FRA.
Zone 3a	High	• This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0% AEP) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5% AEP) in any year Developers and the local authorities should seek to reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage. • Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test. • All developments in this zone require an FRA.
Zone 3b	Functional Floodplain	• This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain should take account of local circumstances. • Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain storage, no impediment to water flows and no increase in flood risk elsewhere' • All developments in this zone require an FRA.

3.4 The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. Information contained in this SFRA is used to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded.

In addition, the risk of flooding from other sources and the impact of climate change must be considered when considering which sites are suitable to allocate.

The LPA will apply the Sequential Test to strategic allocations. For all other developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sides in the Sequential Test. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of Strategic Housing Land or Employment Land Availability Assessments.

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for. **Table 2 of the NPPG** defines the vulnerability of different development types to flooding. **Table 3 of the NPPG** shows whether, having applied the Sequential Test first, that vulnerability of development is suitable for that Flood Zone and where further work is needed.

Table 3-2 below shows how site allocation is determined by the flood zone.

Table 3-2 Local Plan Sequential Approach to Site Allocation

Development location	Appropriateness for site allocation
Flood Zone 1	Appropriate for allocation.
Flood Zone 2	Appropriate for allocation if highly vulnerable development can be located in Flood Zone 1.
Flood Zone 3a	Appropriate for allocation if: • highly vulnerable development is located in Flood Zone 1 or 2. • can demonstrate that there are wider strategic planning objectives for the development in high risk areas. • can demonstrate that that development would remain safe and not increase the flood risk elsewhere.
Flood Zone 3b	Not appropriate for development (except water compatible infrastructure such as amenity, biodiversity and public open space, and essential infrastructure passing the Exception Test).

3.5 The Exception Test

It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required.

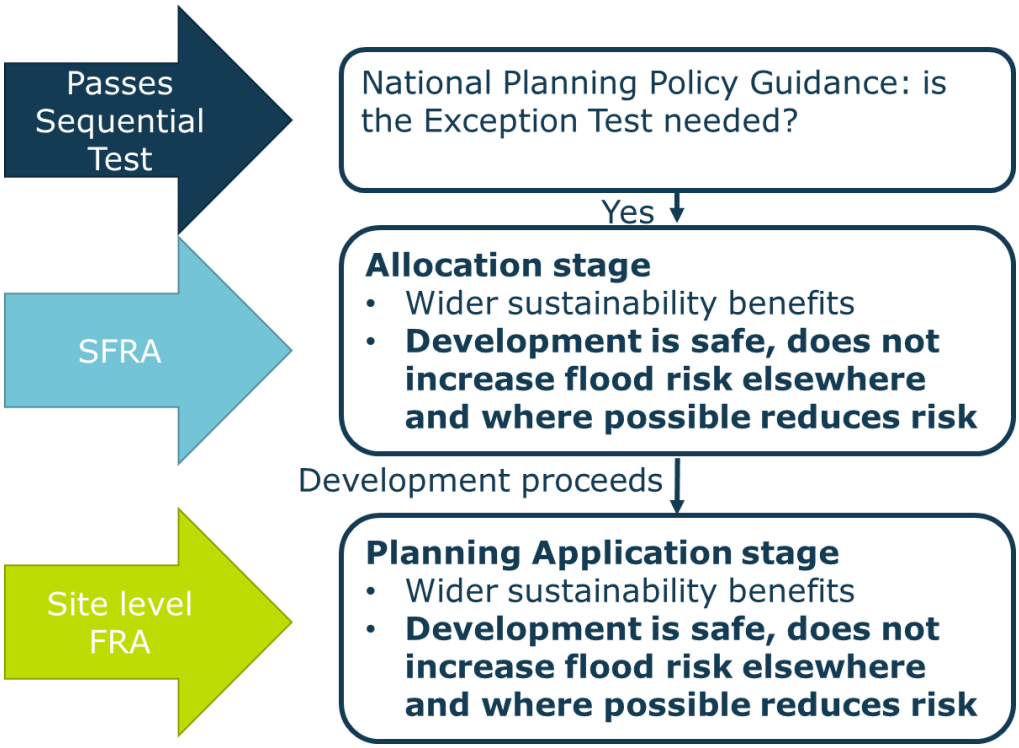
The Exception Test should only be applied following the application of the Sequential Test. It applies in the following instances:

- More vulnerable in Flood Zone 3a
- Essential infrastructure in Flood Zone 3a or 3b
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)

Figure 3-1 below shows what the Exception Test informs at each level of assessment. For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriate flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA. This should demonstrate that the site will still pass the flood risk element of the Exception Test based on the detailed site level analysis.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

Figure 3-1 The Exception Test



There are two parts to demonstrating a development passes the Exception Test:

1 *Demonstrating that the development would provide wider sustainability benefits to the* community *that outweigh the flood risk.*

Local planning authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused.

At the stage of allocating development sites, Local Planning Authorities should consider wider sustainability objectives, such as those set out in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

The Local Planning Authority should consider the sustainability issues the development will address and how doing so will outweigh the flood risk concerns for the site, e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

2 *Demonstrating that the development will be safe for its lifetime taking account of the* vulnerability *of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

A Level 2 SFRA is likely to be needed to inform the Exception Test in these circumstances for strategic allocations. At Planning Application stage, a site-specific Flood Risk assessment will be needed. Both would need to consider the actual and residual risk and how this will be managed over the lifetime of the development.

3.6 Making a Site Safe from Flood Risk over its Lifetime

Local Planning Authorities will need to consider the actual and residual risk of flooding and how this will be managed over the lifetime of the development:

- The actual risk is the risk to the site considering existing flood mitigation measures. The fluvial 1% AEP chance flood in any year event (and 0.5% AEP chance for tidal) is a key event to consider because the National Planning Policy Guidance refers to this as the 'design flood' against which the suitability of a proposed development should be assessed and mitigation measures, if any, are designed.
- Safe access and egress should be available during the design flood event. Firstly, this should seek to avoid areas of a site at flood risk. If that is not possible then access routes should be located above the design flood event levels. Where that is not possible, access through shallow and slow flowing water that poses a low flood hazard may be acceptable.

  Shelter in situ in a safe, dry accessible space for all occupants that has an external escape route may be suitable for some developments when the duration of flooding is not likely to be significant. This would need to be above the 0.1% AEP flood event flood level taking account of climate change. Access for emergency services should be considered and this is more likely to be appropriate for smaller infill developments than larger strategic ones where access routes should be planned such that access is available as a minimum for emergency services. A Flood evacuation and warning plan that is regularly tested would be necessary.
- Residual risk is the risk that remains after the effects of flood defences have been taken into account and/ or from a more severe flood event than the design event. The residual risk can be:

- The effects of an extreme 0.1% AEP chance flood in any year event. Where there are defences this could cause them to overtop, which may lead to failure if this causes them to erode, and/ or
- Structural failure of any flood defences, such as breaches in embankments or walls.

Flood resistance and resilience measures should be considered to manage any residual flood risk by keeping water out of properties and seeking to reduce the damage it does, should water enter a property. Emergency plans should also account for residual risk, e.g. through the provision of flood warnings and a flood evacuation plan where appropriate. These plans should consider requirements of the ADEPT guidance on the preparation of the Flood Emergency Plans. Where emergency plans are required, suitability of the site and appropriate use of the site should be considered.

In line with the NPPF, the impacts of climate change over the lifetime of the development should be considered when considering actual and residual flood risk.

