

CAPITA SYMONDS

**GREAT YARMOUTH AND
GORLESTON**

**STRATEGIC FLOOD RISK
ASSESSMENT**

For Great Yarmouth Borough Council

VOLUME 1: DECISION SUPPORT

SEPTEMBER 2009

**Great Yarmouth and Gorleston Strategic Flood Risk Assessment
Decision Support Document**

FINAL Report REV 1.1 / September 2009

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PREFACE

It is accepted that the technical content of the Great Yarmouth and Gorleston SFRA will need to be reviewed and amended in the future as new information becomes available.

Although there is no statutory consultation requirement at this stage the nature of the intended end use for the information makes it appropriate to obtain feedback relating to the report in order to contribute to the overall robustness and credibility of this work. This information will also be an aid when formulating the necessary next steps in engaging those parties who will be involved in the future.

It is the responsibility of the reader to be satisfied that they are using the most up to date information and that this has been included within the Great Yarmouth SFRA.

Notes:

- 1. This version of Volume 1 of the SFRA has been prepared in advance of the application of the Sequential and Exception tests and the preparation of policy on flood risk and land allocations by Great Yarmouth Borough Council (GYBC). It is recommended that the contents of this document are thoroughly reviewed following the preparation of policy and the application of the Sequential and Exception Tests in order that the contents of Volume 1 of the SFRA are compatible with the final plan outcomes.***

FOREWORD

Great Yarmouth Borough Council is required to prepare a Strategic Flood Risk Assessment (SFRA) to support their Local Development Framework (LDF). This has been done in response to the guidance in Planning Policy Statement 25 – *Development and Flood Risk* that states that a sequential risk based approach should be applied to decision making at all levels of the planning process. The principle stages being the Regional Level (East of England Plan), the Local Level (this assessment) and the site level (planning applications).

The SFRA creates a strategic framework for the consideration of flood risk when making planning decisions at local level. It has been developed with reference to Planning Policy Statement 25 (PPS25) and additional guidance provided by the Environment Agency.

The fundamental concepts that underpin the SFRA are outlined in PPS25. The guidance provided in PPS 25 requires local authorities and those responsible for development decisions to demonstrate that they have applied a risk based, sequential approach in preparing development plans and consideration of flooding through the application of a sequential test. Failure to demonstrate that such a test has been undertaken at this level potentially leaves planning decisions and land allocations open to challenge during the planning process.

The underlying objective of the risk based sequential allocation of land is to reduce the exposure of new development to flooding and reduce the reliance on long-term maintenance of built flood defences. Within areas at risk from flooding, it is expected that development proposals will contribute to a reduction in the magnitude of the flood risk.

SFRAs are essential to enable a strategic and proactive approach to be applied to flood risk management. The assessment allows us to understand current flood risk on a wide-spatial scale and how this is likely to change in the future.

The main objectives of the Great Yarmouth and Gorleston SFRA are to provide flood information:

- As the evidence base for the application of the risk based sequential approach to support planning decisions, in line with PPS25;
- that is strategic in that it covers a wide spatial area and looks at flood risk today and in the future;
- that supports sustainability appraisals of the local development framework; and
- that identifies what further investigations may be required in flood risk assessments for specific development proposals.

The SFRA is presented in a number of documents:

- VOLUME 1 – Decision Support Document (this document);
- VOLUME 2 – Technical Report; and,
- VOLUME 3 – Mapping.

The SFRA is a live document that is intended to be updated as new information and guidance become available. The outcomes and conclusions of the SFRA may not remain valid in the event of future changes to the data or the baseline flooding situation. Decisions also require the inclusive assessment of wider planning issues and the user should be aware that changes to decision making principles affecting other planning issues can potentially affect the outcome of the risk based sequential test. The contents of this document are also dependant on the outcome of the Regional Flood Risk Appraisal. It is the responsibility of the user to ensure they are using the best available information.

Great Yarmouth and Gorleston STRATEGIC FLOOD RISK ASSESSMENT - Structure

SFRA VOLUME 1 – DECISION SUPPORT

1. Introduction
2. Flooding in Great Yarmouth and Gorleston
3. How to Use the SFRA in Land Use Planning
4. How to Use the SFRA in Flood Warning and Emergency Planning
5. How to Use the SFRA in Development Control
6. SFRA Maintenance and Management
7. Asset Management
8. Other Possible Users of the SFRA

SFRA VOLUME 2 – TECHNICAL REPORT

1. Introduction and catchment summary
2. Flood Warning and Emergency Planning
3. Asset and Structure Data
4. Flooding from Tidal, Coastal and Fluvial Sources – approach to assessment
5. Flooding from Tidal, Coastal and Fluvial Sources – results of assessment
6. Topography Investigation
7. Flooding from Land, Surface Water, Sewers and SUDS
8. Groundwater Flooding
9. Flooding from Artificial Sources
10. Flood Risk at Development Sites and Strategic Options

SFRA VOLUME 3 – MAPS

DOCUMENT REGISTER

It is accepted that the technical content of the Great Yarmouth and Gorleston SFRA will need to be reviewed and amended as new information becomes available.

It is the responsibility of the reader to be satisfied that they are using the most up to date information and that this has been included within the Great Yarmouth and Gorleston SFRA.

The Great Yarmouth and Gorleston SFRA (this document) is a live document requiring review in the event of an improvement or change in the fundamental principles or best available data underpinning the strategy. This is likely to include, but should not be limited to:

- An improvement in the best available information or a reduction in uncertainty;
- Revision to relevant policy, plans or guidance;
- Outcomes of neighbouring strategies; and
- Changes to the parent guidance contained in the East of England Plan

Revisions to this document should be recorded below in Table 1.0 to maintain clarity for those making decisions involving flood risk issues.

Table 1.0 Document Register

| <i>Version</i> | <i>Date</i> | <i>Issued by</i> | <i>Issued to</i> |
|----------------|-------------|------------------|--|
| 1.0 | 03/11/2008 | CS | Great Yarmouth Borough Council (GYBC) Environment Agency (EA) |
| 1.1 | 24/09/2009 | CS | Great Yarmouth Borough Council (GYBC) Environment Agency (EA) |
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| | | | |

Contents

| | |
|--|-------------|
| 1. INTRODUCTION | 1-1 |
| 2. FLOODING IN GREAT YARMOUTH AND GORLESTON | 2-1 |
| Sources of Flooding | 2-1 |
| Historic flooding | 2-2 |
| Probability of flooding..... | 2-2 |
| Risk of flooding | 2-4 |
| 3. HOW TO USE THE SFRA IN LAND USE PLANNING | 3-1 |
| Introduction | 3-1 |
| Sequential Test | 3-2 |
| Exception Test | 3-6 |
| Potential Development in Great Yarmouth and Gorleston..... | 3-8 |
| 4. HOW TO USE THE SFRA IN FLOOD WARNING AND EMERGENCY PLANNING..... | 4-1 |
| 5. HOW TO USE THE SFRA IN DEVELOPMENT CONTROL | 5-5 |
| Guidance for site-specific flood risk assessments | 5-6 |
| Consultation with the Environment Agency | 5-8 |
| Sustainable Urban Drainage Systems | 5-9 |
| 6. SFRA MAINTENANCE AND MANAGEMENT | 6-1 |
| Introduction | 6-1 |
| Data Collection..... | 6-1 |
| Data Processing..... | 6-3 |
| Data Ownership | 6-3 |
| Incorporating new datasets..... | 6-7 |
| Updating SFRA reports and figures | 6-7 |
| 7. ASSET MANAGEMENT | 7-1 |
| 8. OTHER POSSIBLE USERS OF THE SFRA | 8-2 |
| 9. REFERENCES | 9-1 |
| 10. GLOSSARY AND NOTATION..... | 10-1 |

Appendices

| | |
|--|----------|
| APPENDIX A: HOW THE SFRA LINKS WITH OTHER PLANS AND POLICIES..... | 1 |
| APPENDIX B: HOW FLOOD RISK IS ASSESSED..... | 1 |
| APPENDIX C: GREAT YARMOUTH AND GORLESTON FLOOD RISK MANAGEMENT POLICY MESSAGES..... | 1 |
| APPENDIX D: OVERVIEW MAPPING | 1 |

1. INTRODUCTION

The information in this Strategic Flood Risk Assessment (SFRA) will be used to inform the Great Yarmouth Sustainability Appraisal, land allocations, and policies regarding catchment wide flooding issues. The SFRA provides information required to apply the Sequential Approach and Sequential Test on the Local Development Document scale as defined by PPS25. The SFRA will inform Flood Risk Assessments prepared in support of particular applications for development in accordance with the Local Development Framework (LDF). An summary of the Great Yarmouth Local Development Framework provided by Great Yarmouth Borough Council is included at the end of this chapter.

The SFRA contains information that allows flood risk to inform the preparation of the LDF as it provides data that enables a risk based Sequential Test to be applied. PPS 25 advocates that the risk based Sequential Test is applied at all stages of planning. The applicable stages are identified as being:

- Regional Level (Regional Spatial Strategy) - A Regional Flood Risk Appraisal;
- Local Level (Local Development Framework) - A Strategic Flood Risk Assessment; and
- Site Level (Planning Application) - A Flood Risk Assessment

At the site level it would be necessary for the applicant to refer to the Testing performed within the LDF and be satisfied that the site for which details were being prepared had been "Tested". It is not the responsibility of the applicant to perform the Test but he can be required to submit information to the local planning authority to enable them to perform the Test. The Sequential Approach should be applied throughout all stages so that the vulnerability of the intended use is matched to the risk, eg higher vulnerability uses are sited in locations of lower probability of flooding. The Exception Test should only be applied after the application of the Sequential Test.

The underlying objective of the SFRA is to provide a platform for the consistent consideration of flood risk and accommodation of current practice and best available data for the duration of the plan. Inevitably this will require that consideration is given to the lifetime of development included within the plan (taken to be 100 years for residential development by the Environment Agency) so climate change effects described in PPS 25 should be incorporated.

This decision support document provides information on how to interpret the Great Yarmouth and Goleston SFRA results to inform land use planning, flood warning and emergency planning and development control. The document also provides guidance for site-specific Flood Risk Assessment (FRA). The document requires the user to refer to technical information and flood maps contained in Volumes 2 and 3 of this SFRA. As stated it also informs those making decisions of the effects of climate change on flood risk.

The approach adopted for this SFRA has primarily been developed in recognition of the need to provide flood risk information to support appropriate land use allocation within Great Yarmouth and to allow the application of the Sequential and Exception Tests described in PPS25. The SFRA should also be used to inform Core Strategies, Area Action Plans (AAPs) and development control policies. The requirement for adopting a strategic approach to the assessment and consideration of flood risk should be completed in accordance with the advice provided in PPS25.

SFRAs can also be used to:

- set planning constraints within designated development areas and where relevant in the case of windfall planning applications; and

- identify the level of detail required for site-specific FRAs in particular locations and enable them to determine the acceptability of flood risk in relation to emergency planning (DCLG 2007).

This document is Volume 1: Decision Support, of the SFRA. This is the main SFRA document and should be read in conjunction with the Great Yarmouth and Gorleston SFRA Volume 2: Technical Report. This volume (Vol 1) provides a summary of the background and methodology adopted for assessing strategic flood risk. It provides guidance for planners and developers, and supports the practical use of the maps contained in Volume 3.

Volume 2 is the technical report. It explains in detail the technical methodology adopted to assess the strategic flood risk issues in the Great Yarmouth area. Volume 2 of the SFRA contains important information concerning the use of the SFRA and limitations of the SFRA model. Volume 3 contains maps developed for this study and should be used in conjunction with Volume 1 to determine areas at higher risk of flooding.

This document, Volume 1, has been broken into chapters, with the following structure designed to support Great Yarmouth in a range of activities:

- **Chapter 1: Introduction** – this chapter;
- **Chapter 2: Flooding Great Yarmouth and Gorleston** – brief description of historic, current and future flood risk in the area;
- **Chapter 3: the SFRA in land use planning** – this chapter explains how the SFRA should be used to support Great Yarmouth Borough Council (GYBC) in their strategic land use planning, including an explanation of the Sequential Test, and Exception Test;
- **Chapter 4: How to use the SFRA in flood warning and emergency planning** – this chapter advises on the requirement for emergency planning, and outlines how the SFRA can be used to support these responsibilities;
- **Chapter 5: How to use the SFRA in development control** – this chapter discusses the requirement for FRAs in certain development scenarios, and considers the role of the SFRA in identifying the need, and level of detail required. It also includes case study examples;
- **Chapter 6: SFRA Maintenance and Management;**
- **Chapter 7: Asset Management**
- **Chapter 8: Other Possible Users of the SFRA;**
- **Chapter 9: References;** and,
- **Chapter 10: Glossary and Notations.**

In addition, Appendix A: How the SFRA links with other plans and policies, provides a brief summary of the plans and policies which provided the context for the SFRA, and those that the SFRA will inform. Appendix B: How flood risk is assessed, defines flood risk and explains how various forms of flood risk will be considered in the SFRA. It also considers the implications of climate change, and the uncertainties associated with establishing flood risk in Great Yarmouth. Appendix C: Environment Agency Flood Risk Management Policy Messages records the key local messages from the EA in relation to this SFRA. Appendix D includes summary maps for each of the vulnerability classifications listed in PPS 25, based on the Flood Zones and showing where each type of development is appropriate, not appropriate or may be appropriate (following application of the Exception test).

Great Yarmouth Borough Council Local Development Framework (LDF)

The Great Yarmouth Borough Local Development Framework (LDF) sets out a long-term spatial planning strategy to create sustainable communities. The Core Strategy Development Plan Document (DPD) is the overarching document in the LDF and sets out the overall vision and spatial planning strategy for the borough to 2021 and to 2025 for housing. The Development Control DPD, Site Specific Allocations DPD, Urban Regeneration Company Area Action Plan (AAP) and Supplementary Planning Documents (SPDs) will all conform to the Core Strategy and combine to create the Great Yarmouth Borough LDF. Together, these documents will deliver the spatial planning strategy for the borough and will replace the Great Yarmouth Borough - Wide Local Plan (2001).

Core Strategy DPD

The Amendment to the Core Strategy DPD (February 2009, Regulation 25 consultation document) makes provision for 5000 jobs over the period 2001 - 2021 and 7,240 dwellings by 2025. Approximately 4000 dwellings have been built, allocated or granted planning permission. Approximately 2000 dwellings and the majority of the employment requirement will be allocated in the brownfield waterfront areas covered by the Urban Regeneration Company Area Action Plan. Options for where the remaining housing requirement will be located include Great Yarmouth, Gorleston, Bradwell and Martham, with the majority in Bradwell.

Core Strategy Policy CS1 Spatial Strategy outlines the distribution of development as detailed below:

Core Policy CS1 Spatial Strategy

Development will be supported which is of a scale and nature appropriate to the settlement and location, and which contributes to improving the settlements sustainability. In order to promote sustainable patterns of travel and achieve urban renaissance, development proposals should accord with the following spatial strategy:

- a. Approximately 7560-70 % of the borough's housing requirement up to 2021 plus the 1200 units from 2021-2025 and approximately 80-90% of employment, retail, leisure and cultural development requirements will be located in the main towns of Great Yarmouth and Gorleston. This will primarily be focussed in the town centre and waterfront redevelopment areas of Cobholm, North Quay, Southtown, South Denes and Runham Vauxhall. These locations reflect the spatial priorities for urban renaissance and regeneration, the need to tackle high levels of unemployment and deprivation and utilise the existing services and high levels of accessibility.
- b. In Bradwell and Caister-on-Sea, the scale of future development should will reflect the settlements size and function and the physical and functional links with Great Yarmouth and Gorleston. Bradwell and Caister-on -Seas role in providing a service function centre for the larger and smaller villages will be sustained and enhanced. Over the plan period, aApproximately 15-1225% of the housing requirement up to 2021 2025 and approximately 5-10% of employment requirement will be accommodated within Bradwell and Caister-on-Sea. Of this approximately on 50% will be on previously developed land to support and promote sustainable communities.
- c. In the larger villages of Belton, Hemsby, Hopton-on-Sea, Martham and Ormesby St Margaret limited development, largely on previously developed land, will take place to increase sustainability by maintaining and enhancing the level of services, facilities and jobs, or, to meet the needs of the settlement and its immediate area, including affordable housing. AOver the plan period, approximately 1110-15% of the remaining housing requirement up to 2021 2025 and approximately 5-10% of employment requirement will be accommodated in these larger villages to support and promote sustainable communities.
- d. In the smaller villages of Burgh Castle, Filby, Fleggburgh, Fritton with St Olaves, Ormesby St Michael, Repps with Bastwick, Stokesby, Thurne, Winterton-on-Sea, West Caister and West Somerton only small scale future development proposals will be supported which contribute towards rural diversification, create or maintains the viability of existing community facilities and meet identified local needs, including affordable housing. AOver the plan period up to 2021, approximately 2-5% of the housing requirement up to 2025 will be accommodated in these smaller villages to support and

promote sustainable communities.

e. In the other settlements and in the countryside development will be permitted in exceptional circumstances such as agricultural or forestry workers dwellings and affordable housing that meets a local need. Access to services and facilities and the character of the settlement and the impact on the landscape will be important in determining proposals.

Where no alternative sites exist, limited development to meet the essential and proven housing and community needs of rural communities may be permitted adjacent to rural settlements provided there is no adverse effect on the character of the settlement or the surrounding rural area.

