

East Riding of Yorkshire Council
Strategic Flood Risk Assessment (SFRA)
Level 1

January 2010



East Riding of Yorkshire Council
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EXECUTIVE SUMMARY

Introduction

1. The East Riding of Yorkshire is situated to the north of the Humber Estuary, covering a wide expanse of 930 square miles, and has a population of approximately 330,000. The largest town is Bridlington with 36,500 people. The other major settlements are Beverley (30,000), Goole (19,500), Driffield (10,000) and the 'Haltemprice' settlements to the west of the City of Hull: Cottingham (17,000); Anlaby/Willerby/Kirkella (23, 500); and Hessle (15,000). However, over half of the population live in rural communities dispersed throughout the area, ranging from small market towns and coastal resorts (such as Pocklington and Hornsea), to numerous villages and hamlets.
2. Development pressure continues steadily in many parts of East Riding, and a significant proportion of these areas are affected by a potential risk of flooding from rivers and the sea. It is essential therefore that the Council are in a position to take informed decisions, providing a careful balance between the risk of flooding and other unrelated planning constraints that may place pressure upon 'at risk' areas. The East Riding of Yorkshire SFRA endeavours to provide specific advice to assist the Council in this regard.
3. **This report (and the supporting mapping) represents the Level 1 SFRA, and should be used by the Council to inform the application of the Sequential Test.** Following the application of the Sequential Test, it may be necessary to develop a Level 2 SFRA should it be shown that proposed allocations fall within a flood affected area of the Authority area. The Level 2 SFRA should consider the risk of flooding in greater detail within a local context to ensure that the site can be developed in a safe and sustainable manner.

Why carry out a Strategic Flood Risk Assessment (SFRA)?

4. Flooding can result not only in costly damage to property, but can also pose a risk to life and livelihood. It is essential that future development is planned carefully, steering it away from areas that are most at risk from flooding where possible, and ensuring that it does not exacerbate existing known flooding problems.
5. *Planning Policy Statement (PPS) 25: Development and Flood Risk* has been developed to underpin decisions relating to future development (including urban regeneration) within areas that are subject to flood risk. In simple terms, PPS25 requires local planning authorities to review the variation in flood risk across their jurisdiction, and to steer development away from areas at risk. Where this cannot be achieved and development is to be permitted in areas that may be subject to some degree of flood risk, PPS25 requires the Council to adopt a sequential approach that will minimise the risk of flooding that is posed to vulnerable land uses. The Council must also demonstrate that there are sustainable mitigation solutions available that will ensure that the risk to property and life is minimised (throughout the lifetime of the development) should flooding occur.
6. The Strategic Flood Risk Assessment (SFRA) is the first step in this process, and it provides the building blocks upon which the Council's planning and development control decisions will be made.

What is a Strategic Flood Risk Assessment (SFRA)?

7. The East Riding of Yorkshire Strategic Flood Risk Assessment (SFRA) has been carried out to meet the following key objectives:
- To collate all known sources of flooding, including tidal, river, surface water (local drainage), sewers and groundwater, that may affect existing and/or future development within the Authority area;
 - To delineate areas that have a 'low', 'medium' and 'high' probability of flooding within the East Riding, in accordance with Planning Policy Statement 25 (PPS25), and to map these;
 - Within flood affected areas, to recommend appropriate land uses (in accordance with the PPS25 *Sequential Test*) that will not unduly place people or property at risk of flooding;
 - Where flood risk has been identified as a potential constraint to future development, recommend possible flood mitigation solutions that may be integrated into the design (by the developer) to minimise the risk to property and life should a flood occur (in accordance with the PPS25 *Exception Test*).

The Sequential Test

8. The primary objective of PPS25 is to steer vulnerable development towards areas of lowest flood risk. PPS25 advocates a sequential approach that will guide the planning decision making process (i.e. the allocation of sites). In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. **Only if it can be demonstrated that there are no reasonably available sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated.** This is referred to as the Sequential Test.
9. PPS25 stipulates 'appropriate' land uses for each flood zone. It is the responsibility of both the Council (at the allocation stage) and developers (at the development stage) to make reference to Tables D1 and D2¹ of PPS25, restricting proposed land uses within areas that are at risk of flooding. In some instances, PPS25 requires both careful planning considerations to be placed upon the proposed development, and mitigating measures to be incorporated within the site to reduce the impact of flooding. These further considerations form part of the Exception Test, explained below, and reference should be made to Table D3² of PPS25 to determine where this will be triggered.
10. The PPS25 Sequential Test is depicted in Figure 4.1 of the PPS25 Practice Guide (December 2009) and Section 6.4.1 of this document.

The Exception Test

11. Many towns within England are situated adjacent to rivers, and are at risk of flooding. The future sustainability of these communities relies heavily upon their ability to grow and prosper. PPS25 recognises that, in some areas, including the East Riding, restricting residential development from areas designated as Zone 3a High Probability may compromise the viability of existing communities within the region.
12. For this reason, PPS25 provides an Exception Test. Where a local planning authority has identified that there is a strong planning based argument for a development to proceed

¹ Refer Appendix H

² Refer Appendix H

following the application of the Sequential Test, it will be necessary for the Council to demonstrate that the Exception Test can be satisfied.

13. For the Exception Test to be passed it must be demonstrated that:

- *“...the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the ‘submission’ stage, the benefits of the development should contribute to the Core Strategy’s Sustainability Appraisal;*
- *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 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.”*

Outcomes of the East Riding of Yorkshire SFRA

14. The East Riding of Yorkshire has been delineated into zones of low, medium and high probability of flooding, based upon existing available information provided by the Environment Agency. A relatively large proportion of the Authority area is affected by flooding from rivers and/or the sea. The spatial variation in flood risk across the Authority area has been delineated in the following manner:

Zone 3b (Functional Floodplain)

15. Areas subject to flooding up to (and including) once in every 25 years on average, and land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas), have been delineated as Zone 3b Functional Floodplain.
16. Within the context of the PPS25 Practice Guide³ (refer paragraph 4.90), it is highlighted that existing permanent buildings that represent a solid barrier to floodwater are generally not considered functional floodplain, and therefore may be redeveloped if the requirements of both the Sequential Test and the Exception Test can be satisfied. Notwithstanding this however, the land surrounding these buildings are critical flow paths and/or flood storage areas, and must be retained.
17. It is important to recognise that all areas within Zone 3b are areas that are subject to relatively frequent flooding, and may be subject to fast flowing and/or deep water. Very careful consideration must be given to future sustainability and safety issues within this area, and development may only be considered following application of the Sequential Test.
18. No development is permissible in Zone 3b apart from water compatible uses⁴ and essential infrastructure, and only then if the Exception Test can be passed. Specific planning responses have been developed for Zone 3b, and these are set out in Section 6.4.

Zone 3a High Probability

19. Areas subject to river (fluvial) flooding in the 1% probability of occurring in any one year (1 in 100) design event, or tidal flooding in the 0.5% (1 in 200) design event, have been delineated as Zone 3a High Probability. In the East Riding, this zone covers a large area (due to the low-lying topography). Zone 3a has been ‘sub-delineated’ between

³ Refer paragraph 4.90 of PPS25 Practice Guide (December 2009)

⁴ Refer Appendix H

'tidally dominated' and 'fluvially dominated' risk to reflect a more 'real' depiction of risk within this zone. A relatively large proportion of the East Riding is protected against tidal flooding by a system of raised flood defences, and those areas immediately behind these defences may be susceptible to *rapid inundation* following a catastrophic failure of the earthen embankments. To assist the Council's application of a sequential approach, the 'tidally dominated 3a' has been further sub-delineated to broadly indicate areas at immediate risk following a breach failure in the Humber Estuary defences, depicted as 'danger to all', 'danger to most', and 'danger to some'. It also identifies areas that will receive a flood warning following a breach failure, delineated as 'less than 6 hours', '6-12 hours', and 'greater than 12 hours'. The methodology adopted for the sub-delineation of Zone 3a High Probability is explained in Section 5.1. A table showing which settlements fall within 'tidally dominated' and 'fluvially dominated' 3a, and relevant SFRA map references (in Appendix A) is provided below.

20. Development within Zone 3a High Probability may only be considered following application of the Sequential Test and Exception Test and 'More Vulnerable' development⁵ should be avoided where possible.
21. The SFRA has outlined specific development control recommendations (at Section 6.4.4) that should be placed upon development within Zone 3a High Probability to minimise the damage to property, the risk to life in case of flooding, and the need for sustainable drainage systems (SUDS). It is essential that the developer carries out a detailed Flood Risk Assessment (see Section 6.6) to consider the site-based constraints that flooding may place upon the proposed development.
22. Re-development provides an opportunity to reduce the causes and impacts of flooding for example by incorporating SUDS and resilient building design, creating flood storage, re-creating functional floodplain and setting back defences.

Zone 2 Medium Probability

23. Areas subject to flooding in events exceeding the 1% (1 in 100) fluvial or 0.5% (1 in 200) tidal event, whichever is greater, and up to (and including) the 0.1% (1 in 1000) event have been delineated as Zone 2 Medium Probability. In the East Riding, Zone 2 forms a relatively narrow band between Zone 3a and Zone 1. Development within these areas may only be considered following application of the Sequential Test. 'Highly Vulnerable Development'⁶, for example emergency services, should be avoided in these areas and is only permissible if it has passed the Exception Test.
24. There are generally no other restrictions placed upon land use in these areas, however it is important to ensure that the developer takes account of possible climate change impacts to avoid a possible increase in the risk of flooding in future years (achieved through completion of a simple Flood Risk Assessment).

Zone 1 Low Probability

25. All areas outside of Zones 2 and 3 have been delineated as Zone 1 Low Probability. There are no restrictions placed on land use within Zone 1 Low Probability (i.e. all remaining areas of the East Riding) by PPS25. It is essential however that consideration is given to the potential risk of flooding from other sources (outlined in 'Localised Flooding Issues' below), ensuring that future development is not inadvertently placed at risk. It is also essential to ensure that future development does not exacerbate the current risk posed to existing homes and businesses.

⁵ Refer Appendix H

⁶ Refer Appendix H

| List of settlements/locations | Tidally dominated 3a | Fluvially dominated 3a | Appendix A Small Map No.(s) | Appendix A Large Map No.(s) |
|---|----------------------|------------------------|-----------------------------|-----------------------------|
| Aldbrough | | √ | ~ | 40 |
| Beeford | | √ | ~ | 18/19 |
| Beverley | | √ | 16/17/18/19 | 29/30/37 |
| Brandesburton | | √ | ~ | 24 |
| Bridlington | | √ | 31/32 | 6/7/13 |
| Bubwith | | √ | ~ | 33 |
| Drifffield | | √ | 30 | 11 |
| Easington | √ | | 26 | 59 |
| Elloughton-cum-Brough | √ | | 7 | 44 |
| Flamborough | | √ | ~ | 7 |
| Gilberdyke | √ | √ | 5 | 43 |
| Goole* | √ | | 9 | 50 |
| Haltemprice - Anlaby/Kirk Ella/Willerby | √ | | 13 | 45 |
| Haltemprice - Cottingham | | √ | 14 | 45 |
| Haltemprice - Hessle | √ | | 12 | 53 |
| Hedon | √ | | 22 | 46/54 |
| Hedon Haven | √ | | ~ | 54 |
| Hornsea | | √ | 27 | 25 |
| Howden | √ | | 8 | 42 |
| Hull boundary - Orchard Park | | √ | 15 | 37/38 |
| Hutton Cranswick | | √ | ~ | 17 |
| J37 Howdendyke | √ | √ | 8 | 42 |
| J38 (Newport/North Cave) | √ | | 6 | 43 |
| Kelleythorpe | | √ | 30 | 17 |
| Keyingham | √ | | 24 | 55 |
| Kilham | | √ | ~ | 12 |
| Leven | | √ | 20 | 31 |
| Market Weighton | | √ | 4 | 28 |
| Melbourne | | √ | ~ | 26 |
| Melton | √ | | ~ | 44/52 |
| Middleton on the Wolds | | √ | ~ | 22 |
| Newport | √ | √ | 5 | 43 |
| North Cave | | √ | 6 | 35/36 |
| Pocklington | | √ | 2 | 21 |
| Pocklington Industrial Estate | | √ | 2 | 21 |
| Rawcliffe | √ | | 10 | 49 |
| Roos | | √ | ~ | 47 |
| Skirraugh | | √ | ~ | 38/39 |
| Snaith | √ | | 11 | 49 |
| South Cave | √ | | 6 | 44 |
| Stamford Bridge | | √ | 29 | 14 |
| Wetwang | | √ | ~ | 10 |
| Wilberfoss | | √ | 28 | 14 |
| Withernsea | | √ | 25 | 56 |

* Please note that data is currently unavailable for Goole pending completion of a Level 2 SFRA

Localised Flooding Issues

26. Properties and infrastructure within the East Riding are also at risk of flooding from other sources. These include surface water flooding, groundwater flooding, the surcharging of the underground sewer system, and the blockage of culverts and gullies (which results in overland flow). Evidence of localised flooding of this nature has been captured through consultation with the Council, Internal Drainage Boards, Yorkshire Water and the Environment Agency and is presented in the flood maps (refer Appendix A).
27. PPS25 does not address issues of this nature within its delineation of flood zones and what development is acceptable within them. Incidents of this nature can often be addressed through the design process, and therefore will not generally affect decision making with respect the allocation (or otherwise) of sites within the East Riding. The recent flooding in June 2007 highlights the importance of considering localised flooding as an integral part of the planning process however. Whilst this was (statistically) a relatively rare event⁷, this did provide a timely reminder that uncontrolled flooding as a result of particularly heavy rains can create significant damage and disruption.
28. The PPS25 Practice Guide (December 2009) advocates the application of a sequential approach, taking into consideration *all* sources of flooding, and it is absolutely essential not to overlook the potential risk of localised flooding during the design process. A proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Specific development control recommendations have been provided accordingly (refer Section 7.4).
29. Developers are encouraged to liaise early with the relevant organisations including Yorkshire Water, Internal Drainage Boards, and the Council's Land Drainage team to ensure that any potential adverse impacts on the existing drainage infrastructure can be mitigated through appropriate design solutions. As a minimum, the implementation of sustainable drainage systems (SuDS) must be ensured (unless demonstrated not to be practicable), and careful consideration given to avoiding the obstruction of overland flow routes with buildings and/or landscaping.

A Proactive Approach – Reduction in Flood Risk

30. It is crucial to recognise that PPS25 considers not only the risk of flooding posed to new development, but that it also seeks to positively reduce the risk of flooding posed to existing properties within the Authority area. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within the East Riding.
31. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the Authority area, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SuDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should be reflected through the inclusion of a positive statement within the detailed FRA that clearly and concisely summarises how this reduction in flood risk will be delivered.

⁷ Estimated to be equivalent to approximately a 0.25% (1 in 400) design event

The Way Forward

32. A relatively large proportion of the East Riding of Yorkshire is at risk of flooding. The risk of flooding posed to properties within the Authority area arises from a number of sources including river flooding, tidal flooding, localised runoff, sewer and groundwater flooding.
33. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test. Specific planning recommendations have been provided for all settlements within the Authority area.
34. Where other planning considerations must guide the allocation of sites following the application of the Sequential Test, it will be essential that a Level 2 SFRA is carried out for all potential allocations that fall within a flood affected area. This will ensure that the Council can allocate the site safe in the knowledge that the risk of flooding can be safely (and sustainably) mitigated over the lifetime of the development.
35. Following application of the Sequential Test, and the decision to proceed with development in areas at risk of flooding due to other planning considerations (that outweigh flood risk), it will be necessary for the Exception Test to be applied. Specific recommendations have been provided to assist the Council and the developer to incorporate design features that will mitigate the potential risks of flooding within the site. These should be applied as development control recommendations for all future development. It is essential that these are applied, not only where there is a direct risk of flooding to the proposed development site, but elsewhere within the Authority area. It is important to recognise that all development may potentially have an adverse impact upon the existing flooding regime if not carefully mitigated.
36. Council policy is essential to ensure that the development control recommendations can be imposed consistently at the planning application stage. This is essential to achieve future sustainability within the East Riding with respect to flood risk management. It is recommended that Council policy within the LDF is developed in a robust manner to support PPS25 and the findings and recommendations of the SFRA process.
37. Emergency planning is imperative to minimise the risk to life posed by flooding within the Authority area. It is recommended that the Council advises the Local Resilience Forum of the risks raised in light of the East Riding of Yorkshire SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

A Living Document

38. The East Riding of Yorkshire SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Authority area. A rolling programme of detailed flood risk mapping within the Yorkshire region has been completed and a programme of improvements is now underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk and may alter predicted flood extents within East Riding. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25. Given that this is the case, a periodic review of the East Riding SFRA is imperative.
39. It is recommended that the East Riding SFRA is reviewed on a regular basis. A series of key questions to be challenged as part of the SFRA review process are set out in Section 7 of this document, providing the basis by which the need for a detailed review of the document should be triggered.