3.7 The Sequential Test and Exception Test and Individual Planning Applications

3.7.1 The Sequential Test

Developers are required to apply the Sequential Test to all development sites, unless the site is:

- A strategic allocation and the test has already been carried out by the LPA, or
- A change of use (except to a more vulnerable use), or
- A minor development (householder development, small non-residential extensions with a footprint of less than 250m^2), or
- A development in Flood Zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, ground water, sewer flooding).

The SFRA contains information on all sources of flooding and taking into account the impact of climate change. This should be considered when a developer undertakes the Sequential Test, including the consideration of reasonably available sites at lower flood risk.

Local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear e.g. school catchments, in other cases it may be identified by other Local Plan policies. For some sites e.g. regional distribution sites, it may be suitable to widen the search area beyond LPA administrative boundaries.

The sources of information on reasonably available sites may include:

- Site allocations in Local Plans
- Site with Planning Permission but not yet built out
- Strategic Housing and Economic Land Availability Assessments (SHELAAs)/ five-year land supply/ annual monitoring reports
- Locally listed sites for sale

It may be that a number of smaller sites or part of a larger site at lower flood risk form a suitable alternative to a development site at high flood.

Ownership or landowner agreement in itself is not acceptable as a reason not to consider alternatives.

3.7.2 The Exception Test

If, following application of the Sequential Test it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied

if required (as set out in Table 3 of the NPPG). Developers are required to apply the Exception Test to all applicable sites.

The applicant will need to provide information that the application can pass both parts of the Exception test:

- *Demonstrating that the development would provide wider sustainability benefits to the* community *that outweigh the flood risk.*

  Applicants should refer to wider sustainability objectives in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

  Applicants should detail the suitability issues the development will address and how proceeding with development will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

- Demonstrating *that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

  The site-specific Flood Risk Assessment should demonstrate that the site will be safe, and the people will not be exposed to hazardous flooding from any source. The FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:

  - The design of any flood defence infrastructure;
  - Operation and maintenance;
  - Access and egress;
  - Design of the development to manage and reduce flood risk wherever possible;
  - Resident awareness;
  - Flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event; and
  - Any funding arrangements required for implementing measures.

4 The Impact of Climate Change

4.1 Introduction

The **Climate Change Act 2008** creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050.

The NPPF sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. NPPF and NPPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

Climate change modelling for the watercourses in Greater Norwich was undertaken as part of the Level 1 SFRA. Modelling was completed for the Rivers Wensum, Yare and Waveney using TUFLOW. Both defended and undefended scenarios have been modelled and the undefended scenarios have been used to assess the risk of flooding. In addition, recent climate change uplifts were applied, including the +80% (H++) scenario, for sites in the East Norwich Regeneration area.

4.2 Revised Climate Change Guidance

The Environment Agency published **updated climate change guidance** in July 2020 on how allowances for climate change should be included in both strategic and site specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development. Whilst the guidance was updated in 2020, fluvial allowances are still to be updated from those in the original 2016 guidance.

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency are currently using these to further update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances. Developers should check on the government website for the latest guidance before undertaking a detailed Flood Risk Assessment. At the time of writing this report, this was likely to be due in mid-2021, but is not yet released.

Note that the method in the SFRA was based on the Environment Agency climate change guidance update from December 2019. In late July 2020 the Environment Agency updated their guidance to say that the sensitivity of significant urban extensions and new settlements to the extreme H++ scenario should be considered in SFRAs. The H++ scenario has been considered for the urban sites within the East Norwich Regeneration area and for the Three Score Urban Extension at Bowthorpe in this SFRA, which were determined significant development in consultation with the Environment Agency.

This SFRA has taken a conservative approach and used the Upper End (+65%) climate change allowances as per the guidance to consider sensitivity to flood risk when allocating sites. Within each site-specific summary table, sensitivity to climate change has been assessed and recommendations for future site-specific assessments made. Associated interactive mapping also shows how climate change could impact the flood extents and depths across each site, and we have also included the Upper Central (35%) allowance for 1% AEP in the mapping. The council are also advised to encourage developers to account for the H++ scenario for significant urban extensions and new settlements for the 1% AEP design event when master planning and ensure a development is resilient to flooding in the extreme 0.1% AEP event with the H++ scenario.

4.3 Applying the Climate Change Guidance

To apply the climate change guidance, the following information needs to be known:

- The vulnerability of the development – see the **NPPG**
- The likely lifetime of the development – in general 75 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA
- The River Basin that the site is in – the Greater Norwich area is situated in the Anglian River Basin District.

- Likely depth, speed and extent of flooding for each climate change allowance over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s)
- The 'built in' resilience measures used, for example, raised floor levels
- The capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach

4.3.1 Relevant Allowances for Greater Norwich

Table 4-1 shows the peak river flow allowances and Table 4-2 shows the peak rainfall intensity allowances that apply to Greater Norwich.

Table 4-1 Peak River Flow Allowances by River Basin District

River Basin District	Allowance category	Total potential change anticipated for '2020s' (2015 to 39)	Total potential change anticipated for '2050s' (2040 to 2069)	Total potential change anticipated for '2080s' (2070 to 2115)
Anglian	Extreme (H++)	25%	40%	80%
	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%

Table 4-2 Peak Rainfall Intensity Allowance in Small and Urban Catchments

Applies across all of England	Total potential change anticipated for 2010 to 2039	Total potential change anticipated for 2040 to 2059	Total potential change anticipated for 2060 to 2115
Upper end	10%	20%	40%
Central	5%	10%	20%

4.4 Representing Climate Change in a Level 2 SFRA

Appendix C summarises the flood modelling work used in the Level 2 SFRA and how the latest climate change allowances have been applied. To take account of rising sea levels, appropriate increases to the tidal level at the tidal limit of the Wensum, Yare and Waveney models was considered alongside increases in fluvial flows.

It is recommended that the impact of climate change on a proposed site is considered as part of a detailed Flood Risk Assessment, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development as described in this Chapter.

4.5 Adapting to Climate Change

The NPPG sections on climate change contain information and guidance for how to identify suitable mitigation and adaptation measure in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime.
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.

- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses; and
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space.

5 Sources of Information used in Preparing the Level 2 SFRA

5.1 Data Used to Inform the SFRA

This chapter discusses all the datasets used in the Level 2 SFRA to assess the sites against flood risk. Several different sets of data may have been used to inform the extent, depth, hazard and velocity for each site. Appendix C contains a summary of the modelling data used in the Level 2 SFRA.

Table 5-1 Overview of data used for the Greater Norwich L2 SFRA

Flood Source	Data Description	Data Source
Historic (All Sources)	Historic Flood Map and Recorded Outlines	Environment Agency
Historic (All Sources)	Greater Norwich L1 SFRA - 2017	Greater Norwich Authorities JBA Consulting
Historic (All Sources)	Historic flood incidents/records	Norfolk County Council LLFA NCC Local Highways Authority Anglian Water
Fluvial	Flood Map for Planning Risk of Flooding from Rivers and Sea	Environment Agency
Fluvial	River Wensum & Tud Models (2017) River Yare Model (2014) River Bure Model (2018) River Waveney Model (2013) Spixworth Beck (North Norfolk Rivers Study, 2006)	Environment Agency
Tidal	Broads BESL model	Environment Agency
Fluvial	Greater Norwich Level 2 SFRA strategic modelling	Norfolk County Council
Surface Water	Risk of Flooding from Surface Water dataset Level 1 SFRA surface water modelling for climate change	Environment Agency Norfolk County Council
Groundwater	Areas Susceptible to Groundwater Flooding dataset Bedrock geology/superficial deposits dataset	Environment Agency
Sewer	HFRR Register Historic flooding records	Anglian Water
Reservoir	Risk of Flooding from Reservoirs dataset	Environment Agency

5.2 Flood Zones

The data used to prepare the fluvial mapping for this study is based on the results from hydraulic models, either provided by the Environment Agency or prepared for the purposes of this SFRA.