Site Specific Allocations DPD

The Site Specific Allocations DPD allocates sites for development in accordance with the Core Strategy's spatial strategy. The Site Specific Allocations DPD is at an early stage, therefore the preferred sites for development have not been selected from the submitted expression of interest sites.

Development Control Policies DPD

The Development Control Policies DPD will conform to the Core Strategy and include detailed policies against which planning applications will be assessed. The Development Control Policies DPD is at an early stage, therefore the preferred policies have not been finalised.

2. FLOODING IN GREAT YARMOUTH AND GORLESTON

Study Area

Great Yarmouth and Gorleston are located on the east coast of the UK between the North Sea and the Norfolk Broads. Great Yarmouth's setting close to both major marine and fluvial environments has influenced its historic development and can be anticipated to do so in the future.

The harbour at Great Yarmouth provides an area of sheltered water for shipping and has long been known as a safe haven, the narrow harbour mouth and sharp angle of the entrance give it this characteristic and the harbour stretches up the estuary towards the centre of Great Yarmouth. Between the Inner Harbour and the sea is the South Denes Peninsular, a peninsular of land which is the location of much marine based and other general industry and which is a focus for regeneration. The western bank of the harbour, along Riverside Road, is also lined by industry for much of its length. Both sides of the harbour are characterised by engineered banks to facilitate docking and to provide flood defence.

On the North Sea coast itself there are limited lengths of flood defence and much of the coast line is natural or semi natural with well developed beaches and dune systems in many areas notably north of Great Yarmouth and at Caister on Sea. The sea ward side of Great Yarmouth is not sheltered like the Inner Harbour and in this area wind and wave action are much more prominent.

The Great Yarmouth area is also located directly adjacent to the Norfolk Broads, and a number of water courses flow from the Broads through the Great Yarmouth and Gorleston area meeting the Inner Harbour upstream or within the urban area of Great Yarmouth. Breydon Water is a tidal basin of significant size located directly upstream of the main urban area of Great Yarmouth and is fed by the Rivers Yare and Waveney. The River Bure which flows through the northern part of the study area joins the Yare downstream of Breydon Water within Great Yarmouth itself. The fluvial watercourses within the area are all strongly influenced by the tidal conditions in the lower reaches and are embanked or defended for much of their length within the study area and beyond. The Bure, the Yare, the Waveney and Breydon Water are navigable and provide routes from Great Yarmouth into the Broads.

Sources of Flooding

SFRAs are to be used to refine information on areas that may flood, taking into account other sources of flooding and the impacts of climate change, in addition to information on the Flood Map (PPS 25, Annex E). Volume 2 of this SFRA is a technical assessment of the risk in Great Yarmouth which seeks to meet all three objectives of a SFRA as summarised above.

Due to its location on the North Sea coast and at the mouth of the River Yare, Great Yarmouth is considered to be at risk of fluvial (river) and tidal and coastal (sea) flooding. The definitions of tidal, coastal and fluvial sources of flooding applied in this SFRA are summarised in Table 2.1. Tidal flooding from defence overtopping and breach scenarios is considered to be the most significant source of flooding in Great Yarmouth. The risk of surface water flooding in the SFRA study area is also considered to be high. Although the consequences of surface water flooding are typically less than the consequences of tidal flooding, the probability of occurrence is significantly greater. The risk of fluvial (river) and groundwater flooding is considered to be relatively low compared to the risk of tidal flooding.

Table 2.1: Definition of tidal, coastal and fluvial sources of flooding in Great Yarmouth

| Source of flooding | Definition |
|--------------------|--|
| Tidal | Flooding caused by elevated water levels in the tidal rivers (Yare, Bure and Waveney) during storm surge tides in the North Sea. This may lead to overtopping of existing flood defences in the Inner Harbour area and flooding of undefended areas to the north and west of Great Yarmouth. |
| Coastal | Flooding caused by elevated water levels in the North Sea during storm surge tides combined with large waves. This may lead to overtopping of existing coastal defences, beaches or undefended areas in Great Yarmouth and on the coastal zone north and south of the town. |
| Fluvial | Flooding caused when the channel capacity of rivers is exceeded during flood events in the catchments of the Rivers Yare, Waveney and Bure. This may result in the overtopping of existing defences and the flooding of undefended areas. |

Historic flooding

Much of the study area is currently defended from flooding and as such widespread flooding of Great Yarmouth due to a tidal, coastal or fluvial event has not been experienced in the recent past. Some flooding of the area around North River Road adjacent to the Bure has been experienced in recent years however this was reportedly due to surface water becoming trapped behind the defences rather than direct flooding from the river.

In 1953 major flooding was experienced on the east coast of the UK and in Great Yarmouth as the result of a storm surge in the North Sea. The extent of flooding observed in Great Yarmouth in this event is shown in **Volume 2: Figure 4.1**. In the more distant past major floods have effected the Great Yarmouth area, on January 1st 1779 for example, however in recent history the flood defences have largely succeeded in protecting the area and as such the local perception of the risk of flooding may be lessened.

During the November 2007 storm surge event the existing flood defences prevented significant tidal flooding in Great Yarmouth however flood levels in the River Yare did reach the soffit of Haven Bridge. During this event surcharged sewers caused flooding in low-lying parts of the town. Around the Town Hall and South Quay, flood waters were observed to reach two feet in depth.. (Independent, 2007).

In March 2008, strong gales forced a storm surge southwards down the North Sea. Tide levels overtopped existing defences at low-lying Riverside Road in Gorleston, and the riverside in Bure close to the White Swan Inn however the overtopping was relatively minor. Overtopping at Ice House Quay caused flooding in the Matalan car park. As in the November 2007 event, as levels in the River Yare rose above existing ground levels, water from surcharged manholes at Town Hall Quay and North Quay caused flooding on the quayside and in the car park at Havenbridge House. Tide locking on the Broads meant that high levels persisted into the next high tide (Mercury, 2008).

Probability of flooding

This section provides an introduction to the terminology which is used to describe the probability of flooding events in this SFRA.

The probability of fluvial, tidal and coastal (river and sea) flooding is described in this SFRA using the Annual Exceedance Probability (AEP). This is sometimes known as the 'annual probability' of flooding. A flood event described as a 1% AEP has a 1% (or 1 in 100) chance of occurring in any

given year. This could alternatively be described as a 100 year return period flood event, that is, it is an event that is likely to occur, on average, once every 100 years.

The assessment of risk from fluvial, tidal and coastal sources in this SFRA is focussed on four different probability flood events summarised below in Table 2.2.

Table 2.2 Flood events considered in this SFRA and Flood Zones from PPS 25

| Annual Exceedance Probability (AEP) of flood event | Return Period of flood event | Use in this assessment |
|--|------------------------------|---|
| 5% AEP Flood Zone 3b | 1 in 20 years | Used in the assessment of Flood Zones and to determine the extent of the Functional Floodplain. Fluvial and tidal events of this probability have been considered. |
| 1% AEP Flood Zone 3a | 1 in 100 years | Used in the assessment of Flood Zones and actual risk of flooding. Only fluvial events of this probability have been considered. Land in this zone has a high probability of flooding |
| 0.5% AEP Flood Zone 2 | 1 in 200 years | Used in the assessment of Flood Zones and actual risk of flooding. Only tidal events of this probability have been considered. Land in this zone has a medium probability of flooding. |
| 0.1% AEP Flood Zone 1 | 1 in 1000 years | Used in the assessment of Flood Zones and residual risk of flooding. Fluvial and tidal events of this probability have been considered and are described as having a low probability of flooding. |

A four stage process has been used to assess the risk of fluvial, tidal and coastal flooding in Great Yarmouth. This process considers **Flood Zones, actual risk of flooding, residual risk of flooding** and **breach hazard** and is described fully in **Volume 2: Chapter 4** of this SFRA.

The fluvial and tidal flood zones are prepared in a scenario that ignores the presence of defences. When the flood zones are derived all existing defences are removed from the modelled scenarios. The fluvial flood zones are derived using the 5%, 1% and 0.1% AEP flood events and the tidal and coastal flood zones are derived using the 5%, 0.5% and 0.1% AEP flood events.

The actual risk of flooding in Great Yarmouth and Gorleston has been assessed in this SFRA for a defended scenario assuming that all the defences are in place and fully maintained and operational. The actual risk of fluvial flooding is assessed for a 5% and 1% AEP flood event and the actual risk of tidal flooding is assessed for a 5% and 0.5% AEP flood event.

The residual risk of flooding in Great Yarmouth and Gorleston has been assessed in this SFRA for a defended scenario assuming that all the defences are in place and fully maintained and operational. The residual risk of flooding is assessed for an extreme flood event typically greater than that for which the defences were designed. The residual risk of fluvial and tidal flooding has been assessed in this SFRA using the 0.1% AEP flood event.

Additionally in this SFRA four breach scenarios have been assessed to consider the potential flood hazard created if there is a 'hole' in the existing defences during a flood event. This breach might be caused by a defence wall collapsing due to structural failure or perhaps as a result of a ship collision. The chance of this happening is very low and it is not possible to assign a probability to this occurring. The scenarios considered in this SFRA assume that a breach in the defences occurs during a 0.5% and 0.1% AEP tidal surge event. When the breach scenarios are assessed all existing defences are assumed to be in place and operational apart from the location at which the breach is modelled.

Risk of flooding

Flood risk can be considered as the product of the probability and the consequences of a flood event. This method of defining flood risk is explained in **Volume 1: Appendix B** of this SFRA and takes in to account the predicted hazard from flooding and the vulnerability of the receptor affected by the flooding. Using this definition, the flood risk of a low probability event such as a breach scenario may be equivalent to that of a relatively higher probability event (defence overtopping) if the consequences of the breach event are significantly greater than the consequences of the overtopping event.

Table 2.3 shows the sources of flooding which affect Great Yarmouth and summarises the magnitude of the risk which can be attributed to each source. This table provides a starting point for users of the SFRA and indicates which types of flooding require more detailed consideration in land allocation, planning policy, development control and emergency planning.

The risk of tidal flooding in Great Yarmouth is considered to be the most significant source of flood risk in this SFRA. The risk of flooding will increase in the future as a consequence of rising sea levels and is expected to become extreme.

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Table 2.3 Sources of flooding affecting Great Yarmouth

| Type of risk | Summary of risk | Reference for further information |
|---|---|--|
| Fluvial / river flooding | The probability of occurrence of flooding in Great Yarmouth from the Rivers Yare, Bure and Waveney is considered to be low and therefore the fluvial flood risk within the SFRA area is low . | Volume 2: Chapter 4 and 5 provides more information on the risk of fluvial flooding. Predicted flood extents from fluvial flooding scenarios are mapped in Volume 3: Series 15 . |
| Tidal flooding caused by defence overtopping | <p>Tidal flooding is caused by storm surges in the North Sea which cause elevated water levels in the tidal reaches of the Rivers Yare, Bure and Waveney.</p> <p>The existing tidal defences in Great Yarmouth have a standard of protection of 1:100 year. In tidal surge events with an annual probability of occurrence of less than 1%, tidal flooding in Great Yarmouth caused by overtopping of defences would be expected. The risk of tidal flooding in the SFRA area is high.</p> | Volume 2: Chapter 4 and 5 provides more information on the risk of tidal flooding. Hydraulic modelling of tidal flooding scenarios has been undertaken and predicted flood extents from tidal flooding scenarios are mapped in Volume 3: Series 3 – Series 6 and Series 11 – Series 12 . |
| Tidal flooding caused by a breach in defences | There is a risk of a breach in the tidal defences in Great Yarmouth. For example, structural failure of the defences or a collapse in defences as a result of ship collision. The probability of a breach occurring is low but the consequences of a breach event would be significant and may result in extremely high depths and velocities of flooding. The consequences of a breach would be greatest if the event coincided with a high storm surge. The flood risk from a breach scenario in the SFRA area is high . | Volume 2: Chapter 4 and 5 provides more information on the risk of tidal flooding in a breach scenario. Hydraulic modelling at four breach locations has been undertaken and predicted flood extents and hazard rating in the breach scenarios are mapped in Volume 3: Series 17 – Series 32 . |
| Other sources of flooding | <p>The risk of flooding from surface water and sewers in Great Yarmouth is considered to be high. Surface water flooding in the SFRA area has a greater probability of occurrence than tidal flooding (or breach events) however the consequences of surface water flooding tend to be less severe.</p> <p>The risk of groundwater flooding in Great Yarmouth is considered to be low.</p> <p>There are no major sources of artificial flooding within the SFRA area.</p> | <p>Volume 2: Chapter 6 provides more information on the risk of flooding from surface water and sewers.</p> <p>Volume 2: Chapter 7 provides more information on the risk of groundwater flooding.</p> |
| Climate change | <p>The predicted impacts of climate change include a rise in sea level (more than 1m over the next 100 years), increased river flows (+ 20%) and increased rainfall intensity (+30% over the next 100 years).</p> <p>The risk of tidal flooding is expected to significantly increase as a consequence of climate change as the tidal defences will overtop far more frequently than currently predicted. Future defence overtopping events will lead to greater flood depths and velocities than currently experienced. Without significant improvements to the existing flood defences, the risk of tidal flooding in the future is expected to become extreme. Similarly, the consequences of breaches during high storm surges would be greater than presently expected.</p> | <p>Volume 2: Chapter 4 and 5 provides more information on the impacts of climate change on the risk of tidal flooding. Hydraulic modelling of tidal flooding scenarios has been undertaken and predicted flood extents from tidal flooding scenarios are mapped in Volume 3: Series 7 – Series 10 and Series 13 – Series 14. Predicted flood extents and hazard rating for future breach scenarios are mapped in Volume 3: Series 33 – Series 48.</p> <p>Volume 2: Chapter 4 and 5 also provides more information on the impacts of climate change on the risk of fluvial flooding Volume 2: Chapters 6 and 7 provide more information on the risk of flooding from surface water and sewers and groundwater flooding respectively.</p> |

3. HOW TO USE THE SFRA IN LAND USE PLANNING

Introduction

Guidance on development and flood risk is given in PPS25. This statement requires that flood risk be considered through the application of a Sequential Test. The process of how to obtain the information needed to perform the Sequential Test is described in this chapter.

PPS25 advocates a sequential risk based approach when preparing an assessment. The policies in PPS25 require that all stages of the development planning process should take account of both the nature and spatial distribution of flood risk and the degree of vulnerability of different types of development. Thus this should be achieved in the Great Yarmouth Local Plan, the Local Development Framework and in planning applications.

It is not the intention for guidance provided in this document to supersede that contained in PPS25 or other plans or policies. The information and procedures are included as an interpretation of national policy for the use in the SFRA.

The Environment Agency's 'Strategy for Flood Risk Management 2003 - 2008' (Environment Agency 2003), describes flood risk as a combination of two components, the:

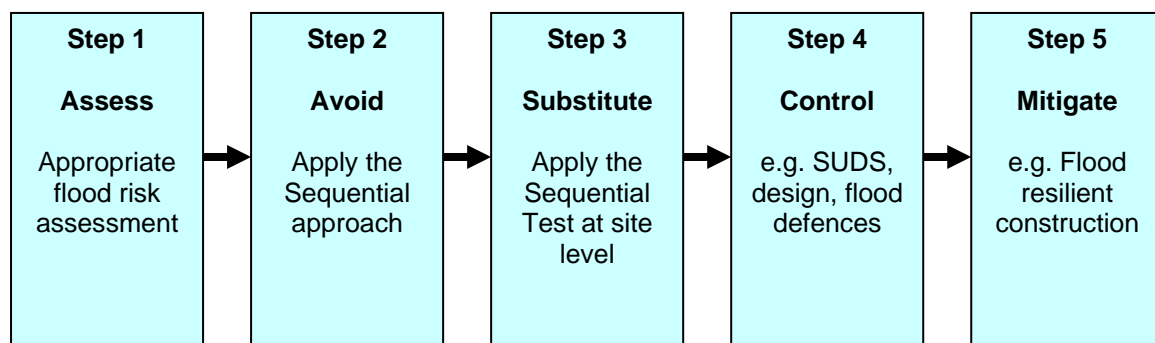
- **"chance (or probability) of a particular flood event; and,**
- **impact (or consequence) that the event would cause if it occurred."**

PPS 25 captures this intent by requesting that flood risk is avoided, reduced and managed *by taking full account in decisions on plans and application of:*

- *present and future flood risk, involving both the statistical probability of a flood occurring and the scale of its potential consequences, whether inland or on the coast; and*
- *The wider implications of flood risk of development located outside of flood risk areas.*

The concept of flood risk is described in further detail in Appendix B.

The PPS 25 Practice Guide develops the avoid – reduce – manage approach advocated in PPS 25 into a flood risk management hierarchy of assess – avoid – substitute – control – mitigate. This hierarchy is summarised in the flow chart below (from PPS 25 Practice Guide, CLG, June 2008).



The evidence in the SFRA is intended to inform the formulation of the vision, policies and broad search areas during the production of the Core Strategy to an appropriate level of detail so that the Core Strategy is robust with respect to flood risk.

The SFRA provides GYBC with the information required to assess their allocations of new development sites and apply a risk based Sequential Test. The SFRA also provides the necessary information for planners to make strategic decisions that identify the amount and type of development that may be appropriate, requirements for the management of run off, and identification of strategic responses (options) to manage flood risk.

The results of the SFRA can be used to:

- Prepare appropriate policies for the management of flood risk within GYBC area; and,
- Inform the Sustainability Appraisal so that flood risk is taken into account when considering options and the preparation of strategic land use policies.