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Glossary

| | |
|-----------------------------------|--|
| AEP | Annual Exceedance Probability e.g. 1% AEP is equivalent to 1% probability of occurring in any one year (or, on average, once in every 100 years) |
| Core Strategy | The Development Plan Document within the Council's Local Development Framework, which sets the long-term vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development. |
| DCLG | Department of Community and Local Government |
| Defra | Department of Environment, Food and Rural Affairs |
| Development | The carrying out of building, engineering, mining or other operations, in, on, over or under land, or the making of any material change in the use of a building or other land. |
| Development Plan Document (DPD) | A spatial planning document within the Council's Local Development Framework, which set out policies for development and the use of land. Together with the Regional Spatial Strategy, they form the development plan for the area. They are subject to independent examination. |
| EA | Environment Agency |
| Flood Zone Map | Nationally consistent delineation of 'high' and 'medium' flood risk, published on a quarterly basis by the Environment Agency |
| Formal Flood Defence | A structure built and maintained specifically for flood defence purposes |
| FRA | Flood Risk Assessment |
| Habitable Room | A room used as living accommodation within a dwelling but excludes bathrooms, toilets, halls, landings or rooms that are only capable of being used for storage. All other rooms, such as kitchens, living rooms, bedrooms, utility rooms and studies are counted. |
| Informal Flood Defence | A structure that provides a flood defence function, however has not been built and/or maintained for this purpose (e.g. boundary wall) |
| Local Development Framework (LDF) | Consists of a number of documents which together form the spatial strategy for development and the use of land |
| Local Resilience Forum | A multi-agency contingency planning meeting attended by the chief officers of the responding organisations in the Humber area |
| NFCDD | National Flood & Coastal Defence Database (owned and operated by the Environment Agency) |
| Planning Policy Guidance (PPG) | A series of notes issued by the Government, setting out policy guidance on different aspects of planning. They will be replaced by Planning Policy Statements. |

| | |
|--|---|
| Planning Policy Statement (PPS) | A series of statements issued by the Government, setting out policy guidance on different aspects of planning. They replace Planning Policy Guidance Notes |
| PPG25 | Planning Policy Guidance 25: Development and Flood Risk Office of the Deputy Prime Minister (ODPM), 2001 |
| PPS25 | Planning Policy Statement 25: Development and Flood Risk Department of Community & Local Government, 2006 |
| Previously Developed (Brownfield) Land | Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example, a house and its garden would be considered to be previously developed land. |
| Residual Risk | A measure of the outstanding flood risks and uncertainties that have not been explicitly quantified and/or accounted for as part of the review process |
| SEA | Strategic Environmental Assessment |
| SuDS | Sustainable Drainage System |
| Supplementary Planning Document (SPD) | Provides supplementary guidance to policies and proposals contained within Development Plan Documents. They do not form part of the development plan, nor are they subject to independent examination. |
| Sustainability Appraisal (SA) | Appraisal of plans, strategies and proposals to test them against broad sustainability objectives. |
| Sustainable Development | Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (The World Commission on Environment and Development, 1987). |
| Zone 1 Low Probability | This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%) |
| Zone 2 Medium Probability | This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year |
| Zone 3a High Probability | This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year |
| Zone 3b Functional Floodplain | This zone comprises land where water has to flow or be stored in times of flood. Within East Riding, this has been defined as land which would flood with an annual probability of 1 in 20 (5%) or greater in any year |

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1 Introduction

1. The East Riding of Yorkshire is situated to the north of the Humber Estuary, covering a wide expanse of 930 square miles, and has a population of approximately 330,000. The largest town is Bridlington with 36,500 people. The other major settlements are Beverley (30,000), Goole (19,500), Driffeld (10,000) and the 'Haltemprice' settlements to the west of the City of Hull: Cottingham (17,000); Anlaby/Willerby/Kirkella (23, 500); and Hessle (15,000). However, over half of the population live in rural communities dispersed throughout the area, ranging from small market towns and coastal resorts (such as Pocklington and Hornsea), to numerous villages and hamlets.
2. The East Riding is bounded to the east by the North Sea. The Holderness coastline begins at Spurn Point at the mouth of the Humber Estuary and extends north to the chalk cliffs of Flamborough Head. The coastline is mostly composed of boulder clay and in parts is the fastest eroding coast in Europe. Holderness itself forms the eastern strip of the Authority area. It is low-lying, undulating countryside, and includes the River Hull which flows south from Driffeld. The Yorkshire Wolds form the middle ridge of the Authority area. They are rolling chalk hills curving north from near Hessle and spreading out before ending abruptly at the cliffs of Flamborough and Bempton. To the west of the Wolds is the Vale of York, which is relatively flat, low-lying ground. The River Derwent forms most of the East Riding's western boundary from Stamford Bridge to near Howden where it joins the River Ouse. The south-western portion of the East Riding is characterised by the convergence of several major rivers and canals, linking into the River Ouse, which becomes the Humber Estuary near Goole.
3. Development pressure continues steadily in many parts of East Riding, and the current housing requirement for the Authority area, set by the Yorkshire and Humber Regional Spatial Strategy (2008), is to deliver a minimum of 1190 dwellings per annum – 17,850 dwellings between 2011 and 2026. To ensure that this demand is satisfied in a sustainable manner, the East Riding of Yorkshire Council (ERYC) is preparing a Local Development Framework (LDF).
4. An integral element of the LDF is the Core Strategy. This will set the spatial strategy for the area, determining how growth will be distributed throughout the East Riding over the next 15-20 years.
5. As within many historical centres of England, the proximity of key settlements to the coast and rivers, in particular the Humber Estuary, does mean that areas of the East Riding of Yorkshire are susceptible to flooding. Indeed, the Environment Agency's high level national overview of flood risk (NaFRA) indicates that the East Riding is within the top ten areas ranked on the basis of the number of people living within an area at significant risk of flooding. The current Environment Agency flood zone map covering East Riding of Yorkshire is presented in Figure A (areas at risk of flooding are shaded).
6. Planning Policy Statement (PPS) 25: Development and Flood Risk requires that local planning authorities prepare a Strategic Flood Risk Assessment (SFRA) in consultation with the Environment Agency. The primary purpose of the SFRA is to determine the variation in flood risk across the Authority area. Robust information on flood risk is essential to inform and support the Council's revised flooding policies in its emerging Local Development Framework (LDF).
7. This SFRA is a critical element of the evidence base that will inform the preparation of the Local Development Framework (LDF) and the Development Control process. In particular the SFRA will feed into the Preferred Options⁸ stages of the Core Strategy, Site Allocations, and other Development Plan Documents (DPDs) that make up the East Riding of Yorkshire LDF. As with all evidence base documents, the SFRA will be submitted to the Secretary of State in due course at the Submission⁹ stage of each DPD.

⁸ Refer to the Plan-Making Manual (2008) at <http://www.pas.gov.uk/planmakingmanual>

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8. **This report (and the supporting mapping) represents the Level 1 SFRA, and should be used by the Council to inform the application of the Sequential Test.** Following the application of the Sequential Test, it may be necessary to develop a Level 2 SFRA should it be shown that proposed allocations fall within a flood affected area of the Authority area. The Level 2 SFRA should consider the risk of flooding in greater detail within a local context to ensure that potential development areas can be planned in a safe and sustainable manner.

2 SFRA Approach

9. The primary objective of the East Riding of Yorkshire SFRA is to inform the preparation of the Local Development Framework, including the overall strategic distribution of development throughout the East Riding, and the allocation of land for development at the local scale. The SFRA has a broader purpose however, and in providing a robust depiction of flood risk across the Authority area, it can:
 - Inform the development of Council policy that will underpin decision making within the Authority area, particularly within areas that are affected by (and/or may adversely impact upon) flooding;
 - Assist the development control process by providing a more informed response to development proposals affected by flooding, influencing the design of future development within the Authority area;
 - Assist developers in providing information for site-specific Flood Risk Assessments
 - Help to identify and implement strategic solutions to flood risk, providing the basis for possible future flood alleviation works;
 - Support and inform the Council's emergency planning response to flooding.
10. Whilst general guidance is available as to what should be presented as an outcome of the SFRA process, the Government provides no specific *methodology* for the SFRA delivery. Therefore, to meet these broader objectives in a pragmatic manner that is 'fit for purpose', the SFRA has been developed in consultation with both the Council and the Environment Agency.
11. A considerable amount of knowledge exists with respect to flood risk within the Authority area, including information relating both to historical flooding, and the predicted extent of flooding from rivers and the sea under extreme weather conditions (i.e. as an outcome of detailed flood risk modelling carried out by the Environment Agency). The East Riding SFRA has built upon this existing knowledge, underpinning the delineation of the Authority area into zones of 'high', 'medium' and 'low' probability of flooding, in accordance with PPS25.
12. A large proportion of the Authority area is defended against fluvial and tidal flooding however, and therefore it is essential to establish a robust understanding of the 'real' risk posed to communities across the Authority area (i.e. arising from a possible failure of the defences). Further analyses have therefore been undertaken to sub-delineate Zone 3 into areas of increasing risk to life. These zones have then been used to provide a robust and transparent evidence base for the development of flooding related policy, and the allocation of sites for future housing and employment uses.

Cross Boundary Issues

13. It is important to recognise that Local Planning Authority boundaries do not necessarily coincide with river catchment boundaries. There is a very clear risk of flooding to properties in the City of Hull, surrounded entirely by East Riding, and future development within the Authority area could exacerbate this risk if not carefully managed. It is imperative that all local authorities clearly understand the core issues that flood risk raises within their jurisdiction, and adapt their decision making accordingly. They must be aware of the impact that misinformed planning decisions may have, not only locally, but upon adjoining local authority areas.
14. A number of authorities across the region are carrying out similar strategic flood risk investigations. These will help provide the evidence base for the Core Strategies and site specific development allocations that will form part of the Local Development Frameworks that all local planning authorities must produce.
15. Of particular relevance is the City of Hull SFRA (Halcrow, 2008) that considers the

potential risk of fluvial, tidal, groundwater and surface water flooding within the city. In an endeavour to address cross boundary issues, the Hull SFRA has extended its risk mapping into the East Riding by approximately 1km along all common borders.

16. It is important to recognise that the methodology adopted by Hull City Council for the delineation of risk is subtly different to the East Riding SFRA, reflecting the difference in the issues of particular relevance to the two Authority areas. A thorough check has been carried out as part of this investigation to ensure that any potential differences in the information presented can be readily explained through a simple difference in definition. The core assessment of flood risk that underpins the investigations however is largely identical.
17. **All potential development within East Riding of Yorkshire should be guided by the policy and development control recommendations set out within the East Riding SFRA.** It is important for developers to recognise that the adopted local planning policy does differ between the two Authority areas. For this reason, the interpretation of both flood risk, and the policies that will underpin development within these areas, must be established appropriately.

A Living Document

18. The SFRA has been informed by existing knowledge with respect to flood risk within the East Riding. It is based upon emerging and existing policy guidance, including PPS25 (December 2006) and the supporting Practice Guide to PPS25 (December 2009).
19. The Environment Agency regularly review and update their Flood Zone maps and a rolling programme of flood risk management investigations is underway within the North East region. This will improve the current knowledge of flood risk within the Authority area, and may alter predicted flood extents over time. It is important that the SFRA is adopted as a living document and is reviewed regularly in light of emerging policy directives and improving understanding of flood risk within the Authority area. Given that this is the case, a periodic review of the East Riding of Yorkshire SFRA is imperative.
20. It is recommended that East Riding of Yorkshire SFRA is reviewed on a regular basis. A series of key questions to be challenged as part of the SFRA review process are set out in Section 8 of this document, providing the basis by which the need for a detailed review of the document should be triggered.

3 Policy Framework

3.1 Introduction

21. This section provides a brief overview of the strategy and policy context relevant to flood risk in the East Riding of Yorkshire.
22. The success of the SFRA is heavily dependent upon the ability of the Council to implement the recommendations put forward for future sustainable flood risk management, both with respect to planning decisions and development control recommendations. A framework of national and regional policy is in place, providing guidance and direction to local planning authorities. Ultimately however, it is the responsibility of the Council to establish 'sound' planning policies that will ensure future sustainability with respect to flood risk.

3.2 National Planning Policy

3.2.1 Overview

23. National planning policy is set out through a number of Planning Policy Statements (PPSs) and Planning Policy Guidance Notes (PPGs). The Government is currently reviewing all PPGs with revised advice being set out in a PPS and, where necessary, accompanying best practice guidance.
24. PPSs and PPGs cover a full range of planning issues drawing on the central issue of sustainable development. Central themes include the re-use of 'deliverable' previously developed land, promoting economic growth, including the intention to steer inappropriate development away from areas at risk of flooding. Under paragraph 4.31 of 'PPS12: Local Spatial Planning' it is a requirement of Regional Assemblies and Local Authorities to ensure their Regional Spatial Strategies (RSS) or Local Development Frameworks (LDFs) are in conformity with the guidance in PPSs and PPGs. The regional and local policy context for SFRA is set out in the next section.

3.2.2 Planning Policy Statement (PPS) 1: Delivering Sustainable Development

25. Planning Policy Statement 1 (PPS1) sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system. The following extract provides a succinct summary of the principles set out by PPS1.

Planning shapes the places where people live and work and the country we live in. Good planning ensures that we get the right development, in the right place and at the right time. It makes a positive difference to people's lives and helps to deliver homes, jobs, and better opportunities for all, whilst protecting and enhancing the natural and historic environment, and conserving the countryside and open spaces that are vital resources for everyone. But poor planning can result in a legacy for current and future generations of run-down town centres, unsafe and dilapidated housing, crime and disorder, and the loss of our finest countryside to development.

Good planning is a positive and proactive process, operating in the public interest through a system of plan preparation and control over the development and use of land.

Sustainable development is the core principle underpinning planning. At the heart of sustainable development is the simple idea of ensuring a better quality of life for everyone, now and for future generations.

The Government set out four aims for sustainable development, namely:

- social progress which recognises the needs of everyone;*
- effective protection of the environment;*
- the prudent use of natural resources; and,*
- the maintenance of high and stable levels of economic growth and employment.*

These aims should be pursued in an integrated way through a sustainable, innovative and productive economy that delivers high levels of employment and a just society that promotes social inclusion, sustainable communities and personal well being, in ways that protect and enhance the physical environment and optimise resource and energy use.

3.2.3 Planning Policy Statement (PPS) 25: Development and Flood Risk

26. Planning Policy Statement 25 (PPS25) was released in December 2006, and underpins the process by which local planning authorities are to account for flood risk as an integral part of the planning process. The overarching principles set out by PPS25 for the management of flood risk at a planning authority level are encapsulated in Paragraph 6 of the document:

“Regional planning bodies (RPBs) and local planning authorities (LPAs) should prepare and implement planning strategies that help to deliver sustainable development by:

Appraising risk

- identifying land at risk and the degree of risk of flooding from river, sea and other sources in their areas;*
- preparing Regional Flood Risk Appraisals (RFRAs) or Strategic Flood Risk Assessments (SFRAs) as appropriate, as freestanding assessments that contribute to the Sustainability Appraisal of their plans;*

Managing risk

- framing policies for the location of development which avoid flood risk to people and property where possible, and manage any residual risk, taking account of the impacts of climate change;*
- only permitting development in areas of flood risk when there are no reasonably available sites in areas of lower flood risk and benefits of the development outweigh the risks from flooding;*

Reducing risk

- safeguarding land from development that is required for current and future flood management, e.g. conveyance and storage of flood water, and flood defences;*
- reducing flood risk to and from new development through location, layout and design, incorporating sustainable drainage systems (SuDS);*
- using opportunities offered by new development to reduce the causes and impacts of flooding, e.g. surface water management plans; making the most of the benefits of green infrastructure for flood storage, conveyance and SUDS; recreating functional floodplain; setting back buildings;*

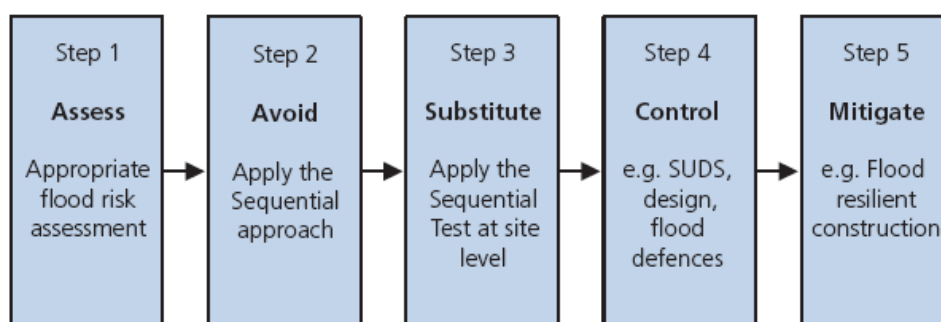
A partnership approach

- working effectively with the Environment Agency, other operating authorities and other stakeholders to ensure that best use is made of their expertise and information so that plans are effective and decisions on planning applications can be delivered expeditiously; and*
- ensuring spatial planning supports flood risk management policies and plans, River Basin Management Plans and emergency planning.”*

27. These broad objectives effectively set the scope for the specific outcomes of the SFRA process. The SFRA in turn then informs planning and development control decisions to ensure that the objectives set out above can be achieved.
28. The guidance in PPS25 also indicates that Sustainability Appraisals should be informed by the SFRA for their area. Under the Town and Country Planning (Local Development) (England) Regulations 2004, a Sustainability Appraisal (SA) is required for all Local Development Documents (LDDs) which form part of Local Development Frameworks (LDFs). The purpose of SA is to promote sustainable development through better integration of sustainability considerations in the preparation and adoption of plans. The Regulations stipulate that SAs of LDFs should meet the requirements of the Strategic Environmental Assessment (SEA) Directive.
29. It is important to reiterate that PPS25 is not applied in isolation as part of the planning process. The formulation of Council policy and the allocation of land for future development must also meet the requirements of other planning policy statements, including (for example) PPS3: Housing. Clearly a careful balance must be sought, and the SFRA aims to assist in this process through the provision of a clear and robust evidence base upon which informed decisions can be made.