Fluvial mapping is described using annual exceedance probability (AEP). This is the probability of a flood event occurring in any year, and is expressed as a percentage.

5.3 Climate Change

The mapping provides a strategic assessment of climate change risk; developers should undertake detailed modelling of climate change allowances as part of a site-specific FRA, following the **Climate Change Guidance** set out by the Environment Agency.

This would include the Central (1% AEP +25%), Higher Central (1% AEP +35%) and Upper End (1% AEP +65%) climate change allowances, for the Anglian basin's 2080s epoch. The sensitivity to the extreme H++ scenario should be assessed for significant urban extensions and new settlements.

Future flood zones are a required output from the study. The Upper End climate change, undefended model has been run based on the Year 2080 band (2070 to 2115) for fluvial and Year 2120 for tidal boundaries consistent with the model runs as described in Appendix C Modelling Summary. These are adopted as future flood zones within the Level 2 SFRA.

For surface water, the Level 1 SFRA surface water modelling (which used a 40% uplift in rainfall intensity) was used in the assessment.

5.4 Surface Water

Mapping of surface water flood risk in Greater Norwich has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFfSW) mapping, which is a slightly more detailed resolution than that published online by the Environment Agency. Surface water flood risk is subdivided into the following four categories:

- **High**: A chance of flooding greater than 3.3% AEP (1 in 30 year).
- **Medium**: A chance of flooding between 1% AEP (1 in 100 year) & 3.3% AEP (1 in 30 year).
- **Low**: A chance of flooding between 0.1% AEP (1 in 1,000 year) & 1% AEP (1 in 100 year).
- **Very Low**: A chance of flooding of less than 0.1% (1 in 1,000 year).

The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be required to more accurately illustrate the flood risk at a site-specific scale. Such an assessment should use the RoFSW in partnership with other sources of local flooding information (including the Level 1 SFRA surface water climate change modelling) to confirm the presence of a surface water risk at that particular location. Detailed modelling based on site survey will be necessary where there is a significant risk of surface water flooding.

5.5 Groundwater

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater (AStGWF) dataset. The AStGWF dataset is a strategic-scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and does not take account of the chance of flooding from groundwater rebound.

This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

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

5.6 River Networks

Main Rivers are represented by the Environment Agency's Statutory Main River layer. Ordinary Watercourses are represented by the Environment Agency's Detailed River Network

Layer. Caution should be taken when using these layers to identify culverted watercourses which may appear as straight lines but in reality, are not.

Developers should be aware of the need to identify the route of and flood risk associated with culverts. They should also be aware of easements that will affect development over and adjacent to watercourses which may affect the area of developable land.

5.7 Flood Warnings

Flood Warning and Flood Alert Areas are represented by the EA's GIS datasets.

5.8 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been identified from the Environment Agency's **Long Term Flood Risk Information website.**

5.9 Sewer Flooding

Historical incidents of flooding are detailed by Anglian Water in their sewer flooding register. The sewer flooding register records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. This data was used to describe any sewer flooding in the Level 2 summary tables. Due to licencing and confidentiality restrictions, sewer data has not been represented on the mapping.

5.10 Historic Flooding

Historic flooding was assessed using the Environment Agency's Historic Flood Map and Recorded Flood Outlines datasets. In addition, historic flooding records have been supplied by Norfolk County Council as LLFA and Local Highways Authority.

5.11 Flood Defences

Flood defences are represented by Environment Agency's Asset Information Management System (AIMS) Spatial Defences data set. Their current condition and standard of protection are based on those recorded in the tabulated shapefile data. None of the sites being assessed are formally protected by a flood defence.

5.12 Residual Risk

The residual flood risk to sites is identified as where potential blockages or overtopping/ breach of defences could result in the inundation of a site, with the sudden release of water with little warning. Given the limited extent of flood defences affecting allocation sites there was no fluvial breach modelling undertaken for the Level 2 SFRA. Tidal breach modelling of the Yare at Breydon Water showed that resultant flooding was not likely to affect sites in Norwich, with water levels remaining below current river bank levels.

Residual risk from breaches to flood defences, whilst rare, needs to be considered in Flood Risk Assessments. Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the Environment Agency to collate and standardise these methodologies. It is recommended that the Environment Agency are consulted if a development site is located near to a flood defence, to understand the level of assessment required and to agree the approach for the breach assessment.

5.13 Depth, Velocity and Hazard to People

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people during the defended fluvial and surface water 1% AEP and 0.1% AEP events. The 1% AEP flood event has been investigated in further detail because the Level 2 assessment helps inform the Exception Test and usually flood mitigation measures and access/ egress requirements focus on flood events lower than the 0.1% AEP event (e.g. the

1% AEP or 1% AEP plus climate change events). Any development should be designed such that it is resilient to the extreme 0.1% AEP plus climate change event and this should be considered for a site-specific Flood Risk Assessment.

Depth, velocity and hazard information was derived from 2D generalised modelling, or detailed modelling where this exists.

The depth, hazard and velocity of the 1% AEP surface water flood event has also been mapped and considered in this assessment. Hazard to people has been calculated using the below formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in Table 5-2.

Table 5-2 Defra's FD2321/TR2 "Flood Risks to People" Classifications

Description of Flood Hazard Rating	Flood Hazard Rating	Classification Explanation
Very Low Hazard	<0.75	Flood zone with shallow flowing water or deep standing water
Danger for some (i.e. children)	0.75 - 1.25	Danger: flood zone with deep or fast flowing water
Danger for most	1.25 - 2.00	Danger: flood zone with deep fast flowing water
Danger for all	>2.00	Extreme danger: flood zone with deep fast flowing water

As part of a site-specific FRA, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood depth, velocity and hazard based on the relevant 1% AEP plus climate change event as part of a site-specific FRA, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all information is known at the strategic scale. If tidal breach modelling is required, then the relevant 0.5% AEP plus climate change event would apply.

5.14 Note of SuDS Suitability

The hydraulic and geological characteristics of each site were assessed to determine the constraining factors for surface water management. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

The assessment is based on catchment characteristics and additional datasets such as the AStGWF map and British Geological Survey (BGS) Soil maps of England and Wales which allow for a basic assessment of the soil characteristics on a site by site basis. LIDAR data was used as a basis for determining the topography and average slope across each development site. Other datasets were used to determine other factors and include:

- Historic landfill sites
- Groundwater Source Protection Zones
- Detailed River Network
- Flood Zones derived as part of this Level 2 SFRA

This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups, as shown in Figure 5-3. This assessment should not be used as a definitive guide as to which SuDS would be suitable but used as an indicative guide of general suitability. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

Table 5-3 Summary of SuDS Categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Under-drained Swale, Wet Swale

The suitability of each SuDS type for the site options has been described in the summary tables, where applicable. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. Norfolk County Council as LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors.