Sequential Test

It is recognised that flood risk information must be considered alongside other spatial planning issues. Allocations are thus “Tested” on the basis of their flood risk attributes and the outcome used to inform decisions that include other spatial planning issues.

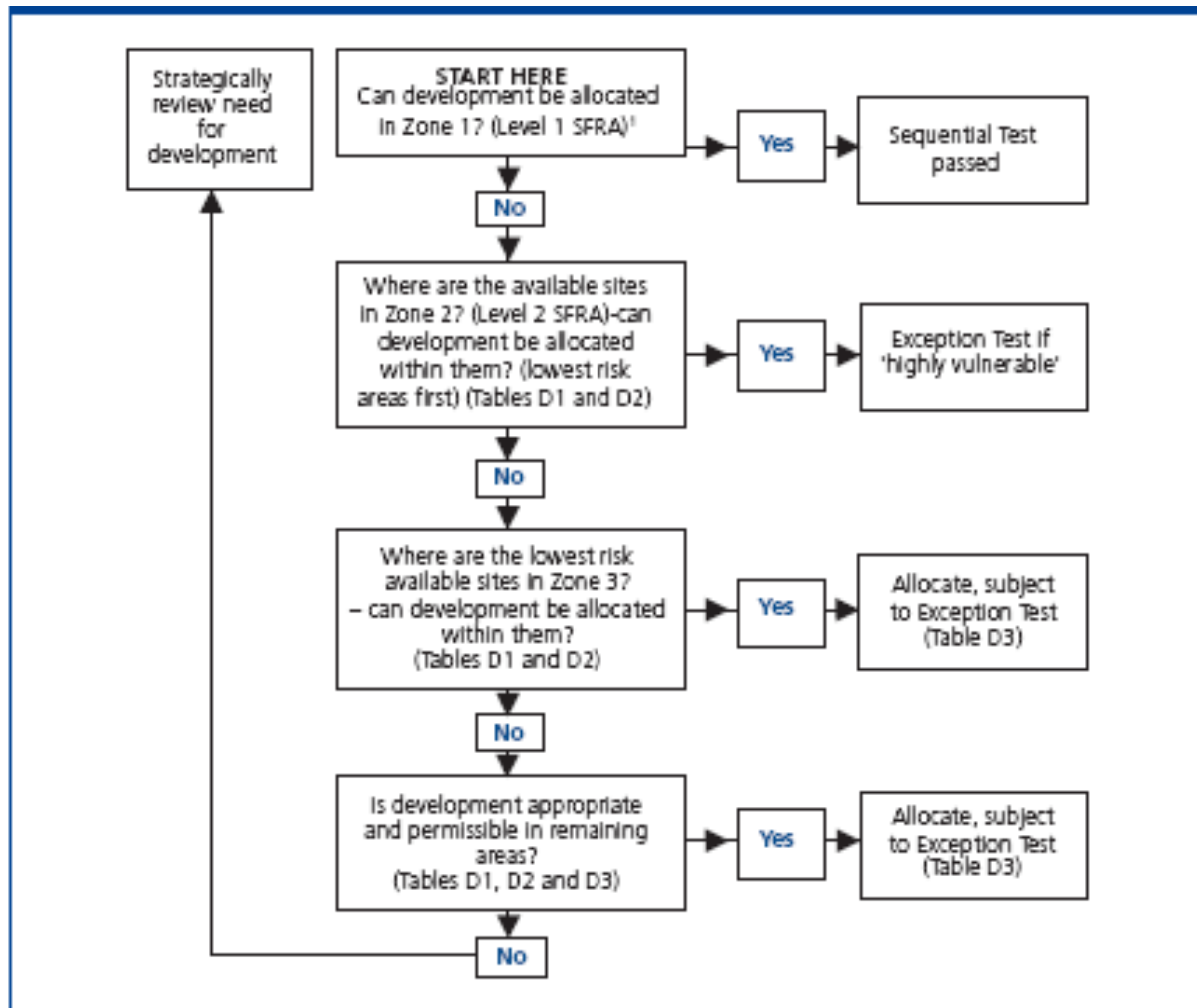
The Sequential Test is applied at all stages of planning. The SFRA provides the flood risk data to enable the application of the risk based Sequential Test in the process of identifying land that is suitable for development in the Local Development Framework. It also provides information to inform Flood Risk assessments at particular sites. Specifically the SFRA contains information on flood risk that enables GYBC to demonstrate that they have tested the reasonably available alternatives using a risk based search sequence.

To perform the Test GYBC first need to be aware of what sites are reasonably available alternatives in their council area. It is necessary to clearly define “reasonably available” and be able to provide evidence that there are not locations outside of those considered with a lower probability of flooding that could be considered to be “reasonably available”.

When applying the Test it will be important for GYBC to demonstrate:

- That a transparent process has been formulated and followed;
- That this process has sought to steer new development to areas with the lowest probability of flooding (according to table D.1 of PPS 25); and
- That full consideration has been given to reasonably available alternatives on land with a lower probability of flooding.

Figure 4.1 of the PPS 25 Practice Guide (reproduced below as Figure 3A) provides a flow chart for use by local authorities in the application of the Sequential Test. It is a tool to help the decision-maker locate a proposed development in lower flood risk categories. Below this flow chart (Table 3.1) are some additional notes which direct the user to the particular sections of technical information or mapping within this SFRA which should be used in each stage of the process.

**Note**

¹ Other sources of flooding need to be considered in Flood Zone 1

Figure 3.A Application of the Sequential Test reproduced from Figure 4.1, PP2 25 Practice Guide (June 2008).

The flood risk information required to address the four stages in the application of the Sequential Test noted above is provided in the flood maps in Volume 3 of this SFRA. Users of this SFRA and the Flood Maps in Volume 3 should be aware of the recommended limitations of use of the maps discussed in **Volume 2: Chapter 6** of the SFRA. Specific guidance for Great Yarmouth on the use of these flood maps in the application of the Sequential Test is provided below in Table 3.1.

Table 3.1. Guidance for GYBC on the use of this SFRA in the application of the Sequential Test

| Stage in Sequential Test | Guidance | Associated Map Series in GY SFRA (Volume 3) |
|---|--|--|
| 1. Can development be allocated in Zone 1? | GYBC should use Flood Zone maps to identify areas within Zone 1 and consider whether proposed developments can be allocated in Zone 1 land. Within Zone 1, areas at risk from other sources of flooding should be avoided where possible | Series 1 |
| 2. Where are the available sites in Zone 2? Can development be allocated within them? | GYBC should use Flood Zone maps to identify areas within Zone 2 and consider whether proposed developments can be allocated in these areas | Series 1 |
| 3. Where are the lowest risk available sites in Zone 3? Can development be allocated within them? | GYBC should use more detailed information within this SFRA to understand the distribution of risk within Flood Zone 3. The Flood Zones do not take account of existing control structures and defences. Maps are presented in this SFRA which show the actual risk of fluvial and tidal flooding when existing defences are in place. Hazard maps are also provided for four breach locations considering a failure of defences during a tidal surge event in Great Yarmouth. Future development should be first directed towards the lowest hazard areas and then moderate, significant and finally extreme hazard areas. | <p>Predicted flood level, depth and hazard maps</p> <p>Series 3, 4, 5, 6, 11 & 12 - tidal flooding and defence overtopping</p> <p>Series 15 – fluvial flooding</p> <p>Series 17 – 32 – breach scenarios</p> |
| 4. Is development appropriate and permissible in remaining areas? | In considering the appropriateness of development in remaining areas, GYBC should consider the vulnerability of the proposed development and Tables D2 and D3 of PPS 25. Information on the flood hazard in tidal flooding events (including breaches) is provided in maps in this SFRA. | <p>Predicted flood hazard maps</p> <p>Series 4, 6 & 12 - tidal flooding and defence overtopping</p> <p>Series 18, 20, 22, 24, 26, 28, 30 & 32 – breach scenarios</p> |

It should be noted that the process illustrated in Figure 3A does not take into account the potential impacts of climate change on the level of flood risk. It is recommended that GYBC consider the potential impacts of climate change when applying the third and fourth stages of the Sequential Test process described above. **Volume 3: Map Series 7-10, 13&14, 16 and 33-48** show the potential impacts of climate change on the risk of fluvial and tidal flooding in Great Yarmouth. The potential impacts of climate change on other sources of flood risk in Great Yarmouth are discussed in the Volume 2: Technical Report and should be referred to when considering the areas of lowest risk within Flood Zone 3.

The protocols adopted for the Sequential Test should ideally be agreed with the Environment Agency. It is important that the decision maker engages key stakeholders early in the decision making process. It is also important to consider uncertainty of information when making land use planning decisions. GYBC may decide to adopt a 'layered' approach to the application of the Sequential Test in Great Yarmouth. At the first stage, the Sequential Test will be applied to the general development areas within the borough and then subsequently, in the second stage, applied to individual allocation

sites within these development areas. It is recommended that this 'layered' approach is agreed in principle with the Environment Agency prior to application.

As described in PPS 25 flood risk information is considered alongside other spatial planning issues in the application of the Sequential Test such as transport, housing, economic growth, natural resources (see Figure 3.B). If the site were to be in conflict with one of the other planning issues, such as biodiversity or lack of transport access then the site may not pass the Sequential Test.

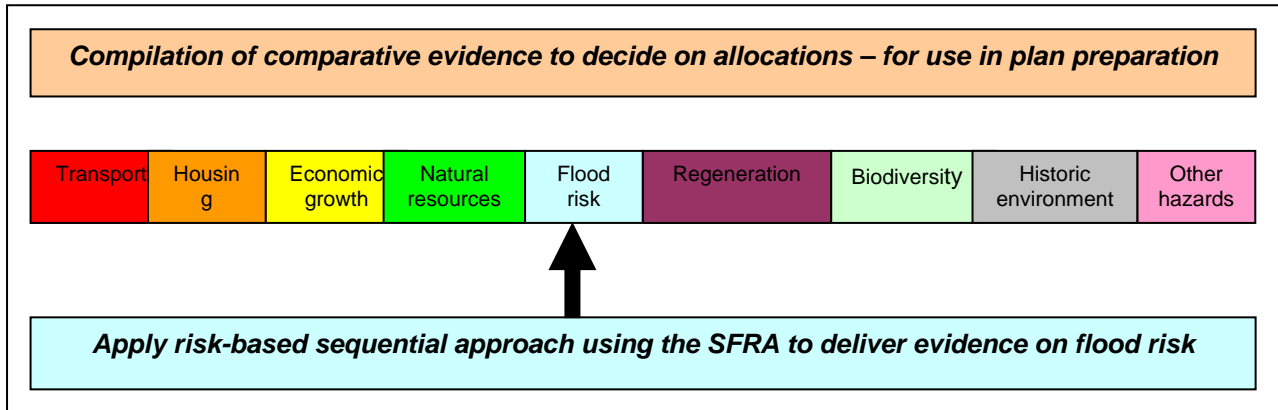


Figure 3.B How the risk based sequential approach informs decision-making

It is recommended that GYBC formulate a bespoke flow chart that:

- Adopts the same conceptual logic as shown in Figure 3A;
- Clearly sets out the information used to inform the “Yes/No” decisions shown in Figure 3A and where this information can be found;
- Identifies the process used to select “reasonably available alternatives”; and
- Records how information on other material planning issues has been considered in the decision making process.

Table 3.1 provides a template table for Great Yarmouth BC to consider when undertaking the Sequential Test. This table can be used to record the information used in the decision making process for each allocated area/site following the methodology outlined in the flow chart, Figure 3A.

Appendix D of this volume of the SFRA includes overview Figures of the Great Yarmouth and Gorleston area, mapping flood risk vulnerability and flood zone compatibility as described in PPS25 (Tables D.2 and D.3). These Figures should be used as a starting point by the GYBC Planning team, as they identify where certain development types are appropriate in the borough based on flood risk, and where they should not be permitted. This should then be considered in accordance with the Sequential Test and alongside other spatial planning issues.

Exception Test

As shown in Map Series 1, a significant area of Great Yarmouth lies within Flood Zones 2 and 3 and is predicted to have a medium or high risk of flooding from rivers or the sea. Following application of the Sequential Test it may not be possible for Great Yarmouth Borough Council to steer all new development towards Flood Zone 1. Consequently it may be accepted that in Great Yarmouth it is necessary for sites for new development and redevelopment to be allocated in Flood Zones 2 and 3 and therefore that further work will be required in relation to flood risk management for such sites. There are further requirements in PPS25 for situations such as this.

If, following the application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for the development to be located in zones of lower probability of flooding, the Exception Test can be applied in accordance with Table D3 and paragraphs D9 to D14 of PPS25. It is expected that the Exception Test will have to be applied to allocated sites in Great Yarmouth as it is not likely that it will be possible to avoid all development in Flood Zones 2 and 3. The Test provides a method of managing flood risk while still allowing necessary development to occur. It may not always be appropriate to apply the Exception Test.

Figure 3C is a reproduction of Figure D.3 in PPS 25 which illustrates the scenarios that an Exception Test is required.

Figure 3.C. Flood Risk Vulnerability and Flood Zone ‘Compatibility’ reproduced from Figure D.3, PPS 25 (Environment Agency, 2006)

| Flood Risk Vulnerability classification (see Table D2) | | Essential Infrastructure | Water compatible | Highly Vulnerable | More Vulnerable | Less Vulnerable |
|--|---------------------------------|--------------------------|------------------|-------------------------|-------------------------|-----------------|
| Flood Zone (see Table D.1) | Zone 1 | ✓ | ✓ | ✓ | ✓ | ✓ |
| | Zone 2 | ✓ | ✓ | Exception Test required | ✓ | ✓ |
| | Zone 3a | Exception Test required | ✓ | X | Exception Test required | ✓ |
| | Zone 3b ‘Functional Floodplain’ | Exception Test required | ✓ | X | X | X |

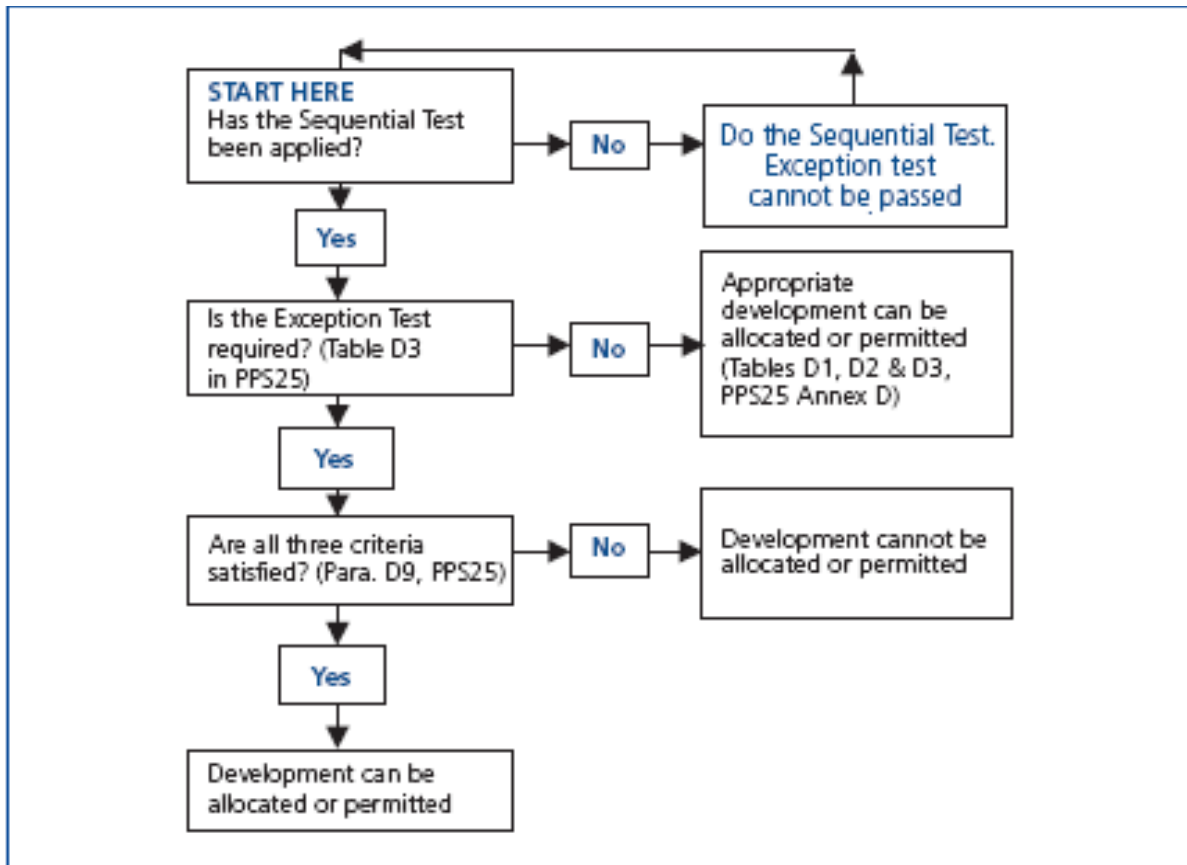
Key:

✓ Development is appropriate

X Development should not be permitted

Figure 3D is a reproduction of Figure 4.2 in the PPS 25 Practice Guide which illustrates the process that should be followed by GYBC in the application of the Exception Test.

Figure 3.D Application of the Exception Test reproduced from Figure 4.21, PPS 25 Practice Guide (CLG, June 2008).