3.2.4 PPS25: Development and Flood Risk Practice Guide

30. The PPS25 Practice Guide was first published in June 2008, and an updated version in December 2009, providing additional guidance on the principles set out in PPS25 which should be considered by East Riding of Yorkshire Council when preparing its LDF. The primary principle put forward by the Practice Guide, which ultimately underpins the development of recommendations set out within the East Riding of Yorkshire SFRA, is the 'flood risk management hierarchy', i.e.:



31. This hierarchy reinforces the principles of the PPS25 Sequential and Exception Tests. For example, the mitigation of flood risk within a development (i.e. 'Control') may only be considered once it has been clearly demonstrated that careful consideration has been taken as to where the development is to be situated (is there a suitable alternative site within Zone 1, i.e. 'Avoidance'), and the vulnerability of the proposed land use has been minimised (i.e. 'Substitute').

3.2.5 Planning Policy Statement: Planning and Climate Change

32. The final planning policy supplement on climate change was published in December 2007 following a 12 month consultation period. This is intended to supplement the existing PPS1: Delivering Sustainable Development. The document highlights the issue of climate change, and sets out ways planning should prepare for its effect, which includes managing flood risk.

3.3 Regional Planning Policy

3.3.1 The Regional Spatial Strategy (Yorkshire & Humber)

33. The Regional Spatial Strategy (RSS) was adopted in May 2008. The current RSS includes a broad development strategy for the region, setting out regional priorities in terms of location and scale of development. The plan guides development up to 2021 and beyond, and provides a regional policy framework within which local planning authorities must establish their Local Development Framework. Specific policies that directly influence the analysis and mitigation of flood risk (from a planning perspective), and future decision making within areas that are at risk of flooding, are summarised below.

34. Policy ENV1 Flood Risk states:

- A. *The Region will manage flood risk pro-actively by reducing the causes of flooding to existing and future development, especially in tidal areas, and avoid development in high flood risk areas where possible.*
- B. *Allocation of areas for development will follow a sequential approach and will be in the lowest risk sites appropriate for the development (identified by Strategic Flood Risk Assessments).*
- C. *Flood management will be required to:*
 - 1. *Facilitate development in the cities of Leeds, Bradford, Sheffield, Hull and York, coastal towns including: Bridlington, Grimsby, Scarborough, and Whitby, inland urban areas including Doncaster, Goole, Halifax, Scunthorpe, Selby and Wakefield where there is little development land available outside high flood risk zones, and land on the south bank of the Humber, provided the sequential approach has been used to inform decisions regarding flood risk.*
 - 2. *Protect parts of the strategic transport network, especially the Selby-Hull, Doncaster-York, and Doncaster - Immingham transport corridors.*
 - 3. *Provide flood storage, habitat creation and managed realignment in areas around the Humber, and other river corridors as required.*
 - 4. *Provide positive land management for flood alleviation, particularly in the upland areas of the Yorkshire Dales, the North York Moors, the Howardian Hills and the Pennines.*

35. Policy YH8 Green Infrastructure states:

- A. *Areas and networks of green infrastructure will be identified, protected, created, extended, enhanced, managed and maintained throughout the region to ensure that an improved, accessible and healthy environment is available for the benefit of present and future communities whilst protecting the integrity of internationally important biodiversity sites.*
- B. *LDFs should:*
 - 1. *Define a hierarchy of green infrastructure, in terms of location, function, size and levels of use, at every spatial scale and across all areas of the region based on analysis of existing natural, historic, cultural, sport and playing field, and river and landscape assets, including the identification of new assets required to deliver green infrastructure;*
 - 2. *Identify and require the retention and provision of substantial connected networks of green infrastructure, particularly in urban, urban fringe and adjacent countryside areas;*
 - 3. *Ensure that policies have regard to the economic and social as well as environmental benefits of green infrastructure assets; and*
 - 4. *Identify the functional role of green infrastructure in supporting the provision of renewable energy, urban microclimate control, and flood risk management.*
- C. *Assets of particular significance for the protection and enhancement of green infrastructure include national and inter-regional trails (policy T5E), floodplains (policy ENV1), woodlands (policy ENV6), biodiversity (policy ENV8) and heritage (policy ENV9) and distinctive landscapes (policy ENV10).*

36. Policy HE1 Humber Estuary sub area states:

Plans, strategies, investment decisions and programmes for the Humber Estuary sub area should:

- A Roles and functions of places*
 - 1. Transform the role of Hull as a Regional City, particularly through remodelling the city centre to provide more and better jobs, shops, services, public spaces and homes, and transforming residential areas to create a better mix of housing and quality environments*
 - 2. Strengthen the roles of Scunthorpe and Grimsby/Cleethorpes as Sub Regional Towns, particularly through town centre renaissance and housing renewal and growth*
 - 3. Support the roles of Beverley, Driffield and Goole as Principal Towns*
- B Economic development*
 - 1. Diversify and develop the sub area's economy, making the most of the multimodal transport links, ports, city and town centres and workforce*
 - 2. Foster value-added port-related activities and maximise opportunities around the ports and close to the estuary's deep water channel including through safeguarding land north west and south east of Immingham for estuary-related uses*
 - 3. Diversify and develop the local economies of Hull, Grimsby and Scunthorpe – particularly to develop a stronger service sector*
 - 4. Enhance the tourism offer and attraction of Cleethorpes*
- C Environment*
 - 1. Improve the environment of housing and employment areas in Hull, Scunthorpe and Grimsby, including through increased tree planting*
 - 2. Protect and enhance the biodiversity and landscape character of the Humber Estuary and the Wolds area, improve green infrastructure, and protect the integrity of the internationally important biodiversity sites*
 - 3. Develop the sub area's renewable energy generation potential, whilst taking account of the potential cumulative impact of large numbers of wind turbines and associated development*
 - 5. Avoid depleting the Sherwood Sandstone aquifer in the western part of the sub area*
 - 6. Safeguard the sub area's main economic assets and settlements from tidal and fluvial flooding, including through managed realignment*
 - 7. Improve air quality, particularly in parts of Hull and Scunthorpe (based on AQMAs).*
- D Transport*
 - 1. Coordinate development in Hull, at the port of Hull and south Humber ports, and for estuary-related uses on the south Humber Bank with implementation of the relevant transport investment priorities set out in Table 13.24*
 - 2. Increase rail and road accessibility to Hull, the port of Hull and to the south Humber ports*
 - 3. Improve the opportunities for inter-modal transfer from road to rail or water (sea and inland waterway)*
 - 4. Improve public transport links to and within Hull*
 - 5. Improve connectivity to and between Scunthorpe, Immingham, Grimsby and Cleethorpes, particularly by public transport*
- E Strategic patterns of development*
 - 1. Focus most development on Hull, Scunthorpe and Grimsby/Cleethorpes,*
 - 2. Promote development at Goole, Beverley and Driffield to strengthen their service centre roles and where necessary aid regeneration or provide more affordable housing*
 - 3. Manage housing development in the Hull strategic housing market area to*

reduce the amount of development in East Riding and increase development in Hull over the Plan period coordinated with the Pathfinder programme for renewal, demolition and vacancy reduction and with improved infrastructure and community facilities.

4. *Provide development to meet local housing needs and for economic diversification in the rural areas and smaller settlements, particularly west and north of Hull, west of Scunthorpe and south of Grimsby*
 5. *Manage flood risk in line with policy ENV1 in all parts of the Humber sub area at risk from flooding*
- F** *Regionally significant investment priorities*
1. *Secure rapid urban renaissance progress in Hull, Grimsby and Scunthorpe*
 2. *Manage and minimize risk of flooding from the Humber and associated river and drainage systems to Hull, Sub Regional Towns, Principal Towns and other settlements*
 3. *Improve multimodal land access to the Humber Ports and develop their complementary roles*
 4. *Secure a healthy housing market for all tenures of housing in Hull and surrounding area, in the Grimsby area, and in Goole*
- G** *Joined up working*
1. *Promote collaborative working on LDFs and between all agencies to regenerate Hull, Grimsby and Scunthorpe*
 2. *Foster collaboration across the sub area between public and private partners to realise the potential of the City Region and Humber Ports as the 'Global Gateway'*
 3. *Manage the release of land for housing in a manner which will support interventions to address both fragile and failing housing markets and affordability*
 4. *Develop public transport corridors and services*
 5. *Develop an integrated approach to habitat management, creation and enhancement across the Humber Estuary, designed to secure positive environmental benefits whilst allowing effective flood management and appropriate development proposals to be progressed*

3.4 Local Planning Policy

37. The Council is required to prepare a Local Development Framework (LDF) for the East Riding. A LDF is a folder of documents which together with the Regional Spatial Strategy will form the 'statutory development plan' for the East Riding. The existing statutory development plan for the East Riding comprises the **Regional Spatial Strategy** (Adopted May 2008), and '**saved**' policies within the **Joint Structure Plan** for Hull and East Riding (Adopted June 2005), and four **Local Plans**: Beverley Borough (1996) Boothferry Borough (1999) East Yorkshire Borough (1997) and Holderness District (1999). The Joint Structure Plan and Local Plans (including the schedules of policies that have been saved) can be accessed online at <http://www.eastriding.gov.uk/planning/forwardplanning>. The LDF will eventually replace the Joint Structure Plan and the four Local Plans.

38. Relevant local planning policies that have been saved until they are superseded by LDF policies include:

Joint Structure Plan

T4 – Strategic Waterways and Ports
NAT6 – Coastal Management

Beverley Borough Local Plan

D18 - Drainage/Water Provisions
D21 - Tidal and Fluvial Defences
E19 and E20 - Water Environment

Boothferry Borough Local Plan

EN64 and EN65 - Land Drainage and Pollution Control
EN66 - Floodplains, Water Courses and River Corridors
EN70 - Flood Defences and Managed Retreat
EN71 - Humber Estuary

East Yorkshire Borough Wide Local Plan

EN16 - Foul and Surface Water Disposal
EN17 - Flood Risk

Holderness District Wide Local Plan

U9 and U10 - Foul and Surface Water Drainage
U11 – Culverting
U12 and U13 – Flood Protection

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4 Data Collection

4.1 Overview

39. A considerable amount of knowledge exists with respect to flood risk within the Authority area, including (but not limited to):
- Historical river flooding information;
 - Information relating to localised flooding issues (surface water, groundwater and/or sewer related), collated in consultation with the Council, Yorkshire Water, Internal Drainage Boards, and the Environment Agency;
 - Detailed flood risk mapping;
 - Environment Agency Flood Zone Maps (June 2008);
 - Topography (OS mapping & LiDAR).
40. This data has been sourced from the Council, the Environment Agency, the Internal Drainage Boards, and Yorkshire Water. It has formed the core dataset that has informed the SFRA process. The application of this data in the delineation of zones of 'high', 'medium' and 'low' probability of flooding, along with the formulation of planning and development control recommendations, is explained in Sections 5 and 6. An overview of the core datasets, including their source and their applicability to the SFRA process, is outlined below.

4.2 Environment Agency Flood Zone Maps

41. The Environment Agency's Flood Map shows the natural floodplain, ignoring the presence of defences, and therefore areas potentially at risk of flooding from rivers or the sea. The Flood Map shows the area that is susceptible to a 1 in 100 (1% annual exceedance probability (AEP)) chance of flooding from rivers, and a 1 in 200 (0.5% AEP) chance of tidal flooding, in any year. It also indicates the area that has a 1 in 1000 (0.1% AEP) chance of flooding from rivers and/or the sea in any given year. This is also known as the Extreme Flood Outline.
42. The Flood Map outlines have been produced from a combination of a national generalised computer model, detailed modelling, and some historic flood event outlines. The Environment Agency's knowledge of the floodplain is continuously being improved by a variety of studies, detailed models, data from river flow and level monitoring stations and actual flooding information. The Environment Agency has an ongoing programme of improvement and updates are made on a quarterly basis.
43. The Environment Agency's own definition of the flood map is defined in their policy 541_05. An excerpt from it reads:

'Flood Zones are required to identify the extents over which flooding could occur, from rivers and the sea, ignoring the presence of flood defences. The way in which different types of flood defences are considered is explained below:

- *[The Environment Agency] interpret PPS25 to mean that flooding is not constrained by formal raised flood defences. Therefore, the Flood Zones ignore the effect of defences in reducing the probability of flooding but do not underestimate the extents of flooding where defences increase the area potentially at risk.*
- *The definition of Flood Zone 3b (Functional Floodplain) in PPS25 includes land which 'is designed to flood in an extreme (0.1%) flood'. This means that [the Environment Agency's] mapped extent of a flood with an annual probability of 1% (1 in 100) fluvial / 0.5% (1 in 200) tidal will include areas that are designed to flood due to the operation of flood storage areas.*

- *Other types of flood defences or infrastructure (whether or not their primary purpose is flood alleviation) such as engineered river channels, bypass channels, culverts and bridges are considered as existing infrastructure for the purpose of Flood Zones. In principle this means they are included when modelling and mapping Flood Zones. This principle also applies to embankments that are not flood defences, although any pathways through the embankment should be taken into account'.*

4.3 Historical Flooding

44. Discussions have been held with the Council and the Environment Agency to identify areas that are known to have been susceptible to flooding in the past. It is important to note that, given the heavily defended nature of the region, flooding in recent years has generally been relatively localised (i.e. due to the breaching of raised defences at particular locations). Should these defences fall into disrepair in future years, large swathes of East Riding are at risk of coastal and river flooding, as depicted in adjoining Figure A. Areas in the western part of the Authority area, including Rawcliffe, Gowdall, and Stamford Bridge were significantly affected by flooding during the winter of 2000. However, engineering works have been completed by the Environment Agency to restore the flood defences to these areas. Widespread flooding inundated large swathes of Yorkshire during the summer of 2007, including a significant number of homes and businesses in East Riding. This is explained further below.
45. Issues of a localised nature have also been identified, largely through discussions with long serving officers of the Council, and these are reflected in the adjoining flood zone maps. These incidents are events in which properties have been affected by flooding arising as a result of (for example) issues including surcharging of the underground sewer system, blockage of culverts and gullies, and/or surface water runoff (flash flooding). It is highlighted that often the source of flooding in incidents of this nature is very unclear, based purely upon anecdotal evidence provided by the local resident. It is also important to recognise that these recorded incidents are very unlikely to be all-encompassing, and many issues are likely to have gone unrecorded.
46. These historical incidents are an important reminder however that the risk of flooding must always be carefully considered when planning future development, irrespective of the site's proximity to a local river or watercourse. Development control decisions must consider all forms of potential flooding to the site. They must also be made with due consideration to the potential impact that future development may have upon known existing flooding problems if not carefully managed.

June 2007 Flood Event

47. A number of areas throughout England were affected by widespread flooding in June 2007. Prolonged intense rainfall fell over many parts of the East Riding, resulting in flash flooding that inundated a substantial number of homes and businesses.
48. Following the event, the Council carried out a comprehensive data collection exercise to capture information relating to the source and severity of the flooding. The parts of the Authority area that were affected by the June 2007 event are presented in Appendix D. The return period associated with the June 2007 event has not been accurately determined, and is variable across the region. It is clear however that this exceeded the 1% (100 year) design event.
49. The Council set-up an Overview and Scrutiny Flood Review Panel to investigate the June 2007 event and advise on necessary actions to improve the way in which the impacts of such events are managed/reduced in the future. The meetings of the Panel were held in public at twelve community venues throughout the East Riding between September 2007 and February 2008. The Panel published a report in May 2008 detailing its key findings and recommendations. The content of that report and its recommendations have been taken into account in compiling the SFRA.

4.4 Detailed Hydraulic Modelling

50. A large number of investigations have been carried out by the Environment Agency within the study area, and many of these have involved the development of detailed hydraulic models to assess the potential impact of flooding from rivers.
51. A relatively large proportion of East Riding is dominated by the risk of tidal flooding from the North Sea and the Humber, and this in turn is governed by sea levels within the Humber Estuary. The Authority area is also affected by river flooding from Burstwick Drain, the River Hull, the River Derwent, the River Ouse, the River Aire, the River Trent and the Dutch River. All of these river systems have been modelled by the Environment Agency to support strategic investigations in recent years. Data relating to predicted flood extents associated with these river systems has been provided for SFRA purposes.
52. It should be noted that the detailed hydraulic models developed on behalf of the Environment Agency assume existing 'typical' conditions within the respective river systems that are being analysed. The predicted water levels may change if the operating regimes of the rivers involved are altered, e.g. culverts become blocked, or the condition of the river channel alters or deteriorates, both of which may occur despite ongoing maintenance.

4.5 Flood Defences

53. Flood defences are typically raised structures that alter natural flow patterns and prevent floodwater from entering property in times of flooding. They are generally categorised as either 'formal' or 'informal' defences. A 'formal' flood defence is a structure that was built specifically for the purpose of flood defence, and is maintained by its respective owner, which could be the Environment Agency, Local Authority, or an individual. An 'informal' flood defence is a structure that has not been specifically built to retain floodwater, and is not maintained for this specific purpose, but may afford some protection against flooding. These can include boundary walls, industrial buildings, railway embankments and road embankments.
54. The Environment Agency has no statutory responsibility to maintain rivers and/or flood defences within the UK. This remains the responsibility of the riparian land owner. The EA retain 'permissive powers' however, and using these powers the EA carry out a programme of monitoring and maintenance. Government funding is clearly finite however, and the long term structural integrity of the defences can never be fully guaranteed. Homes and businesses within defended areas will always face a residual risk of possible failure, as was graphically demonstrated in New Orleans during Hurricane Katrina (2005). In 2000, over 100 homes were affected by flooding in Gowdall as a direct result of a defence failure, resulting in the evacuation of two thirds of the village's population.
55. Within defended areas there will always be a residual risk of flooding. This may be due to an extreme event that overtops the design 'height' of the defence, changing climatic conditions that increases the frequency and severity of extreme flooding, a structural failure of the constructed flood defence system, or flooding behind the defences due to local runoff or groundwater.
56. It is incumbent on both the Council (in preparing the Local Development Framework) and developers (at the planning application stage) to ensure that the level and integrity of defence provided within developing areas can be assured for the lifetime of the development. This should include an appraisal of the current structural integrity of the defence, including an indication of the anticipated residual life of the structure, and the standard of protection (from a flooding perspective) that the defence offers.
57. It is important that careful consideration is given to the ongoing maintenance of the defence, over the lifetime of the proposed development, and how this will be funded. It is important to recognise that it is the responsibility of the *landowner* to protect them self against the risk of flooding. The Environment Agency has *permissive* powers to construct and maintain flood defences, however there is no obligation upon the EA to provide flood defence to property in England and Wales. The Environment Agency will establish its

investment policy for the future maintenance (and improvement) of flood defences within the East Riding through a programme of Flood Risk Management Strategies and Catchment Flood Management Plans. These are currently being prepared, and are referred to within Section 6.3 below.