Developers should investigate and consider all options for SuDS and should demonstrate that SuDS are not appropriate where they are not implemented.

6 Level 2 Assessment Methodology

6.1 Sites Taken Forward to Level 2 Assessment

As proposed by Greater Norwich Planning Policy team, 26 sites were taken forward for Level 2 assessment.

All 26 sites required a Level 2 assessment of flood risk, although the priority were 3 sites in the East Norwich Regeneration Area which is a large strategic development with significant known flood risk.

Table 6-1 summarises the present-day flood risk to sites which have been taken forward to Level 2 assessment, using percentage of Flood Zones 1, 2, 3a and 3b, and Risk of Flooding from Surface Water (RoFSW) for 3.3% AEP, 1% AEP and 0.1% AEP.

Table 6-1 Summary of present day risk to sites at Level 2 Assessment

**Flood Zones updated using latest modelling data; hence these may differ from the EA's Flood Map for Planning Flood Zones.*

'Unmodelled' fluvial risk relates to there being the presence of watercourses on OS mapping, but the catchments are smaller than those represented in the EA's Flood Zones.

Site code	Site location	Updated FZ3b (%)*	Updated FZ3a (%)*	Updated FZ2 (%)*	Updated FZ1 (%)*	RoFSW (%) 30yr	RoFSW (%) 100yr	RoFSW (%) 1,000yr
GNLP0068	**Duke St, central Norwich**	0	0	92.2	7.8	0	8.5	73.2
GNLP0133-E	**Bluebell Road, south of UEA**	1.1	2	3.4	96.6	0	0	0.5
GNLP0360	**East Norwich, south Wensum**	39	43.5	62.2	38.8	0	0.5	4
GNLP0401	**Duke St south Wensum, central Norwich**	0	0	40	60	2.5	5.8	13.7
GNLP0409AR	**Central Norwich, south Barrack St**	0	0	44	56	2	7	32
GNLP0409BR	**Central Norwich, south Barrack St**	0	1	85	15	7	16	54
GNLP2114	**Central Norwich, Duke St/Colegate**	0	0	12.6	87.4	0	0	0.1
GNLP2163	**Central Norwich, Friars Quay**	0	0	20.8	79.2	0	0	4.7
GNLP3053	**East Norwich, south Wensum**	0.2	0.4	1.5	98.5	1.4	4.5	12.0
GNLP3054	**Central Norwich, east of Oak St**	0	0	73.8	26.2	0	0	13.6
CC04b	**Central Norwich, east of Mountergate**	1.9	20.6	79.6	20.4	1.3	8.3	29.1
CC07	**East Norwich, King St/Hobrough Lane**	1.1	1.8	19.1	80.9	0	0	0.7
CC08	**East Norwich, King St**	0.5	0.9	4.7	95.3	0	0	0

Site code	Site location	Updated FZ3b (%)*	Updated FZ3a (%)*	Updated FZ2 (%)*	Updated FZ1 (%)*	RoFSW (%) 30yr	RoFSW (%) 100yr	RoFSW (%) 1,000yr
CC30	**Central Norwich, Westwick St Car Park**	0	0	100	0	0.0	0.1	71.5
CC16	**East Norwich, adjoining Norwich City FC**	0	0	47	53	2.1	4.4	15.2
R38	**Bowthorpe, Saxoncote Avenue (apply H++)**	0	0	0.1	99.9	0.3	2.4	8.0
R10	**East Norwich, north Wensum/Yare confluence**	0.2	4.3	62.7	37.3	0.9	2.9	16.5
R31	**North Norwich, Waterworks Road**	0	11	44	56	0	8	28
R36	**North Norwich, Mile Cross Road**	0	0	9.7	90.3	2.3	5.9	15.1
GNLP0608	**Great Witchingham, St Faith's Close**	0	0	0	100	0	0	6
GNLP0264	**Horsford, Horsbeck Way**	0	0	3	97	3.3	4.5	10.5
FOU_2	**Foulsham, north of Bintree Road**	0.1	9.8	19.4	80.6	1.4	6.3	28.3
BKE3	**Brooke, Industrial park**	0	0	0	100	2.0	2.6	4.3
DIS_2	**Diss, land south of Park Road**	0.0	0.0	3.8	96.2	5.2	18.6	66.3
DIS_3	**Diss, land north of A0166**	0.0	48.9	65.1	34.9	0.5	2.0	41.5
GNLP0253	**West of Uni**	3.4	3.7	3.9	96.1	0	1.8	3.8

Table 6-2 Summary of future risk to sites at Level 2 Assessment (in the Upper end (+65%) climate change scenario)

Site code	Site location	Updated FZ3b (%)*	Updated FZ3a (%)*	Updated FZ2 (%)*	Updated FZ1 (%)*	Future FZ3b (%)	Future FZ3a (%)	Future FZ2 (%)	Future FZ1 (%)
GNLP0068	Duke St, central Norwich	0	0	92.2	7.8	82.0	93.5	99.9	0.1
GNLP0133-E	Bluebell Road, south of UEA	1.1	2	3.4	96.6	2.2	3.57	6.3	93.7
GNLP0360	East Norwich, south Wensum	39	43.5	62.2	38.8	60.1	73.3	81.3	18.7
GNLP0401	Duke St south Wensum, central Norwich	0	0	40	60	0.0	43.4	57.6	42.4
GNLP0409AR	Central Norwich, south Barrack St	0	0	44	56	8.4	57.7	99.8	0.2
GNLP0409BR	Central Norwich, south Barrack St	0	1	85	15	56.6	93.3	95.8	4.2
GNLP2114	Central Norwich, Duke St/Colegate	0	0	12.6	87.4	0.0	47.3	100.0	0.0
GNLP2163	Central Norwich, Friars Quay	0	0	20.8	79.2	0.0	49.1	100.0	0.0
GNLP3053	East Norwich, south Wensum	0.2	0.4	1.5	98.5	1.3	1.9	3.1	96.9
GNLP3054	Central Norwich, east of Oak St	0	0	73.8	26.2	0.0	88.7	100.0	0.0
CC04b	Central Norwich, east of Mountergate	1.9	20.6	79.6	20.4	57.6	90.5	99.3	0.7
CC07	East Norwich, King St/Hobrough Lane	1.1	1.8	19.1	80.9	58.0	69.0	71.9	28.1
CC08	East Norwich, King St	0.5	0.9	4.7	95.3	2.6	8.4	14.5	85.5

Site code	Site location	Updated FZ3b (%)*	Updated FZ3a (%)*	Updated FZ2 (%)*	Updated FZ1 (%)*	Future FZ3b (%)	Future FZ3a (%)	Future FZ2 (%)	Future FZ1 (%)
CC30	**Central Norwich, Westwick St Car Park**	0	0	100	0	0.0	100.0	100.0	0.0
CC16	**East Norwich, adjoining Norwich City FC**	0	0	47	53	35.8	72.1	93.3	6.7
R38	**Bowthorpe, Saxoncote Avenue (apply H++)**	0	0	0.1	99.9	0	0	0.3	99.7
R10	**East Norwich, north Wensum/Yare confluence**	0.2	4.3	62.7	37.3	54.1	86.0	99.8	0.2
R31	**North Norwich, Waterworks Road**	0	11	44	56	22.1	44.2	50.0	50.0
R36	**North Norwich, Mile Cross Road**	0	0	9.7	90.3	0.3	15.5	46.6	53.4
GNLP0608	**Great Witchingham, St Faith's Close**	0	0	0	100	0.0	0.0	0.0	100.0
GNLP0264	**Horsford, Horsbeck Way**	0	0	3	97	0	0.3	2.1	97.9
FOU_2	**Foulsham, north of Bintree Road**	0.1	9.8	19.4	80.6	13.5	24	32.1	67.9
BKE3	**Brooke, Industrial park**	0	0	0	100	0	0	0	100.0
DIS_2	**Diss, land south of Park Road**	0.0	0.0	3.8	96.2	0	2.2	5	95.0
DIS_3	**Diss, land north of A0166**	0.0	48.9	65.1	34.9	47.4	65.8	77.9	22.1
GNLP0253	**West of Uni**	3.4	3.7	3.9	96.1	3.6	3.9	4.4	95.6