The three criteria of the Exception Test referred to in the process in Figure 3D are listed above. The PPS 25 Practice Guide provides additional guidance in Chapter 4 on the application of this test.

Where it is appropriate to apply the Exception Test, all of the following three elements must be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk;
- the development should be on developable previously-developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously-developed land; and,
- a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The first criterion of the test reflects the wider sustainability benefits of the development which should be tested against the aims and objectives of the Sustainability Appraisal and other LDD policy. GYBC may wish to develop a sustainability checklist for use in assessing this criteria of the Exception Test.

The second criterion of the Exception Test relates to the previous use of the site and further guidance on this is provided in PPS 3.

The third part of the Exception Test relates to the “safety” of the development and Chapter 4 of the PPS 25 Practice Guide provides detail on ‘What is safe?’ and ‘Access and egress’. When considering the question of “what is safe?” the PPS 25 Practice Guide refers to guidance in the Defra R&D report FD2320/TR2 Flood Risk Assessment Guidance for New Development. This report includes guidance on the danger to people based on different combinations of depth and velocity. Further information on this assessment of flood hazard is provided in **Volume 2: Chapter 4** of this SFRA.

Information in Table 3.2 of this SFRA can be used to assess the safety of particular locations for site specific FRA since it gives greater detail on the actual risks, residual risks and the associated magnitude of the flood hazard. Consideration should be given to the safe access and egress

arrangements that can be implemented so that during flood events the appropriate level of safety can be maintained.

Table 3.2. Guidance for GYBC on the use of this SFRA in the application of the Exception Test

| Exception Test part c): safe development | | |
|---|--|--|
| Source of flood risk | Guidance | Associated Map Series in GY SFRA (Volume 3) |
| 1. Tidal and coastal flooding | There are areas at risk of tidal flooding in Great Yarmouth and in places the predicted flood hazard is extreme due to a combination of high depths and velocities of flood waters. The level of risk is expected to increase in the future as a consequence of sea level rise. There is also a risk of a breach event occurring causing rapid and significant flooding. | <p>Predicted flood level maps Map Series 3, 5 and 11 – tidal flooding</p> <p>Predicted flood hazard maps Map Series 4, 6 and 12 – tidal flooding</p> <p>Future predicted flood level maps Map Series 7, 9 and 13 – tidal flooding</p> <p>Future predicted hazard maps Map Series 8, 10 and 14 – tidal flooding</p> |
| 2. River flooding | The risk of fluvial flooding in Great Yarmouth is low compared to the risk of tidal flooding. In the upper parts of the Bure, Waveney and Yare catchments the risk of fluvial flooding is greater. | <p>Predicted flood extents Map series 15 – present day Map series 16 - future</p> |
| 3. Other sources of flooding | This SFRA has also considered the risk of flooding from surface water, sewers and groundwater. There are records of observed surface water flooding incidents within the town. | See Chapters 5, 6 and 7 of Volume 2 |

Users of this SFRA and the Flood Maps in Volume 3 should be aware of the recommended limitations of use of the maps discussed in **Volume 2: Chapter 6** of the SFRA.

It is important the Great Yarmouth Borough Council retain a record of all their assumptions and decisions with regard to both the Sequential and Exception Tests, in order to demonstrate that they have performed the process. DPD's submitted with Sequential/Exception Tests will be found unsound or objected to by the Environment Agency. Once the Tests are completed, and GYBC are satisfied with the outcome, it is then possible to continue with the development process.

Flood events, more than many other emergencies, can affect a wide number of homes and the time to recover from a flood emergency can be prolonged. Accordingly it should be remembered that the level of "safety" will vary depending on the vulnerability of the community affected. More vulnerable residents will potentially be more severely affected by the consequences of flooding and levels of safety should be commensurate with the risk.

Potential Development in Great Yarmouth and Gorleston

The Great Yarmouth Borough-Wide Local Plan (2001) will be replaced by the emerging Local Development Framework (LDF). A short summary of the Great Yarmouth Local Development Framework is provided in **Volume 1: Chapter 1** of this SFRA. The Core Strategy is the key strategic document in the LDF and sets out the spatial strategy for development. The Core Strategy has been subject to two rounds of statutory consultation and is now at the Preferred Options Stage. The Core Strategy spatial strategy is to focus the future development on the urban areas to promote regeneration and sustainable development. This reflects the Regional Spatial Strategy for the East of England (2008) Policy GYL1 which promotes the comprehensive regeneration of Great Yarmouth and Policy SS2 and SS3 which directs the redevelopment of the main urban areas.

1st East is an Urban Regeneration Company aiming to generate economic growth by co-ordinating development in the brownfield and waterfront areas of Lowestoft and Great Yarmouth. An Area Action

Plan (Preferred Option) has been developed as part of the Great Yarmouth LDF and it outlines that future development in GYBC is to be concentrated in six Action Areas known as:

- Runham Broad (in the loop of the River Bure);
- Breydon Reach;
- Haven Approach (the existing entrance to the town between Gapton Hall roundabout and the Haven Bridge);
- Ice House Quay (the west bank of the River Yare, south of Haven Bridge);
- South Denes - comprising three distinct areas – South Gate, South Denes industrial (area surrounding Nelson's monument) and EastPort; and
- Nelsons Bridge.

The Area Action Plan (AAP) will form part of Great Yarmouth's LDF and will replace the existing Local Plan. The AAP contains the goals and objectives taken from 1st East's vision, which are then turned into economic and housing strategies designed to support existing businesses and encourage a more diverse economy and expand the housing market. The AAP aims to create around 2000 new homes in Great Yarmouth in and around the waterfront. Development in the six Action Areas shown in the Great Yarmouth Proposals Map are planned to be of mixed uses and includes new jobs and new houses.

The section below summarises the flood risk issues in each of the six Action Areas. As noted below, much of these areas lies within Flood Zones 2 and 3, areas of medium and high risk of flooding. GYBC must demonstrate that the Sequential Test has been applied to the allocation of development within these areas and that there are no reasonably available alternative sites for development in areas of lower risk. Following application of the Sequential Test, the Exception Test will also have to be applied for more vulnerable and highly vulnerable development in these zones.

The entire Action Areas of Runham Broad and Haven Approach are located within Flood Zone 3 which have a high probability of flooding from fluvial or tidal sources when the presence of defences is ignored, accordingly it is necessary for Great Yarmouth Borough Council to demonstrate that there are no reasonably available alternative sites for such development in areas with a lower probability of flooding.

The majority of Breydon Reach, Ice House Quay and Nelson's Bridge are located in Flood Zone 3 which have a high probability of flooding from fluvial or tidal sources when the presence of defences is ignored. Again it is necessary for Great Yarmouth Borough Council to demonstrate that there are no reasonably available alternative sites for development in areas with a lower probability of flooding. When the presence of the existing defences is taken into account, in a tidal surge event with an annual probability of 0.5% the actual risk of flooding from overtopping of the defences is low

With an increase in tide levels as a consequence of climate change the probability of defence overtopping will become higher in the future. There is a residual risk of flooding in the areas of Breydon Reach, Ice House Quay and Haven Approach from a breach in the River Yare defences. Following application of the Sequential Test, if development proceeds in Flood Zones 2 and 3 the Exception Test may have to be applied. As noted above the Exception Test requires a demonstration that a site is safe and does not increase the risk of flooding. Application of the Exception Test requires the consideration of this breach hazard when allocating sites within these high risk zones. The areas of greatest hazard should be avoided to reduce the risk of flooding. Further breach assessment may be required on individual site-specific FRAs.

Much of the South Denes area is located in Flood Zone 1 and has a low probability of flooding. In Flood Zone 1 all types of land use are appropriate. This risk is expected to increase as a consequence of climate change and rising sea levels. The actual risk of tidal flooding in South Denes taking account of the presence of existing flood defences is less than that indicated on the present day and future Flood Zone maps. There is a residual risk of defence overtopping or from a breach in the defences in this area and an assessment of this hazard has been included in the SFRA. When

allocating sites for 'more vulnerable' land uses (residential), these areas of actual risk of flooding and high breach hazard should be avoided. Further breach assessment may be required on individual site-specific FRAs.

It should be noted that if, following the application of the Sequential Test, it is identified as being necessary to locate development in Zone 3 it follows that:

- A commitment must be enshrined to maintain the standard of protection so that development is safe for its intended lifetime (this commitment could involve contributions through a planning agreement attached to proposed development in Zone 3 (the long term commitment to management and maintenance of the defences would also need to be captured));
- A commitment must be made to maintain flood warning and emergency response capacity so that the duty could be performed for the lifetime of the development (again this might require contributions to ensure that there is future capacity in circumstances where the risks are increasing due to climate change effects);
- A commitment must be made to seek to identify strategic measures that can contribute to a long term reduction in the flood consequences and identification of an adaptation strategy that over the long term improves the general resilience of the affected communities. This adaptation strategy will evaluate the resilience of critical civil infrastructure (eg identified as being a "single point of failure") and identify strategic measures that will reduce the vulnerability of the existing community to flood emergencies during the strategic, tactical and post event phases of a flood event; and
- Generic measures should be identified which improve the resilience to all forms of flooding, in particular surface water and drainage flooding caused by high intensity local rainfall; and
- The design and layout of the development should aim to reduce the flood risk on site and to surrounding properties.

As shown in the flow chart in Figure 3C, the application of the Exception Test to proposed development in areas at high risk of flooding requires consideration of the safety of the development. As described above an assessment of the safety of a proposed development must include consideration of the access/egress arrangements from the development in the event of a flood. The safety of people during a flood event depends on the depth and velocity of the floodwaters and guidance on the relative danger of different depth/velocity combinations is provided in the Defra/EA Report FD2320/TR2 "Flood Risk Assessment Guidance for New Development." Due to the nature and widespread predicted extent of the flooding in Great Yarmouth Access/egress arrangements present a significant challenge. The Environment Agency, Great Yarmouth Borough Council and the Government Office for the East of England are continuing discussions on the demonstration of safe access/egress in Great Yarmouth and the outcomes of these discussions will be incorporated into future revisions of this SFRA.

The information in Table 3.3 will need to be used by the LPA to undertake the Sequential Test for the sites identified. From the Sequential Test and the information from Table 3.3 it will be possible to determine which sites are to be taken forward and which sites are to be disregarded, and the reasons for such decisions.

Table 3.3 Template table for recording Sequential Test process

| Sites Identified for Potential Future Development | Flood Zones (see Figure ST1, Appendix D of this Volume for Flood Zones overview mapping) | Actual Risk <i>The risk that has been estimated based on a qualitative assessment of the performance capability of the existing flood defences</i> | Residual Risk <i>Flood risks resulting from an event more severe than for which particular flood defences have been designed to provide protection.</i> | Risk of surface water and sewer flooding | Risk of ground water flooding | Risk of flooding from artificial sources | Existing use of Site | Proposed use of Site | Vulnerability of Site | Additional comments |
|---|--|---|--|--|-------------------------------|--|----------------------|----------------------|-----------------------|---------------------|
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4. HOW TO USE THE SFRA IN FLOOD WARNING AND EMERGENCY PLANNING

PPS25 recognises that flooding is a natural process that plays an important role in shaping the natural environment. However, flooding also threatens life and causes substantial damage to property. Although flooding cannot be wholly prevented, its impacts can be avoided and reduced through good planning and management. While physical flood defences may provide a level of protection, they may be breached or overtopped. A necessary component of flood defence is flood warning, backed up by civil protection measures. In this context, the Environment Agency is the authority responsible for issuing forewarning of possible flooding due to defense/river bank overtopping (but not Breach flooding events due to the sudden and unpredictable nature of a breach flood) events to the public, local authorities and emergency services.

Structures and procedures for civil protection drawn up under the Civil Contingencies Act came into force in November 2004. The Act formalises the duties on Category 1 responders to emergencies by requiring risk assessment and contingency planning to deal with emergencies, and the provision of advice and information to the public about actual or likely emergencies.

Under the Act, risk assessment and planning is arranged through Local and Regional Resilience Forums. The Forums, which are led by the Regional Resilience Teams in the Government Offices of the Regions, seek to draw in all those bodies, which may be exposed to risk or be required to respond to events, including flooding. This includes production of an emergency flood management plan, which may then be incorporated into a local emergency plan or a major incident plan as judged appropriate. The Teams also assist local authorities and emergency services in responding to and recovering from events.

The Norfolk Emergency Response Strategy (2006) produced by the Norfolk Resilience Forum outlines the agreed procedures and arrangements for effective integrated multi agency command, control and co-ordination when dealing with emergencies in the county. The Norfolk Resilience Forum is a Regional Resilience Forum (RRF) which promotes cooperation and information sharing. The RRF have a responsibility in the pre-event stage to contribute to the development of emergency plans but are not involved in incident management during an actual flood event.

The Norfolk Resilience Forum have also produced a Strategic Flood Response Plan (2008) which outlines the arrangements which should be implemented to ensure that an efficient and effective response is put into place for a severe flooding incident, or the risk of such an incident. Using established procedures, activities are co-ordinated by the Police working in partnership with Local Authorities, Emergency Services, the Environment Agency and other agencies that are appropriate to the response. The procedures set out in this plan are intended primarily for coastal, tidal and fluvial flooding, but also relate to surface water flooding and groundwater flooding. These procedures are then fed down to the Local Authorities and response units to devise their own emergency response plans.

The Norfolk Constabulary Great Yarmouth Area Flood Plan (October 2007), which is in the process of being replaced by the Norfolk Resilience Forum (NRF) Multi Agency Flood Plan for the Borough of Great Yarmouth sets out procedures for when flood threatens. The Plan provides a comprehensive overview of the response to a flooding situation and is developed and updated by the GYBC Emergency Planning Manager.

Key responses when a flood warning is issued include the management of a response to a critical incident and coordination of the team which make up the Silver Joint Operations Centre (JOC). Silver JOC will be set up at Great Yarmouth Police Station if required and will always be opened when a severe flood warning has been issued. The facility brings together representatives of responding agencies in order to effectively co-ordinate their work. Operations issued from the JOC include evacuations, closure of flood gates, sand bag collection point security, staffing of rest centres and road closures. The aim of Silver JOC is to maximise resources and deal with requests for assistance

and to better exchange information between organisations dealing with an incident to obtain a more accurate overview of the emergency.

There are 13 flood gates/boards along both banks of the rivers in Great Yarmouth which are required to be put in place by the owner of the land where they are located when a flood event is threatened. The Environment Agency are responsible for informing the relevant land owners when a flood warning message has been issued. The EA are also responsible for checking all gates/boards are in place with the assistance of the Police. It has been long agreed that the double checking of flood gates and boards is good practice.

This SFRA has identified that the risk of tidal flooding from defence overtopping or breach scenarios in Great Yarmouth is high. The probability of a defence breach or failure has not been quantified but is considered to be lower than the probability of defence overtopping however the consequences of such an event may be greater. When considering the response to such risk it is useful to be aware of the following phases of flood emergencies. Great Yarmouth Borough Council has roles and responsibilities in relation to flood warning and emergency planning for flood events in all these stages.

- **Pre-event: Strategic planning phase.**
 - Preparation of a multi-agency communication strategy for informing residents;
 - allocation of rest, reception and media centres; and
 - mapping the location of vulnerable people and sites;
- **Pre-event: Warning and evacuation phase.;**
- **During event: Tactical phase.**
 - Co-operation with all category one and two responders (including the emergency services and the Environment Agency) to coordinate response,
 - Evacuation protocols and implementation are primarily the responsibility of the Police, however in the event of an evacuation a multi-agency "Evacuation Cell" shall be established to oversee the operation,
 - assisting the emergency services and the Environment Agency in warning and informing residents; and
 - liaison with the water authority (Anglian Water) to ensure provision of clean drinking water. This is primarily the responsibility of Anglian Water but it is expected that GYBC will assist where necessary;
- **Immediately after an event: Rescue phase; and**
- **Post-event: Recovery phase.**
 - cleaning up of debris on highways and in Council housing / other council properties,
 - provision of accommodation for Council residents made homeless by the event,
 - assisting residents in removal of damaged goods where appropriate. GYBC would not do this in insured property as the insurance loss adjuster would direct on this matter, including the appointment of contractors; and
 - ensuring continuing education of pupils if schools are affected.

In order for emergency response to be effective, the key locations during a flood emergency such as Police / Fire / Ambulance stations, control centres, telecommunications installations, and rest, reception and media centres should be located in low risk areas. As PPS 25 states, these facilities are considered highly vulnerable to flood risk, as they are required to be operational during flooding. At present sirens are used in part of the County to augment other methods to advise people to leave their homes and make their way to a safe location including rest centres.

The Civil Contingencies Act 2004 also places a legal duty on category one responders (which includes Local Authorities) to produce a community risk register. Community risk registers (<http://www.norfolkprepared.gov.uk/norfolkprepared/DispalyArticle.asp?ID=5413>) are a compilation of risk assessments for hazards, including flood risk. GYBC is part of the Norfolk resilience forum area which prepares its own community risk register.

The outputs of the SFRA will support GYBC in the maintenance of the Community Risk Register and provide data of a higher resolution than shown on Environment Agency mapping so that the magnitude of risks can be evaluated with greater precision in GYBC. This will help to facilitate joined-up local planning, based on consistent planning assumptions and provide data that can be used to prepare strategic responses to reduce the consequences of flood emergencies and hence reduce the risks to all.