58. A large proportion of East Riding is defended against both tidal flooding, and fluvial flooding from rivers including the River Aire, the River Ouse, the Dutch River, the River Hull and the Humber. Land levels within the Authority area are, in some areas, situated below Mean High Water Spring (MHWS), and therefore the future sustainability of these areas is almost wholly reliant upon the long term integrity of these flood defences.

4.6 Consultation

59. Consultation has formed a key part of the data collation phase for the East Riding of Yorkshire SFRA. The following key stakeholders have been comprehensively consulted to inform the current investigation:

East Riding of Yorkshire Council

Planning: Consulted to identify areas under pressure from development and/or regeneration

Drainage: Consulted to identify areas potentially at risk from river flooding, urban drainage and groundwater

Environment Agency

The Environment Agency has been consulted to source specific flood risk information to inform the development of the SFRA. The Environment Agency is a statutory consultee under PPS25 and therefore must be satisfied with the findings and recommendations for sustainable flood risk management into the future. For this reason, the Environment Agency has been consulted during the development of the SFRA to discuss potential flood risk mitigation measures and planning recommendations.

Internal Drainage Boards

A large proportion of the East Riding is relatively low lying land that is heavily dependant upon artificial drainage for future sustainability. These areas are almost exclusively utilised for agricultural purposes, and it follows that development pressure within these areas is minimal.

Notwithstanding this however, a number of Internal Drainage Boards (IDBs) are responsible for managing the drainage of low lying areas within the East Riding. These were consulted early in the SFRA process, and notes of interviews conducted with the main IDB clerks are provided in Appendix B.

Yorkshire Water

Yorkshire Water is responsible for the management of urban drainage (surface water) and sewerage within the Authority area. The utility company was consulted to discuss the risk of localised flooding associated with the existing drainage/sewer system. Unfortunately the feedback provided was very general in nature, providing simply a summary of the number of recorded incidents per post code. It is not possible therefore to pinpoint known capacity problems and/or infrastructure at risk of structural failure.

It is noted that Yorkshire Water collates a summary of properties affected by flooding as a result of the failure (or surcharging) of the sewer system, referred to as the 'DG5 register'. This register is a collation of the addresses of all incidents of sewer related flooding over time, and it is worth noting that properties are only removed from the list when improvements are made to the system to rectify the problem. Due to issues of confidentiality, the information that could be made available for publishing within a public document is very general in nature, and relatively little knowledge can be drawn. Yorkshire Water is obliged to provide this data upon request however, and detailed site based investigations should approach the organisation to seek

information relating to historical incidents of sewer system related flooding.

The events of June 2007 clearly highlighted the potential risk that surface water flooding can have upon an area, triggering (in part) the government's commissioning of the independent Pitt Review. A key recommendation of the Pitt Review was the importance of considering explicitly the potential risks associated with surface water flooding. For this reason, the East Riding of Yorkshire SFRA has carried out a strategic review of surface water risks to highlight areas that may warrant further detailed investigation as part of the planning process.

It is essential to ensure that future development does not exacerbate known existing surface water related problems. Planning decisions should be made with due consideration to potential drainage and sewer capacity problems (to be advised by Yorkshire Water as part of the statutory LDF consultation process), and conditions should be placed upon future development to ensure that these capacity issues are rectified before development is permitted to proceed.

4.7 Flood Warning Areas

60. Areas benefiting from the Environment Agency's Flood Warnings Direct Service can be seen in Figure C. The Environment Agency's Flood Warnings Direct Service provides flood warnings direct to customers by telephone, mobile, fax or pager. Customers can also get practical advice on preparing for a flood and what to do if one happens. The areas that are within the flood warning zone include properties at risk of tidal and/or fluvial flooding from the River Aire, River Ouse, River Derwent, Dutch River, River Hull and Humber Estuary.
61. It is important to recognise that flood warning in England is currently provided as an 'opt in' service. For this reason, only those property owners that actively register with the service will receive a flood warning. This is a cause for concern, and is an issue of national debate at the time of writing. It is understood that the Environment Agency is keen to establish an 'opt out' system for flood warning, within which property owners would have to actively elect *not* to receive warnings of a possible flooding event. Until this time, raising community awareness with respect to the inherent risks posed by flooding within East Riding is of critical importance.

4.8 Topography & Geology

62. Topographic information has been provided by East Riding of Yorkshire Council and the Environment Agency.
 - LiDAR has been provided by the Environment Agency, restricted purely to known fluvial and tidal floodplain areas. LiDAR is a detailed Digital Elevation Model (DEM) that, in simple terms, offers a three dimensional representation of the local topography. The vertical accuracy of LiDAR data is generally very good, within $\pm 250\text{mm}$ in many cases, in predominantly rural areas such as East Riding.
 - Contour information has been provided by East Riding of Yorkshire Council for the whole district. This data has been converted into a DEM (using ArcGIS) to enable the assessment of potential overland flow routes. The source of the contour information is not readily known, however it is understood that the vertical accuracy of this data is relatively poor (up to $\pm 10\text{m}$ in steep areas). Caution should be used in the application of this data therefore.
63. Geological information has been retrieved from the British Geological Society (BGS), providing an overview of soils and substrate.
64. The topographic and geological characteristics of East Riding are discussed in Section 5.5 below

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5 Data Interpretation

65. The data captured from key sources to inform the development of the East Riding SFRA is outlined in Section 4 above. This section provides an overview of how this data has been interpreted to meet the requirements of PPS25.

5.1 Delineation of the PPS25 Flood Zones (Fluvial & Tidal Flood Risk)

66. It is emphasised that the risk of an event (in this instance a flood event) is a function of both the probability that the flood will occur, and the consequences of the flooding. PPS25 endeavours to assess the likelihood (or probability) of flooding, categorising the Authority area into zones of low, medium and high probability. It then provides recommendations to assist the Council to manage the consequence of flooding in a sustainable manner; for example, through the restriction of vulnerable development in areas of highest flood risk.
67. To this end, a key outcome of the SFRA process is the establishment of flood maps that will inform the application of the Sequential Test in accordance with Appendix D (Table D1) of PPS25. To inform the planning process, it is necessary to delineate the area into zones that depict the likelihood (or probability) that flooding will occur.
68. The Authority area has been delineated into the flood zones summarised below:

Zone 3b Functional Floodplain

Parts of the Authority area susceptible to flooding within which “water has to flow or be stored in times of flood” (PPS25)

Zone 3a High Probability

Land assessed as having a 1% (1 in 100) or greater annual probability of river flooding in any year, or a 0.5% (1 in 200) or greater annual probability of tidal flooding in any year

Zone 2 Medium Probability

Land assessed as having between a 0.5% AEP (1 in 200) and 0.1% AEP (1 in 1000) annual probability of river flooding in any year

Zone 1 Low Probability

Land assessed as having a less than 0.1% (1 in 1000) annual probability of river flooding in any year

5.1.1 Delineation of Zone 3b Functional Floodplain

69. Zone 3b Functional Floodplain is defined as those areas in which “water has to flow or be stored in times of flood”. The definition of functional floodplain remains somewhat open to subjective interpretation. PPS25¹⁰ states that “SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)”. For the purposes of the East Riding of Yorkshire SFRA, Zone 3b has been defined in the following manner:
- land subject to flooding in the 4% AEP (25 year) flood event; and/or

¹⁰ Table D1, Appendix D, PPS25

- land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas); and
 - land where the flow of flood water is not prevented by flood defences or by permanent buildings or other solid barriers during times of flood;
70. Detailed modelled flood extents for the 4% (1 in 25) design event were adopted for rivers within the Authority area for the basis of Zone 3b Functional Floodplain delineation, as discussed in Section 4.4. In addition, dedicated washland areas that are retained specifically for flood retention purposes have been delineated as Zone 3b Functional Floodplain.
71. As highlighted in Section 5.5 below, there are areas of the Authority area that are reliant upon raised defences and artificial pumping to drain the land. Detailed modelling carried out by the Environment Agency has indicated that, in some locations, areas could be at risk of flooding in the 4% (1 in 25) design event should these flood defences and/or pumping systems fail. Whilst these areas are *not* considered Zone 3b Functional Floodplain from a planning perspective, they have been highlighted as hatched areas on the adjoining flood maps (see Appendix A). It is important to recognise the importance of retaining investment in the artificial drainage systems that service these areas if their future sustainability is to be assured.

5.1.2 Delineation of Zone 3a High Probability

72. Zone 3a High Probability is defined as those areas of East Riding that are situated within the 0.5% (1 in 200) flood extent within tidally influenced areas¹¹, and the 1% (1 in 100) flood extent within areas that are dominated by fluvial flooding.
73. The Environment Agency Flood Zone Map (June 2008) has been adopted for the delineation of Zone 3a High Probability. Whilst detailed modelling of the River Hull, Burstwick Drain, River Derwent, River Ouse, River Aire and Dutch River is available, it is important to recognise that Zone 3a is to be delineated *without* the presence of formal and/or informal defences. The detailed modelling of the rivers depicts the physical characteristics of the existing system, *including* raised walls where these exist. These are therefore not suitable for the assessment of Zone 3a High Probability, and reliance is therefore placed upon the Environment Agency Flood Zone Map to delineate the extent of this flood zone.
74. It is clear however that a relatively large proportion of the East Riding is affected by Zone 3a High Probability. To assist the Council to sensibly apply the Sequential Test therefore, it is important to consider more carefully the delineation of 'real' risk to property and life as a result of flooding within Zone 3a. The adopted approach is outlined below.

Sub-delineation of Zone 3a within Areas Dominated by Flooding from Rivers

Within those areas of the East Riding that are at risk of fluvial flooding, but are not affected by a risk of tidal flooding¹², the sub-delineation of Zone 3a is based purely upon the PPS25 flood zones (i.e. Zone 3b Functional Floodplain) as set out in Sections 5.1.1 above.

¹¹ This includes areas adjacent to the Humber, the River Aire, the River Ouse and Dutch River

¹² Including, for example, Beverley and Stamford Bridge that are situated some distance from the Humber Estuary

Sub-delineation of Zone 3a within Areas Dominated by Tidal Flooding

Within those areas that are potentially at risk of flooding from the sea, a more detailed appraisal of flood risk has been carried out. It is important to reiterate that a large proportion of this area is low lying, and therefore heavily reliant upon the presence of raised defences to prevent the frequent inundation of the area during high tides (and tidal flooding events). The delineation of flood risk has been carried out accordingly, namely:

Areas at immediate risk following a breach failure

Within areas situated in close proximity to the raised defences, the sub-delineation of Zone 3a has been carried out assuming the potential danger posed by a breach failure of the defences. The methodology adopted has been based upon the 'Simple Method' established within FD2320, and this is explained in Appendix J. In simple terms however, this methodology considers the height of the flood defence, and consequently the likely depth and speed of the flood wave following a sudden defence collapse. The area is then sub-delineated into zones of likely danger to people that may be caught unexpectedly by the flood wave, including a 'Danger to All', a 'Danger to Most' and a 'Danger to Some'. Specific spatial planning and development control recommendations have been established accordingly.

Areas that will receive a warning following breach failure

Within areas situated some distance away from the raised flood defences, it is likely that a warning can be issued following a defence failure, enabling the local community to take action to reduce the damage sustained and/or the risk to life. It is considered sensible to assume that the likely risk to property and life is proportional to the length of forewarning that can be provided, and for this reason the area has been delineated on the basis of less than 6hours warning (i.e. of a breach failure), 6-12hours warning, and greater than 12hours warning. Once again, specific planning recommendations have been established for each sub-zone accordingly.

75. A table showing which settlements fall within the 'tidally dominated 3a' and 'fluvially dominated 3a' is provided at Section 6.4.4. It is important to highlight that a detailed two dimensional analysis is being carried out for Goole, as part of a Level 2 SFRA. This should be referred to, once complete, for an appraisal of risk within the town. This is discussed further in Section 5.2 below.

5.1.3 Delineation of Zone 2 Medium Probability

76. Zone 2 Medium Probability is defined as those areas of East Riding that are situated between the 0.1% AEP (1 in 1000) and the 0.5% AEP (1 in 200) flood extents. In this instance, Zone 2 Medium Probability is defined in accordance with the Environment Agency Flood Zone Map.

5.1.4 Delineation of Zone 1 Low Probability

77. Zone 1 Low Probability is defined as those areas of East Riding that are situated outside of the 0.1% AEP (1 in 1000) flood extent. For SFRA purposes, this incorporates all land that is outside of the shaded Zone 2 and Zone 3 flood risk areas (as defined above).

5.2 Assessment of Risk (Flood Hazard)

78. The assessment of flood risk has thus far considered the maximum extent to which flooding will occur during a particular flood event. This provides the basis for assessing broadly the areas potentially impacted by flooding. Of equal importance however is the speed with which (and depth) flooding occurs as water levels rise, particularly within East Riding where a relatively large proportion of the Authority area is protected by a system of raised flood defences. The sudden inundation of floodwaters into low lying areas can pose a considerable risk to life.

Detailed Assessment of Flood Hazard (Site Based)

79. Substantial research has been carried out internationally into the risk posed to pedestrians during flash flooding, arising as a result of a rapid increase in river levels, and/or the sudden collapse of a flood defence. This research has concluded that the likelihood of a person being knocked over by floodwaters is related directly to the depth of flow, and the speed with which the water is flowing.
80. To ensure that the risk posed by floodwaters is assessed consistently, Defra (in collaboration with the Environment Agency) has produced a guidance document entitled FD2320 Flood Risk Assessment Guidance. The guidance provides criteria for determining the degree of danger that is posed to life, assessed as a product of flood depth and flow velocity (i.e. $\text{depth(m)} \times (\text{velocity(m/sec)} + 0.5) + \text{debris factor}$). The guidance states that if this product is below 0.75, then caution should be exercised due to “*shallow flowing water or deep standing water*”. In contrast, if the product exceeds 2.0 then the hazard posed to life is extreme with “*deep fast flowing water*”, representing a danger to all.
81. **This guidance should be used as part of the design process for all site based Flood Risk Assessments to ensure that the proposed development is safe under all flooding conditions.**
82. The delineation of flood hazard should also be used to inform a sequential approach to the siting of development within an area, guiding vulnerable uses away from areas most at risk. Goole is a key area of regeneration within the East Riding, and with a very large proportion of the town situated below Mean High Water Spring (MHWS) tide level, Goole is entirely dependent upon the future integrity of the raised flood defences that surround it.
83. In recognition of the critical importance of the potential hazard that flooding poses to the area, the Council is carrying out a detailed Level 2 SFRA that focuses specifically upon establishing a thorough appreciation of the current standard of protection provided by the defences, and how this will change over time (i.e. as a result of climate change).

5.3 Assessment of Localised Flood Risk

5.3.1 Surface Water Flooding

84. The risk of flooding from other (non fluvial) sources is an important consideration. The recent flooding that affected England, and particularly Yorkshire, in the summer of 2007 highlighted the potential risk that groundwater, surface water runoff and sewer flooding can have upon an area. Approximately 6000 homes, 200 businesses, 38 schools, 700km of road, and 12,000 hectares of agricultural land were affected in East Riding during the summer 2007 event, and surface water flooding was the primary source of flooding in this instance.
85. Within East Riding, relatively limited information is available relating to anecdotal observations of localised flood risk problems (with the exception of the widespread flooding that affected the Authority area in 2007). Anecdotal information relating to localised incidents have been captured, and these are generally as a result of blocked culverts and gullies, surface water runoff, and failures of the underground sewer system.
86. It is important to highlight however that this information only relates to localised problems *once they have occurred*. PPS25 strongly advocates the prediction (where possible) of potential flood risk, seeking an avoidance strategy that guides development away from these areas wherever possible. It is very difficult to sensibly predict the potential risk of localised flooding, particularly given that many of these incidents will be as a result of (for example) the collection of leaves over a gully during a rainfall event.
87. The topography and geology of the Authority area provides a means of broadly identifying those areas within which surface water runoff is likely to cause the most disruption and potentially damage to property. Areas in which the soils are highly impermeable (reducing the capacity of infiltration into the ground during periods of wet weather) and localised 'sags' in the topography (where ponding is likely to occur) can be considered locations within which the potential risk of localised flooding should be taken into account as part of the design process. An overview of the geology and topography of the Authority area is provided in Figures D and E.
88. To provide an overview of areas that are potentially most at risk of surface water flooding however, a detailed analysis of surface water hazard has been carried out. The adopted methodology is explained in Appendix C, however in simple terms an assessment of the Authority area topography has been carried out in the initial instance to identify localised areas of low lying ground that may be subject to ponding. The potential hazard posed by surface water flooding has been determined as a function of the likelihood of local runoff flowing *through* the site, and the likelihood (and depth) of local runoff ponding *within* the site.
89. It is important to recognise that development can fundamentally alter drainage patterns, obstructing overland flow routes, and altering the volume and speed of runoff. The SFRA has therefore captured readily available information relating to localised flooding in an effort to inform future detailed Flood Risk Assessments (FRAs). It is essential to highlight that this should not be considered a comprehensive representation of all localised flood risks as indeed not all observed incidents may have been reported (and the blockage of culverts and gullies can happen anywhere).