The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. For example: If 50% of a site is in the Flood Zones, taking each Flood Zone individually, 50% would be in Flood Zone 2 but say only 30% might be in Flood Zone 3a and only 10% in Flood Zone 3b. This would be displayed as stated above, i.e. the total % of that particular Flood Zone in that site. Flood Zone 1 is the remaining area of the site outside of Flood Zone 2, so Flood Zone 2 + Flood Zone 1 will equal 100%.

6.2 Site Summary Tables and Mapping

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites listed above. Table 6-2 below sets out the information included in site summary tables and the sources of data. The site summary tables can be found in Appendix A.

To accompany each site summary table, there is an Interactive Geo-PDF map in Appendix B, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow navigation of the data. The Level 2 Geo-PDF mapping as well as the study area wide Geo-PDF maps from the Level 1 SFRA identify communities, features, structures and properties affected by flood risk.

To use the Interactive Geo-PDF mapping, maps should be downloaded and opened using a PDF reader. The Geo-PDFs will not work opened in an internet browser.

Table 6-3 Contents of Level 2 SFRA site summary tables and maps

Content	Table	Map
Site information	√	
Existing drainage features	√	√
Fluvial flood risk	√	√
Coastal/ tidal flood risk	√	√
Surface water flood risk	√	√
Reservoir flood risk	√	
Groundwater flood risk	√	√
Climate change	√	√
Flood history	√	
Flood risk defences and assets	√	√ (Areas benefiting from defences and location of key defences)
Emergency planning	√	√
Sustainable drainage requirements	√	√
Exception Test	√	

Content	Table	Map
Requirements and guidance for site-specific Flood Risk Assessment	√	
Key messages	√	

6.3 Cumulative Impact Assessment Findings

As part of the Level 2 SFRA, a CIA was undertaken. The full assessment can be found in Appendix D.

The CIA included a broadscale assessment and a catchment level analysis. The broadscale assessment determined where the cumulative impacts of development may have the biggest effect on flood risk based on historic and predicted flood risk. Catchments at the highest risk were taken forward to a catchment level analysis.

Three catchments were identified as high risk:

- The Wensum through Norwich
- The Tiffey Upstream of Wymondham
- The Yare (Tiffey To Wensum)

6.3.1 Policy Recommendations

From analysing the results of the CIA, high-level recommendations for flood storage and betterment have been proposed for the GNLP area and sites in each of the high-risk catchments. These recommendations should be considered by developers as part of a site-specific assessment, but more detailed modelling must be undertaken by the developer to ascertain the true storage needs and potential at each site at the planning application stage. Developers should also include a construction surface water management plan to support the Construction Drainage Phasing Plan. This should provide information to the Environment Agency, LLFA and the LPA regarding the proposed management approach during the construction phase to address surface water management during storm events.

6.3.1.1 GNLP Area Wide Recommendations

The cumulative impact analysis has highlighted the importance of managing both the rate and volume of surface water runoff from new developments to mitigate the impact of flood risk along watercourses. Where reasonably practical, all new development should control both the rate and volume of runoff to greenfield characteristics. Where the developer can demonstrate it is not reasonably practical, runoff must be discharged at a rate that does not adversely affect flood risk.

The size of development sites and their location within a catchment will impact the effect that it will have on catchment response to storm events. In line with national planning policy and the national requirements for SuDS, storage will always be required for the 100-year plus applicable climate change allowance event. Whether any additional storage would benefit downstream areas depends on where the site is located within the catchment.

In rural catchments draining towards urban areas, particularly those upstream of central Norwich, LPAs should work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for the future use of natural flood management features and flood storage.

It is also important to note that in rural catchments, farming practices can also have a significant impact on runoff rates and flood risk downstream, and Local Authorities should seek to promote Catchment Sensitive Farming and Natural Flood Management techniques within rural upstream catchments.

6.3.1.2 Tiffey Upstream of Wymondham

There are nine sites currently allocated or included within Wymondham Area Action Plan. Seven of the sites are located around the south of Wymondham, in the lower catchment, and two are located further to the west. A further three large sites were previously identified as preferred and reasonable sites for development and are located immediately south and east of Wymondham. Should these sites be developed in future, this should be accompanied by an overall Surface Water Management Masterplan and Strategy. Details of what this should include can be found in 6.3.1.3.

The opportunity should be taken to store additional water on development sites in this catchment to alleviate flooding in the wider area, in addition to long term storage requirements. As the sites are primarily greenfield, it is important that any development aims to limit runoff to the current rate.

As the catchment drains through Wymondham and toward Norwich, LPAs should work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for any future flood alleviation schemes and natural flood management features.

6.3.1.3 Yare (Tiffey to Wensum)

There are 37 currently allocated sites that lie within, or partially within the Yare (Tiffey to Wensum) catchment. Several sites are located on the north edge of Hethersett, several large greenfield sites are located along the A47, which cuts across the centre of the catchment from north to south. The remaining sites are generally smaller sites within the existing urban area on the east bank of the river.

As there are multiple large greenfield sites in the catchment, in particular GNLP0307 and GNLP2043/0581, it is important that any development aims to limit runoff to the current rate. Large urban extensions on greenfield land should be accompanied by an overall Surface Water Management Masterplan and Strategy, which should cover:

- How the cumulative effects of potential peak rates and volumes of water from development sites would impact on peak flows, duration of flooding and timing of flood peaks on receiving watercourses. This should be used to develop and implement appropriate drainage sub catchments and specific runoff rate and volume requirements for each phase of the development.
- The risk of flooding from all sources, including for rainfall events greater than the design standard of the surface water drainage system should be taken into account to ensure there is no flood risk to new properties and that exceedance flows in extreme events are safely routed around those properties.
- The consideration of how SuDS, natural flood management techniques, green infrastructure and green-blue corridors can be designed into the development master plan to facilitate drainage flood risk management and ensure wider benefits such as biodiversity, amenity, water quality and recreation are realised.
- Based on the above, a Drainage Phasing Plan should be developed, based on the SuDS train method (considering firstly how water can be infiltrated/stored at a plot level, then conveyed through the site and any regional storage needs at a settlement level).
- The provision of drainage during the building phase shall be based on the Drainage Phasing Plan to ensure adequate drainage is provided and implemented throughout the development life.
- The LLFA, Environment Agency and LPA should be consulted during the development of the Surface Water Management Masterplan and Strategy.

As the loss of floodplain storage has the potential to increase downstream flood risk, any development within Yare (Tiffey to Wensum) sub-catchment should identify potential areas of flood plain loss as a result of development and either avoid developing in those areas or provide compensatory storage onsite.