The Great Yarmouth SFRA provides detailed information on the spatial distribution of flood hazard. Figures in Volume 3 of this report show the predicted flood level expected in tidal events which cause overtopping of existing defences and the predicted depths expected in a number of breach scenarios. Additionally there are figures showing the predicted flood hazard (see **Volume 2: Chapter 4**) in overtopping and breach scenarios. Animations showing the flood mechanisms in Great Yarmouth are also available with this SFRA which indicate the progression of a flood event indicating the time taken for inundation of certain areas and key infrastructure routes.

The information in the SFRA if made available to those attending flood emergencies would potentially reduce the magnitude of the risks that personnel might be exposed to. Importantly it enables those attending flood emergencies to prepare in advance and reduce the chance of unforeseen exposure to high hazard magnitudes during a flood emergency.

This information should be used to feed upwards to strategic planning (the Great Yarmouth Flood Plan), and down to individual site development control decisions. Inappropriate development in flood risk areas can pose a significant risk to life, especially to the young, elderly and infirm. Flood risk maps are provided in Volume 3 of this SFRA. It is essential that those new developments which for wider reasons must be located within flood risk areas are safe, and that new developments are designed and constructed such that the health, safety and welfare of people is appropriately managed. This is of particular reference to developments which proceed following the application of the Exception Test.

It is a recommendation of this SFRA, that the Emergency Planning team at GYBC are given notification of significant developments approved or planned to take place in the borough so that they can be assessed and additional emergency planning preparations or alterations to existing borough plans be made as necessary. The Emergency Planning Officer will identify whether the risk presented in the SFRA is so significant (because of planned development) that additional steps need to be taken to identify alternative evacuation centres or additional emergency stores.

Consideration of health and safety issues should also be a fundamental issue during the design and construction of new developments. The outputs of this SFRA will support GYBC in understanding the level of flood risk management requirements at each proposed development. As noted the safety levels considered should be proportionate to the vulnerability of the community affected by the flood risk.

The information relating to the spatial distribution of flood hazard presented in this SFRA should also inform the Great Yarmouth Area Flood Plan and any future revisions of this plan. Emergency flood management plans such as this should minimise risks to life and property, through, for example, ensuring that evacuation procedures are adequate to the kinds of risks that a major flooding event

may create. Developers and consultants preparing site specific emergency plans for new developments should consult with the GYBC Emergency Planning team during the preparation of such plans.

The information on flood risk presented in this SFRA can be used to inform and support decisions and actions in nearly all the phases of a flood event. Most importantly it can be used “pre-event” to examine the consequences of a flood emergency incident and identify the necessary responses and also any strategic measures that could be taken so that the risks taken during emergency responses are reduced. Hazard information is particularly useful in this regard since it can:

- Be used strategically to reduce the magnitude of consequences by identifying high hazard areas and implementing pre-event management strategies to reduce the level of hazard or to match the hazard with the capacity to respond to emergencies. The outputs of this SFRA may be used to inform strategic emergency planning in GYBC (for example, in locating emergency centres);
- Be integrated with information on the vulnerability of development or the community so that levels of safety can be defined; and
- Be used to review the overall capacity required to respond to tactical situations during a flood emergency.

The animations of flood event scenarios which have been provided with this SFRA show the predicted mechanisms of flooding for some key scenarios. The animations can be used for example to identify how long it takes for flooding to reach certain locations or to see the predicted depth of flooding on key roads through the town. The animations could even be used by the emergency planners in Great Yarmouth and other emergency responders to drive a ‘practice run’ emergency response exercise.

5. HOW TO USE THE SFRA IN DEVELOPMENT CONTROL

SFRAs set the context within which any planning application should be considered, by establishing:

- the category of Flood Zone within which the proposed site sits;
- the flood risk constraints in accordance with guidance in PPS25; and,
- the basis of the policies of GYBC regarding proposed development in each Flood Zone.

The SFRA should be used to provide high level flood risk information for decisions on land use planning. This can be done on an “as required” basis, matching the needs of phased submission of applications.

It is the responsibility of developers to carefully consider the flood risks at a site as early as possible. Developers should be referred to the SFRA at the start of any pre-application consultation with GYBC.

A developer is not required to apply the Sequential Test if a proposed development is located on a site which has been allocated for that type of development in a LDD that applied the Sequential Test during the allocation process and was supported by a SFRA. However, the developer should still apply the sequential approach to any flood risk within the site itself and demonstrate compliance with PPS25 when determining the location of appropriate land uses within the site. The aim of the sequential approach is to minimise flood risk by considering the probability of flooding in conjunction with the vulnerability of receptors.

Where developers promote development outside of the allocated areas identified in the LDDs they are responsible for:

- demonstrating compliance with PPS25 notably obtaining confirmation from GYBC that the proposed application site passes the Sequential Test. This might require the developer to collect and submit information to GYBC as evidence to be used in performing the Sequential Test and if appropriate the Exception Test;
- providing an assessment of the impact of flooding on the development and of the development on flood risk elsewhere; and
- satisfying the LPA that flood risk to the development and the impact of the development on flood risk elsewhere will be appropriately managed and where possible reduced.

In areas where flood risk has been identified as an issue, developers should liaise with GYBC to agree on who should be consulted in the pre-planning stage. The scope of any site specific FRA should be agreed with GYBC, and will be informed by the outputs from this SFRA and consultation with the Environment Agency.

The level of information in FRAs should be proportionate to the degree of flood risk and the scale, nature and location of the proposed development. The SFRA provides information on flood hazards which should be considered in the production of site-specific FRAs. The SFRA allows the LPA to identify the level of detail required in site specific FRAs and to advise developers accordingly.

The information within the SFRA should also be used to inform the development of planning constraints within development areas designated in the LDDs and where relevant, in the case of windfall planning applications.

The overview Figures in Appendix D of this volume should be used at the start of the development control process. This will enable the Development Control team at GYBC to quickly identify the likely level of information on flood risk and flood risk management required from a developer. The Figures included in Appendix D of this volume are as follows:

- Figure ST1: Environment Agency Flood Zones
- Figure ST2: Sequential Test – Essential Infrastructure
- Figure ST3: Sequential Test – Highly Vulnerable Land Uses

- Figure ST3: Sequential Test – More Vulnerable Land Uses
- Figure ST3: Sequential Test – Less Vulnerable Land Uses
- Figure ST3: Sequential Test – Water Compatible Land Uses

The Development Control team should then refer to the more detailed maps in Volume 3 as appropriate. Users of this SFRA and the Flood Maps in Volume 3 should be aware of the recommended limitations of use of the maps discussed in **Volume 2: Chapter 6** of the SFRA.

Guidance for site-specific flood risk assessments

Although this SFRA has been undertaken for the GYBC area, it does not negate the need for site specific Flood Risk Assessments (FRA) to be undertaken at the planning application stage. Instead, this SFRA provides advice on the scope of the additional information required within a site specific FRA. The SFRA model was not developed by GYBC for use by developers or the Environment Agency in site specific assessments and should not be used for this purpose.

Planning Policy Statement 25

The FRA will be required to demonstrate that flood risk to the development can be managed now and in the future, and that the development will not increase the risk of flooding elsewhere and that the proposals are compliant with the SFRA. The requirement for site-specific FRAs is detailed in PPS25. Planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 require a FRA.

The principles and key requirements of a FRA are provided in PPS25 Appendix E. The scope of a FRA should include:

- a description of the development and the planning context:
 - what is the development proposed and where will it be located?
 - what is the proposed developments Vulnerability Classification (see Table D.2 of PPS25)?
 - Is the proposed site consistent with Local Planning Policy, and has the Sequential Test or Exception Test been applied in the selection of the proposed site for the development type proposed?
- definition of flood hazard:
 - what sources of flooding could affect the proposed development site?
 - for each source, describe the pathway and receptor of the flooding. Refer to historic records where available.
 - What are the existing surface water drainage arrangements for the proposed development site?
- probability of flooding:
 - which flood zone is the proposed development site within?
 - what does the GYBC SFRA show of relevance to the proposed development site?
 - what is the extent of flooding, including depth and velocities, on the proposed development site?
 - what are the existing rates and volumes of run-off generated by the proposed development?
- impacts of climate change on flood risk:
 - how is the flood risk at the proposed development site likely to be affected by climate change?
- detailed description of development proposals:
 - details of the development layout, referring to relevant drawings:
 - where appropriate, demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding.

- flood risk management measures including the application of Sustainable Urban Drainage Systems (SUDS):
 - how will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime?
 - how will the developer maintain flood defence walls? The riparian owner is required to survey, renew and maintain the flood defences.
- impacts of the development off site:
 - how will the proposed development ensure it does not increase flood risk elsewhere, both in terms of flood protection measures on site and run-off from the completed development?
- an assessment of residual risk:
 - what forms of flood risk management are proposed for the site, for example, flood warning and evacuation?
 - what flood related risks will remain after implementing flood risk management measures?
 - A breach analysis may be required for developments close to a watercourse. The parameters of the breach analysis should be agreed with the Environment Agency.
 - how, and by whom, will these risks be managed over the lifetime of the development?

Planning Policy Practice Guide (CLG, 2008)

PPS 25 Practice Guide introduces a Flood Risk Management Hierarchy that allows developers, local planning officers, development control officers and other parties to follow a logical progression in their approach to Flood Risk on a proposed site. PPS 25 Practice Guide has a 5 step hierarchy guide that:

1. Assess: Appropriate flood risk assessment
2. Avoid: Apply the Sequential approach
3. Substitute: Apply the Sequential Test at every level,
4. Control: SUDS, design and flood defenses, and,
5. Mitigate: e.g. Flood resilient structures.

Following the above hierarchy should allow uses of the PPS25 Practice Guide to determine if a site is suitable for development or not.

A Guide for Developers

The Environment Agency Guide for Developers (November 2006) provides a tool for developers to refer to during each development stage. The guide gives advice on how a development can be designed and implemented to provide benefits for people and the environment

At the Pre-Planning Application stage, the Environment Agency encourages developers to make enquiries on the Agency website that allows for a considered response. This stage of enquiries allows issues to be addressed such as; a lack of information in the application, if there is any more information available to help the application, and whether the application is likely to be refused. Pre-Planning Application Enquiries save the developer time and money, and make sure the development is better for the environment (Section 1.4, Developers Guide, November 2006).

In addition to PPS 25, the Guide for Developers provides advice on "Managing the risk of flooding" by ensuring the site land use and layout is appropriate to risk of flooding. This section of the guide also reiterates the government regulations set out by PPS 25 by stating the need for developers to "avoid causing flooding elsewhere".

The Guide for Developers details the permissions needed for any Flood Risk Management measures proposed. Any development under the following conditions will require permission under the Land

Drainage Act 1991 and the Water Resources Act 1991, and the Environment Agency must also be contacted as local byelaws which also apply will vary:

- Development in, over, under or within the byelaw margin of main rivers, or likely to affect the integrity of tidal defences.
- The raising of ground levels in the floodplain beside a main river.
- Construction or alteration of a culvert or structure to control the flow of the river (such as a weir) on any ordinary watercourse.

Great Yarmouth Urban Regeneration Company Area Action Plan

1st East's Preferred Options Draft (June 2006) recognises that the majority of the Action Areas set out by the plan are within the Environment Agency's Indicative Floodplain where the risk of flooding is greater than 1% AEP and states the flooding:

"When development is proposed within high risk areas in the floodplain, developers will have to produce a flood risk assessment to demonstrate that the development is and will remain safe throughout its lifetime and does not increase flood risk elsewhere. Suitable flood protection measures will need to be carried out as part of the development. Flood defences for most new housing, commercial and industrial development should be designed and constructed to protect against the flood with an annual probability of 1% for river flooding and 0.5% for coastal flooding for a period of 50years¹, taking into account the allowances for climate change. Flood-resistant construction may be required in all areas, depending on the results of that assessment."

The AAP indicates developers are also expected to assist with a range of measures required to deliver the regeneration of Great Yarmouth which include Flood Risk Management measures.

Once a planning application, together with an appropriate FRA, is submitted by the developer, it should be assessed to ensure that the applicant has considered flood risk from all sources and demonstrated how flood risk will be managed taking climate change into account.

A critical component of site specific FRAs for new developments is a consideration of the safety of the development and users of the developers. An assessment of the safety of a proposed development must include consideration of the access/egress arrangements from the development in the event of a flood. The safety of people during a flood event depends on the depth and velocity of the floodwaters and guidance on the relative danger of different depth/velocity combinations is provided in the Defra/EA Report FD2320/TR2 "Flood Risk Assessment Guidance for New Development." Due to the nature and widespread predicted extent of the flooding in Great Yarmouth access/egress arrangements present a significant challenge. The Environment Agency, Great Yarmouth Borough Council and the Government Office for the East of England are continuing discussions around the issue of safe access/egress in Great Yarmouth and the outcomes of these discussions will be incorporated into future revisions of this SFRA.

Consultation with the Environment Agency

Due to the large number and variety of planning applications received by GYBC, and the need to consult with the Environment Agency on many of these applications, it can be difficult to identify when, and how, GYBC should consult with the Environment Agency on receipt of a planning application.

The Environment Agency provide Standing Advice to local authorities related to development and flood risk (based on the policies in PPS 25) which can be used to establish the level of risk associated with the development and to deal with low risk applications without needing direct consultation with the EA. This Standing Advice was updated in February 2009 and can be found on the Environment Agency website: <http://www.environment-agency.gov.uk/research/planning/33098.aspx> The Standing Advice allows LPAs to identify those higher risk development situations where consultation with the Environment Agency is essential.

¹ Development Lifetime for commercial buildings is 60 years and 100 years for residential.

The EA Standing Advice also has a section for planning applicants and agents which includes a matrix that provides specific guidance for developments based on the size/extent of the application and which flood zone the site is located in. The GYBC SFRA can support this process, by identifying the location of the development site within a particular flood zone and the likely vulnerability of the site. The matrix (<http://www.environment-agency.gov.uk/research/planning/93498.aspx>) should be used at the earliest stage of the planning application process to determine whether a flood risk assessment is necessary. The Standing Advice also includes guidance on other EA consents which may be required.

Sustainable Urban Drainage Systems

As recognised within PPS25 and the accompanying guidance, SUDS are a useful tool in the management of flood risk and water quality and as all sites over 1Ha in area require a FRA which should include SuDS which should be implemented as far as possible. As a result, the use of SUDS in individual planning applications should be promoted by GYBC.

The advantages and disadvantages of different SUDS techniques should be considered for each proposed development site, further discussions on SuDS techniques are found in Volume two, Chapter six. When doing this, the Development Control team should consider the particular setting, (including consideration of the site area, the proposed development type, its environmental soundness, and its location in or out of the flood plain) and especially the ground conditions.

Based on the geology and soils of Great Yarmouth there are very few areas within the catchment with permeable soils that would be suitable to implement infiltration based SUDS techniques. Non infiltration based SUDS techniques are generally recommended for use in Great Yarmouth, this is due to the soil properties which appear to have a high clay content, thus reducing the potential for infiltration. Green (living) roofs are at the top of the sustainability hierarchy for SUDS techniques and are suitable in this area, however, for sites greater than 1Ha in size the Environment Agency wish to see other SuDS techniques to supplement the green roof. As well as flood reduction benefits, green (living) roofs also provide pollution control and landscape and wildlife benefits. Permeable surfaces and filter drains are another non- infiltration based SUDS technique that should be considered in all new development in Great Yarmouth.

It is recommended that developers should consult GYBC, the Environment Agency, and relevant service authorities and Utility Companies at the earliest stage of the development process to establish the best solution for a particular site.

Volume 2: Chapter 7, provides further information on the uses of SUDS in GYBC.

6. SFRA MAINTENANCE AND MANAGEMENT

Introduction

This chapter provides an introduction to the maintenance and management procedures that are required to ensure the Great Yarmouth and Gorleston SFRA remains up-to-date and continues to make use of the best available information. Implementing a maintenance and management procedure for the SFRA will assist GYBC to regularly review the technical data available and to commission technical updates where necessary.

Throughout this chapter, several key actions are recommended for GYBC in the implementation of a maintenance and management structure for the SFRA. These actions are highlighted in **blue bold text**.