5.3.2 Groundwater Flooding

90. A large proportion of the East Riding is characterised by chalk geology, and following heavy rainfall elevated groundwater levels are often experienced. At times this will result in flooding. Incidents of property flooding attributed to elevated groundwater levels were recorded in Cottingham, Burton Fleming and Kilham following the widespread flooding of November 2000, and most recently within North Cave in 2007.

91. The impact of groundwater flooding can be quite severe, and it is important that planning decisions are taken in an informed manner within areas that may be susceptible. Some key characteristics of groundwater flooding are set out below¹³:
- During groundwater flooding events, property, land, roads and services are “under water” for long periods of time with significant physical, economic and social consequences. Compared to fluvial events where floodwater dissipates in a few hours or at the most a day or two, groundwater flooding can be present for periods of many months. The maximum known period in England is six months (Orpington) and in France is three years (Abbeville). This long duration of inundation increases the level of impact compared to fluvial flooding.
 - The damage to property is of a different type to that normally associated with fluvial flooding. Properties that are subjected to groundwater inundation for long periods can suffer damp penetration to the extent that they become structurally unsafe and require significant structural repairs or even demolition.
 - Where groundwater flooding affects roads, it can cause deterioration to the road top surface and sub-base due to erosion and hydrostatic uplift pressures.
 - The surcharging of sewers by groundwater can cause backwater flows of untreated sewage into properties. In homes and businesses that have cellars, this impact can be particularly damaging and unpleasant;
 - Groundwater can exacerbate the potential risk of river flooding, increasing the base flow within the river channel, and reducing the capacity of the river to capture overland flow.
92. The risk of groundwater flooding is highly variable and heavily dependent upon local conditions at any particular time. In an endeavour to provide an indication of areas throughout the country that may be at risk of flooding, Defra commissioned the development of a national ‘Groundwater Emergence Map’ (Jacobs, 2004¹⁴). This identifies areas that may be susceptible to elevated groundwater levels following prolonged rainfall. The outcomes of this modelling and mapping exercise (within East Riding) is presented in Appendix I. Incidents of recorded groundwater flooding following the widespread flooding of 2000 within the Authority area are also provided.
93. It is recognised that the risks associated with groundwater flooding are not well understood, and it is important to ensure that future development is not placed at unnecessary risk. For this reason, the following recommendations are put forward for consideration:

Forward Planning

- It is a requirement of the PPS25 Practice Guide that all emerging allocations that fall within Zone 3a High Probability and/or Zone 2 Medium Probability are subject to a Level 2 SFRA. The primary purpose of this investigation is to review in greater detail the potential risk that flooding poses to the site. It is recommended that all sites that fall within the Groundwater Emergence Zone, as depicted in Appendix I, are also subject to a Level 2 SFRA, i.e. irrespective of their susceptibility to fluvial and/or tidal flooding. This will allow a more detailed assessment of the potential risk of groundwater flooding to the site, considering (for example) the history of flooding within the immediate area, and the local geology.

Where it is determined that the site cannot safely be developed in light of the potential risk of groundwater flooding (i.e. as an outcome of the Level 2 SFRA) then consideration may need to be given to avoiding the allocation of the site for

¹³ Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (Defra), Jacobs 2004f

¹⁴ Strategy for Flood and Coastal Erosion Risk Management: Groundwater Flooding Scoping Study (Defra), Jacobs 2004f

future development.

Development Control

- In accordance with PPS25, all future development will require an appropriate Flood Risk Assessment (FRA) at the planning application stage, commensurate with the level of flood risk posed to the site. In those areas where a possible risk of groundwater flooding has been identified, i.e. within the Groundwater Emergence Zone (Appendix I), the FRA should consider more explicitly the localised risk of flooding to the site due to groundwater.

The adopted development will need to mitigate both the risk of groundwater flooding to the development itself, and the potential increase in flood risk posed to adjoining properties. The raising of thresholds and the provision of high-level access may be required to minimise the potential risk to tenants within the development. It is also important to consider the impact that groundwater may have upon the effectiveness of any adopted SUDS system.

5.4 Potential Impacts of Climate Change upon Flood Risk

94. A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change is perceived to represent an increasing risk to low lying areas of England, and it is anticipated that the frequency and severity of flooding will change measurably within our lifetime.
95. It is essential that East Riding of Yorkshire Council and developers consider the possible change in flood risk over the lifetime of the development as a result of climate change. The likely increase in flow over the lifetime of the development should be assessed proportionally to the guidance provided above.

Fluvial Flooding

96. PPS25 (Appendix B) states that a 10% increase in rivers' 1% AEP (1 in 100) flood flow can be expected within the next 20 years, increasing to 20% within the next 100 years.
97. As highlighted in Section 4.5 above, the detailed modelling of watercourses within the study area has included the presence of existing raised formal flood defences when considering the potential impacts of climate change. As the planning process must consider the risk of flooding over the lifetime of development (up to 100 years), it is important to assume that existing structures may not be retained in the longer term, and/or may fail unexpectedly. For this reason, the detailed model outputs are not appropriate for planning purposes in this instance.
98. In accordance with current best practice therefore, the Environment Agency's Flood Zone Maps have formed the basis for the assessment of flood risk in East Riding. In the absence of detailed modelling, the Environment Agency advocate using the current 0.1% AEP (1 in 1000) flood outline, i.e. Zone 2 Medium Probability, as a conservative estimation of the anticipated extent of the 1% AEP (1 in 100) flood affected area in 100 years (i.e. as a result of climate change).

Tidal Flooding

99. A relatively large proportion of the area at risk of flooding within East Yorkshire is dominated by tidal flooding. In tidally affected areas within the north east of England, an increasing rate of change in predicted sea levels is to be assumed with time, as summarised in the table below, equating to an anticipated increase in predicted sea levels of up to approximately 1m over the next 100 years.

Recommended Contingency Allowances for Net Sea Level Rise

North East England (applied to 1990 base sea level)

PPS25 (Appendix B) Table B2

| 1990 to 2025 | 2025 to 2055 | 2055 to 2085 | 2085 to 2115 |
|--------------|--------------|--------------|--------------|
| 2.5mm/yr | 7.0mm/yr | 10.0mm/yr | 13.0mm/yr |

100. Once again, the heavily defended nature of the Authority area reiterates the importance of considering the long term standard of protection that will be provided. Whilst a robust standard of protection may be available today, in many areas protecting properties against flooding in a 0.5% (1 in 200) design event, this will reduce over time as sea levels rise. It is vitally important that this deterioration in the standard of protection is understood, and more detailed investigations should be carried out in due course, guiding planning decisions¹⁵.

Localised Flooding

101. It is important to remember that the potential impacts of climate change will affect not only the risk of flooding posed to property as a result of river and tidal flooding, but it will also potentially increase the frequency and intensity of localised storms over the Authority area. This may exacerbate localised drainage problems, and it is essential therefore that the detailed FRA considers the potential impacts of climate change upon localised flood risks, as well as the risks of fluvial and tidal flooding. The predicted increase in rainfall intensity as a result of climate change (for design purposes) is provided in Table B2, Appendix B of PPS25.

5.5 Topography & Geology

Topography

102. The eastern area of the East Riding is characterised by low-lying, undulating countryside, and features the River Hull which flows south from Driffeld, past Beverley, and into the Humber at Kingston-upon-Hull. The South Holderness catchments are characteristically low lying areas of the East Riding, situated to the south east of Hull at the mouth of the River Humber estuary.
103. The Yorkshire Wolds are rolling chalk hills that run through the heart of the East Riding. To the west of the Wolds is the Vale of York, which is relatively flat, low-lying ground. The River Derwent forms most of the East Riding's western boundary, flowing from Stamford Bridge to near Howden where it joins the River Ouse. The River Aire and Dutch River also flow into the River Ouse near Goole, which then flows in an easterly direction into the Humber.
104. The characteristic low lying nature of the East Riding, and its many rivers, result in a sizeable proportion of the Authority area being at risk of flooding. A relatively large

¹⁵ A detailed Level 2 SFRA is being undertaken for the Goole area to assess the potential impact that climate change will have upon the long term standard of protection provided by the existing raised defences. This is explained in Section 5.2

proportion of the 'at risk' areas highlighted in Figure A are situated beneath Mean High Water Spring (MHWS) level, and would be subject to frequent tidal inundation in the absence of the raised system of flood defences. These areas are also reliant upon pumping to lower groundwater levels, keeping the area drained. This system of artificial drainage can quickly become overwhelmed following particularly intense rainfall, resulting in surface water and groundwater, as was evident in June 2007.

105. An overview of the Authority area topography is provided in Figure E.

Geology

106. The geology of the East Riding is characterised by clay, sand and silts to the west, beneath the floodplains of the River Aire, River Ouse and River Derwent (i.e. including Goole). These soils are also characteristic of the River Hull floodplain. The remainder of the Authority area is characterised by chalk, and these areas are susceptible to both elevated groundwater levels in inland locations (refer Section 5.3.2 above), and an eroding coastline.
107. An overview of the East Riding of Yorkshire geology is provided in Figure D.

5.6 Coastal Erosion

108. The East Riding is bounded to the east by the North Sea, extending northwards from Spurn Point (at the mouth of the Humber Estuary) to the chalk cliffs of Flamborough Head. The coastline is mostly composed of boulder clay and in parts is the fastest eroding coast in Europe.
109. The long term sustainability of the coastline is heavily dependent upon a robust understanding of coastal processes, and the careful management of future development within coastal areas. In an endeavour to develop this understanding, and to establish policies for effective future investment in coastal management, a series of Shoreline Management Plans have been developed across the country.
110. A Shoreline Management Plan covering the East Riding coast was established in 1998, spanning from Flamborough Head to Donna Nook. A subsequent study entitled the "East Riding Integrated Coastal Zone Management Plan" was developed in 2002. A second generation SMP is currently under development to review future policy for coastline management. This is due to be completed by the end of 2010.
111. Whilst the specific outcomes of the emerging second generation SMP were not available to inform this investigation, the risk of coastal flooding affecting communities situated along the North Sea coastline¹⁶ within the East Riding of Yorkshire is generally low, with very few properties affected. Notwithstanding this however, the East Riding coastline is heavily susceptible to coastal erosion, and the future sustainability of the area requires the careful balancing of development against the protection of environmentally sensitive areas and natural coastal processes. The current adopted policy for coastal management within the East Riding is the protection of the major coastal communities including Hornsea, Withernsea and Bridlington, and key infrastructure, such as Easington gas terminal. The remainder of the coastline is being largely left undefended, allowing naturally occurring coastal processes to take their course.

¹⁶ including (for example) Withernsea, Hornsea and Bridlington

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6 Sustainable Management of Flood Risk

6.1 Overview

112. An ability to demonstrate 'sustainability' is a primary government objective for future development within the UK. The definition of 'sustainability' encompasses a number of important issues ranging broadly from the environment (i.e. minimising the impact upon the natural environment) to energy consumption (i.e. seeking alternative sources of energy to avoid the depletion of natural resources). Of particular importance however is sustainable development within flood affected areas.
113. Recent history has shown the devastating impacts that flooding can have on lives, homes and businesses. A considerable number of people live and work within areas that are susceptible to flooding, and ideally development should be moved away from these areas over time. It is recognised however that this is often not a practicable solution. For this reason, careful consideration must be taken of the measures that can be put into place to minimise the risk to property and life posed by flooding. These should address the flood risk not only in the short term, but throughout the lifetime of the proposed development. This is a requirement of PPS25.
114. The primary purpose of the SFRA is to inform decision making as part of the planning and development control process, taking due consideration of the scale and nature of flood risk affecting the Authority area. It also provides a tool for developers to assist the preparation of site-specific Flood Risk Assessments. Responsibility for flood risk management resides with all tiers of government, and indeed individual landowners, as outlined below.

6.2 Responsibility for Flood Risk Management

115. There is no statutory requirement for the Government to protect property against the risk of flooding. Notwithstanding this however, the Government recognise the importance of safeguarding the wider community, and in doing so the economic and social well being of the nation. An overview of key responsibilities with respect to flood risk management is provided below.
116. The Environment Agency exercises permissive powers to provide flood management and defence in England. It assists the planning and development control process by providing timely information and advice on flooding issues that is fit for purpose.
117. The Local Planning Authority is responsible for carrying out a Strategic Flood Risk Assessment. The SFRA should consider the risk of flooding throughout the Authority area and should inform the allocation of land for future development, development control policies and sustainability appraisals. Local Planning Authorities have a responsibility to consult with the Environment Agency when making planning decisions.
118. Within the East Riding, there are a number of Internal Drainage Boards (IDBs) that hold permissive powers to carry out maintenance (for example, the clearing of vegetation and the maintenance of local pumping facilities) upon ordinary¹⁷ watercourses and drains in rural areas of the Authority area.
119. Landowners & Developers¹⁸ have the primary responsibility for protecting their land against the risk of flooding. They are also responsible for managing the drainage of their land such that they do not adversely impact upon adjoining properties.
120. Yorkshire Water is responsible for the management of urban drainage (surface water) and sewerage, and the provision of water supplies within the East Riding.
121. The Environment Agency has developed a guide entitled "Living on the Edge" that provides specific advice regarding the rights and responsibilities of property owners, the

¹⁷ Ordinary watercourses are smaller river systems that are not managed and/or maintained by the Environment Agency

¹⁸ Referred to also as 'landowners' within PPS25

Environment Agency and other bodies. The guide is targeted at owners of land situated alongside rivers or other watercourses, and is a useful reference point outlining who is responsible for flood defence, and what this means in practical terms. It also discusses how stakeholders can work collaboratively to protect and enhance the natural environment of our rivers and streams. This guide can be found on the Environment Agency's website at <http://www.environment-agency.gov.uk/subjects/flood/362926/>.

6.3 Strategic Flood Risk Management - The Environment Agency

6.3.1 Overview

122. With the progressive development of urban areas along river corridors and sea fronts, particularly during the industrial era, a reactive approach to flood risk management evolved. As flooding occurred, walls or embankments were built to prevent inundation to developing areas. Needless to say, construction of such walls should be carefully assessed so that it does not result in the redistribution of floodwater, inadvertently increasing the risk of flooding elsewhere.
123. The Environment Agency in more recent years has taken a strategic approach to flood risk management. The assessment and management of flood risk is carried out on a 'whole of catchment' basis. This enables the Environment Agency to review the impact that proposed defence works at a particular location may have upon flooding at other locations throughout the catchment.
124. A number of strategic investigations are underway within the region, encompassing the river systems that influence flood risk within the East Riding of Yorkshire. A brief overview of these investigations is provided below, and the emerging outcomes of the Environment Agency's strategy umbrella is summarised in Appendix G. It should be noted however that the Council has serious concerns about both the process of consultation adopted by the Environment Agency and the technical content of the various plans. At the present time, the emerging outcomes referred to in Appendix G are for information only, particularly in relation to statements about future policy and investment proposals.

6.3.2 Catchment Flood Management Plan (CFMP)

125. *"One of the Environment Agency's main goals is to reduce flood risk from rivers and the sea to people, property and the natural environment by supporting and implementing government policies.*
126. *Flooding is a natural process – we can never stop it happening altogether. So tackling flooding is more than just defending against floods. It means understanding the complex causes of flooding and taking co-ordinated action on every front in partnership with others to reduce flood risk by:*
 - *Understanding current and future flood risk;*
 - *Planning for the likely impacts of climate change;*
 - *Preventing inappropriate development in flood risk areas;*
 - *Delivering more sustainable measures to reduce flood risk;*
 - *Exploring the wider opportunities to reduce the sources of flood risk, including changes in land use and land management practices and the use of sustainable drainage systems.*
127. *Catchment Flood Management Plans (CFMPs) are a planning tool through which the Agency aims to work in partnership with other key decision-makers within a river catchment to explore and define long term sustainable policies for flood risk management. CFMPs are a learning process to support an integrated approach to land use planning and management, and also River Basin Management Plans under the*

*Water Framework Directive.*¹⁹

128. A series of CFMPs are being developed for catchments that fall within the East Riding. These include the River Aire, River Derwent, River Don (Dutch River), River Trent, River Hull, and River Ouse catchments. Draft CFMPs for each catchment were issued for public consultation between 2007 and 2008. As outlined in the description above, the CFMP will provide the framework beneath which future investment decisions relating to flood risk management will be made within the region. In simple terms, the CFMP will consider (for example) whether further investment in flood mitigation is warranted, or whether future sustainability - measured in both economic and environmental terms - within the wider region can only be achieved by 'walking away', allowing the natural floodplain to re-establish. This balance will be assessed on a reach by reach basis along the length of the respective river systems.
129. A summary of proposed CFMP recommendations relevant to the East Riding is provided in Appendix G, for information only.

6.3.3 Flood Risk Management Strategy (FRMS)

130. As explained in the section above, the CFMP provides an over-arching policy for future investment in flood defence within a catchment area. Within the Environment Agency's hierarchy of plans, the Flood Risk Management Strategy (FRMS) examines the possible opportunities available to deliver this CFMP policy into the future, and establishes the most effective and sustainable way forward for the area.
131. A number of Flood Risk Management Strategies are underway within this region of the EA, and the outcomes of these investigations will directly influence the rivers that fall within the East Riding of Yorkshire. Once again, it is important for the Council to be aware of emerging EA strategies for flood risk management, particularly in areas such as East Riding where there is such a high degree of dependency upon flood defence.