As the upper catchment drains towards and through Norwich, it is recommended the LPAs work closely with the Environment Agency and LLFA to identify any areas of land that should be safeguarded for any future flood alleviation and natural flood management features. There are likely to be opportunities in the upper catchment for NFM techniques to improve upstream storage, which are additional to those included within developments.

6.3.1.4 Wensum Through Norwich

There are 75 currently allocated sites that lie within, or partially within the Wensum Through Norwich catchment and a further 6 sites were previously identified as preferred or reasonable sites.

Due to the largely urbanised nature of the catchment, there are limited opportunities for flood storage and natural flood management.

Much of the catchment is located within already designated Critical Drainage Areas. This means that a detailed Flood Risk Assessment is required for all development within these areas, regardless of size. It is recommended that the Council consider expanding and joining the existing Critical Drainage Areas to cover the Richmond Hill and Cathedral Quarter areas where much development is currently proposed but which currently falls between the Catton Grove and Sewell and Nelson and Town Close Critical Drainage Areas.

As the majority of sites within the catchment are brownfield, development is less likely to increase current runoff rates however as the catchment is particularly vulnerable to increasing surface water flooding as a result of climate change, it is recommended that future development proposals identify opportunities to reduce runoff rates through implementation of SUDS features. Whilst new and redeveloped properties are not eligible for the Council's CATCH project, which provides slow release water butts and rain planters, developers should seek to incorporate rainwater harvesting and reuse within developments as part of the surface water management strategy.

There are known runoff pollution issues within Norwich Urban area, in particular from industrial sites within the Lionwood area, and development sites within the Norwich urban area should demonstrate through a drainage strategy that development will not exacerbate, and where possible seek to alleviate, these known issues.

As the loss of floodplain storage has the potential to increase flood risk in the City Centre, any development within this area should identify potential areas of flood plain loss as a result of development and either avoid developing in those areas or provide compensatory storage onsite.

7 Flood Risk Management Requirements for Developers

7.1 Introduction

The report provides a strategic assessment of flood risk in Greater Norwich. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk and any defences at a site are considered in more detail. Developers should, where required, undertake more detailed further hydrological and hydraulic assessments of the site to verify flood extent (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the Exception Test can be satisfied.

A detailed Flood Risk Assessment (FRA) may show that a site is not appropriate for development of a particular vulnerability or even at all. However, a detailed Flood Risk Assessment undertaken for a windfall site[3] may find that the site is entirely inappropriate for development of a particular vulnerability, or even at all. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not be seen as an alternative to proving these tests have been met.

7.2 Principles for New Developments

Apply the Sequential and Exception Tests

Developers must provide evidence that the Sequential Test has been passed for windfall developments. If the Exception Test is needed, they must also provide evidence that all parts of the Test can be met for all developments, based on the findings of a detailed Flood Risk Assessment.

Developers should also apply the sequential approach to locating development within the site. The following questions should be considered:

- Can risk be avoided through substituting less vulnerable uses or by amending the site layout?
- Can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
- Can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?

Consult with the statutory and non-statutory consultees at an early stage to understand their requirements

Developers should consult with the Environment Agency, Norfolk County Council as LLFA and Anglian Water as the sewerage company, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design, including the proposed foul and surface water drainage strategy and details of the adoption and maintenance of any SuDS features.

Consider the risk from all sources of flooding and that they are using the most up to date flood risk data and guidance

The SFRA can be used by developers to scope out what further detailed work is likely to be needed to inform a site-specific Flood Risk Assessment. At a site level, Developers will need to check before commencing on a more detailed Flood Risk Assessment that they are using the latest available datasets. Developers should apply the 2020 Environment Agency climate change guidance, until updated guidance is available later in 2021[4], and ensure the development has considered climate change adaptation measures.

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3 'Windfall sites' is used to refer to those sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan.

4 Latest guidance is available at https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Ensure that development does not increase flood risk elsewhere and in line with the NPPF, seeks to reduce the causes and impacts of flooding

The Level 1 SFRA sets out these requirements for taking a sustainable approach to surface water management. Developers should also ensure mitigation measures do not increase flood risk elsewhere and that floodplain compensation is provided where necessary.

Ensure the development is safe for future users

Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered. Developers should consider both the actual and residual risk of flooding to the site.

Further flood mitigation measures may be needed for any developments in an area protected by flood defences, where the condition of those defences is 'fair' or 'poor', and where the standard of protection is not of the required standard.

Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for an amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted. Where possible, developers should identify and work with partners to explore all avenues for improving the wider river corridor environment.

Consider and contribute to wider flood mitigation strategy and measures in Greater Norwich and apply the relevant local planning policy

Wherever possible, developments should seek to help reduce flood risk in the wider area e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or natural flood management or by contributing in kind by mitigating wider flood risk on a development site. Developers must demonstrate in an FRA how they are contributing towards this vision.

7.3 Requirements for Site-Specific Flood Risk Assessments

7.3.1 When is an FRA Required?

Site-specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments and change of use) in Flood Zones 2 and 3.
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency).
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.
- Where a site is within a Critical Drainage Area (CDA) as identified through a SWMP.

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1)
- Where evidence of historical or recent flood events have been passed to the LPA
- In an area of significant surface water flood risk.

7.3.2 Objectives of Site-Specific FRAs

Site-specific FRAs should be proportionate to the degree of flood risk, as well as appropriate to the scale, nature and location of the development. Site-specific FRAs should establish:

- whether a proposed development will be at risk of flooding, from all sources, both now and in the future, taking into account climate change;
- whether a proposed development will increase flood risk elsewhere;
- whether the measures proposed to deal with the effects and risks are appropriate;
- the evidence, if necessary, for the local planning authority to apply the Sequential Test; and
- whether, if applicable, the development will be safe and pass the Exception Test.

FRAs should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and the Greater Norwich Local Plan team. Guidance and advice for developers on the preparation of site-specific FRAs include:

- **Standing Advice on Flood Risk** (Environment Agency);
- **Flood Risk Assessment for Planning Applications** (Environment Agency);
- **Site-specific Flood Risk Assessment: CHECKLIST** (NPPF PPG, Defra).

Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – **Flood Risk Assessment: Local Planning Authorities**.

7.4 Local Requirements for Mitigation Measures

The Level 1 SFRA for Greater Norwich provides details on the following mitigation measures in Section 8.3 of the SFRA Report and should be referred to alongside this report:

- Site Layout and Design (8.3.1)
- Raised Floor Levels (8.3.2)
- Development and Raised Defences (8.3.3)
- Modification of Ground Levels (8.3.4)
- Developer Contributions (8.3.5)

7.4.1 Flood Storage Compensation

For any development (both major and minor), that results in built volume below the design flood level (1% AEP plus climate change flood level), mitigation shall be required for loss in floodplain storage volume. Flood storage compensation should be on a level for level and volume by volume basis. Any variation to this approach would be as a result of detailed technical discussions with either the Environment Agency or the LLFA.

7.4.2 Resistance and Resilience Measures

The consideration of resistance and resilience measures should not be used to justify development in inappropriate locations.

Having applied planning policy, there will be instances where developments, such as those that are water compatible and essential infrastructure are permitted in high flood risk areas. The above measures should be considered before resistance and resilience measures are relied on. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system and the use of back up pumping to evacuate water from a property as quickly as possible. The proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate.