Data Collection

The datasets used in the Great Yarmouth and Gorleston SFRA were supplied by:

- **The Environment Agency**
- **Great Yarmouth Borough Council**
- **Anglian Water**
- **Great Yarmouth Port Authority**
- **BESL**

Table 6-1 details the key data sets received from various organisations in order to develop the Great Yarmouth and Gorleston SFRA. The SFRA is a living document and as such **the contents of this table should be updated when the SFRA is revised and new data is incorporated. A record should be kept so that it is possible to attribute the data used to inform flood risk at any moment in time throughout the plan period.**

Table 1 Data Register Table 1 Data Register

| Data | Description | Date Provided | Source |
|-------------------------------|---|----------------------|---------------|
| LiDAR data (2000) | Topographic Data for study area. Further information provided in 2008 is no different to the 2000 LiDAR provided in 2005. | July 2005 | EA |
| Beach Profile Data | Recorded beach profiles | April 2008 | EA |
| Study on Extreme Tidal Levels | Environment Agency Anglian Region, Eastern and Central Areas. Report on Extreme Tide Levels. Royal Haskoning, February 2007 | March 2008 | EA |
| Inner Harbour survey | Bathymetry. Surveyed bed information from the Inner Harbour | October 2005 | PA |

| Data | Description | Date Provided | Source |
|--|--|----------------|-------------|
| Broadland ISIS model | Model of the broadland area including GY and surrounding watercourses, Bure, Yare and Waveney. | July 2005 | EA/BESL |
| 2000 Surveyed embankment levels. | Survey of flood banks in the Broadlands area | October 2005 | EA/BESL |
| 2004 Surveyed embankment levels | Survey of floodbanks in the Broadland area | October 2005 | EA/BESL |
| EA NFCDD download | Details of flood defences | April 2008 | EA |
| Flood defence info | Walkover of flood defences with EA. | 2005 | EA |
| Inner Harbour bank info | Visual survey (by boat), discussion with PA. | 2005 | PA |
| S105 Hydrology | Inflows for Bure, Yare and Waveney | December 2006 | EA/JBA |
| Tide Data | Tidal Harmonics Study | September 2005 | PA |
| Wave Information | HR Wallingford study for the Outer Harbour | July 2005 | PA |
| Shoreline Management Plan | Final Report | August 2006 | ACAG |
| Great Yarmouth Flood Defence Strategy Review | By Posford Haskoning | July 2005 | GYBC |
| OS mapping | 1: 10,000 of whole area | July 2005 | EA |
| Great Yarmouth Borough Plan | | Feb 2001 | GYBC |
| Address point data | As GIS layer | July 2005 | EA |
| Main River Line | Main River Line and Tidal Limits as GIS layer | July 2005 | EA |
| OS mapping | Landline (1:1250) mapping of the area | July 2005 | GYBC |
| Flood gate and Penstock locations | Descriptions of gate locations and operation | April 2008 | EA and GYBC |
| IDB Plans | Drainage network plans and pump locations | December 2005 | IDB |

| Data | Description | Date Provided | Source |
|---------------------|---|---------------|------------|
| Norwich Flood Study | Includes FEH hydrology. January 2002 Report by JBA. | 2005 | EA |
| Flood History | Records of observed flood events (surface water and tidal/fluvial flooding). Includes post code data from Anglian Water and newspaper clippings | 2008 | EA/GYBC/AW |

It is recommended that during future iterations of the SFRA, the above organisations are contacted to ensure that the most up-to-date records are included in the SFRA.

Data Processing

The following data processing was undertaken during the development of the SFRA:

- Flood extent datasets are shown beyond the extent of Great Yarmouth and Gorleston but this assessment is focussed on the Borough and should not be used for assessment beyond this boundary.
- Topographic datasets (LiDAR) were processed to produce specific Digital Terrain Models (DTMs). The LiDAR dataset was supplied as a series of tiles of various resolutions. 0.5m LiDAR was used wherever possible. Where this was not available 1m and 2m resolution LiDAR was used instead.
- Historic records of flooding were assessed to determine source of flooding and GIS layers were compiled.
- The SFRA datasets were produced through the methods described in Volume 2 of the SFRA.
- Maps and figures were produced using map templates designed for the SFRA report.

Data Ownership

The datasets obtained for use in the SFRA have come from a number of sources under licence agreement. These datasets can not be passed to external sources without permission from the owner and that those requiring the data ensure that they possess the appropriate copyrights and access. **The GYBC should be aware of the IPR they possess so that they only issue data that is contractually appropriate. Datasets produced during the SFRA are owned by Great Yarmouth Borough Council and can be passed to external parties at their discretion.** The key datasets are summarised in **Table 2**.

Table 2 Key Datasets

| List of Key Data Sets | Ownership | Licence Required | Contact |
|---|--------------------|------------------|---|
| Floodplain topography – LiDAR, and topographic survey | Environment Agency | Yes | Environment Agency -Twerton |
| Flood Warning Areas | Environment Agency | Yes | Flood Mapping & Data Environment Agency |

| | | | |
|----------------------------------|--------------------------------|--------------|--|
| Historic flood information | Environment Agency | Yes | Flood Mapping & Data Environment Agency |
| Tidal Data | Environment Agency | Yes | Environment Agency |
| Fluvial Data | Environment Agency | Yes | Flood Mapping and Data, Environment Agency, JBA |
| Broadland ISIS Model | Environment Agency | Yes | Flood Mapping & Data Environment Agency and BESEL |
| Existing Defences and Structures | Environment Agency | Yes | System Asset Management, Environment Agency and BESL |
| Broadland Rivers CFMP | Environment Agency | Yes | Flood Mapping and Data, Environment Agency |
| OS Mapping | Ordnance Survey | Yes | GYBC |
| SFRA reports and Maps | Great Yarmouth Borough Council | No | GYBC |
| Great Yarmouth Flood Plans | Great Yarmouth Borough Council | No | GYBC |
| IDB Plans | IDB | Confidential | IDB |
| Solid and Drift Geology Maps | Environment Agency | Yes | Flood Mapping & Data Environment Agency |
| Soil Maps | Environment Agency | Yes | Flood Mapping & Data Environment Agency |
| Sewer Plans | Anglian Water | Yes | Anglian Water |

It is recommended that information on all sources of flooding continues to be collected and that where appropriate more resources are invested in determining the source and pathways of flooding.

When more detailed or updated hydraulic modelling becomes available from the EA or other sources this information should be incorporated into the SFRA.

More detailed information may also be collected for FRAs carried out by developers and land owners at the local site scale. Information from site level FRAs will be submitted to the councils and the Environment Agency as part of the development control process and this information should be used to inform the SFRA in the future.

SFRA data management system

The data management strategy developed for the SFRA is designed to account for likelihood that external parties will seek to make use of the information within the SFRA in preparing flood risk assessments and assessing sites. The SFRA is also a “live” document, and as such it is necessary to ensure at regular intervals in the future that the information within it remains valid.

The final deliverables of the SFRA are delivered in two forms:

- Hardcopies of the SFRA reports – the SFRA contents are divided into several volumes and chapters to allow easier update during future iterations.
- Electronic datasets including:
 - Raw GIS data - SFRA flood outlines and additional GIS data layers used to produce the SFRA maps and figures. Some of these were obtained under licence from the Environment Agency. All data is provided in a format compatible with Great Yarmouth Borough Councils existing corporate GIS infrastructure.
 - Electronic document management system - PDF versions of all maps and reports produced during the SFRA

To ensure that the SFRA remains 'live' it is important to nominate a Management Group with responsibility for monitoring, managing and maintaining the SFRA, as shown in Figure 6A. It is recommended that the monitoring of the SFRA is linked to the Borough's LDF Annual Monitoring report.

By following this process of information dissemination and review, the management team can ensure a consistent and up to date supply of strategic flood risk information to all levels of planning process.

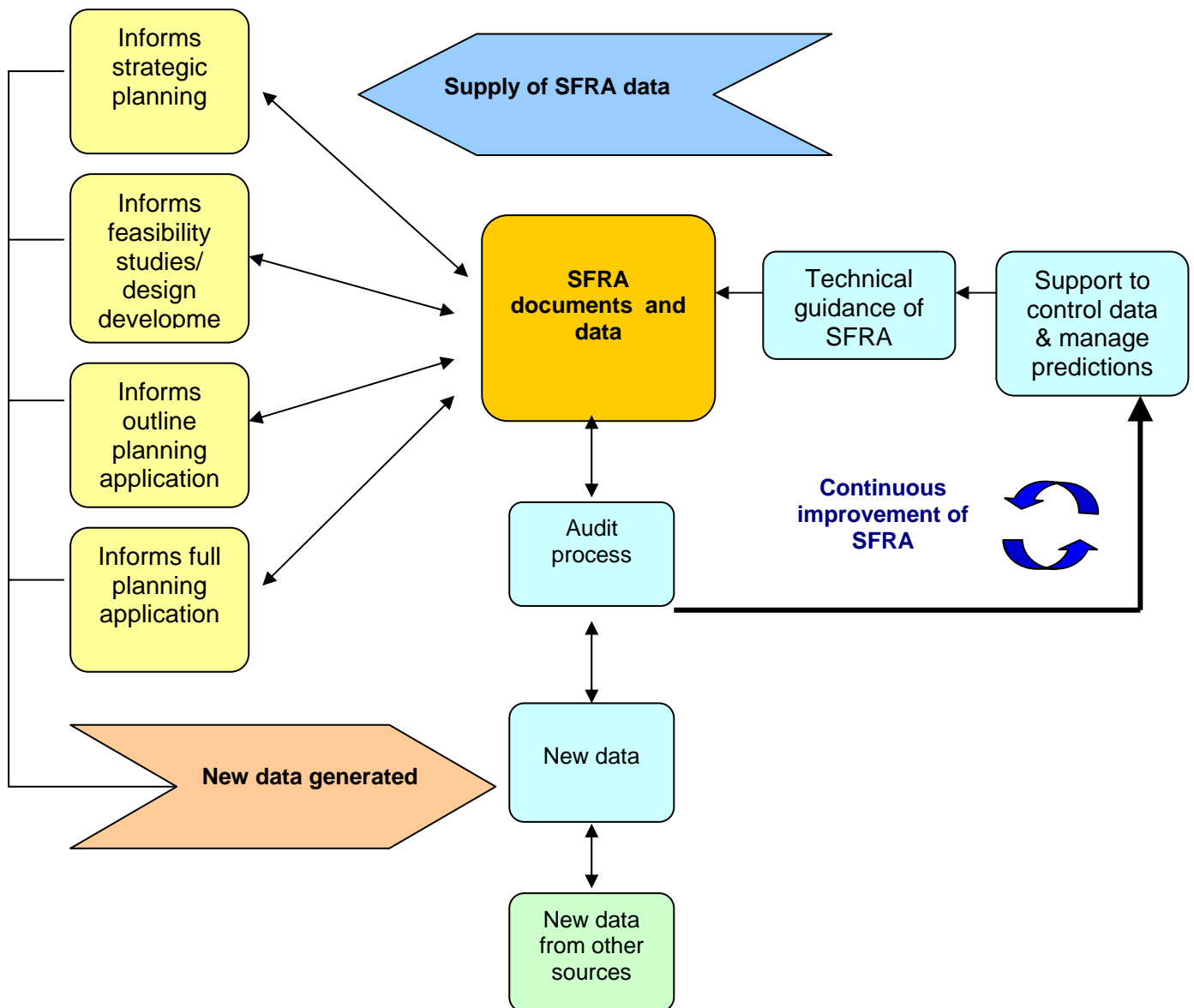


Figure 6A Conceptual SFRA management process

Monitoring the SFRA

It is in the interest of Great Yarmouth Borough Council that the SFRA remains current and up-to-date. **To help facilitate this, it would be useful for the Great Yarmouth Borough Council to liaise with Anglian Region of the Environment Agency to discuss the need for an update and if necessary organise an annual meeting to review the SFRA. Prior to this meeting it is recommended that the following maintenance checks be undertaken:**

- **Review the currency of datasets used in the SFRA.**
- **Consider whether a formal review of the SFRA is necessary.**

Whilst all datasets should be checked for updates and key organisations contacted, **Table 3** contains a list of datasets that are likely to be updated regularly.

Table 3 Datasets that are known to be updated regularly

| Dataset | Owner | Comment |
|---|---|---|
| Flood Zones | Environment Agency | Updated quarterly |
| Catchment Flood Management Plans | Environment Agency | Updated every five years |
| National Flood and Coastal Defence Database (NFCDD) | Environment Agency | Ongoing updates |
| System Asset Management Plans | Environment Agency | Unknown |
| Historic flood incidents | Environment Agency, Water companies, Fire Brigade, Highways Depots | Data is updated on the Norfolk Resilience Forum Community Risk Register |

The UK Climate Change Impacts Programme is expected to launch the next package of climate change scenarios for the UK in 2009. The package is titled UK 21st Century Climate Scenarios and is known as UKCIP08. The scenarios will include marine projections including revised predictions for the increase in sea level as a result of climate change. Following release of these scenarios in 2009 Great Yarmouth Borough Council must review the predicted increase in sea level used in this assessment against the latest scenarios. The hydraulic modelling undertaken for this SFRA to assess the level of risk from tidal flooding events may need revisiting to take account of new projections for sea level rise.

Incorporating new datasets

The following tasks should be undertaken when including new datasets in the Great Yarmouth and Gorleston SFRA:

- Identify new dataset.
- Save new dataset/information.
- Record new information in log so that next update can review this information.

Volume 2: Chapter 6 of this SFRA discusses the limitations of the topographic data used in the SFRA model and includes recommendations for future revisions of the SFRA to incorporate revised modelling and mapping based on new and high quality topographic datasets (when available).

Updating SFRA reports and figures

Volume 2 provides a record of all of the technical analyses used to develop the Great Yarmouth and Gorleston SFRA. In recognition that the SFRA will be updated in the future, the report has been structured in chapters according to the six sources of flooding investigated. By structuring the report in this way, it is possible to undertake further analyses on a particular source of flooding and only have to supersede the relevant chapter, whilst keeping the remaining chapters unaffected.

When the UKCIP08 Climate Change report is issued the climate change tables and associated text may need to be amended to keep the SFRA up to date. Similarly when the Outer Harbour development is completed, then the relevant section shall need updating. The existing structure of the SFRA should result in the any updates being relatively simple to complete.

In keeping with this principle, the following tasks should be undertaken when updating SFRA reports and figures:

- **Undertake further analyses as required after SFRA review**
- **Document all new technical analyses by rewriting and replacing relevant Volume 2 chapter/s.**
- **Amend and replace relevant SFRA Maps in Volume 3.**
- **Review and if required, amend Chapter 1 of Volume 1.**
- **Reissue to departments within Great Yarmouth Borough Council and other stakeholders.**

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7. ASSET MANAGEMENT

Great Yarmouth is currently protected from flooding by a system of defences which are the responsibility of the Environment Agency. The Environment Agency has indicated that the Standard of Protection offered by existing defences in Great Yarmouth is 1:100 (i.e. the existing defences will protect the town for flood events with an annual probability of 1% or less).

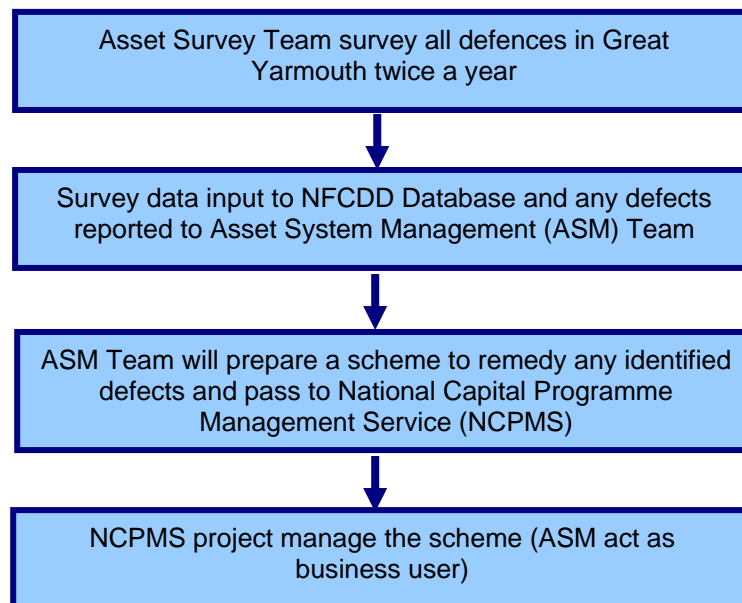
The maps in **Volume 3: Series 1** of this SFRA shows the Flood Zones in the study area indicating the potential extent of tidal and coastal flooding in Great Yarmouth *ignoring the presence of existing defences*. The maps in **Volume 3: Series 5 and 6** show the predicted extent of flooding in a 1 in 200 year return period tidal flooding event (0.5% annual probability) assuming that all defences are in place and operational during the surge event. A comparison of these figures indicates the area within Great Yarmouth that can be considered to benefit from existing defences. Without the existing defences Great Yarmouth would be expected to experience tidal flooding significantly more frequently than is currently observed.

The assessment of risk presented in this SFRA reflects a situation where all defences are assumed to be in place and fully operational. No defences can be considered 100% reliable. As highlighted in Volume 2 of this SFRA there remains a residual risk of flooding in Great Yarmouth in the event of a failure of the defences (for example caused by a breach in the defence wall as a consequence of a ship collision). The predicted flood hazard resulting from a breach event is discussed in **Volume 2: Chapter 4** of this SFRA. While the probability of such an event occurring remains low, the consequence would be significant and as such this is considered a high risk for Great Yarmouth.

It is therefore critical to the future management of flood risk in Great Yarmouth that the standard of protection offered by existing defences is monitored and maintained. The predicted impacts of global climate change are expected to lead to a rise in sea level on the east coast of England of more than 1m over the next 100 years. In order to maintain the current standard of protection improvements to the existing system of defences will therefore be required.

The existing assets and the management regime of these assets are described in **Volume 2: Chapter 3** of this SFRA. The Environment Agency is responsible for the flood defences within Great Yarmouth and riparian landowners (including the Ports Authority) are responsible for the piling which supports the flood defences. The Environment Agency maintenance regime is indicated in Figure 7A below.

Figure 7A. Environment Agency maintenance regime for defences in Great Yarmouth



Where it is identified that repairs or improvements to existing flood defences are required the EA provide the capital for the maintenance of the defences and require the riparian landowners to ensure the structural integrity of the piling prior to any defence works taking place above the piling.

There is currently no management group responsible for the defences in Great Yarmouth and communication between the Environment Agency, the Port Company and other riparian landowners takes place on an ad-hoc / as necessary basis. The EA hold ownership details of all the frontages throughout Great Yarmouth so are able to contact owners as necessary.