6.4 Application of PPS25 within the East Riding of Yorkshire

6.4.1 Planning Solutions to Flood Risk Management

The Sequential Test

132. Historically, urbanisation has evolved along river corridors due to the rivers providing a critical source of water, food and energy. This leaves many areas of England with a legacy of settlements that, because of their close proximity to rivers, are at risk of flooding.
133. The ideal solution to effective and sustainable flood risk management is a planning led one, i.e. steer urban development away from areas that are susceptible to flooding. To this end, PPS25 advocates a sequential approach that will guide the planning decision making process. In simple terms, this requires planners to seek to allocate sites for future development within areas of lowest flood risk in the initial instance. Only if it can be demonstrated that there are no suitable sites within these areas should alternative sites (i.e. within areas that may potentially be at risk of flooding) be contemplated. This sequential approach is referred to as The Sequential Test, and is summarised in Figure 4.1 of the PPS25 Practice Guide (December 2009).
134. It is highlighted that the sequential approach should be adopted at *all* stages of the planning process. In addition to the application of The Sequential Test when allocating sites, it is also necessary for developers to consider the variation in the risk of flooding across their site, orienting vulnerable development away from areas that are most at risk.

¹⁹ Catchment Flood Management Plans – Volume 1 (Guidance), Version 1.0, July 2004

It is absolutely imperative to highlight that the SFRA does not attempt, and indeed cannot, fully address the requirements of the PPS25 Sequential Test. As highlighted in Figure 4.1 of the PPS25 Practice Guide, it is necessary for the Council to demonstrate that sites for future development have been sought within the lowest flood risk zone (i.e. Zone 1 Low Probability). Only if it can be shown that suitable sites are not available within this zone can alternative sites be considered within the areas that are at greater risk of possible flooding (i.e. Zone 2, and finally Zone 3).

135. In an endeavour to minimise the risk of flooding, PPS25 stipulates 'appropriate' land uses for each flood zone. It is the responsibility of both the Council (at the allocation stage) and developers (at the development stage) to make reference to Tables D1 and D2 of PPS25, restricting proposed land uses within areas that are at risk of flooding. In some instances, PPS25 requires both careful planning considerations to be placed upon the proposed development, and mitigating measures to be incorporated within the site to reduce the impact of flooding. These further considerations form part of The Exception Test, explained below, and reference should be made to Table D3 of PPS25 to determine where this will be triggered.
136. The Council must restrict development to the appropriate land uses summarised in PPS25 Appendix D Table D1 and Table D2 (duplicated in Appendix H for ease of reference). This may involve seeking opportunities to 'swap' more vulnerable allocations at risk of flooding with areas of lesser vulnerability that are situated on higher ground.
137. It is important to recognise that the principles of the sequential approach are applicable throughout the planning and development cycle, and refer equally to the forward planning process (delivered by Council as part of the LDF) as they do to the assessment of windfall sites. The detailed FRA will be required to demonstrate the careful and measured consideration of whether indeed there is an alternative site available within an area of lesser flood risk, in accordance with the PPS25 Sequential Test²⁰.

The Exception Test

138. A large proportion of the East Riding is situated within Zone 3a High Probability, affecting many existing communities within the Authority area. Prohibiting future development within these areas may have a detrimental impact upon the economic and social welfare of the existing community. It is essential that a sequential approach is taken to underpin all planning decisions as stipulated above. It may be however that pressing planning arguments (that outweigh flood risk) remain, putting into place a requirement to investigate further the possibility of regeneration and/or future development within areas at risk of flooding.
139. In this instance, the Council and potential future developers are required to work through the **Exception Test** (PPS25 Appendix D) where applicable. It is important to remember that the Sequential Test should always be carried out prior to the Exception Test. For the Exception Test to be passed:
 - *"It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission' stage, the benefits of the development should contribute to the Development Plan Document's Sustainability Appraisal;*
 - *the development should be on developable, previously development land or if it is not on previously developed land, that there are no reasonable alternative sites on previously developed land;*

²⁰ It is strongly recommended that developers agree the application of the Sequential Test with the Council **before** embarking upon a detailed site based FRA, thereby ensuring that the site can be taken forward on planning grounds prior to considering potential design solutions

The first two points set out in the Exception Test are planning considerations. A planning solution to removing flood risk must be sought at each specific location in the initial instance, seeking to relocate the proposed allocation to an area of lower flood risk (i.e. Zone 1 Low Probability or Zone 2 Medium Probability) wherever feasible.

The East Riding of Yorkshire SFRA has been developed to inform the Sequential Test. It will be the responsibility of the Council to carry out the Sequential Test on the basis of this information, allocating potential sites for future development accordingly. Equally developers proposing sites in Zone 3 or Zone 2 will be required to demonstrate within the detailed Flood Risk Assessment that the Sequential Test has been applied, and (where appropriate) that the risk of flooding has been adequately addressed in accordance with PPS25.

- *a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall;*

The management of flood risk throughout the Authority area must be assured should development be permitted to proceed, addressing the third critical element of the Exception Test. The SFRA has provided specific recommendations that ultimately should be adopted as design features, with evidence provided of how they will be fulfilled prior to permission being granted for all future development. It is the responsibility of the prospective developer to build upon these recommendations as part of a detailed Flood Risk Assessment to ensure that the specific requirements of PPS25 can be met.

140. An overview of flood risk throughout the Authority area has been provided in Section 6. **Future planning decisions should consider the spatial variation in flood risk across the Authority area, as defined by the delineated flood zone that applies at the specified site location, and apply the recommendations provided below accordingly.** It is reiterated that PPS25 applies to allocated sites identified within the emerging LDF and to future windfall sites.

6.4.2 A Proactive Approach – Positive Reduction of Flood Risk through Development

141. It is crucial to reiterate that PPS25 considers not only the risk of flooding posed to new development. It also seeks to positively reduce the risk of flooding posed to existing properties within the Authority area. It is strongly recommended that this principle be adopted as the underlying 'goal' for developers and Council development control teams within East Riding.
142. Developers should be encouraged to demonstrate that their proposal will deliver a positive reduction in flood risk to the East Riding, whether that be by reducing the frequency or severity of flooding (for example, through the introduction of SUDS), or by reducing the impact that flooding may have on the community (for example, through a reduction in the number of people within the site that may be at risk). This should not be seen as an onerous requirement, and indeed if integrated into the design at the conceptual stage, will place no added demands upon the development and/or planning application process.
143. Possible risk reduction measures for consideration may include the following:
 - The integration of SUDS to reduce the runoff rate from the site;
 - A change in land use to reduce the vulnerability of the proposed development;
 - A reduction in the building platform area and intensity of use. This is to prevent intensification through the addition of storeys (or other conversion) within the same footprint;

- Incorporating flood resilience into building design, for example, the raising of internal floor levels and flood proofing (within existing buildings) to reduce potential flood damage;
 - The rearrangement of buildings within the site to remove obstructions to overland flow paths. This is to ensure that water does not pond and cause localised flooding;
 - Apply the sequential approach at a site level to minimise risk by directing the most vulnerable development to areas of lowest flood risk, matching vulnerability of land use to flood risk (as stated in PPS25);
144. A clear statement will be required within each detailed FRA that concisely summarises how a reduction in flood risk has been achieved within the proposed (re)development. This may be specified as (for example) a reduction in flow from the site, a reduction in water levels within (or adjacent to) the site, or a reduction in the consequences of flooding.

6.4.3 Surface Water and Groundwater Flood Risk within the Planning Process

145. The PPS25 Practice Guide advocates the application of a sequential approach when allocating land, taking into consideration *all* sources of flooding. A review of potential groundwater and surface water hazard has been undertaken in an effort to inform and support the planning process.
146. From a spatial planning perspective, it may be unreasonable to restrict future development within areas that may have suffered a localised flooding incident in years past. Whilst the impact of the flooding that occurred in June 2007 is fresh in the minds of many, it is recognised that this was an extreme event, and rational decisions must be taken in this light.

It is essential however not to overlook the potential risk of surface water and/or groundwater flooding during the design process. A proactive approach to risk reduction through design can mitigate the potential for damage, both to the development itself and elsewhere. Advice from the Environment Agency says it is for the site-specific FRA to demonstrate whether a site is acceptable or not within a localised flood area. Developers are encouraged to liaise early with organisations such as Yorkshire Water, Internal Drainage Boards, and the Council's Land Drainage team to ensure that any potential adverse impacts on the existing drainage infrastructure can be mitigated through appropriate design solutions. Specific development control recommendations have been provided accordingly.

6.4.4 Spatial Planning & Development Control Recommendations

| | | | | | | |
|--|---|--|--|---|------------|-----------|
| PPS25 Requirement | PPS25 Flood Zone | | | | | |
| | TIDALLY DOMINATED FLOOD RISK (Flood Zone 3a) | | | | | |
| | Areas in Close Proximity to Defences | | | Areas Warned of a Defence Failure | | |
| | Danger to All | Danger to Most | Danger to Some | <6 hours | 6-12 hours | >12 hours |
| SPATIAL PLANNING RECOMMENDATIONS | | | | | | |
| Important Considerations | Future development within areas at risk of tidal flooding can only be considered following application of the Sequential Test | | | | | |
| Land Use (refer Table D2 of PPS25) | Land use should be restricted to Water Compatible, Essential Infrastructure or Less Vulnerable development. More Vulnerable development may only be considered if Exception Test can be passed | | | | | |
| | New development should be sited away from existing flood defences except in exceptional circumstances, where a flood risk assessment shows how the building and its users will be made safe (refer Appendix E). | | | Refer to advice under 'Areas in Close Proximity to Defences' | ~ | ~ |
| | More vulnerable development should not be permitted at ground level | More vulnerable development should not be permitted in single storey buildings; habitable uses should not be permitted at ground level in multi-storey buildings | More vulnerable development should not be permitted in single storey buildings | | | |
| DEVELOPMENT CONTROL RECOMMENDATIONS | | | | | | |
| Detailed Flood Risk Assessment (FRA) | Required | | | | | |
| Floor Level | To be agreed on a site by site basis | | | | | |
| Site Access & Egress | A safe refuge should be available on an upper floor, providing an immediate route of escape should a breach failure occur | | | To ensure the safety of residents and employees during a flood, access and egress routes must be designed to meet Environment Agency defined criteria, as set out in Appendix E. It is essential to ensure that the nominated evacuation route does not divert evacuees onto a 'dry island' upon which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event. | | |
| Basements | Basements are subject to rapid inundation without warning within this zone, and should not be permitted | | | Separate dwellings should not be permitted at basement level. All basements must have an access point that is above the 1 in 100 year fluvial, or 1 in 200 year tidal (whichever is greater) flood level, including climate change | | |
| **Please note that these recommendations do not apply to Goole. Development proposals within Goole will continue to be dealt with on a site by site basis until specific recommendations for Goole are agreed through a Level 2 SFRA** | | | | | | |

| PPS25 Requirement | PPS25 Flood Zone | | | |
|--------------------------------------|---|---|--|---|
| | FLUVIALLY DOMINATED FLOOD RISK | | Zone 2 Medium Probability | Zone 1 Low Probability |
| | Zone 3b Functional Floodplain | Zone 3a High Probability | | |
| SPATIAL PLANNING RECOMMENDATIONS | | | | |
| Important Considerations | It should be recognised that property situated within this zone will be subject to frequent flooding, on average, no less than once in every 25 years. There are clear sustainability implications to be considered in this regard, and it is highly questionable whether insurance against flooding related damages will be available in the longer term. Future development within Zone 3b Functional Floodplain can only be considered following application of the Sequential Test. | Future development within Zone 3a High Probability can only be considered following application of the Sequential Test | Future development within Zone 2 Medium Probability can only be considered following application of the Sequential Test | It is important to recognise that sites within Zone 1 may be susceptible to flooding from other sources. Development may contribute to an increase in flood risk elsewhere if not carefully mitigated |
| Land Use (refer Table D2 of PPS25) | Land use should be restricted to Water Compatible development or Essential Infrastructure. | Land use should be restricted to Water Compatible, Essential Infrastructure or Less Vulnerable development. More Vulnerable development may only be considered if Exception Test can be passed | Land use should be restricted to Water Compatible, Less Vulnerable, Essential Infrastructure or More Vulnerable development. Highly Vulnerable development may only be considered if Exception Test can be passed | No restrictions |
| DEVELOPMENT CONTROL RECOMMENDATIONS | | | | |
| Detailed Flood Risk Assessment (FRA) | Required | Required | Required | Required for all sites greater than 1ha in area, and/or situated within the Groundwater Emergence Zone, and/or a Surface Water Hazard Zone. |
| Floor Level | To be agreed on a site by site basis | Finished floor levels to be set at 600mm above average site level or adjacent road frontage level, whichever is higher plus an additional 300mm flood proofing. (Road frontage level defined as the average between the gutter and the crown of the road). | Finished floor levels to be set at 300mm above average site level or adjacent road frontage level, whichever is higher. (Road frontage level defined as the average between the gutter and the crown of the road). | No minimum level stipulated by PPS25 |
| Site Access & Egress | N/A | To ensure the safety of residents and employees during a flood, access and egress routes must be designed to meet Environment Agency defined criteria, as set out in Appendix A. It is essential to ensure that the nominated evacuation route does not divert evacuees onto a 'dry island' upon which essential supplies (i.e. food, shelter and medical treatment) will not be available for the duration of the flood event. | | No minimum level stipulated by PPS25 |
| Basements | N/A | Separate dwellings should not be permitted at basement level. All basements must have an access point that is above the 1 in 100 year fluvial, or 1 in 200 year tidal (whichever is greater) flood level, including climate change | No restrictions | No restrictions |

| ADDITIONAL DEVELOPMENT CONTROL RECOMMENDATIONS FOR ALL FLOOD ZONES | |
|--|--|
| Site Runoff | Implement SuDS on all sites unless it can be demonstrated that they are not practicable or that they will present an unacceptable pollution risk to controlled waters. Development on greenfield sites will be expected to restrict runoff to the greenfield runoff rate. Developments on brownfield sites will be expected to reduce existing runoff rates by a minimum of 30% in order to tackle the predicted impacts of climate change. Any SuDS design must take due account of groundwater and geological conditions (refer Section 6.6.3). It should be ensured that all developments adequately mitigate for the additional volume of surface water generated, not just the rate at which it runs off, to ensure that existing receiving waters are not over burdened. |
| Buffer Zone | A minimum 8m buffer zone should be provided to 'top of bank' within sites immediately adjoining a river corridor. This relates to both open waterways and culverted waterway corridors. Reference should be made to the Environment Agency's "Living on the Edge" guide (www.environment-agency.gov.uk) that discusses any development situated in, over, under or adjacent to rivers and/or streams. This requirement may be negotiated with the EA in heavily constrained locations. |
| Other | Ensure that the proposed development does not result in an increase in maximum flood levels within adjoining properties. This may be achieved by ensuring (for example) that the existing building footprint is not increased, that overland flow routes are not truncated by buildings and/or infrastructure, or hydraulically linked compensatory flood storage is provided within the site (or upstream) |
| | As an integral part of the government's "Making Space for Water" agenda, the Environment Agency is actively seeking the renaturalisation of culverted watercourses as part of any future development. Realistic opportunities to reinstate the natural open waterway within existing culverted reaches of the river(s) should be promoted |

| List of settlements/locations | Tidally dominated 3a | Fluvially dominated 3a | Appendix A Small Map No.(s) | Appendix A Large Map No.(s) |
|---|----------------------|------------------------|-----------------------------|-----------------------------|
| Aldbrough | | √ | ~ | 40 |
| Beeford | | √ | ~ | 18/19 |
| Beverley | | √ | 16/17/18/19 | 29/30/37 |
| Brandesburton | | √ | ~ | 24 |
| Bridlington | | √ | 31/32 | 6/7/13 |
| Bubwith | | √ | ~ | 33 |
| Driffield | | √ | 30 | 11 |
| Easington | √ | | 26 | 59 |
| Elloughton-cum-Brough | √ | | 7 | 44 |
| Flamborough | | √ | ~ | 7 |
| Gilberdyke | √ | √ | 5 | 43 |
| Goole* | √ | | 9 | 50 |
| Haltemprice - Anlaby/Kirk Ella/Willerby | √ | | 13 | 45 |
| Haltemprice - Cottingham | | √ | 14 | 45 |
| Haltemprice - Hessle | √ | | 12 | 53 |
| Hedon | √ | | 22 | 46/54 |
| Hedon Haven | √ | | ~ | 54 |
| Hornsea | | √ | 27 | 25 |
| Howden | √ | | 8 | 42 |
| Hull boundary - Orchard Park | | √ | 15 | 37/38 |
| Hutton Cranswick | | √ | ~ | 17 |
| J37 Howdendyke | √ | √ | 8 | 42 |
| J38 (Newport/North Cave) | √ | | 6 | 43 |
| Kelleythorpe | | √ | 30 | 17 |
| Keyingham | √ | | 24 | 55 |
| Kilham | | √ | ~ | 12 |
| Leven | | √ | 20 | 31 |
| Market Weighton | | √ | 4 | 28 |
| Melbourne | | √ | ~ | 26 |
| Melton | √ | | ~ | 44/52 |
| Middleton on the Wolds | | √ | ~ | 22 |
| Newport | √ | √ | 5 | 43 |
| North Cave | | √ | 6 | 35/36 |
| Pocklington | | √ | 2 | 21 |
| Pocklington Industrial Estate | | √ | 2 | 21 |
| Rawcliffe | √ | | 10 | 49 |
| Roos | | √ | ~ | 47 |
| Skirlaugh | | √ | ~ | 38/39 |
| Snaith | √ | | 11 | 49 |
| South Cave | √ | | 6 | 44 |
| Stamford Bridge | | √ | 29 | 14 |
| Wetwang | | √ | ~ | 10 |
| Wilberfoss | | √ | 28 | 14 |
| Withernsea | | √ | 25 | 56 |
| * Please note that data is unavailable for Goole pending completion of a Level 2 SFRA | | | | |

6.4.5 Building Extensions

147. Concern is mounting throughout England that valuable floodplain areas are being progressively lost to extensions and/or outbuildings that are below a specified size. These are 'permitted' developments that can take place without specific planning approval. Whilst each individual extension may not result in a measurable impact upon localised flood levels, the cumulative impact of building extensions has the potential to be considerable.
148. It is recognised that permitted development rights heavily limits the ability of a local authority to restrict some developments. Article 4 of the Town and Country Planning General Permitted Development Order 1995 (GPDO 1995) provides a possible vehicle for removal of these rights in exceptional circumstances. However, this measure has implications for property rights. As such, it may be open to compensation claims from affected landowners, albeit in exceptional circumstances.
149. The Planning White Paper: *Planning for a Sustainable Future* (May 2007) recognises the shortfalls of the existing Article 4 procedure and mentions that measures to remove such barriers are being considered. These were consulted on through the *Changes to Permitted Development: Permitted Development Rights for Householders* consultation paper between May and August 2007 and raised a number of proposals. The proposals seek to enable greater local planning authority flexibility in issuing Article 4 directions by removing the need for the Secretary of State's consent and by amending existing compensation arrangements.
150. The *Changes to Permitted Development: Permitted Development Rights for Householders* consultation paper does not exclusively refer to flood reduction measures nor do the proposals suggest any changes to the existing GPDO 1995 that will tighten the limit on the size of land within the curtilage of a dwelling permitted for householder development. Therefore the cumulative impact of such development upon localised flood levels will remain and intensify with time.
151. Local Development Orders (LDOs) enable local planning authorities to apply permitted development rights to certain types of development which would otherwise require planning permission. LDOs are considered to be appropriate for minor development that is common and invariably gains planning permission with little objection or to assist the development of an area where significant change is anticipated. LDOs are not an appropriate mechanism in trying to restrict development outright. They can be tailored, however, to direct that permitted development rights do not apply to development in specific areas such a higher flood risk areas, for example.
152. Notwithstanding this, the importance of a long term sustainable view on the loss of floodplain to building extensions is widely accepted.