7.4.2.1 Resistance measures

Permanent Barriers: Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

Temporary Barriers: Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale, temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Community Resistance Measures: These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

7.4.2.2 Resilience Measures

These measures aim to ensure no permanent damage is caused, the structural integrity of the building is not compromised and the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding can include electrical circuitry installed at a higher level and water-resistant materials for floors, walls and fixtures.

7.5 Reducing Flood Risk from other Sources

Section 7.6 of the Level 1 SFRA Report discusses how to reduce flood risk from other sources, such as groundwater, surface water and sewer flooding.

7.6 Duration and Onset of Flooding

The duration and onset of flooding affecting a site depends on a number of factors:

- The position of the site within a river catchment, with those at the top of a catchment likely to flood sooner than those lower down. The duration of flooding tends to be longer for areas in lower catchments.
- The principal source of flooding. Where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g. a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding or from flash flooding from small watercourses is short (hours rather than days).
- The preceding weather conditions prior to the flooding. Wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions.
- Whether a site is defended, upon failure of defences, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach).
- Catchment geology. Chalk catchments talk longer to respond than typical clay catchments for example.

The position of the wider site area in an upper/ mid catchment location has been taken into account to develop the following guidelines for the duration and onset of flooding.

It is recommended that a site-specific Flood Risk Assessment refines this information, based on more detailed modelling work where necessary.

7.6.1 Flood Warning and Emergency Planning

Emergency planning covers three phases: before, during and after a flood. Measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding. National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and considering the vulnerability of new developments to flooding.

The NPPF (paragraph 163) requires site level Flood Risk Assessments to demonstrate that:

"d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."

Certain sites will need emergency plans:

- Sites with vulnerable users, such as hospitals and care homes.
- Camping and caravan sites.
- Sites with transient occupants e.g. hostels and hotels.
- Developments at a high residual risk of flooding from any source e.g. immediately downstream of a reservoir or behind raised flood defences.
- Situations where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach).

Emergency Plans will need to consider:

- The characteristics of the flooding e.g. onset, depth, velocity, hazard, flood borne debris.
- The vulnerability of site occupants.
- Structural safety.
- The impact of the flooding on essential services e.g. electricity, drinking water.
- Flood warning systems and how users will be encouraged to sign up for them.
- Safe access and egress for users and emergency services.
- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach.
- A safe place of refuge where safe access and egress and advance warning may not be possible, having discussed and agreed this first with emergency planners. Proposed new development that places an additional burden on the existing response capacity of the Councils will not normally be appropriate.

The Environment Agency and the Association of Directors of Environment, Economy, Planning and Transport (ADEPT) have produced joint guidance on **flood risk emergency plans for new development** aimed at local authority planners to help identify when they should be asking for planning applications to be supported by flood risk emergency plans, and what should be included in them. It encourages local planning authorities to produce their own guidelines and set up local consultation arrangements to ensure emergency plans are fit-for-purpose and receive proper scrutiny. It also provides a framework for them to appraise emergency plans in the absence of such local arrangements.

As of September 2020, LoRaWAN was deployed in Norfolk which is a long-range wide area network. It allows monitoring and measuring of rainfall which can be set up by businesses. This network is free to use and enables remote monitoring and could be useful for developers should they need to monitor water levels and rainfall on and in the vicinity of their sites should the development be on a currently ungauged catchment.

8 Surface Water Management and SuDS

8.1 Role of the LLFA and Local Planning Authority in surface water management

In April 2015, Norfolk County Council was made a statutory consultee on the management of surface water and, as a result, provides technical advice on surface water drainage strategies and designs put forward for major development proposals.

When considering planning applications, Norfolk County Council will provide advice to the Planning Department on the management of surface water. The LPA should satisfy themselves that the development's proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the lifetime of the development.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS.

8.2 Natural flood management (NFM)

Natural flood management can work alongside other techniques such as SuDS to manage surface water flood risk within the catchment. Whilst some sites will be too small for these techniques to be appropriate, some natural flood management techniques could, where appropriate, be used in open space settings within large developments with a significant proportion of land at flood risk. NFM aims to store water in the landscape and slow the rate of runoff through features such as wetland creation, soil management and leaky dams.

8.3 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits that can be secured from surface water management practices.

SuDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

It is a requirement for all new major development proposals to ensure that sustainable drainage systems for management of runoff are put in place. Likewise, minor developments should also ensure sustainable systems for runoff management are provided. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and current drainage arrangements is essential.

8.4 Sources of SuDS Guidance

8.4.1 C753 CIRIA SuDS Manual (2015)

The **C753 CIRIA SuDS Manual** (2015) provides guidance on planning, design, construction and maintenance of SuDS. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document.

8.4.2 Non-statutory Technical Guidance, Defra (March 2015)

Non-Statutory Technical guidance provides non-statutory standards on the design and performance of SuDS. It outlines peak flow control, volume control, structural integrity, flood risk management and maintenance and construction considerations.

8.4.3 A Guide to SuDS and Drainage in Greater Norwich

The **Norfolk County Council Lead Local Flood Authority Statutory Consultee for Planning Guidance Document** provides guidance for developers and relevant professionals on the SuDS requirements within the study area. The guide sets out the planning, design and maintenance requirements for SuDS schemes with the aim of producing benefits for the environment and communities whilst enabling developers to achieve compliance with LLFA SuDS requirements to gain SuDS approval.

The document is intended to be complementary to the National Standard for SuDS (2015) and The SuDS Manual (CIRIA C753).

8.4.4 Anglian Water SuDS Adoption Manual

Anglian Water has produced a **SudS Adoption Manual** providing general information and guidance for developers and relevant professionals on the design, installation and maintenance of SuDS. The document is not intended to provide legal/regulatory or technical advice.

8.4.5 Water UK Sewerage Section Guidance (Design & Construction Guidance)

In April 2020, new sewerage adoption arrangements came into effect through the publication of the **Sewerage Sector Guidance.** The old industry guidance on the design of sewers for adoption by the water industry has subsequently been replaced by the Design and Construction Guidance. In addition to updated guidance around pipes, manholes and pumping stations, the new document now includes information on SuDSs, not present in the previous guidance. SuDS features included within the Design and Construction Guidance can now be adopted by water companies under s104 of the Water Industry Act 1991.

8.5 Other Surface Water Considerations

8.5.1 Groundwater Vulnerability Zones

The Environment Agency have published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise of the underlying bedrock. The map shows the vulnerability of groundwater at a location based on the hydrological, hydro-ecological and soil propertied within a one-kilometre grid square.

The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas. Groundwater vulnerability maps can be found on **Defra's interactive mapping.**

8.5.2 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones (SPZs) near groundwater abstraction points. These protect areas of groundwater used for drinking water. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. Groundwater Source Protection Zones can be viewed on the **Defra website**.

The majority of Level 2 assessment sites are in a Groundwater Source Protection Zone.

8.5.3 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The NVZ coverage can be viewed on the **Environment Agency's online maps**.

The definition of each NVZ is as follows:

- Groundwater NVZ – water held underground in the soil or in pores and crevices in rock, which has or could have if action is not taken, a nitrate concentration greater than 50mg/l.
- Surface water NVZ – areas of land that drain into a freshwater water body which has or could have is action is not taken, a nitrate concentration greater than 50mg/l.
- Eutrophic NVZ – bodies of water, mainly lakes and estuaries, that are or may become enriched by nitrogen compounds which cause a growth of algae and other plant life that unbalances the quality of the water and to organisms present in the water.