The Environment Agency does not have powers to enforce a riparian owner to repair or replace piling. Enforcement powers under the 1991 Water Resources Act do allow the Environment Agency to remove any piling which has failed and is obstructing the flow. This power covers the removal but not the replacement of piling.

In January 2005 Defra approved a strategy for the future management of flood defences in Great Yarmouth. The aim of this strategy is to provide a standard of defence equivalent to 1 in 300 years (0.33% risk in any year) for the year 2050, taking into account the potential impacts of climate change. The approval from Defra is conditional upon getting contributions from frontage owners in proportion to the benefits they receive.

The first major stage in the implementation of this strategy is concerned with the right bank of the River Yare between Breydon Bridge and Malthouse Quay. This is the length of defences which protects Cobholm and Southtown from flooding. This area was identified as a top priority because it has the highest number of properties within the floodplain. A Project Appraisal Report is currently being prepared and is expected to be complete and presented to the National Review Group in late 2009.

It may be accepted that to meet the regeneration needs and aims for Great Yarmouth development is required to take place behind existing defences, subject to the application of the Sequential Test and Exception Test (see Chapter 3). Arrangements must therefore be in place prior to the approval of any development applications in defended areas to ensure the continued protection in the face of climate change. It is anticipated that developers will be required to contribute financially to the maintenance and, if necessary, upgrade of defences on which they depend. Great Yarmouth Borough Council and the Environment Agency must therefore agree a mechanism through which this can take place and be managed.

A SFRA Management group is proposed in Chapter 6 of this SFRA to take responsibility for the management and maintenance of this SFRA in the future. It is recommended that a sub-group is formed within this group with a responsibility for defence management. Such a group would be formed of representatives of the Environment Agency Asset System Management team, of Great Yarmouth Borough Council, of Great Yarmouth Port Company and of other riparian landowners. The two primary purposes of this group would be to:

1. administer the mechanism for managing developer contributions to flood risk management in relation to new development behind existing flood defences; and
2. disseminate information in relation to the implementation of the 2005 Defra strategy.

8. OTHER POSSIBLE USERS OF THE SFRA

Through discussion with the Great Yarmouth and Gorleston SFRA project team a number of additional potential users of the SFRA have been identified (above and beyond those discussed in detail throughout this report). These potential users include (but are not limited to);

- Transport and highways team including strategic transport planners – the SFRA can be used to identify flood risk to essential infrastructure, both proposed and existing;
- Education Building Development and Education and Childrens teams – the SFRA should be used to ensure flood risk is considered in the allocation of land for new schools and also used to inform emergency plans that make use of school buildings;
- Asset management teams – the SFRA has identified key assets and features which are critical to flood risk management in Great Yarmouth and Gorleston. The teams should be aware of these assets and have plans in place for the management and maintenance of them; and
- Strategy and performance teams – at a broad scale, strategic level key teams must be aware of flood risk issues in Great Yarmouth and Gorleston identified in the SFRA and of the strategies in place for managing and reducing flood risk through land use / strategic planning, development and building control and emergency planning.
- The SFRA can be used to inform future updates of the Norfolk Resilience Forum (NRF) Multi Agency Flood Plan for the Borough of Great Yarmouth. Information within this SFRA on the spatial distribution of flood risk throughout the area should also be used by the [Police (and other Developers of critical infrastructure) when locating new sites or developments.
- 1st East – the urban regeneration company with responsibility for transforming brownfield and waterfront areas of Lowestoft and Great Yarmouth. The outputs of this SFRA should be used to inform the distribution of development within the six action areas in Great Yarmouth. Furthermore 1st East should make reference to the guidance for land use planning and development control in this volume of the SFRA.

In order to ensure these teams are integrated into the SFRA process, it is recommended that this report is made available for their comment, review and future input as appropriate.

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9. REFERENCES

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10. GLOSSARY AND NOTATION

| | |
|---------------------------------|---|
| 1st East | An urban regeneration company aiming to generate economic growth by co-ordinating development in the brownfield and water front areas of Great Yarmouth and Lowestoft. |
| ACAG | Anglian Coastal Authority Group |
| Actual risk | The risk that has been estimated based on a qualitative assessment of the performance capability of the existing flood defences |
| AEP | Annual exceedence of probability. The annual chance of experiencing a flood with the corresponding flood magnitude, i.e. a 1% AEP flood is a flood with a flow magnitude that has a 1% chance of occurring in each and every year |
| AAP | Area Action Plan |
| BESL | Broadland Environmental Services Ltd – a body appointed by the Environment Agency to maintain and improve the flood defences on the Norfolk Broads. |
| Breach or failure hazard | Hazards attributed to flooding caused by a breach or failure of flood defences or other infrastructure which is acting as a flood defence. |
| CFMP | Catchment Flood Management Plan |
| CLG | Communities and Local Government. Government Department responsible for issuing Planning Policy Statement 25: Development and Flood Risk |
| Consequence | Impact that a flood event would cause if it occurred |
| DPD | Development Plan Document |
| Flood defence | Natural or man-made infrastructure designed to prevent flooding |
| Floodplain | Area of land that borders a watercourse, an estuary or the sea, over which waterflows in time of flood, or would flow but for the presence of flood defences where they exist. |
| Flood risk | <i>Flood risk is a combination of two components: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it occurred (EA 2003).</i> |
| FRA | Flood Risk Assessment |

| | |
|-----------------------------------|---|
| FRSA | Flood Risk Standing Advice – EA guide to planning authorities available at http://www.environment-agency.gov.uk/research/planning/33098.aspx |
| Flood risk management | <i>Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response (EA 2003).</i> |
| Flood Zones | This refers to the Flood Zones in accordance with Table D1 of PPS25. For the purpose of the SFRA, the definition of Flood Zones varies slightly from PPS25 in that it shows the extent of flooding ignoring the presence of flooding defences, "except where the 'actual risk' extent is greater" |
| Fluvial | Relating to a watercourse (rivers or streams) |
| Groundwater | Groundwater is the term used to describe the water stored underground in areas of permeable rocks, known as aquifers. Consistently high levels of groundwater can lead to groundwater flooding. |
| GYPA | Great Yarmouth Port Authority |
| LDD | Local Development Documents |
| LDF | Local Development Framework |
| LPA | Local Planning Authority |
| PPS25 | Planning Policy Statement Note 25: Development and Flood Risk (December 2006). |
| Precautionary principle | <i>"Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation".</i> The precautionary principle was stated in the Rio Declaration in 1992. Its application in dealing with the hazard of flooding acknowledges the uncertainty inherent in flood estimation. |
| Probability of Consequence | The probability of a flood event being met or exceeded in any one year. For example, a probability of 1 in 100 corresponds to a 1 per cent or 100:1 chance of an event occurring in any one year. |
| Residual risk | Flood risks resulting from an event more severe than for which particular flood defences have been designed to provide protection. |
| RFRA | Regional Flood Risk Appraisal |
| RPB | Regional Planning Body |
| RSS | Regional Spatial Strategy |
| SFRA | Strategic Flood Risk Assessment |

| | |
|-----------------------|--|
| SPD | Supplementary Planning Document |
| SUDs | Sustainable Urban Drainage Systems |
| Surface water | Any body of water that is not groundwater (for example rivers, estuaries, ponds etc) as well as temporary waters resulting from flooding, run-off etc. |
| Tidal | Relating to the sea. |
| UDP | Unitary Development Plan |
| Windfall Sites | Sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan |

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Appendix A: HOW THE SFRA LINKS WITH OTHER PLANS AND POLICIES

National Planning Policy for Flood Risk

- A.1 Guidance on development and flood risk is given in PPS25. This statement requires that flood risk be considered through the application of a Sequential Test. SFRAs enable LPAs, in this instance GYBC, to allocate areas for development in accordance with the Sequential Test, and as appropriate the Exception Test, as described in PPS25. Where the Sequential Test cannot be met and allocations are proposed within higher probability Flood Zones, SFRAs should be refined to provide information necessary for application of the Exception Test (PPS25).
- A.2 PPS25 outlines how flood risk should be considered at all stages of the planning development process. It gives guidance on how flood risk can be managed and reduced through the land use planning process. PPS25 acts on a precautionary basis and takes into account climate change.
- A.3 PPS25 uses the planning process to promote a risk-based approach to ensure new development is not exposed unnecessarily to flooding by considering flood risk at every stage. New developments should reduce flood risk where possible and maintain floodplains as natural areas that continue to function effectively. Therefore, floodplains should be protected from inappropriate development. The guidance also places emphasis on the adoption of the precautionary principle and the benefits that should be derived from developer contributions.
- A.4 Planning policies and decisions should consider flood risk and its management on a whole-catchment basis and not be restricted to floodplains. PPS25 states that regional and local planning bodies should prepare and implement strategies that help deliver sustainable development by:
- appraising risk;
 - managing risk; and,
 - reducing risk.
- A.5 SFRAs fall into the first category of 'Appraising risk' so that the risk can be appropriately managed or reduced.
- A.6 Flood risk can be assessed to various degrees of detail, which should be proportionate to the nature and complexity of the flood risk within the administrative boundary. To ensure that an appropriate level is included, guidance in the draft Practice Companion Guide to PPS25 (DCLG 2007) recommends two levels of detail:
- Level 1 (initial assessment) - should be carried out for all of the administrative area, as it is necessary for the LPA to understand comparatively flood hazard across its administrative area, in order to consider flooding on a risk basis.
 - Level 2 (more detailed) - where the result of the Level 1 assessment indicates that there is an issue of flood risk, then it is necessary to undertake a more detailed assessment of flood risk to collect further information on the spatial distribution of flood hazard.
- A.7 This SFRA for Great Yarmouth and Gorleston is a combination of a Level 1 and a Level 2 assessment. Level 1 assessment has been undertaken at a broad scale across the whole Borough which identifies areas of flood risk. Further detail (Level 2) has been provided for these areas identified as having a high risk of flooding.

- A.8 The role of the SFRA in the hierarchical planning structure in England is summarised in Table A.1 below. Figure A.1 illustrates how the SFRA may fit into the conceptual land use planning framework.

Table A.1 Hierarchy of flood risk appraisal

| Flood Risk Management Tool | Applicable to | Prepared by |
|---------------------------------|---------------------------------------|--------------------------|
| Regional Flood Risk Appraisal | Regional Spatial Strategy (see 2.1) | Regional Planning Body |
| Strategic Flood Risk Assessment | Local Development Framework (see 2.2) | Local Planning Authority |
| Flood Risk Assessment | Specific sites (See 2.3) | Developer/land owner |

Additional National Planning Policy Guidance / Statements

- A.9 When completing the sequential test inline with PPS25 Great Yarmouth BC should be aware of the full gamut of National PPS and Planning Policy Guidance (PPG). The following PPS and PPG documents summarised briefly here are likely to be of particular importance to GYBC when preparing their LDF:

- PPS1: Delivering Sustainable Development: sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system;
- Planning and Climate Change – Supplement to PPS1: sets out how planning, in providing for the new homes, jobs and infrastructure needed by communities, should help shape places with lower carbon emissions and resilient to the climate change now accepted as inevitable;
- PPS3: Housing: underpins the delivery of the Government's strategic housing policy objectives and the government's goal to ensure that everyone has the opportunity to live in a decent home, which they can afford in a community where they want to live;
- PPS6: Planning for Town Centres: sets out the Government's policy on planning for the future of town centres;
- PPS11: Regional Spatial Strategies: sets out the procedural policy on the nature of Regional Spatial Strategies (RSSs) and focuses on what should happen in preparing revisions to them and explains how this relates to the Act and associated regulations;
- PPS12: Local Development Frameworks: sets out the Government's policy on the preparation of local development documents which will comprise the local development framework;
- PPG2: Green Belts: outlines the history and extent of Green Belts and explains their purposes. It describes how Green Belts are designated and their land safeguarded. Green Belt land-use objectives are outlined and the presumption against inappropriate development is set out;
- PPG15: Planning and the Historic Environment: provides a full statement of Government policies for the identification and protection of historic buildings, conservation areas, and other elements of the historic environment. It explains the role played by the planning system in their protection; and,

- PPG16: Archaeology and Planning: sets out the Secretary of State's policy on archaeological remains on land, and how they should be preserved or recorded both in an urban setting and in the countryside.

Regional Spatial Strategy

The Regional Spatial Strategy (RSS) covering Great Yarmouth is the East of England Plan (May 2008). The first objective of the overall spatial vision for the East of England in this plan is to reduce the region's impact on, and exposure to, the effects of climate change and a key component of this objective is to reduce the risk of adverse impact of flooding on people, property and wildlife habitats.

The two key policies from the Plan related to Flood Risk Management and to development in Great Yarmouth are reproduced in Table A2.

Table A2. Key policies from the East of England Plan

| |
|---|
| <p>WAT 4. Flood Risk Management</p> <p>Coastal and river flooding is a significant risk in parts of the East of the England. The priorities are to defend existing properties from flooding and locate new development where there is little or no risk of flooding. Local Development Documents should:</p> <ul style="list-style-type: none"> • use Strategic Flood Risk Assessments to guide development away from floodplains, other areas at medium or high risk or likely to be at future risk from flooding, and areas where development would increase the risk of flooding elsewhere; • include policies which identify and protect flood plains and land liable to tidal or coastal flooding from development, based on the Environment Agency's flood maps and Strategic Flood Risk Assessments supplemented by historical and modelled flood risk data, Catchment Flood Management Plans and policies in Shoreline Management Plans and Flood Management Strategies, including 'managed re-alignment' where appropriate; • only propose departures from the above principles in exceptional cases where suitable land at lower risk of flooding is not available, the benefits of development outweigh the risks from flooding, and appropriate mitigation measures are incorporated; and • require that sustainable drainage systems are incorporated in all appropriate developments. <p>Areas of functional floodplain needed for strategic flood storage in the Thames Estuary should be identified and safeguarded by local authorities in their Local Development Documents.</p> |
| <p>GYL1. Great Yarmouth and Lowestoft Key Centres for Development and Change</p> <p>The strategy for Great Yarmouth and Lowestoft is to promote the comprehensive regeneration of the two towns, capitalising on their strengths and protecting and enhancing their environmental assets. Local Development Documents and other strategies should pursue this strategy by:</p> <ul style="list-style-type: none"> • Promoting radical change in the economy building on the area's established sectors and diversifying into new and emerging sectors including: <ul style="list-style-type: none"> – the renewable energy cluster, building on offshore engineering skills; – a more diverse tourism cluster, based on the resort and leisure role of the towns, the proposal for a casino at Great Yarmouth and proximity to the Broads; – environmental technologies and the wider environmental economy furthered by establishing a research and teaching centre supported by further and higher educational institutions and others; and – port and related activities strengthening links with the rest of Europe. • Encouraging an urban renaissance by identifying priority areas and projects for brownfield redevelopment to achieve economic, physical and social regeneration in inner urban areas and taking advantage of key waterfront sites. Priority will be given to regeneration projects that can assist in dealing with concentrations of deprivation. • Delivering at least 11,800 additional dwellings in line with the Policy H1 to support a healthy housing market, assist the regeneration of brownfield sites and meet local affordable housing needs. • Promoting improvements on key transport corridors into the area and between the towns, together with measures to relieve congestion, improve access to regeneration areas, and enable a significant increase in public transport, walking and cycling. |

The Plan recognises that the vulnerability to tidal flooding is one of the key challenges to development in Great Yarmouth and notes that Local Development Documents must take account of SFRAs in this area.

Regional Flood Risk Appraisals

The East of England Regional Assembly has started work on an early Review of the East of England Plan (the Regional Spatial Strategy) which will look ahead to 2031. In line with the requirements of PPS25, a Regional Flood Risk Appraisal is required to inform the preparation and sustainability appraisal of the RSS Review. The East of England Regional Assembly has recently (October 2008) appointed Capita Symonds Ltd to undertake this appraisal.

- A.10 RFRAs should make reference to and use existing assessments of flood risk including SFRAs where available. In turn the RFRA should inform the requirements of sub-regional scale SFRAs as they are produced or updated.
- A.11 The RFRA should remain a live document with regular updates to reflect the changing position in relation to both climate change and development pressure and policy responses, as will this SFRA. It is hoped that the RFRA will be useful to spatial planners, developers, infrastructure and utility operators and emergency planners.