6.5 Overview of Flood Risk & SFRA Interpretation

153. The spatial variation in flood risk across the Authority area is depicted in the adjoining maps (refer Appendix A). **The East Riding of Yorkshire SFRA (Level 1) should be used by both the Council and prospective developers to assist them to meet their obligations under PPS25 throughout the planning cycle**, including the delivery of a detailed site-based Flood Risk Assessment. Instructions for use are provided below:

East Riding of Yorkshire Council (Forward Planning)

154. The SFRA flood maps in Appendix A provide an overview of the spatial variation in tidal and fluvial flood risk throughout the Authority area, based upon current climate predictions. It is necessary to adopt a sequential approach when considering where land should be allocated for future development, and this is described in Section 6.4. The SFRA maps should be used to inform this sequential approach. Furthermore, PPS25 provides clear guidance on permissible land use within areas potentially at risk from flooding, and this too is discussed in Section 6.4.
155. Whilst there is no particular constraint placed upon land use within areas of Zone 1 Low Probability within East Riding, it is strongly recommended that the Council takes due consideration of flooding from other sources (i.e. non fluvial):
- Areas of potential surface water hazard have been identified (see Appendix C), and future development within areas of higher hazard must very carefully consider the potential risk that surface water flooding may pose, and the site layout and design should be adapted accordingly;
 - Areas that may be at risk from groundwater flooding have been identified (see Appendix I). Once again, future development within these areas should very carefully consider the potential risk that groundwater flooding may pose, and the design of buildings within the site should be adapted accordingly;
 - Observed incidents of localised flooding are provided in Appendix A, supporting the evidence base provided above.
156. Many of these 'other' sources of flooding can be effectively managed through the design process. However, it is recommended that advice is taken from the Environment Agency to ensure that the severity of the local issue that may affect (or be exacerbated by) the proposed allocation is fully appreciated.
157. It is noted that it is likely that a *Surface Water Management Plan (SWMP)* will be a mandatory requirement within areas that are known to be at risk from 'other' (non fluvial) sources of flooding. The SWMP will consider the potential risk of surface water and groundwater flooding in greater detail, and will establish a recommended mitigation plan to manage this risk effectively over time. It is anticipated that the development of the SWMP will be led by the Council, however input from stakeholders including the Environment Agency and Yorkshire Water will be essential.

East Riding of Yorkshire Council (Development Control) & Developers

158. All development applications should consider the need for a further, more detailed assessment, of flood risk. All sites situated within Zone 2 or Zone 3, and sites greater than 1ha within Zone 1, require a detailed Flood Risk Assessment, in accordance with Section 6.6.1 of this report. The SFRA flood maps provided in Appendix A summarise the extent of flooding (from rivers and the sea) across the site, highlighting the zone within which the proposed development site will fall. These should be used to trigger a more detailed assessment of flood risk related issues within the site, as described in Section 6.4 and Section 6.6.1.

159. The assessment of flooding related issues is imperative for all proposed development, irrespective of its location and/or scale within the Authority area, and the SFRA provides some helpful tools to assist in this regard. **It is imperative that the information outlined below is used with careful reference to the discussion and guidance provided in Sections 5 and 6 of this report.**

- The **risk of flooding to the site from rivers and the sea** is shown in the maps in Appendix A. These include the locality of **formal flood defences** along the Humber Estuary and the Dutch River. Recorded accounts of historical flooding within the Authority area (where available) are shown in Figure B and the flooding that occurred during June 2007 in Appendix D. Available **flood warning services** throughout the Authority area are indicated in Figure C.
- Figure E offers a broad indication of the **topography of East Riding**. Appendix C provides an indication of areas that are potentially at risk from **surface water flooding**, identifying zones of high, medium, and low surface water hazard, and Appendix I provides an overview of areas potentially at risk from **groundwater flooding**. It is imperative that landscaping and building design within these areas carefully consider these potential risks, both to minimise the damage sustained should localised flooding occur, and to reduce any potential increase in risk as a result of proposed development.
- The SFRA flood maps in Appendix A and Appendix D provide a summary of **locations that have been susceptible to localised flooding historically**. This is not a comprehensive record of flooding, and relies upon community reports of flooding made to the Council. It is a good indication of areas that may be susceptible to localised flooding however, and reiterates the importance of considering flood risk related issues in areas that are outside of the designated PPS25 flood zones.
- Within all areas of the East Riding, groundwater levels and soil permeability should be assessed on site at an early stage, and this should be used to inform the design of buildings and sustainable drainage systems (SUDS). An overview of the **geology of the Authority area** is provided in Figure D.
- Appendix F provides the current Interim National Guidance for developers for Rainfall Runoff Management. This guidance has been provided by the Environment Agency (June 2008) and will **assist developers to design the drainage system for their site**.
- Appendix E provides clear guidance for developers to ensure that **safe access and egress** can be provided to/from the site to address the residual risk of flooding.

6.6 Detailed Flood Risk Assessment (FRA) – The Developer

6.6.1 Scope of the Detailed Flood Risk Assessment

160. The SFRA is a strategic document that provides an overview of flood risk throughout the Authority area. Once the Sequential Test has been applied in accordance with Section 6.4 to determine the allocation of sites for future development, it is imperative that a site-based Flood Risk Assessment (FRA) is carried out by the developer for all proposed developments. This should be submitted as an integral part of the planning application. **It is emphasised that, for windfall sites, it will be necessary for the developer to provide evidence as part of the planning application, to allow the Council to undertake the Sequential Test (in accordance with PPS25). This evidence should be presented as a separate section within their Flood Risk Assessment.**
161. The FRA should be commensurate with the risk of flooding to the proposed development. For example, where the risk of flooding to the site is negligible (e.g. Zone 1 Low Probability), there is little benefit to be gained in assessing the potential risk to life and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site does not exacerbate flooding lower in the catchment. The particular requirements for FRAs within each delineated flood zone are outlined below.

The detailed FRA should utilise the background information provided within this Level 1 SFRA, as explained in Section 6.5. It is important to reiterate that the SFRA provides the best available information at the time of writing. As highlighted below, the Environment Agency is an excellent source of information to inform the development of the detailed FRA, and they should be contacted as early as possible to source additional (more recent) information as appropriate.

Proposed Development within Zone 3a High Probability & Zone 3b Functional Floodplain

162. All FRAs supporting proposed development within Zone 3b Functional Floodplain²¹ and Zone 3a High Probability should include an assessment of the following.
- The vulnerability of the development to flooding from other sources (e.g. surface water and/or groundwater flooding) as well as from fluvial and tidal flooding. In addition to the use of information provided within the SFRA, this will involve discussion with the Council (Land Drainage) and the Environment Agency to confirm whether a localised risk of flooding exists at the proposed site. Specific guidance is provided in Section 6 for the assessment of flood risk from other sources.
 - The vulnerability of the development to flooding over the lifetime of the development, including the potential impacts of climate change, **for all sources of flooding**²², i.e. maximum water levels, flow paths and flood extents within the property and surrounding area. The Environment Agency may have carried out detailed flood risk mapping (with respect to fluvial flooding) within localised areas that could be used to underpin this assessment. Where available, this will be provided at a cost to the developer. Where detailed modelling is not available, hydraulic modelling by suitably qualified engineers will be required to determine the risk of flooding to the site. The propensity of culverted systems to block, increasing the risk of flooding, should be considered.
 - The presence of both formal and informal (including, for example, local road and/or rail embankments) flood defences within the proximity of the site must be considered. Flood defences may alter the risk of flooding within the site, and it is imperative that any change in the flooding regime as a result of a flood defence is thoroughly understood. The integrity of the defence must be assessed to ensure that the defence will be structurally sound throughout the lifetime of the proposed development. The potential

²¹ It is highlighted that only water compatible development and essential infrastructure is permissible within Zone 3b Functional Floodplain. Any development within this flood zone however will require a detailed Flood Risk Assessment, in accordance with guidance set out within this section.

²² Including (as a minimum) fluvial, tidal, surface water & groundwater flooding

impact of a defence failure must be considered. The SFRA maps (in Appendix A) identify some locations within the Authority area (from detailed modelling carried out by the Environment Agency) that could be at risk of flooding in the 4% (1 in 25) design event if flood defences and artificial pumping regimes were to fail, referred to on the maps as “1 in 25 year if Undefended” (explained at para. 71). For proposed developments in these areas, the residual risk of defence/pump failure should be considered.

- The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff, and the effect of the new development on depth and speed of flooding to adjacent and surrounding property. This will require a detailed assessment, to be carried out by a suitably qualified engineer. It is emphasised that the detailed assessment of potential impacts elsewhere should not be limited (in a geographical sense) to the East Riding. Future development within the Authority area may adversely affect sites within adjoining areas, particularly within Hull, and it is essential that this is mitigated.
- A demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account) are acceptable. Measures may include flood defences, flood resistant and resilient design, provision for escape/evacuation (refer Appendix E), effective flood warning and emergency planning.
- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum
- Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates and volumes. Any SUDS design must take due account of topographical, groundwater and geological conditions;
- The developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Authority area (refer Section 6.4.2);

Proposed Development within Zone 2 Medium Probability

- For all sites within Zone 2 Medium Probability, a high level FRA commensurate with the level of risk posed to the site should be prepared based upon readily available existing flooding information, sourced from the EA. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed through, for example, the provision of raised floor levels and the provision of a planned evacuation route and/or safe haven (refer Appendix E).
- The risk of alternative sources of flooding (e.g. urban drainage and/or groundwater) must be considered, and sustainable drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area. Once again, it is reiterated that future development within the Authority area may adversely affect sites within adjoining areas, and it is essential that this is mitigated. Specific guidance is provided in Section 6 for the assessment of flood risk from other sources.
- As part of the high level FRA, the developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Authority area (refer Section 6.4.2).
- Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates and volumes. Any SUDS design must take due account of topographical, groundwater and geological conditions (refer Section 7.6.3).

Proposed Development within Zone 1 Low Probability

163. For all sites greater than 1 hectare in area and/or situated within the Groundwater Emergence Zone and/or a Surface Water Hazard Zone, a simple Flood Risk Assessment must be prepared:

- The risk of alternative sources of flooding (e.g. surface water and/or groundwater) must be considered. Developers are encouraged to liaise with organisations such as Yorkshire Water, the Internal Drainage Boards, and the Council's Land Drainage team to ensure that any potential surface water/groundwater risk can be mitigated through appropriate design solutions. As a minimum, the implementation of sustainable drainage systems (SUDS) must be ensured (unless demonstrated not to be practicable), and careful consideration given to avoiding the obstruction of overland flow routes with buildings and/or landscaping. Once again, it is reiterated that future development within the Authority area may adversely affect sites within adjoining Authorities, and it is essential that this is mitigated. Specific guidance is provided in Section 6 for the assessment of localised flood risk.
- As part of the high level FRA, the developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Authority area (refer Section 6.4.2).
- Details of proposed sustainable drainage systems (SUDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates and volumes. Any SUDS design must take due account of topographical, groundwater and geological conditions (refer Section 7.6.3)

Liaison with the Environment Agency

164. To assist local planning authorities, the Environment Agency has produced standing advice to inform on their requirements regarding the consultation process for planning applications on flood risk matters. Full details of their Flood Risk Standing Advice can be found on the website www.environment-agency.gov.uk.
165. The Environment Agency is an excellent source of information to inform the development of the detailed FRA. The external relations team should be contacted as early as possible to source information relating to (for example) historical flooding, hydraulic modelling and topography (LiDAR). It is emphasised that the information provided within the SFRA is the best available at the time of writing. More up to date information may be available, and contact should always be made with the EA at an early stage to ensure that the detailed site based FRA is using the most current datasets, avoiding unnecessary re-work.
166. It is strongly recommended that a draft of the detailed FRA is provided to the EA for review and comment before submitted with the Planning Application, thereby reducing potentially costly delays to the planning process.

6.6.2 Raised Floor Levels & Basements

167. The raising of floor levels can help to ensure that damage to property is minimised. Specific recommendations regarding floor levels are provided for each Flood Zone at Section 6.4.4.
168. The use of basements within areas at risk of flooding should be discouraged. Where basement uses are permitted, it is necessary to ensure that the basement access points are situated in accordance with the floor level recommendations at Section 6.4.4. The basement must be of a waterproof construction to avoid seepage during flooding conditions. Separate dwellings and habitable uses at basement level within areas at risk of flooding should not be permitted. It must be demonstrated that any below ground construction does not adversely increase the risk of groundwater flooding to adjoining properties.

6.6.3 Sustainable Drainage Systems (SuDS)

169. SUDS are the various approaches that can be used to manage surface water drainage in a way that mimics the natural environment. The management of rainfall (and then surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Indeed, reducing the rate and volume of discharge from urban sites to greenfield conditions is one of the most effective ways of reducing and managing flood risk within an area. The integration of SUDS into a site design can also provide broader benefits, including an

improvement in the water quality of runoff discharged from the site, the capture and re-use of site runoff for irrigation and/or non potable uses, and the provision of green space areas offering recreation and/or aesthetic benefits.

170. SuDS may improve the sustainable management of water for a site by²³:
- reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
 - reducing volumes and the frequency of water flowing directly to watercourses or sewers from developed sites;
 - improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
 - reducing potable water demand through rainwater harvesting;
 - improving amenity through the provision of public open space and wildlife habitat;
 - replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.
171. In catchment terms, the cumulative affect of applying SUDS to a number of sites can have a significant affect in reducing the volume of water entering a watercourse.
172. There are numerous different ways that SUDS can be incorporated into a development and the most commonly found components of a SUDS system are described in the following table²⁴. The SUDS techniques may be introduced simply to slow discharge from impermeable surfaces, or to capture and store rainfall on site for non-potable uses (i.e. rainwater harvesting).

| | |
|----------------------------|--|
| Pervious surfaces | Surfaces that allow inflow of rainwater into the underlying construction or soil. |
| Green roofs ²⁵ | Vegetated roofs that reduce the volume and rate of runoff and remove pollution. |
| Filter drain | Linear drains consisting of trenches filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water; they may also permit infiltration. |
| Filter strips | Vegetated areas of gently sloping ground designed to drain water evenly off impermeable areas and to filter out silt and other particulates. |
| Swales | Shallow vegetated channels that conduct and retain water, and may also permit infiltration; the vegetation filters particulate matter. |
| Basins, Ponds and Wetlands | Areas that may be utilised for surface runoff storage. |
| Infiltration Devices | Sub-surface structures to promote the infiltration of surface water to ground. They can be trenches, basins or soakaways. |
| Bioretention areas | Vegetated areas designed to collect and treat water before discharge via a piped system or infiltration to the ground |


173. The appropriate application of a SUDS scheme to a specific development is heavily dependent upon the **geology of the site** (and its surrounds) as well as the local groundwater regime. For example, infiltration techniques are generally most suitable in areas of permeable soils and geology. The geology of the Authority area is summarised in Figure D.
174. The **topography of the site** is also an essential consideration for the selection of an appropriate SUDS system. For example, areas of steeply sloping ground are generally unsuitable for techniques that rely on the storage and/or infiltration of runoff upon the surface. An overview of the topography of East Riding is included in Figure E to assist in this regard.