One groundwater NVZ covers the entire Norwich City area and extends to the north and south covering much of the Broadlands District and South Norfolk. Additionally, two further groundwater NVZs lie within the west of the Broadlands District.

Seven surface water NVZs occupy or partially occupy the majority of South Norfolk, with one surface water NVZ extending into the Broadlands District and a further surface water NVZ extending into Norwich City.

One Eutrophic NVZ lies in the north-east of South Norfolk, with two eutrophic NVZ identified in the centre and north-west of the Broadlands District.

9 Summary of Level 2 Assessment

9.1 Assessment Methods

As part of the Level 2 SFRA, detailed site summary tables have been produced for the 26 sites identified as being at high risk. As part of the site screening assessment, these sites were found to be at risk from fluvial and/or surface water flooding.

The summary tables in Appendix A summarise flood risk to each site based on a range of flood risk datasets and the strategic or detailed modelling completed as part of this study. Climate change mapping has also been produced, either through the broadscale 2D modelling completed in the Level 1 SFRA or as part of the strategic and detailed modelling completed for the Level 2 SFRA. Each table sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. The tables consider requirements for passing the Exception Test where this is relevant and possible. A broadscale assessment of suitable SuDS options has been provided, giving an indication where there may be constraints to certain types of SuDS techniques.

To accompany each site summary table, there is an Interactive GeoPDF map, with all the mapped flood risk outputs per site. This includes fluvial flood zone extents, depths and velocities as well as hazard mapping where modelling has been completed. Interactive mapping in Appendix B, should be viewed alongside the detailed site summary tables.

9.2 Summary of Key Site Issues

The following points summarise the Level 2 assessment:

- The majority of the sites assessed as part of this Level 2 SFRA are at fluvial flood risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site. Sites significantly affected by fluvial flooding will require more detailed investigations to inform a sequential approach to site layouts, SuDS possibilities, safe access and egress etc, as part of a site-specific Flood Risk Assessment taken forward by a developer.
- The majority of sites at fluvial risk are also at risk from surface water flooding, with areas of ponding in the higher return period events across some sites and the access roads surrounding them. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. For example, Site R38 presents very little present-day fluvial risk, although has a significant surface water through path through the west of the site. The impact of surface water flooding at sites such as this will need more detailed investigations undertaken as part of a site-specific Flood Risk Assessment at a later stage.
- Climate change allowances were applied to the existing watercourse models and 2D strategic models completed as part of this SFRA. For the 3.3% AEP, 1% AEP and 0.1% AEP events, the 2080s period was used, and all three allowance categories were modelled (25%, 35% & 65%). Modelling indicates that flood extents will increase as a result of climate change and therefore, the depths, velocities and hazard of flooding are also seen to increase. Some sites are more sensitive to climate change increases than others. Site-specific Flood Risk Assessments (FRAs) should confirm the impact of climate change using latest guidance.
- Sites in the Level 2 assessment are likely to be unaffected by a coastal breach scenario and tidal flooding, even with climate change increase, although a site-specific FRA should investigate the impact further for the sites in the east of Norwich.
- For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles. Where there is no safe access of egress, shelter in situ should be provided.
- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken to understand which SuDS option would be best.

- Sites which have areas designated by the Environment Agency as being a historic landfill site will require site ground investigations to determine the extent of the contamination and the impact this may have on SuDS.
- The Cumulative Impact Assessment (CIA) identified three catchments as at a high risk of increased risk as a result of development in the future. These are:
    - The River Wensum, through Norwich
    - The River Yare, from Tiffey to Wensum
    - The River Tiffey, Upstream of Wymondham

  The full CIA is in Appendix D and a summary is included in Section 6.3.
- To enable development in the East Norwich Regeneration Area, a carefully considered flood risk and sustainable drainage strategy covering sites GNLP0360, GNLP0353 and R10 must support early master planning and feasibility work. This will involve sacrificing some areas as functional floodplain and increasing flood storage to allow other areas of sites to be defended against fluvial flooding. There should be no overall loss of floodplain storage and the risk of flooding should not be increased up or downstream of the sites. The most suitable site in flood risk terms is GNLP0353.
- Major reprofiling, flood defences and sustainable drainage work would be required to bring forward such as high flood risk site. This will involve sacrificing some areas as functional floodplain and increasing flood storage to allow other areas of the site to be defended against fluvial flooding. This is likely to affect the amount of land available for development. Areas of functional floodplain should be safeguarded from future development but may be appropriate for green infrastructure and open space uses.

At the planning application stage and as part of a Flood Risk Assessment, developers will need to undertake detailed hydrological and hydraulic assessments of watercourses to verify flood extent, depth, velocity and hazard (including considering the latest **climate change allowances**), inform development zoning within the site and prove, if required, whether the Exception Test can be passed.

For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriate flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

It is recommended that as part of the early discussions relating to development proposals, developers discuss requirements relating to site-specific Flood Risk Assessment and drainage strategies with both the Local Planning Authority and the LLFA, to identify any potential issues that may arise from the development proposals. The Developer should also consider surface water drainage in the construction phase of any developments to prevent increasing flood risk during the construction phase.

9.3 Considering the Exception Test for the Proposed Sites

The site tables contain key messages that are specific to each site regarding the extent of flood mitigation work that is likely to be necessary to enable the development to be made from safe from flooding and such that it does not increase flood risk elsewhere.

It should be noted that the flood risk to a number of sites is high and a number of sites are particularly sensitive to the impact of climate change, even if they are at relatively low flood risk today. When making a decision on the Exception Test, the LPA will need to weigh up the costs and implications of the scale of the work on site viability when determining if the site can pass the Test, alongside considering the relative importance of wider planning reasons for allocating in high flood risk areas.

9.4 Planning Policy Recommendations

A flood resilience policy is recommended for development in flood risk areas in the GNLP area, that is adaptive to latest climate change science. Development must be resilient and adaptable to the impact of climate change on flood risk. To achieve this:

- Development layout and form must be designed using the latest climate change guidance on development and flood risk
- There should be high quality flood resilient urban design that integrates into the historic riverside setting in Norwich
- Mitigation measures should be integrated into the overall development masterplan and designed such that they protect users of the development and ensure there is no increase in flood risk elsewhere. Care should be taken to ensure there is no incremental loss of floodplain in Norwich, where a number of riverside developments are proposed.
- Residual risk from an extreme flood is carefully considered to ensure that further users of a development can be kept safe
- An integrated sustainable drainage approach to green infrastructure, water quality and flood risk should be taken. Betterment in flood risk terms should be sought from development identified in the catchments most sensitive to changes in flood risk due to new development in the Level 2 SFRA. These catchments are; the Wensum through Norwich, Tiffey Upstream of Wymondham, and Yare Tiffey to Wymondham. Detailed policy recommendations for these catchments may be found in section 6.3.

9.5 Use of SFRA Data and Future Updates

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The SFRA should be a 'living document', and as a result should be updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by the Greater Norwich Authorities, Anglian Water and the Environment Agency. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a future flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood alleviation schemes.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment. It is recommended that the SFRA is reviewed in line with the Environment Agency's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information.

Appendices

A Level 2 Assessment – Site Summary Tables

B Level 2 Assessment – Interactive Mapping

C Modelling Summary

D Cumulative Impact Assessment

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1 Broughton Park
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North Yorkshire
BD23 3FD
United Kingdom

+44(0)1756 799919
info@jbaconsulting.com
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