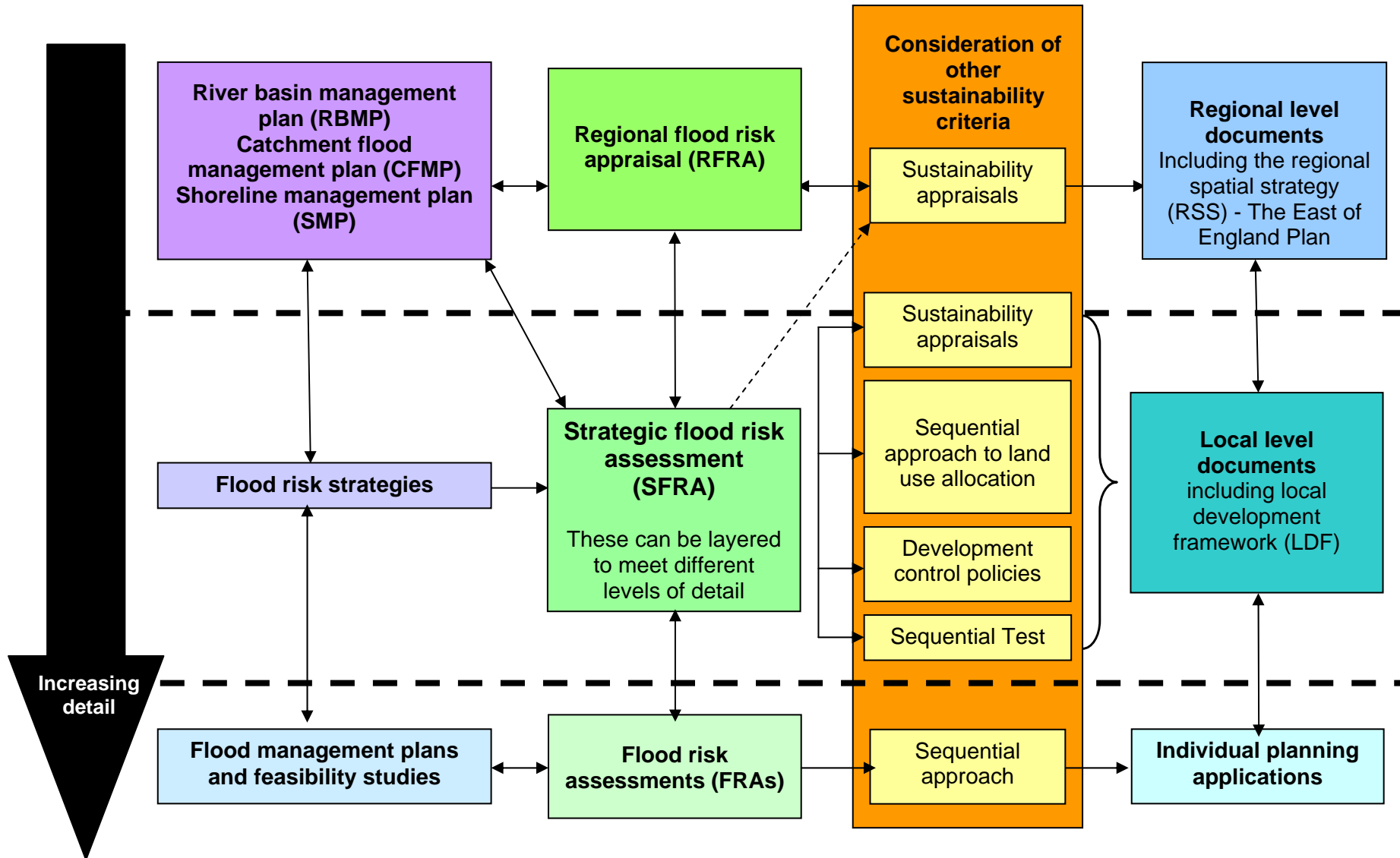


Figure A.1 How the SFRA may fit into the conceptual land use planning framework

Local Development Framework

- A.12 Local Planning Authorities (LPAs) are responsible for carrying out spatial planning and, following the introduction of the Planning and Compulsory Purchase Act 2004, preparing Local Development Frameworks (LDF) which supersede the existing planning framework documents. SFRA are undertaken to inform the spatial planning process at the local scale.
- A.13 When the Government introduced a new process of plan making in 2004, the legislation allowed councils to save adopted Unitary Development Plans (UDPs) for a period of 3 years from 28 September 2004. Great Yarmouth Borough Council sought permission from the Government to further extend the lifetime of some policies within the UDP beyond 27 September 2007 whilst they progressed the new LDF. A schedule is available which lists the policies that have been saved² and would be used to guide planning decision beyond 27 September 2007. The policies not named in the Direction will not be considered in planning decisions after that date.
- A.14 The SFRA must inform the development of the vision, policies and broad search areas during the production of the LDF, and will support the finalisation of the issues and options for spatial planning. The SFRA has been undertaken to an appropriate level of detail to help ensure that the Core Strategy is robust and is able to underpin the production of LDD and the LDF in accordance with statutory requirements. Using the SFRA will enable GYBC to apply the Sequential Test, and the Exception Test as necessary, as described in Planning Policy Statement 25 (PPS25).
- A.15 SFRA should provide the necessary information for planners to be able to take the strategic decisions that identify the amount of development that may be permitted, how the drainage of that development should function and how vulnerable areas should be protected or adapted.
- A.16 Additionally, the Planning and Compulsory Purchase Act 2004 requires for LDFs to have regard to national policies and guidance issued by the Secretary of State. The Act also requires those preparing (RSS and) LDDs to consider the needs of sustainable development. The Act requires therefore a Sustainability Appraisal of the strategies and policies in the LDDs. The material provided by the SFRA can be used to support this requirement.
- A.17 Whilst this SFRA has been developed to inform the LDF, the technical information held within the SFRA could be used to inform these other frameworks and the accompanying assessments of flood risk therein.
- A.18 When using this SFRA to inform other LDFs, consideration must be given to the level of detail and certainty of information provided, as the spatial extent and detail of the technical assessments undertaken have been tailored to be appropriate to inform a strategic scale assessment.
- A.19 It may be necessary to further refine some of the information presented in Volume 2 of this SFRA to ensure that it is sufficiently detailed and presented at a level that is appropriate to inform other LDFs.

Site Specific Development

- A.20 In addition to its primarily strategic role, the SFRA plays an important part in the identification and management of site specific flood risk. Using the outputs from the SFRA will allow GYBC to identify the level of detail required for site-specific FRAs (required by PPS25).
- A.21 PPS25 states that those proposing development are responsible for:

² http://www.great-yarmouth.gov.uk/planning/planning_policy/local_plan.htm

- demonstrating that it is consistent with the policies in PPS25 and those on flood risk in the LDF;
- providing a FRA demonstrating:
 - whether any proposed development is likely to be affected by current or future flooding from any source;
 - that the LPA are satisfied that the development is safe and where possible reduces overall flood risk;
 - whether it will increase flood risk elsewhere; and
 - the measures proposed to deal with these effects and risks. Any necessary flood risk management measures should be sufficiently funded to ensure that the site can be developed and occupied safely throughout its proposed lifetime;
- designs which reduce flood risk to the development and elsewhere, by incorporating sustainable drainage systems and where necessary, flood resilience measures; and
- identifying opportunities to reduce flood risk, enhance biodiversity and amenity, protect the historic environment and seek collective solutions to managing flood risk.

A.22 By utilising the outputs of the SFRA, GYBC Development Control Officers will be able to ensure flood risk is considered as early as possible in preparing development proposals.

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Appendix B: How FLOOD RISK IS ASSESSED

Introduction

B.1 This appendix defines flood risk and its sources. It then goes on to consider the four stage approach to the assessment of flood risk that has been undertaken in line with PPS25. It then considers the impact of climate change on flood risk, before going on to consider uncertainty. It concludes with a brief discussion of currency of information.

Defining flood risk

B.2 The Environment Agency's 'Strategy for Flood Risk Management 2003 - 2008' (Environment Agency 2003), describes flood risk as a combination of two components, the:

- **"chance (or probability) of a particular flood event; and,**
- **impact (or consequence) that the event would cause if it occurred."**

B.3 By considering both the definition of risk and the "source-pathway-receptor" model, it is beneficial to assess risk in terms of the components shown in Figure B.1.

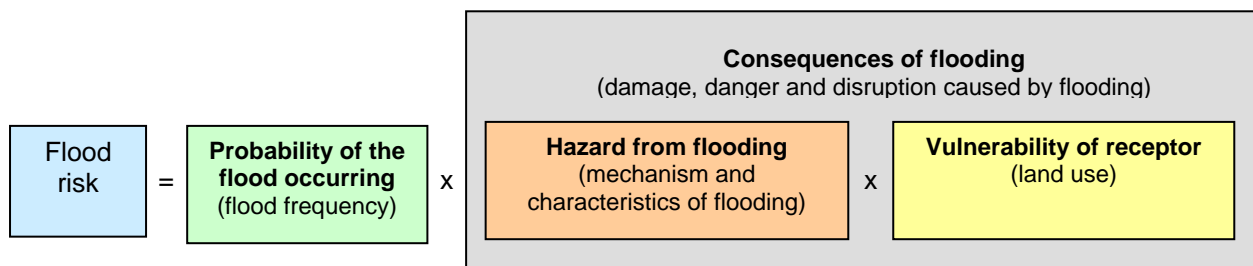


Figure B.1 Risk equation

B.4 The probability of flooding can be defined using data and statistical analysis. The hazard from flooding can be evaluated by considering the depth of floodwater, the velocity of flow, the speed of onset of flooding and the rate of rise of floodwater. The vulnerability of flooding can be assessed through analysis of the land use, property or people that would be affected by flooding.

B.5 It can be seen from the risk equation Figure B.1 above that by reducing the hazard or vulnerability of flooding, it is possible to reduce the risk. It follows that, development proposals within GYBC area should be developed and assessed using a risk-based search sequence avoiding risk where possible and managing it elsewhere.

B.6 There is inherent uncertainty in estimation of flood probability due to the need to simplify variability in rainfall, storm types, soil types, land cover and antecedent conditions into one design event. By separating flood risk into its three components, it is possible to gauge risk even if the exact probability of an event is uncertain. In this way a precautionary principle can be applied, as flood risk will be higher for floods with significant hazards and consequences, even when the probability of occurrence is uncertain.

B.7 This information can then be used to inform the Sequential Test. By including consideration of climate change the procedure is precautionary, in accordance with PPS25.

B.8 The SFRA provides high level information for decisions on land use planning within the GYBC area. The strategic approach defined in this document will require that information supporting all planning applications in the study area make reference to the SFRA and clearly demonstrate adoption of a risk-based sequential approach.

Sources of flood risk

- B.9 Flooding can come from rivers, the sea, directly from rainfall, groundwater, highway and sewer drainage systems, and from artificial sources such as canals. The impact of flooding will depend upon its source and the land-use. Further information on flooding from the six sources is contained within Annex C PPS25 and the PPS25 Practice Companion Guide.
- B.10 The Autumn 2000 Flood Report produced by the Environment Agency reported that 42 per cent of flooding reported nationally arose from sources other than river flooding (Environment Agency 2000).
- B.11 The Flood Zones based on the Environment Agency Flood Map account only for river flooding and flooding from the sea.
- B.12 In accordance with PPS25 the SFRA has refined the information on the Environment Agency Flood Map to account for other forms of flooding as well. Information on groundwater, surface water, sewers and artificial sources has been collated. This information should be used when preparing appropriate policies for flood risk management and land use allocation.

Types of flood risk

- B.13 The SFRA provides a range of information so that the hazard of flooding, not just the probability of flooding, can be examined. In keeping with PPS25, there are four types of flood risk to be considered.

1. Flood Zones

- B.14 As defined in Table D1 of PPS25, Flood Zones show areas at risk of river and sea flooding, ignoring the presence of flood defences. It is important to recognise that because the Flood Zones ignore the presence of flood defences, they do not describe an actual level of flood risk. Thus, large areas of development behind flood defences can be shown as at risk.
- B.15 PPS25 also defines the functional floodplain as the area where water has to flow or be stored at times of flood, and that SFRAs should identify this by the land liable to flood during a flood with a 5 per cent annual exceedance probability (AEP). The Practice Companion Guide to PPS25 clarifies that this should be with flood defences in place. In consultation with the environment Agency it has been determined that there are no areas within Tower Hamlets where "water has to flow or be stored" at times of flood and therefore no land that meets the PPS 25 definition of functional floodplain (Volume 2, Chapter 4).
- B.16 PPS25 requires that all sources of flooding be examined. Flood Zones are a good starting point for this assessment as they show areas at risk of flooding from rivers and the sea, which cause the most damage across England and Wales. However other sources and types of flooding must be examined, even if a proposed development lies within a low probability Flood Zone. Thus the actual and residual risks must be examined as well.

2. Actual risk

- B.17 Actual risk provides information on flooding, when the impact of existing flood defences is considered (assuming that they operate as they are supposed to). The actual risk of river flooding is usually assessed using the 1% AEP flood event. As the hazards associated with tidal flooding are typically greater than for river flooding, the actual risk of tidal flooding is usually assessed using the less probable 0.5% AEP flood event.
- B.18 Actual risk of flooding from other sources (land, groundwater, sewers and artificial sources) can be assessed using a range of analyses. However, for the level of assessment required in an SFRA, these sources are usually assessed via a review of historic flood incidents records and a qualitative analysis of catchment characteristics.

3. Residual risk (overtopping or exceedance)

- B.19 In recognition that engineered flood reduction measures cannot completely eliminate flood risk, there is a need to be aware of the residual risk generated by an event more severe than that for which the defences have been designed to provide protection. Accordingly, this risk assessment usually considers the flooding associated with an extreme event (such as a 0.1 per cent AEP) or flooding that may result from climate change.

4. Residual risk (breach and/or failure)

- B.20 This involves the assessment of breach or failure of flood defences or other features, which may act as a defence. Such scenarios may include collapse of a flood defence wall, blockage of a culvert or structural failure of a canal or reservoir embankment. Whilst the probability of a breach or failure is generally low, the consequences of an event are often very high. Following the precautionary principle, such high hazards should be considered when making land use planning decisions.
- B.21 Breach and failure hazards are site specific and should be assessed in individual flood risk assessments. The Great Yarmouth and Gorleston SFRA has considered the breach hazard at four locations to present an indication of the likely breach hazard in the Borough. For individual site specific FRAs, the EA will advise of the breach location and conditions to be assessed.

Climate change

- B.22 Projections of future climate change indicate that more frequent short-duration, high intensity rainfall and more frequent periods of long duration rainfall could be expected. Winters are expected to become wetter with summers and autumn becoming drier than at present. Global sea level rise is also expected to continue. These kinds of changes will have implications for all forms of flooding.
- B.23 Changes in the extent of inundation as a result of climate change are likely to be negligible in well-defined floodplains but may be dramatic in low-lying and flat areas. It is expected that climate change will lead to a reduction in the standard of protection provided by defences constructed in the past. Changes in the depth of flooding may reduce the return period of a given flood and as a result the flood zone classification within which certain areas fall.
- B.24 The Environment Agency Flood Map and Flood Zones do not take account of climate change. PPS25 requires that the spatial planning process should consider the implication of changes in our climate.
- B.25 The Great Yarmouth and Gorleston SFRA contains information on flood probability areas in the future based on a time horizon representing 100 years (2108) into the future. Refer to Volume 2, Chapter 4 of this SFRA for further information about the climate change projections for sea level rise used in this assessment.
- B.26 In the UK the implications of climate change are assessed by the UK Climate Impacts Programme and latest government guidance on allowance for the impacts of climate change on flooding is provided in Defra guidance issued in October 2006 and reproduced in PPS 25 Annex B. Further research and updates are expected in the future.
- B.27 It is imperative that allowances for climate change are based on the latest predictions and up to date guidance. PPS25 states:
- “The most up-to-date guidance on climate change and flooding from the Environment Agency, Defra, Communities and Local Government and the UKCIP should be considered in the preparation of...Strategic Flood Risk Assessments...”*
- B.28 The user must ensure that the most recent climate change guidance is considered over an appropriate time horizon when using the SFRA to inform decision making.

Uncertainty

- B.29 Flood risk can be assessed using a number of techniques and also to various degrees of detail. It is important to be confident that the methods used for estimation of flood risk produce results that are sufficiently certain for land use planning decisions to be based upon.
- B.30 Uncertainty in flood estimation arises from the:
- Complexity of the flooding;
 - Quality of the input data; and
 - The uncertainty of climate change.
- B.31 When using the SFRA to inform land use planning the following questions must be answered:
- Is the assessment suitable for the type of flooding and the scenarios being considered (fit for purpose)?
 - Is the study appropriate for the level of detail required for the proposed land use (vulnerability)?
 - Are the limitations of the method clearly understood and reported?
 - Are the studies appropriately verified?
 - Are the key assumptions identified and stated?
 - Is the key input data justified and appropriate for the level of assessment (fit for purpose)?
 - Have sensitivity analyses been carried out?
 - Have all relevant uncertainties (such as climate change) been identified and appropriately addressed?
- B.32 Where there is high certainty in flood estimation there may be no need for further analyses. Conversely low certainty requires more detailed assessment.
- B.33 The potential impacts of climate change are an important aspect of uncertainty relevant to flood risk estimation. Government guidance suggests that the impacts of climate change can be managed by either monitoring change in risk and adapting in the future as the need arises (Managed Adaptive Approach) or acting now to manage the eventuality (Precautionary Approach).
- B.34 Adopting a "Managed Adaptive Approach" to land use planning is not advised. Future adaptation to the impacts of climate change may not be technically feasible in the long-term or practical in intervening periods and the requirement to review and take action can be managed more effectively through individual planning applications rather than by GYBC within the LDF process.
- B.35 Climate change information within the SFRA has been based therefore on a precautionary approach to ensure that planning led decisions are sustainable and do not leave a legacy of risk on future owners.

Currency of information

- B.36 It is imperative to ensure that the latest information is used when assessing flood risk. The source and currency of the flood risk information should be checked before using any information. Management protocols are included in Volume 1, Chapter 6 of the Great Yarmouth and Gorleston SFRA.

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Appendix C: OVERVIEW MAPPING

Contents:

Figure ST1: Sequential Test - Flood Zones

Figure ST2: Sequential Test - Essential Infrastructure

Figure ST3: Sequential Test - Highly Vulnerable land uses

Figure ST4: Sequential Test - More Vulnerable land uses

Figure ST5: Sequential Test - Less Vulnerable land uses

Figure ST6: Sequential Test - Water Compatible land uses

More detailed mapping can be found in Volume 3 of this SFRA