²³ Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

²⁴ Interim Code of Practice for Sustainable Drainage Systems National SUDS Working Group, 2004

²⁵ Refer Environment Agency's Green Roofs Toolkit at www.environment-agency.gov.uk/greenroofs

175. It is important to highlight that a shallow water table will compromise the operation of an infiltration system, and it is essential that **groundwater levels** (in addition to soil permeability) are assessed on site as an integral part of the design process. Groundwater Emergence Maps are provided in Appendix I, indicating areas of the Authority area within which the potential risk of groundwater flooding is considered relatively high. These should be used to trigger a more localised (focussed) assessment of the groundwater regime.
176. The **adoption and future maintenance of sustainable drainage systems** is a crucial consideration when implementing SUDS. Two possible options available to ensure that the SUDS are properly implemented and maintained, and the arrangement to be adopted will be dictated by East Riding of Yorkshire Council. These include an agreement under Section 106 of the Town and Country Planning Act, or by a condition to planning permission. Further information relating to the adoption and maintenance of SUDS within East Riding should be sought from the Council. It is noted that the Floods and Water Management Bill consultation (April 2009) proposed that local authorities should be responsible for the adoption and maintenance for SUDS.
177. For more guidance on SuDS, the following documents and websites are recommended as a starting point:
- Interim Code of Practice for Sustainable Drainage Systems, National SUDS Working Group, 2004
 - Planning Policy Statement 25, Annex F, CLG, December 2006
 - The SUDS Manual (C697), CIRIA, 2007
 - The Building Regulations, Approved Document H - Drainage and Waste Disposal (2002)
 - www.ciria.org.uk/SUDS/
178. Developers should also utilise the guidance within the document '**Rainfall Runoff Management for Developments - Interim National Procedure**', which can be seen in Appendix F of this report.

| <p>Most Sustainable</p>  <p>Least Sustainable</p> | SUDS technique | Flood Reduction | Water Quality Improvement | Landscape & Wildlife Benefit |
|--|--|-----------------|---------------------------|------------------------------|
| | Living roofs | ✓ | ✓ | ✓ |
| | Basins and ponds - Constructed wetlands - Balancing ponds - Detention basins - Retention ponds | ✓ | ✓ | ✓ |
| | Filter strips and swales | ✓ | ✓ | ✓ |
| | Infiltration devices - soakaways - infiltration trenches and basins | ✓ | ✓ | ✓ |
| | Permeable surfaces and filter drains - gravelled areas - solid paving blocks - porous paving | ✓ | ✓ | |
| | Tanked systems - over-sized pipes/tanks - storm cells | ✓ | | |
| | | | | |

179. It is noted that on 1 October 2008, the Government introduced permitted development rights to allow the surfacing of more than 5 square metres of domestic front gardens, provided a permeable material is used. The use of traditional materials, such as impermeable concrete, requires planning permission. Further information can be sought from Communities & Local Government via <http://www.communities.gov.uk/publications/planningandbuilding/pavingfrontgardens>.

6.7 Local Community Actions to Reduce Flood Damage

180. There will always be a residual risk of flooding, whether that be (for example) from an event that is more extreme than that considered, or whether as a result of a flood defence system that fails unexpectedly. Flood resistance and flood resilience may need to be incorporated into the design of buildings for this reason.
181. In all areas at risk of flooding, a basic level of flood resistance and resilience will be achieved by following good building practice and complying with the requirements of the Building Regulations 2000²⁶. The difference between 'resilience' and 'resistance' is explained below:
- *Flood resistance*, or 'dry proofing', where flood water is prevented from entering the building. For example using flood barriers across doorways and airbricks, or raising floor levels.
 - *Flood resilience*, or 'wet proofing', accepts that flood water will enter the building and allows for this situation through careful internal design for example raising electrical sockets and fitting tiled floors. The finishes and services are such that the building can quickly be returned to use after the flood.
182. Examples of both flood-resistant and flood resilient design are given in Improving the Flood Performance of New Buildings (Flood Resilient Construction), CLG (2007). It is worth noting that in May 2007 Defra put into place a grant scheme, providing monetary support to householders to improve the resilience of housing within 'at risk' areas. Further information is available on the Defra website at www.defra.gov.uk.
183. A number of homes and businesses within the East Riding are at risk of flooding. It is essential therefore to ensure a broad awareness with respect to flood risk, providing the community with the knowledge (and tools) that will enable them to help themselves should a flood event occur.
184. The following 'community based measures' are cost effective solutions that local communities may introduce to minimise the damage sustained to their own homes in the case of flooding. Further guidance is provided by the EA, Defra and CLG²⁷ (refer the National Flood Forum (www.floodforum.gov.uk)).
185. It is recommended that the Local Authority proactively support the Environment Agency to raise awareness within the community with respect to flooding (and indeed 'self help' flood risk reduction opportunities). This may include, for example, the circulation of a targeted newsletter to affected residents to coincide with the release of the East Riding of Yorkshire SFRA.

6.7.1 Flood Proofing

186. The 'flood proofing' of a property may take a variety of forms:

For new homes and/or during redevelopment

- Raising of floor levels

The raising of floor levels above the anticipated maximum flood level ensures that the interior of the property is not directly affected by flooding, avoiding damage to furnishings, wiring and interior walls. It is highlighted that plumbing may still be impacted as a result of mains sewer failure.

- Raising of electrical wiring

The raising of electrical wiring and sockets within flood affected buildings reduces the risks to health and safety, and reduces the time required after a flood to rectify the damage.

²⁶ Office of Deputy Prime Minister (ODPM) – now Communities & Local Government (CLG)

²⁷ Improving the Flood Performance of New Buildings – Flood Resilient Construction (May 2007)

For existing homes

➤ Flood boards

The placement of a temporary watertight seal across doors, windows and air bricks to avoid inundation of the building interior. This may be suitable for relatively short periods of flooding, however the porosity of brickwork may result in damage being sustained should water levels remain elevated for an extended period of time. This may lessen the effectiveness of flood proofing to existing properties affected by flooding from larger river systems such as the Humber.

6.8 Emergency Planning

187. The Council is designated as a Category 1 Responder under the Civil Contingencies Act 2004. As such, the Council has defined responsibilities to assess risk, and respond appropriately in case of an emergency, including (for example) a major flooding event. The Council's primary responsibilities are²⁸:
- from time to time assess the risk of an emergency occurring;*
 - from time to time assess the risk of an emergency making it necessary or expedient for the person or body to perform any of his or its functions;*
 - maintain plans for the purpose of ensuring, so far as is reasonably practicable, that if an emergency occurs the person or body is able to continue to perform his or its functions;*
 - maintain plans for the purpose of ensuring that if an emergency occurs or is likely to occur the person or body is able to perform his or its functions so far as necessary or desirable for the purpose of:*
 - preventing the emergency,*
 - reducing, controlling or mitigating its effects, or*
 - taking other action in connection with it*
188. The Environment Agency monitors river levels within low lying areas adjoining the Humber Estuary, the River Hull, the River Aire, the River Ouse, the River Derwent, and the Dutch River. Based upon a sophisticated in-house forecasting computer model, the Agency makes an assessment of the anticipated maximum water level that is likely to be reached within the proceeding hours (and/or days) due to tidal and/or fluvial flooding. Where these predicted water levels are expected to result in the inundation of populated areas²⁹, the Environment Agency will issue a series of flood warnings within defined flood warning areas, encouraging residents to take action to avoid damage to property in the first instance.
189. As water levels rise and begin to pose a risk to life and/or livelihood, it is the responsibility of the emergency services to coordinate the evacuation of residents. This evacuation will be supported by the Council. It is essential that a robust plan is in place that clearly sets out (as a minimum):
- roles and responsibilities;
 - paths of communication;
 - evacuation routes;
 - community centres to house evacuated residents;
 - contingency plans in case of loss of power and/or communication.

²⁸ Civil Contingencies Act 2004

²⁹ Restricted to those urban areas situated within Environment Agency flood warning zones

190. Coordination with the emergency services and the Environment Agency is imperative to ensure the safety of residents in time of flood. Flooding within the East Riding of Yorkshire will typically occur following relatively long duration rainfall events, and consequently forewarning will generally be provided to encourage preparation in an effort to minimise property damage and risk to life. It is worth highlighting however that the benefits of flood warning are often compromised to a large degree by the lack of 'take up' within the local community. This emphasises the extreme importance of raising local awareness with respect to the potential risks of flooding.
191. Areas suffering from localised flooding issues will tend to be at greater risk. These areas are susceptible to 'flash' flooding, associated with storm cells that pass over the Authority area resulting in high intensity, often relatively localised, rainfall. It is anticipated that events of this nature will occur more often as a result of possible climate change over the coming decades. Events of this nature are difficult to predict accurately, and the rapid runoff that follows will often result in flooding that cannot be sensibly forewarned.
192. All urbanised areas are potentially at some degree risk of localised flooding due to heavy rainfall. The blockage of gullies and culverts as a result of litter and/or leaves is commonplace, and this will inevitably lead to localised problems that can only realistically be addressed by reactive maintenance.
193. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the East Riding of Yorkshire SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

6.9 Insurance

194. Many residents and business owners perceive insurance to be a final safeguard should damages be sustained as a result of a natural disaster such as flooding. Considerable media interest followed the widespread flooding of 2000 when it became clear that the insurance industry were rigorously reviewing their approach to providing insurance protection to homes and businesses situated within flood affected areas. Not surprisingly, the recent widespread flooding of July 2007 has further exacerbated the discussion surrounding the future of insurance for householders and business owners situated within flood affected areas.
195. The following quotations are an extract from the Association of British Insurers (ABI) website, dated August 2007:

"The UK is unique in offering flood cover as a standard feature of household and most business policies. Unlike much of Europe and worldwide, cover is widely available to the UK's 23.5 million householders.

In the long term, this situation could worsen, unless we take action to reduce flood risk to people and property. Climate change will increase winter rainfall, the frequency of heavy rainfall, and sea levels and storm surge heights. With no change in Government policies or spending, climate change could increase the number of properties at risk of flooding to 3.5 million. Furthermore, continued pressure on land could mean even more new developments being situated in floodplains.

By spreading the risk across policy holders, insurance enables householders and businesses to minimize the financial cost of damage from flooding. In the modern competitive insurance market, premiums reflect the risks that customers face. This enables insurance to be offered at very competitive prices to customers living in low flood risk areas.

In 2003 ABI members agreed to extend their commitment to provide flood insurance to the vast majority of UK customers. The result of discussions between Government and insurers was a Statement of Principles, which aims to provide reassurance to the overwhelming majority of insurance customers living in the floodplain about the continued availability of insurance in future.

Individual property owners can do much to increase the resistance and resilience of their properties to flood damage - further information is available. ABI has issued a factsheet for property owners on a range of measures that could be taken by a homeowner to improve the resilience of their property to flood damage."

196. In summary, for the time being, residents and business owners can be assured that insurance will be available to assist in recovery following a flood event. It would appear fair to say however that the future availability of flood insurance within the UK will be heavily dependant upon commitment from the government to reduce the risk of flooding over time, particularly given the anticipated impacts of climate change. Investment is required in flood defence and improving the capacity of sewage and drainage infrastructure, however it is also essential to ensure that spatial planning decisions do not place property within areas at risk of flooding.
197. To this end, in July 2008 the ABI reached an agreement with Defra to establish a long-term strategy for flood risk management. This provides a commitment to improving our understanding of the risks that flooding poses, and putting into place a long term funding plan for risk reduction. The key elements of the agreement are set out below:
- *The Government will put in place a long-term investment strategy, which will set out strategic flood prevention aims and assess future policy options and funding needs.*
 - *Planning systems will be designed to prevent inappropriate development in flood-risk areas and there will be measures to raise public awareness in areas where flood risks are significant.*
 - *Property owners will be provided with more information about how to obtain flood insurance and take sensible precautions to avoid the dangers of flooding.*
 - *Steps will be taken to promote home insurance to low-income households.*
 - *The insurance industry has pledged to make flood insurance for both homes and small businesses available under household and commercial insurance, where the flood risk is no worse than a one in 75 (1.3%) annual risk.*
 - *It has also agreed to offer flood cover to existing domestic and small business customers at significant flood risk, providing there are plans to reduce the risk to an acceptable level within five years.*

7 Conclusion & Recommendations

198. The risk of flooding within the East Riding arises from a number of sources, including fluvial, tidal, surface water and groundwater flooding. The rivers Aire, Derwent, Ouse, Hull, Trent, Dutch River, and the Humber all pose a potential risk of flooding to homes and businesses within the East Riding, and a large proportion of the Authority area is reliant upon raised flood defences to protect against regular inundation. A risk of surface water flooding also exists, a result of the low lying flat areas to the south of the Authority area that rely upon artificial drainage.

SFRA Recommendations

199. Planning policy needs to be informed about the risk posed by flooding. A collation of potential sources of flood risk has been carried out in accordance with PPS25, developed in close consultation with both East Riding of Yorkshire Council and the Environment Agency. The East Riding of Yorkshire has been broken down into zones of 'high', 'medium' and 'low' probability of flooding in accordance with PPS25, providing the basis for the application of the PPS25 Sequential Test.
200. A planning solution to flood risk management should be sought wherever possible, steering vulnerable development away from areas affected by flooding in accordance with the PPS25 Sequential Test.
201. Local Authorities (and, indeed, developers) are encouraged to aim for a positive reduction in flood risk through future development and regeneration. This process strives to ensure that decisions taken not only avoid the creation of a future legacy of new development at risk of flooding, but also progressively reduce the risk of flooding to existing development. This is a key objective of PPS25.
202. If after having undertaken the Sequential Test it has been identified that there are no reasonably available sites in areas at risk of flooding, specific recommendations have been provided to assist the Council and the developer to apply the Exception Test (refer Section 6.4). These should be considered when writing new policies as part of the Local Development Framework, as well as in the determination of planning applications.
203. Council policy is essential to ensure that the suggested development control recommendations can be imposed consistently at the planning application stage. This is essential to achieve flood risk reduction and future sustainability within East Riding.
204. Emergency planning is crucial for the minimisation to the risk to life posed by flooding within the Authority area. It is recommended that the Council advises the local Resilience Forum of the risks raised in light of the East Riding of Yorkshire SFRA, ensuring that the planning for future emergency response can be reviewed accordingly.

A Living Document

205. The SFRA has been developed building heavily upon existing knowledge with respect to flood risk within the Authority area. A rolling programme of detailed flood risk management investigations within the region is underway. This, in addition to observed flooding that may occur throughout a year, will improve the current knowledge of flood risk within the Authority area and may alter predicted flood extents within the East Riding. Furthermore, Communities and Local Government (CLG) are working to provide further detailed advice with respect to the application of PPS25 and future amendments to the PPS25 Practice Guide are anticipated. Given that this is the case, a periodic review of the East Riding SFRA is imperative.

206. It is recommended that the East Riding of Yorkshire SFRA is reviewed on a regular basis. A series of key questions to be challenged as part of the SFRA review process are set out in below, providing the basis by which the need for a detailed review of the document should be triggered. It is recommended that a review of these triggers is carried out once every 2 years:

Question 1

Has any flooding been observed within the Authority area since the previous review? If so, the following information should be captured as an addendum to the SFRA:

- What was the mapped extent of the flooding?
- On what date did the flooding occur?
- What was the perceived cause of the flooding?
- If possible, what was the indicative statistical probability of the observed flooding event? (i.e. how often, on average, would an event of that magnitude be observed within the Authority area?)
- If the flooding was caused by overtopping of the riverbanks, are the observed flood extents situated outside of the current Zone 3a? If it is estimated that the frequency of flooding does not exceed, on average, once in every 100 years then the flooded areas (from the river) should be incorporated into Zone 3a to inform future planning decision making.

Question 2

Have any amendments been made to PPS25 or the Practice Companion Guide, or has any other relevant Government Statement been released since the previous review? If so, the following key questions should be tested:

- Does the revision to the policy guidance alter the definition of the PPS25 Flood Zones presented within the SFRA?
- Does the revision to the policy guidance alter the decision making process required to satisfy the Sequential Test?
- Does the revision to the policy guidance alter the application of the Exception Test?
- Does the revision to the policy guidance alter the categorisation of land use vulnerability, presented within Table D2 of PPS25 (December 2006)?

If the answer to any of these core questions is 'yes' then a review of the SFRA recommendations in light of the identified policy change should be carried out.

Question 3

Has the Environment Agency issued any amendments to their flood risk mapping and/or standing guidance since the previous policy review? If so:

- Has any further detailed flood risk mapping been completed within the Authority area, resulting in a change to the 20 year, 100 year or 1000 year flood outline? If yes, then the Zone 3b and Zone 3a flood outlines should be updated accordingly.
- Has the assessment of the impacts that climate change may have upon rainfall and/or river flows over time altered? If yes, then a review of the impacts that climate change may have upon the Authority area is required.
- Do the development control recommendations provided in Section 6.4 of the SFRA in any way contradict emerging EA advice with respect to (for example) the provision of emergency access, the setting of floor levels and the integration of sustainable drainage techniques? If yes, then a discussion with the EA is required to ensure an agreed suite of development control requirements are in place.

It is highlighted that the Environment Agency review the Flood Zone Map on a quarterly basis. If this has been revised within the Authority area, the updated Flood Zones will be automatically forwarded to the Council for their reference. *It is recommended that only those areas that have been amended by the Environment Agency since the previous SFRA review are reflected in Zone 3 and Zone 2 of the SFRA flood maps.* This ensures that the more rigorous analyses carried out as part of the SFRA process are not inadvertently lost by a simple global

replacement of the SFRA flood maps with the Flood Zone Maps.

Question 4

Has the implementation of the SFRA within the spatial planning and/or development control functions of the Council raised any particular issues or concerns that need to be reviewed as part of the SFRA process?

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